INSPECTION TRENDS

FEBRUARY 2023

THE MAGAZINE FOR MATERIALS INSPECTION AND TESTING PERSONNEL

ACFM Inspection of Storage Tanks

Bridge Inspection

Quality Assurance vs. Quality Control

IN THIS ISSUE: TIPS FOR READING CODES AND STANDARDS ■ INTERNATIONAL CWI PROFILE

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AWS MISSION STATEMENT: The mission of the American Welding Society is to advance the science, technology, and application of welding and allied joining processes worldwide, including brazing, soldering, and thermal spraying.

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BY CARLOS GUZMAN

Dear Readers,

Welcome to a new year of *Inspection Trends*. If you are reading this on paper, you've realized *Inspection Trends* is now published as part of the *Welding Journal*. Facing the increasing costs of mailing, printing, and paper because of worldwide supply shortages, we've decided not to keep printing *Inspection Trends* as a stand-alone magazine. However, the digital version will remain a stand-alone publication, and all AWS Certified Welding Inspectors (CWIs) and Senior CWIs will continue to receive *Inspection Trends* in digital format. An upside of this new configuration is that all AWS members will now have access and be exposed to more welding inspection content. Furthermore, we are working on a new online format to deliver all AWS periodicals in a manner that will be easier to access and read. Stay tuned.

On a separate note, I want to congratulate our long-time contributor, Calvin E. Pepper, on receiving his CWI Lifetime Achievement Award at FABTECH 2022 in Atlanta, Ga. (Read more about it in this issue's News Bulletin section.) Pepper has been a constant contributor to the *Welding Journal* and *Inspection Trends* for many years, and this well-deserved award reiterates his high level of expertise and professionalism as well as his commitment to AWS and giving back to the welding community.

Additionally, we have more exciting news to share. After a long delay due to the pandemic, the Inspection Expo & Conference (IEC) will take place in Austin, Tex., on November 8–10. The IEC allows inspection professionals to network with industry experts, attend expert panel presentations and breakout sessions, and make connections that can boost their career and keep their inspection business on the cutting edge while earning up to 22 professional development hours. Learn about quality assurance/quality control roles, corrosion and inspection plan development, remote inspections, documentation, auditing, steel structural bolting, and advanced ultrasonic testing, among other vital topics. Visit *aws.org/conferences* for more information.

Call for Volunteers

The Certification Department is looking for volunteers to serve in the AWS Qualification & Certification (QC) subcommittees. This is an opportunity for industry leaders and subject-matter experts to play an integral role in the future of welding by providing knowledge and expertise to AWS certification programs and other publications. Anyone with a range of knowledge and experience in the welding industry is encouraged to apply. As a QC subcommittee member, you will be able to review and contribute to new standards and revisions of existing standards, be invited to join the QC committee biannual meetings, and network with leading experts in the industry. For more information and to apply, visit *aws.org/certification/page/certification-committees*.

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AWS DIVERSITY, EQUITY, AND INCLUSION STATEMENT

AWS values diversity, advocates equitable and inclusive practices, and engages its members and stakeholders in establishing a culture in the welding community that welcomes, learns from, and celebrates differences among people. AWS recognizes that a commitment to diversity, equity, and inclusion is essential to achieving excellence for the Association, its members, and employees.

Calvin E. Pepper Earns the CWI Lifetime Achievement Award

Calvin E. Pepper received the AWS Certified Welding Inspector (CWI) Lifetime Achievement Award at the AWS 103rd Annual Business Meeting during FABTECH, Atlanta, Ga. He was inducted with a plaque and medallion.

Pepper was recognized for his work in promoting welding inspection in the industrial sector as well as in education at the secondary, technical college, and university level. He has taught at many local colleges and universities and initiated welding technology and inspection courses at each of the institutions.

He developed a device for the inspection of flow restrictions in lead transfer pipelines for a tetraethyl lead process unit at the ExxonMobil refinery in Baton Rouge, La.; expanded underwater welding inspection techniques for underwater pipelines used in offshore crude and gas gathering systems; and formulated a technique for inspecting joints in fiberglass and solid polymer piping systems. He has also been a consultant to the U.S. Department of Energy and various energy companies for underwater welding and inspection techniques and procedures.

Additionally, Pepper has been a member of the AWS Qualification and Certification Committee for 35 years, including eight years as chair. He has also been a member of the *Welding Handbook* Committee for 22 years, serving as committee and chapter chair. He was an AWS director-at-large from 1996 to 1999 and currently serves as District 9 director. He has been awarded two AWS Lifetime Memberships.

Calvin E. Pepper displayed his CWI Lifetime Achievement Award at the AWS 103rd Annual Business Meeting.

ASNT Announces Winners for First UT Competition

The winner of the American Society for Nondestructive Testing's (ASNT's) first Ultrasonic Testing (UT) Competition was Aaron Guidry of Versa Integrity Group, Sulphur, La. He took home the top prize of $500. Guidry is certified through ASNT's Industry Section Qualification for Oil & Gas (ISQ – O&G) program in ultrasonic thickness testing and ultrasonic shear wave testing. Tim Everhart of MISTRAS Group, Heath, Ohio, placed second, winning a prize of $250.

The competition was held November 1, 2022, during ASNT 2022: The Annual Conference in the exhibit hall of the event. Six Level II personnel from five different states and Peru had 30 minutes at each of five stations to standardize the equipment, conduct the test, and evaluate the sample.

Each sample offered a different challenge for competitors: carbon steel corrosion, carbon steel single-V plate weld, carbon steel pipe weld, and carbon steel double-V plate as well as a mystery sample in the shape of Texas. Naming each sample after a different horror movie added to the fun of the event.

Six ASNT Level II personnel tried their hand at difficult corrosion and weld samples during ASNT's first UT Competition. Aaron Guidry (third from right) and Tim Everhart (second from left) were declared the winners.

The point system for scoring was based on the accuracy of the flaw reporting, and the winner was determined by a group of ASNT Level III subject matter experts.

"These six Level IIs were brave enough to try their hand at some very difficult corrosion and weld samples supplied by Materials Research & Technology," said Brian Frye, ASNT ISQ program manager. "The competition was amazingly close, and the entire group finished within ten points of each other. If I were starting a UT department, I would hire all of them." — *Courtesy of ASNT.*

InterTest and Cavitar Partner in Weld Inspection Divisions

InterTest Inc., Columbia, N.J., a remote visual inspection and nondestructive examination equipment provider, and Cavitar Ltd., Tampere, Finland, a manufacturer of diode laser illumination technology, are partnering to bolster their weld-viewing technology divisions. The agreement will increase Cavitar Welding Camera production and bring its technology to InterTest's customer base of weld quality assurance and inspection groups within North American manufacturing, aerospace, and automotive industries.

"[Cavitar] technology, along with our distribution channels, experience, and support, will allow customers to view more welding applications and increase their productivity by reducing manufacturing scrap and human risk," said Thomas Daly, president and owner of InterTest.

The camera uses proprietary bandpass filtering and laser illumination, allowing users to see through the bright welding arc in real time. It produces a clear image of the welding torch, weld pool, and base metals so operators can monitor, record, and adjust their welding process from a distance, reducing human safety risk and scrap on long automated production runs.

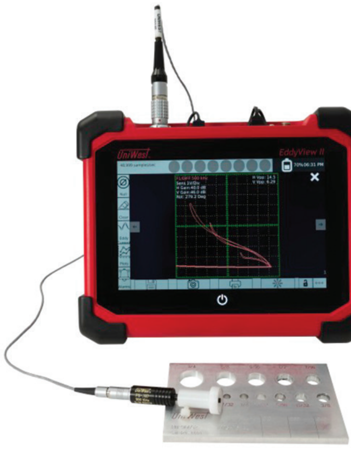
EinSource Cofounder Receives NDE Award

Ripi Singh, cofounder and chief innovation officer of EinSource, Ellington, Conn., earned the American Society for Nondestructive Testing (ASNT) Robert C. McMaster Gold Medal Award for outstanding contributions to the nondestructive examination (NDE) profession. The award was presented at the annual ASNT Conference, which was held in Nashville, Tenn., October 31–November 3, 2022.

