NONDESTRUCTIVE TESTING OF WELDS

Olympus NDT offers complete solutions for all your nondestructive weld inspection and code compliance needs

Pipeline girth welds, automotive spotwelds, steel sheet laser welds, structural T-joint welds, and friction stir welds are typical applications that require either manual testing or automated inspection. Olympus NDT offers a wide range of innovative testing products to meet all requirements related to the following technologies and inspection techniques: pulse-echo (PE), TOFD, combined TOFD/PE, phased array UT, linear scans, and sectorial scans.

For Info go to www.aws.org/ad-index  See us at FABTECH booth #7109

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Dear Readers,

You might call this the back-to-basics issue of *Inspection Trends*. That’s because all of the articles are related to visual inspection. Because so many of you carry multiple certifications, we try to cover all of the nondestructive examination methods in the magazine. And, yes, methods such as time-of-flight diffraction ultrasonic testing, digital radiography, and infrared thermography may seem to have more pizzazz than visual testing, you know as well as I do that visual testing is the most widely used inspection method in the world. You also know that many welds receive no other examination beyond visual inspection. Since visual testing is your particular bailiwick, and so much depends on having good, strong welds, we want you to have the information you need to do your job the best that you can.

This issue has three visual testing-related articles. The first, by Jeff Noruk, Blake Holmes, and Bob Bruss, on page 15 discusses a laser tool that you can use as an alternative to weld measurement gauges. I queried a group of SCWIs and asked them to tell me some of the things they’ve learned over the years that might just help you do your job better. You’ll find their tips on page 21. Howard K. Jones, an experienced CWI, discusses situations that no one expects to occur but somehow do anyway, then gives you his experience-based advice on how to deal with them. You’ll find that article on page 18.

With this issue, we’re closing out another year of *Inspection Trends*. The end of the year is always jam-packed in terms of both our work and personal lives. There are quarterly and annual reports to submit, fiscal and calendar years to close out, and stacks of paperwork to finish, while at the same time we’re attempting to spend time with family and friends, get our work done despite days off for the holidays, and often attempting to squeeze in some final vacation time as well. I wish you all some peace during the end-of-the-year insanity and want you to know that we’ve got plenty of useful things planned for *Inspection Trends* in 2012. — Mary Ruth Johnsen
Expand your credentials with an endorsement that fulfills your recertification requirements. Recertification every nine years requires either 80 hours of documented continuing education, retaking the “Part B” Practical Exam, or an endorsement to your certification. You can do this at any time, so why not do it now and secure the prestige and enhanced career potential of a credential in an additional welding code?

A CWI or SCWI can take a Supplemental Inspection Exam anytime during the nine-year cycle. Qualifying for and passing one of these exams meets the requirements for recertification. Endorsements are listed on your endorsement card. Endorsements to codebooks require passing a two-hour Open-Book Code Application exam on one of the following codes:

- AWS D1.1 Structural Welding
- AWS D1.2 Aluminum
- AWS D1.5 Bridge
- AWS D15.1 Railroad
- API 1104 Pipeline

- ASME Section IX, B31.1 and B31.3 Boiler and Pressure Vessel
- ASME Section VIII, Div. 1 and Section IX Boiler and Pressure Vessel

Seminars to prepare you for the two-hour exam on D1.1 or API 1104 are available at numerous seminar sites across the country. Three new code clinics will be offered at FABTECH in Chicago:

- D1.5 Bridge Code Clinic – Nov. 14
- D15.1 Railroad Code Clinic – Nov. 14
- ASME Section IX, B31.1 and B31.3 Code Clinic – Nov. 15

One other stand-alone credential can serve as an endorsement credit and also fulfills your recertification requirement. At any time during your nine-year cycle, if you meet the prerequisites, you can apply to become certified as an AWS Certified Radiographic Interpreter (CRI).

The five-day CRI seminar is designed to ensure that you have the knowledge to properly assess indications produced on radiographic media. It will prepare you for the CRI certification exam, which is given at the end of each seminar week. This is a valuable certification that fulfills your nine-year requirement. Upcoming seminars and exams for CRI are:

- Pittsburgh – Oct. 17-22 • Allentown – Nov. 7-12

If you don’t want to take any exams at all, you can fulfill the 80-hour education requirement by attending a six-day AWS 9-Year Recertification Course. Courses are scheduled for:

- Dallas – Oct. 17-22 • New Orleans – Nov. 7-12 • Miami – Dec. 12-17

One more option is to recertify by taking the “Part B” CWI Practical Exam. This exam and refresher Visual Inspection Workshop seminars are offered at convenient CWI seminar/exam sites across the country. Our new Advanced Visual Inspection Workshops in Miami are specifically designed to prepare you for this exam.
Phoenix Inspection Systems Equipment Testing Large Floating Oil Production Facility

This ultrasonic scanner from Phoenix Inspection Systems is being used to inspect the mooring chains holding one of the world’s largest FPSOs in place. Here it is shown in place on a section of chain during trials.

Ultrasonic testing equipment from Phoenix Inspection Systems, Warrington, UK, is being used to test the mooring chains for one of the world’s largest floating production, storing, and offloading (FPSO) vessels. The vessel is located in the Schiehallion oilfield, 175 miles west of the Shetlands off the coast of the United Kingdom. Owned by BP and in operation since 1998, the FPSO features a processing capacity of around 200,000 barrels of oil a day and has a storage capacity of about 950,000 barrels.

Fourteen mooring chains, each 6.25 in. in diameter, anchor the FPSO to piles in the seabed below. The chains are due for replacement but must be inspected first to ensure they can be safely removed. The entire operation is taking place underwater, with the equipment being carried by divers and fixed into position. The inspection is focusing on the point where the chains fix onto the ship.

Prototype Robot Inspects for Structural Damage in Nuclear Reactors

The Welding Institute (TWI), Abington, UK, has designed a prototype inspection robot to detect structural damage in aging nuclear reactors. The work is part of the approximately $1.9 million NozzleInspect project. Nozzle sections made from austenitic steel can be susceptible to rapid crack growth due to thermal fatigue and stress corrosion. Early detection of cracks is essential to ensure safe operation of the facility.

Currently, conventional ultrasonic probes are used to do the inspections. But because the probes need to be changed to allow full inspection of the nozzle weld areas, each

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change requires completion of a recalibration, defect detection and sizing capabilities are not optimum. In addition, operators are exposed to a certain amount of radiation during installation.

TWI’s prototype uses 128 piezoelectric elements placed in a circular formation. The automatic robot assembly will carry a novel matrix phased array probe that will be combined with 3-D beam steering to enable a large area of the weld to be inspected in a single operation.

The design is currently undergoing final testing. Additional information is available at www.nozzleinspect.eu.

Former Shipyard Worker Sentenced for False Certifications

Robert Raymond Ruks of Portsmouth, Va., was sentenced in August to 37 months in prison, followed by a term of three years supervised release for making false statements to Navy officials and federal agents. He falsely certified that he had inspected welds on the hulls of Navy ships and submarines. Subsequent inspections found certain welds on these vessels to be defective.

“Lying on weld inspection reports is a dangerous crime that threatens the safety of our men and women who serve in the U.S. Navy,” said U.S. Attorney Neil H. MacBride. “Because of his lies, the Navy and its shipbuilding partners had to conduct a thorough technical review and reinspection of the affected vessels to ensure the ships’ safety. My office is committed to ensuring that government contractors are held responsible when they attempt to defraud the government and put our Navy personnel in danger.”

According to court documents, Ruks worked for Northrop Grumman Shipbuilding, Newport News, Va., as a NDT inspector. He admitted to his supervisors on May 14, 2009, that he had falsely certified he had inspected three lift pad welds on a Navy submarine when in fact he had not. Ruks was later questioned by agents of the Naval Criminal Investigative Service (NCIS) and, although he admitted the false certifications of the lift pad welds, he lied to the agents regarding the number of other ship and submarine hulls he had failed to inspect. NCIS determined Ruks had been falsely certifying weld inspections on various hulls from 2007 through 2009. Based upon archived inspection reports, Northrop Grumman officials estimated Ruks performed approximately 9500 weld inspections on as many as six submarines that he certified in the company’s electronic records system. A reinspection of all the welds Ruks had certified revealed that 14 structural welds and two pipe welds (one of which was a SUBSAFE, critical weld) were determined to be defective/unsatisfactory. There were also a considerable number of welds Ruks certified that were labeled as “inaccessible” due to their location.

