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At Hascor, we truly believe in thinking globally and acting locally.
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M. Lanzoni et al.

On the cover: An energy-efficient stud welding inverter with motorized gun. (Photo courtesy of Nelson Stud Welding, Inc.)
All the Tools You Need

As you have probably noticed, the theme for this year’s giant FABTECH exhibition is “All the Tools You Need — All in One Place.” Join us at the Georgia World Congress Center in Atlanta November 2–4, and you’ll see what we mean. Virtually every sort of equipment used for welding, cutting, metal forming and fabricating, tube and pipe, stamping, and finishing will be shown in live demonstrations at the show. It’s the one place you can go to look at every option for your metal manufacturing and construction needs.

Proud cosponsors of the FABTECH exhibition are the American Welding Society (AWS), the Society of Manufacturing Engineers (SME), the Fabricators and Manufacturers Association Intl’l. (FMA), the Precision Metalforming Association (PMA), and the Chemical Coaters Association Intl’l. (CCAI). Set up in several large sections — Welding, Forming and Fabrication, Tube and Pipe, Stamping, and Finishing — the show is expected to host more than 1000 exhibitors with nearly 400,000 sq ft of products on display. The AWS Welding portion stands at 142,000 sq ft at this writing, an increase of 12,000 sq ft over the total figure for the last show we had in Atlanta in 2006. Show attendees thus only have to attend this one FABTECH event to cover the whole range of metal manufacturing and assembly.

New this year is the Finishing Pavilion and Conference, sponsored by CCAI. Here is where you’ll find the latest technologies in painting, powder coating, electrocoating, plating, and pretreatment. Don’t miss it.

While the recovering economy is not yet where we would like it to be, it is certainly better than a year ago, perhaps making this the best time to attend the FABTECH event. The show offers a great opportunity to invest in your business and position your company for strong future growth.

In addition to all the products and equipment on display at FABTECH, there will be more opportunities than ever to sharpen your personal skills at the many seminars and conferences offered. Individuals who attend AWS education programs are awarded one professional development hour (PDH) for each hour spent attending. Some of the welding programs offered are What’s New in Weld Consumables?, Weld Repair and Strengthening of Welded Structures, New Developments in Thermal Spray Coatings, Processes and Applications, the RWMA Resistance Welding School, and Welding and Cutting of Pipe and Tubing, not to mention an outstanding professional program of technical papers on welding research and practical applications.

Other essential welding events at this year’s FABTECH include

• The AWS general business meeting and Comfort A. Adams Lecture (Monday, Nov. 1)
• The AWS Officers/Presidents/Counterparts Reception (Monday, Nov. 1)
• The Image of Welding Awards Ceremony (Tuesday, Nov. 2)
• The AWS Awards and Foundation Luncheon (Tuesday, Nov. 2)
• Job Fair and Career Pavilion (Tuesday–Thursday, Nov. 2–4). AWS also recently launched two new occupation-related Web sites: jobsinwelding.com and careersinwelding.com.
• The AWS Skills Competition Weld-Off (Thursday, Nov. 4)

And, that’s just scratching the surface. I encourage you to register online now for FABTECH (www.fabtechexpo.com), free of charge, and we look forward to seeing you in Atlanta.

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AWS Executive Director
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See us at FABTECH booth #7617
Tariff Reductions to Assist Manufacturing

President Obama has signed into law the Manufacturing Enhancement Act of 2010. This statute will temporarily reduce or suspend import tariffs on a range of materials and chemicals used in many manufacturing processes. Most reductions are retroactive to January 1, 2010, and will expire at the end of 2012.

House Passes Manufacturing Strategy Act

The House of Representatives has approved the National Manufacturing Strategy Act of 2010 by a strong majority. This bill would establish a Manufacturing Strategy Task Force comprised of governmental officials and a Manufacturing Strategy Board comprised of representatives from business to assist in developing a national manufacturing strategy that identifies goals and recommendations for how the federal government, as well as state, local, and private institutions, can best support the improvement and growth of manufacturers.

Name Change Coming to U.S. Vocational Education Office

The Office of Vocational & Adult Education within the U.S. Department of Education may soon have a new name. Legislation pending in Congress would change the name to the Office of Career, Technical, and Adult Education.

House Approves SECTORS Act

The House of Representatives has passed the Strengthening Employment Clusters to Organize Regional Success (SECTORS) Act on a unanimous vote. The SECTORS Act would establish a new Industry or Sector Partnership Grant program administered by the U.S. Department of Labor. Sector partnerships organize stakeholders connected to an industry — employers, labor unions, education and training providers, and local workforce and education system administrators among others — to develop plans for growing (or saving) that industry, with a particular focus on building new workforce pipelines where skilled worker shortages exist and transforming the ways existing workers are utilized, retrained, and compensated.

OSHA Establishes New Whistleblower Site

The Occupational Safety and Health Administration (OSHA) now has a new Web site specifically dedicated to its whistleblower protection program, www.whistleblowers.gov. The site is designed to provide workers, employers, and the public with easily accessible information about the 18 federal whistleblower protection statutes that OSHA currently administers.

Federal workplace safety laws allow workers to file discrimination complaints with OSHA if they believe their employer has retaliated against them for exercising a broad range of rights protected by law. These rights include filing safety or health complaints with OSHA and seeking an OSHA inspection, participating in any proceeding related to occupational safety or health, or reporting an injury or illness to their employer.

Legislation Promotes Repatriation of Jobs Moved Offshore

The recently introduced Bring Jobs Back to America Act would require the Secretary of Commerce to develop a national manufacturing and job repatriation strategy and set targets for manufacturing sector job creation. It also would create “Repatriation Task Forces” to identify American companies with manufacturing operations abroad and work with state and local governments to facilitate the return of those jobs to the United States. The bill also calls for a study of new tax incentives to promote the repatriation of jobs.

Federal Register 2.0 Web Site Introduced

The Federal Register has unveiled a newly designed, easy-to-use Web site. As the Federal Register is the official government publication for federal agency proposed and final regulations, it is somewhat dense and difficult to navigate. The updated Web site essentially presents the Federal Register Web site as a daily online newspaper, which should allow users to locate rules and comment on proposed rules. Broad communities are presented at www.federalregister.gov, including the following: business and industry, environment, health and public welfare, money, science and technology, and world.

Contractor Database to be Made Public

A new law requires the Office of Management and Budget to disclose on a public Web site information in the Federal Awardee Performance and Integrity Information System (FAPIIS). Currently, this database is available only to listed contractors and a relatively few U.S. legislators and regulators. The FAPIIS was designed to provide federal contracting officers with a single source to verify a vendor’s conduct and past performance. The database includes criminal and civil proceedings against suppliers in connection with federal awards and lists vendors whose contracts were terminated and those banned from doing business with the government.

Bill Seeks to Bar Contractors Who Violate Foreign Corrupt Practices Act

The Overseas Contractor Reform Act, recently approved by the Homeland Security and Governmental Affairs Committee, would debar from federal contracts any company that is found by a court to have violated the Foreign Corrupt Practices Act (FCPA). The FCPA generally prohibits U.S. companies from making payments to foreign government officials to assist in obtaining or retaining business.
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Rethink your approach to welding and cutting.
U.S. Department of Transportation Reveals Uniform High-Speed Rail Design Standards

U.S. Transportation Secretary Ray LaHood recently announced the first uniform technical standards for manufacturing high-speed intercity passenger rail cars.

“This is a milestone in the history of rail transportation,” said Federal Railroad Administrator Joseph C. Szabo. A uniform standard creates a level field and economies of scale based on a common set of designs and technical requirements, allowing U.S.-based manufacturers to compete more effectively. This strong economic competition will drive down costs for rail owners and operators along with the traveling public. In addition, maintenance and repair costs will be lower due to lower parts acquisition costs, and training can be streamlined with one type of equipment.

The first technical standard will apply to bi-level passenger rail cars for use in high-speed passenger rail operations. It will also ensure newly manufactured cars can be used with the current passenger locomotive fleet, alone or with existing bi-level cars, and designed to accommodate entry and departure from low-level platforms.

Hobart Institute Named School of Excellence

The Hobart Institute of Welding Technology, Troy, Ohio, has been named a recipient of a 2009–2010 Accrediting Commission of Career Schools and Colleges (ACCSC) School of Excellence Award. The honor recognizes schools for their commitment to the expectations and rigors of this commission’s accreditation, as well as efforts in maintaining high levels of achievement among their students.

To be eligible, a school must meet all of the criteria established by the Commission for its School of Distinction Award, plus a majority of the schools’ graduation and employment rates from all programs offered must meet or exceed the average rates of graduation and employment among all ACCSC-accredited institutions.

Michale S. McComis, ACCSC executive director, announced the award in a letter to the Hobart Institute. It’s expected to be presented September 30 during the fourth annual ACCSC Professional Development Conference Awards Ceremony in Philadelphia, Pa.

Caterpillar Expands North Carolina Construction Facility

Caterpillar, Inc., is expanding its Compact Construction Equipment operations in Sanford, N.C. The development will provide increased logistics and fabrication capacity to meet growing global demand for the skid steer, compact track, and multiterrain loaders currently produced in Sanford.

The plans include a 270,000-sq-ft building addition that will house up-to-date robotic welding technology for fabrication production. Construction is expected to begin this fall, with operations commencing in July 2011. When the expansion is complete and operational, it’s anticipated about 325 additional workers will be added over a five-year period, bringing the total workforce to approximately 750.

Students Win Manufacturing Scholarships from Nuts, Bolts & Thingamajigs

Nine students seeking manufacturing careers earned $15,000 toward their college or trade school education from Nuts, Bolts & Thingamajigs® (NBT), The Foundation of the Fabricators & Manufacturers Association, Intl.®, Rockford, Ill.

This year, scholarships were awarded totaling $13,500 to college- or trade school-bound postsecondary students who seek careers in manufacturing. The 2010 winners are as follows: John Bennett, New Franklin, Mo.; Thomas Brown, Evansville, Ind.; Guy Chan, Vancouver, Wash.; Christopher Ditalia, Deer Park, N.Y.; Joe Dobie, Yakima, Wash.; Earley Cody Hill, Albany, Ohio; Ryan Melville, Naches, Wash.; Christopher Norman, Willingboro, N.J.; and Lance Poepelman, West Mansfield, Ohio. Each winner also received a copy of SolidWorks Corp.’s Student Design Kit CAD software package.

Gerald Shankel, NBT’s president and CEO, mentioned half of this year’s winners are over 40 years old and going back to school full-time. For more details about the winners and next year’s awards, visit www.nutsandboltsfoundation.org/Scholarships.
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Ford Sets New Standard for Flexible Manufacturing

Ford Motor Co.’s transformed Wayne, Mich., assembly plant will be the company’s new standard for flexible manufacturing when preproduction of its 2012 Focus begins this year. The plant will build this car as well as the Focus Electric beginning next year, with more models to come.

More than 80% of the body tooling can be programmed to weld a variety of body styles without delay in tooling changeover and can adjust the mix between models without restrictions.

While the facility is utilizing Ford’s virtual manufacturing technology, three-wet paint process, and a common build sequence in the final assembly area, the most significant step toward improving flexibility lies in its body shop. The company’s manufacturing operations worked with its product development teams to make product platform designs enabling the use of programmable equipment to produce many product variations in one place.

Ford’s latest approach reduces physical tooling constraints through using programmable tooling technologies that eliminate the need to replace model-specific tooling for locating, clamping, and welding. This saves time and limits disruption to the plant’s operations.

NDE Training Courses Offered Online

Various NDE methods, including magnetic particle and ultrasonic testing, can be learned by taking an online course at www.worldspec.org.

WorldSpec.org offers online nondestructive examination (NDE) training programs at www.worldspec.org for learning in a no-pressure environment where students can study at their own pace. The site provides curriculums made to be self-taught.

Training is available in liquid penetrant, magnetic particle, radiographic, and ultrasonic testing; materials resource; radiation safety and equipment operator; radiation safety officer; radiographic film interpretation; and visual inspector.

Each student is assigned an online Level III instructor. When signing in online, the student is given 24/7 access to their course and a detailed instruction sheet/template. The new exam process pulls multiple choice questions randomly from a database and is automatically graded, then sent via e-mail to the student upon completion. Once the final exam has been passed, the student is sent an authorized certificate via e-mail or can order a hard copy.

Also, the company is creating a piece of shareware, expected to be available in late November, that allows all classroom training and NDE companies worldwide to potentially be able to train every student to meet its in-house or company requirements.

Airgas Presents Third $100,000 Donation to Operation Homefront

Airgas, Inc., Radnor, Pa., made its third annual contribution of $100,000 to Operation Homefront, a charity that supports America’s service members by providing emergency assistance and moral support to the families left behind when they are deployed and to wounded service members when they return home.

In 2008, Airgas announced its $300,000 pledge to be paid in increments of $100,000 per year over three years, with 70% going toward Operation Homefront’s projects. The company recently met its goal of hiring 100 veterans from Iraq and Afghanistan service and began offering the Airgas Welding 101 course to any interested veteran of Iraq and Afghanistan service.

This recent presentation took place at the “Great Expectations” baby shower honoring expectant mothers with spouses in
the military. Terry Lodge, president of Airgas Mid South, presented Carol Herrick, president of Operation Homefront’s Oklahoma chapter, with the donation.

**ESAB Filler Metals Help Build 1 World Trade Center**

ESAB Welding & Cutting Products, Florence, S.C., recently announced several hundred thousand pounds of its filler metals have already been used in the construction of 1 World Trade Center on the former twin towers site in New York City, N.Y.

The company partnered with DCM Erectors and the MRP LLC fabrication shop on this project. Tower 1 will stand at 107 stories on completion in 2011. So far, DCM has used more than 100,000 lb of Coreshield 8 flux cored wire. The 20th floor will feature complete joint penetration welds. The company is working with Airgas of Piscataway, N.J., to stock and distribute the filler metals needed for this job. ESAB will provide all the filler metals for Tower 4 as well, which will stand at 65 stories.

**Lincoln Electric Partners with College to Open Intermountain Training Center**

The Lincoln Electric Intermountain Training Center at Davis Applied Technology College (DATC) in Kaysville, Utah, features a 5000-sq-ft welding demonstration and training facility. For the company, it provides a venue for the manufacturer to conduct customer seminars and training for new products, cost reduction, productivity/process improvements, automation and engineering design, as well as continuing education for existing customers and distributors. For the college, this public/private partnership supports and enhances its existing welding program and provides graduates with welding skills.

The training center has been outfitted with Lincoln’s welding equipment and technology. Nick Price, the college’s welding instructor, and Michael Bouwhuis, DATC campus president, anticipate the center will provide a strong level of quality and value to the welding program.

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SAS/Optrel AG Develop Agency Agreement

Optrel AG, Switzerland, formerly Sperian Welding Protection AG, a welding helmet designer and manufacturer, formed a agency partnership with SAS Marketing LLC, Coventry, R.I.

Resulting from Optrel AG’s detachment from its parent company Sperian Protection, SAS will assume the account management and growth initiative roles of its business in the Americas. The company will manage customer service, marketing, and sales activities for accounts in the United States, Canada, Mexico, and South America, excluding Brazil.

Also, SAS will hire 7–10 employees immediately with a plan to have a total of 25–30 employees within the next two years. Positions will rank from sales through administrative roles, including senior management positions. Interested candidates may e-mail info@sasmarketingllc.com.

Job Skills Partnership Funds Training for Metalcasting Industry Employees

The state Department of Employment and Economic Development’s Minnesota Job Skills Partnership Program (MJSP) recently announced a $230,000 grant to support green manufacturing training for 270 metalcasting industry employees.

The collaboration includes MJSP; Enterprise Minnesota, a nonprofit consulting business; and five manufacturers — Dotson Co., Le Sueur, Inc., Smith Foundry, Pier Foundry & Pattern Shop, Inc., and St. Paul Brass & Aluminum Foundry.

Lead and line workers, molders, office personnel, and managers will participate in a 32-month program customized for each employer in the metalcasting consortium. The first training phase will evaluate green and lean training benefits, plus review energy and financial assessments. The second will include value stream mapping, Kaizen events, and coaching while the third phase will cover measures, evaluations, and impact analysis. Employee participants will earn a certificate of completion.

Tidewater Community College Dedicates New Campus

Tidewater Community College (TCC) recently dedicated its new $65 million campus in Portsmouth, Va., that replaces and reinvents the college’s founding campus. Programs are offered in the sciences, including welding, heating/ventilation/air conditioning, computer-aided drafting and design, and nursing. It has 25 modern classrooms, plus 11 computer and 20 instructional labs.

“The Fred W. Beazley Portsmouth Campus exemplifies the best in successful partnering, to include three governors’ administrations, legislators, the City of Portsmouth, its school system, the Beazley Foundation, and key business leaders,” said TCC President Deborah M. DiCroce.

Currently, the college’s welding program enrolls 194 students. This program also offers triple the capacity to train welding students; welding labs with interactive learning opportunities, such as small-profile flex cameras demonstrating intricate techniques via 65-in. LCD monitors; and up-to-date welding equipment so students can practice and be prepared to take American Welding Society certification tests. Approximately 520 welding job openings are predicted for the region over the next five years.

At the campus dedication, DiCroce joined Virginia Governor Bob McDonnell and area dignitaries. Hundreds of faculty, staff, students, and guests were in attendance. The group of govern-
At Tidewater Community College’s (TCC) dedication of its Portsmouth campus, a portrait of the college’s original benefactor, Fred W. Beazley, was unveiled by (from left) Virginia Community College System Chancellor Glenn DuBois, Beazley Foundation CEO Richard Bray, Portsmouth Campus Provost Terry Jones, Virginia Governor Bob McDonnell, plus TCC Board Chair Lee Armistead and President Deborah M. DiCroce at the podium. (Photo courtesy of TCC.)

ment, industry, and education officials also jointly pulled 20-ft ribbons tied to the tip of a symbolic ship’s bow.

Industry Notes

- Miyachi Unitek Corp., Monrovia, Calif., launched a redesigned Web site at www.miyachiunitek.com with improved navigation and instant access to company representatives, technical documentation, a chat feature, and new features to be added monthly.
- Gerald Chandler II formed a new company, Acculloy Manufacturing Solutions, Inc., Houston, Tex. It offers welding, machining, coating, and inspection divisions.
- Olympus NDT acquired Innov-X Systems, Inc., Woburn, Mass., a manufacturer of portable X-ray fluorescence analytical instruments, retaining its current management team and employees.
- CryoVation, Fort Myers, Fla., finished an industrial and specialty gas cylinder filling plant for Sims Welding Supply, Long Beach, Calif., with customized equipment and a unique plant layout.
- The Parker Fluid Control Division launched a new site at www.ParkerFluidControl.com to ease manufacturer and OEM searches for local distributors of the division’s valve products.
- Union Pacific Railroad, Omaha, Neb., has been named one of the 2010 Best Employers for Healthy Lifestyles award winners from the National Business Group on Health.
- Matheson Tri-Gas, Inc., Basking Ridge, N.J., changed its brand name to Matheson. The company’s legal name will stay the same.
- Lepel Corp., a provider of induction cap sealing equipment, is combining and relocating its branches from Waukesha, Wis., and Edgewood, N.Y., to a new facility in Waukesha, Wis.
- Precision Custom Components, LLC, York, Pa., has been named one of the “Top 50 Fastest Growing Companies” in central Pennsylvania by the Central Penn Business Journal.
- TÜV Rheinland® acquired Rail Sciences, Inc., Atlanta, Ga., a rail industry consulting firm and train dynamics specialist with a testing and metallurgical analysis lab in Omaha, Neb.
- Fabrico, a provider of design and manufacturing services for flexible materials, now offers ultrasonic welding capabilities at the Kennesaw, Ga., facility.
- Bishop-Wisecarver Corp., Pittsburgh, Calif., announced Suad Bujric of Mississauga, Canada, won the 2010 Creative DualVee Ap-
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**ALUMINUM Q&A**

**BY TONY ANDERSON**

Q: I am working with thin-gauge aluminum, 0.125-in.-wall tubing and 0.080–0.100 in. sheet material. I was told there may be advantages to moving from regular gas metal arc (GMA) and gas tungsten arc (GTA) welding, which I am using at the moment, to pulsed gas tungsten arc welding (GTAW-P) or even pulsed gas metal arc welding (GMAW-P). My primary problems are melt-through on the back of the weldments and warping issues from too much heat. These issues are currently producing excessive amounts of rework. Do you think there would be any advantages to using GTAW-P or GMAW-P for welding thin-gauge aluminum?

A: Pulsed welding equipment has been around for a long time. However, technical advancements have made pulsed welding equipment much easier to use and, consequently, better for training operators to make quality welds. Some of the new GMAW-P and GTAW-P technologies provide excellent welding performance on thin-gauge aluminum.

In theory, upgrading to modern pulsed gas metal arc or pulsed gas tungsten arc inverter technology could potentially help you increase productivity, improve weld quality, reduce weld costs, and boost operator efficiency. That being said, you will need to study your particular application in detail to determine which, if any, of these processes is appropriate for you. Remember, pulse welding is not the answer to all aluminum welding-related problems. It is reasonable to say that GMAW-P has been promoted for some applications for which it was not necessarily the best choice. However, your application sounds like it could substantially benefit from this technology.

When considering a move to pulse welding technology, evaluate the following factors:

- Modern GTA inverters can pulse as fast as 5000 pulses/s, and they produce a narrower heat-affected zone as well as provide increased arc stability, improved penetration, and faster travel speeds than older, conventional GTA machines. These enhancements may improve the mechanical properties of the as-welded joint, improve overall weld quality, boost productivity, and cause less distortion.

Some of the new GMAW-P programs have been designed to produce welds with cosmetic profiles that are almost identical to the characteristic GTA weld profiles — Figs. 1, 2.

**Fig. 1** — Some of the new pulsed GMA programs have been designed to produce welds with cosmetic profiles that are almost identical to the characteristic GTA weld profiles.

**Fig. 2** — GMAW or GTA? It’s hard to tell with pulsed GMAW, which is what was used for this weld. Pulsed GMAW has come a long way in recent years. It has become easy to use and simple to train operators to make quality welds, much more so than training a GTA operator. Plus, the appearance of some pulsed GMA welds can rival that of GTA welds.

- Modern GMAW-P inverters have replaced conventional spray transfer GMA welding machines for many thin-gauge aluminum applications, and they may also be a viable alternative in some conventional alternating current (AC) GTA applications. The pulsed GMA process makes this possible by providing tighter control of heat input, faster travel speeds, reduced potential for melt-through on thin-gauge aluminum, and better control of the weld bead profile. Some of the new GMAW-P programs have been designed to produce welds with cosmetic profiles that are almost identical to the characteristic GTA weld profiles — Figs. 1, 2.

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If you are welding thin-gauge aluminum with conventional welding equipment and experiencing the types of problems you mentioned (an example of which is provided in Fig. 3), you may want to evaluate the use of pulse welding technology. The challenge of welding thin-gauge aluminum efficiently involves obtaining good fusion while simultaneously controlling the following:

- Heat input
- Weld bead profile
- Arc starts/stops
- Arc performance
- Activities that do not add value such as grinding and rework.

The key word here is control. Conventional and older pulsed welding technologies cannot provide the advanced control capabilities of the new technology. Today’s control algorithms, software, and microprocessors operate much more efficiently than those developed five or ten years ago. While thicker sections of aluminum might not need advanced control and are often welded successfully with conventional GMA spray transfer, thin-gauge aluminum offers little room for improvement. Consider the following weld characteristics when evaluating the pulsed GMA process as a replacement for conventional GMAW or AC GTAW:

- The ability to control heat input. The pulses of peak current, which occur above the transition point, provide the good fusion associated with spray transfer, while the lower background current cools the weld pool and allows it to freeze slightly to help prevent melt-through — Fig. 2.
- Much higher travel speeds. When switching from conventional AC GTAW to pulsed GMAW, travel speeds usually increase substantially. This can result in a significant reduction of heat input to the welded component, a decrease in residual stress, and a lower probability for distortion.
- The ability to control bead profile. Using a function called arc control, operators can adjust the width of the arc cone, which lets them tailor the bead profile to the application. A wider bead can help tie in both sides of a joint, and a narrow bead helps provide good fusion at the root of a joint. A bead of the right size helps to eliminate excess heat input, overwelding, and postweld grinding.

- Superior arc starts. A good pulsed GMAW program for aluminum provides more energy at the start of the weld, which helps ensure good fusion, and then reduces energy to normal parameters for optimal welding characteristics.
- Superior arc stops. Today’s pulsed GMAW equipment provides the technology to ramp down to a cooler welding parameter to fill in the crater at the end of a weld. This helps to eliminate termination cracking, which can be a serious issue when welding aluminum.
- The ability to use a larger-diameter wire to weld thin-gauge material. This can increase the deposition rate and aid feeding by using a stiffer wire, and can also save money on filler wire. The difference in price between a 0.030 and 0.045 wire, for instance, can be considerable.

If you also consider the reduction in time and materials wasted on rejected parts, pulsed GMAW may look like an attractive alternative for your particular application.

**Conclusion**

I regard GTAW-P and GMAW-P as potential solutions to some of your problems. Depending on the types of joint designs, joint fitup characteristics, and joint consistency, one of these options may be more suitable for your application than the other. Both processes may have a place in helping you improve your welding operation. Pulsed GMAW may provide the greater potential for major improvement as this process is capable of faster travel speeds, which could improve productivity.

I suggest you work with a reputable welding equipment supplier who has these types of equipment available to determine whether pulsed welding can resolve your problems.

**TONY ANDERSON** is director of aluminum technology, ITW Global Welding Technology Center. He is a Fellow of the British Welding Institute (TWI), a Registered Chartered Engineer with the British Engineering Council, and holds numerous positions on AWS technical committees. He is chairman of the Aluminum Association Technical Advisory Committee for Welding and author of the book “Welding Aluminum Questions and Answers.”

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Q: We are brazing aluminum 3003 tubing with aluminum housings using the 4047 wire and noncorrosive fluoride-based flux. The tube is fixed in the housing wall by expanding outside; however, the tube should also be brazed along the housing wall for about 9 in. From time to time, we notice worsening in the braze flow and wetting in this long joining area, which results in voids. Degreasing, caustic etch, and rinsing of aluminum tubes is carried out as a group treatment of number of tubes in one day, while brazing of these tubes is carried out within the next eight to ten days. We suggest that additional oxidation of aluminum parts, when they are in the shop storage, causes our brazing quality problem. Are there some time limitations to store surface-treated aluminum parts before brazing, and what is the optimal storage temperature? The temperature varies from about 60° to 84°F in our shop. The AWS C3.7-2005, Specification for Aluminum Brazing, does not contain any data about this.

A: I don’t think that periodical bad wetting is caused by an additional oxidation of Aluminum 3003 within two weeks, because the duration of shelf life almost does not change properties of the oxide film when aluminum is stored in dry air. If your flux corresponds to its specifications and you use a reducing flame during torch heating, the oxide film should not affect the wetting and braze flow on the aluminum surface under standard conditions. At the same time, you are right, temperature and humidity may have strong effects on the thickness and structure of the aluminum oxide film.

Dense and high-temperature melting aluminum oxide film should be removed from the mating surfaces during brazing to provide good wetting and flow of a filler metal. Vacuum or many fluxes are used for this purpose. However, the site conditions and/or climate affect the composition, density, and structure of alumina film; therefore, parameters of ambient atmosphere should be controlled in the aluminum brazing shop. The oxide film is formed fast on the same surface after the removal, whereby the thickness, structure, and moisture value of the oxide film depend on the temperature and humidity of the air that may deteriorate quality of brazing. Adsorption of oxygen by the aluminum surface occurs immediately on contact of the cleaned surface with air. The amount of adsorbed oxygen is almost linearly proportional to time during first 15 min, then the absorption rate slows down. The amount of adsorbed oxygen is approxi-
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growth and structure of alumina film on the aluminum surface then stops. The oxide film has a not-ordered, ionic structure at the very first stage of formation (less than 15 min). This is an amorphous, thin film about 0.5 nm thick. When the amorphous film builds up, the ionic structure becomes ordered step by step, the alumina crystal lattice appears, and the amorphous structure transforms into the crystal structure.

From the brazing point of view, the oxidation process is important in the time period between surface treatment (e.g., caustic etch and rinsing) and brazing. During this time period, the treated aluminum parts are exposed to the air atmosphere in the shop that presumably has a relative humidity of 45-55%. Therefore, the formation of alumina oxide film should be considered as formation in a moist air, instead of dry air atmosphere. The kinetics of the alumina film growth in a wet atmosphere is different (Ref. 1). It resembles “saturaion kinetics,” but with significantly larger film thicknesses (Table 1).

The alumina film is dense after its crystallization because at the fairly small thickness, the volume of the aluminum oxide film is larger than that of the oxidized metal (the volume ratio of oxide film to metal is 1:214). The first-formed oxide film does not have pores or cracks, and oxygen from the air cannot penetrate this film to reach the metal surface. Therefore, an interaction between oxygen and aluminum continues due to the mutual diffusion of oxygen and aluminum through the oxide film. After the formation of the 0.03-3.5 nm-thick film, the oxide film becomes an impenetrable barrier for the diffusion of oxygen — Fig. 1.

What happens when the ambient air temperature rises and the humidity increases higher than 55%? Recently, the growth and structure of alumina film on the base Alloy A3003 and its behavior during flux brazing with A4045 as the filler metal (AWS BAISi-5) was investigated depending on different conditions of base metal oxidation. Applications of XPS and Fourier Transformed Infrared Spectroscopy (FTIR) permitted to study a few nanometers thick oxide or hydroxide films in situ and in brazing experiments (Ref. 2).

Holding of the A3003 base metal in dry air at 23°C (50% humidity) does not affect the oxide film on the aluminum alloy surface. An increase in air temperature to 104°F (40°C) and humidity to 92% resulted in a significant growth of the thickness of oxide film from 4 to 8 nm. Further increase in humidity to 100% (i.e., reaching the dew point temperature at the surface) at room temperature (23°C) resulted in growth of the alumina film thickness by 50% for nine days.

The brazability test confirmed a significant effect of storage and climate conditions on wetting and flow of the brazing filler metal BAISi-5 on the surface of A3003 base metal. The brazability after 50 days in dry air (50% humidity) was estimated as 98%, while the brazability after nine days in wet air (92% humidity) or after three days at 100% humidity (condensation) was 79%, and finally, after nine days at 100% humidity, the brazability was estimated as only 5%.

Bottom line: If the humidity in your shop is less than 55%, there is nothing to worry about. The shelf lifetime does not affect quality of brazing aluminum. In this case, I would recommend that you check the caustic etch bath, and/or brazing process parameters, or try to exclude the caustic etching from the process. Bad etching is worse than no etching.

However, if the humidity and air temperature in your shop are higher than normal, you may face wetting or flow problems of the filler metal when brazing aluminum parts after many days of exposure to the moist atmosphere.

Prof. D. Sekulic of the University of Kentucky suggests that a problem with wetting may also be impacted by “other influences” (e.g., the design and assembly features, for example, a lack of centricity and corresponding noncapillary clearances, etc.). He noted in many of his visualizations of wetting that excessive flux and nonuniformity may lead to trapping effluents that penetrate only to a certain extend the surface of the molten metal flow. So, the flux application may lead to the voids in particular if clearance is small and/or if a trapped gas forms.

The author gratefully acknowledges discussion of this question with Prof. Dusan P. Sekulic, University of Kentucky, and his help in preparing this column.

References

This column is written alternately by TIM P. HIRTHE and ALEXANDER E. SHAPIRO. Both are members of the C3 Committee on Brazing and Soldering and several of its subcommittees, ASH Subcommittee on Filler Metals and Fluxes for Brazing, and the Brazing and Soldering Manufacturers Committee (BSMC). They are coauthors of the 5th edition of AWS Brazing Handbook.

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Readers are requested to post their questions for use in this column on the Brazing Forum section of the BSMC Web site www.brazingandsoldering.com.

Table 1 — The Rate of Aluminum Oxide Film Growth in Air of 45-55% Humidity

<table>
<thead>
<tr>
<th>Time</th>
<th>30 min</th>
<th>1 day</th>
<th>10 days</th>
<th>71 days</th>
<th>147 days</th>
<th>3 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness of aluminum oxide film, nm</td>
<td>0.7</td>
<td>1.7</td>
<td>2.2</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

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Increasing Gas Purging Efficiency at the Pearl GTL Plant

When completed, the Pearl gas-to-liquids (GTL) project will be the largest GTL complex in the world — Fig. 1. A joint project of Qatar Petroleum and Royal Dutch Shell plc in Ras Laffan, Qatar, it involves the development of offshore natural gas resources in the Qatar North Field and is comprised of offshore upstream gas production facilities and an onshore GTL plant that will produce thousands of barrels per day of GTL products and equivalent amounts of natural gas liquids (Ref. 1). The plant will produce a range of clean liquid products and fuels, which will include naphtha, GTL fuel, normal paraffins, kerosene, and lubricant base oils (Ref. 2). With lower emissions at point of use, it can play a role in reducing local air pollution in cities and provide a strategic diversification of liquid transport fuel for importing countries (Ref. 2).

The Methodology behind Using New Technology

Consolidated Contractors International Company (CCC), based in Athens, Greece, was one of 11 contractors awarded work on the project, which employs more than 50,000 workers. Construction is expected to be complete by the end of this year, with production ramp-up in 2011.

A key to CCC’s being awarded this project was agreeing to adhere to Shell’s Flawless Startup Initiative, a process the company has developed over the last 15 years to ensure successful commissioning, startup, and first cycle operation of the facility.

With CCC’s corporate initiative to “care for the protection of the environment and the welfare of our planet,” the company considered it more important than ever to select construction consumables that reduce waste. Utilizing new, more efficient technology that is also “green” certainly was an important and significant consideration when selecting products.

“CCC has a green initiative organization in place and has conducted many studies without external financing, to reduce its CO2 emissions,” said Dimitri Mavrikios, group technical manager. He added that other variables are also factored into decisions on adopting new technology such as the nature of the product, where the product will be used, and the circumstances surrounding its use. There are also criteria related to quality assurance; health, safety, and the environment; evaluation of the technical and commercial aspects of the product; and any previous experience CCC might have had with the product.

All of these criteria were considered when it came time to select a gas purging method.

The Need for Gas Purging

The Pearl GTL piping is many miles long and requires many technical operations including fabricating, assembling, welding, purging, and hydro-testing of the pipes. These operations are time consuming, labor intensive, and use inordinate amounts of materials including welding wire, rod, tungsten electrodes, shielding gas, and purging equipment. With a variety of stainless steel pipe diameters ranging from 2 to 72 in. (51 to 1829 mm) to be welded and stringent procedures in place, maintaining quality has always been a critical issue. Failure to eliminate oxygen can result in porosity, corrosion, and premature failure of the joint due to cracking. To obtain a quality weld, complete evacuation of oxygen is necessary.

Inert gases such as argon or a noble gas mix (argon and helium) are used to shield the molten weld pool from atmospheric contamination and oxidation. The inert gas is pumped into the dammed area through a tube inserted into the weld joint. Since argon has a greater density, it will naturally displace the oxygen, requiring it to evacuate through the root opening or other exit point. Two processes that commonly use inert gases are gas tungsten arc welding (GTAW) and gas metal arc welding (GMAW).

The objective of pipe purging is to shield the back of the joint from atmospheric contamination. It is a two-stage operation, involving a pre-purge, then purging during welding. The pre-purge displaces air inside a pipe with an inert gas; the purge during welding maintains the oxygen-free backing gas achieved by the pre-purge and prevents air ingress into the system.

As any accountant will tell you, true cost is a function of many variables. In welding, shielding gas is often overlooked as a potential area of savings. Shielding gas can be costly and, at times, short in supply. As the area to be purged increases, so does the cost. In addition, construction managers often overlook crew waiting time for filling the line with gas. A cost is also attached to idle welding crews; therefore, it is important to select a purging system that minimizes shielding gas usage and crew waiting time as well as help keep the project on schedule.

For CCC’s work on the Pearl GTL Project, purging was localized. Total purging of the pipe would be impractical or extremely costly. Therefore, it was necessary to select from an array of purge systems that could isolate the weld area and minimize the amount of gas used. The time to pre-purge the line and ease of product setup and removal were additional factors considered for selection of a purging system.

Cost and Time Associated with Purging

The CCC engineers compared all the existing systems and took note of the far placement associated with conventional purging methods such as inflatable rubber bladders, rubber gaskets, and cardboard discs.

Purge bladders consist of “balloon” devices connected by a tube that carries gas to inflate them. The bladders are positioned on each side of the weld area and, once inflated, form a seal. Once the bladders are inflated, a release valve opens to flood the weld area between the two bladders with shielding gas. Once the weld is complete, the bladders can be deflated and extracted. Purge bladders can only be used on one joint at a time, then must be removed.

To avoid thermal damage, purge bladders require placement far from the weld.
Fig. 2 — An example of the 72-in.-diameter water-soluble purge dam created for the Pearl GTL Project.

zone, anywhere from 10 to 40 ft (3–12 m). Remote placement of the purge bladders would require large amounts of noble gas to displace the oxygen in the weld zone for the many miles of construction. In addition, positioning and removing purge bladders can prolong setup and teardown.

The company eventually decided to use the EZ Purge® system from Aquasol Corp., North Tonawanda, N.Y.

EZ Purge® is a preformed, patented, water-soluble and self-adhesive purge dam. Made of sodium carboxy methyl cellulose and wood pulp, the purge dam dissolves instantly and completely in most liquids and is 100% biodegradable. Its zero air permeable (ZAP™) technology prevents air from permeating the dammed area, creating an airtight enclosure.

“Our construction manager on the Pearl GTL project, Salem Mahrouse, was the construction manager at our Bahrain project. He was satisfied with EZ Purge, advised us, and convinced us to use it again on this project,” explained Abdallah G. Akkad, deputy project director/project manager, Process Area Pearl GTL Project.

He added, “One of the good features, other than saving time and cost, is that we don’t have to worry about forgetting the plug inside the line, which will create later problems and waste of time. This also satisfies Shell Flawless Startup requirements.” Shell’s Flawless Startup is a system that attempts to identify and mitigate potential flaws in plant and equipment startups.

CCC’s Bahrain office first commissioned use of the water-soluble purge dam in 2006 shortly after the product was launched. At that time, standard pipe diameter sizes of up to 24 in. (605.5 mm) were being offered in the marketplace. Then in 2008, CCC challenged Aquasol to engineer the product up to 72 in. in diameter.

This challenge presented a multitude of design issues because the proposed size was enormous. What would need changing in the manufacturing process? How could the purge dam be designed to allow retention of gas flow pressure and be 100% impermeable to air? Faced with a tremendous undertaking, the engineering design team tackled each issue one by one.

In a matter of months, an enhanced patented design was birthed and the new sizes were made available. The company unveiled the largest water-soluble purge dam in the world, possessing a diameter and height of 72 in. (1829 mm), the height of a tall man — Fig. 2.

Similar to a mechanical purge device, the shape of the larger-size purge dam would remain flat to allow equal distribution of gases across the body of the dam and to prevent blowouts. The larger sizes were designed to contain the company’s water-soluble paper combined with other water-soluble polymeric composites to provide a uniform, substantive body designed to maximize gas retention. Water-soluble tape was built into the purge dam sidewall so the customer did not need to purchase separate inventories of the adhesive and the purge dams. The portion of water-soluble tape along the tapered sidewall was proportionate to the size of the dam and preinstalled in sections, a design that allows for easy alignment and tacking of the dam — Fig. 3. To enable the welder to maneuver the large-sized dams and place them in position, the manufacturer’s engineering team specifically designed an installation disk.

Aquasol President Mike Hacikyan commented, “I consider our products to be ‘Greenventions,’ the marriage of biosustainability with invention. There is no reason the two cannot exist simultaneously creating a more eco-friendly manner of doing business yet still offer improved efficiencies.” It took more than two years to develop EZ Purge because of the design challenges, Hacikyan said.

Water-Soluble Alternatives

Water-soluble paper in sheet and roll format has been available for many years. And, in certain situations, may still be the best alternative. For instance, for pipes with diameters less than 2 in., the welder...
need only crumple half a sheet of the 8½ × 11-in. water-soluble paper into each end of the pipe to be joined.

Water-soluble film works similarly. The film must be measured, cut, and constructed to fit the pipe. A liquid adhesive, which requires 15 to 30 min to dry, is often used to attach the film to the pipe. Drawbacks to the film are that it is transparent, fragile, awkward to work with, and unsuitable for large pipe diameters.

Welders sometimes make their own purge dams out of water-soluble paper, but for larger pipes this can be time consuming, requiring the skilled welder to precisely measure, cut, and construct them by hand. As the diameter of the pipe increases, the time required to build the dam increases and the operation becomes more complex. Since standard paper widths are limited, the welder may be required to splice together two or more sheets of paper with water-soluble tape in order to create the required size. Large handmade dams can also be delicate and difficult to maneuver.

As the diameter of EZ Purge increases, the paper increases in thickness and the exposed water-soluble skirt available for adhesion to the pipe increases in area. This is the primary and most important difference between handmade and preformed purge dams. For instance, the largest size EZ Purge (72 in.) is 0.045 in. (1.15 mm) thick and contains a 20-in. (508 mm) water-soluble skirt. With a handmade dam, the maximum thickness would be 0.008 in. (0.2 mm) and the water-soluble tape (skirt) 2 in. (50 cm).

With thousands of joints to be welded, it made little sense for CCC’s skilled welders to painstakingly expend numerous hours creating handmade dams when that time could be saved and improve the timeline of the project. CCC was provided with two tools that helped to convince the company to use the new technology.

Calculation spreadsheets were designed to convince project engineers and salespeople of the advantages of using the product. The Labor and Cost Savings spreadsheet calculates labor and time savings for using the manufactured purge dam. The user simply enters the pipe size, number of welds, and labor rate into the spreadsheet, and the savings are automatically calculated. The Argon Cost Saver Spreadsheet works in a similar fashion and compares EZ Purge to other purging devices. Here, the user enters the price of argon, and the spreadsheet calculates savings based on cubic feet of gas. Both spreadsheets can be accessed at www.aquasolcorporation.com.

“IT is standard CCC procedure to justify any expenditure, therefore these savings were evaluated in detail,” Mavrikois said.