"I'm grateful to the ASNT for recognizing our efforts to digitally transform the inspection industry," Singh said. "And I'm equally grateful to my partner and coauthor of the book *The World of NDE 4.0: Let the Journey Begin*, Dr. Johannes Vrana. The award could have gone to either of us. I happened to be the fortunate one this year. I was happy to share the credit with him in Nashville."

Singh is a U.S. delegate to ISO 56000 on Innovation Management Guidance; chair of NDE 4.0 for ASNT; a member of the Connecticut Academy of Science and Engineering; guest editor for *Springer* on NDE 4.0; and a member of industrial advisory boards at the University of New Haven, the University of Hartford, Tsinghua University, and the International Association of Innovation Professionals. IT

Portable Eddy Current Flaw Detector Facilitates Standard and Complex Inspections



Designed for use by nondestructive examination (NDE) professionals, the EddyView® II portable eddy current flaw detector recognizes standard eddy current measurements and complex inspections, including use of eddy current array probes up to 32 elements as well as large-scale automated and robotic production applications. It features an 8-in. touch screen display with gesture adjustments for gain and rotation, drives conventional or array probes, an independent channel that monitors probe-to-part coupling (lift-off), and signal performance with very low signal-to-noise ratio. It also includes multifrequency probe drive and signal mixing, digital conductivity and nonconductive coating thickness, and compatibility with the ECS-1S and JF-15 rotating bolt hole scanners. The unit can be connected to the internet for remote diagnostics, calibration, and exporting raw eddy current data for postprocessing flexibility. For use in demanding and often dirty NDE environments, the flaw detector's rugged housing is designed to meet the standards of an IP65 rating.

UniWest
uniwest.com

Compact Videoscope Designed for Inspections in Tight Areas

The IPLEX™ G Lite-W videoscope lets users visually inspect inside a wind turbine gearbox without disassembling it. Weighing 1.16 kg (2.56 lb) with a scope diameter of 4 mm (0.157 in.), the instrument is easy to carry to the top of wind tower nacelles, and its ergonomic design enables users to control it while wearing gloves in tight confines. The videoscope's optics balance the need to view areas of the wind turbine gearbox up close, spot defects in large spaces, and is small enough to fit into the space between a turbine's bearings. The insertion tube's durable articulation mechanism protects the scope when it is used in tight spaces. The sealed tip keeps out oil. Channels on the oil-clearing tip adaptor use capillary action to draw oil away from the lens, keeping images clear. The scope's smooth, oil-resistant coating provides for fast, simple cleaning. It's designed to meet IP65 standards and built to pass the U.S. Department of Defense testing.

Evident
evidentscientific.com

THE ANSWER IS

BY ALBERT J. MOORE JR.

Q I've been studying in preparation for the AWS Certified Welding Inspector examination, and I am struggling with the code. I am having a difficult time trying to find answers to the practice questions. I feel like I'm chasing my tail or trying to run down a football that bounces one way and then another. Is there a secret or a secret decoder ring needed to decipher a code? Thanks for any help you can offer.

A The first thing to recognize is the code is not read like a novel or epic poem, where you read from the front to the back. Don't try to memorize the code. Rather, all codes and standards follow the same basic rules. The hard part for someone new using a standard is figuring out the rules.

Rule 1. The number one rule is this: The numbering system used follows a certain hierarchy. See below:

1. Header
1.1. Subclause is subordinate to 1
1.2. Subclause is subordinate to 1
  1.2.1. Subclause is subordinate to 1.2
  1.2.2. Subclause is subordinate to 1.2
    1.2.2.1. Subclause is subordinate to 1.2.2
    1.2.2.2. Subclause is subordinate to 1.2.2

Each subclause, subordinate to those before it, provides more-detailed information — either additional details, exceptions, or exemptions to the information contained in the clause higher in the hierarchy. Often, the subclause (lower in the hierarchy) will direct the user to a clause in a different section of the standard. The reference may be an additional test, table, or figure.

Rule 2. Another rule is that you use the code in a fashion similar to how you would use a map. With a map, you look for the final destination and follow from point to point until you get to where you want to go. Using the standard is more like the map function on your cellphone. To find your final destination, you input the address and the map leads you by providing the route from one point to another in sequence. If you stray from the directions provided, the program recalculates and redirects you back on the correct path. But that isn't going to happen when you don't follow the map provided by the standard.

Rule 3. The code is used to find answers to specific questions. Learn how the code or standard is organized.

Let's use a real-world example with AWS D1.1/D1.1M:2020, *Structural Welding Code — Steel*. We need to know which welder performance test should be administered to the welder, and we need to know some basic information to find a meaningful answer. First, the welder will be depositing groove welds and fillet welds in a high-strength, low alloy using the gas-shielded flux cored arc welding (FCAW-G) process. The thickness is unlimited, and the work will be in all positions. The application is nontubular structural shapes, e.g., not pipe (tubular).

In the D1.1 standard, there are two starting points for the novice user: the table of contents (TOC) and index. The TOC, located in the front, lists the main subjects along with the main subclauses. The index is located in the back of the code. In this case, start with the TOC. There are 11 main clauses. Look at the question, and look for a clause that might include the information you are searching for. Our question is about welder performance qualification. There is a clause listed in the TOC titled Qualification. It is Clause 6. That's where you begin your search to find an answer to the question.

Start with Clause 6 and continue on to subclause 6.1. The subclause shows Clause 6 is divided into four parts: Part A — General Requirements, Part B — Welding Procedure Specification (WPS) Qualification, Part C — Performance Qualification, and Part D — Requirements for CVN Toughness Testing.

Back to the map analogy. You're in your driveway, and before you back into the street, you need to determine whether to turn left or right or proceed straight back. You decide to turn right. In our case, you are directed by Subclause 6.1 to go to Part C — Performance

Table 6.10
Welder and Welding Operator Qualification—Production Welding Positions Qualified by Plate Tests (see 6.16.1)[a] a

Qualification Test			Production Plate Welding Qualified			Production Pipe Welding Qualified					Production Box Tube Welding Qualified				
	Weld Type	Test c Positions[c]	Groove		d	Butt Joint[b] b		T-, Y-, K-Connections			Butt Joint		T-, Y-, K-Connections		
			CJP	PJP	Fillet[d]	CJP	PJP	CJP	PJP[b,e]	Fillet[d]	CJP[f]	PJP	CJP	PJP[e]	Fillet[d]
P	Groove[g]	1G	F	F	F, H	F	F		F	F, H	F	F		F	F, H
L		2G	F, H	F, H	F, H	F, H	F, H		F, H	F, H	F, H	F, H		F, H	F, H
A		3G	F, H, V	F, H, V	F, H, V	F, H, V	F, H, V		F, H, V	F, H, V	F, H, V	F, H, V		F, H, V	F, H, V
T		4G	F, OH	F, OH	F, H, OH	F, OH	F, OH		F, OH	F, H, OH	F, OH	F, OH		F, OH	F, H, OH
E		3G + 4G	All	All	All	All	All		All	All	All	All		All	All
	Fillet	1F			F					F					F
		2F			F, H					F, H					F, H
		3F			F, H, V					F, H, V					F, H, V
		4F			F, H, OH					F, H, OH					F, H, OH
		3F + 4F			All					All					All
	Plug	Qualifies Plug and Slot Welding for Only the Positions Tested													

CJP—Complete Joint Penetration
PJP—Partial Joint Penetration

[a] The qualification of welding operators for electroslag welding (ESW) or electrogas welding (EGW) shall only apply for the position tested.
[b] Only qualified for pipe equal to or greater than 24 in [600 mm] in diameter with backing, backgouging, or both.
[c] See Figures 6.3 and 6.4.
[d] See 6.22 and 10.19 for dihedral angle restrictions for plate joints and tubular T-, Y-, K-connections.
[e] Not qualified for welds having groove angles less than 30° (see 10.14.4.2).
[f] Not qualified for joints welded from one side without backing, or welded from two sides without backgouging.
[g] Groove weld qualification shall also qualify plug and slot welds for the test positions indicated.