The reinspections required 18,906 worker hours, which included the correction of the defective weld joints, at a cost of approximately $654,000.

A search of American Welding Society records revealed Ruks has never been a Certified Welding Inspector.
Clarence Wyland was recently named national sales manager, a new position, for Test Equipment Distributors, Troy, Mich., a supplier of NDE equipment and supplies nationwide.

Wyland is a 27-year veteran of the NDE industry and has worked in sales at American NDT Products and Met Chem Testing Laboratories.

Ian Nicol has recently been named president and CEO for the Americas operations of TÜV SÜD America, Inc. This includes TÜV SÜD Canada, TÜV SÜD América de México, and TÜV SÜD America do Brasil. The company, based in Peabody, Mass., is a global testing, inspection, and certification services firm.

Nicol has served in numerous senior management roles in the certification, inspection, and testing
industries, most recently as senior vice president of SGS Industrial Services NAM.

Fluke Donates Test Tools for United Association’s Mobile Training Trailers

Fluke Corp. donated two sets of tools to the United Association for use in its HVACR training trailers.

Fluke Corp., Everett, Wash., a manufacturer of portable electronic test and measurement equipment, recently donated more than $4000 of test tools to the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada (UA) to help equip two new mobile training trailers. The heating, ventilation, air-
conditioning, and refrigeration (HVACR) trailers will be used to train apprentices and journeymen on the latest equipment used in the industry.

The two 53-ft-long trailers are the UA’s first HVACR mobile training labs. The UA has 40 fully equipped mobile training centers in all. The new units will be utilized in various locations around the United States.

The Fluke donation includes two units each of a complete suite of tools, from airflow, temperature, humidity, and carbon monoxide meters designed for HVAC and indoor air quality control to digital multimeters and clamp meters for electrical measurement, as well as infrared and contact digital thermometers.

**Boulder Imaging Names Senior Optical Solutions Engineer**

Neil Vanasse recently joined Boulder Imaging, Boulder, Colo., as a senior optical solutions engineer. The company manufactures high-performance quality inspection, machine vision, and high-speed imaging equipment.

Vanasse has more than 15 years of experience as an optical and mechanical engineer.

**TÜV Rheinland to Acquire Dutch NDE Firm**

TÜV Rheinland, Cologne, Germany, is acquiring Sonovation B.V., a specialized nondestructive examination services provider based in The Netherlands. Among other services, the company provides weld examination and pipe system and pressure equipment corrosion inspection.

Sonovation was founded in 1988 and employs 50 people. It has locations in The Netherlands, United Kingdom, Belgium, and Germany. Its revenues in 2010 were approximately $17 million. The company will be renamed TÜV Rheinland Sonovation.

**Exova Introduces Pipeline Weld Integrity Test Service**

Exova recently introduced a new immersion ultrasonic testing technique for girth weld inspection in the oil and gas industry.

The immersion technique will be added to the company’s automated ultrasonic testing process to identify if all defects are accurately located and none is missed. Due to the higher signal-to-noise ratio, the immersion testing environment used with high-accuracy robotics is useful for every type of material inspections where small defects have to be detected. The system will allow Exova to identify an increased number of defects, such as cracking, porosity, incomplete penetration, inclusions, incomplete sidewall fusion, and others that can compromise the strength of pipeline girth welds.

Sander van Nieuwenhuijzen, operational manager for the company in The Netherlands, said, “Due to the increased demands on pipeline integrity, it is important that any defect in the welds is detected, accurately located, sized, and reported quickly.”
Inspection Kit Useful for NDE and Mining Inspection

The Spectroline® EK-3000 EagleEye UV-A/white light LED inspection kit features the palm-sized EagleEye inspection lamp that is engineered with two ultrahigh-intensity UV-A (365-nm) LEDs. An adjustable strap allows the lamp to be worn on a hard hat or directly on the head for hands-free operation. A lamp mount/sprayer attachment allows the lamp and a spray can to be mounted together for single-handed fluorescent yoke inspection. The patent-pending kit is designed for fluorescent magnetic particle and penetrant testing, mining inspection, and other operations. The lamp produces a nominal steady-state UV-A intensity of 4500 μW/cm² at 15 in. It features a built-in fan and is powered by a rechargeable lithium-ion battery that provides up to 75 min of continuous inspection. It comes with a lanyard, two replacement splash guards with integral particulate filters, three batteries, a battery-charging cradle with AC and DC cords, UV-absorbing spectacles, and a carrying case.

Spectroline
www.spectroline.com

Small-Sized Impact Marker Designed for Test Stand Applications

The Model 78 Mite-E-Mark line of impact markers is useful for marking one or two characters that need to be permanently stamped into steel, aluminum, plastic, and other components. The markers are designed for cycle times (advanced and return) in under four tenths of a second for more than 2 million cycles. They are available in 1- or 2-in. stroke models and feature a return cylinder indicator option that allows the user to sense its return, which is useful for automated applications for which it is necessary to know when the marker is clear when the part transfers. The models are available with either an “A” rod style for multiple characters or a
The company’s 2-ft-long LED Magnalight work light features 100 ft of cord ending in an explosion-proof plug. It is designed to allow users to connect the light to explosion-proof outlets within a hazardous workplace. The lamp produces a glare-free wide flood of light and is useful for close work and inspection activities where contrast and color rendering are critical. The Model EPL-FL1524-LED-100-1523 lamp features a high lumen per watt output and efficient reflector design. It is approved for Class 1 Div. 1 and Class 2 Div. 2 locations.

Larson Electronics
www.magnalight.com

Spectrometer Offers Precise Metal Analysis

The updated version of the Spectrolab metal analyzer is easier to use and offers reduced operating costs. Components that require maintenance are placed in easy-to-access locations. The optical emission spectrometer features an extended diagnosis and log file system that helps users to monitor the instrument’s status and perform accurate troubleshooting. The analyzer features optimized excitation parameters and a readout system that enables permanent enhancements for lead analysis with a focus on battery technology or in the analysis of precious metals. Among the metals the instrument is able to analyze with a single hardware configuration are aluminum, magnesium, and titanium alloys. It features optimized optical resolution and a focal width of 750 nm in both optical segments.

SPECTRO Analytical Instruments

Precious Metal Analyzer Features Easy Operation

The company’s Niton LX2 precious metal analyzer combines point-and-shoot operation with lab-quality nondestructive analysis to provide exact metal content in seconds. The instrument comes with a mobile test stand, battery and battery charger, PC connection cables, locking carrying case, and belt holster. It provides on-the-spot sorting and valuation of all precious metals as well as quantification of other desirable and undesirable elements.

Thermo Fisher Scientific, Inc.
www.thermoscientific.com/niton

CAN WE TALK?

The Inspection Trends staff encourages an exchange of ideas with you, our readers. If you’d like to ask a question, share an idea or voice an opinion, you can call, write, e-mail or fax. Staff e-mail addresses are listed below, along with a guide to help you interact with the right person.
Laser Tool Offers Alternative for Precise Visual Weld Inspection

Three-dimensional laser precision measurement technology is now available for hand-held visual weld inspection purposes.

Fig. 1 — A variety of commercially available manual weld gauges.

For many years, manual weld gauges have remained the go-to tool for every inspector performing nondestructive visual weld inspection. Examples of these type gauges are shown in Fig. 1.

Simple in design, these gauges have done what they were intended to do: give simple feedback as to whether a weld meets the minimum weld quality standard requirements. However, these devices are limited to the types of joints and weld sizes they can measure, and various joints require different gauges and techniques. Many types of gauges are on the market today, with most doing only one specific task. In fact, one company even sells a fanny pack to carry all these gauges. Even with the correct gauge for an application, the inspector gets only a go/no-go result since most manual gauges do not give actual measurements. These gauges are also only useful for basic welds and joints so, for example, if a fillet weld has unequal leg sizes or an angle that is not 90 deg, additional calculations and equipment are required to accurately measure the weld. These subjective measurements are then typically recorded manually making the whole process quite time consuming and open to possible errors.