The advantages of the new technology as a solution to backpurging of weld roots in stainless steel piping, according to Mavrikois, “are simplicity of installation and considerable time and cost savings.”

References


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— continued from page 28
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Visit us at the 2010 Fabtech International & AWS Welding Show -Booth #7221
Reducing Gas Surges Improves GMAW Profitability

Measures are outlined that can help lower your gas costs

BY RICHARD GREEN

Do you like throwing money into the wind? Well, you could be doing just that if your company is performing gas metal arc welding (GMAW). Every GMAW arc start has the potential for excess waste because of gas surge.

Installing the optimum gas flow control equipment is a proven source of cost savings that can impact a company’s operating efficiency and profitability. Other factors such as adjustability, pipeline layout, and distance from the gas solenoid valve also impact cost. This article reviews the benefits and drawbacks of controlling shielding gas coverage with flowmeter, flow gauge, and flow orifice technology with and without local pressure control.

The ideal candidates for maximum cost savings are those weldments that require multiple tack welds or a large number of short welds. In this scenario, the gas control system pressurizes and depressurizes as the wire feeder solenoid valve actuates. Think of the feeder solenoid as a dam opening and closing the flood gates of gas. Typically, the operator experiences a gas surge built up behind the solenoid valve, which could lead to erratic arc starts and porosity caused by siphoned atmosphere. The hose length, device proximity to the solenoid valve, hose diameter, and static gas pressure impact the volume of gas buildup behind the solenoid valve. Peak surge and surge duration are terms used to describe the severity the operator experiences.

Determining Peak Surge

Peak surge is the maximum instantaneous flow observed that is defined by the pressure drop across an orifice. For the calculations in this article, we assume a sharp-edged orifice and sonic flow. Sonic flow is the range in which $\Delta P \geq \frac{1}{2}$ of the inlet pressure, or as referenced in CGA E-4 for air $P_2/P_1 \leq 53$ (Ref. 1). The flow rate can be calculated within a 4–5% margin of error using the following equation:

$$Q = \frac{(816.6 C_v P_1)/(GT)^{\frac{1}{2}}}{(Ref. \ 1)}.$$

$C_v$ is a term used to describe an orifice or valve’s fluid flow capacity. As reference, a $C_v$ of 1 means the valve or orifice can flow 1 gal of water with a $\Delta P$ of 1 lb/in.$^2$. The $C_v$ can also be related to the surface area of the orifice or the open area of a regulating valve such as a pressure regulator’s seat. Examples of the $C_v$ values listed in CGA E-4 Table A1 for sharp edge orifices are $C_v$-0.01 for an orifice diameter of 0.025 in., $C_v$-0.03 for 0.043 in., and $C_v$-0.1 for 0.079 in. (Ref. 1). $G$ is the specific gravity of the gas, 1.38 for argon and 1.52 for carbon dioxide. $T$ is the inlet gas temperature expressed in the Rankine scale calculated as $R = ^\circ F + 460$. $P_1$ is the inlet pressure expressed in pounds per square inch (lb/in.$^2$).

Peak surge is also affected by the inlet pressure and spring closing forces acting on the regulator’s seat. Gas coverage settings are usually set in the flowing condition. As the seat closes, the static pressure filling the hose exceeds the preset value by cumulative forces closing the seat, causing the pressure in the hose to rise 5–15 lb/in.$^2$ higher than the calibration pressure. This in turn increases $\Delta P$ across flow devices such as flowmeters, orifices, or flow gauges leading to greater waste. The calibration pressure can vary from manufacturer to manufacturer as much as 20–80 lb/in.$^2$. In general, flowmeters yield lower surge than orifices because the float material provides some backpressure as compared to the orifice. In either case, both discharge the shielding gas to the atmosphere.

Surge duration is the time it takes the flow device to settle from the peak surge to the desired flow rate. The amount of gas stored in the hose reservoir impacts surge duration. As the hose diameter, length, and static pressure increase, the duration of the surge and subsequent waste increase.

Flow Control Equipment

Not all flow control equipment guards against gas surge as expected. Figure 1 illustrates in red a flow gauge that is designed to limit the duration and peak of the gas surge. However, this type of flow
Reduction and Surge Performance

Gas surge can be reduced by coupling a noncompensated flowmeter, an orifice, and an adjustable regulator, as illustrated in Fig. 2. The operator adjusts the regulator pressure while observing the flow on the scale in the flowmeter. The flowmeter accurately displays the gas flow rate even when the regulator is adjusted to as low as 3 or 4 lb/in.². This minimizes the static pressure buildup in the hose. The gray curve in Fig. 1 shows the reduction in gas peak surge and surge duration because of this design.

Optimism is high at this point that a 20% reduction in gas cost is achievable, but care must be taken when specifying gas-saver regulation equipment. The flip side of reducing gas surge is it takes longer for the gas to travel from the solenoid to the end of the weld gun. Depending on the amount of air movement, the welding gun should be limited to 15 ft to ensure sufficient gas coverage upon arc initiation. Remember, with gas-saver equipment, the designed flow rate is what you get and not the surge in excess rate of 600 ft³/h.

With adequate gas coverage ensured, a simple spreadsheet can be used to determine the payback and subsequent cost savings by weldment as illustrated in Fig. 3. By quantifying the number of arc starts per part and the number of parts per shift, the manager can make an informed decision. Coupled with the cost per cubic foot, the data can then be translated into savings by management.

Installing the best equipment for the application will ensure cost savings are realized — and not taken by the wind.

Reference

Robert Evans, shown here with his gas tungsten arc welding power source, has become a skillful welder as part of his recovery from an injury sustained in Iraq in 2007.

Evans shows his gas tungsten arc welding skills, which he learned by volunteering at a local community college during the past seven months.
Army veteran Sgt. Robert Evans lost his right hand in Iraq, yet that hasn’t stopped him from training to be a welder and modifying his pickup truck for racing

BY ANDY WEYENBERG

You can’t get much closer to a true American welder than Sgt. Robert Evans. A five-year Army veteran, Evans served twice in Iraq, first for 15 months in 2005 and then again for three months in 2007, during which time he lost his right hand to an improvised explosive device (IED). He’s also an adept gas tungsten arc (GTA) welder (see lead photos).

Not one to feel sorry for himself or back down from adversity, Evans began teaching himself to GTA weld as part of his recovery from the accident. Not to mention, he wanted to prove everyone wrong.

Learning to Perform GTA Welding

Initially, Evans traveled around the Reno-Sparks, Nev., area where he lives, attempting to find a GTA welding apprenticeship at various off-road and race shops, but to no avail.

“I had so many people tell me that I couldn’t learn to gas tungsten arc weld. They’d blow me off and tell me that they didn’t want to baby sit me,” Evans said. “But I’m the type of person who doesn’t like to back down from a challenge. I always try to rise to the occasion and do my best.”

Step-by-Step Guidance

Evans’s perseverance paid off. After much searching, he found himself volunteering for a high school and college welding program at Truckee Meadows Community College in Washoe County, Nev. There, in exchange for prepping metal and assisting in the classroom, instructor Gaylord Rodeman allowed Evans to use the welding equipment.

Evans first learned to weld autogenous beads (GTA welds without the filler metal), a task that he spent up to eight hours a day, five days a week tackling until he mastered the basics. When he and Rodeman felt comfortable with his progress, Evans began welding with a filler rod — Fig. 1.

Overcoming Challenges

His first obstacle was determining whether to hold the filler rod with his prosthesis, which he eventually chose, or his left hand, along with obtaining the correct angles to complete a good GTA weld. Because Evans can’t feed the rod the same way as a two-handed welder, he needs to stop welding completely to move it forward.

Also, when it came time for Evans to learn welding T-joints, he learned that the lack of a wrist unit affected the angle at which he could weld, requiring him to reposition the workpiece to a location where he could reach the joint fully with the filler metal.

Still, like any other part of his training, Evans was never deterred by the difficulty of the process. And it wasn’t only his determination that drove him to master GTA welding. There also stood another passion: racing.

Using Welding Skills to Enhance Racing a Pickup Truck

Since 2008, Evans and his race team — including TJ Brown, Keith Evans (Robert’s father and team manager), James Delcastillo, and Josh Atkinson — have continued to modify and race a three-quarter ton 2004 Dodge Ram pickup truck with a Cummins diesel engine — Fig. 2. They have participated at competitions across the country.

Not surprisingly, Evans has completed most of the welding on the truck’s engine and frame by himself — Fig. 3.

ANDY WEYENBERG (andy.weyenberg@millerwelds.com) is a motorsports manager for Miller Electric Mfg. Co., Appleton, Wis.
Competitive Spirit Wins First Place, Makes History at Contest

In 2009, Evans competed in the Diesel Power Challenge, hosted by Diesel Power magazine. The team clinched a first place position and made track history by being the only diesel truck — without nitrous oxide, propane, or other injectable fuel — to take that title. Impressively, the Dodge’s time in the drag racing portion of the competition clocked in at 11.07 s on a quarter-mile track running 128 miles/h.

Evans approaches racing with the same tenacity as GTA welding.

“It’s the same principle. I had a lot of people tell us we couldn’t accomplish things that we are accomplishing with diesel alone. Other people add nitrous and such,” Evans explained. “But we’re doing it. We’re putting in the time and effort and having a great time along the way.”

Future Ambitions

To prepare for additional races that he plans to enter this year, Evans is relying on a recent sponsorship from Miller Electric Mfg. Co., which includes the donation of a Dynasty® 200 GTAW power source and Millermatic® 211 with Auto-Set for gas metal arc welding. So far, he has used the equipment to meet the racing industry’s safety regulations, namely the fabrication and installation of an internal roll cage to protect him during each race.

Also, he plans to continue improving his pickup with the welding equipment, in hopes of winning many more races.

So what’s the end goal for Evans? “I see gas tungsten arc welding as a barrier that I need to overcome. It’s a difficult process for anyone, and for me, the challenge is great,” Evans concluded. “But I don’t want people to think that I can weld well for someone who is disabled. I want them to look at a weld and think it’s great regardless — to have it be good as far as anybody’s standards.”

Most would argue that through his unfailing grit, Evans has already met that goal.

Fig. 2 — The diesel 2004 Dodge Ram pickup truck that Evans races has clinched several first-place wins during recent years, making it unique from other competitors who opt to use nitrous oxide or propane as fuel.

Fig. 3 — Evans has completed much of the welding and modifications on the pickup truck, which he has personalized with his own style.
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In announcing $256 million from the American Recovery and Reinvestment Act, Energy Secretary Steven Chu said, “Supporting the development of the latest industrial technologies plays an important role in helping U.S. industry to lead the world in energy efficiency and productivity.” U.S. auto plants were singled out to receive Energy Saving Assessments from the Department of Energy and Industrial Technologies Program to identify savings opportunities in compressed air usage in many auto assembly processes. For instance, each vehicle may contain hundreds of weld studs pneumatically conveyed from stud feeder to weld tool. Its low overall efficiency of 10–15% makes compressed air one of the most expensive sources of energy. Also, the U.S. Navy has just directed the National Shipbuilding Research Program to focus on developing green technologies to save energy consumption in naval ship construction and repair. Each ship may contain millions of studs and fasteners that are welded using electric power, and therefore represent a significant portion of the utility bill. Green technologies in stud welding can make a significant impact in auto plants, shipyards, industrial plants, and construction sites.

The energy consumption of a stud welding machine is directly related to the...
New stud welding technologies save energy, lower operating costs, and boost quality and productivity in renewable energy fabrication

BY CHRIS HSU AND DOUG PHILLIPS

Plunge Current Waveform Reduces Power Waste

Drawn arc stud welding follows this process:

• Push the stud against the workpiece to make contact
• Start a low pilot current and lift the stud to draw a small pilot arc current
• Increase current to the welding current level for a set time to melt the stud and the workpiece
• Plunge the stud back into the workpiece to extinguish the arc and complete the weld
• Turn off the welding current and remove the weld tool.

The synchronization of current turn-off and stud plunge is always guesswork and a source of weld defects. If the current is shut off too soon at the end of the process, cold welds result. If the current is left on too long, too much energy is wasted, and cables and connectors can overheat causing downtime. Shutting off the current upon short circuit detection incurs the risk of prematurely turning off the heat to react to an incipient liquid bridging condition, commonly seen in short lift, angle iron, or out-of-position welding. Now, however, the current waveform from an inverter controlled by a digital signal processor can be choreographed with the stud motion during plunge. This reduced plunge current saves electricity, reduces cable and connector wear by removing the excess heat, provides better flash ring appearance, and compensates for process variation due to the mechanical motion of the gun. Reduced plunge current keeps the weld pool warm, without the risk of cold plunge, created by turning off the current completely.

CHRIS HSU (chris.hsu@nelsonstud.com) is director of Global Engineering and DOUG PHILLIPS (doug.phillips@nelsonstud.com) is director of Product Management – Equipment, Nelson Stud Welding, Inc., Elyria, Ohio.
Fig. 1 — Conventional stud welding waveform (A) vs. reduced plunge current waveform (B).

Fig. 2 — Eco Escape™ stud feeder cuts air consumption by up to 62% in automotive fabrication.

upon short circuit. Utilizing the controlled plunge current can result in an estimated 9% reduction in energy use for drawn arc stud welding with ferrule, and up to 24% for short cycle processes without ferrule — Fig. 1.

**Stud Feeder Reduces Air Consumption and Noise**

In robotic, hard-tooled automation or semiautomatic (autofeed hand gun) stud welding, compressed air is used to blow feed the stud from the feeder to the weld tool held by a robot or operator. Compressed air is considered the most expensive form of energy in an automotive plant according to sources at General Motors. GM has reached out to all of its suppliers to develop airless manufacturing technologies. Welding OEMs were asked to develop airless welding systems. Although the compressed air is not eliminated, its consumption has been significantly reduced by an innovative green design at a German automaker. The design has been dubbed the “Eco Escape™ feeder.” The device incorporates a mechanism for separating the studs called an escapement, that is precisely assembled to seal leaks. This saves up to 62% of compressed air in the stud feed process — Fig. 2. The Eco Escape design also reduces ambient noise levels, utilizing other innovative features used to sort and orient the studs, to silence the loud noise of leaking air and to create a better work environment.

For example, Eco Escape at Bavarian Motor Works AG feeds a 5-mm-diameter, 14.2-mm-long, 7-mm flange stud with 8.2-L air, a reduction from 21.4-L air per stud feed. At 1€ per Nm³ cost for pneumatic power — for 200 studs per car body, 240,000 cars per year — $8055 per year can be saved in welding this particular stud alone.

**Put Welding Machines to Sleep when Idle**

One good way to save energy is simply to turn off the equipment. New automotive stud welding machines will actually go into sleep mode during idle times to save energy. In most automotive plants, the welding machines are left on during breaks and in between shifts and through shutdowns. These welding machines, feeders, and guns are still consuming power when they are not in active use. The previous generation welding machines consumed 113 W of power plus the 50 W in the gun and feeder. This has now been reduced to 7.5 W in the welding machine and 0 W in the gun and feeder in the sleep mode. This means a 155.5-W reduction during idle times. At a 2% maximum duty
cycle, the savings can amount to 1335 kWh (kilowatt-hour) per single gun welding system per year. At the U.S. Energy Information Administration (EIA) Web site, the 2010 U.S. average retail price of electricity for all sectors is 9.8¢ per kWh. For example, an assembly plant with 100 welding machines can save $13,083 per year by using the sleep mode during idle production times. The savings can be calculated by multiplying the number of machines in the plant by the electricity rate, and retooling old equipment based on the return on investment.

**Inverter Stud Welding Machines**

The majority of the studs welded today are still done by welding power sources made with line frequency transformer and rectifier topology, and sometimes by still older motor-generators and timer boxes, or even by labor-intensive shielded metal arc welding around the stud base. A welding machine made with a line frequency transformer and rectifier has a poor energy conversion rate and high idle power. This is due to the fact that the transformer that converts high input voltage to lower output voltage, suitable for arc welding, operates at a line frequency of 50 or 60 Hz. A transformer operating at 60 Hz has high magnetizing currents and wastes a tremendous amount of energy during idle mode, the time at which the welding machine is on but is not being used.

Modern stud welding inverters derive significant savings, in the range of 10–30%, from transforming power at about 1000 times the frequency (see lead photo). This is done with a compact, low weight, and highly efficient planar transformer designed specifically for stud welding creating high peak weld current — Fig. 3. Additional benefits include reducing idle and fan power by a factor of 30–45. The idle power is important because most auto plants leave the machines on between shifts, and shipyards and other fabricators leave the welding machines on overnight to avoid a preproduction weld qualification test after cycling power. Improved power factor is another benefit to utility companies. Faster regulation of current by inverters also eliminates the characteristic current spike during the stud welding process when the stud plunges into the weld pool. This current spike is a main source of weld spatter at the conclusion of the weld process. Reducing the weld spatter increases the longevity of the welding equipment and extends the periods between preventive maintenance tasks.

In addition, the inverter design is more tolerant to “dirty” power from generators and brownout-prone electrical grids in certain manufacturing locations. For example, a 40-lb one-man portable inverter welding machine can shoot ½-in.-diameter studs using 15-A service instead of the typical 30-A service traditionally required, and a 79-lb welding machine can shoot ¾-in.-diameter studs using 30-A service instead of the typical 60-A service traditionally required. Reduced input power requirement results in savings in installation costs. Less wasted energy or heat also results in less blowing of the cooling fan to bring dirt into the welding machine and thus extends its service interval. The portability from lower weight and size can benefit all trades in shipyards such as outfitting, electrical, hull fairing, and pipe Fig. 3 — Portable inverter stud welding machine saves energy in an eastern Canada shipyard.

Fig. 4 — Headed anchors stud welded to the ring structure of a Gamesa wind tower monopole at Trinity.
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Increased Productivity

Green Fastening Applications

The advent of new stud welding technologies has brought improved productivity and quality in wind, solar, and hydro renewable energy generation. For example, 25-mm-diameter, 300-mm-long Nelson S3L studs are used for the giant ship lift in China's Three Gorges Dam that spans the Yangtze River. This massive renewable energy project represents a historic turning point in a country that is among the leaders in greenhouse gas emissions.

Solar power is another growing industry that can benefit from power-efficient stud welding technology. Photovoltaic cells and parabolic trough collectors are commonly attached to concrete footings with anchors attached to steel embedment plates. The footings typically have embedment plates cast in place with H4L headed anchors or D2L deformed bar anchors. Once cured, the CFL fully threaded studs are drawn-arc welded for strong panel connection. In addition, nonthreaded studs are used as standoffs to keep the solar panels at a distance from the inner frame during the glazing operation.

Composite designs to connect steel and concrete are commonly employed in hydro power generation. For example, 25-mm-diameter, 300-mm-long Nelson S3L studs are used for the giant ship lift in China's Three Gorges Dam that spans the Yangtze River. This massive renewable energy project represents a historic turning point in a country that is among the leaders in greenhouse gas emissions.

Two estimates of energy savings are provided assuming an EIA rate of 9.8e per kWh, and a 7-h, 2 shifts per day, 20 days per month work schedule. One example is welding ½-in.-diameter threaded studs at 800 A, 550 ms, 4000 studs per week. A 60-Hz stud welding machine consumes $2760 per year, vs. $144 by a 60-kHz machine, a $2616 savings per welding machine per year. Another example is pinning at 650 A, 100 ms, 25,000 pins per week. A 60-Hz stud welding machine consumes $2736 per year, vs. $140 by a 60-kHz unit, a $2592 savings per welding machine per year. It amounts to $157,000 for a 60-machine yard and $1.3 million for a 500-machine yard if it transitions from 60-Hz to 60-kHz technology. An online calculator can be used to estimate a fabricator's stud welding energy savings under specific application conditions (Ref. 1).

Energy savings can also be realized in capacitor discharge (CD) stud welding machines with a high-frequency switched mode power supply to charge the capacitor bank. Electricity consumption is expected to be cut in half with this new design.

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Location
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Show Dates and Hours
Tuesday, November 2 — 9:00 a.m. – 5:00 p.m.
Wednesday, November 3 — 9:00 a.m. – 6:00 p.m.
Thursday, November 4 — 9:00 a.m. – 4:00 p.m.

Located in the heart of downtown Atlanta, the Georgia World Congress Center is one of the world’s finest convention, sports, and entertainment venues. The GWCC opened in 1976 and has hosted a wide variety of special events including FABTECH in 2006 and now in 2010. The center is easily accessible from both Interstate 20 and the Connector (Interstates 75/85). With Hartsfield-Jackson Atlanta International Airport, the Georgia World Congress Center is accessible by 80% of the American population in two hours or less. The GWCC campus is served by two MARTA (Metropolitan Atlanta Rapid Transit Authority) stations. To find more information on the GWCC, directions, parking, etc., log on to www.gwcc.com.

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Shuttle service is provided to/from Georgia World Congress Center for all the hotels noted below except for the Omni Hotel at CNN Center and Hilton Garden Inn. Both are within walking distance of the GWCC.

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Sheraton Atlanta
Hilton Atlanta (AWS HQ Hotel)
Omni Hotel at CNN Center
Hyatt Regency Atlanta (CCAI HQ Hotel)
Atlanta Marriott Marquis
Hilton Garden Inn Atlanta Downtown

Proposed Routes & Boarding Point*

Route 1
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Boarding Point: SE Corner of Baker and Courtland

Route 2
Atlanta Marriott Marquis
Hyatt Regency Atlanta (CCAI Headquarters)
Boarding Point: Curbside, Front Entrance

Route 3
Sheraton Atlanta
Westin Peachtree Plaza Atlanta
Boarding Point: NE Corner of Courtland and International

Walking Distance / No Service Needed
Hilton Garden Inn
Omni Hotel @ CNN Center

*Please be advised that pickup times and locations listed above are subject to change. Please consult the sign in your hotel lobby for up-to-date schedules and boarding point information.

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8:00 a.m. – 5:30 p.m. Tuesday and Wednesday
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CERTIFIED WELDING SALES REPRESENTATIVE — SAMPLE SESSION

Wednesday, November 3
1:00 p.m. – 4:00 p.m.
Room C308
FREE • Registration Code: W41
CERTIFIED WELDING SUPERVISOR — SAMPLE SESSION

Thursday, November 4
9:00 a.m. – 12:00 noon
Room C308
FREE • Registration Code: W42
CERTIFIED WELDING INSPECTOR — SAMPLE SESSION

Thursday, November 4
1:00 p.m. – 4:00 p.m.
Room C308
FREE • Registration Code: W43
CERTIFIED RADIOGRAPHIC INTERPRETER — SAMPLE SESSION
Monday, November 1

9:00 a.m. – 10:30 a.m. 
**AWS OPENING SESSION & ANNUAL BUSINESS MEETING**

During the AWS Opening Session and 90th Annual Business Meeting, 2010 AWS President John Bruskotter will give the Presidential Report and John Mendoza will be inducted as AWS President for 2011. Following the induction, the 2010 Class of AWS Counselors and Fellows will be introduced. This meeting is open to all AWS Members and Show registrants.

10:30 a.m. – 11:30 a.m. 
**COMFORT A. ADAMS LECTURE — Welding, Key Technology in Power Generation Industry**

The Comfort A. Adams Lecture is named after the founder and first president of AWS. This annual lecture is made by an outstanding scientist or engineer, honored by the AWS Board of Directors. This year the presentation will be given by Horst Cerjak on the topic “Welding, Key Technology in Power Generation Industry.” Cerjak served as head of the Institute for Materials Science and Welding at Graz University of Technology, Austria, from 1982 until 2008. He received his degree in metallurgy from the University of Leoben, Austria, in 1963, and performed his PhD thesis at the Technical University, Hannover, Germany. In 1967, he joined Siemens AG Nuclear Power in Erlangen, Germany. There he became general manager, materials and welding, responsible for materials development and welding technology of nuclear power plants. Among the highlights of his more than 40-year career are 350 scientific papers and 14 books in the fields of nuclear materials, materials development, weldability, modeling approaches, and creep-resistant steels. Cerjak introduced the IWE education at his university, served from 2004 to 2007 as vice rector academics, and is founder and chairman of the IIW international seminar “Numerical Analysis of Weldability.” He has received a number of awards for his scientific achievements, including the IIW Sossenheimer Software Innovation Award in 2005, IIW Yoshinski Arata Award in 2007, the Dr.-Wolfgang-Houska Price Award for research in 2008, and the AWS Adams Memorial Membership Award in 2009.

6:30 p.m. – 8:00 p.m. 
**AWS OFFICERS/PRESIDENTS/COUNTERPARTS RECEPTION**

This reception is held annually during the Show and is open to all registrants. Take advantage of this opportunity to meet the AWS Officers, network with members and prospects. A complimentary hors d’oeuvres buffet is included, along with a cash bar. Evening business attire, please.

Tuesday, November 2

10:00 a.m. – 11:00 a.m. 
**PLUMMER MEMORIAL EDUCATION LECTURE**

This year the Plummer Lecture will be given by R. Bruce Madigan on the topic “Welding Education: Encouraging a Continued Posture for Learning.” Madigan, an American Welding Society member for more than 27 years, is an associate professor at Montana Tech at the University of Montana. He is an AWS Section officer and participates in numerous AWS activities including the Education, Scholarship, Welding Handbook, and Technical Papers Committees. Madigan worked in industry as a welder before obtaining his BS and MS in welding engineering from The Ohio State University. After working for the Edison Welding Institute and the National Institute of Standards and Technology, he obtained a PhD in metallurgical and materials engineering from the Colorado School of Mines. The Plummer Memorial Education Lecture Award has been established by the American Welding Society to recognize an outstanding individual who has made significant contributions to welding education and training, and to recognize Fred L. Plummer’s service to the society as president from 1952 to 1954 and executive director from 1957 to 1969.

10:30 a.m. – 12:15 p.m. 
**IMAGE OF WELDING AWARDS CEREMONY**

Join the AWS Image of Welding Committee (a subcommittee of the Welding Equipment Manufacturers Committee) and special guests as they recognize the individuals and organizations that have excelled in promoting the image of welding in their communities.

12:00 p.m. – 2:00 p.m. 
**AWS AWARDS/AWS FOUNDATION RECOGNITION CEREMONY AND LUNCHEON**

Price: $30 • Registration Code: W37

The first AWS award, the Samuel Wyllie Miller Memorial Medal, was presented to Comfort A. Adams in 1927. As the Society and the industry it serves have grown, so has the need to recognize outstanding scientists, engineers, educators, and researchers. Join an assembly of distinguished award presenters, recipients, and guests for a well-paced ceremony and a delicious lunch. The cost for attending the ceremony and luncheon is $30, and is open to all registrants. Tickets will also be available at the door.

Wednesday, November 3

10:00 a.m. – 10:30 a.m. 
**R. D. THOMAS, JR., INTERNATIONAL LECTURE**

This year’s R. D. Thomas, Jr., International Lecture Award recipient is David A. Fink of Lincoln Electric, who will speak on “Are We There Yet? — A Review of the Current Status of International Standardization of Filler Metals.” The R. D. Thomas, Jr., International Lecture Award was created to honor R. D. Thomas, Jr., for his participation in IIW/ISO activities and is presented by AWS to an individual who is also involved in IIW/ISO international activities. The recipient is invited to deliver a lecture illustrating the incorporation of global studies in the standardization of welding technology during FABTECH and at the Annual Assembly of the IIW.

10:30 a.m. (Immediately following the R.D. Thomas Jr., International Lecture) 
**AMERICAN COUNCIL OF IIW**

**WELD TRIALS COMPETITION**

The AWS Skills Competition Committee will showcase six finalists selected from 24 student welders that competed in the SkillsUSA Championships in 2009 and 2010. They will test their skills in this qualifying event for the WorldSkills Competition in Calgary, Alberta, Canada in 2011, and only three will advance to the next round.
Don’t miss the chance to see competitors demonstrate their skills by completing standard test weldments (plate and pipe), sheet metal projects in aluminum and stainless steel, and a pressure vessel. Welds will be judged for soundness and appearance. Written skills and welding code interpretation will also be judged. Ultimately, the 2011 TeamUSA Welder who will represent the U.S. at WorldSkills will be selected at the U.S. Open Weld Trials in 2010. This winner will receive a four-year scholarship worth $40,000 from the AWS Foundation and sponsored by The Miller Electric Manufacturing Co., a four-year AWS membership, an AWS Certification, and up to $1,000 in AWS publications.

**JOB FAIR AND CAREER PAVILION**

**Tuesday, November 2 — Thursday, November 4**

The Job Fair will take place during show hours on Tuesday, November 2nd, and Wednesday, November 3rd.

The Career Pavilion will be open during show hours Tuesday through Thursday.

Get your résumé ready. Whether you’re a veteran professional or a student just entering the workforce, the Job Fair and Career Pavilion offers you an excellent opportunity to network with prospective employers, education and career development advisors, and other job seekers.

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**AWS EVENTS AT A GLANCE**

**Monday, November 1**

**SPECIAL PROGRAMS**

- Opening Session/Annual Business Meeting • 9:00 a.m.
- Adams Lecture • 10:30 a.m.
- Fellows/Counselors Induction Luncheon • 1:00 p.m.
- Officers/Presidents/Counterparts Reception (H) Grand Ballroom East • 6:30 p.m.

**Tuesday, November 2**

**CONFERENCES**

- National Welding Education Conference (W20) • 9:15 a.m. – 4:30 p.m.
- What’s New in Weld Consumables (W21) • 9:00 a.m. – 4:00 p.m.

**SEMINARS**

- Why and How of Welding Procedure Specifications (W25) • 9:00 a.m. – 4:30 p.m.
- Road Map through the D1.1:2010 Structural Welding Code – Steel (W26) • 9:00 a.m. – 4:30 p.m.
- Visual Inspection Workshop Day 1 (W30) • 9:00 a.m. – 4:30 p.m.
- Certified Welding Sales Representative Seminar • 9:00 a.m. – 5:00 p.m.

**PROFESSIONAL PROGRAM**

- Session 1: International Trends in Welding Research (W32) • 8:00 a.m. – 10:15 a.m.
- Session 2: Friction Stir Welding (W32) • 2:00 p.m. – 5:00 p.m.
- Session 3: Weldability Issues (W32) • 2:00 p.m. – 5:30 p.m.

**SPECIAL PROGRAMS**

- Education Program (including Plummer Lecture) (W39) • 9:00 a.m. – 12:00 noon
- Image of Welding Awards • 10:30 a.m.
- Awards/AWS Foundation Recognition Luncheon (W37) • 12:00 noon – 2:00 p.m.
- Thermal Spray Basics (W38) • 1:00 p.m. – 5:00 p.m.
### Wednesday November 3

<table>
<thead>
<tr>
<th>CONFERENCES</th>
<th>Time</th>
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<tbody>
<tr>
<td>Weld Repair and the Strengthening of Welded Structures (W22)</td>
<td>9:00 a.m. – 4:00 p.m.</td>
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<tr>
<td>Thermal Spray Technology: High-Performance Surfaces (W23)</td>
<td>9:00 a.m. – 3:30 p.m.</td>
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<tr>
<td>Metallurgy Applied To Everyday Welding (W27)</td>
<td>9:00 a.m. – 4:30 p.m.</td>
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<tr>
<td>D1.1:2010 – Fabrication and Inspection (W28)</td>
<td>9:00 a.m. – 4:30 p.m.</td>
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<tr>
<td>Visual Inspection Workshop Day 2 (W30)</td>
<td>9:00 a.m. – 4:30 p.m.</td>
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<tr>
<td>Certified Welding Sales Representative Seminar (W31)</td>
<td>9:00 a.m. – 5:00 p.m.</td>
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<tr>
<td>RWMA Resistance Welding School Day 1 (W31)</td>
<td>7:45 a.m. – 5:30 p.m.</td>
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<tr>
<td><strong>PROFESSIONAL PROGRAM</strong></td>
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<tr>
<td>Session 4: Laser and Hybrid Processes (W33)</td>
<td>8:00 a.m. – 12:00 noon</td>
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<tr>
<td>Session 5: Welding Metallurgy (W33)</td>
<td>8:00 a.m. – 12:00 noon</td>
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<tr>
<td>Session 6: Mechanical and Corrosion Properties (W33)</td>
<td>2:00 p.m. – 5:30 p.m.</td>
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<tr>
<td>Session 7: FSW and Solid-State Processes (W33)</td>
<td>2:00 p.m. – 5:30 p.m.</td>
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<tr>
<td>International Brazing and Soldering Symposium (W33)</td>
<td>9:00 a.m. – 2:30 p.m.</td>
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<td><strong>SPECIAL PROGRAMS</strong></td>
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<tr>
<td>R. D. Thomas Jr. Lecture</td>
<td>10:00 a.m. – 10:30 a.m.</td>
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<tr>
<td><strong>NEW</strong> Free Certified Welding Sales Representative – Sample Session (W40)</td>
<td>9:00 a.m. – 12:00 noon</td>
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<tr>
<td><strong>NEW</strong> Free Certified Welding Supervisor – Sample Session (W41)</td>
<td>1:00 p.m. – 4:00 p.m.</td>
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### Thursday November 4

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<tr>
<th>CONFERENCES</th>
<th>Time</th>
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<tr>
<td>The Welding and Cutting of Pipe and Tubing (W24)</td>
<td>9:00 a.m. – 4:00 p.m.</td>
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<tr>
<td><strong>SEMINARS</strong></td>
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<tr>
<td>Certified Welding Sales Representative Seminar (W27)</td>
<td>9:00 a.m. – 5:00 p.m.</td>
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<tr>
<td><strong>RWMA SCHOOL</strong></td>
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<tr>
<td>RWMA Resistance Welding School Day 2 (W31)</td>
<td>8:00 a.m. – 3:45 p.m.</td>
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<tr>
<td><strong>PROFESSIONAL PROGRAM</strong></td>
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<tr>
<td>Session 8: Arc Welding Applications (W34)</td>
<td>8:00 a.m. – 12:00 p.m.</td>
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<tr>
<td>Session 9: Applied Technology (W34)</td>
<td>8:00 a.m. – 12:00 p.m.</td>
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<tr>
<td>Session 10: Process Modeling (W34)</td>
<td>2:00 p.m. – 5:30 p.m.</td>
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<tr>
<td>Session 11: Sensing and Control (W34)</td>
<td>2:00 p.m. – 5:30 p.m.</td>
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<tr>
<td><strong>SPECIAL PROGRAMS</strong></td>
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<tr>
<td><strong>NEW</strong> Free Certified Welding Inspector – Sample Session (W40)</td>
<td>9:00 a.m. – 12:00 noon</td>
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<tr>
<td><strong>NEW</strong> Free Certified Radiographic Interpreter – Sample Session (W41)</td>
<td>1:00 p.m. – 4:00 p.m.</td>
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Welding Show 2010
Professional Program

Pick and choose between concurrent sessions for the latest in welding research and commercial developments. Pay by the day or attend the entire three-day program, with special discounts for students and members of AWS, FMA, SME, CCAI, PMA, or NAM.

3-day Professional Program Member: $225, Nonmember: $360 (Code W35)
3-day Student Professional Program Member: $75, Nonmember: $90 (Code W36)
1-day Professional Program Member: $150, Nonmember: $285

Tuesday, November 2
8:00 a.m. – 5:30 p.m.

SESSION 1: Room C210
INTERNATIONAL TRENDS IN WELDING RESEARCH

A. 8:00 a.m. “Trends in Welding Research & Development in South Africa”
Madaleine du Toit, University of Pretoria

B. 8:45 a.m. “Trends in Welding Research & Development in Australia”
John Norrish, University of Wollongong

SESSION 2: Room C210
FRICITION STIR WELDING

A. 2:00 p.m. “Friction Stir Welding of Small Radius, Thin Walled Hemispheres and Pipes”

B. 2:30 p.m. “3D Transient Modeling of Heat and Material Flow in AZ31B Magnesium”
Zhenzhen Yu and Hahn Choo, University of Tennessee; Wei Zhang and Zhili Feng, Oak Ridge National Laboratory

C. 3:00 p.m. “Tool Wear in Friction Stir Welding of Composite Materials”
Tracie J. Prater, Alvin M. Strauss, George E. Cook, Chase D. Cox, and Brian T. Gibson, Vanderbilt University

D. 3:30 p.m. “Effects of Rotation and Traverse Speeds on Lap Joints of Friction Stir Welded Mg AZ31B H24”
Chase D. Cox, David Lammlein, George E. Cook, and Alvin M. Strauss, Vanderbilt University

E. 4:00 p.m. “A Novel Approach to Transient Liquid Phase Bonding Using Friction Stir Processing”
Scott Gordon, Tariq AlGhamdi, Collin Trickle, and Stephen Liu, Colorado School of Mines

F. 4:00 p.m. “Evaluation of FSW Process and Properties for Aerospace”
Dwight Burford, Gimenez Britos, E. Boldsaikhan, and J. Brown, Wichita State University

SESSION 3: Room C211
WELDABILITY ISSUES

A. 2:00 p.m. “Weld Metal HAC in HSLA Structural Steels”
Eduardo Asta, ESAB-CORARCO, and Monica Zalazar, Universidad Nacional del Comahue

B. 2:30 p.m. “Analysis of Hot Cracking in Alloy 718/Alloy B2 Laser Welds”
Gerald A. Knorovsky and Danny O. MacCallum, Sandia National Laboratories

C. 3:00 p.m. “Weldability of HSLA-115 Steel for Critical Naval Ship Structures”
Paul J. Konkol and Kevin M. Stefanick, Concurrent Technologies Corporation and Gregory S. Pike, Northrop Grumman Shipbuilding

D. 3:30 p.m. “Lessons from 25 years of Welding of Irradiated Materials”
Suiqiong Li, Zhongwu Zhang, and Bryan A. Chin, Auburn University, and M.L. Grossbeck, Oak Ridge National Laboratory

E. 4:00 p.m. “Microstructure Heterogeneity in Steel Welds”
Hye Yun Song and S.S. Babu, The Ohio State University; O. Barabash, ORNL; K. Graff, EWI, and G.M. Evans, Consultant

F. 4:30 p.m. “Preventing Dissimilar Metal Weld Failures”
Gregory J. Brentrup, John DuPont, Brett Leisler, Brett Snowden, and Joachim Grenestedt, Lehigh University

G. 5:00 p.m. “Laser Cross-Wire Welding of Pt-10%Ir and 316-LVM Stainless Steel”
Yongde Huang and Norman Zhou, University of Waterloo, Guisheng Zou, Tsinghua University, and Jicai Feng, Harbin Institute of Technology

Wednesday, November 3
8:00 a.m. – 5:30 p.m.