Fig. 1 — Table 6.10 has been partially populated with the footnotes highlighted to reduce the possibility of overlooking them. Make sure you read the footnotes where they are listed.

Table 6.10
Welder and Welding Operator Qualification—Production Welding Positions Qualified by Plate Tests (see 6.16.1)[a] P132

Qualification Test		Production Plate Welding Qualified	Production Pipe Welding Qualified		Production Box Tube Welding Qualified	
Weld	Test	Groove	Butt Joint[b]	T-, Y-, K-Connections	Butt Joint	T-, Y-, K-Connections

Fig. 2 — Table 6.10: The red text is the return address added by the reader to return to Clause 6.16.1 quickly and easily.

Qualification. Parts A, B, and D don't address welder performance testing, so you don't have to read them.

Once you get to Part C, the first subclause you will encounter is Clause 6.16 — General. Next we see Clause 6.16.1 Production Welding Positions Qualified; our question has included the requirement that the welder will be welding in all positions. Then you'll see Clause 6.16.1.1. We know that the subclause is subordinate to 6.16.1, and it is providing more-detailed information on welding positions. Clause 6.16.1.1 will direct you to Table 6.10 — Fig. 1.

The table is divided into four main columns; the far left is the weld type and test positions. The three columns to the right list the product form and the positions in which the production welds will be made. The product forms listed are structural shapes (other than tubular, pipe), and moving farther to the right, the table addresses pipe and box tubes. Pipe and box tubing are often referred to as hollow structural shapes (HSS).

It is easy to overlook the footnotes, so I highlight them or rewrite them in large text.

The question stated groove welds and fillets are to be welded in all positions on nontubular connections, e.g., structural shapes other than hollow structural shapes (pipes and tubulars).

The far-left column in the table lists "plate." This means the welder is tested using a plate assembly rather than an assembly consisting of pipe or tube. The table indicates that if a grooved plate is used, the welder is qualified for both grooves and fillets (see footnote g). If the welder takes a fillet weld test, the welder is limited to fillet welds. We conclude that the welder should be tested using a grooved plate assembly.

The next column to the right lists the test positions. 1G is flat, 2G is horizontal, 3G is vertical, and 4G is the overhead position. The alphanumeric designations — 1G, 2G, 3G, and 4G — are test positions. Production positions are flat, horizontal, vertical, or overhead. The welder can be tested in the 3G and 4G positions to qualify the welder for all positions on structural shapes other than HSS.

This is probably a good time to mention forwarding and return addresses. If a clause includes a reference to another clause, table, or figure, it is good practice to write the page where the reference is found. The page number is written in the margin next to the clause containing the reference. I call these notations in the margin forwarding addresses. The table or the figure also includes a reference back to the clause that sent you to that table or figure. The page number where the clause is located is written in the margin adjacent to the table or the figure. I call this the return address — Fig. 2. Navigating the code is easier and quicker when the user adds the forwarding and return address.

You are not done yet. You now know you can test the welder using a grooved plate assembly. But what are the details of the test assembly? You need to go back to Clause 6.16.1.1 to resume your reading.

You will stumble upon Clause 6.16.2, where the subject of the thickness of the production weld is discussed. Clause 6.16.2.1 addresses the qualified thickness range of the welder performance qualification. Clause 6.16.2.1 directs the reader to Table 6.11. Write the forwarding address for Table 6.11 (page 156) in the margin adjacent to Clause 6.16.2.1. When you find Table 6.11, you will note the table header lists Clause 6.16.2.1. That notation tells the reader where Table 6.11 was referenced. You can write a return address for Clause 6.16.2.1 (page 132) in the margin adjacent to the table.

From Table 6.11, if the thickness of the test plate is 1 in. or thicker, the qualified thickness range is ⅛ in. to unlimited thickness. One must read all relevant footnotes listed by the table or figure. The only relevant footnote in Table 6.11 appears to be footnote d. The footnote states the 1 in. or thicker test assembly qualifies the welder to weld fillets and partial joint penetration (PJP) groove welds of any size. What about footnotes a, b, and c? They are applicable when evaluating the test assembly (i.e., visual examination, using radiographic testing [RT] as an alternate to bend testing, and when side bends are substituted for face and root bends). They are applicable to our question. From Table 6.11, Figs. 6.16, 6.17, or 6.19 may be applicable. You must now follow the map and see if one of the figures is germane to the question. Figure 6.16 is used for manual and semiautomatic welding processes (welder qualification), Fig. 6.17 is for mechanized or automatic welding (welding operator), and Fig. 6.19 is used for welder qualification in the horizontal (2G) test position. We now know that only Figs. 6.16 and 6.19 are applicable to our question.

We also see from the figures that Clause 6.21.1 may be applicable. A quick look tells us that Clause 6.21.1 simply reiterates which figures apply to the welder performance qualification.

Using the return address listed by Table 6.11, go back to Clause 6.16.2.1. You did write the return address in the margin adjacent to Table 6.11, right?

Continue reading the clauses and you will see that Clause 6.16.3 states a welder or welding operator may be qualified by welding a successful WPS qualification test assembly within the constraints of Table 6.10, thereby, meeting the conditions of Clauses 6.16.1 and 6.16.2. There's nothing in the question alluding to welding up a coupon to qualify the WPS, so this clause doesn't apply.

Continuing to read, you will come across Clause 6.17, a clause that is addressing something not germane to the question.

I believe you have all the information you need to test the welder. You will administer two plate tests that utilize groove welds. One test is in the horizontal position having the geometry depicted in Fig. 6.19, and the second test is a groove weld in the overhead position with the geometry depicted in Fig. 6.16.

To recap, you start with Clause 6, Part C; go to Clause 6.16; then Clause 6.16.1; then on to Clause 6.16.1.1; then proceed to Table 6.10; then Figs. 6.16 and 6.19; back to 6.16.1.1; then to Clause 6.16.2.1. The next couple of clauses, 6.16.3 and 6.17, have nothing to do with our question.

The point-to-point map you followed looks like the following:

Clause 6, Part C → 6.16 → 6.16.1 → 6.16.1.1 → Table 6.10 → Fig. 6.16 and 6.19 → 6.16.1.1 → 6.16.2.1

You have all the information needed to answer the original question.

Your description that it feels like you are chasing a football bouncing on the ground isn't too far off. One must learn to follow the map provided by the code. Even when you get comfortable using the code, don't try to skip a step. That clause you skip may contain some important information. I hope this exercise clears up some of the mystery of using the code to answer a question. No magic decoder ring is required. IT

The Society is not responsible for any statements made or opinions expressed herein. Data and information developed by the authors are for specific informational purposes only and are not intended for use without independent, substantiating investigation on the part of potential users.

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An Inspiring Story about Becoming a SCWI and CWEng in Taiwan

After majoring in mathematics at an American college, Michael Chang returned to Taiwan to work for his family business, Froch Enterprise Co. Ltd., claimed to be the largest stainless tubing manufacturer in Taiwan. Serving as a process engineer, he was given the responsibility of overseeing the automatic pipe manufacturing process, including welding, inspection, and quality control.