Three-dimensional laser precision measurement technology has been around for decades, but due to equipment size, cost, and complexity has been mainly reserved for robotic and hard automation applications. With recent developments in computer component size, battery life, and wireless technologies, laser-based measurement tools have been developed for hand-held weld inspection purposes. With simple interfaces not unlike a current-generation smart phone (Fig. 2), these tools are easy to use, small in size for tight-area access (Fig. 3), and repeatable so that subjectivity is reduced, thus minimizing the possibility of error. A simple click of a trigger can yield many useful measurements such as leg sizes, convexity/concavity, and toe angles, as well as the detection of discontinuities such as undercut and porosity. Figure 4 offers a pictorial view of the possible measurements with a T fillet weld joint. This information can then be downloaded and saved into a database for reporting or to be maintained as a permanent record. If this sounds too good to be true, it’s not, it’s simply combining the technology that’s already available today into a wireless hand-held device.

To help point out the advantages of the laser precision tool, the following scenario of measuring a skewed fillet (Fig. 5) is reviewed.

Laser Tool vs. Fillet Gauge for a Skewed Fillet Weld

Fillet Gauge

1. Choose correct fillet gauge for specific weld.
3. Determine the included angle of the fillet joint.
4. Consult the skewed fillet calculator.
5. Measure the leg sizes of the fillet.
6. Decide if the weld fits within the pass/fail criteria.
7. Manually record results.
Inspection Applications

With one laser inspection tool, joints such as T, butt, corner, and lap can all be measured by simply switching tasks from one type joint to the next. Typical weld sizes can range from small gas tungsten arc welds to multipass submerged arc welds. It is even possible to measure joints before welding, thus giving you an opportunity to prevent problems from occurring earlier in the manufacturing process. Since these devices can yield so much information about your welding operations, it gives engineers the opportunity to improve quality, reduce overwelding, and find upstream problems in part and tooling preparation.

Best Practices

Visual weld inspection is the most prevalent nondestructive examination (NDE) method used today to ensure that the welding manufacturing process is done correctly and meets all applicable standards. Because of the capabilities of this new laser-based precision measuring tool, you need to look at the existing best practices associated with traditional visual weld inspection and determine how these will change. Let’s look at some specific areas of the visual testing process.

Qualified People: As is true with all NDE methods, you need to start with the people side of the equation to make sure the person doing the visual weld inspection is qualified to do the work with respect to using the measuring tool and is familiar with the requirements to be met. Using a laser measurement tool does not change this requirement, but because there is the possibility to preprogram the inspection tool, the inspector doing the work only needs to know how to use the tool properly to do a valid inspection.

Measuring Tools and Methodology: Gauge repeatability and reproducibility are fundamental to using any type of gauge or measuring device correctly. Typical manual gauges used for weld inspection normally change only from wear so a calibration is not really relevant. However, there is a large margin for error with respect to how the inspector uses the gauge, and thus two inspectors may get different results. A laser inspection tool, such as the WikiScan, when used per the approved operating instructions, is quite repeatable when measuring standard AWS-type weld joints and welds. Subjectivity is largely eliminated, thus reducing the need for redundant inspections and the fallout from those redundancies, which is to increase unnecessary repairs.

Do the Job Right the First Time: Typically, inspection is seen as
occurring after the weld is made and the results are locked in stone. While there have been attempts to use gauges for weld joint fitup checking, their go/no-go nature has made it difficult to get quantifiable data to act on. However, with laser-based measuring tools, you can accurately check fitup (included groove angle, mismatch, etc.) before starting welding, thus giving you the chance to prevent making a bad weld. Even further upstream, you can use this tool during the procedure qualification work so as to accurately determine the robustness of the design and welding process.

**Documentation and Information Sharing in a 24/7 World:** The older practice of using a gauge to measure a weld, writing the results down on a piece of paper, transposing them to a computer spreadsheet or database, and then printing a report is labor intensive, prone to error, and slow. The around-the-clock world we live in with engineering being done in one country, the product manufactured in another, and the actual use of the product taking place in yet another, means information must be in an electronic format that is easily transmitted. With a laser measuring tool, not only can you automatically do the inspection and get the results entered into an Excel file as noted in the skewed fillet scenario, but then you can add a picture to the record as well as verbal comments and e-mail this to anyone in the world. Imagine being onsite doing a critical weld inspection and being able to immediately send all this information to your manager, the owner of the product being inspected, or anyone else who needs to know the result to make a timely decision.

**Welder Training and Assessment:** Welder training and assessment methodology had remained fairly static for many years until the computer started impacting this field. The computer has made virtual reality (VR) a very useful tool for teaching welding without having to burn as much wire and make as much smoke. Whether VR or conventional training is employed, the techniques used to evaluate the welder’s skills still involve eyeballing and manual weld gauging. Laser vision measurement allows you to precisely measure the weld size and check for defects, thus quantifying the results such that an accurate score can be given. This benchmark can then be used later to determine whether the welder’s skills are improving, degrading, or staying the same.

**Conclusion**

Now that the digital era is here for surface profile weld inspection, the possibility for advancements is endless. Useful tools such as a pyrometer for measuring preheat, interpass, and postheat temperatures could be a simple upgrade or attachment. There is even the possibility of such upgrades being available in an “app store” where programs are downloaded from the Internet and installed directly into the device.

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**Fig. 6 — The same skewed fillet shown in Fig. 5 being scanned with the handheld laser inspection tool.**
How to Deal with the Unexpected

As an inspector, you need to be able to think on your feet. You can find yourself in some unexpected situations. For instance, you could start your inspection career at an outage. Outages are fast paced, and the companies involved have a lot at stake. Outages can be difficult even for seasoned inspectors, let alone someone fresh from taking the CWI test.

We’ll start with some general advice and then move on to four specific situations you do not expect to encounter, but very well might.

Preparing for the Job

During an outage, you may be working 12-h days, 7 days a week. This can get tedious, so you need to stay focused. In addition, you will be covering a lot of ground. If you’re the quality control (QC) person on the night shift, you may be working by yourself, and even if you’re on the day shift, most likely it will be just you and the site QC manager.

Here are some tips that may help you to be prepared.
• Keep the welders’ names and their stencils with you.
• Keep a copy of the scope of work for the job on your desk because the customer may have added some additional inspection requirements.
• Make sure you have the quality control plan for the outage, as well as a copy of the quality control manual and the Welding Procedure Specifications (WPSs).
• Keep a memo book with you at all times. In your memo book, list all the base metals, wall thicknesses, pipe outside and inside diameter measurements, preheat temperatures, filler metals, and the WPS identification numbers for each process by system.
• Know what code each system is in that you will be inspecting. Keep a copy of those codes on your desk, and review the visual inspection requirements each time you get back to your desk.

But, remember, if you are staying on top of everything like you should, you won’t have time to be in the office because you need to be in the field — and vice versa. So be prepared, because that’s the way it is for the inspector during an outage.

Maintain Good Relationships with Other Workers

• It is advisable to include the safety person in your work. Regularly invite that person to make your rounds with you. He or she will almost always be happy to team up with you and join you on your rounds.
• Be fair, honest, and act in a professional manner with everyone on the job site.
• Maintain your integrity, and guard your language for your own respect and that of the company you represent. Doing this will increase your chances that the customer will want you back later on for another quality-minded, professional job, not to mention you will earn the respect of the people you work with.
• When you do reject a craftsperson’s work, treat that person with respect. Give the person a measurement, show him or her what was wrong, and state what the code requires and what it will take to make it right. Don’t just say, “Fix it, it’s wrong.”

Scenario 1: Dealing with a Welder Who Has Failed a Test

Here’s one of those situations you never thought about when you were taking your CWI test:

After testing welders all day long, you finally get back to your hotel only to find yourself face to face with four angry welders whom you have failed that day, and a mad hotel manager who is losing four paying customers.

Here are some tips about what you can do at the job site to help you prevent “the angry welder” situation.
• Introduce yourself to all the welders with a smile and a hand shake.
• Look the welders in the eye when you talk to them.
• Treat welders with respect.
• Print out and post all visual inspection requirements for the test, the test shop rules, and the required hold points. Go over these with the welders being tested, and ask them if they have any questions prior to the start of the test.
• Identify the welders by checking their identification. Record all information, as well as list all the required documents, immediately on
the Test Shop Log. Immediately match the welders’ test coupons to their names and IDs.
- Help each welder set up, and have him or her tack the coupon at the proper angle as you hold it there.
- Always be available during testing.
- If welder fails the test, use a measurement tool to show that person the exact spot that did not meet the inspection requirement, so that he or she can clearly see where the problem occurred.