SESSION 4: Room C210
LASER & HYBRID PROCESSES

A. 8:00 a.m. “Characterization of Transmissive and Reflective Optics in High Power Lasers”
Shawn Kelly, Jared Blecher, Todd Palmer, and Rich Martukanitz, Applied Research Laboratory, Penn State University
B. 8:30 a.m.  “Laser Enhanced GMAW: Process and Fundamentals”  
Yi Huang and YuMing Zhang, University of Kentucky

C. 9:00 a.m.  “Out-of-Position Wire-Based Laser Cladding for Field Repair”  

D. 9:30 a.m.  “Role of Heat Source Separation Distance and Arc Current on Hybrid Welding”  
Bandon Ribic and Tarasankar DebRoy, Penn State University

E. 10:00 a.m.  “Microstructure Evolution in Flash Processed Steel Welds”  
Sri Venkata Tapasvi Lolla and Sudarsanam S. Babu, The Ohio State University, Gary Cola, SPF Works, Shawn M. Kelly and Todd Palmer, Pennsylvania State University

F. 10:30 a.m.  “Microstructure and Mechanical Properties of Hybrid Laser Arc Welds on High Strength Steels”  
Caleb Roepke and Stephen Liu, Colorado School of Mines, Shawn Kelly and Rich Martukanitz, PSU ARL

G. 11:00 a.m.  “Repair Crystallography of Pulsed Laser Powder Deposition GTD-111”  
Andrew Deceuster, Chunbo Zhang, and Leijun Li, Utah State University

SESSION 5:  
WELDING METALLURGY  

A. 8:00 a.m.  “Welding Procedure Effect on SMSS All Weld-Metal Properties”  
Estela S. Surian, SEYTEMA, FR San Nicolas, National Technological University, National University of Lomas de Zamora, Sebastian Zappa and Herman G. Svoboda, National University of Lomas de Zamora, Mabel Ramini de Risson, DEYTEMA, FR San Nicolas, National Technological University, Luis Alberto de Vedia, National University of San Martin-CNEA

B. 8:30 a.m.  “Effects of Surface Chemistry on Asymmetry in Stainless Steel Welds”  
Charles V. Robino, Donald F. Susan, and Steven M. DeBlassie, Sandia National Laboratories

C. 9:00 a.m.  “The Effect of Minor Potassium Additions on Weld Bead Morphology for GTA Welding of Aluminum”  
Erik M. Lord, Stephen Liu, and David Olson, Colorado School of Mines

D. 9:30 a.m.  “Microstructural and Mechanical Property in a Copper-Precipitation Strengthened Steel”  

E. 10:00 a.m.  “Part I: Metallurgical Characterization”  
B. Alexandrov, J. Sowards, A. Hope, and J. Lippold, The Ohio State University

F. 10:30 a.m.  “Part II: Carbon Behavior during PWHT”  
J. Sowards, B. Alexandrov, A. Hope, and J. Lippold, The Ohio State University

G. 11:00 a.m.  “High Temperature Failure of Dissimilar Metal Welds — A Review”  
John N. DuPont, Lehigh University

SESSION 6:  
MECHANICAL AND CORROSION PROPERTIES  

A. 2:00 p.m.  “SENT Testing for Pipeline Weld Toughness Measurement”  
Douglas P. Fairchild, Huang Tang, Fredrick F. Noeker II, and Joshua W. Sleighb, ExxonMobil Upstream Research Company

B. 2:30 p.m.  “Variation of Impact Toughness at Fusion Line of EGW Welded Joint”  
Hee Jin Kim, Hoi Soo Ryoo, and Jun Seok Seo, Korea Institute of Industrial Technology

C. 3:00 p.m.  “Recent Advances in Welding Consumables for High Strain Pipeline Girth Welds”  
Joshua W. Sleighb, Nathan Nissely, Martin Hurkle, and Fredrick F. Noecker II, ExxonMobil Development Company, and Donald To, University of Illinois

D. 3:30 p.m.  “Corrosion Behavior of Nickel Based Alloy Coatings Co-Extruded and Weld Overlay Coatings”  
Andrew W. Stockdale and John N. DuPont, Lehigh University

E. 4:00 p.m.  “Fracture Toughness of Welded NUCu-140 Testing of Thermal Simulations”  
Brett Leister, Jeffrey Farren, and John N. DuPont, Lehigh University

F. 4:30 p.m.  “Shock Twin Formation during Explosive Cleaning of T22 Grade Steel Tubes”  
Collin Trickle, Scott Gordon, Juan Carlos Madeni, and Stephen Liu, Colorado School of Mines

G. 5:00 p.m.  “Formability Improvement of Welded Exhaust Pipes”  
Hironki Mori and Kazutoshi Nishimoto, Osaka University, and Y. Zhou, University of Waterloo
SESSION 7: Room C211
FSW AND SOLID-STATE PROCESSES
A. 2:00 p.m. “Thermoelectric Element Welding for High Temperature Applications”
Yoni Adonyi, Robert Warke, Mark Taylor, and Nathan Sumrall, LeTourneau University

B. 2:30 p.m. “AI-to-Mg Friction Stir Butt Welding”
Vahid Firouzdor and Sindo Kou, University of Wisconsin

C. 3:00 p.m. “Friction Stir Weld Tool Form and Welding Parameters Influence on Weld Structure and Properties”
Judy Schneider, Mississippi State University

D. 3:30 p.m. “AI-to-Friction Stir Lap Welding”
Vahid Firouzdor and Sindo Kou, University of Wisconsin

E. 4:00 p.m. “Diffusion Bonding CuCrZr to 316L Stainless Steel for ITER Applications”
Joseph D. Puskar, Sandia National Laboratories, and Steven H. Goods, Sandia National Laboratories

F. 4:30 p.m. “Evaluation of Bonding in VHP UAM”
Sriraman M. Ramanujam, Hiromichi Fujii, and Sudarsanam S. Babu, The Ohio State University

G. 5:00 p.m. “Effect of Pressurized Post-Weld Treatment on Bond Strength of Ultrasonically Consolidated Aluminum Parts”
Chunbo (Sam) Zhang, Link Gao, Andrew Deceuster, and Leijun Li, Utah State University

Thursday, November 4
8:00 a.m. – 5:30 p.m.
SESSION 8: Room C210
ARC WELDING APPLICATIONS
A. 8:00 a.m. “Welding Wire Surface Preparation”
Kai Boockmann, Michaela Boockmann, and Gerhard Boochmann, Boockmann GmbH, and Richard Slover, The Slover Group

B. 8:30 a.m. “Real-Time Estimation of Three-Dimensional Weld Pool Surface in GTAW”
Weijie Zhang and YuMing Zhang, University of Kentucky

C. 9:00 a.m. “Droplet Heat Content in Nickel Sheathed WC-Cored GMAW Wires”
Kevin Scott, Patricio Mendez, and Adrian Gerlich, University of Alberta

D. 9:30 a.m. “The Development of Automatic Welding System”
Jae-Gwon Kim, Ji-Hyung Lee, Jong-Jun Kim, Beom-Chan Bae, and In-Wan Park

E. 10:00 a.m. “Dynamic Active Contour (Snake) Methodology for Computer Visual Tracking of High-Speed Videos of Free-Flight Metal Transfer”
Nilanjan Ray, Alisa Ahmetovic, Kevin Scott, Adrian Gerlich, and Patricio Mendez, University of Alberta

F. 10:30 a.m. “A Weld Seam Tracking Algorithm for the Corrugations”
Jeom-Goo Kim, Yong-Baek Kim, In-Wan Park, and Jong-Jun Kim, Hyundai Heavy Industries

G. 11:00 a.m. “Image Processing of Weld Pool Surface”
Xiang Zhang, Zhenzhou Wang, and YuMing Zhang, University of Kentucky

SESSION 9: Room C211
APPLIED TECHNOLOGY
A. 8:00 a.m. “New Shear Connection Methods For Challenging Nuclear and General Composite Construction”
Chris Hsu and Clark Champney, Nelson Stud Welding, Inc., and Feng Gao, Joint Project Management Organization AP1000, Shanghai

B. 8:30 a.m. “Weldability of Advanced High Strength Steel Drawn Arc Stud Welding”
Chris Hsu and Jim Mumaw, Nelson Stud Welding, Inc.

C. 9:00 a.m. “A Comparison of ANSI/AWS A2.4 and ISO 2553 Welding Symbols”
John P. Christein and Pamela R. Coates, Northrop Grumman Shipbuilding – Newport News

D. 9:30 a.m. “Laser Welding of Conical Steel Poles — Reduced Production Costs and New Design Potential”
Mathias Binder, Soutec Ltd.

E. 10:00 a.m. “Combating Corrosion by Weld Overlay — An Unique Experience”
J.V.D. Murty, Qatargas Operating Company Limited

F. 10:30 a.m. “Thermal Sprayed Active Metallic Coatings against Environmental Corrosion”
Fred van Rodijnen, Sulzer Metco Europe GmbH

G. 11:00 a.m. “Al-Mg Filler Metal Alloy Melting Behavior and Process-Integrated Quality Assurance in Pulse GMA Welding”
S. Rajasekaran, El-Shaddai Welding and Cutting Consultants

SESSION 10: Room C210
PROCESS MODELING
A. 2:00 p.m. “Weld Penetration Depth Modeling in High Productivity GTAW”
Üstün Duman, Colorado School of Mines, and Patricio F. Mendez, University of Alberta
B. 2:30 p.m.  “SOAR: Applications for Weld Analysis and Optimization”
Phillip Fuerschbach and G. Richard Eisler, Sandia National Laboratories

C. 3:00 p.m.  “Modeling and Characterizations of a Multi-Pass GTA Weld”
John O. Milewski, Ching-Fong Chen, Donald Brown and Thomas Sinerios, Los Alamos Lab and James Dereskiewicz, NNSA Kansas City Plant

D. 3:30 p.m.  “Spiking in Electron Beam Welding”
PS. Wei, K.C. Chuang, and J.S. Ku, National Sun Yat-Sen University, and T. DebRoy, The Pennsylvania State University

E. 4:00 p.m.  “Modeling of Electron Beam Micro-Welding Process under High Peclet Number”
Satya S. Gajapathi, Sushanta K. Mitra and Patricio F. Mendez, University of Alberta

F. 4:30 p.m.  “Dual Torch P-GMA Welding of Dissimilar Metals”
Marissa P. LaCoursier, D.K. Aidun, and Justine Schrader, Clarkson University

G. 5:00 p.m.  “Variable Materials Properties on Electrode Extension”
Gregory Lehnhoff, Colorado School of Mines, and Patricio F. Mendez, University of Alberta

H. 5:30 p.m.  “A New Test Method for LME Cracking Sensitivity Evaluation of AHSS during Gas Metal Arc Welding and Brazing”
Chonghua (Cindy) Jiang and J. Hunt, AET Integration Inc.

AWS POSTER SESSION

The AWS Poster Session is an integral part of the Professional Program. Graphic displays of technical achievements are presented for close, first-hand examination in the Poster Session. Posters present welding results and related material, which are best communicated visually, as well as research results that call for close study of photomicrographs, tables, systems architecture, or other illustrative materials. Posters are presented in five categories: Students in a High School Welding Program, Students in a Two-Year College or Certificate Program, Undergraduate Students, Graduate Students, and Professionals. Be sure to stop by and observe this year’s entries.

FREE • during show hours • located on the show floor in C Hall and outside Professional Program session rooms.

CATEGORY A: 2-YEAR DEGREE STUDENT LEVEL
The Effect of Inert Gas Shielding on Titanium Welds
Michael Lannom and Matt Gilliland, Orange Coast College, Costa Mesa, Calif.

CATEGORY B: 4-YEAR DEGREE STUDENT LEVEL
A Design Methodology for Welded Structures
Pamela Coates, Old Dominion University/Northrop Grumman Shipbuilding, Newport News, Va.

Phase Transformation Analysis in Ni-Base Gas Tungsten Arc Welds
Adam Hope, Boian Alexander, and John C. Lippold, The Ohio State University, Columbus, Ohio.

New Hybrid FSW Process Development
Riley Wyers, Justin Boldt, and Barry Brown, LeTourneau University, Longview, Tex.

Phase Transformations in Alloy 282
Margaret Kittila, The Ohio State University, Columbus, Ohio.

Phase Transformations in the ICHAZ of P91 Steel Welds
Daniel Saltzmann, The Ohio State University, Columbus, Ohio.
The symposium is free to registrants of the AWS Professional Program. It consists of expert panel discussions on current and emerging technologies and developments in brazing and soldering. The 37th Annual Brazing and Soldering Symposium is a must-attend event if you work in the field of brazing and soldering or have an interest in research and applications, as well as networking with industry experts.

9:00 a.m. - 2:30 p.m. Room C212

High-Temperature Brazing Developments Since the “Bow-Tie Generation”
Anatol Rabinkin, Metglas, Inc./Hitachi Metals, Morris Plains, N.J.

9:30 a.m. Evolution of High-Temperature Nickel Brazing: New Filler Metals for the 21st Century
Alun Battenbough, Wall Colmonoy, Ltd., Pontardawe, Swansea, Great Britain

10:00 a.m. Iron-Based Brazing Filler Metals for High-Temperature Brazing
Ulrika Persson, Hoganas, AB, Sweden

10:30 a.m. Flow Dynamics of Thin-Foil, Nickel-Based Filler Metals on Stainless Steel and Interfacial Characterization
Juan Carlos Madeni, Colorado School of Mines, Golden, Colo.

11:00 a.m. Melting Temperatures of BAg-8 and BAu-4 at High Pressure
Toshi Qyama, WESGO Metals, Hayward, Calif.

11:30 a.m. Gold-Based Active Filler Metal for Ceramic Brazing
Edgar Vanegas, WESGO Metals, Hayward, Calif.

12:00 p.m. Lunch

2:00 p.m. Brazing and Soldering of Silicon Carbide to Metal Substrates
Nick Ludford, TWI Ltd., Cambridge, Cambridgeshire, UK.

2:30 p.m. Brazing Niobium to Alumina Ceramic

3:00 p.m. Low-Temperature Brazing Titanium Using New Al-Mg, Al-Ag-Cu and Al-Cu-Si Braze Foils
Alex Shapiro, Titanium Brazing Inc., Columbus, Ohio.

3:30 p.m. Develop Novel Compact Heat Exchanger Using Aluminum Brazing Technology
Hui Zhao, Creative Thermal Solutions, Urbana, Ill.

4:00 p.m. Solderability Testing of Pd-Based Electrical Contact Alloys
Donald Susan, Sandia National Laboratories, Albuquerque, N.Mex.

4:30 PM Solderability Testing Of Electroless Nickel-Electroless Palladium-Immersion Gold

THE 37TH INTERNATIONAL BRAZING AND SOLDERING SYMPOSIUM

Wednesday, November 3

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CONFERENCES

Tuesday, November 2

9:00 a.m. – 4:10 p.m.

WHAT’S NEW IN WELD CONSUMABLES?
Member: $345, Nonmember: $480 • Registration Code: W21

A low-hydrogen weld deposit is obviously the result of proper use of low-hydrogen filler metals. Much has been done and is still being done in the development of low-hydrogen manual arc electrodes. It has become imperative that the relatively new grade 91 steel be welded by low-hydrogen filler metals, and much is under way in the development of new chemistries for these electrodes. Many of the gas metal arc welding technologies also produce low-hydrogen weld deposits. So does submerged arc welding. When not in use, industry still has to learn to store these electrodes in rod ovens. That practice is not always observed in fabricating plants throughout America. The main thrust here is in ASME Code work, shipbuilding, offhighway equipment, the chemical industry, and power plants. The introduction of duplex stainless steels and the higher strength versions of same require new filler metals, that are the answers to the needs of many plants that deal with corrosion-resistant materials. In many instances, the roles of heat treatment and shielding gases will also be discussed.
8:50 a.m. – 9:00 a.m.
Welcome Remarks
Robert Irving, Chairman

9:00 a.m. – 9:35 a.m.
NEW CONSUMABLE DEVELOPMENTS FOR THE MANUFACTURE OF WIND TOWERS
Deanna Murlin, The Lincoln Electric Co.

As the number of wind tower manufacturers in the U.S. continues to rise, fabricators are looking for ways to increase productivity to remain competitive. New welding procedures are being adopted to reduce the number of passes and time required to fill the welded joint. Welding consumables play a crucial role in maintaining the same mechanical properties with these new methods. New consumables developed specifically for the wind tower industry provide impact toughness of 60–100 ft/lb at -40°F when welded with these new methods.

9:35 a.m. – 10:10 a.m.
FILLER METALS FOR THE NEW CREEP STRENGTH ENHANCED FERRITIC STEELS
Russel Fuchs, bohler welding Group USA, Inc.

By increasing the operating temperatures and pressures of fossil fuel power generation plants, the efficiency of the plant can be improved. In order to realize the increased operating parameters, new steels had to be developed with improved elevated temperature properties. These are the so-called creep strength enhanced ferritic (CSEF) steels. The common names for these steels include P91, P92, T/P23, and T/P24. Welding, as an integral part of the fabrication and construction process, must also be considered. Matching filler metals to the CSEF steels have been developed that exhibit sufficient properties to ensure safe and reliable operation of these plants under the more demanding operating conditions. The design considerations necessary in the development of these consumables, as well as the achieved properties, will be discussed. Various applications for these materials will also be highlighted.

10:25 a.m. – 11:00 a.m.
WHAT’S CHANGING IN THE FCAW WORLD?
Jerry Mathison, ESAB

This brief presentation will look at a few of the changes occurring with FCAW electrodes, namely, more welder friendly, how’d they do that? Why’d they do that? Lower diffusible hydrogen levels, and the overall evolution of the FCAW process.

11:00 a.m. – 11:35 a.m.
EPRI P87, A NEW FILLER MATERIAL FOR DISSIMILAR METAL WELDS
Roger Swain, Euroweld, Ltd.

Dissimilar metal welds (DMW) between ferritic and austenitic materials at elevated temperatures have concerned boiler manufacturers/operators because of the proven potential for premature failure. The industry has desired an improved filler metal that would minimize or eliminate DMW failures while retaining suitable creep strength for joining higher-strength materials. After years of research, EPRI concluded the development and initial commercialization of a nickel-based, shielded metal arc welding electrode, EPRI P87. This work describes both the mechanical behavior and weldability of EPRI P87 for application in gas tungsten arc, gas metal arc, and shielded metal arc welding processes. Mechanical evaluation of EPRI P87 included creep testing, elevated temperature tensile testing, and FQR evaluations of several tube combinations. Weldability evaluation of EPRI P87 included varestraint testing, microstructure evaluation, circular patch, and edge buildup plates. This paper supports the acceptability of EPRI P87 for its intended use in high-temperature power generation applications. This alloy should also offer solutions for other industries, depending on operating conditions.

11:35 a.m. – 1:35 p.m. Lunch on your own.

1:35 p.m. – 2:10 p.m.
METAL CORE — A PROCESS WITH POTENTIAL FOR PRODUCTIVITY IMPROVEMENT
Doug Krebs, Hobart Brothers Co., an ITW Co.

Organizations are increasingly recognizing the advantages of the metal core process. These advantages cannot be recognized without a thorough examination of the fabrication process. A comprehensive look at the pre and postweld operations must be undertaken. An examination including only the welding cell will not reveal the full benefit of metal core. This discussion will examine several critical fabrication issues that can be mitigated, or eliminated, using the metal core process. In addition, it will address potential productivity enhancements linked to adoption of the process. Finally, an examination of the latest tools to capture productivity information inside the welding cell will be discussed.

2:10 p.m. – 2:45 p.m.
WELDING THE LEAN DUPLEX LDX 2101 STAINLESS STEEL
Joe Zowadny, Avesta Welding LLC

Presentation will focus on the use of filler materials for welding LDX 2101, including GMAW, GTAW, SAW, and FCAW. Highlights include “How to Weld LDX 2101,” welding procedure dos and don’ts, comparison to using other filler materials, and status of AWS classification for LDX 2101.

2:45 p.m. – 3:00 p.m. Afternoon break

3:00 p.m. – 3:35 p.m.
HARDFACING APPLICATIONS FOR WEAR AND CORROSION RESISTANCE
Ravi Menon, Stoody, A Thermadyne Co.

Hardfacing technology has progressed significantly in the past twenty years from the days where the primary applications were in the mining and construction areas. With the rapid advancements in cored wire manufacturing technology, composite alloy systems are being created that can combat wear and corrosion situations in a multitude of applications. Some of these include slurry transportation in the oil sands, steel mill rolling components, and severe erosive-corrosive conditions in oil and refinery process equipment. The presentation will cover ferrous and non-ferrous consumables developed for many of these applications, as well as some novel consumable concepts such as “crack-free” wires for severe wear/impact applications.

3:35 p.m. – 4:10 p.m.
NEW APPLICATIONS FOR SHIELDING GASES
Kevin Lytle, Praxair, Inc.

Shielding gases are viewed by some as a necessary evil to accomplish the job at hand. In doing so, some fabricators miss the opportunity to improve weld quality and mechanical properties while achieving higher levels of productivity. Carbon steel welding operations at a single manufacturing site can be both simplified
and optimized by identifying the best shielding gas composition to be used with the various filler materials — solid, metal-cored and flux-cored wires — that may be used at that site. It is also possible, through the use of minor additions of gases such as hydrogen and nitrogen to an argon-based mixture, to produce enhanced weld quality and improve welding productivity when joining specialty stainless or aluminum alloys. An understanding of how recent developments in shielding gases can impact welding operations will increase a fabricator’s ability to reduce welding costs.

**Tuesday, November 2**

9:00 a.m. – 4:30 p.m.  Room C205

**NATIONAL WELDING EDUCATION CONFERENCE**

*Member: $149, Nonmember: $149 • Registration Code: W20*

Presented by the National Center for Welding Education and Training (Weld-Ed), this conference is designed to bring together educators for professional development and networking opportunities. Weld-Ed's focus is on the preparation of welders, welding technicians, and welding engineers to meet the needs of industry. This conference will include presentations on topics such as Weld-Ed accomplishments in the last year, the partnership between Weld-Ed and AWS, welding industry workforce needs, recruitment tips and tools for educators, competency models, externship programs for educators, tips on partnering with other secondary and postsecondary schools, welding education trends, curriculum, materials science education and applications, distance learning updates, new technology applications, how the economic stimulus package will affect educators, and presentations from welding educators who will share their best practices.

9:00 a.m. – 9:15 a.m.

**WELD-ED OVERVIEW**

Discussion is centered on the National Center for Welding Education and Training (Weld-Ed) and its contributions to the field of welding.

9:15 a.m. – 10:30 a.m.

**INSTRUCTOR PROFESSIONAL DEVELOPMENT**

This session gives information about the professional development opportunities offered by Weld-Ed. This includes both on-line and face-to-face training programs. Weld-Ed also offers customized training catering to the needs of the educators. Assistance with curriculum design, teaching modules, planning guides, etc., is available.

10:30 a.m. – 10:45 a.m. Break

10:45 a.m. – 11:30 a.m. **Speaker from AWS**

11:30 a.m. – 12:15 p.m.

**CURRICULUM COMMITTEE PROGRESS**

The Weld-Ed curriculum committee has been working to create a core curriculum for welding technician education. It includes a collection of student learning outcomes for welding technicians from Weld-Ed’s ten Regional Partner colleges, a crosswalk of student learning outcomes across Partner colleges, and establishing the current core being taught by the majority of colleges.

12:15 p.m. – 1:15 p.m.

Lunch and Speaker from Industry — HYPERHERM

1:15 p.m. – 2:45 p.m.

**ADVANCED MANUFACTURING AND PROCESS SHOWCASE**

Industry folks share what products and services they have that can benefit the welding educator and assist in the delivery of instruction.

Session #1 Lincoln Electric  
Session #2 Miller Electric  
Session #3 ESAB

2:45 p.m. – 3:00 p.m. Break

3:00 p.m. – 3:30 p.m.

**EVALUATIONS AND ASSESSMENT**

Learn from your fellow educators and share tips and techniques for assessing welds.

3:30 p.m. – 4:00 p.m.

**ABET-BASED ASSESSMENT MODEL**

This is an electronic documentation tool used to provide the information on course learning outcomes, infused general education outcome, learning assignments, assessment methods, expected results, and actual students’ performance that helps the instructor to implement continuous quality improvement in the teaching and learning processes.

4:00 p.m. – 4:15 p.m.

**GROWTH OF NETWORK**

Join Weld-Ed in its quest to build a solid foundation of highly trained technicians to fulfill the demands of industry.

4:15 p.m. – 4:30 p.m.

**WRAP UP AND EVALUATIONS**

1:00 p.m.– 5:00 p.m.  Room C213

**THERMAL SPRAY BASICS**

*FREE • Registration Code: W38*

Presented by The International Thermal Spray Association

This basic introduction to thermal spray benefits will cover four major areas: processes, equipment, applications, and industry usage.

• Processes covered will include molten metal flame spraying, powder flame spraying, wire flame spraying, ceramic rod flame spraying, detonation flame spraying, high velocity oxyfuel spraying (HVOF), cold spraying, plasma spraying, electric arc spraying, and RF plasma spraying.

• Equipment will be on display. Several spray guns will be available for attendees to handle and discuss throughout the class. Other larger items such as complex systems and spray booths will be illustrated and discussed.

• Application examples will be presented for a variety of requirements from several different industries.

• Industry usage charts will be reviewed listing several processes and coating applications used by various industries.
9:00 a.m. – 4:40 p.m.  Room C203

WELD REPAIR AND THE STRENGTHENING OF WELDED STRUCTURES

Chairman: Robert Irving, Co-Chair: Ralph Nugent

From the standpoint of knowledge, one of the most important aspects in welding is the repair of faulty welds or the prevention of failures from occurring in the first place. This will be one of the most important conferences at FABTECH. Duane K. Miller of Lincoln Electric will be the keynote and he will discuss the new AWS D1.7 code. Other speakers will include Jim Worman of the National Board of Boiler and Pressure Vessel Inspectors, who will describe what is needed to obtain an “R” certificate; David J. Barton of PCI/WEC will comment on weld repairs in the nuclear industry; and Brent M. Williams of Miller Electric will discuss the use of GTAW inverter technology for aircraft engine repair work.

9:00 a.m. – 9:05 a.m.
Opening Remarks
Robert Irving, Chairman

9:05 a.m. – 9:40 a.m.

A NEW GUIDE FOR OLD STRUCTURES
Duane Miller, The Lincoln Electric Co.

AWS D1.1, Structural Welding Code — Steel, is a world-recognized code governing the design, fabrication, erection, and inspection of welded steel structures. Typically, the structures to which D1.1 is applied are new. When existing structures are repaired or strengthened, Clause 8 of D1.1 applies. However, this clause consists of a mere two pages, and provides only very general directions. The engineer is obligated by clause 8.1 to “…prepare a comprehensive plan for the work. Such plans shall include, but are not limited to, design, workmanship, inspection, and documentation.” AWS D1.1, however, provides only minimal assistance to the engineer who is responsible for such plans. With the introduction of AWS D1.7, Guide for Repairing and Strengthening Existing Structures, both the engineer and the contractor responsible for such projects have specific guidance on weld repairs, weld strengthening, weldability of obsolete steels as well as alternate acceptance criteria. NDE methods used for evaluating existing structures are discussed. Detailed guidance is provided on flame straightening. This presentation will overview the new D1.7 Guide and show how it can be applied to projects involving repair and strengthening of old structures.

9:40 a.m. – 10:15 a.m.
WELD REPAIRS IN THE NUCLEAR INDUSTRY
David Barton, WEC Welding and Machining LLC

PCI, a subsidiary of Westinghouse Electric Company Welding & Machining (WEC W&M) group, is an OEM of machining and specialized welding equipment used for special repair applications primarily in the nuclear industry. PCI also provides field welding services focused on being able to respond on the shortest possible notice to emergent welding problems. This presentation will focus on some of the welding challenges associated with nickel filler materials and the installation of structural weld overlays (SWOL). A SWOL is a repair and mitigation technique for primary water stress corrosion cracking (PWSCC) of susceptible dissimilar metal Alloy 82/182 welds. The full SWOL deposited on the outside diameter of the pipe, component, or associated weld is designed such that it is capable of supporting the system design loads, without consideration for the piping, component, or associated weld below the overlay acting as if the pipe were not there. The presentation will also include overlays deposited on reactor vessel head penetrations (RVHP). The embedded flaw repair process provides a nonstructural barrier to the J-weld area of the RVHP to stop the corrosion process also associated with PWSCC. Alloy 52M is applied over the Alloy 82/182 weld using remotely operated machine GTAW specifically developed for the application. The presentation will also include a summary of some of the largest repairs performed in the nuclear industry where the entire steam generator is removed and replaced in record times. During a steam generator replacement project the heavy wall reactor coolant pipes are severed, the several hundred ton generator is removed, and a new steam generator is set in place and welded. Welding of the three- to four-inch-thick piping utilizes the narrow-groove machine GTAW process with welding operators brought in from all over the country. Other similar types of repairs and the use of the narrow groove welding process will also be discussed during this presentation.

10:30 a.m. – 11:05 a.m.

THE ACCREDITATION PROCESS FOR OBTAINING AN “R” CERTIFICATE

Jim Worman, The National Board of Boiler and Pressure Vessel Inspectors

This presentation will outline the accreditation process for those organizations applying for an “R” Certificate of Authorization from the National Board of Boiler and Pressure Vessel Inspectors. Included will be how repair organizations are accredited, the prerequisites for issuing a Certificate of Authorization, procedures for obtaining or renewing a Certificate of Authorization, the Quality System that each certificate holder must have and maintain, and the requirements for a written quality system manual.

11:05 a.m. – 11:40 a.m.

REPAIR OF TRANSMISSION PIPELINES USING WELDED FULL-ENCIRCLEMENT STEEL SLEEVES
William Bruce, DNV Columbus, Inc.

External corrosion is a major concern for operators of high-pressure transmission pipelines. Corrosion is second only to mechanical damage as the primary cause of natural gas pipeline failures in the U.S. To prevent an area of corrosion damage from causing a pipeline to rupture, the area containing the damage must be reinforced to prevent the pipeline from bulging. While the use of nonmetallic composite materials to repair corrosion damage has increased in recent years, the most predominant method of reinforcing corrosion damage in cross-country pipelines is to install a welded full-encirclement steel sleeve. The basic principles of pipeline repair using steel sleeves, along with some advantages over the use of composite materials, will be presented.

11:40 a.m. – 1:40 p.m.  Lunch on your own.

1:40 p.m. – 2:15 p.m.

UTILIZING COMPUTER-ASSISTED GTAW
Ralph Nugent, Dresser-Rand

Rotating equipment utilized by chemical plants and refineries are critical components with demanding material requirements. Repairs to these materials require precision welding techniques with closely controlled weld parameters to produce a repair that is fit for the service and operating conditions of the component. The final properties of a repair must meet the original equipment design criteria. Computer-assisted gas tungsten arc welding (CA-GTAW) provides the control of the weld deposition sequence and minimizes the potential for production of weld flaws. The process produces repeatable weld deposit properties that are required for repair of rotating equipment. The discussion will cover general information on the CA-GTAW process and controls with examples of applications on actual repair situations.
Prior to transiting the Panama Canal, grounding caused considerable damage to a fully loaded bulk freighter, requiring immediate repair to the ruptures and tears to the bow section of the vessel. A unique repair procedure was developed and subsequently accepted by all certifying bodies and performed without delay. This presentation describes the underwater weld repair performed on the vessel while anchored in a lightly sheltered outer anchorage on the Atlantic side of the Panama Canal.

2:55 p.m. – 3:30 p.m.
PREDICTING AND CONTROLLING DISTORTION AND RESIDUAL STRESS FOR CRACK REPAIRS IN TRUNIONS USED ON MINING EQUIPMENT

Alma Olsen, ARO Testing

This presentation will go into detail with real world examples on how to identify cracking in the trunnions using several methods, including nondestructive examination is used to map out the extent and locations of the cracks, and how the welding procedure is developed for the specific case to predict and control distortion and residual stresses during the repair to provide the best repair without reducing the life of the trunion. Measures will also be discussed on what preventive maintenance is recommended to prevent catastrophic failure.

3:30 p.m. – 4:05 p.m.
CONTROLLED DEPOSITION TECHNIQUES FOR WELD REPAIR

Jose Ramirez, Edison Welding Institute

During weld repair of pressure vessels and other welded structures, application of the normally required PWHT may sometimes be very difficult or impossible to carry out. Use of standard repair procedures may result in hard and brittle welded joints with high susceptibility to cracking during welding or during service. A number of controlled deposition techniques are available for weld repair that can achieve different degrees of microstructural control and softening of the HAZ. One of the ultimate goals in the application of such techniques is to eliminate the PWHT without affecting structural integrity. However, the selection of the appropriate controlled deposition technique depends on the reason for the need for PWHT.

4:05 p.m. – 4:40 p.m.
INVERTER TECHNOLOGY IMPROVES AIRCRAFT ENGINE AND COMPONENT REPAIR

Brent Williams, Miller Electric Manufacturing Co., an ITW Co.

Advances in gas tungsten arc welding (GTAW) power source technology provide new dimensions of arc control that offer significant benefit for the welding repair of aircraft engines and components. Weld quality and integrity are extremely critical and commonly repaired materials in the industry are anything but ordinary — often presenting welding challenges relating to alloy content and/or service conditions. The precision and control of the GTAW process are often utilized to produce the required high-quality welds. Inverter power source technology provides advanced controls that enhance arc control for improved weldability. These advanced controls and capabilities will be discussed as they pertain to specific alloy and component examples, providing an overview of benefits in key applications.
the high-energy power piping for the heat recovery steam generator (HRSG) and the training of local personnel, and provides perspective for future projects.

10:30 a.m. – 11:05 a.m.
**AUTOMATING PIPE AND TUBE CUTTING AND PROFILING PROCESSES: BENEFITS AND CONSIDERATIONS**

*Jeff Bennett, Vemon Tool Co., A Lincoln Electric Co.*

Conventional thought leads many manufacturers to the conclusion that investing in automated machinery is only justified if high sequences can be repeated over hundreds and thousands of parts. To counter this notion, current and emerging technologies and developments will be presented to illustrate the benefits of automating pipe/tube cutting in all environments, including low volume/high mix operations. In addition, several key factors will be discussed that play an important role in designing and selecting the optimal automation solution. These considerations include material handling, software, programming, CAD/CAM functionality, and work cell layout.

11:05 a.m. – 11:40 a.m.
**USING ORBITAL GMAW/FCAW IN A FAB SHOP**

*John Emmerson, Magnatech LLC*

Orbital welding can increase productivity in a fabrication shop, even in situations where the pipe is being rotated. Several case studies will be discussed. With the recent introduction of a new model, the root pass can also be done by machine. Productivity increases by eliminating the fatigue factor of the welder, which is significant, even when welding in the 1G position. Orbital welding also provides a better work environment for the employee: lessening exposure to fumes, and eliminating the hand held torch and potential for repetitive motion injuries.

1:40 p.m. – 2:15 p.m.
**AUTOMATIC PIPELINE WELDING**

*Eric Carlson, CRC-Evans Automatic Welding*

Founded in 1933, CRC-Evans Pipeline International supplies the pipeline construction industry with the infrastructure and resources to support pipeline contractors worldwide. Since the first mechanized welding process was introduced in 1969, CRC-Evans automatic welding systems have been designed, tested, used, and continuously upgraded for more than 40 years. The focus of this presentation will be general pipeline construction, the history of automatic welding systems, and the advantages of automatic welding technology from its first introduction to present.

2:15 p.m. – 2:40 p.m.
**FRICION WELDING OF PIPE AND TUBING**

*Daniel Adams, Manufacturing Technology, Inc.*

There are several popular friction welding techniques for pipe and tubing applications. The most popular of these is rotary friction welding, but there is increasing interest in friction stir welding. Many of these applications will be discussed to show how friction welding has proven to be a high quality and cost effective means of joining.

2:55 p.m. – 3:30 p.m.
**A COMPARISON OF THERMAL CUTTING OPTIONS**

*Joe Sorvaag, ESAB Cutting Systems*

This discussion will provide a comparative exploration of simple to complex plasma and oxyfuel systems in order to rationalize the relative benefit and returns of each process. Included in the discussion will be the comparative cost and output results benefit of single gas air plasma, shielded gas plasma, water injection plasma, and oxyfuel technology, as well as levels of automation integration available for each process. The output results benefit comparison will include the following cutting attributes: Applicability or advantage of the cutting process for different material types (carbon, stainless steel, and aluminum), resultant edge quality for welding, the capability for each process to produce compound bevel edges for weld preparation, and the achievable accuracy for the finished cut from each process.

3:30 p.m. – 4:05 p.m.
**EXPLOSION WELDING FOR DISSIMILAR METAL PIPE TRANSITIONS**

*Michael Blakely, Dynamic Materials Corp.*

Explosion welding (EXW) is used in many industries to join similar and dissimilar metals. One use of explosion welded materials is to create transitions between materials in critical tube and piping applications. Combinations of material include aluminum to stainless steel and copper nickel to aluminum. This presentation will discuss how explosion welded plates are prepared and subsequently turned into transition joints for piping. A few example applications of these transition joints will also be covered.

**SEMINARS**

**Tuesday, November 2**
**9:00 a.m. – 4:30 p.m.**
**Room C212**
**THE WHY AND HOW OF WELDING PROCEDURE SPECIFICATIONS**

*Member: $345, Nonmember: $480 • Registration Code: W25*

If you are responsible for planning a welding operation, which of the following items are most critical: base metal, welding process, filler metal, current and range, voltage and travel speed, joint design tolerances, joint and surface preparation, tack welding, welding position, preheat and interpass temperature, or shielding gas? This course provides the answers.

**Who Should Attend**

This session will benefit owners, managers, engineers, and supervisors who must qualify, write, or revise their own welding procedure specifications to satisfy codes and contract documents.

**Topics Covered:**
- Proper preparation and qualification of welding procedure specifications.
- Selecting and documenting welding variables.
- Documenting standard procedure qualification testing for commonly used processes for joining ferrous plate and pipe materials.

**You Can Learn:**
- Specifying essential and nonessential variables commonly used in sample AWS, ASME, and API code formats.
- Using standards when preparing procedures.
- Documenting welding variables and qualification tests.
- Avoiding the pitfalls in revising previously qualified procedures.
Tuesday, November 2
9:00 a.m. – 4:30 p.m. Room C202
ROAD MAP THROUGH THE D1.1: 2010 STRUCTURAL WELDING CODE — STEEL
Member: $345, Nonmember: $480 • Registration Code: W26
This one-day program will provide participants with a comprehensive overview of AWS D1.1/D1.1M: 2010, Structural Welding Code — Steel. Each of the code sections, including General Requirements, Design of Welded Connections, Prequalification, Qualification, Fabrication, Inspection, Stud Welding, and Strengthening and Repair of existing structures, will be summarized, with emphasis on their interrelationships and usage. In addition, the role of mandatory and nonmandatory annexes will be reviewed, along with tips for how to use the code commentary. Though not a prerequisite, this session provides a broad basis of understanding the code for those who are attending other detailed sessions later.

Who Should Attend
This program will benefit managers, engineers, supervisors, inspectors and other decision makers who need a good overall understanding of what is and what is not covered by D1.1:2010 in order to improve their job effectiveness.

Tuesday, November 2 – Wednesday, November 3
9:00 a.m. – 4:30 p.m. Room C201
VISUAL INSPECTION WORKSHOP
Member: $550, Nonmember: $685 • Registration Code: W30
A 16-hour course for CWI exam candidates to review the basic concepts and applications of visual inspection. After a discussion of the limitations and advantages of visual inspection, types of weld data that may be obtained by visual inspection are presented and discussed. Includes the many types of discontinuities encountered during the visual inspection of welds. Common tools used for visual inspection are presented and discussed (a machinist's scale, dial calipers, micrometers, fillet weld gauges, the Palmgren gauge, and the V-WAC). Participants will use these gauges to make measurements on weld replicas. This will prepare candidates for Part “B” of the exam. A sample weld specification containing acceptance criteria is presented and discussed, after which students use the specification and visual inspection tools to evaluate the weld replicas using a series of specific questions and scenarios.

By Attending, You Can Learn:
• How to use weld measuring instruments.
• Compliance to a specific code.
• Dos and don’ts of documentation.
• When a discontinuity is OK.
• When a defect is rejectable.
• Why visual inspection can be the most effective NDE technique.

Wednesday, November 3
9:00 a.m. – 4:30 p.m. Room C202
D1.1: 2010 – FABRICATION AND INSPECTION
Member: $345, Nonmember: $480 • Registration Code: W28
This one-day program will provide a review of the Fabrication and Inspection section of the new D1.1:2010 Structural Welding Code — Steel. This section provides an in-depth look at the control and storage of welding consumables, stress-relief heat treatment, base metal preparation, joint dimensions and tolerances, structural member dimensional tolerances, and other topics. The significance of weld profiles and repair of effects will also be covered, along with an overview of the acceptance criteria for the different weld categories and inspection methods. Discussions on stud welding and requirements for strengthening and repairing existing structures round out this intense program. Qualifications and responsibilities of inspectors and contractors will be covered. Procedures and techniques for visual, liquid penetrant, magnetic particle, radiographic, and ultrasonic inspection are highlighted as a prelude to a detailed review of the inspection acceptance standards. Test method fundamentals will be covered, where necessary, to understand the more in-depth tables and criteria, along with tips on what to look for in inspection reports. Whether you are a supervisor, engineer, inspector, or auditor, you will find this clear presentation a must for better understanding of weld quality.

Who Should Attend
This program will benefit managers, engineers, supervisors, inspectors and other decision makers who need a good overall understanding of what is and what is not covered by D1.1:2010 in order to improve their job effectiveness.

Wednesday, November 3
7:45 a.m. – 8:00 a.m. Room C109
Welcome and Introduction to Resistance Welding
Bill Brafford, Technical Liaison Manager, Tuffaloy Products, Inc.
8:00 a.m. – 8:30 a.m.
Basics of Resistance Welding Video – Part I
8:30 a.m. – 11:00 a.m.
Electrodes and Tooling
Bill Brafford, Technical Liaison Manager, Tuffaloy Products, Inc.
Focus on the classification, selection and maintenance of electrodes and fixtures as they pertain to numerous applications. By revealing some problem-solving techniques and suggestions, Bill will familiarize you with some powerful problem/evaluation/solution techniques that will keep your production process running longer and operation more efficient.

Wednesday, November 3
8:00 a.m. – 4:30 p.m. Room C207
METALLURGY APPLIED TO EVERYDAY WELDING
Member: $345, Nonmember: $480 • Registration Code: W27
Metallurgy of welds in carbon and low-alloy steels shouldn’t be complicated. This short course will help you understand how welding affects the properties of base materials, and how weld defects occur.

Who Should Attend
Owners, inspectors, engineers, and supervisors who specify welding and need to understand the interactions of base, filler, and welding processes should attend.
11:15 a.m. – 12:45 p.m.
Tabletop Exhibits and Lunch Served

12:45 p.m. – 2:45 p.m.
Welding Controls

Don Soreson, Director of Engineering, Entron Controls, LLC

This discussion focuses on the selection, descriptions, and applications of welding timers, contactors, and accessories. Packed with a punch, Don drives home $H = I^2 RT$ in a way you’ll never forget. He shows you how this invaluable formula is used in every resistance welding application — every day, every cycle, all the time.

3:00 p.m. – 5:30 p.m.
Electrical Power Systems

Mark Siehling, Vice-President-Engineering, Roman Engineering Services

This session reviews the descriptions and maintenance of electrical power components and conductors from the weld control to the electrode. This lively presentation has something for everybody. Utilizing several small demonstrations, Mark helps you understand this very important part of the resistance welding process.

Thursday, November 4

8:00 a.m. – 10:00 a.m.
Welding Processes and Machines

Tim Foley, Sr. Applications Engineer, Automation International, Inc.

This session will reinforce the very essence of how the resistance welding process works and how the process relates to each of the four resistance welding processes. This session will be full of application examples from each process and how machinery utilizes the individual components and elements illustrated in the other sessions.

10:15 a.m. – 10:45 a.m.
Basics of Resistance Welding Video – Part II

10:45 a.m. – 12:00 p.m.
Troubleshooting and Maintenance

Bruce Kelly, President, Kelly Welding Solutions

With over 30 years’ experience in the auto industry, specifying, installing and troubleshooting resistance welding systems, Bruce will give you tips on how to find the reasons why welds don’t turn out the way you would like. This presentation is filled with real-life examples of problems that baffled maintenance persons.

12:00 p.m. – 1:15 p.m.
Lunch Served

1:15 p.m. – 3:15 p.m.
Initial Machine Set-Up

Robert Matteison, Director-Product Development, Taylor-winfield, Inc.

Robert takes you through the selection and maintenance procedures of proper weld schedules and preventive maintenance programs designed to make your resistance welding operations profitable. Hands-on demonstrations peak this presentation.