To get ready for this job, Chang started learning the gas tungsten and gas metal arc welding processes from the company's senior welders and studying welding basics on his own during off-duty hours. After gaining some experience, he enrolled in the AWS Certified Welding Inspector (CWI) training courses in Taiwan and passed the test, obtaining the credentials in 2006. Afterward, he was promoted to manager of the R&D department, where he was responsible for enhancing the company's welding technology and welder training program.

Chang continued his AWS certification journey to become a Certified Welding Engineer (CWEng) in 2013, and in 2014, he passed the Senior Certified Welding Inspector (SCWI) test. He was promoted to the position of vice president in charge of the engineering and manufacturing work in the company. Becoming a CWI has turned Chang into a remarkable success in his profession and a reputable leader in stainless steel welding in Taiwan.

Chang has served as vice chair of the AWS Taiwan Section for many years. He is a strong and frequent advocate of the AWS certification programs in Taiwan. He has been a frequent speaker on various occasions, inspiring the welding interest of young professionals, using his own experience as examples. In addition, he has co-sponsored many AWS Taiwan Section activities, including meetings, conferences, and seminars.

Inspection Trends asked Chang to elaborate more about his welding inspection career and his current position:

1. Why did you decide to become an AWS CWI in 2006 and then a SCWI in 2014?

When I joined Froch Enterprise, my job was to help the factory in many areas, including quality. Also, I was assigned to supervise the construction of new plants, which was usually related to various welding of steel structures. Consequently, I knew I needed more than just experience and verbal lessons from onsite workers. I turned to AWS Taiwan to pursue my certification.

2. What inspection processes do you use at Froch Enterprise?

Various nondestructive examination methods, such as eddy current and radiography, are performed throughout the inspection procedures. Understanding the theories and operations of different tests allows us to deliver qualified products to customers.

3. How has being an AWS CWI and SCWI been beneficial to your professional career?

With the SCWI credential, it is easier to communicate with colleagues, especially those who have been welding for a long time and are experienced. Being a SCWI also allows me to give welders better guidance so they can improve their skills, resulting in the entire production team's growth.

4. Why are you an advocate of AWS certification programs in Taiwan?

Froch Enterprise is a family-owned entity. It was founded by my father, Ping-Yao Chang, who built this company in a small workshop. In the last 50 years, it has grown to be one of the world's leading brands in stainless steel tubes and pipes with distribution in more than 130 countries. Welding a pipe is like making a piece of jewelry: It requires knowledge, craftsmanship, and mindfulness. Running such a business requires not only the leadership of professional management but also unconditional devotion and persistence. As a second-generation family member, I understand the importance of passing it on to the next generation. It is our responsibility to make sure the legacy is inherited and continues for the next 50 years and beyond.

Michael Chang is an AWS SCWI and CWEng in Taiwan.

5. What words of encouragement do you have for individuals in your country thinking about becoming an AWS CWI?

Back in school, I had studied business-related majors and hadn't been in contact with welding before. Instead of sitting in an office or working on Wall Street, my first job after graduation was operating a semiautomatic pipe welding system. Without any knowledge of welding, it took me quite some time to figure it out, but I've come so far, and now I'm a SCWI and CWEng. For those who have just started welding, stay focused, be open-minded, and I believe you will have better opportunities.

IT FEATURE

The Role of the CWI or SCWI in Fracture Critical Applications

Fracture critical materials, welds, and applications; related special testing; and personnel qualification and certification are discussed

BY CALVIN E. PEPPER, HANNAH J. WOLF, AND ANTHONY D. BLAKENEY

When identified in contract documents, the requirements for inspection and testing of fracture critical materials and welds may be significantly different from standard procedures and production welds typically encountered by the Certified Welding Inspector (CWI) or Senior Certified Welding Inspector (SCWI).

A fracture critical member (FCM) is defined within the American Association of State Highway and Transportation Officials (AASHTO)/AWS D1.5M/D1.5:2020, *Bridge Welding Code*, section 12. AASHTO/AWS Fracture Control Plan (FCP) for Nonredundant Members, subsection 12.2, Definitions, states, "12.2.2 Fracture Critical Member (FCM). AASHTO LRFD Bridge Design Specifications define an FCM as a steel primary member or portion thereof subject to tension whose failure would probably cause a portion of or the entire bridge to collapse."

For many certified inspectors, bridge welding was not a part of their original career choice, and they prefer to work with standard structural fabrication and erection described in AWS D1.1/D1.1M:2020, *Structural Welding Code — Steel*, or other industry standards for piping, equipment, or tanks. However, recent initiatives by the U.S. Congress to improve the nation's infrastructure have placed inspectors from dif-

ferent industries in positions where they need to become familiar with the codes and other standards relating to bridges.

This article is intended to identify and discuss the topics related to fracture critical materials and welds during the quality and inspection procedure development phase, as follows:

The source and rationale for fracture critical materials and welds

- How does the inspector know that a procedure, materials, and welds are fracture critical?
- What codes and standards are used to govern fracture critical?
- What is the FCP?
- What is the relationship between the inspector and the engineer of record?

Special testing requirements for welding procedure specifications (WPSs) used to produce fracture critical welds

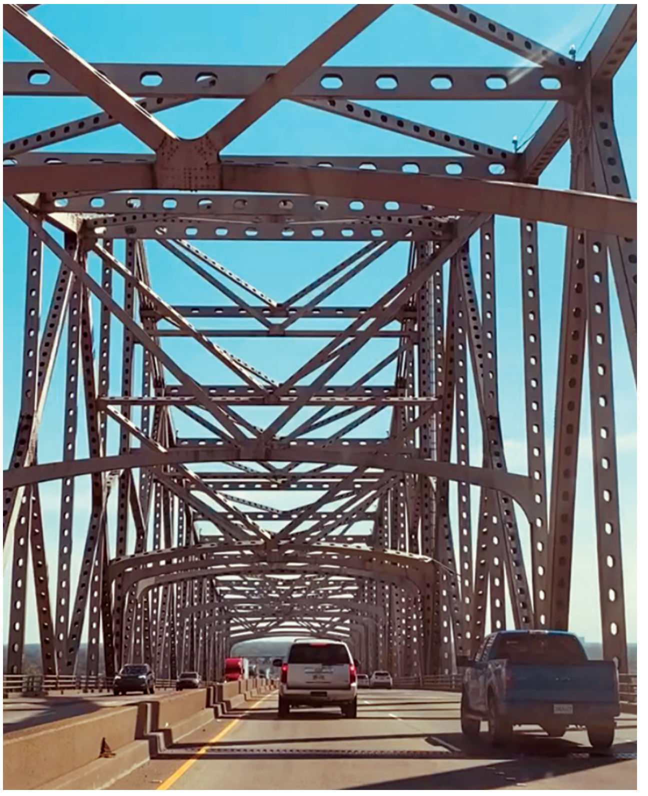
- Are prequalified welding procedure specifications (PWPSs) allowed for fracture critical welds?
- What welding processes are allowed?
- What materials are allowed?
- What special considerations are there for filler metals or base metals?
- What is the reference for removal (location) of supplemental Charpy V-Notch (CVN) test specimens?

Personnel qualification and certification required for fracture critical applications

- What are the personnel requirements within the governing documents?
- Are specific CWI/SCWI endorsements required for fracture critical?

The inspector should note that the relevant section in D1.5M/D1.5 regarding the special requirements for FCM is section 12, AASHTO/AWS Fracture Control Plan (FCP) for Nonredundant Members. This approach to identifying fracture critical members and weldments focuses on the requirement for an FCP, which will be used whenever the engineer of record identifies structural members as fracture critical. Bridge structures that do not contain fracture critical members rely on the content of all sections of D1.5M/D1.5, except section 12.