The following references might help you. Visual inspection requirements for D1.1:2010, **Structural Welding Code — Steel**, are found in part C at 4.31.1. The Code then refers you to 4.9.1 for acceptance criteria. Section 4.31.5 for root, face, and side bend specimens refers you to 4.9.3.3 for the acceptance criteria specimens. Welder performance qualification can be found in QW Article 1 (QW 100 through QW 190) of Section IX of the ASME **Boiler and Pressure Vessel Code**. Additional information is also available in Article III QW-300 through QW-380. Bend test acceptance criteria can be found at QW-163.

**Scenario 2: Sticking to the Task at Hand**

Imagine the following scene: The test shop is full, and you are in the middle of testing. One of the craft superintendents walks up to you and demands that you leave to look at something that has to be inspected right now.

What should you do? Here are some experience-based tips to help you deal with this situation. First and most importantly, don’t refuse but respectfully tell the craft superintendent you will have to get a qualified person there to witness and conduct the testing in your absence.

Stand your ground, but if he or she insists, suspend the testing. Collect the coupons and take them to the office.

The advice here is that, as a CWI, you actually have no choice. Do not give in to the person’s demands, and do not sign off on anything you have not actually witnessed. It is not worth the inconvenience to your reputation for integrity or that of your fellow CWIs.

Most importantly, this one job is definitely not worth losing your CWI card over, which you should if you make the decision to sign for something you did not witness. Inspection is not a matter of trust, but of verified records.

Remember that you are bound by the Code of Ethics, Rules of Conduct, and Practice found in Section 11 of **AWS QC1:2007, Standard for AWS Certification of Welding Inspectors**. In addition, ASME Section IX, QW-103.1, under “Responsibility:” states: “Welding. Each manufacturer or contractor (which is whom you represent) is responsible for the welding done by his organization and shall conduct the test required in this section to qualify the weldments he uses in this code, and the performance of the Welders and Welding Operators, who apply these procedures.” This means the entire test, not just part of it.

**Scenario 3: Contract Violation**

The construction manager brings you a stack of prints and wants you to start inspecting roughly three acres of fiberglass spool pieces that have been lying in the sun for weeks and tells you to start transferring the stencils on the spool pieces to the prints.

In this situation, you know how long the spools have been lying there, by the date next to the stencils. However, there are no system IDs, line IDs, nothing. The advice here is for the inspector to print out all code requirements.

With that information, you start inspecting. Because of the exposure to sunlight — when they beveled the pipe, nearly every spool was left without the protective coating — you have no choice but to reject the fit. The fitters were not tested when the spools were made up. The glue was stored improperly. You, as the inspector, suggest going to the Engineer of Record and the manufacturer to see if there is a way to resolve the issue. Management immediately gets very upset and everyone quits talking to you. They immediately began hauling the pipe to the site and installing it. Things from that point go from bad to worse.

So what should have been done in a case like this? You should have left. That’s right, you should have left as soon as you had all the inspection criteria and the facts concerning the fabrication of the spool pieces. Unfortunately, there is nothing else you can do. With this much pipe and money at stake, coupled with everyone’s reactions, you must realize the company will win at your expense. It is what it is. A situation like this is rare, but it happens. You do not need to represent any contractor who acts and works like this. It might not seem so at the time, but believe it or not, there is another job down the road.

**Scenario 4: Refusing to Follow the Procedure**

In this situation, the inspector is on a large outage with several inspectors on each shift. The problem is welding starts, and from the very beginning, electrodes are left everywhere. There are either no rod caddies or they are not assigned to anyone. There is no preheating, no supervision.

As you move down the weld lines, you get to the heavy-wall, 2¼ chrome welds, and you can’t believe what you are seeing. Four fits are made lugged off, right on top of the paint; no weld prep; no preheat, nothing.

The advice here is don’t get angry; keep a professional demeanor. Print a copy of the filler metal controls and the WPSs concerning the 2¼ chrome welds and give it to the supervisor. (They should already be posted in the work area or at the rod shack.) Go over these with that supervisor again. Write a nonconformance report, and make them refile the welds according to the procedure. Brief the rod room attendant and have each weld team go over the filler metal controls. Explain how important this is and how it will be enforced. Take pictures. And immediately inform your supervisor.

Keep inspecting, documenting, and enforcing the procedure — confiscating welding rods on the spot, if necessary. Do no name calling. Hold onto your integrity and strictly enforce all hold points.
Conclusion

Here is the final scenario. You are hired by a company you have never worked for before. The job is the replacement of the main steam distribution boxes commonly known as the Wyes. The power company has brought a man out of retirement to oversee this replacement on two units at this station. At the first meeting, he explains that this is a very important and critical system replacement, and the power company wants it done to the letter at all costs.

You make sure everyone is in agreement with each step, everything from the postweld heat treatment (PWHT), to verifying all dimensional checks, and from the boiler superintendent to the power company representative. You post the welding procedures on the scaffold at each unit. Every electrode used comes out of a brand-new can and is checked before it leaves the rod room. As soon as it hits the scaffold, it is immediately put in a caddy, with the temperature being checked often.

The temperature at the weld is checked with a temperature-indicating crayon, in addition to PWHT monitoring. Every pass is cleaned and inspected. The boiler superintendent who is in charge is a pleasure to work with. He knows his work and makes sure everything is 100% exactly the way it should be. The welders are as good as they come. They take pride in their work and stay focused every minute of their 12-h shift. You are out of the office and on the scaffolds before the shift starts. You keep moving back and forth until the shift is over and you go back to the office. You have made the rounds so many times you know there are 250 steps between each weld station.

This is the job that keeps you committed to continuing on, that assures you there are above-average, first-class craftspeople out there.

HOWARD K. JONES (ccarvings@msn.com) is an AWS CWI and CWE, Ellijay, Ga.
By Mary Ruth Johnsen

Visual Inspection Tips from the Pros

Several experienced inspectors offer good advice that you can use on the job

The Benefits of Good Lighting

Bob Wiswesser: One of the key tips I can contribute is to emphasize the need for proper use of sufficient lighting when performing visual weld inspection. I have often seen CWIs attempting to perform weld measurement and flaw evaluation without the use of auxiliary lighting such as a good flashlight or extension “drop” light, which might be necessary to flood the examination area with at least 50 foot-candles of general lighting or 100 foot-candles for performing critical flaw evaluation.

Most of the modern “high-tech” flashlights an inspector can use today are capable of producing these minimum white light intensities at sensible distances such as 10–15 in. from the inspection surface. The distance needed to meet the required light intensity can be verified simply by checking the flashlight or drop light source with a white light meter.

The use of a handy portable light source is more often than not necessary in the fab shop environment because overhead fixed shop lighting rarely is adequate to provide even the minimum visual inspection white light intensity referenced in some of the older visual weld inspection standards including the ASNT Visual Inspection Handbook, of 32.5 foot-candles. Most of today’s current ASTM standards for NDE surface flaw detection methods do require the minimum light intensity to be 100 foot-candles for critical flaw evaluation, so this should be our minimum standard lighting requirement for CWIs while performing visual weld inspection.

Bob Wiswesser is operations chief, Welder Training & Testing Institute, Allentown, Pa. He is chair of the AWS Certification Committee. He is also a Certified Radiographic Interpreter, and has earned endorsements to AWS D1.5 and D1.2, API 1104, ASME Sections VIII and IX, and for bolting inspection.

Things to Do before Work Even Begins

James Ivy: Here are things to look for prior to the start of welding:

1. Ensure that all welders know the safety requirements.
2. Meet with the contractor, so everyone is on the same page for:
   • Welder/tacker performance, weld procedures, code and visual inspection requirements.
   • Fitup tolerances, weld sizes, and how to use weld gauges.
3. When everyone is aware of what to expect, the job will run smoother with rework reduced or eliminated. It will come within budget and have zero safety issues.

James Ivy is project manager/welding inspector in the Facilities Dept. at Ingalls Shipbuilding. His current duties include inspections for the launch pontoon, tugboat, storage tanks, rail track welding, utility piping, and other items as projects are implemented. He has held many positions in the local AWS Section and is a past District 9 director.

Take Good Field Notes

Al Moore: The inspector should write field notes with the thought in mind that there is only one opportunity to gather information. The final report submitted to the client is based on the data and information gathered during that inspection. The details included in the final report should be substantiated by the details included in the field notes. The final report may not include all the details recorded in the field notes, but the inspector can rarely add details to the final report that were not included in the field notes.