3:15 p.m. – 3:45 p.m.
Question and Answer Session

AWS VOLUNTEER COMMITTEE MEETINGS

Location
H - Hotel
C - Convention

Saturday, October 30
2:00 p.m. – 5:00 p.m.
Membership Committee Meeting • (H) Room 301

Sunday, October 31
8:00 a.m.
AWS Foundation Board • (H) Grand Salon D
8:00 a.m.
Education Committee Meeting • (H) Room 401
1:30 p.m.
Districts Council • (H) Grand Ballroom West

Monday, November 1
2:00 p.m. – 6:00 p.m.
C7/C7B High Energy Beam Welding and Cutting Committee • (H) 204
2:30 p.m.
Fellows Committee • (H) 214
3:00 p.m.
Educational Scholarship Committee • (H) Grand Salon East
4:00 p.m.
Counselor Committee • (H) 213

Tuesday, November 2
7:30 a.m. – 9:00 a.m.
D16 Committee on Robotic Welding • (C) 305
8:00 a.m. – 10:00 a.m.
A5K Subcommittee on Titanium Filler Metals • (C) 306
8:00 a.m. – 12:00 p.m.
D14l Subcommittee on Welding on Hydraulic Cyclinders • (C) 304
8:00 a.m. – 5:00 p.m.
D14G Subcommittee on Welding of Rotating Equipment • (C) 303
8:00 a.m. – 5:00 p.m.
D15C Subcommittee on Track Welding • (C) 306
10:00 a.m. – 12:00 p.m.
WHC-WH5 Welding Handbook Committee and Committee on Volume 5 • (C) 105
10:00 a.m. – 12:00 p.m.
G2D Subcommittee on Welding of Titanium • (C) 307
10:30 a.m. – 12:00 p.m.
C6 Committee on Friction Welding • (C) 305
1:00 p.m. – 5:00 p.m.
C2A Subcommittee on Machine Element Repair and Restoration • (C) C305
1:00 p.m. – 5:00 p.m.
C5 Committee on Arc Welding Processes • (C) 307
1:00 p.m. – 5:00 p.m.
D14B Subcommittee on Welding Design in Heavy • (C) 304
2:00 p.m.
National Nominating (Open Session) • (C) 207
2:00 p.m. – 5:00 p.m.
C2 Committee on Thermal Spray • (C) 305

Wednesday, November 3
8:00 a.m. – 10:00 a.m.
B1C Subcommittee on Welding Inspection Handbook • (C) 307
8:00 a.m. – 12:00 p.m.
D14C Subcommittee on Welding of Earthmoving and Construction Equipment • (C) 304
8:00 a.m. – 12:00 p.m.
D14E Subcommittee on Welding of Cranes and Presses • (C) 305
8:00 a.m. – 5:00 p.m.
D17D Subcommittee on Resistance Welding in Aerospace Applications • (C) 208
8:00 a.m. – 5:00 p.m.
D9 Committee on Sheet Metal Welding • (C) 303
8:00 a.m. – 5:00 p.m.
D15/D15A Committees on Welding in Railroad Applications • (C) 306
9:00 a.m.
Product Development • (C) 301
10:00 a.m. – 12:00 p.m.
B1B Subcommittee on Visual Inspection • (C) 307
1:00 p.m. – 5:00 p.m.
D14 Committee on Welding of Heavy Machinery • (C) 305
1:00 p.m. – 5:00 p.m.
D17K Subcommittee on Fusion Welding in Aerospace Applications • (C) 304
2:00 p.m. – 5:00 p.m.

**FMA, SME, PMA, AND CCAI EDUCATIONAL PROGRAMS**

**Tuesday, November 2**

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<th>TECHNOLOGY</th>
<th>8:00 a.m. – 10:00 a.m.</th>
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<th>1:30 p.m. – 3:30 p.m.</th>
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<td><strong>CUTTING</strong></td>
<td>Lasers 101 with Tech Tour (F20)</td>
<td>Comparative Cutting with Tech Tour (F30)</td>
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<tr>
<td>NEW TRACK!</td>
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<tr>
<td><strong>FINISHING</strong></td>
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<tr>
<td>Introduction to Finishing (Painting) Processes (C10)</td>
<td>Selecting Coatings for Your Parts: An Overview of Today’s Coating Technologies (C20)</td>
<td>Right-Sizing Your Finishing System (C30)</td>
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<tr>
<td>Introduction to Galvanizing and Environmental Regulations (C11)</td>
<td>Understanding the Basics of Electrocoat (C21)</td>
<td>The Future of Coatings Technology (C31)</td>
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<tr>
<td>Manual Powder Coating Basics (C12)</td>
<td>The Ins and Out of IR and IR Applications (C22)</td>
<td>Modern Pretreatment: The Basics (C32)</td>
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<tr>
<td><strong>FORMING AND FABRICATING</strong></td>
<td>NEW Forming and Fabricating of Lightweight Metal (F10)</td>
<td>Safeguarding Your Equipment (F21)</td>
<td>Punch Press and Tooling Technology (F31)</td>
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<tr>
<td><strong>GREEN/ENERGY INITIATIVES</strong></td>
<td>NEW Introduction to True Kaizen (F11)</td>
<td>Lean 101 — Principles of Lean Manufacturing (F23)</td>
<td>Lean 202 — Advanced Value Stream Mapping (F34)</td>
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<td><strong>MANAGEMENT</strong></td>
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<td>NEW Developing the Next Generation Leader (F25)</td>
<td>NEW ISO Certification: Increase Profitability While Delivering Better Products and Services (F36)</td>
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<tr>
<td>Driving Productivity Through Employee Engagement (F12)</td>
<td>NEW Automation Strategies to Streamline Your Job Shop Office (F26)</td>
<td>NEW Strategic IT Planning (F37)</td>
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<tr>
<td>Is Your Company Leaving Money on the Table? R&amp;D Tax Credit (F13)</td>
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<tr>
<td><strong>STAMPING</strong></td>
<td>Value Added Stamping Technologies I (S10)</td>
<td>Value Added Stamping Technologies II (S20)</td>
<td>Competitive Strategies (S30)</td>
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<tr>
<td>Optimizing Die Design (S11)</td>
<td>Stamping Efficiently (S21)</td>
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<tr>
<td><strong>TUBE &amp; PIPE</strong></td>
<td>Today’s Tooling Designs for Tube Mill Set-Up and Maintenance Program (F14)</td>
<td>NEW Materials/Metallurgy (F27)</td>
<td>NEW Tube &amp; Pipe Inspection (F38)</td>
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**Thursday, November 4**

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<tr>
<th>8:00 a.m. – 12:00 p.m.</th>
<th>A5H Subcommittee on Filler Metals and Fluxes for Brazing • (C) 306</th>
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<td>8:00 a.m. – 12:00 p.m.</td>
<td>D17 Committee on Welding in Aerospace Applications • (C) 304</td>
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<tr>
<td>1:00 p.m. – 5:00 p.m.</td>
<td>C3 Committee and Subcommittees on Brazing and Soldering • (C) 306</td>
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<tr>
<td><strong>Friday, November 5</strong></td>
<td>8:00 a.m. – 5:00 p.m. C3 Committee and Subcommittees on Brazing and Soldering • (H) 204/205</td>
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### Wednesday, November 3

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<th>TECHNOLOGY</th>
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<th>10:30 a.m. – 12:30 p.m</th>
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<tbody>
<tr>
<td><strong>CUTTING</strong></td>
<td>Laser Cutting Technology (F40)</td>
<td>Waterjet Cutting Advancements (F50)</td>
<td>Plasma Plate and Structural Cutting (F60)</td>
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<td>NEW Laser Cutting Considerations for</td>
<td>NEW New Laser Technology and</td>
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<td>First-time Buyers (F51)</td>
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<tr>
<td><strong>FINISHING</strong></td>
<td>Advancements in Liquid Coating</td>
<td>The Efficiencies of Electrocoating</td>
<td>Maximizing Your Electrocoat</td>
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<tr>
<td>NEW TRACK!</td>
<td>Materials and Equipment (C40)</td>
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<td>So You Want to Paint A Part: Working</td>
<td>Understanding and Lowering Your</td>
<td>Advancements in Pretreatment (C61)</td>
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<td>with a Custom Coater or Doing it In-House (C41)</td>
<td>Finishing Costs (C51)</td>
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<td>Finishing System Design for the 21st</td>
<td>Fast and Profitable Powder Coatings</td>
<td>Emerging Technologies in</td>
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<td>Century (C42)</td>
<td>Systems (C52)</td>
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<td><strong>FORMING AND FABRICATING</strong></td>
<td>Press Brakes (F41)</td>
<td>Roll Forming Basics (F52)</td>
<td>Roll Forming Tooling/Advanced (F62)</td>
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<td>Getting Started with Robotics (F42)</td>
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<tr>
<td><strong>GREEN/ENERGY INITIATIVES</strong></td>
<td>NEW Fabrication for the Solar Energy</td>
<td>NEW Fabrication for the Wind Energy</td>
<td>NEW Sustainability Tools for</td>
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<td>Industry (F43)</td>
<td>Shop (F54)</td>
<td>Manufacturers (F64)</td>
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<td>NEW Lean 203 – 5S Workplace Organization and Standardization (F44)</td>
<td>Demand Pull in the Fabrication Job Shop (F54)</td>
<td>NEW Low Volume, High Variety Production – No Problem for Lean (F65)</td>
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<tr>
<td><strong>MANAGEMENT</strong></td>
<td>Seven Secrets of Manufacturer Marketing (F46)</td>
<td>NEW Search Engine Optimization: The Must-Have for Every Company Web Site (F55)</td>
<td>NEW Lean Above the Shop Floor (F66)</td>
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<td>NEW Financial Forecasting and Cash Flow Management (F47)</td>
<td>NEW Congrats You Survived: Strategies for Re-emerging (F56)</td>
<td>NEW Developing, Implementing, and Maintaining a Successful Safety Program (F67)</td>
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<tr>
<td><strong>STAMPING</strong></td>
<td>Tooling Technologies I (S40)</td>
<td>Tooling Technologies II (S50)</td>
<td>Optimizing Stamping Fluids (S60)</td>
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<td>Sensors for Error-Proof Metal Forming I (S41)</td>
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<td><strong>TUBE &amp; PIPE</strong></td>
<td>Tube &amp; Pipe Fabrication Basics (F48)</td>
<td>NEW Lasers for Tube &amp; Pipe</td>
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<td>Manufacturing with Tech Tour (F57)</td>
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### Thursday, November 4

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<tr>
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<td>NEW Use of Lasers in Renewal Energy Applications (F70)</td>
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<td><strong>FINISHING</strong></td>
<td>Racking and Stripping: Finishing</td>
<td>Curing Options: Beyond Conventional</td>
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<td>NEW TRACK!</td>
<td>Essentials (C70)</td>
<td>Curing (C80)</td>
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<td></td>
<td>Process Control and Preventive</td>
<td>Troubleshooting Your Electrocoat</td>
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<td>Maintenance for Electrocoat Systems</td>
<td>System (C82)</td>
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<td>(C72)</td>
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<tr>
<td><strong>FORMING AND FABRICATING</strong></td>
<td>Coil Processing (F71)</td>
<td>NEW Environmentally Friendly Surface</td>
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<td>and Part Cleaning Options (F80)</td>
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<tr>
<td><strong>GREEN/ENERGY INITIATIVES</strong></td>
<td>NEW What Color is Compressed Air? Automation Makes it Green (F72)</td>
<td>NEW Building Successful Work Teams</td>
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<td><strong>MANAGEMENT</strong></td>
<td>Total Productive Maintenance for the Fabrication Job Shop (F73)</td>
<td>NEW How Healthcare Reform Impacts</td>
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<td>Fabricators (F74)</td>
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<td>Four Steps to Improving Sales and</td>
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<td>Productivity in a Recession (F82)</td>
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<td>NEW Increasing Revenue Through</td>
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<td>Collaborative Efforts (F75)</td>
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<td><strong>STAMPING</strong></td>
<td>Cost-Effective Environmental Strategies (S70)</td>
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<td>Forming Simulation (S71)</td>
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FREE EXPO ADVANCE REGISTRATION FORM

- **FREE** advance registration with this form before October 30, 2010. Register online and pay the $50 onsite registration fee.
- Online registrants: receive an immediate e-mail confirmation.
- Fax/Mail-in registrants: receive confirmation within 3 business days.
- Students: Do not use this form to register. Please call (800) 733-4763 for assistance.
- No one under 18 years of age admitted.

**3 EASY WAYS TO REGISTER:**

**ONLINE:** www.fabtechexpo.com

**FAX:** (706) 344-4444

**MAIL TO:** FABTECH 2010
1000 Georgia World Congress Center
P.O. Box 541
Brookfield, IL 60504-0541

If you register online or fax, DO NOT mail this form. Photocopy this form for additional registrants.

**PRIORITY CODE:** PDF

☐ Mr. ☐ Mrs. ☐ Ms. ☐ Dr.

**PLEASE PRINT - One Form per Person**

**Name:**

**Title:**

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**Postal Code/Country:**

**Phone:** [ ] E-Mail

**Fax:** [ ] Please do not use my e-mail for communications outside of FABTECH.

[ ] Please call (800) 733-4763 if you require special assistance.

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☐ Authorize charge to my credit account (Complete credit card information below)

☐ Check One
☐ VISA ☐ American Express
☐ MasterCard ☐ Discover

**Name (Please print):**

**Signature:**

[ ] Credit Card Number

[ ] Exp. Date

[ ] CVV2/CVC2 (3 or 4 digits)
Please indicate your name and member number to receive full pricing benefits.

Name

Company

I am a member of: □ AWS □ FMA □ SME □ PMA □ CCAI □ NAM □ Non-member

Member Number

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<th>NON-MEMBER</th>
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<td>□ 1 Session</td>
<td>$ 175</td>
<td>$ 200</td>
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<tr>
<td>□ 2 Sessions</td>
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<td>□ 3 Sessions</td>
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<td>$ 470</td>
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<tr>
<td>□ 4-5 Sessions</td>
<td>$ 460</td>
<td>$ 570</td>
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<tr>
<td>□ 6-8 Sessions (Maximum value includes one (1) $15 lunch voucher.)</td>
<td>$ 685</td>
<td>$ 795</td>
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</table>

Please select the sessions below you would like to attend. The price for a multiple session purchase is noted above.

Do not register for more than one session in each time slot each day as sessions run concurrently.

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<th>Thursday, November 4</th>
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<tr>
<td>□ (C10) □ (C11) □ (C12)</td>
<td>□ (C40) □ (C41) □ (C42)</td>
<td>□ (C70) □ (C71) □ (C72)</td>
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<td>□ (F10) □ (F11) □ (F12) □ (F13) □ (F14)</td>
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<td>PM Sessions - 1:30 p.m. - 3:30 p.m.</td>
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<td>□ (C30) □ (C31) □ (C32)</td>
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<td>□ (C80) □ (C81) □ (C82)</td>
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Please select the sessions below you would like to attend. The price for a multiple session purchase is noted above.

Do not register for more than one session in each time slot each day as sessions run concurrently.

| FABTECH SESSIONS SUBTOTAL: $ |

<table>
<thead>
<tr>
<th>AWS WELDING SESSIONS</th>
<th>MEMBER</th>
<th>NON-MEMBER</th>
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<tbody>
<tr>
<td>1-Day Welding Education Conference</td>
<td>$ 149</td>
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<tr>
<td>1-Day Conference or Seminar</td>
<td>$ 345</td>
<td>$ 480</td>
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<tr>
<td>2-Day Seminar</td>
<td>$ 550</td>
<td>$ 685</td>
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<tr>
<td>2-Day IWMA Welding School</td>
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<tr>
<td>1-Day Professional Program</td>
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<td>3-Day Professional Program</td>
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<tr>
<td>3-Day Student Professional Program</td>
<td>$ 75</td>
<td>$ 90*</td>
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<tr>
<td>AWS Awards Luncheon</td>
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<td>Special Programs</td>
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Please select the AWS sessions below you would like to attend. The price for purchases is noted above.

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<th>3-Day Professional Program</th>
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<td>□ (W25) Nov. 2 - 4</td>
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<td>□ (W26) Nov. 2 - 4</td>
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<td>□ (W26) Nov. 2</td>
<td>AWS Awards Luncheon</td>
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<td>□ (W31) Nov. 2</td>
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<td>□ (W24) Nov. 4</td>
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<td>FREE Special Programs</td>
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**Nonmember price for AWS Sessions only includes a two-year AWS Individual Membership (except the Welding Education Conference). Member benefits include a subscription to the Welding Journal, a 25% discount on AWS publications, membership in a local section and more.**

**Nonmember Student Professional Program price includes a one-year AWS Student Membership.**

**Cancellation Policy**

Cancellations must be made in writing and faxed to Att: FABTECH Conference Cancellation at (313) 425-3407 no later than October 15, 2010 to receive a full refund minus a $50 administrative fee. Cancellations received after this date are non-refundable.

**Without Registration**

(Same as Pre-Registered + $50 Cn site)

Complete form on reverse side.

TOTAL FEES

Full payment must accompany your registration.

Please complete Payment Section on reverse side.

<table>
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<th>MEMBER</th>
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<td>$795</td>
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**FABTECH WELDING SESSIONS SUBTOTAL: $**
NEW POLIFAN®-STRONG FROM PFERD

Takes the Hard Work out of Hard Stock Removal

MAJOR CUTS
Here’s the ultimate time and work saver. This powerful flap disc, with a patented new design, removes more steel more quickly than other discs or grinding wheels. Whether it’s weld dressing, edge grinding, deburring or chamfering, POLIFAN®-STRONG’s aggressive grinding cuts labor time and disc replacement costs dramatically.

MAJOR DIFFERENCE
Extended flap lengths make POLIFAN®-STRONG different from conventional flap discs - and make possible maximum metal removal with longest disc life.

MAJOR SAVINGS
Your nearest PFERD distributor can demonstrate these remarkable cost-saving tools. Call him today or contact us directly and we’ll set it up. Meanwhile, preview how POLIFAN®-STRONG takes the hard work out of hard stock removal. Go to www.pferdusa.com and click on “videos.”

PFERD INC.
30 Jytek Drive
Leominster, MA 01453
800-342-9015
fax (978) 840-6421
www.pferdusa.com

For Info go to www.aws.org/ad-index

See us at FABTECH booth #7067
Welding Show 2010
Exhibit Highlights

This alphabetical listing of exhibitors in the 2010 AWS Welding Show offers a preview of what they display in each booth. AWS Sustaining Member Companies are highlighted in color.

ABB, Inc. 7323
www.us.abb.com
ABB will feature its industrial robots, modular manufacturing systems and service features at its booth. Its products and services are designed to help manufacturers improve productivity, product quality, and worker safety.

ABICOR Binzel Corp. 6355
www.abicorusa.com
ABICOR Binzel Corp. will display its air- and water-cooled torches, accessories, and welding chemicals for GMAW, GTAW, and robotic welding applications. The company offers custom-design services to meet customers' specific needs.

Ace Industrial Products 6216
www.aceindustrialproducts.com
Ace Industrial Products will showcase its heavy-duty welding fume extractors. Shown will be its lines of source-capture portable and mobile equipment, downdraft tables, extraction arms, and general capture air cleaners, available for both shop and field work. The units effectively control hexavalent chromium fumes.

Advanced Technology & Materials Co., Ltd. 6143
www.atmwwelding.com
The company will feature its lines of flux cored welding wires and special welding materials including superalloys and precision metals.

Advanced Welding Supplies and Solutions, Ltd. 7809
(678) 327-5693
AIDT 7858
www.aidt.edu
Visit the AIDT booth to learn about its educational programs for training in manual welding, robotic welding, robotic programming, and PLC programming.

Ajan Elektronik Servis San Ve 7407
www.ajancnc.com
Ajan Elektronik, a holder of the ISO 9001:2000 quality certificate, will display its computer numerical controlled (CNC) equipment for automating plasma and oxyfuel cutting, drilling, and pipe-cutting.

Alabama Laser 7258
www.alabamalaser.com
Alabama Laser will detail its laser job shop services customized to each customer's needs. Featured will be its custom laser systems, specialized laser research services, and process development capabilities for laser cladding, cutting welding, etching/marking, heat treating/hardening, hybrid welding, and micromachining.

Albany Door Systems, Inc. 7749
www.albanymdoors.com
Albany Door Systems will highlight its line of

Markal. The Choice of Welding Pros!

The most comprehensive selection of markers for welding and fabrication.

Thermomelt® Heat Stik®
The welding industry's longest-lasting temperature indicators.

The highest-quality products, with a 75-year tradition of excellence.

Made in the U.S.A.

Available from your preferred welding distributor.

Call Markal today for a Free Sample of our new Silver-Streak & Red-Riter Welders Pencils, ideal for marking all types of metal surfaces!

See us at FABTECH booth # 7202 For info go to www.aws.org/ad-index
doors for protecting people, machinery, and products during a wide variety of manufacturing processes. Featured will be doors for use with high-speed machinery, welding, robotic cells, cutting, milling, painting, tool handling, conveyor systems, and storage systems. Shown will be low-maintenance doors fashioned from metal, fabric, and rubber.

**Alcotec Wire Co.**

www.alcotec.com

Alcotec will display its extensive line of aluminum welding wires for all applications. Detailed will be its manufacturing techniques for drawing and spooling to assure accurate dimensional, mechanical, and metallurgical control, improved feedability, and precise diameter, cast, helix and sliding friction controls.

**ALM Corp.**

www.almcorp.com

ALM Corp. will feature its positioners for welding and assembly operations. Highlighted will be its heavy-duty lifting equipment designed to meet customers’ specifications.

**AMERIC**

www.americ.com

AMERIC will feature its wide variety of ventilators including multifunctional, industrial, high-capacity, light-industrial, and pneumatic types.
Come see the wonders of Koike metalworking technology for free.

We’ll throw in the wonders of Niagara Falls.

The best way to decide if a piece of Koike equipment can make your shop more efficient is to get your own hands-on look at the machine. Koike makes it easy. We’ll pay all your travel, hotel and meal expenses for a trip to our Arcade, NY headquarters. Put one of our positioners or welding systems through its paces. Then, if you like, we’ll pay for a side trip to Niagara Falls, one of the world’s must-see destinations.

Call Brad Williams at 800-252-5232, ext. 242 to see if you qualify and to set up your visit.

Koike Aronson, Inc./Ransome
Arcade, NY USA
800-252-5232

www.koike.com
We understand wear and corrosion in all of its forms. Get superior wear and corrosion protection with proven surface technologies. With Sulzer Metco in charge your profits will stay where they belong... on your bottom line.

Sulzer Metco is a leading global supplier of solutions, products, services and equipment for thermal spray, thin-film and other selected functional surface technologies as well as a provider of specialized machining services.

Meet us at

**FABTECH International & AWS Welding Show**
November 2 – 4, 2010, Georgia World Congress Center, Atlanta, Georgia
Booth# 6327

**Practical Solutions for Wear and Corrosion Problems Symposium**
November 8 – 10, 2010, Bourbon Hotel and Convention Center Ibirapuera, São Paulo, Brazil

info@sulzermetco.com • www.sulzermetco.com

For Info go to www.aws.org/ad-index
OKI Bering is looking forward to seeing you at the 2010 Fabtech Show in Atlanta, Georgia. Please stop by our booth #7455 to see all of the manufacturers that support us and our industry.

For info go to www.aws.org/ad-index

America Fortune Co. 6127
www.americafortune.com
America Fortune Co. will exhibit its aluminum, and high-pressure gas and acetylene cylinders.

American Society for Nondestructive Testing (ASNT) 7716
www.asnt.org
The society will promote its many services to create a safer world by serving the NDT professions and promoting nondestructive testing technologies through its publications, certification programs, research, and conferencing activities.

American Technical Publishers 7860
www.go2atp.com
The company will showcase its books and training materials detailing numerous industrial skills.

American Torch Tip Co., Inc. 7547
www.americantorchtip.com
American Torch Tip will showcase its extensive line of replacement parts for oxyfuel, GMAW, GTAW, plasma arc, metal spray, and laser beam welding and cutting equipment.

American Welding Society 8003
www.aws.org
The American Welding Society (AWS) was

real savings!

No matter the size of your shop or the equipment you use, our revolutionary EWR system can offer you:
- a 40% - 60% reduction in shielding gas use
- improved weld quality, manual or robotic
- reduced environmental impact

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New distributor for Mexico, Central & South America:
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www.blazei.com.mx

416 Gallimore Dairy Road, Suite 1 / Greensboro, NC 27408 / 336 605 1880 / www.regulasystemsusa.com

For info go to www.aws.org/ad-index
The power to choose.

<table>
<thead>
<tr>
<th>Step</th>
<th>Choose your feature-set.</th>
<th>Choose your power level.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basic – MA23 A manually set feeder for reliable MIG and stick welding.</td>
<td>MIG 4002c – 400 A For every type of welding.</td>
</tr>
<tr>
<td></td>
<td>Guided – MA24 Features QSet, which automatically selects the correct welding parameters for the required wire/gas combination.</td>
<td>MIG 5002c – 500 A For heavy-duty welding of solid and flux-cored wires.</td>
</tr>
<tr>
<td></td>
<td>Advanced – U6 Offers pulse MIG capabilities, more memory, and the ability to create synergic lines.</td>
<td>MIG 6502c – 650 A Designed for the most demanding heavy-duty, high-duty cycle welding, carbon arc gouging.</td>
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<td>Sophisticated – U8 Plus Our top-of-the-line feeder – includes USB capability, user synergic lines, and SuperPulse for superior control of heat input.</td>
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</tbody>
</table>

ESAB Announces Industry’s First Customizable Line of Welding Machines

Every welder knows it’s critical to have the right equipment. Unfortunately, purchasing a new welding machine can be a difficult decision – you don’t want to sacrifice performance, but you also don’t want to pay for features you don’t need.

But that decision just got easier, thanks to ESAB Welding & Cutting Products’ new line of welding systems. For the first time ever, you can mix and match machine components that best fit your needs and applications.

**Step one** is choosing your feature-set. ESAB’s new line includes four feature-rich feeders. You simply select the machine that best meets your project’s requirements.

**Step two** is choosing your power level. No matter which of the four feeders you choose, it can be combined with any of the three new universal power sources. It all depends on how much power you need for your application.

**Step three** is choosing one of ESAB’s Ready to Weld packages that include all the accessories you need to start welding.

**Extraordinary flexibility.**

ESAB also made it easy and cost-effective to upgrade your machine. So should your needs change down the road, you can simply swap out one component or the operating panel, rather than buying a whole new system.

By giving you the power to choose, and letting you build the system you need, ESAB is revolutionizing the way you purchase welding equipment.

To see how easy it is to configure a machine to your needs, visit esabna.com/choose today.
founded in 1919 as a multifaceted, not-for-profit organization with a goal to advance the science, technology, and application of welding and related joining disciplines. AWS will provide a wide array of technical, education, and certification programs at the show. Visit www.aws.org/show for details.

**AWS Certification.** The Society develops and administers a variety of certification programs for welding professionals to help industry identify qualified personnel and provide individuals with meaningful career objectives. The AWS Certified Welding Inspector (CWI) program currently has more than 32,000 CWIs and CAWIs. Since 1975, more than 69,200 have been certified. The AWS CWI program has become the gold standard for weld inspection credentials and has enhanced the careers of many thousands of welding professionals. In 1989, the AWS Certified Welder program was launched to document the qualifications of welders nationwide. The testing facilities used to conduct the qualification procedures are AWS accredited. AWS maintains these certifications and a list of Accredited Test Facilities (ATF) in a National Registry. Welding instructions and test reports can earn an important credential through the AWS Certified Welding Educator program implemented in 1991. Other AWS certification programs are Senior Certified Welding Inspector, Certified Welding Supervisor, Certified Radiographic Interpreter, Certified Welding Fabricator, Certified Robotic Arc Welding, and Certified Welding Sales Representative. All of these programs are offered domestically and many are offered internationally. Stop by the Certification booth to find out why AWS certifications may be the right answers for you and your company.

**AWS Foundation.** For the 2010–2011 school term, the AWS Foundation has awarded almost $340,000 in scholarships to more than 400 students. Since its founding in 1991, the Foundation has presented nearly $5 million to more than 3,400 students for welding-related training.

Four years ago, the American Welding Society Foundation inaugurated the Welding for the Strength of America Capital Campaign to add financial support to assist with the critical shortage of welders in the United States workforce. The effort has dual goals: Establish additional scholarships and a list of Accredited Test Facilities (ATF) in a National Registry. Welding instructions and test reports can earn an important credential through the AWS Certified Welding Educator program implemented in 1991. Other AWS certification programs are Senior Certified Welding Inspector, Certified Welding Supervisor, Certified Radiographic Interpreter, Certified Welding Fabricator, Certified Robotic Arc Welding, and Certified Welding Sales Representative. All of these programs are offered domestically and many are offered internationally. Stop by the Certification booth to find out why AWS certifications may be the right answers for you and your company.

The Foundation urges all companies that might be affected by a welder shortage to financially support the Foundation now and become an active part of the solution to this problem. Call Sam Gentry (800/305) 443-9353, ext. 331, for the details. Be sure to stop by Booth #8003 to meet the Foundation staff members and learn about the Foundation's achievements and goals and how your financial participation now can benefit your business and the welding industry now and in the future. Join the "Welding for the Strength of America" Capital Campaign.

**Membership.** AWS provides services to more than 60,000 individual members and nearly 1900 corporate members worldwide. AWS members include engineers, scientists, educators, researchers, welders, inspectors, welding foremen, company executives, and sales associates. Member interests include automatic, semiautomatic, and manual welding, as well as brazing, soldering, ceramics, laminations, robotics, and safety and health. Drop by the AWS Membership Booth #8003 on the Show floor to sign up for an Individual Membership and receive a popular welding publication (up to a $192 value) at a 90% discount. Browse through the AWS Bookstore and save 25% on more than 300 AWS publications.

Save $135 and get a two-year AWS Membership when you sign up for the Professional Program at the Show. Stay informed on the latest products, trends, and technology through 12 issues of the *Welding Journal*. Looking for a job? Establish valuable partnerships with others in your field by attending local AWS Section meetings and dozens of educational events. Gain a voice in determining the future of your industry by getting involved in one of AWS’s 180 technical committees. For depth, detail, and technical insight, AWS has the answers.

**Welding Journal/Inspection Trends.** *Welding Journal* is the official publication of the American Welding Society. This monthly magazine contains feature articles on practical and applied welding technology, information on AWS activities and programs, a variety of monthly columns, and peer-reviewed welding research papers. Industry experts also answer readers’ questions regarding stainless steel, aluminum, brazing, and resistance welding. The *Welding Journal* has received numerous editorial and design awards over the years. *Inspection Trends* will also be featured. This publication serves the nondestructive examination industry including more than 30,000 AWS Certified Welding Inspectors. It contains timely features on all phases of nondestructive examination, profiles of inspection personnel, and columns that bring the latest industry news and practical answers to inspection questions.

**AMET, Inc.**

www.ametinc.com

Advanced Manufacturing Engineering Technology (AMET) will showcase its extensive line of welding automation and bore-cladding equipment, including weld controls, positioners, spiral pipe mills, circumferential welding machines, seamers, and numerous other products.

**Ametek Specialty Metal Products**

(800) 233-2266; FAX (201) 294-0196

**Aoseng Electric Machinery, Co., Ltd.**

6135

Aoseng Electric will display its line of welding helmets at its booth.

**AQC, Inc.**

6240

www.aqcdust.com

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Slip-on Abrasives
Save Time & Money
Shadow-free satin finish – up to a mirror polish

Double-sided Deburring of Sheet Metal up to .2” Thick

PIE-MAKES Sander/Grinder/Polisher Renders Weld Seams Invisible
- Deburr, grind & polish closed and open pipe constructions from 3/8” to 12” dia.
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Owning an H&M Pipe Cutting and Beveling Machine Makes Good $ and $

H&M’s Patented Cuboid Spacers and exclusive features save thousands of dollars in downtime and lost parts during the first year of operation:

- 7F Blow Hole Eliminator
  (No more grinding to eliminate notches)
- Patented Cuboid Spacers
  (No more lost spacer bolts)
- 2DH Boomer Strap Eye Assembly
  (No more lost boomer assemblies)

The competition may pipe up with cheap imitations, but H&M’s 70 years of experience reap greater savings. Go to www.hmpipe.com for more information.

For info go to www.aws.org/ad-index

AOC will feature its high-performance industrial dust collectors, and fume, smoke, and particle control and extraction equipment.

Aquasol Corp. 6367
www.aquasolcorporation.com

Aquasol will display its many products to enhance purging efficiency during welding. Included will be water-soluble paper and tape, preformed water-soluble purge dams, purge gas retaining tape, cleaning wipes, and fiberglass backing tape. Also to be shown are a 100 ppm oxygen monitor, socket weld spacer rings, water-soluble alignment sticks to maintain precise gaps between pipes, plates, and flanges, and Deflecto heat-resistant paper.

ARC Abrasives, Inc. 7949
www.arcabrasives.com

The ARC Abrasives booth will feature its innovative solutions to weld removal, deburring, flash removal, and metallic surface finishing.

Arc Machines, Inc. 6554
www.arcmachines.com

Arc Machines will introduce its new AMI Model 21 series fusion weld heads at the show, capable of welding stainless steel tubing from 3/8 in. (3.3 mm) to 1 in. (25.4 mm) OD, and wall thicknesses up to 0.125 in. (3.175 mm). Shown will be its automated tube clamping and alignment verification feature to reduce the setup time and increase production.

ArcMelt™ 6420
www.arcmelt.com

ArcMelt™ will spotlight its complex composite alloys, wires, and powders to combat corrosion, abrasion, oxidation, and many other severe-service applications. The product line includes composite alloys and thermally applied wire feed stocks to produce composite coatings and overlays for many industrial markets.

Arc Products 7165
www.ap-automation.com

Arc Products will detail its in-house services for support, design, and manufacturing of a wide range of automated welding products. Its services include electrical and mechanical engineering, fabrication, and assembly. Displayed will be its own product line, AP Automation, including seam tracking, torch height control (AVC), magnetic arc control, and a complete line of orbital welding equipment.

Arc Specialties, Inc. 7412
www.arcspecialties.com

Arc Specialties will display at its booth its robotic, CNC, and PLC systems, as well as sample parts welded using the GTAW, PTAW, SAW, and RSW processes.

ARCON Welding Equipment LLC 6223
www.arconweld.com

ARCON Welding Equipment will highlight its Workhorse line of portable, inverter arc, and
Arcos, The Standard of Excellence in Covered Electrodes and Bare Wire, offers two outstanding welding products designed to withstand critical temperature extremes.

Arcos 625 and Arcos 1N12 (625) are nickel-chromium-molybdenum products which are designed to be virtually immune to chloride-ion stress-cracking. They feature moderate strength, good fabricability and excellent oxidation resistance. Each is military-approved and provides superior corrosion resistance, over a range of temperatures from cryogenic to extremely elevated (up to 1,800°F).

Arcos 625 is ideal for welding alloys 625, 601, 802 and 9% nickel. This wire is well suited for welding piping systems and reactor components in the power generation industry and for high temperature service in a wide variety of other engineering applications.

Arcos 1N12 (625) is utilized for welding alloys such as 625, 800, 801, 825 and 600. This covered electrode is the smart choice for applications including petrochemical plants, reactor components, furnace equipment, heat exchangers and offshore marine environments.

To learn about the many advantages of specifying Arcos 625 and Arcos 1N12, call us today at 800-233-8460 or visit our website at www.arcos.us.

Arcos Industries, LLC
One Arcos Drive • Mt. Carmel, PA 17851
Phone: (570) 339-5200 • Fax: (570) 339-5206

For Info go to www.aws.org/ad-index
TOTAL TORCH TECHNOLOGY MEANS CLEAR SOLUTIONS TO YOUR PROBLEMS.

Find out how our total torch technology can help your company save. Visit us at the 2010 AWS/Fabtech Show November 2-4 at the World Congress Center in Atlanta, Georgia.

See what innovations and custom solutions we offer to help fill your piggy at booth #6355.

Enter for a chance to win one of two Apple iPods. Call to set up an appointment with a team member before the show and get additional entries. 301.846.4196 x 160

Welders are tough... their job doesn’t have to be. ABICOR® Binzel is introducing the new lightweight cable. Turning even the toughest jobs into lightweights.

Booth #6355

For Info go to www.aws.org/ad-index
stud welding machines designed for harsh environments such as shipyards, mines, power plants, oil rigs, and paper mills, as well as fabrication and maintenance operations.

ArcOne 7425
www.arc1weldsafe.com

ArcOne will showcase the latest products in its lines of autodarkening welding helmets, inverter power sources, respiratory protection, and head and face protection products. Featured will be hard hats, eyewear, goggles, visors, and respiratory protection.

Astro Arc Polysoude, Inc. 7433
www.arc1weldsafe.com

The Astro Arc booth will feature its orbital and mechanized welding solutions, specializing in narrow-gap, hot wire GTAW, multiprocess cladding and seam welding machines, and tube, pipe, and sheet welding systems.

ATI Garryson 7616
www.atigarryson.com

ATI Garryson will display its lines of tungsten carbide burrs, routers, and abrasives at its booth.

ATI Industrial Automation 7442
www.ati-ia.com

ATI Industrial Automation will feature its robotic accessories and robot arm tooling, including automatic tool changers, multiaxis force/torque sensing systems, robotic deburring tools, robotic collision sensors, rotary joints, compliance devices, and robot end-effector products.

AT&M, Ltd. 6143
www.atmweiding.com

Advanced Technology & Materials Go. will display its fine metal products, including flux cored welding wire, special welding materials, superalloys, porous filtration materials, and filtration systems.

Auburn Manufacturing, Inc. 7061
www.auburnmfg.com

Auburn Manufacturing will showcase its line of high-performance textiles for extreme temperature protection wherever flames and extreme heat can be a danger.

AVS Industries, LLC 6163
www.avind.com

AVS Industries will display its new silica fabrics related to protection in welding and cutting environments. To be shown are four different weights of satin-weave silica in widths up to 60 in. Fabricated parts made with engineered silica and fiberglass fabrics will be shown to demonstrate the performance versatility of these fabrics. Silica specialty textile products consisting of tapes, ropes and sleeving will be displayed.

AW&S Co., Ltd. 6262
www.awands.co.kr

Auburn Manufacturing will showcase its line of high-performance textiles for extreme temperature protection wherever flames and extreme heat can be a danger.

NEWER AGAIN
buy another MIG welding nozzle
S.T.A.R.
Single & Tandem Annual Rental program for MIG welding nozzles
www.RentNozzles.com
www.PerfectArcs.com 706.272.0133 ext.103

Come see us in Atlanta!
Booth 7123
Atlantic Welding & Safety Co. will showcase its complete line of lightweight, autodarkening welding helmets and filters at the show.

Basis-Tech Industrial, Ltd. 7824
www.safetywholesaledepot.com

The company will display its line Crystal-Clear™ line of autodarkening welding hoods and other safety-related equipment.

Beijing Advanced Materials Co., Ltd. 6318
www.bam.com.cn

Beijing Advanced Materials will showcase its products and services involving tungsten carbide, tungsten-copper alloys, metal injection molding, and nickel-titanium shape-memory alloy wires.

Beijing Flourishing Start Digital Technology Co., Ltd. 6142
www.startsh.net

Bernard Welding Equipment. 6811
www.bernardwelds.com

Bernard Welding Equipment will display its line of GMAW air-cooled and water-cooled guns and consumables, including hand-held and flux cored Dura-Flux guns and the Centerfire™ family of nozzles, tips, and diffusers.

Blackjack Machine and Fab, Inc. 7866
www.pipejack.com

BLUCO Corp. 6255
www.bluco.com

Bluco’s booth will highlight the company’s modular fixturing system for welding features, 3D tables, and a complete family of modular elements that can be assembled quickly and accurately to fixture just about any size and type of part. Shown will be how these systems can be used for fixturing for inspection, assembly, testing, and machining of large parts.

BMM Welding Material Co. 6032
www.bjmmt.com

BMM Welding Material will display its wide assortment of wires, rods, bars, and electrodes made from alloys of copper, aluminum, nickel, titanium, magnesium, hafnium, zirconium, tungsten, molybdenum, and silver. Also to be shown are its stainless steel wire, flux cored wire, gouging carbon electrodes, ceramic nozzles, beads, backing, and related products.

Bohler Welding Group USA, Inc. 7222
www.bohlerweldinggroupusa.com

Bohler Welding Group personnel will be at the booth to discuss your applications, specifications, and approvals needed by today’s international welding community for the petrochemical, power-generation, maintenance, and repair industries. Displayed will be the company’s electrodes, wires, strip, flux, and flux cored wires. Shown will be products from four brands: Bohler, T-PUT, Soudokay, and UTP.

Bolttech Mannings 7833
www.bolttchmannings.com

Bolttech Mannings will feature its on-site heat treating equipment and on-site hydraulic torquing, tensioning, stud-removal, and on-site machining services offered worldwide. Detailed will be its medium-frequency induction, high- or low-voltage resistance and high-velocity combustion heating technology. Showcased will be its solutions for preheating, postheating, stress relieving, and heat treating of materials to all recognized codes and special applications.

Bonal Technologies, Inc. 6365
www.bonal.com

Bonal Technologies will present its subharmonic vibratory technology of metal at its booth. Shown will be its Pulse Puddle Arc Welding equipment and the Meta-Lax 2700-CC computerized stress-relief equipment that offers less weld distortion, and cracking with greater ductility. Also displayed will be portable equipment for field use.

Bore Repair Systems, Inc. 7721
www.borerrepair.com

Bore Repair Systems will showcase its portable GMA bore welding machinery for on-site repair of worn bores on mining and construction equipment.

Bortech Corp. 6033
www.bortech.com
Bortech will detail its services working with companies that must make high-quality automated circular GMA overlay welds, quickly, for machine repair, corrosion protection, abrasion resistance, or repetitive circular fabrication applications. Detailed will be its machines that are capable of cladding bores, outside diameters, flange faces, or conical surfaces for use in heavy equipment repair, pump and valve repair, and heat-exchanger nozzle cladding with bore sizes from 1 in. to 12 ft.

Bosch Power Tool Corp. 7162
www.boschtools.com

The Bosch booth will display its complete line of power tools and power tool accessories including high-performance angle grinders, a complete line of cordless tools, shears, nibblers, and bench-top tools for welding and metal fabrication.

Bowlin Engineering 6444
www.bowlining.com

Bowlin Engineering will feature its services for building and installing water tables for cutting systems and downdraft, self-cleaning cutting tables.

Bradford Derustit Corp. 7108
www.derustit.com

Bradford Derustit will demonstrate its lines of metal cleaners, pickling, and passivation products, cleaners, and degreasers.

Broco, Inc. 7122
www.brocoinc.com

Broco and Rankin Industries will show a wide range of maintenance and repair welding, cutting and wear-resistant products. Featured will be exothermic cutting and underwater welding systems, and hardfacing and wear solutions products. Displayed will be a line of automatic and semiautomatic tungsten carbide vibratory feeder systems for GMAW applications.

Buffalo Shrink Wrap 7626
www.buffaloshrinkwrap.com

Buffalo Shrink Wrap will display its complete line of heavy-duty shrink wrap and application equipment for protecting items during shipping and storage. Shown will be an easy-to-learn, step-by-step process to protect items of any size or shape. Discuss your specific protection needs with personnel at the booth.