In addition to AWS D1.5M/D1.5, standards such as AASHTO's *Manual for Bridge Evaluation* (MBE), National



There are more than 617,000 bridges across the United States. Currently, 42% of all bridges are at least 50 years old, and 46,154, or 7.5%, of the nation's bridges are considered in poor condition and structurally deficient. Every day, 178 million trips are taken across these structurally deficient bridges. In recent years, as the average age of America's bridges has increased to 44 years, the number of structurally deficient bridges has declined; however, the rate of improvements has slowed. (Source: U.S. Department of Transportation, Federal Highway Administration, InfoBridge™: Data: infobridge.fhwa.dot.gov/data/dashboard.*)*

Bridge Inspection Standards (NBIS), the Federal Highway Administration (FHWA) manuals, and AASHTO *Bridge Design Specifications* (LRFD) all have information the inspector will need when going into a bridge project where the engineer has identified a FCM. Furthermore, any company wishing to perform construction or fabrication of bridges with FCMs must be certified under the American Institute of Steel Construction (AISC) Quality Certification Program, Category III, Major Steel Bridges with Fracture Critical Rating.

Identifying the Presence of FCMs

Identifying the presence of FCMs must begin during the prebid phase to alert all bidders of the need to include requirements contained in section 12 of D1.5M/D1.5. This addition to the scope of the project has a significant impact on the value of fabrication contracts. Additionally, the presence of FCMs and fracture critical welds requires that the list of

A recent estimate of the nation's backlog of bridge repair needs is $125 billion. We need to increase annual spending on bridge rehabilitation from $14.4 billion to $22.7 billion, or by 58%, if we are to improve the conditions of bridges. At the current rate of investment, it will take until 2071 to make all of the repairs that are currently necessary, and the additional deterioration over the next 50 years will become overwhelming. (Source: U.S. Department of Transportation, Federal Highway Administration, InfoBridge™: Data: infobridge.fhwa.dot.gov/data/dashboard.)

contractors be restricted to those with specific experience in fabricating steel with FCMs, as defined by the engineer.

The FCP referenced earlier contains the requirements of section 12 of AASHTO/AWS D1.5M/D1.5 and those additional requirements specified by the engineer of record. The FCP is a document clearly spelling out for both production and quality personnel the requirements that will apply to that specific project and that have been reviewed and approved by the engineer. Because different engineers of record may supplement Section 12 differently, it should be expected that some differences will occur between projects. The inspector must be familiar with the requirements of the FCP as it applies to the project at hand.

FCMs require mill orders of base metals to be manufactured of killed carbon steel and fine-grain base metals normalized, quenched, and tempered as specified with accompanying CVN results at the temperature specified by the engineer, all of which must be included in the contract documents. These requirements are typically specified for orders for structural shapes large enough to consume an entire heat (ladle) at a steel mill, finished and tested to the buyer's specifications, and used to fill only that order. Finding small quantities or partial heats meeting these special requirements and documentation would be very difficult for purchasing and inspection, as noncritical structural shapes are rarely manufactured, tested, and accompanied by this level of documentation. Regardless of whether they're from a mill order or a smaller quantity, all base metal surfaces and edges must be inspected for discontinuities upon arrival at the fabricator or construction site.

Recent events have placed inspectors from other industries in positions where they need to become familiar with the codes and other standards relating to bridges.

Welding Processes and Consumables

According to subsection 12.5, Welding Processes, the following processes listed in 12.5.1 may be used to construct or repair FCMs: shielded metal arc welding (SMAW), submerged arc welding (SAW), flux cored arc welding (FCAW), and gas metal arc welding (GMAW) with metal cored electrodes. Conversely, in 12.5.2, Prohibited Processes and Procedure Restrictions, electroslag welding (ESW) and electrogas welding (EGW) are prohibited for welding FCMs. When GMAW is used (except as allowed in 12.5.1), qualification tests, procedure control, and nondestructive examination (NDE) shall be as specified by the engineer. Subsection 12.5.3, Preferred Processes and Procedures, further stipulates that the engineer may designate specific processes or process controls for specific bridge welds. All special provisions shall be specified in the contract documents. Other restrictions, if any, on the use of welding processes or procedures shall be described in the contract documents.

Prequalified Welding Procedures are allowed to be used for welds in FCMs but only for SMAW using E7016, E7018, E7018-1, and E8018-X electrodes, including those with the C alloy and M classification as well as the R supplemental designator. All other groove weld WPSs using approved welding processes (SAW, FCAW, and GMAW) require testing — including CVN — to have been generated within a year of the start of production welding of FCMs.

Filler metals and fluxes used in FCMs, except for SMAW electrodes, are required to be tested and documented for diffusible hydrogen to meet optional designator H4, H8, or H16 (for ≤ 50 ksi – 345 MPa) or designator H4 or H8 (for ≥ 50 ksi – 345 MPa). Handling, storage, and drying of filler metals generally follow the manufacturer's recommendations; however, these may be modified by the engineer.

According to 6.1.3.2, Heat or Lot Testing, all welding consumables shall be heat or lot tested by the manufacturer to determine conformance with the applicable AWS A5.XX specification. The engineer must also be given certified copies of the test results. The heat and lot information shall be as defined in the latest edition of AWS A5.01, *Welding and Brazing Consumables — Procurement of Filler Metals and Fluxes*. The consumables shall also be tested by welding as specified in the appropriate AWS filler metal specifications. All tests required by AWS A5.01, Schedule J, shall be performed and reported. Also specified by 6.1.3.2, materials of the same specification, classification, brand, product trade name, and manufacturer (but not necessarily the same heat or lot) to

AWS D1.5M/D1.5 covers the welding requirements for welded bridges made from carbon and alloy construction steels and designed to AASHTO or American Railway Engineering and Maintenance-of-Way Association (AREMA) requirements.

be combined during production welding shall be used for heat and lot testing.

Additional consumable requirements are given in 6.1.3.1, Consumable Manufacturer Quality Assurance Program, which states: "Welding consumables shall be produced under continuing quality assurance programs audited and approved by one or more of the following agencies: (1) American Bureau of Shipping (ABS), (2) Lloyd's Register of Shipping, and (3) American Society of Mechanical Engineers (ASME)."

Examination and Quality

Quality functions are shared by the engineer and the contractor's or fabricator's inspector. The engineer is responsible for quality assurance (QA), and the inspector is responsible for quality control (QC). The engineer may contract for QA surveillance and audits; however, the final responsibility for the quality of the finished product rests with the contractor or fabricator. The FCP includes a designation for lead inspectors, who are required to have a minimum of three years of experience specifically in steel bridge construction or fabrication in addition to being a current or former AWS CWI, or an engineer or technician acceptable to the engineer of record (AWS D1.5M/D1.5, sections 8.1.3, Inspection Personnel Qualification, and 12.16.1.1, Inspectors). This lead inspector has the final determination for the acceptability of FCMs and welds associated with FCMs.

The lead inspector must ensure that any NDE technicians assigned to test FCMs are currently certified Level II or III in the appropriate method per the American Society for Nondestructive Testing (ASNT) *Recommended Practice SNT-TC-1A*. The engineer may accept alternative qualifications for NDE personnel that are deemed equivalent.

One of the many unique requirements contained within section 8 of AWS D1.5M/D1.5 is that radiographic examination of welds in FCMs must use hole-type penetrameter (IQI) to capture the quality-level hole size specified in the contract. Wire-type IQI is not allowed for this application. This, and many more such special requirements, is found throughout section 8 and explains the challenges to inspectors ensuring that all requirements are met every time FCMs are identified.