The name of the project, location of the inspection, date of the inspection, name of the inspector, and names of the individuals who participated in any conversations relevant to the project should be included in the field notes. Always list the drawings and the revisions used when the inspection was performed.

Field notes should be descriptive and include details of the nature and extent of the nonconformity. The part number of the assembly and the component that is deficient should be listed. It is not enough to say the weld was cracked. The field notes have to define the type of crack, location of the crack, length of the crack, and any other relevant information that may be helpful in writing the final report submitted to the client. Don’t overlook including the type of tools or gauges used to measure or evaluate the discrepancy. The level of detail recorded in the field notes should be more than what is needed in the final report.

A good quality digital camera is the inspector’s best friend when inspecting welds or other items. Photographs should be logged in the field notes with a date and with identification. Digital cameras identify the photographs in memory with a file number. The photo file number with a description of the condition the
photograph depicts should be included in the field notes. Otherwise, the information and the particulars can be lost or forgotten by the time the actual report is written. It is a good idea to include a ruler in the photograph when there is an issue relating to physical dimensions. The ruler will provide a sense of scale for the person looking at the photograph.

Details, details, and more details: they are the backbone of a good inspection report and key to a successful case should litigation become necessary. Albert J. Moore Jr. is vice president, Marion Testing & Inspection, Canton, Conn. He is an ASNT ACCP NDT Level III. He is also a member of the AWS Certification Committee and the Committee on Methods of Inspection of Welds. He has held numerous offices in the local AWS Section, including chair.

Practices of Effective Inspectors

Steve Snyder: Most inspectors have certain habits or project practices they learn along the way and then take with them through their careers. It is hoped these are positive traits that only aid their success and professional development and help them do their jobs more efficiently and accurately.

A few that come to mind I have consciously and frequently practiced are as follows:

1. Know what the requirements of the job before it begins. Become completely familiar with the inspection requirements and acceptance criteria before the project begins instead of trying to determine what they are during the production phase of the project. I'm well aware that sometimes kickoff meetings are late, are not required, or project work has started before the inspector gets involved, therefore complicating this for the CWI or SCWI. However, often it all takes to clarify what the requirements are and what is expected of you is an informal e-mail correspondence. I suggest you keep a record of any technical clarifications (Table 1) that arise during meetings or prepare a formal request and agreement. These can prove to be essential as a project progresses in the event of selective amnesia.

2. Have your own set of gauges. Many inspectors, especially experienced third-party inspectors, show up expecting the quality control (QC) person to do all inspection in their witness or presence using the QC’s gauges so they say they don’t need or require their own inspection gauges. Others feel it is simply not part of his or her role on the project. While that may well be the case, I feel it is essential that you have the required inspection tools and gauges to perform the project inspections required by QC, even if you are acting as a third party inspector. This sends the message that you understand what is required and, if need be, will verify it yourself.

3. Set up a good tracking system. Having good systems, forms, and documentation practices to track the weld procedure qualifications and/or production acceptances and status on a project is essential to staying organized. Every inspector has his or her own way of doing this. Table 2 is a sample of a form I have used on

Table 1 — Technical Qualification Form

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<th>Item No.</th>
<th>Clause</th>
<th>Qualification</th>
<th>Reason</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td></td>
<td>Proposal is based on execution of the work clearly identified in the attached “Method Statements” for each respective pkg A, B, C, and D.</td>
<td>Basis of proposal.</td>
<td>Qualification remains open.</td>
</tr>
<tr>
<td>1.</td>
<td>Scope of Work</td>
<td>7-30-08 (MOC). Package A is the only scope being awarded at this time. Method Statements are not clear to MOC and not agreed to as of this date. MOC to review Technical proposal and propose acceptable wording to for closure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Company provided items</td>
<td>08-13-08 (S7). Awaiting MOC response to sections T2, T16, and T17 of Technical Tender GM-08-009.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Company provided items</td>
<td>9-8-08 (MOC). T2 and T16 do not represent the project scope and need to be revised with the agreed scenario. T17 is this very document we are working on closure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Company provided items</td>
<td>7-30-08 (MOC) S7 to provide sufficient lead notice for delivery.</td>
<td></td>
<td></td>
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</tbody>
</table>
projects regardless of any other reporting required. This form helps me in tracking my day-to-day activities or status of any and all weld procedure qualifications. Using or updating the form daily has proved essential to providing timely feedback to the client.

Steven T. Snyder is technical manager, Oil States Industries (Asia) Pte Ltd., Singapore. He is an AWS CWE, CSWIP-PAUT, ASNT Level III, ICC-S1 and S2, ASQ CQA with more than 23 years of multiple industry experience.

**Welding and Repair of Galvanized Coatings**

Robert Hay: The incorporation of zinc into weldments has a negative impact on the integrity of welds. This would include coatings at the fused surfaces of fillet welds as well as the groove faces of groove welds. Often there is no forethought given by fabricators in regard to the welding of surfaces with zinc coatings. All zinc coatings should be removed prior to welding as required in AWS D1.1, *Structural Welding Code — Steel*, Section 5.15 Preparation of Base Metal. The specific degree of zinc removal (i.e., distance from weld toe, removal of all intermetallic layers) should be thoroughly discussed with the inspection agency and welding contractor prior to welding operations. The WPS utilized on the project should address coatings and any surface preparation. Proper galvanized coating removal can be labor intensive and costly. Quite often, the removal and subsequent repairs are not anticipated while bidding projects.

The repair of galvanized coatings is very important after welding operations have been completed. The CWI is often asked to review the zinc repairs although most have no formal training to do so. Improperly applied coatings can prematurely fail resulting in unprotected weldments. It is my experience that the performance of cold galvanized coatings is contingent on the quality of the surface preparation prior to application. The repair coating should meet the requirements of ASTM C780 for the repair of damaged hot dip galvanized coatings. It is critical the surfaces be free of oil, moisture, rust, dirt, or other contamination prior to application.

Solder cleaning (SSPC-SP1) is usually sufficient for new steel surfaces. However, surfaces that were repaired or welded might require wire brush cleaning (SSPC-SP2), power tool cleaning (SSPC-SP3), or commercial blast cleaning (SSPC-SP6) in order to remove all welding-associated problems that could compromise the coating. Some manufacturers require that a needle gun finish be performed (SSPS-SP11) on repaired surfaces. It is important that the coating manufacturer’s surface preparation and application instructions be followed.

Robert Hay is a senior project executive for Flood Testing Labs, Chicago, Ill., the largest employer of CWIs in the state. His primary function at the company is as lead technical

<table>
<thead>
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<th>Table 2 — Sample Form Used on Projects</th>
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Inspection Trends / Fall 2011
specialist for building materials. He is an ASNT NDT Level III magnetic particle, dye penetrant, ultrasonic, and visual inspection; and an ICC Structural Steel Bolting Special Inspector, Steel Welding Special Inspector, Masonry Special Inspector, and Master of Special Inspection. He is a member of the AWS Subcommittee on Certification of Structural Inspectors.

Beware of Unscrupulous Companies and Individuals

Eugene Hornberger: A few years ago, I received a phone call from a steel erector contractor who said he had some Welder Performance Qualification records that had my signature on them, and he felt they were not right. I asked him to send me copies of them. I received copies of 20 welder performance records. He was correct in that they were not right; they had been altered.

My signature was in the same place on each document. My SCWI stamp was in the same place on each document. The original welder’s name was whited out and another name typed in. A typeface different than the one I use had been used to type in the new welders’ names.

As I investigated what had happened, I found out the correct story. The steel erector contractor (prime) did not have enough help to erect the steel for a school so he hired a subcontractor (sub) to do the job for him. The prime contractor told the subcontractor that he had to supply welder certification papers for his welders. The subcontractor finished the job but never supplied the welder certification papers. The prime said, “No papers, no money.” The prime and sub battled through lawyers until the sub produced the bogus paperwork that was later sent to me.

I tried to no avail to dispute the altered documents. No one else disputed the alterations: Not the Engineer of Record, no CWI, nor the prime contractor. No one. While I don’t know how to prevent a situation such as this from happening, I do know we all need to be on guard for unscrupulous companies and individuals.

If anyone involved in an unethical practice is an AWS SCWI or a CWI, a complaint can be brought against them. The procedure for that is outlined in AWS QC9-98, Administrative Procedures for Alleged Violations of AWS Certification Programs, which can be downloaded for free from the AWS Web site, www.aws.org.