Cadi Co., Inc. 6148
www.cadicompany.com

Cadi will showcase its high-conductivity copper alloys for the manufacture of resistance welding products and related welding components, plastic mold tooling, and numerous other applications.

C.H. Symington & Co., Inc. 6125
www.chsymington.com

C.H. Symington will feature air-carbon-arc gouging torches for manual, semiautomatic, or fully digital automatic gouging systems. Also on display will be an exothermic cutting torch with the related consumables, cable connectors with a 600-A ground clamp, and a new product, the twist-valve bonnet assembly torch.

Carestream NDT 6120
(A Division of Carestream Health)
www.ndt.carestreamhealth.com

Carestream NDT will introduce its new line of X-ray systems for the non-destructive examination of metal products.

Bug-O-Systems/Cypress Welding 6555
www.bugo.com

Bug-O Systems/Cypress Welding Equipment will introduce the Bug-O Fill-o-matic welding machine at the show; a small but powerful trackless fillet welder with stitch, and/or oscillation capabilities. Also on display will be a new line of positioning, work-holding and material-handling equipment.

Burny-Kaliburn 7033
www.burny.com

The complementary product lines of Burny® and Kaliburn® will showcase an array of conventional and high current density plasma cutting systems, including CNC motion control solutions for use with plasma, oxyfuel, and waterjet cutting machines, as well as for routing, engraving, and dispensing equipment.

Buffalo Shrink Wrap will display its complete line of heavy-duty shrink wrap and application equipment for protecting items during shipping and storage. Shown will be an easy-to-learn, step-by-step process to protect items of any size or shape. Discuss your specific protection needs with personnel at the booth.
WONDER GEL
Stainless Steel Pickling Gel

Achieve maximum corrosion resistance to stainless steel. Surface contamination may drastically reduce the life of stainless steel. Wonder Gel removes (pickles) stubborn impurities, cleans the toughest slag, scale and heat discoloration and restores (passivates) the protective oxide layer.

See us at FABTECH booth # 7108

For info go to www.aws.org/ad-index

OCTOBER 2010
PHASED ARRAY FOR WELD INSPECTION

Phased Array imaging provides many benefits for weld inspectors: fast, easy, reproducible, and cost-effective. Olympus offers manual, semi-automated, and automated solutions for all your nondestructive weld inspection and code compliance needs.

OmniScan MXU-M Software
- Single-axis encoded or time-based C-scan
- Higher A-scan refresh rate
- Simplified user interface
- DAC/TCG, ASME, JIS, and DGS sizing curves
- AWS and API code wizards
- Weld Package option with RayTracing™ and Weld Overlay features

See us at Fabtech 2010, Booth 6015

For worldwide representation visit www.olympus-ims.com • info@olympusNDT.com
For info go to www.aws.org/ad-index
November 2, 2010

The Hottest thing in Direct Manufacturing

will be on display at

FABTECH 2010

Visit booth 7642 and Prepare for Impact!

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For Info go to www.aws.org/ad-index
Grinder Wheels!

DGP offers a complete line of high-quality, low-cost replacement diamond grinding wheels for nearly any tungsten electrode grinder on the market. DGP grinding wheels are in-stock, and ready to ship immediately. 

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www.diamondground.com
See us at FABTECH booth # 6455

Stop by The Chinese Mechanical Engineering Society booth to learn about its various technical products and consulting services.

Chinese Mechanical Engineering Society, The
6047
www.cmes.org/english.html

Stop by The Chinese Mechanical Engineering Society booth to learn about its various technical products and consulting services.

Clean Air America
7454
www.clean-air.com

Clean Air America will feature its complete line of air-filtration-related products, including turn-key solutions for promoting industrial air-quality. Representatives will be at the booth to discuss your specific needs.

Clean Air America
7454
www.clean-air.com

Clean Air America will feature its complete line of air-filtration-related products, including turn-key solutions for promoting industrial air-quality. Representatives will be at the booth to discuss your specific needs.

Cloos Robotic Welding, Inc.
7445
www.cloosrobot.com

Cloos Robotic Welding will feature its tandem welding and laser hybrid welding technologies implemented into state-of-the-art robotic systems.

Cloos Robotic Welding
7445
www.cloosrobot.com

Cloos Robotic Welding will feature its tandem welding and laser hybrid welding technologies implemented into state-of-the-art robotic systems.

COB Industries, Inc.
7632
www.cob-industries.com

COB Industries will display at the booth a selection of products from its lines of pipe freezing equipment, Argweld® weld-purging products, Techweld™ products, pipe plugs, pneumatic saws, Pro-Mag magnetic drills, and other specialized tools.

Computer Engineering, Inc.
6245
www.computereng.com

Stop by the Computer Engineering booth to see demonstrations of the latest next-generation welding documentation software.

Computers Unlimited
6362
www.cu.net

Computers Unlimited will demonstrate its Windows-based TIMS software, a fully integrated application for industrial, specialty gas, and welding supply distributors. Features include cylinder tracking/management; CRM and order processing for gases, hardgoods, and rental equipment; RF inventory and warehouse management; truck dispatching for route and load optimization, and point-of-delivery mobile computers; electronic vendor price updates, EDI and B2B e-commerce; document archiving/imaging, and dynamic data-analysis tools.

Corewire, Ltd.
7948
www.corewire.com

Corewire will display its lines of cored wires for hard-facing applications.

Coxreels, Inc.
7762
http://www.coxreels.com

Coxreels will feature its lines of heavy-duty industrial-grade hose, cord, and cable reels, including spring-retractable hose and cord reels, hand-crank and motor-driven hose, and the EZCoil® safety series retractable reels with controlled rewind.

CS Unitec, Inc.
7507
www.csunitec.com

CS UNITEC will feature a selection of products in its lines of pneumatic portable band saws, portable magnetic drills, hydraulic, electric and pneumatic band saws, pipe saws, sanders, polishers, surface-finishing tools, dust extraction tools, vacuum systems, metal finishing tools, and nonsparking hand-held tools.

COR-MET will showcase its wide selection of cored welding wires made from low-alloy steels and nickel- and cobalt-based alloys, in diameters ranging from 0.035 to 3/16 in. Shown will be products for high-temperature, and corrosion- and abrasion-resistance jobs, and joining, repairing, and overlay applications. Also, the company will show its shielded metal arc welding electrodes.

COR-MET, Inc.
7313
www.cor-met.com

COR-MET will showcase its wide selection of cored welding wires made from low-alloy steels and nickel- and cobalt-based alloys, in diameters ranging from 0.035 to 3/16 in. Shown will be products for high-temperature, and corrosion- and abrasion-resistance jobs, and joining, repairing, and overlay applications. Also, the company will show its shielded metal arc welding electrodes.

Coxreels, Inc.
7762
http://www.coxreels.com

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CS Unitec, Inc.
7507
www.csunitec.com

CS UNITEC will feature a selection of products in its lines of pneumatic portable band saws, portable magnetic drills, hydraulic, electric and pneumatic band saws, pipe saws, sanders, polishers, surface-finishing tools, dust extraction tools, vacuum systems, metal finishing tools, and nonsparking hand-held tools.
For Highly Alloyed Tube & Pipe

- Fully portable for on-site work
- Self-centering and easy to setup
- Torque-free and field-proven
- Pulls thick chip without cutting oils
- Bevels, faces and bores simultaneously
- Performs any angle of welding end prep
- Rugged, totally sealed construction

For sale or rent, 24 hour shipment or less usually available

See us at FABTECH booth # 3253

For info go to www.aws.org/ad-index
Switch from weld to grind in a matter of seconds.

You can’t afford downtime and lost productivity when workers switch between welding and grinding jobs. So we developed our Fibre-Metal QuickSwitch System to go from one job to the other in just a few seconds. This system delivers high-performance head, face, and eye protection, along with all-day comfort – no matter how often workers switch between tasks. Let the Fibre-Metal QuickSwitch System help make your business safer and more productive. For a free demo, contact one of our safety experts today at 888-422-3798.

Take the QuickSwitch Speed Challenge!

How fast can you switch? Find out at our booth at FABTECH in Atlanta, November 2-4, 2010. Winners of fastest time each hour will receive valuable Fibre-Metal head, face and eye protection equipment, plus a chance to win an Apple iPad!

Only Fibre-Metal QuickSwitch System offers two mounting designs to match your work requirements: Speedy™ Mounting Loop and Quick-Lok™ – plus industry-preferred SuperEight™ SwingStrap™ caps.

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For Info go to www.aws.org/ad-index
Thirty-five years of listening to our customers and continuous product improvement have led to the Pipemaster 515 and D-Head. The system welds pipe from 1”-14” (tubes from 1”-5” OD).

Let us demonstrate how you can increase your productivity and lower defect rates with the high duty cycle that only machine welding can achieve.

Worldwide installations in daily use prove that there is a better way.

For Info go to www.aws.org/ad-index

See us at FABTECH booth #7543

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Hobart Institute of Welding Technology offers our comprehensive Technical Training courses throughout the year!

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Prep for AWS Welding Inspector/Educator Exam
Visual Inspection
Welding for the Non Welder
Arc Welding Inspection & Quality Control
Weldability of Metals, Ferrous & Nonferrous
Liquid Penetrant & Magnetic Particle Inspection

Visit www.welding.org for more information.

Visit us at FABTECH booth # 7009
For info go to www.aws.org/ad-index
Eddie Kane Steel Products 7639
www.eddiekanesteel.com

E.H. Wachs 7011
www.ehwachs.com

E. H. Wachs will introduce its new EP 424, an ID mount end prep machine designed to bevel, compound bevel, J prep, face, and counterbore pipe, fittings, and valves, and which features the speed prep autofeed system. The company will also feature its diverse line of portable pipe construction and maintenance tools for cutting, squaring, beveling, and facing pipe, tube and vessels.

Electron Beam Technologies, Inc. 6249
www.electronbeam.com

Electron Beam Technologies will exhibit its new EB-flex, electron beam cross-linked welding cable, which is made in the USA. Fast ‘N Easy bulk electrode accessories will be available and demonstrated for large welding wire packs, reducing downtime due to wire changes. The latest innovations in OEM GMAW/FCAW composite coaxial cables will be presented. Engineers will be available to answer questions.

Environmental Air Solutions 6016
www.keeptheless.com

The company will feature its KeepTheHeat™ air-to-air heat exchanger, which recycles heat and provides ventilation without losing heat.

EPE, Inc. 7215
www.everlastwelders.com

ESAB Welding and Cutting Products 6521, 6611, 8039
www.esabna.com

ESAB will highlight its complete line of welding and cutting equipment and filler metals for virtually every welding and cutting application. Featured will be small and large gantry shape-cutting machines with oxyfuel, plasma, laser, and waterjet processes, arc welding equipment, automated welding lines, plasma cutting machines, gas apparatus, filler metals, and more.

Essen Trade Shows 7718
www.essentradeshows.com

Fab Tool Technologies 6358
www.fabtooltechnologies.com

FANUC Robotics America, Inc. 6655
www.fanucrobotics.com

FANUC Robotics America will feature its more than 200 robot variations working in a wide range of industries including aerospace, alternative energy, automotive, consumer goods, food, pharmaceuticals, and medical devices. The company will also present its simulation packages, application software, controls, and integrated vision products.

Fastenal Co. 7727
www.fastenal.com

Fastenal will promote its extensive fastener distribution services that include a custom mix of immediately available inventory spanning 17 product lines, along with inventory control solutions ranging from bin-stocks to point-of-use vending, as well as services for custom manufacturing, cut-to-length metals, weld-to-length bandsaws, and fastener engineering and design support. The company has more than 2400 stores in North America.

Fein Power Tools, Inc. 6155
www.feinus.com

Fein will highlight its innovative tools for metalworking, the automotive industry, and interior remodeling. The company will emphasize its GRIT grinder with a unique modular system; basic belt grinders and mounted modules designed for specific tasks; the GRIT GX program for use in small workshops; and the GRIT GI program designed for industrial use.

Fibre-Metal/By Honeywell 7419
www.northsafety.com

Flame Technologies, Inc. 6627
www.flametechnologies.com

Flame Tech will launch its entirely new point-of-purchase approach for gas apparatus products. The company's new welding, cutting, and brazing outfits are now packaged in free heavy-duty canvas toolbags, providing contractors storage for cutting attachments, torch handles, cutting/welding tips, and other tools/equipment.
START TO FINISH

HIGH QUALITY, HIGHLY PRODUCTIVE ABRASIVES FOR CUTTING, GRINDING, BLENDING, and FINISHING

www.mercerabrasives.com

Visit us at booth # 6322

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“I converted my conventional plasma torch to HD* and saved up to $70,000”

“I got amazing cut quality with faster cutting speeds, reduced cleaning time, and longer lasting consumables. It meant less labor time, and a higher production rate. Over all I could not be more pleased with the product. Best of all I had no big capital outlay.”

Nick Skrumeda
Plant Manager
Brunswick Steel

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See us at FABTECH booth #7547
Bug-O / Magswitch
A new way to improve productivity.

Bug-O Systems proudly announces a new line of Bug-O Magswitch on-off magnet bars, lifting magnets and accessories.

Magswitch Advantages:
- Saves time and money.
- Faster/easier grounding.
- Replaces clamps.
- Welding angles that stay clean.
- Super strong, controllable hold.
- Fast and easy material handling.
- Fast, precise positioning and workholding.

Call: 1-800-245-3186
Visit: www.bugo.com

BUG-O SYSTEMS
161 Hillpointe Drive
Canonsburg, PA 15317 USA
http://www.bugo.com

Folding Guard Corp.
7826
www.foldingguard.com

Folding Guard will premier its reliable engineered safety solutions, which include machine perimeter guarding comprised of frame welded wire panels, posts, doors, cable trays, wire chases, interlocks/interconnects, and light curtains. The systems meet or exceed current ANSI, OSHA, Canadian, and all European standards.

Freer Tool & Supply
7059
www.freertool.com

Frommelt Safety Products
6448
www.frommeltsafety.com

Frommelt Safety Products will feature a complete line of robotic and welding safety products including Category 4 interlocked automated barrier doors for robotic work cells, perimeter fencing, air filtration products, and fabric area protection. New products will be introduced including fabric enclosures for fume containment and unique solutions for robotic guarding.

Fronius USA LLC
7221
www.fronius-usa.com

Fronius will premier its high-frequency welding technology ranging from compact shielded metal arc, gas metal arc, and gas tungsten arc welding machines to complex automated welding systems and spot welding. The company’s products are manufactured according to product standards, UL/CSA approval, and ISO 9001 standards.

Fusion, Inc.
6248
www.fusion-inc.com

Fusion will showcase its 40 years of providing automation solutions to manufacturers engaged in production brazing and soldering. The company will emphasize its approach to automating an application, which includes paste alloys, applicator equipment, and automatic machines with the intent of reducing costs and increasing productivity.

FW Gartner
6411
www.fwgts.com

G&J Hall Tools, Inc.
7759
www.gjhalltools.com

Garg Sales, Inc.
7813
www.gargwire.com

Gasflux Co.
7805
www.gasflux.com

Gasflux will promote its specialized process of introducing a flux automatically into the flame for torch brazing in most manual or automatic brazing systems. The company will also feature its fluxes in paste and powder forms for low-, medium-, and high-temperature braze applications, along with a supply of quality braze alloys.

Genstar Technologies Co., Inc.
7519
www.genstartech.com

Genstar Technologies will highlight its cutting and welding machines, high-quality pressure regulators, fittings, valves, welding apparatus, and various gas control and handling devices with distribution in 40 countries. Products are manufactured in an ISO 9001 certified facility.
GAS SAFETY SOLUTIONS

Let us build a solution for your compressed gas applications.

- Flashback Arresters
- Quick Connectors
- Custom Heating Solutions
- Gas Manifold Equipment

Stop by our FABTECH/AWS booth #7755 for a FREE oxy/fuel gas safety demonstration!

Goss’s Enterprises
www.industrialcurtains.com/fabtech

Goff’s will showcase its welding curtains and screens designed to withstand tough shop environments. Welding curtains and screens are custom made; constructed of strong, lightweight, extruded aluminum frame; block 100% UV light; and flame retardant.

Golden Eagle Minmetals (Beijing) Widg Materials Co.
www.alloywelding.com.cn

Goodtime Industry Ltd.
www.goodtime.com

Goss, Inc.
www.gossonline.com

Goss will feature its complete line of quality cutting, welding, brazing, soldering, and heating tools that can be used in a variety of applications, manufactured for 70 years.

Gullco International
www.gullco.com

Gullco International will premier its automatic welding carriages, cutting carriages, welding automation, and accessories. The company will also feature services it provides through company-owned branches in many countries, as well as through an extensive worldwide distributor network.

HAI Advanced Materials Specialists
www.halams.com

Hangzhou Appollo Import & Export Co. Ltd.

Harbert’s Products, Inc./Allied Flux Reclaiming Ltd.
www.recycleflux.com

Harbert’s Products and Allied Flux Reclaiming will feature a custom closed-loop SAW flux/slack crushing (reclaiming/recycling) service, which saves money, is environmentally friendly, and performs as new.

Harper Trucks, Inc.
www.harpertrucks.com

Harris Products Group, The
www.harrisproducts.com

The Harris Products, a Lincoln Electric Co., will highlight its design, development, and manufacture of cutting, welding, brazing, and soldering equipment and consumables and gas distribution systems.

HC Starck
www.hcstarck.com

Hermes Abrasives Ltd.
www.hermesabrasives.com

Hermes Abrasives will feature its industrial-grade coated abrasive products for a wide variety of wet or dry metalworking applications.
Hobart Institute will showcase its staff of seasoned professionals who offer advanced training in all major welding processes for the new student, as well as certifications and/or technical training for welders looking to advance their skills. Customized training for corporate welding needs is available on or off site. A wide selection of world-class welding training and educational materials are available for training or reference use.

Hot Coils will feature its new technology for a cost-effective, accurate, safe, and environmentally friendly method for hydrocarbon bake-out or preheat for pipe prior to welding.

Hypertherm will highlight its products for every metal cutting need, including handheld systems for portability and versatility, mechanized systems for around the clock work in highly demanding environments, and controller and nesting software for increased productivity and lower material costs.

SuperFlash Compressed Gas Equipment/IBEDA will offer free oxyfuel safety demonstrations, which will provide safety information for gas users of all types. The company will also feature several new product lines, including a two-gas blender, a line of chemicals for compressed gas use, and the next generation of quick-connectors for oxygen, fuel gas, and inert gas.

Impact Engineering will be exhibiting its arc weld monitoring equipment with an emphasis on the ARCAgent™ product family for manual, fixed, and robotic welding. This family provides monitoring for procedure qualification, auditing, missing weld detection, process control, and weld fault detection.

In-House Solutions will feature its robotic software, support, tutorials, and training for CNC manufacturing industries and educational facilities. The company will highlight its Robot-
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<th>Company</th>
<th>Phone</th>
<th>Website</th>
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<td>CONCOA Cryogenic Solutions: Efficiency via Technology</td>
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<td>CONCOA Intelliswitch II</td>
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<td>Master CAD/CAM-based offline programming software that integrates robot programming, simulation, and code generation. Applications including trimming, deburring, deflashing, grinding, and mold machining.</td>
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<thead>
<tr>
<th>Company</th>
<th>Phone</th>
<th>Website</th>
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<tbody>
<tr>
<td>Indura SA</td>
<td>7840</td>
<td><a href="http://www.indura.net">www.indura.net</a></td>
</tr>
<tr>
<td>Industrial Air Solutions &amp; Coral SPA</td>
<td>7954</td>
<td><a href="http://www.industrialairsolutions.com">www.industrialairsolutions.com</a></td>
</tr>
<tr>
<td>Innerspec Technologies</td>
<td>6121</td>
<td><a href="http://www.innerspec.com">www.innerspec.com</a></td>
</tr>
<tr>
<td>Innerspec Technologies will feature its ultrasonic electro-magnetic acoustic transducer (EMAT) technology for nondestructive testing of metallic parts and components. EMAT technology does not require couplant, is not affected by surface conditions, permits easier deployment of probes, and it can generate unique wave modes.</td>
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<tr>
<td>Innov-X Systems</td>
<td>6165</td>
<td><a href="http://www.innovx.com">www.innovx.com</a></td>
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<tr>
<td>The company will highlight the world’s smallest and lightest analyzers for nondestructive metals analysis. It will feature the Innov-X handheld XRF analyzer designed for in-field testing, and provides on-site alloy chemistry and grade ID for stainless, Ni/Cr, high temps, exotics, catalysts, coatings, precious metals, and thin wire.</td>
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<tr>
<td>Insights &amp; Research</td>
<td>7641</td>
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<tr>
<td>Insights and Research will conduct a marketing research survey. The company wants your opinion. Come by and see if you qualify for the study.</td>
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<tr>
<td>Instrument Technology, Inc.</td>
<td>7440</td>
<td><a href="http://www.scopes.com">www.scopes.com</a></td>
</tr>
<tr>
<td>Interactive Safety Product, Inc.</td>
<td>7711</td>
<td><a href="http://www.helmetsystems.com">www.helmetsystems.com</a></td>
</tr>
<tr>
<td>Intercon Enterprises, Inc.</td>
<td>7738</td>
<td><a href="http://www.intercononline.com">www.intercononline.com</a></td>
</tr>
<tr>
<td>International Welding Technologies, Inc.</td>
<td>6026</td>
<td><a href="http://www.internationalwelding.com">www.internationalwelding.com</a></td>
</tr>
<tr>
<td>The company will feature its complete line of stud welding equipment and fasteners, including for special-purpose equipment.</td>
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<tr>
<td>InterTest, Inc.</td>
<td>7767</td>
<td><a href="http://www.intertestinc.com">www.intertestinc.com</a></td>
</tr>
<tr>
<td>InterTest will launch its specialized vision products, remote visual inspection (RVI) tools, and nondestructive testing (NDT) equipment, including borescopes and fiberscopes. The company will feature its iShot Imaging brand and its capabilities at providing custom solutions to view and access areas previously out of reach.</td>
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<tr>
<td>IPG Photonics</td>
<td>7203</td>
<td><a href="http://www.ipgphotonics.com">www.ipgphotonics.com</a></td>
</tr>
<tr>
<td>IPG Photonics will showcase its high-power industrial fiber lasers, diodes, and amplifiers operating from 10 W to more than 50 kW for applications such as materials processing, telecommunications, medical, and other advanced applications.</td>
<td></td>
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<tr>
<td>Iq Valves</td>
<td>7712</td>
<td><a href="http://www.iqvalves.com">www.iqvalves.com</a></td>
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<tr>
<td>Ironworkers Management</td>
<td></td>
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<tr>
<td>Ironworkers Management Progressive Action Cooperative Trust (IMPACT)</td>
<td>8054</td>
<td><a href="http://www.impact-net.org">www.impact-net.org</a></td>
</tr>
<tr>
<td>IMPACT is a labor management Taft Hartley trust whose primary mission is to expand job opportunities for union Ironworkers and their signatory contractors through progressive and innovative labor management cooperative programs.</td>
<td></td>
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<tr>
<td>Jasic Technology Co. Ltd.</td>
<td>7317</td>
<td><a href="http://www.jasic.com.cn">www.jasic.com.cn</a></td>
</tr>
<tr>
<td>Jasic Technology will feature its complete line of welding equipment including inverter welding machines, welding generators, pipe handling equipment, and automation systems.</td>
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<tr>
<td>Jayesh Industries Ltd.</td>
<td>6442</td>
<td><a href="http://www.jayeshgroup.com">www.jayeshgroup.com</a></td>
</tr>
<tr>
<td>Jasic Technology will feature its complete line of welding equipment including inverter welding machines, welding generators, pipe handling equipment, and automation systems.</td>
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Can YOU Afford to Pay 2 Margins? One for the **Actual** Manufacturer

AND

**One for Blue & Red**

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May 11-12, 2011

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- Agriculture
- Contract Manufacturing
- Construction
- Heavy Equipment
- And more!

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For AWS Weldmex exhibitor information, visit www.awsweldmex.com or call (305) 443-9353 ext 297

American Welding Society®

See us at FABTECH booth #8003
High-Temperature Filler Metals
- Powders, Rods, Pastes (Application by Screen Print, Roller coating, Stencil, Spray or Extrude), Transfer Tape and Sheet
  - Nickel (Nicrobraz)
  - Iron (Niferobraze)
  - Copper (CuBraz•)
- Forms: Gas Atomized

Special Applications
- EXP materials - Custom formulations

Application Systems
- NicroSpray®

Quality
- On-site Chemical and Metallurgical Laboratory

Brazing Aids
- Nicrobraz Flux
- Nicrobraz Cements
- Nicrobraz Stop-Off™ Materials
- NicroBlasta. Grit
- Nicrogap• Alloys

Brazing School
- May 11-13 & November 16-18, 2010: 3 day training course in Cincinnati, OH. Thorough training on furnace brazing. Includes practical experience on the shop floor

For Technical Services and Brazing School Registration
Contact: Lydia Lee, MME, MBA
Director of the Brazing Engineering Center
Phone: 248-585-6400 ext. 252
E-mail: lydialee.brazing@wallcolmonoy.com

www.wallcolmonoy.com/brazing

Jayesh Group will emphasize its capabilities in manufacturing, importing, and exporting ferro alloys, metals, minerals, and chemicals for the welding electrode industry, steel plants, and foundries.

JAZ USA Inc. & Bullard Abrasives, Inc. 7248
www.jazusa.com

JAZ USA, a wholly owned subsidiary of JAZ-ZUBIAURRE, S.A., will feature its wire brushes, which includes a wide range of industrial power brushes, tube brushes, hand scratch brushes, and engineered brushes for specific application needs manufactured to ISO 9001:2000 standards.

Jetline Engineering 7019
www.jetline.com

Jingyu Welding & Cutting Co. Ltd. 6138
www.jingyuwelding.com

The company will highlight its welding and cutting products for GTAW, GMAW, and PAC along with spare parts, electrode holders, gouging torches, earth clamps, amphenol plugs, and welding masks.

Jlc Electromet 7841
www.jlcelectromet.com

John Tillman Co. 7655
www.jtillman.com

Add Water
To A Promising New Career Today In Commercial Diving
The Highest Level of Certifications at The Most Prestigious Academy With A 35 Year Reputation.
Aim High, Dive Deep, Train In 5 Months for A Rewarding And Unique Career.
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The Nissen FELTIP PAINT MARKER has been designed for heavy industrial use, where a clean or dry surface very rarely exists. Even under these conditions, the durable tip, and paint will mark on almost any surface.

- Specifically formulated to write through oil and water.
- The UV resistant marks will not chip, peel, or fade.
- Marks will withstand temperatures in excess of 500°F.
- Marking Range -40°F to 200°F.

For info go to www.aws.org/ad-index

Falltech Corporate    7821
www.falltech.com

For a free sample of this product, please visit us at www.nissenmarkers.com/offers/aws

See us at FABTECH booth #7105

Tillman will highlight its 80 years of supplying industry with more than 2000 welding protective items including gloves, clothing, blankets, screens, and accessories.

Joysun Abrasives Co. Ltd. 7163
www.joysunabrasives.com

JP Nissen Co.
www.nissenmarkers.com

Nissen will feature its full product lines of ballpoint metal markers, Feltip paint markers, solid paint markers, low chloride markers, and specialty paint markers for use in any marking application and to fill the needs of professionals.

Kamman Group 7654
www.kammangroup.com

Kamman Group will showcase its capabilities as a producer and exporter of quality ferro alloys, metal powders, metals, and minerals and chemicals in powder form for the requirements of welding electrode and hardfacing industries, providing critical raw materials in customized sizes.

Kawasaki Robotics (USA), Inc. 7314
www.kawasakirobotics.com

Kawasaki Robotics will emphasize its robots and systems with the debut of the new R-Series robots and E controller, providing reliability, speed, and simple maintenance. With over 88,000 installations worldwide, the company has expertise in a vast range of applications throughout a multitude of industries.

Kimberly-Clark Professional/Jackson Safety 7265
www.kcc.com

Kimberly-Clark Professional and Jackson Safety will highlight their lines of products for safety needs, including personal protective equipment, welding safety products, and work zone solutions. The company will offer a range of products from welding helmets with autodarkening technology, to a comprehensive range of safety eyewear and goggles, road safety, and worker visibility solutions.

Kobelco Welding of America, Inc. 6524
www.kobelcowelding.com

Kobelco will feature flux cored welding wires and introduce its new high-nickel alloy flux cored wire DW-N625 (ENiCrMo3T1-4), and super-duplex flux cored wire DW-2594 as well as an extremely low-fume E70C-6M metal cored wire.

Koike Aronson, Inc./Ransome 6855
www.koike.com

Koike Aronson/Ransome will showcase its cutting machines, welding positioning equipment, portable welding and cutting machines, and gas apparatus. The company will introduce Plate-Pro Extreme, a new dual-side drive, plasma and oxyfuel cutting machine. There will also be multiple new products exhibited and demonstrated from each product line.

KUKA Robotics Corp. 7363
www.kukarobotics.com

KUKA Robotics will be demonstrating innovative welding solutions that will provide information on decreasing cycle times, increasing throughput, and improving quality and uptime with robotic automation.

LA-CO Industries/Markal 7202
www.markal.com

LA-CO/Markal will feature a complete line of high-performance marking products, which include solid paint markers, liquid paint markers, felt-tip ink markers, metal markers, and temperature indicators all designed to meet difficult industrial marking applications.
More Than 50 Low Alloy Electrodes to Meet Your Specs.

Select-Arc Delivers

When your critical welding requirements demand a high quality, low alloy gas-shielded, flux cored electrode, insist on specifying Select-Arc. Select-Arc offers an expanding lineup of over 50 premium wires specially designed for welding low alloy and high strength steels. Whatever your application - from bridge construction to oil exploration equipment, pressure vessels to petroleum plants, mining machinery to submarines, and so many others - we can provide the flat and horizontal or all position low alloy electrode that is ideally suited to handle your individual need.

Select-Arc’s comprehensive selection of low alloy electrode grades includes:

- Nickel Bearing
- Nickel-Molybdenum Bearing
- Nickel-Molybdenum-Chromium Bearing
- Manganese-Molybdenum Bearing
- Carbon-Molybdenum Bearing
- Chromium-Molybdenum Bearing
- Weathering Steel

For more information on choosing the Select-Arc low alloy electrode that is just right for your specific welding requirement, call us today at 1-800-341-5215 or visit our website at www.select-arc.com.
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Since 1984 INDURA cares about manufacturing top quality mig wire ER70S-6, maintaining the most strict quality and care for the environment (ISO 14001).

We care on training and assisting our distributors to implement technological solutions to its customers, to be more efficient and profitable. Our client’s challenges become our challenges.

With warehouses strategically located throughout the country, INDURA cares on timely, efficient, and cost-effective distribution, so our customers may devote their time, capital and resources to their core business and those things they do best. INDURA mig wire is delivered just in time.

INDURA wire is annually approved by: American Bureau of Shipping, Lloyd’s Register of Shipping, Bureau Veritas, Germanisher Lloyd’s, Det Norske Veritas, Canadian Welding Bureau.

For Info go to www.aws.org/ad-index
See us at FABTECH booth #7840
Laserage Technology Corp. 7113
www.laserage.com

Laserage will feature its CO₂, Nd:YAG, and fiber laser systems that precisely cut, drill, scribe, weld, and heat treat a wide variety of materials including ceramics, composites, plastics, glass, rubber, metal, and most materials, with capabilities in medical implants, medical instruments, electronic substrates, and aerospace flight critical assemblies.

Liburdi Dimetrics Corp. 6516
www.liburdi.com

Liburdi Dimetrics will highlight its extensive range of advanced technology orbital welding products including high-precision, vision-based LAWS, Dabber, and Pulsweld power sources, multiaxis articulated motion systems, and controllers for applications in turbine, aerospace, nuclear, industrial, and automotive industries.

Lincoln Electric Co. 6633, 6640, 6642
www.lincolnelectric.com

Lincoln Electric will premier its design, development, and manufacture of arc welding products, robotic arc welding systems, welding fume control equipment, and plasma and oxy-fuel cutting equipment, as well as brazing and soldering alloys.

Mactech, Inc. 7719
www.mactechonsite.com

Mactech, an on-site machining and heat-treating service company, will offer sales, service, and rental information on all of its equipment. The company will also provide technical support as well as designing equipment solutions.

Magnetech LLC 7543
www.magnatechllc.com

Magnetech will display equipment for orbital tube/pipe welding applications. A range of models provides the precision, consistency, and high-duty cycle of GTAW/FCAW machine welding. The Tubemaster power source with Auto-program will be demonstrated welding sanitary stainless tubing. The company’s Pipemaster for multipass welding will also be featured.

Magnegas Corp. 7837
www.magnegas.com

MagneGas Corp. will feature its metal joining products and services such as alloys, fluxes, automated equipment, product design, training and technical assistance, and brazing and soldering materials to the electrical/electronic, appliance, and transportation markets worldwide.

Lord Corp. 7210
www.LORD.com

Lord will showcase its high-strength structural adhesives that bond a variety of dissimilar materials, thin-gauge metals, composite, plastic, wood, rubber, and glass.

Lucas Milhaupt, Global Brazing Solutions 6467
www.lucasmilhaupt.com

Lucas-Milhaupt, a Handy & Harman Co., will feature its metal joining products and services such as alloys, fluxes, automated equipment, product design, training and technical assistance, and brazing and soldering materials to the electrical/electronic, appliance, and transportation markets worldwide.

Luvata Ohio, Inc. 6333
www.luvata.com

Mactech, Inc. will premier its design, development, and manufacture of arc welding products, robotic arc welding systems, welding fume control equipment, and plasma and oxy-fuel cutting equipment, as well as brazing and soldering alloys.

Magnegas Corp. will feature its metal joining products and services such as alloys, fluxes, automated equipment, product design, training and technical assistance, and brazing and soldering materials to the electrical/electronic, appliance, and transportation markets worldwide.

Lord will showcase its high-strength structural adhesives that bond a variety of dissimilar materials, thin-gauge metals, composite, plastic, wood, rubber, and glass.

Laserage will feature its CO₂, Nd:YAG, and fiber laser systems that precisely cut, drill, scribe, weld, and heat treat a wide variety of materials including ceramics, composites, plastics, glass, rubber, metal, and most materials, with capabilities in medical implants, medical instruments, electronic substrates, and aerospace flight critical assemblies.

Liburdi Dimetrics will highlight its extensive range of advanced technology orbital welding products including high-precision, vision-based LAWS, Dabber, and Pulsweld power sources, multiaxis articulated motion systems, and controllers for applications in turbine, aerospace, nuclear, industrial, and automotive industries.

Lincoln Electric Co. will premier its design, development, and manufacture of arc welding products, robotic arc welding systems, welding fume control equipment, and plasma and oxy-fuel cutting equipment, as well as brazing and soldering alloys.

Mactech, Inc. will premier its design, development, and manufacture of arc welding products, robotic arc welding systems, welding fume control equipment, and plasma and oxy-fuel cutting equipment, as well as brazing and soldering alloys.
Mathey Dearman, Inc.
www.mathey.com

Mathey Dearman will exhibit its patented cutting and beveling machines for all types of pipe and pipe diameters along with pipe alignment and reforming clamps for welders and pipeliners requiring fast, accurate fitups.

Matuschek Welding Products, Inc.
www.matuschek.com

Matuschek Welding Products will showcase the weld quality and cost savings benefits of its real-time Master® adaptive control technology for resistance spot welding. Also displayed will be its mid- and high-frequency inverter power supplies for sheet metal welding and microwelding, including precision weld heads and hand-held process analyzers. The company’s controllers offer adaptive feedback, QC software solutions, tolerance band control, and fault alert capabilities.

Maxal, Inc.
www.maxalinc.com

Mercer Abrasives
www.mercerabrasives.com

Mercer Abrasives will showcase its industrial files. New to the company’s line is the Spot Welder Tip File. This 10-in. file is designed to clean welder tips to increase effectiveness and extend life. The file has a cut edge on the concave side and a safe edge on the other. The company will also highlight its flap discs, grinding wheels, and wire wheels for welders.

Meta Vision Systems, Inc.
www.meta-mvs.com

Metabo Corp.
www.metabousa.com

Metabo will offer its power tools and abrasives.

Metallizing Equipment Co.
PVT Ltd.
www.mecpl.com

Metallizing Equipment will feature its thermal spray products, including HVOF as well as arc, rod, and flame sprays.

Metals & Materials Engineers
www.mmelab.com

Micro Air Clean Air Systems
www.microaironline.com

Micro Air will present its line of industrial air cleaners, dust collectors, portable collectors, downdraft tables, clean air booths, source capture arms, and mist collectors. The company will also be introducing its new line of MISTMAX extended life, high-efficiency mist collectors. All equipment is built to fit customer’s specific needs, fabricated to boost productivity, increase safety, and reduce maintenance costs.

Midalloy
www.midalloy.com

Midwesco Filter Resources, Inc.
www.midwescofilter.com

Miller Electric Mfg. Co.
www.millerwelds.com

Miller Electric will present its arc welding and welding safety equipment for fabrication, manufacturing, general metalworking, construction, maintenance, and other applications.

Mission Air Systems LLC
www.missionairsystems.com

Mission Air Systems will focus on heavy-duty and challenging situations involving the treatment of air for occupational health and equipment reliability purposes. This can involve any or all of the following: particulate, chemical, climate control, and energy recovery systems.

MK Products, Inc.
www.mkproducts.com
Our world class manufacturing plant in Florence, Kentucky is a showplace for producing the highest quality welding materials in North America.

Visit our website at:
www.kiswelweldingproducts.com

Our products are sold through one of our fine distributors in your area. Call our office for one near you.

Visit our website at:
www.kiswelweldingproducts.com

Mild Steel Covered Electrodes
Mild Steel & Low Alloy Flux Cored Wires
Mild Steel & Low Alloy TIG & MIG Wires

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General Office Phone: 859.371.0070  Fax: 859.371.5210  Email: kiswel@kiswelusa.com
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- Mild steel flux-cored wire
- Mild steel solid wire

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www.kobelcowelding.com

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View Automated Welds in Real Time!

Record & view the electrode, arc, puddle, joint and surrounding base material before, during and after the welding process with the V2010-UDR Weld Analysis Video System.

The V2010-UDR video system is specially designed to work in the blinding light of arc and laser welding. With a dynamic-range of 1,000,000-to-1, the camera can capture both arc light and metal without the need for special “spot” darkening filters. Detailed video can be viewed live or digitally recorded at the full dynamic range for later analysis or archiving. Save standard JPEG stills or AVI video files, suitable for e-mail. The V2010-UDR system is turnkey and ready-to-run, including software, laptop computer and camera. Visit www.intertest.com, or call 908-496-8008 for more information.

FabTech Booth #7767 • Atlanta, GA • Nov. 2 - 4, 2010
908-496-8008 • 800-535-3626 • Monday - Friday 8am - 5pm est.
Call us today to schedule a demonstration!

Motoman Robotics
www.motoman.com
Motoman’s booth will feature several new robots. The SDA10 dual-arm robot with human-like flexibility is ideally suited for assembly, part transfer, machine tending, packaging, and other handling tasks that formerly could only be done by people. The flexible, 7-axis VA1400 and the slim, 6-axis MA1400 welding robots are both ideal for use in high-density workcells with multiple robots working in close proximity and also for applications requiring access to parts in tight spots.

MTA USA
www.mta-usa.com
MTA USA will display its water chillers.

MultiView, Inc.
www.multiview.com

Nation Coating Systems, Inc.
www.nationcoatingsystems.com
Nation Coating Systems will highlight its thermal spray samples and polymer coating.

www.nomma.org

National Standard LLC
www.nationalstandard.com

For info go to www.aws.org/ad-index

Thermal Spray Technology Highlighted At Fabtech Show

Thermal Spray Basics
Free Tutorial • 1:00 - 5:00 PM
Tuesday, November 2, 2010 • Registration Code: W38

Thermal Spray Technologies:
High Performance Surfaces Conference
4 Sessions, 14 Speakers • 9:00 AM - 4:00 PM
Wednesday, November 3, 2010 • Registration Code: W23

Thermal Spray Pavilion Exhibitors
November 2-4, 2010 • Visit Aisle 6400 Hall C
Visit www.fabtechexpo.com to Register

International Thermal Spray Association
440.357.5400 • ITSA@thermalspray.org
www.thermalspray.org

For info go to www.aws.org/ad-index
National Standard will be introducing its TrueCore flux cored welding wire line of products as well as the Smart Pak bulk weld wire package, which is 100% recyclable as corrugated (no staples or metal rings) with the added feature of being able to accommodate the three primary wire payout systems: direct pull, round cone, and square base with round cone.

**Nederman USA** 7607
www.nederman.com

Nederman, a company focused on providing solutions for a cleaner and safer work environment, will exhibit its products used in capturing and filtering welding smoke; extracting and filtration of particles from cutting and grinding, filtration, and cleaning of oil mist; and a line of hose and cable reels for air/water and electricity delivery.

**Nelson Stud Welding** 6532
www.nelsonstudiwelding.com

**New Fire Co. Ltd.** 6339
www.newfire.biz

New Fire will feature its industrial thermal insulating, welding and cutting, and safety protector products.

**Newland (Tianjin) Welding** 6040
www.groco.cn

**Nimak Braeuer North America, Inc.** 7745
www.nimak.us

**Ningbo Kimpin Industrial Pte. Ltd.** 6136
www.kimpin.com

**Ningbo Powerway Alloy Material Co. Ltd.** 7118
www.pwalloy.com

**Nordfab Ducting** 7663
www.nordfab.com

Nordfab Ducting will display its ducting ideally suited for dust, mist, and fume collection. The company’s Quick-Fit (Q-F) ducting installs quickly, is adaptable to existing ducting, is reusable, and can be taken apart for cleaning and reconfigured without tools.

**North (Nanjing) Instrument Technology Industries Group** 7710
www.northgroup.cn

**Norton/Saint Gobain Abrasives** 7633
www.nortonindustrial.com

Norton will showcase its abrasive products that are engineered to give excellent performance for specific applications classified in good, better, and best performance/price tiers.

**NSRW** 7832
www.nsrw.com

**Ocean Machinery, Inc.** 7933
www.oceanmachinery.com

Ocean Machinery will spotlight its welding positioning and beam turning device.
REDEFINING WELDER PROTECTION.