Conclusion

Even with a high-level review of requirements outlined in section 12 of AASHTO/AWS D1.5M/D1.5, inspectors seeking to expand their work experience into infrastructure — specifically bridge construction and fabrication — will be faced with a large volume of knowledge to master. The three-year experience requirement for a lead inspector can be met by working on bridge fabrication under the supervision of a lead inspector. Once the experience requirement is met and documented by the employer, the inspector can then consider a lead inspector role.

For current CWIs interested in bridge inspection, the authors recommend a code review course focusing on AASHTO/AWS D1.5M/D1.5 and the NBIS for a thorough understanding of the requirements for materials, procedures, as well as the roles and responsibilities of all personnel involved in bridge design, fabrication, and construction.

For new applicants to the AWS CWI program, we highly recommend certification with AASHTO/AWS D1.5M/D1.5 (current edition) as the code of choice. IT

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Quality Assurance vs. Quality Control

The differences and similarities between these two terms are explained

BY DARYL PETERSON

Quality assurance (QA) and quality control (QC) are often considered the same; however, they are distinctly different, and the inspectors performing these functions usually have different duties and responsibilities.

Definitions

QA provides general guidelines used in the comprehensive quality system. The core of QA is to provide confidence that the quality requirements will be fulfilled. Verification is the main focus of QA and is typically accomplished through auditing. The extent of auditing may be defined for the project or may be at the QA inspector's discretion. When the QA inspector's audit finds systemic discrepancies, expanding the score of the audit would be appropriate. The focus of QA is to ensure the QC functions are correctly carried out.

QC is specifically related to products or services. QC is focused on fulfilling the contract-specified quality requirements and is primarily accomplished through inspections.

QA and QC in Welding

How are QA and QC explicitly related to the welding industry, and who is typically responsible for these roles? AWS D1.1:2020, *Structural Welding Code — Steel*, uses the terms *contractor's inspection* and *verification inspection* in Clauses 8.1.2.1 and 8.1.2.2.

The contractor's inspection is the inspection and testing that shall be performed before assembly, during assembly and welding, and after welding to ensure the materials and workmanship meet the requirements of the contract documents. Fabrication and erection inspection and testing shall be the responsibility of the contractor unless otherwise specified in the contract documents. As stated in Clause 8.1.2.1, these are the actual product inspections (i.e., dimensions and weld quality), and these are the contractor's responsibility and generally are delegated to the contractor's inspector. In addition, the contractor must perform welding procedure specifications (WPSs) and welder qualifications. These duties are often delegated to the contractor's inspector as well.

Verification Inspection

The verification inspection is a type of inspection and testing performed in which the results are promptly reported to the owner and contractor to avoid delays in the work. Typical verification inspection (think of auditing for this function) elements are as follows:

- Review of the contractor's WPSs for suitability for the work to be performed;
- Review of the contractor's welder performance qualification records (WPQRs), or perhaps even witness the welder's qualifications demonstrations;
- Review of the material test reports (MTRs);
- Corroboration that the inspection and test plans (ITPs) or travelers are updated and current; and
- Verification that the nondestructive examination (NDE) reports and personnel certifications, as well as other quality-related items required by the contract, are properly documented.

This auditing intends to ensure that the QC functions have been adequately performed and the contractor's quality system is functioning correctly. The intent is basically to "QC" the QC; however, QA functions do not necessarily exclude the QA inspector from verifying some or all of the QC's responsible inspections.

The extent of actual product inspection may be specified in the contract — in the QA inspector's work contract — or may be determined as necessary whenever there is reason to question the credibility of the contractor's inspections. This function is typically performed by the owner's QA or contracted third-party inspector.

At the owner's discretion, QA functions may be delegated to the contractor; however, this may be construed as the fox guarding the hen house. This option is better reserved for contractors with an excellent reputation for quality and with a robust quality system, such as the AWS Certified Welding Fabricator (CWF), ISO 9000, and others. Contractors with certified quality systems are audited by the certification body periodically to ensure there is evidence the contractor is performing the quality duties in accordance with their documented quality system. Typically, the owner's organization would audit the contractor's quality system and approve them as an approved supplier. This approval may justify delegating some or all the QA functions to the contractor.

Welded Products

Concerning welded products, QA and QC inspectors typically play different roles and have different responsibilities. For instance, a QC inspector (who works for the contractor) is generally considered highly knowledgeable in welding and is perhaps an AWS Certified Welding Inspector (CWI). In addition to the typical inspection duties, the contractor's inspector (QC) may be tasked with directing the contractor's welders on quality and welding matters. This same activity would be wholly inappropriate for an owner's inspector (QA). The owner's inspector's responsibility is to promptly report observations (both acceptable and not acceptable) to the owner and the contractor's management or supervision. This means a QA inspector may bring concerns to the welder's supervision, thus allowing the contractor to initiate the appropriate corrections. In either case, the personality of the inspector (either QA or QC) plays a key role in the quality system.

Communication is Vital

The quality professional (QA or QC) must be an excellent communicator. They must be able to speak and understand engineering and welder slang, and they must strive to develop a professional relationship with all parties concerned. Having worked in both the QA and QC roles, I like them equally. They both have their unique challenges and rewards. Both roles are grounded in helping to ensure the customer receives the highest quality products and services within or exceeding the contract requirements. IT

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IT FEATURE

BY CHARLES TREMBLAY

Alternating Current Field Measurement Inspection of STORAGE TANKS

How the Alternating Current Field Measurement (ACFM®) technology can improve tank inspection efficiency

Storage tanks commonly found in the oil, gas, and petrochemical sector are typically constructed from welded steel plates. While the primary failure point in storage tanks is corrosion in the floor plates, inspecting welds for defects is also critical and mandatory. Detection of through-wall defects at the welds is usually carried out using vacuum box technology, although this can be difficult to deploy at complicated lap welds or near obstructions. The traditional technology for inspecting welds for non-through-wall defects is magnetic particle testing (MT), which is said to work through coatings; however, extensive surface cleaning and removal of any protective epoxy coating can be required to provide reliable results. When considering post-inspection cleaning and recoating, MT can be quite expensive and time-consuming. Alternating Current Field Measurement (ACFM®) can be a cost-efficient and reliable method for inspecting storage tank welds to supplement corrosion mapping, and successfully detecting cracks with fast scans on coated, unprepared surfaces.

What is ACFM?

ACFM is a nondestructive examination (NDE) technology developed in response to a specific problem affecting the structural integrity of industry's critical assets. It was initially developed in the 1990s at the University College of London (UCL) in response to major oil companies having experienced fatigue cracking of their offshore structures during the 1980s. The NDE options at the time were inefficient and unreliable for the task.

ACFM enabled fast detection and sizing of surface-breaking cracks on complex welded geometries without removing coatings. It proved forgiving enough to provide reliable inspections even in the most challenging conditions, such as underwater or rope-accessed areas. The birth of ACFM also created opportunities for better inspections in other applications, such as fatigue cracking around steel bridge welds, infrastructure inspections, and storage tanks, to name a few.

How Does ACFM Work?

The basis of the ACFM technique lies in the electromagnetic induction principle, which states that passing an alternating current in a coil generates a magnetic field around it. In ACFM probes, the field inducer coil is driven with a constant alternating current source and sits relatively high above the inspection surface — Fig. 1. It's designed to generate uniform fields in the inspection target just below the sensors.