Eugene Hornberger is the owner of Eugene G. Hornberger, Consultant, LLC, for which he tests welders and prepares Welding Procedure Specifications and Welding Procedure Qualifications for companies. He is a Life Member of the American Welding Society, and has served as chair of the Education Committee and on the Board of Directors of the American Welding Society.

Mary Ruth Johnsen (mjohnsen@aws.org) is Editor of Inspection Trends.
By K. Erickson and C. Mankenberg

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Q: I am a certified Level II liquid penetrant and magnetic particle NDE inspector. Many times, I am sent out to perform these examinations on stainless steel and carbon steel welds. Although I am not a CWI, the welds oftentimes have surface indications such as undercut and porosity that are not corrected. I thought that all welds require some form of visual inspection prior to any NDE being performed?

A: I cannot speak for every project; however, if nondestructive examinations are required, the majority of governing standards used today would also require visual inspections to be performed and accepted by a certified individual to a determined acceptance criteria prior to other NDE. You can always inquire if the visual inspections have been completed, accepted, and documented prior to performing your examinations.

In today’s industries and variety of applications, it is not uncommon to have separate inspectors for both visual testing and other NDE purposes. Many welding and fabrication shops will contract out the nondestructive examinations as opposed to having and maintaining this program in-house.

Also for consideration may be the simple fact that whoever is responsible for performing the visual inspection(s) is either not performing this task or is not competent and/or certified to be inspecting welds. In this case, you should bring this to the attention of your immediate supervisor or manager for investigation and resolution. NDE acceptance criteria may and will differ from visual acceptance criteria, so it is important to establish and acknowledge what it is you are signing for in

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Defects in medical arterial stent as seen with a Hawkeye Pro Slim 12”

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FABTECH. Nov. 14–17, McCormick Place, Chicago, Ill. Contact American Welding Society, (800/305) 443-9353, ext. 264; or visit www.fabtechexpo.com or www.aws.org. The AWS conference schedule during FABTECH is as follows:

- **National Welding Education Conference**, Nov. 15; contact Monica Pfarr at (800/305) 443-9353, ext. 461, or mpfarr@aws.org.
- **Welding Technology to the Rescue**, Nov. 14
- **8th Conference on Weld Cracking**, Nov. 15
- **What's New in Power Sources**, Nov. 16
- **Thermal Spray Technology: High-Performance Surfaces**, Nov. 16

For more information, contact Zoey Oliva at (800/305) 443-9353, ext. 264, or zoliva@aws.org.


Educational Opportunities

NDE Classes. Moraine Valley Community College, Palos Hills, Ill., offers NDE classes in PT, MT, UT, RT, Radiation Safety, and Eddy Current, as well as API 510 exam prep and weld inspection. For more information, contact (708) 974-5735; wdcs@morainevalley.edu; morainevalley.edu/NDE.


EPRI NDE Training Seminars. EPRI offers NDE technical skills training in visual examination, ultrasonic examination, and remote visual inspection. For the complete schedule, contact (866) 243-2638; www.geit-info@ge.com; www.ge.com/inspectiontechnologies.

Nondestructive Examination Courses. A course schedule is available from Hellier, 277 W. Main St., Ste. 2, Niantic, CT 06357, (860) 739-8950, FAX (860) 739-6732.

NDE Training Courses. GE Inspection Technologies offers training on topics such as eddy current, digital radiography, and remote visual inspection. For more information, or to register, contact Thermo Fisher Scientific, Inc., at www.niton.com/News-and-Events.

Preparatory and Visual Weld Inspection Courses. One- and two-week courses presented in Pascagoula, Miss., Houston, Tex., and Houma and Sulphur, La. Contact Real Educational Services, Inc., (800) 489-2890; info@realeducational.com.

CWI/CWE Course and Exam. A ten-day program presented in Troy, Ohio. Contact Hobart Institute of Welding Technology (800) 332-9448; www.welding.org; hiwt@welding.org.

T.E.S.T. NDT, Inc., Courses. CWI preparation, NDE courses, including ultrasonic thickness testing and advanced phased array. On-site training available. T.E.S.T. NDT, Inc., 193 Viking Ave., Brea, CA 92821; (714) 255-1500; FAX (714) 255-1580; ndtguru@aol.com; www.testndt.com.

NDE Training. NDE training at the company’s St. Louis-area facility or on-site. Level III services available. For a schedule of upcoming courses, contact Quality Testing Services, Inc., 2305 Millpark Dr., Maryland Heights, MO 63043; (888) 770-0103; training@qualitytesting.net; www.qualitytesting.net.

CWI/CWE Prep Course and Exam and NDT Inspector Training Courses. An AWS Accredited Testing Facility. Courses held year-round in Allentown, Pa., and at customers’ facilities. Contact: Welder Training & Testing Institute (WTTI). Call (800) 223-9884, info@wtti.edu, or visit www.wtti.edu.

Welding Inspection, INTEG, Welding Health and Safety, and Welding Supervisor Courses. Contact the Canadian Welding Bureau for schedule at (800) 844-6790, or visit www.cwbgroup.org.
### Certified Welding Inspector (CWI)

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<td></td>
</tr>
<tr>
<td>Chicago, IL</td>
<td>Mar. 18–23</td>
<td>Mar. 24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miami, FL</td>
<td>Mar. 25–30</td>
<td>Mar. 31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dallas, TX</td>
<td>Apr. 15–20</td>
<td>Apr. 21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Springfield, MO</td>
<td>Apr. 15–20</td>
<td>Apr. 21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portland, ME</td>
<td>Apr. 15–20</td>
<td>Apr. 21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Las Vegas, NV</td>
<td>Apr. 15–20</td>
<td>Apr. 21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td>Apr. 29–May 4</td>
<td>May 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nashville, TN</td>
<td>Apr. 29–May 4</td>
<td>May 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jacksonville, FL</td>
<td>Apr. 29–May 4</td>
<td>May 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miami, FL</td>
<td>Dec. 12–17</td>
<td>No exam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Orleans, LA</td>
<td>Nov. 7–12</td>
<td>No exam</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Certified Welding Supervisor (CWS)

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SEMINAR DATES</th>
<th>EXAM DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanta, GA</td>
<td>Jan. 9–13</td>
<td>Jan. 14</td>
</tr>
<tr>
<td>New Orleans, LA</td>
<td>Apr. 16–20</td>
<td>Apr. 21</td>
</tr>
</tbody>
</table>

CWS exams are also given at all CWI exam sites.

### Certified Radiographic Interpreter (CRI)

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SEMINAR DATES</th>
<th>EXAM DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allentown, PA</td>
<td>Nov. 7–11</td>
<td>Nov. 12</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td>Feb. 27–Mar. 2</td>
<td>Mar. 3</td>
</tr>
<tr>
<td>Houston, TX</td>
<td>Apr. 16–20</td>
<td>Apr. 21</td>
</tr>
</tbody>
</table>

The CRI certification can be a stand-alone credential or can exempt you from your next 9-Year Recertification.

### Certified Welding Sales Representative (CWSR)

CWSR exams will be given at CWI exam sites.

### Certified Welding Engineer (CWEng)

Exam can be taken at any site listed under Certified Welding Inspector. No preparatory seminar is offered.

### Senior Certified Welding Inspector (SCWI)

Exam can be taken at any site listed under Certified Welding Inspector. No preparatory seminar is offered.

### Advanced Visual Inspection Workshop

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SEMINAR DATES</th>
<th>EXAM DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miami, FL</td>
<td>Feb. 9–10</td>
<td>Feb. 11</td>
</tr>
<tr>
<td>Miami, FL</td>
<td>May 17–18</td>
<td>May 19</td>
</tr>
<tr>
<td>Miami, FL</td>
<td>Aug. 16–17</td>
<td>Aug. 18</td>
</tr>
</tbody>
</table>

### International CWI Courses and Exams Schedules

Please visit [www.aws.org/certification/inter_contact.html](http://www.aws.org/certification/inter_contact.html).
Verifying the Proper Choice of Nondestructive Examination

Some, among the more than 30,000 AWS Certified Welding Inspectors and Senior Certified Welding Inspectors, are certified in one or more methods of nondestructive examination (NDE). Many others are not. A CWI or SCWI is not required to be certified in any NDE method(s). They are, however, required to have a basic knowledge of the major NDE methods and recognize their advantages and limitations in order to determine the appropriateness of their application in any situation.