HEAD & FACE | HAND & BODY | RESPIRATORY | HEAT STRESS

Experience the Arc Armor™ Difference.

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MillerWelds.com

See us at FABTECH booth #6811
Developers of new welding consumables are very busy keeping up with the pace of industry. This one-day conference at FABTECH Atlanta will cover new gas mixtures and filler metals for materials such as creep strength enhanced ferritic steels, lean duplex stainless, and ferritic/austenitic dissimilar welds. Industries like wind towers will also be covered, as well as numerous processes, such as hardfacing, FCAW, and metal core.

For the latest conference information, visit our website at www.aws.org/conferences or call 800-443-9353, ext. 264.
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FROM 1/8” TO 3”

8 PC. SET
1-1/8” TO 2”

8 PC. SET
2-1/8” TO 3”

7 PC. SET
1/8” TO 1”

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Email: info@galgage.com • Web: www.galgage.com

OKI Bering
www.oki-bering.com

Olympus
www.olympus-ims.com

Olympus will provide ultrasonic testing, phased array, eddy current, remote visual inspection and high-speed video, and related support technologies that can be used to survey the quality and integrity of construction welds such as those in pipelines and bridges, as well as sheet metal spot welds and certain other weld geometries found in manufacturing.

Osborn-JacksonLea
6210, 706
www.osborn.com

Osborn-JacksonLea-Jason Finishing Group will feature a full finishing product line, including Novoflex flexible honing tools, Uni-Lok® composite disc brushes, ATB™ brushes, Fastcut™ composite wheel brushes, Softtool® insert hones, PCD diamond superabrasive brushes, fine blanking brushes, Notiflex®, coated abrasive tools, spiral brushes and rollers, Sisal, a variety of wire and abrasive nylon wheels, cups, internal and end brushes, maintenance brushes, buffs, compounds, abrasive belts, flap wheels, nonwoven products, cleaners, and specialty chemicals.

Oskar Environmental, Inc.
7623
www.oskarsales.com

Oskar Air Products will highlight its durable, easy-to-use fume-extraction and filtration products that are manufactured with high standards and quality control procedures.

OTC Daihen, Inc.
www.daihen-usa.com

Panasonic Factory Solutions Co. of America
www.panasonicfta.com

Panasonic Factory Solutions will present its robots and arc welding power supplies, including the TAWERS robot family that combines welding and robotic technology into a common platform utilizing Embedded Arc Control (EAC) technology. This technology has also been integrated into the company’s PerformArc pre-engineered systems.

Panchmahal Steel Ltd.
www.panchmahalsteel.co.in

Osborn-JacksonLea-Jason Finishing Group will feature a full finishing product line, including Novoflex flexible honing tools, Uni-Lok® composite disc brushes, ATB™ brushes, Fastcut™ composite wheel brushes, Softtool® insert hones, PCD diamond superabrasive brushes, fine blanking brushes, Notiflex®, coated abrasive tools, spiral brushes and rollers, Sisal, a variety of wire and abrasive nylon wheels, cups, internal and end brushes, maintenance brushes, buffs, compounds, abrasive belts, flap wheels, nonwoven products, cleaners, and specialty chemicals.

Oskar Environmental, Inc.
7623
www.oskarsales.com

Oskar Air Products will highlight its durable, easy-to-use fume-extraction and filtration products that are manufactured with high standards and quality control procedures.

OTC Daihen, Inc.
www.daihen-usa.com

Panasonic Factory Solutions Co. of America
www.panasonicfta.com

Panasonic Factory Solutions will present its robots and arc welding power supplies, including the TAWERS robot family that combines welding and robotic technology into a common platform utilizing Embedded Arc Control (EAC) technology. This technology has also been integrated into the company’s PerformArc pre-engineered systems.

Panchmahal Steel Ltd.
www.panchmahalsteel.co.in

Panasonic Factory Solutions Co. of America
www.panasonicfa.com

Panasonic Factory Solutions will present its robots and arc welding power supplies, including the TAWERS robot family that combines welding and robotic technology into a common platform utilizing Embedded Arc Control (EAC) technology. This technology has also been integrated into the company’s PerformArc pre-engineered systems.

Panchmahal Steel Ltd.
www.panchmahalsteel.co.in

Pearl Abrasive Co.
7827
www.pearlabrasive.com

Pearl Abrasive will feature its bonded and coated abrasives, diamond blades, cup wheels, core bits, and polishing pads. The company will also offer the new Redline Slim-WELDING JOURNAL 107
Cut cut-off wheel and Greenback trimmable radial flap disc; a line of tile and masonry saws, plus surface preparation equipment; dust containment products; and the new Tuscan leveling system.

Permadur Industries, Inc. 7137
www.permadur.com

Permadur Industries will display its patented electrically controlled permanent lifting magnets, custom-built magnet and vacuum lifting systems, and load positioners.

PFERD, Inc. 7067
www.pferdusa.com

PFERD will showcase its solutions for hand finishing, grinding, cutting, and specialty applications.

Phoenix International, Inc. 6348
www.phx-international.com

Phoenix International will highlight its DryRod ovens and Safetube rod canisters for short-term electrode protection in the field.

Plasma Automation, Inc. 6506
www.plasma-automation.com

Plasma Automation will feature the Monarch heavy-duty, high-end precision plasma cutting system offering cutting applications from sheet metal to plate, structural steel to I-beam, angle iron, channel, and tubing. The company will also be displaying a custom cut-to-length and rollforming line. Vicon ViSoft software demonstrations will be ongoing throughout the show.

Plasma Craft, Inc. 6312
www.plasmacraft.com

Plasma Craft will offer its repair and retrofit services to the CNC plate cutting industry.

Plasma-Tec, Inc. 6415
www.plasmatec.com

Plasma-Tec, a precision machining and grinding company, will feature its thermal sprayed surface coating for original equipment manufacturers.

Plymovent North America 7214
www.plymovent.com

Plymovent 

Polymet Corp. 6427
www.polymet.us

Praxair, Inc. 6833
www.praxair.com

Preston-Eastin, Inc. 7667
www.prestoneastin.com

Primax Mfg. & Trading, Inc./Caiman Gloves 7119
www.caimangloves.com

Primax/Caiman® Gloves will exhibit its Revolution®/Kontour™ welding gloves, M.A.G.™ Multi-Activity Gloves, Boarhide™ protective garments, and Heatrac® winter/outdoor sport gloves that possess quality, aesthetic appeal, and comfort. At the company’s booth will be new styles, including the 21-in. Revolution® welding gloves and Black Gold Deerskin Revolution® welding gloves. Distributors may ask about its no risk offer as well.

Profax/Lenco 7333
www.profax-lenco.com

Profax and Lenco will spotlight its manual welding accessories, GMAW guns and consumables, GTAW torches and consumables, arc gouging torches and carbons, and all types of welding machine repair parts. New products include a straight line track cutting machine, hand-operated pipe beveler, ceramic backing tape, water soluble purge paper, and a line of positioners, turning rolls, and manipulators.

PTR-Precision Technologies, Inc. 7433
www.ptreb.com

Quality Welding Products, Inc. 7737
www.qwpinc.net

Raajratna Stainless Wire (USA), Inc. 7861
www.raajratna.com

Raajratna Stainless Wire (USA) will show its stainless steel wires.
Now you can put the technology of tomorrow to work for you...

TODAY.

Tri Tool continues its long tradition of innovative solutions by providing the AdaptARC® line of welding equipment, featuring the first fully digital Multi Mode Programmable Welding Arc Control System. The new ORBITMASTER® Welding Power Supply Controller, combined with the advanced DualARC® Weld Head offer new technology, flexibility and control to meet the challenges facing welders of today, and tomorrow.

- Degree, Time, or Distance Control
- Precise Seam Tracking
- Narrow Groove
- Multi-Process MIG/TIG
- Cold or Hot Wire
- High deposition GMAW cladding
- GTAW overlay capabilities
- Waveform generation for reduced spatter and smoke and optimum open root pass deposition

Visit Tri Tool at Booth #7155 at FABTECH to witness welding demonstrations featuring Tri Tool’s advanced, patented welding technologies.

TRI TOOL INC.
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www.tritool.com

For Info go to www.aws.org/ad-index
Extensively revised and updated from the eighth edition, this comprehensive volume had more than 50 experts in materials and materials applications assure its accuracy and the currency of its content. It is a great reference source for engineers, educators, welding supervisors, and welders. Covers carbon and low-alloy steels; high-alloy steels; coated steels; tool and die steels; stainless and heat-resisting steels; clad and dissimilar metals; surfacing; cast irons; maintenance and repair welding; and underwater welding and cutting. Includes more than 500 tables, charts, and photos.
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Order by December 31, 2010

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Save $167 when you purchase the Welding Handbook, 9th Ed., Vol. 4, Part I for only $25* ($25 fee applies to AWS Individual Members residing in the U.S. Members outside of the U.S. add $75 for book selection; note: $50 is for shipping). Only AWS Individual Members (Class 'B') are eligible for this special offer. Don't miss out on this exclusive offer for AWS Individual Members.

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Email: sales@cliamondground.com
Visit our website: www.diamondground.com

See us at FABTECH booth # 6455

Radyne Corp. 7112
www.radyne.com
Radyne will showcase energy and cost-efficient induction heating technologies for brazing silver and copper and fluxless brazing of stainless steel for applications, including fuel rails and lines and heat-treating solutions from simple benchtop units to complete automated turnkey systems, which assist in achieving green initiatives of producing repeatable quality parts. Its versatile modular integrated FlexS can easily be fitted with robotics, freeing personnel, or manually loaded/unloaded.

Red-D-Arc 7023
www.reddarc.com
Regula Systems LLC 6463
www.regulasystemsusa.com
Regula Systems will display and demonstrate its Electronic Welding Regulator (EWR). Both the EWR Pro, for communication with a welding robot, and EWR basic, for manual welding, will be featured. The EWR system can reduce shielding gas consumption by as much as 60%. This patented technology precisely controls the flow of shielding gas in GMA and GTA welding, offering cost savings as well as quality improvement and documented carbon emissions reduction.

Reis Robotics USA, Inc. 7524
www.reisroboticsusa.com
Reis Robotics will spotlight its providing, plan-

For info go to www.aws.org/ad-index

WELDING JOURNAL 111
See us at FABTECH booth # 8003

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Booth Number</th>
<th>Website(s)</th>
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<tr>
<td>Resistance Welding Manufacturing</td>
<td>8003</td>
<td><a href="http://www.aws.org/rwma">www.aws.org/rwma</a></td>
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<td>Alliance (RWMA)</td>
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<td>Revco Industries, Inc.</td>
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<td>Revco Industries will highlight its</td>
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<td>Black Stallion and BSX product</td>
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<td>blankets, welding screens, and</td>
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<td>accessories.</td>
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<td>Rex Cut Products Co.</td>
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<td><a href="http://www.rexcut.com">www.rexcut.com</a></td>
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<td>Rhino Welders LLC</td>
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<td><a href="http://www.rhinowelder.com">www.rhinowelder.com</a></td>
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<td>Rhino will present its expanded</td>
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<td>devices, consumables, and parts.</td>
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<td>Robotic Technologies of TN</td>
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<td>Robovent</td>
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<td>Rolled Alloys</td>
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<td>RoMan Manufacturing, Inc.</td>
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<td><a href="http://www.romanmfg.com">www.romanmfg.com</a></td>
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<td>Romar MEC – Fit Up Gear</td>
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<td><a href="http://www.fitupgear.com">www.fitupgear.com</a></td>
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<td>Rose Plastic USA LP</td>
<td>6439</td>
<td><a href="http://www.rose-plastic.us">www.rose-plastic.us</a></td>
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<td>Roueche Co. LLC, The</td>
<td>7359</td>
<td><a href="http://www.trcwelding.com">www.trcwelding.com</a></td>
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<td>Royal Arc Electrodes Ltd.</td>
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<td><a href="http://www.royalarc-electrodes.com">www.royalarc-electrodes.com</a></td>
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<td>Saf-T-Cart</td>
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<td><a href="http://www.saftcart.com">www.saftcart.com</a></td>
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<td>Saint-Gobain Coating Solutions</td>
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<td><a href="http://www.coatingsolutions.saint-gobain.com">www.coatingsolutions.saint-gobain.com</a></td>
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<td>Sakura of America</td>
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<td><a href="http://www.sakuraofamerica.com">www.sakuraofamerica.com</a> Industrial</td>
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<td>Sakura of America will offer its</td>
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<td>industrial marking supplies.</td>
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<td>Samson CNC</td>
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<td><a href="http://www.samsoncnc.com">www.samsoncnc.com</a></td>
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<td>The new Samson CNC plasma cutting</td>
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<td>table will be featured. It cuts</td>
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<td>flat parts out of metal</td>
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<td>thickness; and creates intricate</td>
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<td>metal art. Visitors to the company’s</td>
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<td>Save Phace Inc.</td>
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<td>Sciaky, Inc.</td>
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<td>Sciaky, a pioneer in Free Form</td>
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<td>Fabrication technology, will</td>
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<td>manufacturing, and defense</td>
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<td>markets. The company also offers</td>
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<td>Secoa Technology</td>
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<td><a href="http://www.secoatech.com">www.secoatech.com</a></td>
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<td>be featuring a live welding</td>
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<td>properties of its PerfectArcs self-</td>
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112 OCTOBER 2010
Thermadyne*, a global cutting and welding leader, joins the American Welding Society in encouraging individuals to practice the art, craftsmanship and professions of welding, metalworking and fabrication. Victor, Thermal Dynamics, Thermal Arc, Arcair, Tweco, Stood, Cigweld and TurboTorch are among the Thermadyne family of brands that you can count on for safety, reliability and quality.

NAME: Randy Shewmaker
PROFESSION: Welding and Engineering Instructor
COMPANY: Franklin County Career and Tech Center

JOB EXPERIENCE: Now in his 6th year as a certified welding instructor, Randy Shewmaker is constantly challenging his students to be self-driven individuals. In the classroom they learn how to execute a variety of welding applications on Thermal Arc Portable DC Welders. Outside the classroom Shewmaker enters his students in welding competitions to give them a greater sense of self-discipline and real world responsibility.

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Assembly: 17-20 July 2011
Conference: 21-22 July 2011
Venue: Hotel Le Royal Meridian, Chennai

Conference Theme:
“Global trends in Joining, Cutting and Surfacing Technology”

&
6th International Welding Technology Exhibition
WELD INDIA 2011
21-23 July, 2011
Venue: Chennai Trade Centre

Exhibitor Profile
- Manufacturers, Suppliers & Traders of welding consumables, welding & cutting equipment & automation products.
- Welding fabrication industries, Core sector industries like Railways, Coal Mining, Power Plants, Shipbuilding etc.
- Manufacturers, Suppliers & Traders of Metal & Alloys, Equipment & Accessories, Safety items, Inspection, Mechanical Testing & NDT items.

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Web: www.unitechexpo.com

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Sellstrom will showcase its range of personal protective equipment, including the new Impulse™ MAGSENSE™ autodarkening filter featuring up-to-date magnetic technology, DP4™ plasma faceshield, and 17 Spatter-Guard™ high-temperature fabrics meeting the ANSI/FM 4950 standard.

Servo-Robot will spotlight its advanced 3D laser vision sensing devices that are used in robotic and automated laser vision systems and process monitoring tools. The systems provide real-time joint tracking, adaptive control and visual inspection of welded components, as well as guidance for robotic material handling. The company will also feature its recently introduced mobile welding robot that can be brought to the workpiece, and remote operation is possible with an embedded video camera.

Shanghai Gonglue Machinery & Electrical Technology Co. Ltd. 6050
www.xunweld.com

Gonglue will feature a range of agglomerated flux, wire, and strip. Products will include mild steel and low-alloy steel flux and wire, stainless steel and nickel-alloy wire, and strip for SAW and ESW.

Shanghai Gozhen Intl. Trade Co. Ltd. 6039
86-21-6388-8828
www.sheffectmetal-iti.org

Sheet Metal Workers Intl. Training Institute 8059
www.sheetmetal-iti.org

Shenzhen Huayilong Industrial Development Co. Ltd. 6019
www.huayilong.com

Sherwin, Inc. 6440
www.sherwininc.com

Sidney Lee Welding Supply 7967
www.sidneylee.com

Sintered Powder Rods 7736
www.sprweldingrods.com

Sintered Powder Rods will present its welding, rod, and powder for nickel and tungsten carbide hardfacing.

SkillsUSA Welding Contest 8133
www.aws.org

Southern Copper & Supply Co. 7855
www.southerncopper.com
Special Metals Welding Products Co. 6447
www.specialmetalswelding.com

Special Metals Welding Products will exhibit its nickel-based welding consumables for joining nickel alloys, high-performance steels, cast irons, and dissimilar metals as well as surfacing on steel for corrosion or erosion protection. Products are sold under the brand names such as MONEL, INCONEL, INCO-WELD, NI-ROD, INCOLOY, and INCOFLUX.

Spring Creek Products 7615
www.springcreekproducts.com

St. Louis Metallizing Co. 6420
www.stlmetallizing.com

St. Louis Metallizing will spotlight its thermal spray coatings.

Standard Resistance Welder Co. 6308
www.swelder.com

SteelTailor (Beijing Ess Ltd.) 6314
www.steeltailor.com

SteelTailor™ will feature its reliable and affordable CNC cutting machine at the booth.

Steiner Industries 6433
www.steinerindustries.com

Strong Hand Tools 7645
www.stronghandtools.com

Strong Hand Tools will demonstrate its products designed to help reduce setup time in workholding applications. Adjust-O magnets feature the on/off switches, 4-in-1 sliding arm clamps contain the removable/reversible clamp arm, and 3-axis fixture vises hold 3-axis workpieces in position for welding. Also, the new BuildPro modular welding tables and modular fixturing kits will be displayed for efficient holding, locating, and positioning fixtures.

Sunstone Engineering will offer its microwelding solutions, including resistance, pulse-arc, micro GTA, and resistance welding systems.

Superhot FGH Services, Inc. 6315
www.superheatfg.com

Superheat FGH, an industrial heat-treatment service provider, will present its customer-driven business solutions using advancements in communication and software technology that overcome critical material and construction challenges integral to the sustainability of worldwide energy companies.

Superior Abrasives, Inc. 6219
www.superiorabrasives.com

Superior Abrasives will display its coated and nonwoven abrasives for grinding, polishing, and finishing.

Superior Products, Inc. 7154
www.superiorprod.com

Superior Products, a manufacturer of gas management systems, will be introducing new versions of its Mighty-Max automatic changeover manifold. There are two new versions for laser assist gases. Also, the company will be showing its new line of cryogenic hoses, pressure relief valves, and cryogenic connections.

Swagelok Co. 7565
www.swagelok.com

Synetik Design 7964
www.synetik-di.com

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TOUGH WELD PREP? BRING IT ON!
E.H. Wachs is Your Solution Provider in Weld Prep Tools

PORTABLE PIPE CUTTING APPLICATION
To cut and bevel or counterbore heavy wall pipe (over 1” or 25.4mm,) or to counterbore large diameter pipe or vessels, Wachs LCSF Low Clearance Split Frame and bridgeslide accessory is the solution. Produces a precise, lathe type finish without a heat affected zone, ready for welding.

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Sometimes fittings don’t cooperate by being readily accessible. Wachs Socket Weld Removal Kits are designed to reach into the tightest places and remove welds without disturbing the base materials. Available in both Axial and Radial versions.

NEW! PRECISION END PREP
When clearances are an issue or fittings and elbows need to be machined, bring out the new ID mount Wachs EP 424. The EP 424 with the SPEED PREP auto feed system feeds simultaneously in the axial and radial planes, without templates, incline tool slides or work stoppages.

E.H. Wachs Field Portable Weld Prep Machine Tools are ideal for:
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- Oil and Gas Pipeline Operations
- Boiler Maintenance
- Chemical and Petrochemical Processing Plants
- Pipe Fabrication Shops
- Wellhead & Casing Services
- Shipbuilding and Repair
- High Purity Process Piping

Put E.H. Wachs on your AWS/Fabtech Planner. Stop by the Wachs Booth #7011 and ask for your FREE Pipe Wall or Desk Chart, a handy reference for pipe dimensions from 1/8” to 72” (DN6-1800).

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at the FABTECH
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<thead>
<tr>
<th>Company</th>
<th>Booth Number</th>
<th>Website</th>
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<tbody>
<tr>
<td>TAFA, Inc.</td>
<td>6406</td>
<td><a href="http://www.praxair.com/thermalspray">www.praxair.com/thermalspray</a></td>
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<tr>
<td>TAF  will exhibit its line of thermal spray equipment and consumables.</td>
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<td>Tanis Technologies</td>
<td>7966</td>
<td><a href="http://www.tanistechnologies.com">www.tanistechnologies.com</a></td>
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<tr>
<td>Tanis Technologies will highlight its products to improve working environments in the fabrication and manufacturing industries. The company works to develop products that are value added and solve real-life problems.</td>
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<tr>
<td>Team Industries, Inc.</td>
<td>6213</td>
<td><a href="http://www.teamind.com">www.teamind.com</a></td>
</tr>
<tr>
<td>Team Industries will showcase its Generation III and Generation IV hydraulically elevated) welding positioners and grippers, which provide a complete workstation to improve weld quality and increase operator efficiency. The welding positioner uses a programmable AC motor drive and interchangeable gear multipliers to provide high-quality results for different applications. A programmable AC drive supplies the power and controllability to slowly roll heavy-wall pipe. The positioner also allows operators to weld small-diameter pipe with speeds up to 3.55 rev/min.</td>
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<tr>
<td>TEC Torch Co., Inc.</td>
<td>7055</td>
<td><a href="http://www.tectorch.com">www.tectorch.com</a></td>
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<tr>
<td>Technical Translation Services</td>
<td>7717</td>
<td><a href="http://www.techtranslation.com">www.techtranslation.com</a></td>
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<tr>
<td>Techniweld (USA)</td>
<td>7867</td>
<td><a href="http://www.techniweldusa.com">www.techniweldusa.com</a></td>
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<tr>
<td>Technogenia, Inc.</td>
<td>6443</td>
<td><a href="http://www.technogeniausa.com">www.technogeniausa.com</a></td>
</tr>
<tr>
<td>Technogenia will highlight its hardfacing products for protecting parts against wear. The company will feature its tungsten carbide powder Spherotene, which can be applied as a thermal spray, using an oxyfuel torch or by laser using a process known as Lasercarb.</td>
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<tr>
<td>Techsouth, Inc.</td>
<td>7849</td>
<td><a href="http://www.techsouthinc.com">www.techsouthinc.com</a></td>
</tr>
<tr>
<td>Tecknoweld Alloys</td>
<td>7912</td>
<td><a href="http://www.tecknoweld.com">www.tecknoweld.com</a></td>
</tr>
<tr>
<td>Tempil, an ITW Co.</td>
<td>7021</td>
<td><a href="http://www.tempil.com">www.tempil.com</a></td>
</tr>
<tr>
<td>Tennessee Rand Co.</td>
<td>7523</td>
<td><a href="http://www.tennrand.com">www.tennrand.com</a></td>
</tr>
<tr>
<td>Thermadyne Industries, Inc.</td>
<td>7043</td>
<td><a href="http://www.thermadyne.com">www.thermadyne.com</a></td>
</tr>
<tr>
<td>Thermadyne, a global manufacturer and supplier of metal cutting and welding hard goods, will showcase its products that support the skilled professions of the welding, metalworking, and fabrication trades. Its family of companies include Victor®, Thermal Dynamics®, Thermal Arc®, Arcain®, Tweco®, TurboTorch®, Stoodo®, and Cigweld®.</td>
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<tr>
<td>3M</td>
<td>7233</td>
<td><a href="http://www.3M.com/occsafety">www.3M.com/occsafety</a></td>
</tr>
<tr>
<td>3M will display its latest welding safety equipment, including a collection designed for women welders from Speedglas™. Demonstrations will showcase the durability of Speedglas™ helmets.</td>
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<tr>
<td>ThyssenKrupp VDM USA, Inc.</td>
<td>7733</td>
<td><a href="http://www.thyssenkrupp.com">www.thyssenkrupp.com</a></td>
</tr>
<tr>
<td>Tianjin Jinlong Welding Material Co. Ltd.</td>
<td>6038</td>
<td><a href="http://www.jinlongweld.com">www.jinlongweld.com</a></td>
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<tr>
<td>Tianjin Jinlong Welding Material Co. Ltd.</td>
<td>6038</td>
<td><a href="http://www.jinlongweld.com">www.jinlongweld.com</a></td>
</tr>
<tr>
<td>Tianjin Shuobao Welding Research &amp; Technology Co. Ltd.</td>
<td>6044</td>
<td><a href="http://www.tsangwang.com">www.tsangwang.com</a></td>
</tr>
<tr>
<td>Tianjin Xuzhi Machinery &amp; Electrical Equipment Co. Ltd.</td>
<td>7416</td>
<td><a href="http://www.xuzhi.com">www.xuzhi.com</a></td>
</tr>
<tr>
<td>Tianjin Xuzhi Machinery will feature its equipment for flux cored wire production, including wire drawing, drum packaging, strip slitting, and auxiliary machines.</td>
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The American Welding Society and The International Thermal Spray Association are presenting a thermal spray and coatings conference to be held in conjunction with the 2010 FABTECH show. The program is intended to highlight the Thermal Spray Process and its uses with morning and afternoon sessions focusing on actual applications and new developments in thermal spray technology. This program will benefit both potential users and those actively involved with thermal spray coatings as it will focus on actual applications and new developments in thermal spray technology.

In addition, a free half-day seminar on Thermal Spray Basics: Putting Coatings to Work will be held on Tuesday, Nov. 2.

For the latest conference information, visit our website at www.aws.org/conferences or call 800-443-9353, ext. 264.

Wednesday, Nov. 3, 2010, 9:00 am to 3:40 pm
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(at the FABTECH Show)

AWS Members: $345
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Earn PDH’s toward your AWS recertification or renewal when you attend the conference!
Weartech International, Inc. 7063
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Weartech International will show its line of cobalt- and nickel-based wear, corrosion, and high-temperature-resistant alloys. The line includes all types of hardfacing consumables such as rods, electrodes, wires, and powders. The company also offers cast solid alloy parts and machining and hardfacing services.

Weiler Corp. 7109
www.weilercorp.com

Weiler will display its line of brushes and abrasives for the fabrication and welding industry, including the power brush line, wire wheel, and cup end and tube brushes. Shown will be Roughneck® weld cleaning products, plus Tiger® and Vortec Pro™ flap discs. Featured will be the company’s line of Vortec Pro™ general-purpose bonded abrasives for metal cleaning, grinding, deburring, and finishing.

Weld Engineering Co., Inc. 6547
www.weldengineering.com

Weld Engineering will display its complete line of medium- and heavy-duty submerged arc flux handling systems, including air- and electric-powered automatic, portable, and tractor units. The company will also show its advanced pressure feed and recovery systems, and flux rebake and holding ovens. Live demonstrations of flux recovery will be taking place continuously.

Weld-Aid Products 7242
www.weldaid.com

Weldas Co. 6241
www.weldas.com

Weldcoa 6237
www.weldcoa.com

Weldcoa will display its automated cylinder filling equipment, material handling, and gas filling equipment for welding supply and gas distributors. The company specializes in palletized truck, trailer, fill plant, and other palletized equipment.

Weldcraft 6811
www.weldcraft.com

Welding Alloys Group 7355
www.welding-alloys.com

Welding Alloys will show its tubular welding wires and automatic welding equipment for welding and hardfacing applications.

Welding Equipment Manufacturers Committee (WEMCO) 8003
www.aws.org/wemco

The Welding Equipment Manufacturers Committee (WEMCO) is a standing committee of the American Welding Society (AWS) dedicated to providing a common voice to the welding industry, government bodies, and technical organizations worldwide. The very influential and powerful organization represents manufacturers.

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Making products for welding processes and applications. It also provides value-added information and services to welding industry end-users, distributors, and manufacturers, as well as promotes coalitions between AWS, GAWDA, and other industry organizations. WEMCO hosts one of the industry’s most effective and profitable annual events that include first-class business speakers and key industry leaders, enlightening presentations, and dynamic forums. In addition, members are exposed to unparalleled networking opportunities to promote and exchange invaluable ideas in a competitive atmosphere that cannot be attained anywhere else.

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and polishing products for metal fabrication in wheel or disc form for use on common tools. The line includes abrasive, nonwoven, and felt versions for grinding, blending, and polishing up to a mirror finish in a wide range of sizes and specifications.

Will-Best Welding Equipment Co. Ltd. 6045 www. espot-welder.com

Will-Best Welding will show its line of precision equipment, including spot welding machines, battery-pack spot welding machines, and electronic and hardware products such as spot weld heads, welding power supplies, welding checkers and monitors, and heat seal/hot bar machines.

Winner Tungsten Products Co. Ltd. 6137 www.wqtb.com

Wire Crafters, Inc. 7636 www.wirecrafters.com

Wire Crafters will feature its ANSI/RIA compliant machine perimeter guarding equipment RapidWire-HD, the new RapidGuard, and its new line of stainless steel partitions for the food, beverage, pharmaceutical, and medical markets.

WireFed LLC 7760 (954) 254-0819

Wisconsin Wire Works, Inc. 6215 www.wisconsinwireworks.com

Witt Gas Controls 6340 www.wittgas.com

Wolf Robotics, LLC 6661 www.wolfrobotics.com

Wolf Robotics will offer its expertise as a robotic metalworking integrator offering standard cells and custom-engineered systems for arc welding and cutting, machine tending, material handling, and material removal applications. Information will be provided on its customer service, operation, and process training, and its complete consumables and spare parts department.

Wolverine Joining Technologies 7763 www.silvaloy.com

Wolverine Joining Technologies will showcase its brazing, soldering, and specialty alloys, including its Silvaloy line of high-silver brazing alloys. Company capabilities include cast, melt, roll, extrude, wire, rod and ring forming, preform stamping, strip, and a metallurgical laboratory.

World Engineering Xchange (WEX) 8017 www.awspubs.com

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York Portable Machine Tools 6263 www.yorkmachine.com

York will show its portable, powerful, easy-to-use bore welding machines and boring bars for on-site or in-shop repairs to worn pin and bearing fits.

Yunnan Hengyu Optical Electronics Co. (Optech Co.) 6236 www.optech.cn

Yunnan Hengyu will show its CE- and ANSI-approved autodarkening welding helmets.

Zhejiang Changzheng Project Carbon Electrodes Co. Ltd. 6049 www.czcarbon.com

Zhengzhou Anxin Abrasives Co. Ltd. 7116 http://anxinabrasives.en.busytrade.com

ZJ Industries, Inc. 6366 www.zjindustriesinc.com

ZRID Pty. Ltd. 7741 www.zrid.us

For info go to www.aws.org/ad-index
Know Your Welding Application Nomenclature

**Backstep sequence:** A longitudinal sequence in which weld passes are made in the direction opposite to the progress of welding — Fig. IA.

**Block sequence:** A combined longitudinal and cross-sectional sequence for a continuous multiple-pass weld in which separated segments are completely or partially welded before intervening segments are welded — Fig. IB.

**Cascade sequence:** A combined longitudinal and cross-sectional sequence in which weld beads are made in overlapping layers — Fig. IC.

**Cross-sectional sequence:** The order in which the weld passes of a multiple-pass weld are made with respect to the cross-section of the weld — Fig. 1D, E.

**Boxing:** The continuation of a fillet weld around a corner of a member as an extension of the principal weld — Fig. 1F.

**Intermittent weld:** A weld in which continuity is interrupted by recurring unwelded spaces — Fig. 1G—I. Different types of intermittent welds include the following.  

- **Chain intermittent weld:** An intermittent weld on both sides of a joint in which the weld segments on one side are approximately opposite those on the other side — Fig. 1G.  
- **Staggered intermittent weld:** An intermittent weld on both sides of a joint in which the weld segments on one side are alternated with respect to those on the other side — Fig. 1H.$^\dagger$

---

**Fig 1.** — Welding application nomenclature.

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Technology and Industry Conf. Oct. 12–14, Tehran, Iran. Visit www.iticir.ir; or e-mail info@iticir.ir.


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Preparation and Exam for AWS Certified Welding Supervisor. One-week-long course begins Oct. 18 in Troy, Ohio. Call Hobart Institute of Welding Technology (800) 332-9448; hiwt@welding.org; or visit www.welding.org.


Welding Inspection Course Level 1. A nine-day course presented in Canada beginning Oct. 18, Edmonton, AB; Sept. 27, Langley, BC. Call The Canadian Welding Bureau, (800) 844-6790, or visit www.cwbgroup.org.


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— continued on page 135
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**Essentials of Safety Seminars.** Two- and four-day courses are held at numerous locations nationwide to address federal and California OSHA safety regulations. Call American Safety Training, Inc. (800) 896-8867, or visit www.trainosha.com.

**Fabricators and Manufacturers Assn. and Tube and Pipe Assn. Courses.** Call (815) 399-7755, or visit www.fmanet.org.

**Firefighter Hazard Awareness Online Course.** A self-paced, ten-module certificate course taught online by fire service professionals. Fee is $195. Call Industrial Scientific Corp. (800) 338-3287, or visit www.indsci.com.

**Gas Detection Made Easy Courses.** Online and classroom courses for managing a gas monitoring program from gas detection to confined-space safety. Call Industrial Scientific Corp. (800) 338-3287, or visit www.indsci.com.

— continued on page 137
Some of the most important issues in welding are the repair of faulty welds and the proper use of welding to strengthen existing structures. Topics at this one-day conference will include the new AWS repair code, the process for obtaining “R” certificates, repair of pipelines using sleeves, computer-assisted GTAW repair of rotating equipment, underwater weld repair, controlled deposition techniques, distortion and stress control, and more. Industries covered include nuclear, mining, aviation, and others.

For the latest conference information, visit our website at www.aws.org/conferences or call 800-443-9353, ext. 264.
Hellier NDT Courses. Hellier, 277 W. Main St., Ste. 2, Niantic, CT 06357; (860) 739-8950; FAX (860) 739-6732.

Inspection Courses on ultrasonic, eddy current, radiography, dye penetrant, magnetic particle, and visual at Levels 1–3. Meet SNT-TC-1A and NAS-410 requirements. Call TEST NDT, LLC, (714) 255-1500, or visit www.testndt.com.

INTEG Courses. Various courses for individuals seeking certification in nondestructive testing disciplines accredited by Natural Resources Canada to meet certifications to Canadian General Standards Board or Canadian Nuclear Safety Commission. Call The Canadian Welding Bureau, (800) 844-6790, or visit www.cwbgroup.org.


AWS Certification Schedule

Certification Seminars, Code Clinics, and Examinations

Application deadlines are six weeks before the scheduled seminar or exam. Late applications will be assessed a $250 Fast Track fee.

**Certified Welding Inspector (CWI)**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SEMINAR DATES</th>
<th>EXAM DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nashville, TN</td>
<td>Oct. 3–8</td>
<td>Oct. 9</td>
</tr>
<tr>
<td>Tulsa, OK</td>
<td>Oct. 3–8</td>
<td>Oct. 9</td>
</tr>
<tr>
<td>Long Beach, CA</td>
<td>Oct. 3–8</td>
<td>Oct. 9</td>
</tr>
<tr>
<td>Newark, NJ</td>
<td>Oct. 3–8</td>
<td>Oct. 9</td>
</tr>
<tr>
<td>Portland, OR</td>
<td>Oct. 17–22</td>
<td>Oct. 23</td>
</tr>
<tr>
<td>Roanoke, VA</td>
<td>Oct. 17–22</td>
<td>Oct. 23</td>
</tr>
<tr>
<td>Cleveland, OH</td>
<td>Oct. 17–22</td>
<td>Oct. 23</td>
</tr>
<tr>
<td>Miami, FL</td>
<td>EXAM ONLY</td>
<td>Oct. 28</td>
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<td>Corpus Christi, TX</td>
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<td>Oct. 30</td>
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<tr>
<td>Atlanta, GA</td>
<td>Nov. 14–19</td>
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<td>Dallas, TX</td>
<td>Nov. 14–19</td>
<td>Nov. 20</td>
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<tr>
<td>Sacramento, CA</td>
<td>Nov. 14–19</td>
<td>Nov. 20</td>
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<td>Spokane, WA</td>
<td>Nov. 14–19</td>
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<td>St. Louis, MO</td>
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<td>Dec. 4</td>
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<tr>
<td>Los Angeles, CA</td>
<td>Dec. 5–10</td>
<td>Dec. 11</td>
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<td>Houston, TX</td>
<td>Dec. 5–10</td>
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<tr>
<td>Syracuse, NY</td>
<td>Dec. 5–10</td>
<td>Dec. 11</td>
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<tr>
<td>Reno, NV</td>
<td>Dec. 5–10</td>
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<td>Miami, FL</td>
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<td>Perrysburg, OH</td>
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<td>Mobile, AL</td>
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<td>Rochester, NY</td>
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<td>York, PA</td>
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<td>Knoxville, TN</td>
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<td>April 23</td>
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<td>Waco, TX</td>
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<td>May 7</td>
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<td>May 28</td>
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<td>Corpus Christi, TX</td>
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<td>June 25</td>
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<td>Rochester, NY</td>
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<td>Anchorage, AK</td>
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<td>Sept. 24</td>
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<tr>
<td>St. Louis, MO</td>
<td>EXAM ONLY</td>
<td>Dec. 10</td>
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<tr>
<td>Corpus Christi, TX</td>
<td>EXAM ONLY</td>
<td>Dec. 31</td>
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**Certified Welding Supervisor (CWS)**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SEMINAR DATES</th>
<th>EXAM DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norfolk, VA</td>
<td>Oct. 4–8</td>
<td>Oct. 9</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>Miami, FL</td>
<td>Oct. 18–22</td>
<td>Oct. 23</td>
</tr>
</tbody>
</table>

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

**Certified Welding Sales Representative (CWSR)**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SEMINAR DATES</th>
<th>EXAM DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanta, GA</td>
<td>Nov. 2–4</td>
<td>Nov. 4</td>
</tr>
</tbody>
</table>

CWSR exams will also be given at CWI exam sites.

**Certified Welding Educator (CWE)**

Seminar and exam are given at all sites listed under Certified Welding Inspector. Seminar attendees will not attend the Code Clinic portion of the seminar (usually first two days).

**Senior Certified Welding Inspector (SCWI)**

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

**Certified Robotic Arc Welding (CRAW)**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>WEEK OF</th>
<th>CONTACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genesis-Systems, Davenport, IA</td>
<td>Oct. 4</td>
<td>(563) 445-5688</td>
</tr>
<tr>
<td>Genesis-Systems, Davenport, IA</td>
<td>Oct. 11</td>
<td>(563) 445-5688</td>
</tr>
<tr>
<td>Genesis-Systems, Davenport, IA</td>
<td>Oct. 18</td>
<td>(563) 445-5688</td>
</tr>
<tr>
<td>Genesis-Systems, Davenport, IA</td>
<td>Oct. 25</td>
<td>(563) 445-5688</td>
</tr>
<tr>
<td>Genesis-Systems, Davenport, IA</td>
<td>Nov. 15</td>
<td>(563) 445-5688</td>
</tr>
<tr>
<td>Genesis-Systems, Davenport, IA</td>
<td>Nov. 29</td>
<td>(563) 445-5688</td>
</tr>
<tr>
<td>ABB, Inc., Auburn Hills, MI</td>
<td>Nov. 1</td>
<td>(248) 391-8421</td>
</tr>
<tr>
<td>Genesis-Systems, Davenport, IA</td>
<td>Nov. 8</td>
<td>(563) 445-5688</td>
</tr>
<tr>
<td>Genesis-Systems, Davenport, IA</td>
<td>Nov. 15</td>
<td>(563) 445-5688</td>
</tr>
<tr>
<td>Genesis-Systems, Davenport, IA</td>
<td>Nov. 29</td>
<td>(563) 445-5688</td>
</tr>
<tr>
<td>ABB, Inc., Auburn Hills, MI</td>
<td>Dec. 6</td>
<td>(248) 391-8421</td>
</tr>
<tr>
<td>Genesis-Systems, Davenport, IA</td>
<td>Dec. 6</td>
<td>(563) 445-5688</td>
</tr>
<tr>
<td>Genesis-Systems, Davenport, IA</td>
<td>Dec. 13</td>
<td>(563) 445-5688</td>
</tr>
</tbody>
</table>

**International CWI Courses and Exams**

Please visit www.aws.org/certification/inter_contact.html

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**9-Year Recertification Seminar for CWI/SCWI**

For current CWIs and SCWIs needing to meet education requirements without taking the exam. The exam can be taken at any site listed under Certified Welding Inspector.

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SEMINAR DATES</th>
<th>EXAM DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dallas, TX</td>
<td>Oct. 4–9</td>
<td>NO EXAM</td>
</tr>
<tr>
<td>Miami, FL</td>
<td>Nov. 29–Dec. 4</td>
<td>NO EXAM</td>
</tr>
</tbody>
</table>

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**Important:** This schedule is subject to change without notice. Please verify your event dates with the Certification Dept. and confirm your course status before making your travel plans. For information on AWS seminars and certification programs, visit www.aws.org/certification, or call (800/305) 443-9353, ext. 273, for Certification; or ext. 455 for Seminars. Apply early to avoid paying the Fast Track fee.
A WEBSITE THAT THINKS THE WAY YOU DO

Finding the right equipment and alloys for your project can be tough. Harris is making it easier with a new intuitive website that helps you find products more quickly – at the new HarrisProductsGroup.com. We’ll unveil the website at FABTECH. Visit us in Booth 6533.

New Website Features:

- A new “Product Quick Search”
- Product narrowers to help you find products easily
- Find technical information and documents quickly
- Online database of Harris dealers and distributors
- Instructional videos for using Harris products
- Expanded tips and advice

BRAZING . SOLDERING . WELDING . CUTTING
ALLOYS . EQUIPMENT

For info go to www.aws.org/ad-index
Get the information you need quicker than ever before. The AWS Welding Buyers Guide allows online searchers to easily locate products and services unique to the welding industry, without the clutter of a general Internet search engine. Save valuable time, visit awsweldingbuyersguide.com!