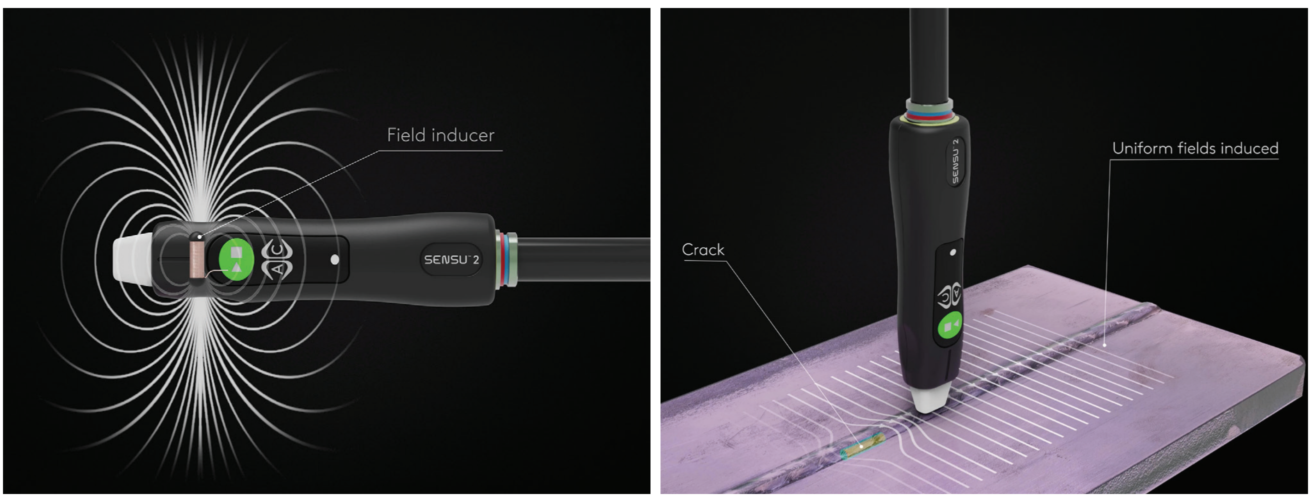


Fig. 1 — The field inducer and the uniform fields generated in the target.

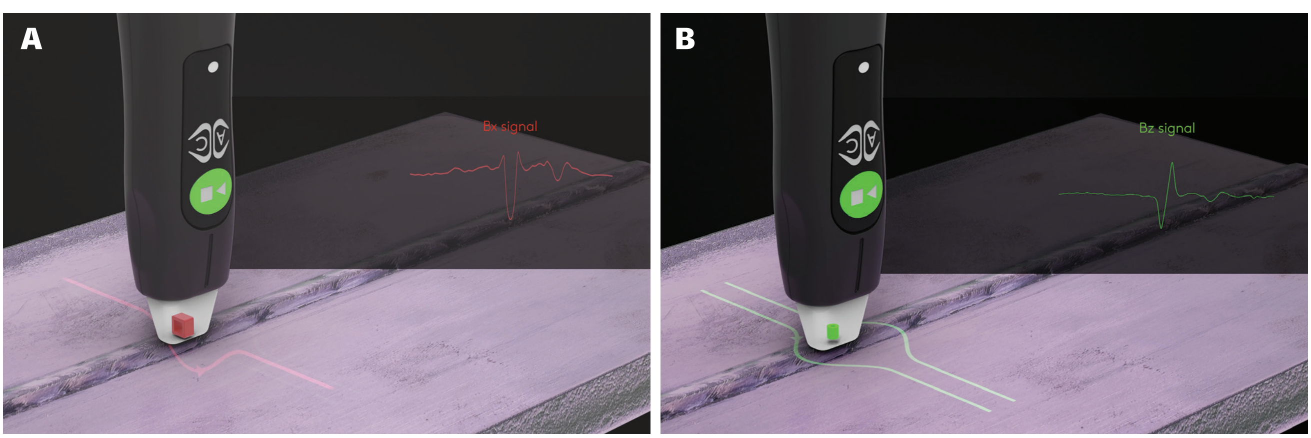


Fig. 2 — Illustration of the interaction between a crack and the induced eddy currents.

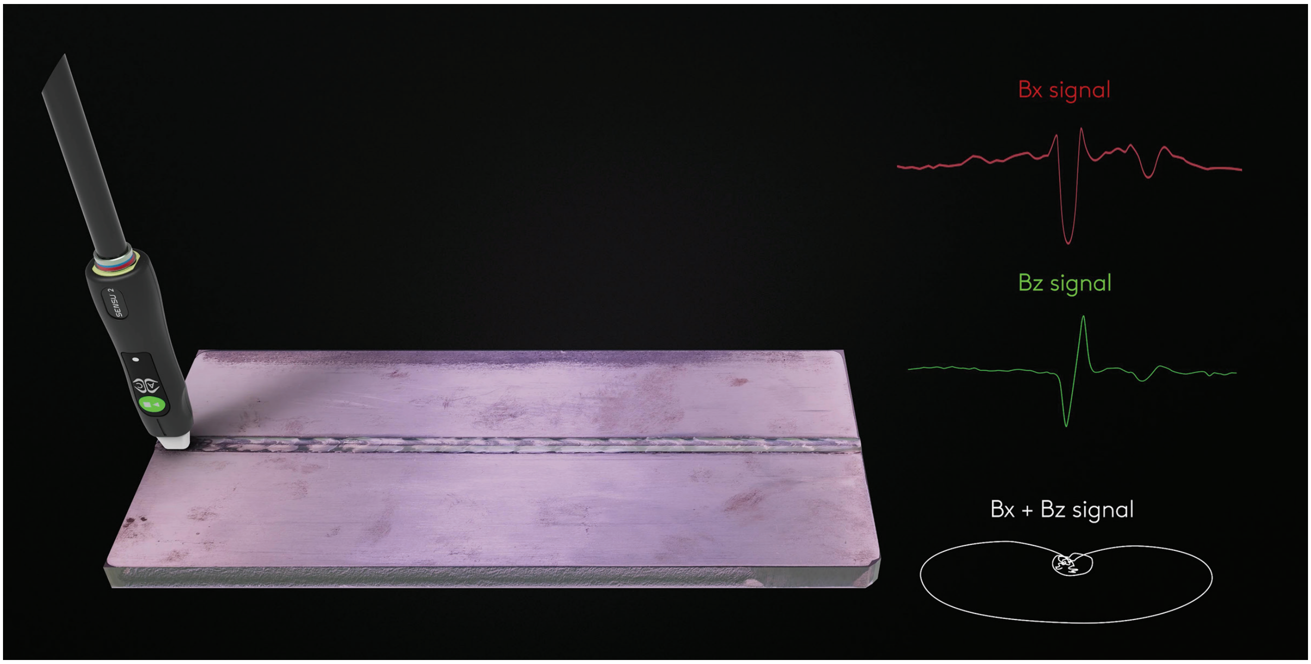
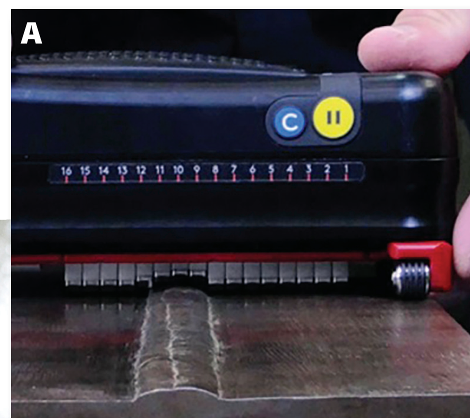


Fig. 3 — The butterfly shape is a combination of the Bx and Bz signals, which provide simple and clear information that enables efficient and reliable analysis to discriminate between cracks and other features.

Fig. 4A — Newer ACFM probes feature increased crack detection and sizing performance using micro sensors instead of mini sensors; B — ACFM instruments enable rapid scanning with the handheld probe, reliable crack detection and characterization, reduced cleaning requirements, and a digital data record for backup, offline, and audit purposes.