---

### Examination Method Selection Guide

<table>
<thead>
<tr>
<th>Typical Equipment</th>
<th>Applications</th>
<th>Advantages</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Visual</strong></td>
<td>Detection of surface discontinuities only. Verification of fitup and joint configuration, weld dimensions, and profiles.</td>
<td>The method is economical and expedient, and requires relatively little training and relatively little equipment for many applications.</td>
<td>The method is limited to surface conditions only and by the experience and visual acuity of the inspector.</td>
</tr>
</tbody>
</table>

- **Light source, magnifiers, color enhancement, protractors, other measurement equipment, i.e., rulers, micrometers, optical comparators.**
- **Detection of surface discontinuities only.**
- **The method is economical and expedient, and requires relatively little training and relatively little equipment for many applications.**
- **Surface films such as coatings, scale, smeared metal may mask or hide discontinuities. Bleed out from porous surfaces can also mask indications. Parts must be cleaned before and after examination.**

| **Liquid Penetrant** | Detection of surface discontinuities only. | The equipment is portable and relatively inexpensive. The examination results are expedient. Results are easily interpreted. Requires no electrical energy except for light sources. | Surface films such as coatings, scale, smeared metal may mask or hide discontinuities. Bleed out from porous surfaces can also mask indications. Parts must be cleaned before and after examination. |

- **Fluorescent or visible dye penetrant, developers, cleansers (solvents, emulsifiers, etc.). Suitable cleaning gear. Ultraviolet light source if fluorescent dye is used.**
- **Detection of surface discontinuities only.**
- **The equipment is portable and relatively inexpensive. The examination results are expedient. Results are easily interpreted. Requires no electrical energy except for light sources.**
- **Surface films such as coatings, scale, smeared metal may mask or hide discontinuities. Bleed out from porous surfaces can also mask indications. Parts must be cleaned before and after examination.**

| **Magnetic Particle** | Detection of surface or near-surface discontinuities only. | The method is relatively economical and expedient. Examination equipment is considered portable. Unlike dye penetrants, magnetic particle can detect some discontinuities slightly below the surface. | The method is applicable only to ferromagnetic materials. Parts must be cleaned before and after examination. Thick coatings may mask rejectable discontinuities. Some applications require the part to be demagnetized after examination. Magnetic particle examination requires use of electrical energy for most applications. |

- **Prods, yokes, coils suitable for inducing magnetism into the weld. Power source (electrical). Magnetic powders — some applications require special facilities and ultraviolet lights.**
- **Detection of surface or near-surface discontinuities only.**
- **The method is relatively economical and expedient. Examination equipment is considered portable. Unlike dye penetrants, magnetic particle can detect some discontinuities slightly below the surface.**
- **The method is applicable only to ferromagnetic materials. Parts must be cleaned before and after examination. Thick coatings may mask rejectable discontinuities. Some applications require the part to be demagnetized after examination. Magnetic particle examination requires use of electrical energy for most applications.**

| **Radiography (Gamma)** | Detection of voluminous discontinuities such as porosity, incomplete joint penetration, slag, etc. Lamellar-type discontinuities such as cracks and incomplete fusion can be detected with a lesser degree of reliability. It may also be used in certain applications to evaluate dimensional requirements such as fitup, root conditions, and wall thickness. | The method is generally not restricted by type of material or grain structure. The method detects surface and subsurface discontinuities. Radiographic images aid in characterizing discontinuities. The film provides a permanent record for future review. | Planar discontinuities must be favorably aligned with radiation beam to be reliably detected. Radiation poses a potential hazard to personnel. Cost of radiographic equipment, facilities, safety programs, and related licensing is relatively high. A relatively long time between exposure process and availability of results. Accessibility to both sides of the weld required. Use and disposal of processing chemicals. |

- **Gamma ray sources, gamma ray camera projectors, film holders, film, lead screens, film processing equipment, film viewers, exposure facilities, radiation monitoring equipment.**
- **Detection of voluminous discontinuities such as porosity, incomplete joint penetration, slag, etc. Lamellar-type discontinuities such as cracks and incomplete fusion can be detected with a lesser degree of reliability. It may also be used in certain applications to evaluate dimensional requirements such as fitup, root conditions, and wall thickness.**
- **The method is generally not restricted by type of material or grain structure. The method detects surface and subsurface discontinuities. Radiographic images aid in characterizing discontinuities. The film provides a permanent record for future review.**
- **Planar discontinuities must be favorably aligned with radiation beam to be reliably detected. Radiation poses a potential hazard to personnel. Cost of radiographic equipment, facilities, safety programs, and related licensing is relatively high. A relatively long time between exposure process and availability of results. Accessibility to both sides of the weld required. Use and disposal of processing chemicals.**
particular situation. It is important for the CWI or SCWI to recognize a situation in which the best NDE method for a particular set of circumstances is in use and determine if that method is indeed being employed. The certified inspector is expected to recognize the proper application of each major method. While the AWS CWI is not required to be certified in any NDE method, he or she is expected to be able to identify each method and process, and its proper application.

AWS B1.10M/B1.10:2009, Guide for the Nondestructive Examination of Welds, Annex A, “Examination Method Selection Guide,” offers an excellent synopsis of the equipment needs, applications, advantages, and disadvantages of the eight most common and popular NDE methods. This will present a good review for knowledgeable individuals and perhaps broaden the knowledge base of others who may not deal with each of these NDE methods on a regular basis. Annex A begins on page 28.

Lyndsey Deckard (Deckard@pbworld.com) is quality manager of the Vehicle Division of Parsons Brinckerhoff Transit & Rail Systems, Inc. He is an AWS Senior Certified Welding Inspector, an ASQ Certified Quality Auditor, and a member of the AWS Certification Committee, Examination Question Bank Subcommittee, and Ethics Subcommittee.

### Examination Method Selection Guide

<table>
<thead>
<tr>
<th>Typical Equipment</th>
<th>Applications</th>
<th>Advantages</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-ray sources (machines), electrical power source, same general equipment as used with gamma sources (previous page).</td>
<td>Same application as previous page.</td>
<td>Same as previous, except that X-ray radiography can use adjustable energy levels, and it generally produces higher quality radiographs than gamma sources. The process also enjoys the same advantages as previous page.</td>
<td>High initial cost of X-ray equipment. Not generally considered portable. Also, same limitations as previous page.</td>
</tr>
<tr>
<td>Pulse-echo instrument capable of exciting a piezoelectric material and generating ultrasonic energy within a weld, and a suitable cathode ray tube scope or digital display capable of displaying the magnitudes of received sound energy. Calibration standards, liquid couplant.</td>
<td>The method can detect most weld discontinuities including cracks, slag inclusions, and incomplete fusion. It can also be used to verify base metal thickness.</td>
<td>The method is most sensitive to planar-type discontinuities. The test results are known immediately. The method is portable, and most ultrasonic flaw directors are battery operated. The method has high penetration capability. Method may be used when access to only one side of the joint is available.</td>
<td>Surface condition must be suitable for coupling of transducer. A liquid couplant is required. Small, thin welds may be difficult to inspect. Reference standards and a relatively skilled operator or inspector are required. Materials with large grain structures may be difficult to inspect. The method is less sensitive to rounded discontinuities.</td>
</tr>
<tr>
<td>An instrument capable of inducing electromagnetic fields within a weld and sensing the resulting electrical currents (eddy) so induced with a suitable probe or detector. Calibration standards.</td>
<td>Detection of discontinuities on or near the surface. Alloy content and heat treatment condition may affect results.</td>
<td>Equipment used with surface probes is generally lightweight and portable. Painted or coated welds can be inspected. The method can be partially or completely automated for a high speed, relatively inexpensive examination.</td>
<td>Relatively shallow depth of examination. Many material and test variables can effect the test signal.</td>
</tr>
<tr>
<td>Leak testing requires a gas or liquid medium, a pump to apply a differential pressure to one side of a weldment and a device to contain the pressure if the weldment is not a closed structure. A detection instrument if the medium penetrating the weld cannot be detected visually may also be required.</td>
<td>Detection of through-thickness discontinuities</td>
<td>Relatively cheap and easy to do if visual detection of leaks is possible. Special mediums such as helium require more sophisticated equipment to detect. However, helium leak testing is very sensitive.</td>
<td>Requires a source of water or other medium, a means of disposing of the medium, and the weldment may require cleaning after testing.</td>
</tr>
</tbody>
</table>
Errata AWS D17.1 and D17.2 Aerospace Welding Specifications


The following errata have been identified and will be incorporated into the next reprinting of this document.