**BENEFITS FOR CONSUMERS:** When leaders in the industry are looking for products and services, they turn to awsweldingbuyersguide.com to quickly get to the right source. Users can easily locate products and services unique to our industry with keyword-driven or category-specific searches. The AWS Welding Buyers Guide gives welding professionals a faster and easier way to find great vendors.

**BENEFITS FOR COMPANIES:** Purchasing a listing in the AWS Welding Buyers Guide will ensure that your company’s brand and message are easily accessible to the buyers who matter most to you. The AWS Guide includes Request for Information (RFI) functionality. This feature allows users to contact participating suppliers with a click of their mouse. Additionally, the guide includes a product showcase that allows you to highlight specific products and special offers on the front page of the guide. Visit the site to post your listing today!

See us at FABTECH booth #8003

American Welding Society  awsweldingbuyersguide.com

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**TOTAL DISORDER**
**CHALLENGER**

**EXTREME SIMPLICITY**
**CHAMPION**

TRADITIONAL SEARCH METHODS

THE AWS WELDING BUYERS GUIDE
Welding Pros Hone Skills at the Annual AWS Instructor Institute

The 2010 Instructor Institute class participants are shown July 29 at AWS Headquarters in Miami, Fla. Shown are (front row, from left) District 5 Director Steve Mattson, Nicholas Pinckney, Tina Buchanan, Lane Smeriglia, Jennifer Skyles, Mark Reese, Tracy Davenport, and David Elsloo; (standing, from left) Jonathan Theberge, Eric Cooper, District 13 Director Rick Polanin, Paul Leadingham, Chris Lanese, George Moore, Mark Gilbert, John McKeehan, Jimmy Goodson, Darin Newman, Jason Schmidt, Chris Hensiak, Nick Peterson, Ed Norman, Kenneth Temme, Nichole Bradley, Jay Ginder, Jason Kiesner, and Rodney Patterson.

Notice of Annual Meeting — American Welding Society

The Annual Meeting of the members of the American Welding Society will be held Monday, Nov. 1, 2010, beginning at 9:00 AM at the Georgia World Congress Center in Atlanta, Ga., during FABTECH. The regular business of the Society will be conducted, including election of officers and nine members of the Board of Directors. Any business properly brought before the membership will be considered.

Life Members — Register Now for Free Professional Program

AWS Life Members should register now to receive the entire Professional Program ($325 value) free plus free admission to FABTECH, scheduled for Nov. 2–4 at the Georgia World Congress Center, in Atlanta. The Registration Form is on page 62 of this issue of Welding Journal. You may also request the form from the Membership Department, call (800/305) 443-9353, ext. 290. To obtain your free registration, mark “AWS Life Member: Free Registration” at the top of your Registration Form. Then FAX both sides of the form to (305) 443-5647, Attn: Rhenda Kenny, membership director, or mail the form to Rhenda Kenny, AWS, 550 NW LeJeune Rd., Miami, FL 33126.
The following errata have been identified and will be incorporated into the next reprinting of this document.

Page 156, Fig. 6.21: Moved illustration from Fig. 6.22 to Fig. 6.21 in order to correctly portray discontinuity height dimension. Also corrected title and added cross references so caption reads, “Discontinuity Height Dimension (see 6.21.2.1, 6.21.2.2, and 6.21.2.3)”.

Page 157, Fig. 6.22: Moved illustration from Fig. 6.21 to Fig. 6.22 in order to correctly portray discontinuity length dimension.

Copies of ISO/DIS 15615 are available for review through your national standards body, which in the United States is ANSI, 25 W. 43rd St., Fourth Fl., New York, NY, 10036; (212) 642-4900. If you wish to participate in the development of International Standards for welding, contact Andrew Davis, adavis@aws.org; (800/305) 443-9353, ext. 466.

Technical Committee Meetings
To attend a meeting, call the staff member listed at (800/305) 443-9353.
- Oct. 6–8, A2 Committee on Definitions and Symbols. Troy, Ohio. A. Alonso, ext. 299.

The following meetings will be held during FABTECH in Atlanta, Ga.
- Nov. 1, C7 Committee on High Energy Beam Welding and Cutting. M. Rubin, ext. 215.
- Nov. 2, ASK Subcommittee on Titanium and Zirconium Filler Metals. S. Borrero, ext. 334.
- Nov. 2, B5Q Subcommittee on Thermal Spray Operators. J. Gayler, ext. 472.
- Nov. 2, C2 Committee on Thermal Spraying. J. Gayler, ext. 472.
- Nov. 2, C5 Committee on Arc Welding and Cutting. M. Rubin, ext. 215.
- Nov. 2, C6 Committee on Friction Welding. J. Gayler, ext. 472.
- Nov. 2, D15C Subcommittee on Track Welding. S. Borrero, ext. 334.
- Nov. 2, G2D Subcommittee on Reactive Alloys. S. Borrero, ext. 334.
- Nov. 3, B1 Committee on Methods of Inspection. B. McGrath, ext. 311.
- Nov. 3, B1B Subcommittee on Visual Examination of Welds. B. McGrath, ext. 311.
- Nov. 3, D9 Committee on the Welding, Brazing, and Soldering of Sheet Metal. A. Alonso, ext. 299.

New Standards Projects (PINS)
Development work has begun on the following new or revised standards. Affected individuals are invited to contribute to the development of these standards. For information, contact the staff secretary listed with the document. Participation on all AWS Technical Committees is open to all persons.


B.2.1/B.2.1M:2009-ADD1, Specification for Welding Procedure and Performance Qualification. This specification provides the requirements for qualification of welding procedure specifications, welders, and welding operators for manual, semiautomatic, mechanized, and automatic welding. The welding processes included are electromagetic welding, electron beam welding, oxyacetylene welding, flux cored arc welding, gas metal arc welding, gas tungsten arc welding, laser beam welding, oxyfuel gas welding, plasma arc welding, shielded metal arc welding, stud arc welding, and submerged arc welding. Base metals, filler metals, qualification variables, welding designs, and testing requirements are included. Stakeholders: Navy, manufacturers, welders, CWIs, engineers. Addenda: S. Morales, ext. 313.

ISO Draft Standard for Public Review
ISO/DIS 15615 — Gas welding equipment — Acetylene manifold systems for welding, cutting, and allied processes — Safety requirements in high-pressure devices.

Standard Reaffirmed by ANSI

Standard for Public Review

AWS was approved as an accredited standards-preparing organization by the American National Standards Institute (ANSI) in 1979. AWS rules, as approved by ANSI, require that all standards be open to public review for comment during the approval process. To order a draft copy, contact R. O'Neall, ext. 451, ronneall@aws.org.

ISO Draft Standard for Public Review
ISO/DIS 15615 — Gas welding equipment — Acetylene manifold systems for welding, cutting, and allied processes — Safety requirements in high-pressure devices.

Interpretation: D1.1:2008 Structural Welding Code — Steel

Subject: Radiography of Welder Performance Qualification Test Plates
Code Provision: Subclauses 6.12.2 and 4.30.3.2, Figures 4.21 and 6.2
AWS Log: D1.1-04-109
Inquiry: Is it the intent of the code that the radiographic areas denoting the 2.5 inch interpretable area on a five (5) inch long welder's performance qualification test plate (i.e., Figure 4.21), be considered as a “free edge” or “intersecting weld” for the requirement of minimum clearance per Figure 6.27?
Response: No.
for Gas Metal Arc Welding (Short Circuiting Transfer Mode) of Galvanized Steel (M-I, 18 through 10 Gauge, in the As-Welded Condition, with or without Backing. This standard contains the essential welding variables for welding galvanized steel in the thickness range of 18–10 gauge, using semiautomatic gas metal arc welding (short circuiting transfer mode). It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet welds and groove welds. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-1-004:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Metal Arc Welding (Short Circuiting Transfer Mode) of Carbon Steel (M-I, Group 1), 18 through 10 Gauge, in the As-Welded Condition, with or without Backing. This standard contains the essential welding variables for welding carbon steel in the thickness range of 18–10 gauge, using semiautomatic gas metal arc welding (short circuiting transfer mode). It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet welds and groove welds. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-1-005:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Metal Arc Welding (Short Circuiting Transfer Mode) of Austenitic Stainless Steel (M-8, P-8, or S-8), 18 through 10 Gauge, in the As-Welded Condition, with or without Backing. This standard contains the essential welding variables for welding austenitic stainless steel in the thickness range of 18–10 gauge, using semiautomatic gas metal arc welding (short circuiting transfer mode). It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet welds and groove welds. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-1-006:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Metal Arc Welding (Short Circuiting Transfer Mode) of Carbon Steel to Austenitic Stainless Steel (M-1 to M-8, P-8, or S-8), 18 through 10 Gauge, in the As-Welded Condition, with or without Backing. This standard contains the essential welding variables for welding carbon steel to austenitic stainless steel in the thickness range of 18–10 gauge, using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet welds and groove welds. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-1-007:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Galvanized Steel (M-I), 18 through 10 Gauge, in the As-Welded Condition, with or without Backing. This standard contains the essential welding variables for welding galvanized steel in the thickness range of 18–10 gauge using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet welds and groove welds. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-1-008:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Carbon Steel (M-I, P-I, or S-I), 18 through 10 Gauge, in the As-Welded Condition, with or without Backing. This standard contains the essential welding variables for welding carbon steel in the thickness range of 18–10 gauge using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet welds and groove welds. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-1-009:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Austenitic Stainless Steel (M-8, P-8, or S-8), 18 through 10 Gauge, in the As-Welded Condition, with or without Backing. This standard contains the essential welding variables for welding austenitic stainless steel in the thickness range of 18–10 gauge using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet welds and groove welds. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-1-010:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Carbon Steel to Austenitic Stainless Steel (M-I, P-I, or S-I to M-8, P-8, or S-8), 18 through 10 Gauge, in the As-Welded Condition, with or without Backing. This standard contains the essential welding variables for welding carbon steel to austenitic stainless steel in the thickness range of 18–10 gauge, using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet welds and groove welds. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-1-011:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Galvanized Stainless Steel (M-I), 10 through 18 Gauge, in the As-Welded Condition, with or without Backing. This standard contains the essential welding variables for welding galvanized steel in the thickness range of 10–18 gauge, using manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet welds and groove welds. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-1-012:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-I, P-I, or S-I to M-I, P-I, or S-I), 10 through 18 Gauge, in the As-Welded Condition, with or without Backing. This standard contains the essential welding variables for welding carbon steel in the thickness range of 10–18 gauge, using manual shielded metal arc welding. It cites
for Gas Tungsten Arc Welding followed by Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), ⅛ through ⅝ inch Thick, ER3XX and E3XX-XX, As-Welded Condition. This standard contains the essential welding variables for austenitic stainless steel in the thickness range of ⅛–⅝ in., using manual gas tungsten arc welding followed by shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B.2.1-1-214:2001 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 2), ⅛ through ⅝ inch Thick, ER80S-6, As-Welded Condition. This standard contains the essential welding variables for carbon steel in the thickness range of ⅛–⅝ in., using manual gas tungsten arc welding followed by consumable insert root. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B.2.1-8-212:2000 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), ⅛ through ⅝ inch Thick, ER3XX and E3XX-XX, As-Welded Condition. This standard contains the essential welding variables for austenitic stainless steel in the thickness range of ⅛–⅝ inch, using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B.2.1-8-210:2001 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding with Consumable Insert Root of Austenitic Stainless Steel (M-1/P-1/S-1, Group 1 or 2), ⅛ through ⅝ inch Thick, IN3XX and IN3XX-XX, As-Welded or PWHT Condition. This standard contains the essential welding variables for carbon steel in the thickness range of ⅛–⅝ in., using manual gas tungsten arc welding with consumable insert root. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This WPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B.2.1-1-211:2001 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding with Consumable Insert Root followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), ⅛ through ⅝ inch Thick, IN3XX, ER3XX, and E3XX, As-Welded or PWHT Condition. This standard contains the essential welding variables for carbon steel in the thickness range of ⅛–⅝ in., using manual gas tungsten arc welding with consumable insert root. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This WPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B.2.1-1-210:2001 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding with Consumable Insert Root of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), ⅛ through ⅝ inch Thick, IN3XX and ER3XX, As-Welded Condition. This standard contains the essential welding variables for austenitic stainless steel in the thickness range of ⅛–⅝ inch, using manual gas tungsten arc welding followed by shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B.2.1-8-214:2001 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding followed by Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), ⅛ through ⅝ inch Thick, ER3XX and E3XX-XX, As-Welded Condition. This standard contains the essential welding variables for austenitic stainless steel in the thickness range of ⅛–⅝ inch, using manual gas tungsten arc welding followed by shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B.2.1-8-215:2001 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding with Consumable Insert Root of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), ⅛ through ⅝ inch Thick, IN3XX and ER3XX, As-Welded Condition. This standard contains the essential welding variables for austenitic stainless steel in the thickness range of ⅛–⅝ inch, using manual gas tungsten arc welding with consumable insert root. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This WPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B.2.1-8-216:2001 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding with Consumable Insert Root followed by Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), ⅛ through ⅝ inch Thick, IN3XX, ER3XX, and E3XX-XX, As-Welded Condition. This standard contains the essential welding variables for austenitic stainless steel in the thickness range of ⅛–⅝ inch, using manual gas tungsten arc welding with consumable insert root. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This WPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B.2.1-8-227:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Carbon Steel (M-1/P-1/S-1, Groups 1 or 2) to Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), ⅛ through ⅝ inch Thick,
Win Great Prizes in the 
2010-2011 
AWS Member-
Get-A-Member 
Campaign*

ABOUT: AWS is looking for individuals to become part of an exclusive group of AWS Members who get involved and win. Give back to your profession, strengthen AWS and win great limited-edition prizes by participating in the 2010-2011 Member-Get-A-Member Campaign. By recruiting new members to AWS, you’re adding to the resources necessary to expand your benefits as an AWS Member. Year round, you’ll have the opportunity to recruit new members and be eligible to win special contests and prizes. Referrals are our most successful member recruitment tool. Our Members know first-hand how useful AWS Membership is, and with your help, AWS will continue to be the leading organization in the materials joining industry.

To recruit new Members, use the application on the reverse, or visit www.aws.org/mgm

PRIZE CATEGORIES

President’s Honor Roll: Recruit 1-2 new Individual Members and receive an AWS Sportpack bag.

President’s Club: Recruit 3-8 new Individual Members and receive an AWS hat and an AWS Sportpack bag.

President’s Roundtable: Recruit 9-19 new Individual Members and receive an AWS polo or denim shirt, hat and an AWS Sportpack bag.

President’s Guild: Recruit 20 or more new Individual Members and receive an AWS Messenger Bag, an AWS polo or denim shirt, a one-year free AWS Membership, the “Shelton Ritter Member Proposer Award” Certificate and membership in the Winner’s Circle.

Winner’s Circle: All members who recruit 20 or more new Individual Members will receive annual recognition in the Welding Journal and will be honored at the FABTECH Show.

SPECIAL PRIZES

Participants will also be eligible to win prizes in specialized categories. Prizes will be awarded at the close of the campaign (June 2011).

Sponsor of the Year: The individual who sponsors the greatest number of new Individual Members during the campaign will receive a plaque, a trip to the 2011 FABTECH Show, and recognition at the AWS Awards Luncheon at the Show.

Student Sponsor Prize: AWS Members who sponsor two or more Student Members will receive an AWS Sportpack bag.

International Sponsor Prize: Any member residing outside the United States, Canada and Mexico who sponsors the most new Individual Members will receive a complimentary AWS Membership renewal.

LUCK OF THE DRAW

For every new member you sponsor, your name is entered into a quarterly drawing. The more new members you sponsor, the greater your chances of winning. Prizes will be awarded in November 2010, as well as in February and June 2011.

Prizes Include:

* Complimentary AWS Membership renewal
* AWS t-shirt
* AWS hat

SUPER SECTION CHALLENGE

The AWS Section in each District that achieves the highest net percentage increase in new Individual Members before the June 2011 deadline will receive special recognition in the Welding Journal.

The AWS Sections with the highest numerical increase and greatest net percentage increase in new Individual Members will each receive the Neitzel Membership Award.

*The 2010-2011 MGM Campaign runs from June 1, 2010 to May 31, 2011.

Prizes are awarded at the close of the campaign.
AWS MEMBERSHIP APPLICATION

4 Easy Ways to Join or Renew:
☐ Mail this form, along with your payment, to AWS
☐ Call the Membership Department at (800) 443-9353, ext. 480
☐ Fax this completed form to (305) 443-5647
☐ Join or renew on our website <www.aws.org/membership>

☐ Mr. ☐ Ms. ☐ Mrs. ☐ Dr. Please print • Duplicate this page as needed

Last Name ____________________________ M.I. ______
First Name ____________________________
Title ____________________________

Were you ever an AWS Member? ☐ YES ☐ NO If “YES,” give year _____ and Member # __________

Primary Phone ( ) ____________________________ Secondary Phone ( ) ____________________________
FAX ( ) ____________________________ E-Mail ____________________________

Did you learn of the Society through an AWS Member? ☐ Yes ☐ No
If “YES,” Member’s name: ____________________________ Member’s # (if known): ____________________________
From time to time, AWS sends out informational emails about programs we offer, new Member benefits, savings opportunities and changes to our website. If you would prefer not to receive these emails, please check here ☐

ADDRESS

NOTE: This address will be used for all Society mail.

Company (if applicable) ____________________________
Address __________________________________________________________________________________________
Address Con’t. ______________________________________________________________________________________

City ____________________________ State/Province __________ Zip/Postal Code __________ Country __________

PROFILE DATA

NOTE: This data will be used to develop programs and services to serve you better.

Who pays your dues?: ☐ Company ☐ Self-paid ☐ Sex: ☐ Male ☐ Female
Education level: ☐ High school diploma ☐ Associate’s ☐ Bachelor’s ☐ Master’s ☐ Doctoral

PAYMENT INFORMATION (Required)

ONE-YEAR AWS INDIVIDUAL MEMBERSHIP .................................................. $80
TWO-YEAR AWS INDIVIDUAL MEMBERSHIP ........................................... $160 $135

New Member? ______ Yes ______ No ______
If yes, add one-time initiation fee of $12 ____________

International Members add $50 for optional hard copy of Welding Journal (note: digital delivery of WJ is standard) ____________

Domestic Members add $25 for book selection ($192 value), and save up to 87% ____________
International Members add $75 for book selection (note: $50 is for international shipping) ____________

NOTE: This address will be used for all Society mail.

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BOOK/CD-ROM SELECTION

(Pay Only $25... up to a $192 value)

NOTES: Only New Individual Members are eligible for this selection. Please be sure to add $25 to your total payment.

ONLY ONE SELECTION PLEASE.
☐ Jefferson’s Welding Encyclopedia (CD-ROM only)
☐ Design and Planning Manual for Cost-Effective Welding
☐ Welding Metallurgy
☐ Welding Handbook (9th Ed., Vol. 3)
☐ Welding Handbook (9th Ed., Vol. 2)
☐ Welding Handbook (9th Ed., Vol. 1)

For more book choices visit www.aws.org/membership

New Member ☐ Renewal ☐

A free local Section Membership is included with all AWS Memberships. Section Affiliation Preference (if known):

Type of Business (Check One only):
☐ Contract construction
☐ Chemicals & allied products
☐ Petroleum & coal industries
☐ Primary metal industries
☐ Fabricated metal products
☐ Machinery except elect. (incl. gas welding)
☐ Electrical equip., supplies, electrodes
☐ Transportation equip. — air, aerospace
☐ Transportation equip. — automotive
☐ Transportation equip. — boats, ships
☐ Transportation equip. — railroad
☐ Utilities
☐ Welding distributors & retail trade
☐ Misc. repair services (incl. welding shops)
☐ Educational Services (univ., libraries, schools)
☐ Engineering & architectural services (incl. assns.)
☐ Misc. business services (incl. commercial labs)
☐ Government (federal, state, local)
☐ Other

Job Classification (Check One only):
01 President, owner, partner, officer
02 Manager, director, superintendent (or assistant)
03 Sales
04 Purchasing
05 Engineer — welding
06 Engineer — design
07 Engineer — manufacturing
08 Engineer — other
09 Architect designer
10 Metallurgist
11 Research & development
12 Quality control
13 Inspector, tester
14 Supervisor, foreman
15 Technician
16 Welder, welding or cutting operator
17 Consultant
18 Educator
19 Librarian
20 Student
21 Customer Service
22 Other

Technical Interests (Check all that apply):
☐ Ferrous metals
☐ Aluminum
☐ Nonferrous metals except aluminum
☐ Advanced materials/Intermetallics
☐ Ceramics
☐ High energy beam processes
☐ Arc welding
☐ Brazing and soldering
☐ Resistance welding
☐ Thermal spray
☐ Cutting
☐ NDT
☐ Safety and health
☐ Bending and shearing
☐ Roll forming
☐ Stamping and punching
☐ Aerospace
☐ Automotive
☐ Machinery
☐ Marine
☐ Piping and tubing
☐ Pressure vessels & tanks
☐ Sheet metal
☐ Structures
☐ Other
☐ Automation
☐ Robotics
☐ Computerization of Welding

American Welding Society

American Welding Society

Member Services Revised 12/12/08

Two-year Individual Membership Special Offers: applies only to new AWS Individual Members. +Discount Publication Offers: applies only to new AWS Individual Members. Select one of the six listed publications for an additional $75. International Members add $75 ($25 for book selection and $50 for International shipping) Multi-Year Discount: Five years $300, each additional year is $75. Be sure to ask for a member discount (note: international shipping). ☐(Student Members Only) Any individual who attends a recognized college, university, technical, vocational school or high school is eligible. Domestic members are those students residing outside the United States. Domestic members are those students residing outside the United States. All of the above offers are limited to one per member. Please check here ☐.

Two-year Individual Membership Special Offers: applies only to new AWS Individual Members. +Discount Publication Offers: applies only to new AWS Individual Members. Select one of the six listed publications for an additional $75. International Members add $75 ($25 for book selection and $50 for International shipping) Multi-Year Discount: Five years $300, each additional year is $75. Be sure to ask for a member discount (note: international shipping). ☐(Student Members Only) Any individual who attends a recognized college, university, technical, vocational school or high school is eligible. Domestic members are those students residing outside the United States. Domestic members are those students residing outside the United States. All of the above offers are limited to one per member. Please check here ☐.

Learn more about each publication at www.awspubs.com

If "YES," give year _____ and Member # ____________
From time to time, AWS sends out informational emails about programs we offer, new Member benefits, savings opportunities and changes to our website. If you would prefer not to receive these emails, please check here ☐

Signature of Applicant: ____________________________
Application Date: ____________________________

Office Use Only

Check # ____________ Account # ____________

Source Code WJ

American Welding Society

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B2.1-18:228:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Groups 1 or 2) to Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), ¼ through 1¾ inch Thick, E309(L), As-Welded Condition. This standard contains the essential welding variables for welding carbon steel to austenitic stainless steel in the thickness range of ¾–1½ in., using manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove and fillet welds. This SWPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-18-231:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding with Consumable Insert Root followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Groups 1 or 2) to Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), ¼ through 1½ inch Thick, IN309, ER309, and E309-15, -16, or -17, or IN309, ER309(L), and ER309(L)-15, -16, or -17, As-Welded Condition. This standard contains the essential welding variables for welding carbon steel to austenitic stainless steel in the thickness range of ¾–1½ in., using manual gas tungsten arc welding, with consumable insert root, followed by shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This SWPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-18-229:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Groups 1 or 2) to Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), ¼ through 1½ inch Thick, ER309(L) and ER309(L)-15, -16, or -17, As-Welded Condition. This standard contains the essential welding variables for welding carbon steel to austenitic stainless steel in the thickness range of ¾–1½ in., using manual gas tungsten arc welding followed by shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove and fillet welds. This SWPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-18-230:2002 (R20XX), Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding with Consumable Insert Root of Carbon Steel (M-1/P-1/S-1, Groups 1 or 2) to Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), ¼ through 1½ inch Thick, IN309 and ER309(L), As-Welded Condition. This standard contains the essential welding variables for welding carbon steel to austenitic stainless steel in the thickness range of ¾–1½ in., using manual gas tungsten arc welding with consumable insert root. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This SWPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-1-302:20XX, Standard Welding Procedure Specification (SWPS) for Naval Applications Shielded Metal Arc Welding of Carbon Steel (S-1), ¼ through 1½ inch Thick, MIL-7018-M, As-Welded or PWHT Condition, Primarily Plate and Structural Naval Applications. This standard contains the essential welding variables for carbon steel in the thickness range of ¾–1½ in., using manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove and complete penetration groove welds. This SWPS was developed primarily for pipe applications. Stakeholders: Manufacturers, welders, CWIs, engineers. Reaffirmed. S. Morales, ext. 313.

B2.1-1-312:20XX, Standard Welding Procedure Specification (SWPS) for Naval Applications Shielded Metal Arc Welding of Carbon Steel (S-1), ¼ through 1½ inch Thick, MIL-7018-M, As-Welded or PWHT Condition, Primarily Pipe for Naval Applications. This standard contains the essential welding variables for carbon steel in the thickness range of ¾–1½ in., using manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds with backing, complete penetration groove welds with backing, and complete penetration welds that are welded from both sides. This SWPS was developed primarily for naval applications that require performance to NAVSEA Publication 9074-AQ-GIB-010/248, Requirements for Welding and Brazing Procedures and Performance Qualification. Stakeholders: Navy, manufacturers, welders, CWIs, engineers. New. S. Morales, ext. 313.
Agricultural Equipment

Guide for D3.7, for Underwater Welding; and D3.9, Aluminum Hull Welding;
gupta@aws.org, ext. 301.

ing Procedure Specification (SWPS) for recom-
ded Practices for Surfacing and Re-
mended for surfacing applications. The applica-
tion of base metal with different cycle life and re-
allowable unit stresses are provided for weld metal and base metal for various cyclically loaded joint designs. Stakeholders: Machinery and equipment industry. Revised. M. Rubin, ext. 215.

standards for the manufacture and main-

Standards Released for Aluminum GTAW, Transparent Screens, and Welding Earthmoving and Construction Equipment

The following three updated documents have recently been published:

AWS F2.3M:2011, Specification for Use and Performance of Transparent Welding Curtains and Screens


AWS B21.22-015:2011, Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Aluminum (M/P-22 to M/P22), 18 through 10 Gauge, ER4043 or R4043, in the As-Welded Condition, with or without Backing.

AWS F2.3:2011 applies to curtains used in industrial applications to shield passersby from sparks, spatter, and radiation, excluding gamma and X-rays, partic-
larly radiation, laser light, and electron beams. The 24-page document lists for $52, $39 for AWS members.

AWS D14.3:2010 applies to all structural welds used in the manufacture and repair of earthmoving, construction, and agricultural equipment. The 94-page standard lists for $80, $60 for AWS members.

Submit Your Nomination for the M.I.T. Award

November 2, 2010, is the deadline for submitting nominations for the 2011 Prof. Koichi Masubuchi Award, sponsored by the Dept. of Ocean Engineering at Massachusetts Institute of Technology (M.I.T.). This award, including an honorarium of $5000, is presented each year to one person, 40 years old or younger, who has made significant contributions to the advancement of materials joining through research and development.

The nomination package should include the candidate’s background, experience, publications, honors, and awards, plus at least three letters of recommendation from fellow researchers. The award is established to recognize Prof. Masubuchi for his numerous contributions to the advancement of the science and technology of welding, especially in the fields of fabricating marine and outer space structures.

Send your nomination package to John DuPont, professor, Lehigh University, at jnd1@lehigh.edu.

Contribute Your Expertise to These Documents

Marine Construction

The D3 Committee for Welding in Marine Construction to contribute to the development of D3.5, Guide for Steel Hull Welding; D3.6, Specification for Underwater Welding; D3.7, Guide for Aluminum Hull Welding; and D3.9, Specification for Classification of Weld-Through Paint Primers. Contact B. McGrath, bmgrath@aws.org, ext. 311.

Mechanical Testing of Welds

The B4 Committee for Mechanical Testing of Welds to contribute to B4.0, Standard Methods for Mechanical testing of Welds. Contact B. McGrath, bmgrath@aws.org, ext. 311.

Surfacing Industrial Mill Rolls


Magnesium Alloy Filler Metals

A5L Subcommittee on Magnesium Alloy Filler Metals to assist in the updating of AWS A5.19-92 (R2006), Specification for Magnesium Alloy Welding Electrodes and Rods. Contact R. Gupta, gupta@aws.org, ext. 301.

Robotic and Automatic Welding


Thermal Spraying


Labeling and Safe Practices

SH4 Subcommittee on Labeling and Safe Practices to update AWS F2.2, Lens Shade Selector; AWS F4.1, Safe Practices for the Preparation of Containers and Piping for Welding and Cutting; and the AWS Safety and Health Fact Sheets. S. Hedrick, steveh@aws.org, ext. 305.
On August 12, American Welding Society representatives Cassie Burrell, deputy executive director, and Donald Llopis, coordinator, international business and certification programs, met with Universidad Tecnológica de Pereira officials in Pereira, Colombia, to authorize the university to serve as an AWS International Agent. The authorization will permit the university to conduct AWS certification events in Colombia.

The university officials included Luis Enrique Arango Jimenez, university dean; Ing. Eduardo Roncancio Huertas, dean, faculty of Mechanical Engineering; Alberto Zapata Meneses, associate professor, faculty of Mechanical Engineering; and Claudia M. Castaño Rodas, international programs coordinator.

Also participating in the meeting were Lincoln Electric de Colombia representatives Sebastian Correa and Juan C. Montoya.
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Educational Institutions
Aircraft Plasma Equipments (India) Pvt. Ltd.
124 Diamond Ind. Estate, Khetkipada, Dahisar (E.) Mumbai Maharashtra 400068, India

Batis Institution Group
2207 E. Manchester Ave.
Los Angeles, CA 90001

Four Rivers Career Center
1978 Image Dr.
Washington, MO 63090

L.U.E.C. Local 8 Joint Apprenticeship and Training Committee
690 Potrero Ave.
San Francisco, CA 94110

Supporting Company
Norco Manufacturing Corp.
PO Box 246
Franksville, WI 53126

Welding Distributor
International Welding Center (IWC)
St. 8, Gate 53 Industrial Area
PO Box 21878, Doha, Qatar

AWS Member Counts
September 1, 2010

Grades
Sustaining........................................ 517
Supporting........................................ 303
Educational....................................... 540
Affiliate........................................... 470
Welding Distributor......................... 46
Total Corporate Members................ 1,876

Individual Members.................. 52,876
Student + Transitional Members... 9,955
Total Members.............................. 62,831

Director Awards Announced for Districts 10, 12, 19, 21

The District Director Award provides a means for District Directors to recognize individuals who have contributed their time and effort to the affairs of their local Section and/or District. The Award provides a means for District directors to recognize individuals who have contributed their time and effort to the affairs of their local Section and/or District.

District 10 Director Richard Harris has nominated the following for this award:
Kenny Jones — Mahoning Valley
Marty Siddall — Northwestern Pa.
Harry Sadler — Cleveland

District 12 Director Sean Moran has nominated the following for this award:
Michael Kersey — Milwaukee
Robert Buss — Milwaukee
Daniel Gibbs — Madison-Beloit
David Dijlak — Madison-Beloit
Bill Dawson — Madison-Beloit
Cory Satka — Fox Valley
Lloyd Cudnahufsky — Upper Peninsula
Dale Lange — Upper Peninsula

District 19 Director Neil Shannon has nominated the following for this award:
Joel Pepin — Alberta
John Bergson — Portland
Peter Macksey — Alaska

District 21 Director Nan Samanich nominated the following for this award:
Creighton Moore — Alaska
John Sisks — Inland Empire
Brenda Moe — British Columbia
Marvin Nitta — Olympic
Steve Nielsen — Puget Sound
Rich Irving — Spokane

Nominations Sought for National Officers

AWS members who wish to nominate candidates for President, Vice President, and Director-at-Large on the AWS Board of Directors for the term starting Jan. 1, 2012, may present their nominations in person at the open session of the National Nominating Committee meeting scheduled for 2:00 to 3:00 PM, Tuesday, Nov. 2, 2010, at the Georgia World Congress Center, Atlanta, Ga., during the FABTECH show.

Nominations must be accompanied by biographical material on the candidate, including a written statement by the candidate as to his or her willingness and ability to serve if nominated and elected, letters of support, plus a 5 x 7 in. color portrait.

Note: Persons who present their nominations at the show must provide 20 copies of the biographical materials and written statement.

jl OCTOBER 2010
Shown at the Connecticut Section Welders Rendevous outing are from left (front row) Rick Etheridge, Chairman Al Moore, and Frank Gorglione, (back row) James Bialowbrezski, Stanley Bialowbrezski, Tim Kinnaman, and Rick Munroe.

**District 1**
Thomas Ferri, director  
(508) 527-1884  
tferri@thermadyne.com

**CONNECTICUT**  
**AUGUST 6**
Activity: The Section held its first Welders’ Rendevous and family outing at the Rock Cats minor league baseball team facility in New Britain, Conn. A welding competition tested the competitors’ skills in joining a series of pipes, plates, and nipples according to a print. The inspections included visual and pressure testing to 3000 lb/in.². **Tim Kinnaman** won the $1000 prize with runners-up James Bialowbrezski, Rick Etheridge, and Mike Genzano. Rick Munroe and Frank Gorglione judged the entries. The event was headed by Chair Al Moore, District 1 Director Tom Ferri, and assistant Stanley Bialowbrezski.

**District 2**
Kenneth R. Stockton, director  
(908) 412-7099  
kenneth.stockton@pseg.com

**District 3**
Michael Wiswesser, director  
(610) 820-9551  
mike@welderinstitute.com

**District 4**
Roy C. Lanier, director  
(252) 321-4285  
rlanier@email.pittcc.edu

**District 5**
Steve Mattson, director  
(904) 260-6040  
steve.mattson@yahoo.com

**District 6**
Kenneth Phy, director  
(315) 218-5297  
KAPhyInc@gmail.com

March for schools in the state of Maine. District 1 Director **Thomas Ferri** said during the presentation, “Jesse reached out to many local business owners, welding supply distributors, and friends for donations, materials and help to put together a successful SkillsUSA event.” Crosby said the job was harder than he thought it would be, but with the first year under his belt, next year should be easier and he is looking forward to doing it again.

**MAINE**  
**JULY 21**
Activity: **Jesse Crosby** was presented the Section Director’s Recognition Award for successfully handling the role of facilitor for the SkillsUSA welding competition in March for schools in the state of Maine. District 1 Director **Thomas Ferri** said during the presentation, “Jesse reached out to many local business owners, welding supply distributors, and friends for donations, materials and help to put together a successful SkillsUSA event.” Crosby said the job was harder than he thought it would be, but with the first year under his belt, next year should be easier and he is looking forward to doing it again.

**District 4**
Roy C. Lanier, director  
(252) 321-4285  
rlanier@email.pittcc.edu

**District 6**
Kenneth Phy, director  
(315) 218-5297  
KAPhyInc@gmail.com

Jesse Crosby (right) is recognized by District 1 Director Tom Ferri for his successful management of the Maine SkillsUSA contest.
Shown at the Northern New York Section executive committee meeting in August are (from left) Bruce Lavalle, Larry Hidde, Chair Dave Parker, Bob Strugar, and Keith Flood.

Shown at the Mahoning Valley golf outing are (from left) Carl Ford, Joe Stepo, Leon Stitt, Tyler Goulding, Cody Stevens, Brandon Green, Nick Ambrosini, Vice Chair Huck Hughes, and Secretary Chuck Moore.

NORTHERN NEW YORK
AUGUST 19
Activity: The Section’s executive committee members held a planning meeting at Mill Road Acres and Restaurant in Lantham, N.Y. Attending were Chair Dave Parker, Vice Chair Bob Strugar, Treasurer Keith Flood, Bruce Lavalle, and Larry Hidde.

COLUMBUS
This Month’s Special Event
Oct. 19, 2010: Hands-on Welding Night
At The Ohio State University, Agricultural Engineering, 590 Woody Hayes Dr., Columbus, Ohio, 6 PM, $20, includes dinner and all activities. Minimum age is 14.
Introduce your entire family to welding with some hands-on welding fun plus interesting presentations on the history of welding and an overview of some of the many modern welding processes.
Contact John Lawmon, Section treasurer, jlawmon@aemi.us; (614) 846-5718. Visit http://awssection.org/columbus.

District 7
Don Howard, director
(814) 269-2895
howard@ctc.com

District 8
Joe Livesay, director
(931) 484-7502, ext. 143
joe.livesay@ttcc.edu

District 9
George D. Fairbanks Jr., director
(225) 473-6362
fits@bellsouth.net

District 10
Richard A. Harris, director
(440) 338-5921
richaharris@windstream.net
MAHONING VALLEY

AUGUST 6

District 11
Etthios Siradakis, director
(989) 894-4101
ft.siradakis@airgas.com

District 12
Sean P. Moran, director
(920) 954-3828
sean.moran@hobartbrothers.com

District 13
W. Richard Polanin, director
(309) 694-5404
rpolanin@icc.edu

CHICAGO
AUGUST 4
Activity: The Section executive committee held a board meeting at Papa Passero’s Restaurant in Westmont, Ill. Attending were Chair Chuck Hubbard, Vice Chair Craig Tichelar, Treasurer Marty Vondra, Secretary Eric Krauss, Cliff Iftimie, and Hank Sima.

District 14
Tully C. Parker, director
(618) 667-7795
tullyparker@charter.net

ST. LOUIS
JUNE 7
Activity: The Section hosted its annual golf outing and scholarship fund-raising event at Fox Creek Golf Club in Edwardsville, Ill. Chairman Victor Shorkey received an award in appreciation for his services from Treasurer Dave Beers. Allen Thomas, Larry Miller, Walter Ford, and Bob Garner,
A few of the Black Hills Student Chapter members are shown at South Dakota School of Mines in Rapid City, S.Dak.

District 18 Section leaders are shown working at the District 18 conference in May.

District 15
Mace V. Harris, director
(612) 861-3870
macevh@aol.com

District 16
David Landon, director
(641) 621-7476
dlandon@vermeermfg.com

Black Hills Student Chapter
July
Activity: The Chapter, based at South Dakota School of Mines, Rapid City, S.Dak., conducted outreach activities for more than 200 middle and high school students during the summer of 2010. Supervised by Student Chapter Advisor Michael West, the activities included presenting hands-on materials-joining demonstrations for students involved in the STEPS Camp, NASA Space Camp, and Materials Camp held at the School of Mines.

District 17
J. Jones, director
(940) 368-3130
jjones@thermadyne.com
District 18
John Bray, director
(281) 997-7273
sales@affiliatedmachinery.com

District 18 Conference
May 15
Activity: The District 18 conference was held at the Hotel Contessa in San Antonio, Tex., chaired by John Bray, District 18 director. Attending were AWS Vice President John Mendoza and Rhenda Kenny, director, AWS Member Services.

Wharton County Jr. College
August 13
Activity: Roy Jones, structural welding instructor at Wharton County Jr. College, Wharton, Tex., proudly attended the graduation of his class of 33 welding students.

Calendar
Oct. 15, 2010: Texas Gulf Coast Welding Expo. Contact Roy Jones, structural welding instructor, jonesr@wcjc.edu, or call (979) 532-6952, Wharton County Jr. College, Wharton, Tex.

District 19
Neil Shannon, director
(503) 419-4546
neilshonn@msn.com

ALBERTA
October 30, 2009
Activity: The Section hosted its annual fall seminar at Devon Branch of Alberta Innovates — Technology Futures (formerly the Alberta Research Council) for 65 attendees. The seminar theme was high-productivity welding processes and automation for the energy industry. The keynote speaker was Tarasankar DebRoy, professor, Penn State University. Presentations were given by Gene Lawson, a past AWS president; David Jordan and Teresa Melfi, Lincoln Electric; Craig Spindler, ITW; Jack Schroeder, ESAB Automation; Carl Heinrich, Roboweld, Inc.; and Matthew Yarmuch, Alberta Innovates.

District 20
William A. Komlos, director
(801) 560-2353
bkoz@arctechllc.com

District 21
Nanette Samanich, director
(702) 429-5017
Nan87@aol.com

District 22
Dale Flood, director
(916) 286-6100, ext. 172
flashflood@email.com
Member-Get-A-Member Campaign

Listed are the members participating in the 2010–2011 Member-Get-A-Member (MGM) campaign effective 8/12/2010. For campaign rules and the prize list, see page 145 in this Welding Journal or visit the AWS campaign Web site www.aws.org/mgm.

Call the AWS Membership Dept. (800/305) 443-9353, ext. 480, for information on your member-proposer point status.

Winner’s Circle
Sponsored 20+ new members per year since 6/1/1999. The superscript indicates the number of years the member has achieved this status.

J. Merzthal, Peru 7
E. Ezell, Mobile 7
J. Merzthal, Peru 7
G. Taylor, Pascagoula 2
L. Taylor, Pascagoula 2
B. Chin, Auburn-Opelika 1
J. Compton, San Fernando Valley 7
E. Ezell, Mobile 7
J. Merzthal, Peru 7
G. Taylor, Pascagoula 2
L. Taylor, Pascagoula 2
B. Chin, Auburn-Opelika 1
S. Esders, Detroit 1
M. Haggard, Inland Empire 1
M. Karagoulis, Detroit 1
S. McGill, NE Tennessee 1
B. Mikeska, Houston 1
W. Shreve, Fox Valley 1
T. Weaver, Johnstown-Altoona 1
W. Wommer, Johnstown-Altoona 1
R. Wray, Nebraska 1

President’s Club
Sponsored 3–8 new members
C. Crompton, Florida W. Coast — 3
W. Sartin, Long Beach/Or. Cty. — 3
W. Sturge, New York — 3

President’s Honor Roll
Sponsored 1 or 2 new members
M. Allen, Charlotte — 2
E. Ezell, Mobile — 2
W. Wall, Auburn — 2

Student Member Sponsors
Sponsored 2 or more
new student members

Journal or visit the AWS campaign Web site www.aws.org/mgm.

Call the AWS Membership Dept. (800/305) 443-9353, ext. 480, for information on your member-proposer point status.

Nominees for National Office

Only Sustaining Members, Members, Honorary Members, Life Members, and Retired Members who have been members for a period of at least three years shall be eligible for election as a director or national officer.