When scanning the probe over a crack, induced eddy currents are forced to flow under the crack and around it — Fig. 2. Those disturbances will, in turn, distort the fields above the crack where two coils are located. The Bx coil, shown in red in Fig. 2A, is sensitive to field distortions caused by eddy currents flowing under a crack. It generally results in a single half-sine signal, where the amplitude is proportional to the crack depth. This is the *Bx signal*. The Bz coil, shown in green in Fig. 2B, is sensitive to field distortions caused by eddy currents curving around the edges of a crack. It generally results in a single sinusoidal signal, where peaks correspond closely to the crack edges.

The crack length and depth sizing capability of ACFM relies on a simultaneous comparison of the Bz and Bx signals with a mathematical model of the interaction between a crack and the electromagnetic fields.

ACFM doesn't rely on on-site calibrations for crack sizing. Factory calibrations are preloaded into each probe head. Most inspections are made using a carbon steel calibration on a 5 kHz probe, but austenitic alloy calibrations are also available on 50-kHz probes. A calibration remains valid whether a probe is connected to the instrument through a 5, 20, or 50 m (16.4, 65.6, or 164 ft) cable. Sizing is possible through up to 4-mm nonconductive coatings using generic probes.

An essential element of ACFM is the butterfly plot, which is obtained by combining the Bx and Bz signals — Fig. 3. The butterfly plot provides a recognizable butterfly shaped signal unique to cracks, which helps differentiate crack signals from other signals, contributing to the ease of crack detection. Crack detection is generally possible through up to 10-mm (0.4-in.) coatings using generic probes.

The same ACFM coil arrangement can be used in various probe geometries to cover most applications and is designed to provide a good balance between noise immunity and sensitivity to cracks for most welded structure inspections. The simplest single-element probe covers 15 mm (0.6 in.) wide in a single pass, and the latest-generation electronics enable fast scans while maintaining a good signal-to-noise ratio (SNR). This makes even the simplest single-element probes quite productive, as most welds can be covered in three detection scans. Detection scans count for most of the time spent running an ACFM inspection. ACFM sensors can be assembled in multielement probes to enable wider scans for more coverage and faster inspections.

Storage Tank Welding Inspection

ACFM was specifically developed to detect and size surface-breaking defects on and around rough welds through several millimeters of nonconductive coating. This is a crucial advantage because the costs associated with paint removal, post-MT reblasting, and recoating are typically four or five times more expensive than MT.

While the primary failure point in storage tanks is corrosion in the floor plates, from either the top surface or the underside, the welded sections are also a direct source of damage mechanisms.

Tank floor weld inspection can be carried out using standard, general purpose, single-sensor probes, or inspection can be sped up using advanced multisensor array probes. Standard weld or pencil probes can assess all anticipated geometries, but overall inspection speed can be improved using array probes, where possible.

Compared to MT, standard ACFM inspection with pencil probes is approximately 25% faster and 20% cheaper. For example, if we consider the inspection of both the external and internal floor-to-shell fillet welds of a 60-m (197-ft) storage tank, the MT fees for blasting, inspecting, reblasting, and recoating have a median international cost of around $15,000. The same inspection performed using pencil ACFM probes costs about $2500. While the MT takes about four to six days for the necessary preparation and post-inspection work, standard ACFM is typically done in a day. This is achieved while providing better Probability of Detection (PoD), depth sizing, and auditable records.

ACFM's cost and productivity advantages can be further increased by using more-advanced array probes for the fillet weld. These new probes include a clever new way to estimate crack lengths that improve analysis speed and do not use moving parts.

Floor and shell joints, including lap joints, can be assessed using the high-speed ACFM array probe, which can further cut costs compared to MT — Fig. 4A. While retaining all the advantages of ACFM, these probes also feature increased crack detection and sizing performance using micro sensors instead of the usual mini sensors. The array probe can scan areas up to 90 mm (3.5 in.) wide, utilizing twin-field technology for biaxial crack detection and sizing with up to 16 individually sprung ACFM sensors. This is less fatiguing on operators, which translates into highly productive, more reliable inspections. The array probe also has an embedded position encoder to record defect locations and regulate data collection automatically. A single pass scan provides a clear view of the weld cap, toes, and heat-affected zone (HAZ) with rich information, including crack length and depth.

Modern ACFM instrumentation adds fast electronics, providing clear, high SNR signals even at high scanning speeds. State-of-the-art software and displays show clear signal representation and auditable records — Fig. 4B.

Fig. 5 — The ACFM fillet weld array probe.

Fillet Weld Inspection

The latest ACFM technology for floor-to-wall fillet weld inspection includes multiple-element probes and the 3BZ method. These array probes enable single-pass detection and sizing of cracks in fillet welds without using an encoder. Their rugged monoblock design with no moving parts makes them suitable for difficult (and dirty) inspection environments, such as tanks — Fig. 5.

The 3BZ method (Fig. 6) enables crack length and depth sizing without encoders or marking surfaces, which is an appreciable advantage in such difficult inspection conditions.

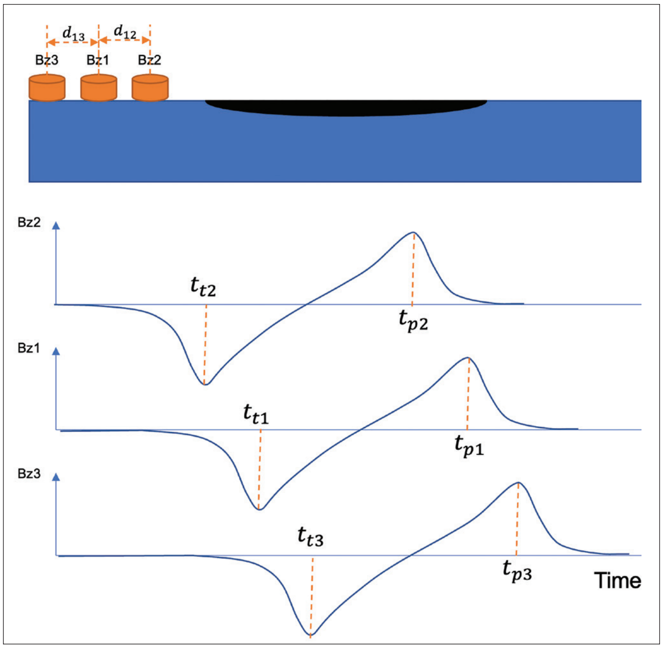


Fig. 6 — The 3BZ method.

It uses two additional Bz coils per sensor for which the relative distances are known. A sizing scan performed at a reasonably constant speed will provide three Bz traces from which time measurements will be taken. Combining the known distances between the Bz coils and the time measured on the Bz signals provides an estimation of the average scanning speed. The average scanning speed and the time elapsed between the through and the peak of a Bz trace are then used to estimate the crack length and depth.

Conclusion

Although ACFM is based on the same basic physics principles as several other NDE techniques, it applies them in a unique way most adapted to the challenges of structural weld inspection. Among other characteristics, the uniform fields, the butterfly, and the sizing have been accepted for weld inspection by major organizations in the oil and gas, petrochemical, nuclear, and aerospace industries.

ACFM has received approval from several organizations, such as Det Norske Veritas (DNV), Bureau Veritas, Lloyd's Register, and the American Bureau of Shipping (ABS). Standard practice guidelines covering ACFM include American Society for Nondestructive Testing (ASNT) E2261/E2261M-17, *Standard Practice for Examination of Welds Using the Alternating Current Field Measurement Technique*, American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (BPVC) Section V, Nondestructive Examination, and the French Confederation for Non-destructive Testing (COFREND). Training schemes are available under the Certification Scheme for Personnel (CSWIP), Personnel Certification in Non-Destructive Testing (PCN), and ASNT. IT

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AWS

Certification QuikCheck

You can easily verify if someone is a Certified Welding Inspector by using AWS's free online certification verification services. Go to the AWS website at *aws.org/certification*. Click on the image that says Certification Quikcheck. Select "AWS Certification Quikcheck" and then type in the person's certification number and last name.