Page 9 — Figure 5.1, S.S. No. — Remove “S.S. No.” from the top of the suggested test record form.

Page 18 — Figure 5.7, Note — Correct “Suggested dimension” to “Where member differ in thickness more than 10% of the thicker member, the cap sheet shall be the thicker member”.

Page 18 — Figure 5.7, Footnote a — Correct “Where member differ in thickness more than 10% of the thicker member, the cap sheet shall be the thicker member” to “Suggested dimension”.

Page 22 — 5.4.2 Procedure Qualification, Numbering sequence — Correct “(8) filler metal used” to “(9) filler metal used”, “(9) joint design” to “(10) joint design”, “(10) electrical characteristics” to “(11) electrical characteristics”, “(11) preheat requirements” to “(12) preheat requirements”, “(12) post-weld heat requirements” to “(13) post-weld heat requirements”, and “(13) other variables required by the Engineering Authority” to “(14) other variables required by the Engineering Authority”.

Page 34 — Table 7.1, Mismatch Between Members after Welding — Correct “Refer to Paragraph 6.14.4 & Figure 6.2 Includes A, B & C Class of Welds” to “Refer to Paragraph 7.5.2.1 & Figure 7.2 Includes A, B, & C Class of Welds”.

Page 36 — Figure 7.1, WIDTH OF WELD FACE OR INDIVIDUAL SURFACE BEAD, W — Correct “W > \frac{5}{16} \text{ in} \ TO \ W < 1 \text{ in}[25 \text{ mm}]” to “W > \frac{5}{16} \text{ in} \ [8 \text{ mm}] TO \ W < 1 \text{ in}[25 \text{ mm}]”.

Page 36 — Figure 7.1, Footnote a — Correct “Refer to 4.3.8.2” to “Refer to 5.3.8.2”.

Page 37 — Figure 7.2, Extra horizontal line within table — Remove horizontal line between “PAW” and “GMAW FCAW SAW”.

Page 38 — Table A.1, Comparable Fillet Weld Size for Same Strength (in [mm]) — Correct “1.23 [21.2]” to “1.23 [31.2]”.

Page 65 — Table C.3, Missing line within table — Add vertical line between “T1” and “W”, “Max.” and “Min.”, and “6” and “7”.

Page 82 — G.4.14 Welding and Weldments — Correct “Figure 6.2 dictates maximum mismatch at the completed weld joint.” to “Figure 7.2 dictates maximum mismatch at the completed weld joint.”


The following erratum has been identified and will be incorporated into the next reprinting of this document.

Page 14, Figure 7, annulus width — Correct “0.15 Sm” to “0.15 Rm”.

Errata: D1.5M, Bridge Welding Code

Standard: AASHTO/AWS D1.5M/D1.5: 2010, Bridge Welding Code

The following erratum has been identified and will be incorporated into the next reprinting of this document.

Page 82, Table 4.1 (Continued), Matching Filler Metal Requirements for WPSs Qualified in Conformance with 5.12.
Correct “ER90C-XXX” to read “E90C-XXX” in the Welding Processes and Electrode Specification Classifications column. This is the fifth entry from the bottom of the column.

Official Interpretation

D1.1, Structural Welding Code — Steel

Subject: Qualifying two welders on one joint for pipe
Code Provision: 4.30.3.1 and 4.19.1.1
AWS Log: D1.1-06-120

Inquiry: Based on 4.30.3.1, is it allowed to qualify two welders on the same joint, each of them welding half pipe circumference, from top center to bottom center (either uphill or downhill progression)?

Response: No.
Addenda Issued for D1.9, Structural Welding Code — Titanium

The following addenda has been made and incorporated into the current edition of this document.

**AWS Standard:** D1.9/D1.9M:2007, Structural Welding Code — Titanium  
**Addenda No.:** ADD1  
**Subject:** Radiographic Crack Allowance in Table 5.2

Page 81: Add a row above “Fine Scattered Porosity” to Table 5.2 for cracks discontinuity types as follows:

<table>
<thead>
<tr>
<th>Discontinuity Types</th>
<th>Base Material Thickness Range, in [mm]</th>
<th>Radiograph Category, in [mm]</th>
<th>Acceptance Level (Reference ASTM E 390 Radiographs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cracks</td>
<td>All</td>
<td>N/A</td>
<td>None allowed</td>
</tr>
<tr>
<td>Fine Scattered Porosity</td>
<td>a1/8 [3] and a1/2 [12]</td>
<td>Up to 3/8 [10], incl.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>&gt;1/2 [12]</td>
<td>Up to 3/4 [19], incl.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>&gt;1-1/2 [38] and a3 [76]</td>
<td>Up to 2 [50], incl.</td>
<td>2</td>
</tr>
<tr>
<td>Coarse Scattered Porosity</td>
<td>a1/8 [3] and a1/2 [12]</td>
<td>Up to 3/8 [10], incl.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>&gt;1/2 [12]</td>
<td>Up to 3/4 [19], incl.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>&gt;1-1/2 [38] and a3 [76]</td>
<td>Up to 2 [50], incl.</td>
<td>2</td>
</tr>
<tr>
<td>Linear Porosity or Rounded</td>
<td>a1/8 [3] and a1/2 [12]</td>
<td>Up to 3/8 [10], incl.</td>
<td>1</td>
</tr>
<tr>
<td>Indications</td>
<td>&gt;1/2 [12]</td>
<td>Up to 3/4 [19], incl.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>&gt;1-1/2 [38] and a3 [76]</td>
<td>Up to 2 [50], incl.</td>
<td>2</td>
</tr>
<tr>
<td>Nonmetallic Inclusions</td>
<td>a1/8 [3] and a1/2 [12]</td>
<td>Up to 3/8 [10], incl.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>&gt;1/2 [12]</td>
<td>Up to 3/4 [19], incl.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>&gt;1-1/2 [38] and a3 [76]</td>
<td>Up to 2 [50], incl.</td>
<td>3</td>
</tr>
<tr>
<td>Tungsten Inclusions</td>
<td>a1/8 [3] and a1/2 [12]</td>
<td>Up to 3/8 [10], incl.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>&gt;1/2 [12]</td>
<td>Up to 3/4 [19], incl.</td>
<td>2</td>
</tr>
<tr>
<td>Incomplete Joint Penetration CJP only</td>
<td>a1/8 [3] and a1/2 [12]</td>
<td>Up to 3/8 [10], incl.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>&gt;1/2 [12]</td>
<td>Up to 3/4 [19], incl.</td>
<td>3</td>
</tr>
<tr>
<td>Incomplete Fusion CJP only</td>
<td>a1/8 [3] and a1/2 [12]</td>
<td>Up to 3/8 [10], incl.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>&gt;1/2 [12]</td>
<td>Up to 3/4 [19], incl.</td>
<td>3</td>
</tr>
<tr>
<td>Incomplete Joint Penetration — Partial joint penetration welds only</td>
<td>All</td>
<td>N/A</td>
<td>3/32 [0.8] width, full weld length 1/8 [0.16] width, 4T in 8T weld length</td>
</tr>
<tr>
<td>Incomplete Fusion — Partial joint penetration welds only</td>
<td>All</td>
<td>N/A</td>
<td>3/32 [0.8] width, full weld length 1/8 [0.16] width, 4T 8T weld length</td>
</tr>
</tbody>
</table>

Notes:
1. Porosity or inclusions allowed by this table shall be cause for rejection when closer than twice their maximum dimension to an edge or extremity of a weldment in a highly stressed or critical area, as determined by design engineering personnel.
2. Linear is described as having a length greater than three times the width. Rounded is defined by the converse.
The Answer Is  
— continued from page 28

accepting or rejecting each weld. Keep in mind that with every separate set of eyes viewing a weld, this may initiate a different evaluation and interpretation of the subject weld.

The exception to this may involve the examination of base materials alone. For specific applications and by engineering request, certain base materials may require only a nondestructive examination both for surface and/or subsurface (volumetric) defects prior to any welding being performed. 

An Important Event on Its Way?

Send information on upcoming events to Inspection Trends, 550 NW LeJeune Rd., Miami, FL 33126. Items can also be sent via FAX to (305) 443-7404 or by e-mail to mjohnsen@aws.org.
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