It is the duty of the National Nominating Committee to nominate candidates for national office. The committee shall hold an open meeting, preferably at the Annual Meeting, at which members may discuss the eligibility of all candidates.

The next National Nominating Committee meeting is scheduled for Nov. 2, 2010, during FABTECH at the Georgia World Congress Center in Atlanta. The terms of office for candidates nominated at this meeting will commence Jan. 1, 2012.

To be considered a candidate for national office the following qualifications and conditions apply:

President: To be eligible to hold the office of president, an individual must have served as a vice president for at least one year.

Vice President: To be eligible to hold the office of vice president, an individual must have served at least one year as a director, other than executive director and secretary.

Treasurer: To be eligible to hold the office of treasurer, an individual must be a member of the Society, other than a Student Member, must be frequently available to the national office, and should be of executive status in business or industry with experience in financial affairs.

Director-at-Large: To be eligible for election as a director-at-large, an individual shall previously have held office as chairman of a Section; chairman or vice chairman of a standing, technical, or special committee of the Society; or District director.

Interested persons should submit a letter stating which office they seek, including a statement of qualifications, their willingness and ability to serve if nominated and elected, and a biographical sketch.

E-mail the letter to Gricelda Manalic, gricelda@aws.org, c/o Victor Y. Matthews, chair, National Nominating Committee.

Honorary Meritorious Awards

The Honorary Meritorious Awards Committee makes recommendations for the nominees presented to receive the Honorary Membership, National Meritorious Certificate, William Irrgang Memorial, and the George E. Willis Awards. These honors are presented during FABTECH.

William Irrgang Memorial Award
Sponsored by The Lincoln Electric Co. in honor of William Irrgang, the award, administered by AWS, is given each year to the individual who has done the most over the past five years to promote the advancement of welding technology, and dedication to AWS affairs, assistance in promoting cordial relations with industry and other organizations, and for contributions of time and effort on behalf of the Society.

National Meritorious Certificate Award
This certificate award recognizes the recipient’s counsel, loyalty, and dedication to AWS affairs, assistance in promoting cordial relations with industry and other organizations, and for contributions of time and effort on behalf of the Society.

George E. Willis Award
Sponsored by The Lincoln Electric Co. in honor of George E. Willis, the award, administered by AWS, is given each year to an individual who promoted the advancement of welding internationally by fostering cooperative participation in technology transfer, standards rationalization, and promotion of industrial goodwill. It includes a $2500 honorarium and a certificate.

Honorary Membership Award
The honor is presented to a person of acknowledged eminence in the welding profession, or to one who is credited with exceptional accomplishments in the development of the welding art, upon whom the Society deems fit to confer an honorary distinction. Honorary Members have full rights of membership.

International Meritorious Certificate Award
This honor recognizes recipients’ significant contributions to the welding industry for service to the international welding community in the broadest terms. The awardee is not required to be an AWS member. Multiple awards may be given. The award consists of a certificate and a one-year AWS membership.

G. Woomer, Johnstown-Altoona 1
R. Wray, Nebraska 1
M. Pelegriino, Chicago — 69
V. Facchiano, Lehigh Valley — 20
E. Norman, Ozark — 18
T. Buchanan, Mid-Ohio Valley — 17
T. Schalzler, Lehigh Valley — 17
G. Seese, Johnstown-Altoona — 16
M. Haggard, Spokane — 15
G. Kirk, Pittsburgh — 11
A. Badeaux, Washington, D.C. — 7
S. Mackenzie, Northern Michigan — 4
C. Warren, N. Central Florida — 4
J. Gerdin, Northwest — 3
J. Goodson, New Orleans — 3
R. Hutchinson, Long Beach/Or. Cty. — 3
D. Kowalksi, Pittsburgh — 3
S. Roberson, Cumberland Valley — 3
J. Sullivan, Mobile — 3
D. Zabel, NE Nebraska — 3

Listed are the members participating in the 2010–2011 Member-Get-A-Member (MGM) campaign effective 8/12/2010. For campaign rules and the prize list, see page 145 in this Welding Journal or visit the AWS campaign Web site www.aws.org/mgm.

Call the AWS Membership Dept. (800/305) 443-9353, ext. 480, for information on your member-proposer point status.
Practical Metal Fabrication Guide Updated

The third edition of *Metal Fabrication — A Practical Guide* serves as the basis for a comprehensive training curriculum in metal fabrication for use in classroom and on-the-job instruction programs. The book covers shop mathematics, blueprint reading, metallurgy, layout methods for precision fabrication, shop safety, and basic machine operations. New to this edition are topics on laser beam and water-jet cutting, an expanded section on plasma arc cutting, and review questions at the end of each chapter. The text presents both theoretical knowledge and an understanding and appreciation of the newer technologies used in manufacturing as well as the basic hand- and power-operated equipment and tooling. The book lists for $62.50, $50 for association members.

The Fabricators & Manufacturers Assn.  
www.fmastore.org/Default.aspx  
(815) 399-8775

CenterLine Launches New Web Site

The company’s new Web site offers a number of new features including video and literature downloads, updated product and service information, enhanced navigation features, and detailed overviews of its capabilities as a supplier to the automotive, mass transit, aerospace, and defense industries. Information is displayed for its standard and custom production systems, component products and technical support services for resistance, GMA, and laser beam welding needs, as well as for metal forming and cold spray applications.

CenterLine (Windsor) Ltd.  
www.cntrline.com  
(519) 734-8464

zeroG® Technology Explained in Brochure

An eight-page, well illustrated brochure details the company’s zeroG® technology that allows tools, parts, and other payloads to be maneuvered as if weightless while retaining a full range of motion. The devices make heavy tools effectively weightless to allow workers to use their fine motor skills for greater precision while reducing fatigue. Illustrated are typical installations coupled with chairs, carts, gantries, and jibs. The devices are entirely mechanical, use no power, air, or hydraulics, and are compatible with a variety of tools including grinders, sanders, drills, rivet squeezers, nut runners, and torque tools. Shown are the proprietary gimbals that interface between the zeroG® arm and the tool it holds to permit the tool to move into any position and angle required. Included are case studies from prominent automotive and aerospace users.

Equipois, Inc.  
www.equipoisinc.com  
(866) 601-2070

Vacuum Chambers and Valves Pictured in Catalog

The 12-page, 2010 Mini Product Catalog illustrates and details a cross-section of the company’s lines of vacuum products including ordering information. Illustrated are angle valves, gate valves, slit...
The 44-page, full-color guide, Our Solutions at Your Service, presents a comprehensive portfolio of the company’s precision motion control products, technologies, and services to serve a variety of applications in research and development, aerospace, defense, life and health sciences, photovoltaics, microelectronics, laser research, fiber-optic communications, semiconductor wafer manufacturing, metrology, and industrial manufacturing. Presented are solutions for custom-built multiaxis motion systems, linear, vertical and rotation stages, air-bearing technology platforms, ceramic materials, and numerous other technologies. Featured are recently introduced products including the SinguLYS™ air-bearing stage and bridge, and URS50BCC and URS50BPP precision rotation stages with 360-deg continuous motion. The guide may be downloaded from the Web site.

Newport Corp.
www.newport.com/motion
(949) 863-3144

Guide to Global Welding Market Updated

The Frost & Sullivan research service titled Strategic Analysis of the Global Welding Market in Energy Generation provides total market values and percent of revenues by geography. Included are the welding equipment and welding consumables in the power, liquid nitrogen gas tanks, pipeline, and offshore sectors. Examined are the following markets: welding equipment for arc welding, shielded metal arc welding, gas metal arc welding, submerged arc welding, and submerged arc welding.
and gas tungsten arc welding, and welding consumables including covered electrodes, solid wires, flux cored wires, and submerged arc welding wires and fluxes. For more information or to order, visit the Web site shown then type “Strategic Analysis Global Welding” in the search window.

Research and Markets
www.researchandmarkets.com
FAX: (646) 607-1907

Temperature Indicators Detailed in Data Sheet

A two-page, full-color data sheet details the features of the Tempilstik® temperature-indicating crayons for precision monitoring of various welding, heat treating, annealing, and stress-relieving operations. Listed are the products’ compliance with various industrial codes, traceability to NIST standards, and certification for nuclear use. The brochure can be downloaded from the Web site, or call for a hard copy.

Tempil®
www.tempil.com
(800) 757-8301

Dust Collector Fan Motors Pictured in Brochure

A four-page, well-illustrated brochure features the company’s new line of energy-efficient fan motors manufactured by Baldor® for use with dust collectors. Information is provided on product features and benefits and a performance table with ordering information for the various models that range from three to 50 hp to fit various fan designs, airflow capacities, and voltage requirements. A full-color illustration displays an exploded view of a motor with construction details. The motors described are designed for both replacement or retrofit applications. To download the catalog in PDF, visit the Web site then type “fans brochure” in the search window.

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(519) 734-8464

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TMK IPSCO Names VP

TMK IPSCO, Downers Grove, Ill., has appointed Paul Fullerton to the newly created position of vice president, TMK Premium, based in Houston, Tex., to support on- and offshore drilling customers worldwide. Fullerton, who joined the company in 2005 as director of tubular products applications engineering, most recently served as general manager, ULTRA Premium Oilfield Services.

GH Induction Atmospheres Appoints Officers

A new company, GH Induction Atmospheres (GH IA), Rochester, N.Y., has appointed Steve Skewes general manager and Dale Wilcox CTO. The company is a provider of induction heating sources for industrial brazing, heat treating, melting, bonding, and other applications. Skewes and Wilcox cofounded Induction Atmospheres in 2002. The GH Group, based in Valencia, Spain, recently acquired a majority interest in the company, changing the name to GH Induction Atmospheres.

Northwire Fills Three Key Positions

Northwire, Inc., Osceola, Wis., has named Mark Johnson vice president of operations, for an electronics manufacturing services company. PierAgostini previously served as director for defense programs, senior manager for new business development, and senior buyer for a major OEM. Prior to joining the company, Jensen served as vice president of sales and marketing for a Wisconsin-based investment company.

MK Products Announces New President and CEO

MK Products, Irvine, Calif., a family-owned welding equipment design and manufacturer, has appointed Chris Westlake president and Doug Kensrue CEO. Westlake previously served the company for ten years as vice president of operations. He succeeds Kensrue who held the post for more than ten years.

AK Steel Names Sales VP

AK Steel, West Chester, Ohio, has named Gary T. Barlow vice president, sales and customer service. He succeeds Douglas W. Gant who has retired after 30 years of service to the company. Barlow previously was president, northeast region, for Ryerson, Inc., a metals-processing and distributing company.

Obituary

David Neal Chapman

David Neal Chapman, 81, died July 31 in Wilmington, Ohio. Chapman had been an active member of the AWS Dayton Section, serving as secretary (1972–1973), vice chair (1973–1974), and chair (1974–1975). He remained a supporter of the Section’s activities for many years thereafter. During the Korean War, Chapman served as an officer in the U.S. Army. He played football for Wilmington College and also served as a football official for numerous high school games.
Stainless Steel Alloys Electrodes

Arcos Industries, LLC offers a 28-page brochure which details the complete line of premium bare wire and covered electrode products for welding stainless steel alloys. Electrode classifications, approvals, applications, diameters, typical mechanical properties and chemical compositions are included.

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One Arcos Drive
Mt. Carmel, PA 17851
(800) 233-8460
Fax: (570) 339-5206
www.arcos.us

Free Web Portal for Welding Instructors and Students

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Aurora, IL 60504
(866) DR BLUCO
www.bluco.com

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See Us at FABTECH
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A New Method for the Design of Welding Consumables

An innovative approach using physical and numerical models was investigated to develop welding consumables

BY D. S. TORDONATO, J. C. MADENI, S. BABU, S. LIU, AND P. MENDEZ

ABSTRACT

This work presents a novel approach for the development of welding consumables with the potential of being much faster than standard practice. It is based on the combination of a physical model of the welding process using an arc button melter and the use of thermodynamic and microstructural evolution mathematical models. In the proposed methodology, only small batches of controlled alloys are produced instead of manufacturing an entire spool of wire. The results are then interpreted with existing mathematical models. Another unique aspect of this work is the simulation of welding of microalloyed steels using an arc button melter. This required the controlled addition of small amounts of alloying elements while accounting for their recovery and the control of the oxygen level in the chamber. The microstructure of the button melts was tested for repeatability and compared with published literature. Metallographic examination showed acicular ferrite to be the dominant microconstituent in both the physical model samples and the welded sample; however, the acicular ferrite microstructure in button melted samples was coarser and contained fewer and larger inclusions compared to that of weld metal samples. This research indicates that the button melting technique can effectively represent the microstructural evolution during welding, but improvements are necessary to more accurately reproduce inclusion characteristics.

Introduction

Developments in high-strength low-alloy and microalloyed steels have allowed significant improvements in their properties with just marginal increases in material costs. As base metal strength level increases, the weld metal strength must increase while maintaining adequate toughness; consequently, new welding methods and consumables are also needed. Development of new welding consumables is typically a slow process, which can take many years. The reason is that, traditionally, welding consumables have evolved incrementally as a result of minor adjustments to alloying components. However, as more complex, controlled microstructures are required, it becomes increasingly more difficult to optimize consumable composition simply by “tweaking” the composition of existing filler metals. The goal of this project was to produce a new methodology suitable for developing welding consumables for a wide variety of applications, especially those requiring microstructures significantly different from the existing ones. This new methodology should avoid the long and expensive process of iterative fabrication of welding wires of different alloys. The above statements lead to the following questions: Is it possible to use a physical model to accurately reproduce the weld microstructure of a specified chemical composition? Is it possible to use existing computational models to gain new insight into the expected nonequilibrium weld microstructures? A new approach to consumable development utilizing a combination of an arc button melt process and computational thermodynamics was explored in this project to address these questions.

In the arc button melter, a sample is melted in a chamber filled with an atmosphere of controlled composition using a manually controlled gas tungsten arc welding (GTAW) electrode. This method was chosen for its ability to rapidly melt and solidify small samples allowing many candidate alloys to be evaluated in a short time.

Others have also used a similar melting process. Alexandrov and Lippold used an arc button melter in combination with a single thermocouple to characterize phase transformations during cooling, but this work did not involve the creation of new alloys using the technique (Ref. 1, 2). Anderson and Dupont examined solidification modes in stainless steel alloys, in which the effect of oxygen on microstructure is smaller than in microalloyed steels (Ref. 3).

The button melt technique for microalloyed steel is a novel approach to physically simulating the welding phenomena and presents several challenges. First, the technique must accurately reproduce the cooling rates experienced during welding. Second, the alloy composition must be finely controlled to generate repeatable results with microalloys. Finally, oxygen must be introduced into the button in a controlled manner so that inclusions of the proper size, composition, and dispersion are formed. Although introduction of oxygen into the weld metal has been studied extensively for the GMAW and GTAW processes (Refs. 4–22), introduction and control of oxygen during the button melt process is new.

This research evaluated the feasibility of using an arc button melter to reproduce microstructures and inclusion characteristics of the submerged arc welding process.

KEYWORDS

Button Melt
Consumable Design
Consumable Composition
Microstructure
Mathematical Model

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In this research, the ability to control the melt compositions through the addition of various wires, granules, and the addition of oxygen into the shielding gas was investigated. To validate the button melt tests, weld microstructures studied before in detail by Liu (Refs. 23, 24) were compared with simulated welds in the button melter. Furthermore, the results for each sample were analyzed and compared with predictions made by a numerical model developed by Babu (Ref. 25).

### Experimental Procedure

In Liu’s study (Ref. 23), several welds were produced with the submerged arc welding process using various combinations of wire, flux, and heat input. Sample Ti 13 H was selected for comparison because of the high fraction of acicular ferrite in the weld metal. The parameters for this weld are listed in Table 1, and the weld bead composition is in Table 2.

This composition was the target for the final composition of the button with some minor changes: no phosphorus, sulfur, zirconium, or molybdenum was added intentionally. Phosphorus and sulfur are typically regarded as impurities and molybdenum and zirconium were present only in small amounts in the sample composition. Furthermore, for simplicity, additional nickel was substituted for copper. While copper and nickel will have different corrosion protection effects in high-alloy compositions, for the purposes of this experiment, they are considered inter changeable as they are both face-centered cubic alloy additions with similar atomic weights and sizes, and they function as solid-solution strengtheners and austenite stabilizers. They also yield an identical carbon equivalent number of 0.393 according to the IIW formula (Ref. 26).

Controlling the composition so that the button melt chemistry is close to the target chemistry presented a challenge. The additions of some elements, such as boron, are exceedingly small; also, in the presence of oxygen, elements may oxidize and float to the button’s surface. Furthermore, some elements may vaporize in the molten pool. It is necessary to account for these changes by accounting for recovery of the ingredients. Recovery is defined as the weight fraction of element in the button after the melting process (present in solution or as a precipitate) divided by the weight fraction of element present in the charge. In this work, the expected recovery for each element was taken from previous experiments conducted with the arc button melter (Ref. 27). These previous button melt experiments indicated that recovery of strong deoxidizing elements, such as titanium and aluminum, is dependent on the amount of oxygen present.
in the button. To achieve the target values, the charge of each ingredient was determined as the target value divided by the expected recovery. A total of five samples (labeled A–E) were prepared, each with the same nominal target composition to assess repeatability.

**Melting Process**

A schematic showing the arc button melt apparatus is shown in Fig. 1. In this system, the melting torch consists of a tungsten electrode held in place by a water-cooled copper sheath attached to a wooden handle. The electrode is mounted in a plastic ball and socket joint, allowing it to rotate, and slide up or down while melting. The sample is placed on a water-cooled copper crucible, which is held in place by a set of clamps. Two types of enclosures were used in the experiments: a sealed glass cylinder, and a glass cylinder with a small port for thermocouple insertion.

Initial experimental work was undertaken to develop a melting process to yield repeatable melting, mixing, and cooling characteristics (Ref. 27). The resulting procedure is detailed in the Appendix. During the melting process, the raw materials formed a completely molten pool, which was approximately 20 mm in diameter and 10 mm in height. The arc size was maintained at roughly the same size as the molten button by adjusting the tip-to-work distance. The button was flipped and a second melting cycle was performed to ensure adequate mixing of the ingredients.

Experimental trials were performed to examine cooling characteristics of this particular process. The Δt% time was measured to be 32–35 s based on data recorded using a bare wire thermocouple harpooned into the button during solidification. Time-temperature profiles for three trial runs are shown in Fig. 2. The cooling rate is a function of the melting process and the experimental apparatus including the water-cooling copper crucible. The measured Δt% time is representative of a submerged arc welding (SAW) process and the welds created by Liu.

The target oxygen content of 350 ppm was obtained by using 145 cm/min of O₂ and 17.5 ft³/h of argon. This is in accordance with correlations developed in initial trials (Ref. 27). Early attempts to use oxidized iron in various sizes and quantities to control oxygen content were unsuccessful as little oxygen was transferred to the button.

**Chemical Analysis**

Three types of chemical analyses were performed for the melted buttons to evaluate the as-solidified composition: gas fusion for oxygen and nitrogen determination (LECO Model TC-436), infrared detection for carbon and sulfur (LECO Model CS-400), and inductively coupled plasma atomic emission spectrometry (ICP-AES) for the remaining components. Details concerning the ICP process can be found in Ref. 28.

Arc button melt samples were sectioned for analysis as indicated in Fig. 3, and chemical analysis using inductively coupled plasma was performed on samples A, C, D, and E to determine composition. A portion of sample B's contents was lost during the digestion process and no results were reported. After melting, the buttons were ground to remove the oxide layer on the surface, and then sectioned for analysis and digested using a two-step process. The first digestion step used a dilute nitric acid/deionized water solution. This process dissolved the matrix but left behind a significant amount of second-phase particles, such as oxides. The contents were filtered, and the filtrate was subsequently dissolved in a second step with a stronger solvent consisting of reagent grade nitric acid, hydrogen peroxide, and sulfuric acid. Because each solution was analyzed separately, the results provide some insight into the chemical composition of oxides or other second-phase particles. One blank sample, i.e., a solution containing no digested metal, was analyzed with ICP to give a baseline for each element. The results of the blank sample were subtracted from the other samples. This was done to correct for any possible error resulting from dissolution of the glassware.

Following the wet chemical analysis, each of the five samples was analyzed for carbon, sulfur, oxygen, and nitrogen using the LECO determinator instruments. Figure 4 summarizes the results of the chemical analysis of all of the buttons. Table 3 shows a comparison of the expected and measured recovery fractions for each element. The error bars in Fig. 4 indicate the variability of each element between the four buttons; each bar is plus or minus a single standard deviation. Variability is

![Fig. 3 — Sectioning diagram for analysis of buttons.](https://example.com/fig3)

![Fig. 4 — Comparison of results from chemical analysis of four identical buttons with the target composition with error bars showing the standard deviation.](https://example.com/fig4)
negligible in most of the alloying additions with the exception of titanium, nitrogen, and oxygen. No attempt was made to control nitrogen in the system. In most cases, the measured compositions were within 10% of the target range. Oxygen and aluminum, however, were significantly lower than expected. The aluminum was likely lost due to deoxidation and formation of a surface slag. No attempt was made to characterize the surface slag of these particular samples. Boron exhibited very low variability, an indication of good experimental control; however, the mean measured value was approximately ten times greater than the target value. In previous trials (Ref. 27), the level of boron was within 30% of the target value. The large amount of boron is most likely due to a measurement error during the alloying process. The recovery of nickel was 10% lower than expected at 90% with very little variability between samples. This may be due to analytical error in the ICP instrument.

Table 4 shows a breakdown of the fraction of each element dissolved in the dissolution step. A large fraction of the aluminum and titanium were insoluble in the dilute nitric acid suggesting that they formed oxide inclusions. A small fraction of the manganese, silicon, boron, and niobium was also insoluble. Thermodynamic models suggest the formation of a carbonitride phase containing chromium and niobium for similar low-alloy steel compositions undergoing Scheil solidification (Ref. 27). Assuming that all chromium and niobium formed carbonitrides and the remaining elements formed oxides, the data from Table 4 can be used to estimate bulk oxide composition to be Al 55%, Si, 15.5%, Ti 15.5%, Mn 8.8%, B 3.7%, and Ni 1.4% (wt-%).

**Microstructural Analysis**

Following chemical analysis, a vertical cross section from each button was mounted in Bakelite for metallographic examination. The samples were ground, polished to 1 μm, and etched with a 2% nital solution. Each button was examined at 200 and 500× magnification with an op-
tical microscope. Sample micrographs for several locations within the button cross section are shown in Fig. 5. In general, the microstructure was predominantly acicular ferrite. A point counting technique was used to quantify the relative volume fractions of each microconstituent present according to the IIW classifications (Ref. 29). The microconstituents considered included acicular ferrite (AF), grain boundary ferrite (GBF), primary ferrite (PF), ferrite with aligned and nonaligned second phase (FSA, FSNA), pearlite (P), and martensite (M). Point counting was performed for samples A, C, D, and E. The micrographs taken at 200x were enlarged to 8½ × 11 in. (22 × 28 cm) and used for point counting by superimposing a transparent grid of 36 × 27 yielding approximately 1000 points. Figure 6 shows the volume fraction variation with position. The values represent the average for all four samples analyzed at each position.

In all microstructures, very little to zero GBF and PF was observed. This is likely due to the presence of boron, which segregates to the grain boundaries and suppresses the formation of grain boundary ferrite (Ref. 30). Locations near the top of the button contained slightly less acicular ferrite than bottom locations. The difference can be attributed to the more rapid cooling rates experienced at the bottom of the button.

The microstructures were compared to those observed in Ref. 23 in particular sample Ti 13 H, which is shown in Fig. 7. In sample Ti 13 H, the microstructure consists primarily of fine acicular ferrite (68% AF) with 18% GBF; and 15% FSA/FSNA. One obvious difference between the welded microstructure of Ti 13 H and the button melt microstructure is the lack of grain boundary ferrite present in the button melted samples. Also, the ferrite laths are finer in the Ti 13 H microstructure. The dispersion of oxide inclusions plays an important role in determining the acicular ferrite morphology, and might be affected by the time and temperature history during the melting and resolidification of the sample. As noted in the Appendix, the button melts using the technique described in this work spend a longer time in the molten state (20–25 s per melt) than the weld they intend to represent. This is due to the hold time required for homogeneous mixing to occur. The effect of this longer molten time will be discussed later.

Solidification should begin at the crucible interface and propagate upward in a direction perpendicular to the maximum temperature gradient. The solidification pattern is not expected to drastically alter the size distribution of the inclusion but there would be an effect on the spatial distribution assuming that inclusion trapping occurs in interdendritic spaces. No attempt was made to characterize the spatial distribution of the inclusions. Examination revealed no lateral variation in the microstructure.

Microhardness

Vickers hardness measurements were recorded for the microconstituents in the button melt samples. The typical load and dwell time was 200 g for ten seconds. In several cases, it was necessary to reduce the load to 50 g to affect only the region of interest. Typical values for acicular ferrite ranged from approximately 190 to 220 H<sub>v</sub>. Values for GBF, FSA, and FSNA also fell within this range. The lowest hardness measurement was 177 H<sub>v</sub> for PF. Acicular ferrite laths create a finer microstructure when compared to primary ferrite or grain boundary ferrite; therefore, the flow stress and hardness are expected to be higher due to the Hall-Petch effect; however, no attempt was made to quantify the acicular ferrite lath size. This observation is in agreement with Vickers hardness data of our arc button melts, and sample Ti 13 H with AF, FSA, and FSNA microconstituents having similar hardness values and grain boundary ferrite having a much lower value. Hardness of each microconstituent in the button melt samples, how-

![Fig. 7 — Comparison of A with B. A — SAW Ti 13 H sample (Ref. 23); B — button melt (model) sample. Both microstructures contain a large fraction of acicular ferrite, but the welded sample has a finer microstructure.](image-url)
Inclusion Analysis

The nucleation of the desirable acicular ferrite microstructure is heavily dependent on the size of the inclusions, diameters greater than 0.2 \( \mu m \) are considered as effective nucleating agents (Ref. 31). A detailed analysis of the nonmetallic inclusions found in the buttons was performed for Sample A.

Special attention must be paid to the characterization of the size distribution of an inclusion population as seen in polished samples. The true diameter of an inclusion is likely to be larger than what is observed in a micrograph. One possible approach is to dissolve the matrix using a dilute nitric acid solution to gain a perspective on the true diameter, but this technique loses information about the number density, which is also important. Nucleation of acicular ferrite requires a sufficient number of particles for efficient nucleation. Using a selective digestion process, in conjunction with a separate SEM observation of inclusions in a mounted sample is another option, but requires twice as many steps to realize the information.

In this study, a carbon extraction replica was used for comparison purposes. The carbon extraction replica process can yield information about number density and true size distribution using a single process. This process was also chosen by Liu (Ref. 23) to characterize the inclusions present in SAW samples. The carbon extraction replica process is detailed by Ashby et al. (Ref. 32), where the volumetric number density, \( N_v \), is related to the area number density as follows:

\[
N_v = N_a \left( \frac{1}{x_{AI}} \right) \left( \frac{1}{\sigma_{AI}} \right) \left( \frac{x_{AI}}{\sigma_{AI}} \right)^2
\]

where \( N_a \) is the number of inclusions per \( \mu m^2 \), \( x_{AI} \) is the average inclusion diameter observed, and \( \sigma_{AI} \) is the standard deviation in mm. In this work, a total of 64 inclusions were observed over nine squares in a standard TEM grid with 100 \( \mu m \) square holes. This translates to an area number density of 911 inclusions per \( \mu m^2 \) in the sample. The mean inclusion diameter observed was 730 nm, with a standard deviation of 340 nm. This results in a volumetric number density of \( 1.5 \times 10^{15} \) inclusions per m\(^3\) or \( 1.5 \times 10^6 \) inclusions per mm\(^3\).

Figures 8 and 9 show histograms of observed diameters for Sample A and sample Ti 13 H. The majority of inclusions in Sample A fell between the range of 250
and 700 nm. Several inclusions larger than 1500 nm were also observed. While most of the inclusions were in the correct range for nucleating acicular ferrite, the mean diameter was larger and volume number density was smaller than the population observed in sample Ti 13 H (210 nm and $1.46 \times 10^5$ inclusions/mm$^3$). Kluchen and Grong also used carbon extraction replicas to characterize inclusions from SAW samples for composition and size. They measured number densities of $10^9$ inclusions/mm$^3$ (Refs. 33, 34). These data suggest that the button melt process is producing inclusions with larger size distributions than a real-world welding process. The larger inclusion size could be due to the hold time (25 s) necessary to achieve proper mixing of ingredients.

**Comparison with Other Techniques, Discussion, and Recommendations**

Additional validation of the button melting technique is proposed here, measurements from the samples made were compared with data available from other techniques including two mathematical models of inclusion number density, an estimated austenitic grain size, and a mathematical model of inclusion composition.

**Inclusion Density**

It is possible to use an overall transformation kinetics theory model to predict the inclusion nucleation and growth during the welding process. In this study, a numerical model developed by Babu (Ref. 25) based on transformation kinetics was used to gain further insight into the effects of a longer melt time on the inclusion population. For simplicity, the model will be referred to as the Babu model. The button melt process was modeled using the chemistry measured by LECO and ICP as the input composition. In the model, it was necessary to manipulate the heat input and preheat temperature to achieve the hold time and cooling curve of the button melt process. Values of 6 kJ/mm and 1500 K were selected to realize a melt, hold, and solidification time of approximately 25 s in total. For these conditions, the Babu model predicts a number density of $4.47 \times 10^9$ inclusions per mm$^3$, and an inclusion diameter of 1.2 μm. When the welding parameters from sample Ti 13 H (corresponding to 0.8 s melt time) are input into the model, the number density rises to $1.47 \times 10^5$ inclusions per mm$^3$, and the diameter shrinks to 0.17 μm. While predicted average diameter is slightly smaller than observed for sample Ti 13 H, the number density prediction is close to the observed value.

The measured number density for the button (Sample A) ($1.5 \times 10^7$ inclusions per mm$^3$) is much lower than observations of others. Kluchen and Grong (Refs. 33, 34) measured number densities of $10^9$ inclusions in submerged arc welds. Sample Ti 13 H had $3.3 \times 10^9$ inclusions per mm$^3$. It is possible that the carbon extraction process failed to extract a significant fraction of the inclusions. However, observations of mounted samples under electron backscatter mode also revealed a sparse inclusion population. It is more likely that inclusion growth occurred during the melting process. It is also possible to have coalescence of inclusions (Ref. 35). The inclusions appeared to be spherical in nature as observed by SEM. Although it is possible to observe oxides in the interrupted stage of coalescence, no oxides were observed in this state.

Another way to study the amount of inclusions is by looking at their volume fraction, which can be determined using the following formula:

$$V_f = \frac{N_v}{n}$$

(2)

Where $N_v$ is volumetric number density calculated in Equation 1, $r_i$ is the measured radius of inclusion $i$, and $n$ is the total number of inclusions measured. The resulting volume fraction was $5.7 \times 10^{-4}$.

Kluchen and Grong found that inclusion volume fraction in submerged arc welds will depend on composition according to the following equation:

$$V_f = 10^{-4}[5.0(O) + 5.4(S - 0.003)]$$

(3)

where $O$ and $S$ represent the amounts of oxygen and sulfur in wt-% (Ref. 33). The prediction by Grong using Equation 3 gives a value of $5 \times 10^{-4}$ if the sulfur term is ignored, very close to what was measured. The sulfur term can be ignored because sulfur in this case is lower than the solubility limit in steel, and does not contribute to inclusion formation.

The agreement between measured and predicted values of inclusion volume fraction gives confidence that all inclusions were extracted during the carbon extraction replica process. While the volume fraction is in line with Kluchen’s and Grong’s prediction of what would be expected during welding, the average diameter observed was larger, and the number density was smaller. These findings, along with the comparison of the various hold times using the Babu model, would suggest the button melts experience greater inclusion growth and/or coalescence during the melting process than during a SAW process.

The nucleation and growth of oxides in the melt requires special considerations that should be taken into account in future implementations of this technique. At melt temperatures above approximately 2000°C, liquid should be the only stable phase according to Thermo-Calc®. If the temperature remains above 2000°C, oxide formation would not occur until the arc is extinguished. The maximum temperature of the molten liquid in the button during the melting process is unknown. Because the arc is a highly localized heat source, it is suspected that temperature fluctuates widely as the electrode is rotated. As the tip-to-work distance is increased, the arc cone becomes larger and less localized. It seems that although the inclusion number density was much lower than a welding process, there were still sufficient nucleation sites for efficient acicular ferrite formation considering the high-volume fraction of acicular ferrite observed in the micrographs. A higher number density would most likely result in a finer microstructure, similar to the microstructure observed in sample Ti 13 H.

**Austenite Grain Size**

Austenite grain growth will also depend on the inclusion size distribution and number density (Refs. 36–38). While large particles do not pin the grain austenite grain boundary, smaller particles exert a drag force limiting grain growth. The Zener-Smith relationship for austenite grain diameter $D_i$ is

$$D_i = \frac{2d}{3f}$$

(4)

where $d$ is the average particle size and $f$ is the volume fraction of inclusions.

It is possible to predict the prior austenite grain size using the measured inclusion parameters with the Zener-Smith relationship developed in Equation 4. Using the calculated volume fraction of 0.00057 and the average inclusion size of 0.7 μm, the expected prior austenite grain size is 818 μm. This value is approximately one order of magnitude greater than the 80 μm measured by Liu for sample Ti 13 H. The reduced fraction of grain boundary ferrite observed in the buttons may be caused not only by the high levels of boron, but also by the enlarged austenite grains.

**Inclusion Composition**

It is also possible to use computational thermodynamic models to predict the inclusion chemical composition. Table 5 shows predictions from the Babu model for the chemical composition of inclusions forming during the button melt process and during the welding process.

The model does not predict any significant changes in inclusion composition for
the 25-s hold time expected in the button vs. no hold time as expected during welding. Using thermodynamics and kinetic growth equations, the Babu model predicts the order of formation for the inclusions. The first oxide to become stable during cooling is $\text{Al}_2\text{O}_3$, which forms the core of the inclusion. As the weld metal cools and other oxides become stable, layers begin to form sequentially as shown in Fig. 10. It should be noted, however, that the model is phenomenological and not a true representation of the structure. As cooling occurs, multiple oxide phases become thermodynamically stable and will continue to precipitate; thus, clearly delineated layers are not expected. The model is useful in predicting when the various phases begin to form as well as the relative volume fraction of each phase.

According to the Babu model, $\text{SiO}_2$ will be the last oxide to form and would therefore be expected to be present in greater concentrations on the inclusion surface. It may therefore act as the substrate for heterogeneous nucleation of acicular ferrite. It is assumed a spherical inclusion is a simplification that allows the diameter to be calculated and the final layer in this case is expected to be $\text{SiO}_2$. These findings are significant because most of the literature on acicular ferrite nucleation places emphasis on the importance of titanium on inclusion nucleation of acicular ferrite. The Babu model predicted that roughly 50% of the inclusion would be comprised of aluminum while the measured value averaged about 30% with the difference being made up with increased manganese levels.

Energy-dispersive spectrometry (EDS) was used to characterize the chemical compositions of 21 inclusions found in the extracted replica. Table 6 compares the average composition for the inclusions that were evaluated with those measured in sample Ti 13 H (Ref. 23).

Inclusions in samples A and Ti 13 H contained similar amounts of manganese and silicon. The difference was the amount of aluminum and titanium measured with Sample A containing a larger fraction of both elements. Inclusion composition was observed to be dependent on size as illustrated in Fig. 11. There is a trend of increasing aluminum with increasing size. Relative amounts of titanium, silicon, and manganese all decrease with increasing size. Manganese decreases most sharply. Aluminum oxides are stable at the highest temperatures and are therefore the first to form during cooling. Inclusions nucleating first have more time to grow. The additional time for growth will occur at a temperature where $\text{Al}_2\text{O}_3$ is stable, and would therefore have a higher aluminum composition. Since the button melted samples had a larger average diameter than sample Ti 13 H, the higher aluminum content is expected.

### Discussion

The goal of the project was to develop a methodology for expedient welding consumable development by way of a melting process designed to simulate welding conditions. Microstructures for multiple compositions can be evaluated without creating new spools of consumables. This process has some inherent limitations and further steps are required before the consumable can be finalized. In the case of SAW, dilution effects and slag additions would need to be accounted for. Therefore, thermodynamic modeling and button melting experimentation represent the initial work required to develop consumables.

### Recommendations

The button melting technique developed was able to mimic the cooling rate, composition, and microstructure of a specific weld created by the SAW process. The technique still needs improvement in several areas including amount of time in molten state and control of oxygen and boron in the melt. It is also desirable to simulate the range of cooling conditions that are expected during various welding processes. Modification and/or further experimentation may be necessary to develop melting processes that simulate these conditions.

The amount of time in the molten state was longer than in the target weld because it was necessary to ensure complete and homogeneous melting of all the solid charge. This resulted in larger inclusions than intended because of the longer time for coarsening. This longer melt time also allowed oxide inclusions to float to the surface and be lost as slag. The lower amount of oxides in the melt could not be compensated for by increasing the oxygen potential in the atmosphere because the large oxides still floated away, while the larger amount of oxide created an oxygen barrier at the surface.

It is recommended that the amount of time in the molten state is reduced to match the time in an actual weld. To achieve homogeneity in this situation, it might be desirable to start with a precompressed charge, so no powders, chips, or small pieces of wire are scattered in the initial melt area. Also, a more powerful torch might be able to create the melt faster.

### Conclusions

- The arc button melter technique presented here was able to reproduce the chemistry and cooling rates of a submerged arc welded sample. Particularly significant is the innovative control of oxygen content in the button melt.
- The button melts reproduced the microstructure of equivalent submerged arc welds; however, with a coarser microstructure and lower hardness.
- Inclusion volume fraction in the arc button melts was similar to the equivalent actual weld, but the inclusions were larger in diameter and lower in number density.

### Acknowledgments

The authors wish to thank Tenaris/Confab, Tenaris/Tamsa, NSF CAREER Award DMI-0547649, and the Goierri Foundation for sponsoring this project. Gaizka Sarasola, Miren Lopezegi, and Dinanbas E. Etuk provided invaluable assistance as undergraduate research assistants.

### References


Appendix

Procedure for Button Melting Process

• Clean and sharpen electrode to an angle of 22 deg.
• Clean crucible with ethanol and steel wool.
• Charge crucible and load into chamber. Powders should be placed near the bottom of the charge to avoid displacement during arc initiation.
• Set electrode protrusion at 0.75 in. (19 mm).
• Set gas flow typical values: 17.5 ft³/h (argon), 145 cfm (oxygen).
• Set welding parameters: 150 A.
• Open coolant.
• Wait two minutes.
• Start the arc.
• Position the copper sheath so that the arc diameter is approximately the same size as the charge.
• Rotate torch counterclockwise around the sample until the sample is completely melted. Melt for 25 s (approximately 30 rotations).
• Terminate the arc.
• Allow sample to cool at least 200 s prior to removal of the copper crucible.
• Turn the sample over, push any loose granules to the center of crucible.
• Remelt using the same technique for 20 s (20 rotations).

Underwater Welding Workshop

The 3rd International Workshop on the “State of the Art, Science and Reliability of Underwater Welding and Inspection Technology” will be held at the Sheraton Suites (Galleria) in Houston, Texas, November 17-19, 2010. The Workshop will examine recent developments in underwater welding and inspection and define the state of engineering and the practice of underwater welding and inspection of fixed and floating marine structures and pipelines. The event will be co-sponsored by the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE), Pipeline & Hazardous Materials Safety Administration (DOT-PHMSA), American Bureau of Shipping, American Welding Society, and American Society of Nondestructive Testing. For more detailed information regarding programming, registration, participation, and sponsorship, please access: http://csmospace.com/utwist/
Significant differences in hot ductility behavior and repair weldability were observed among Nb-bearing stainless steel castings after exposure to similar service conditions

ABSTRACT

The loss of repair weldability after service exposure in heat-resistant alloys has been related to the loss of ductility due to the formation of carbides and other compounds, such as nickel silicide. The hot ductility behavior of three service-aged, heat-resistant stainless steel castings, HP-45Nb, HP-50Nb, and 20-32Nb, were studied using the Gleeble® thermomechanical simulator. Results from hot ductility testing are presented and detailed fractographic analysis of samples tested at 900° and 1100°C is described. During the simulated cooling cycle, the HP-Nb modified alloy demonstrated significantly higher ductility as compared to the 20-32Nb alloy. The differences in high-temperature stability of the preexisting embrittling constituents in these alloys resulted in different microstructure evolution that influenced their hot ductility behavior. Based on the results, the service-exposed HP-Nb modified alloy is considered to have acceptable repair weldability. In contrast, the service-exposed 20-32Nb alloys showed severe susceptibility to liquation cracking and significant loss in on-cooling ductility, and are considered difficult to repair unless a high-temperature solution annealing heat treatment is performed.

Introduction

Heat-resistant, cast stainless steels such as Alloy HP-Nb modified (ASTM A297) and Alloy 20-32Nb (ASTM A351/A351M-05) are used in applications requiring good corrosion resistance and moderate strength at temperatures up to 1100°C (2012°F) (Ref. 1). At these temperatures the cast microstructure will transform with time leading to the formation of carbides and other compounds, such as nickel silicide. The loss of repair weldability after service exposure in these heat-resistant alloys, including HP-Nb modified and 20-32Nb, has been related to the loss of ductility due to the formation of \( \text{M}_{32}\text{C}_6 \) and nickel silicide (Refs. 2–4). Cracking during shut-down or repair welding due to the service-induced embrittlement of these heat-resistant castings is of great practical concern in the power-generation, refinery, and petrochemical industries. The materials studied were provided by two independent petrochemical companies. The as-received HP-45Nb has experienced fracture during service — Fig. 1. For the 20-32Nb alloy, liquation cracking was immediately observed in the heat-affected zone (HAZ) during repair welding — Fig. 2. Difficulties in repair of service-exposed 20-32Nb alloy have been reported in other refineries. As shown in Fig. 3, cracking has been observed during repair welding. One of the objectives of this work was to develop a fundamental understanding of the repair weldability of the three materials provided.

Microstructure evolution during service exposure and simulated thermal exposure during repair are critical to understanding the hot-ductility behavior discrepancies and resultant repair weldability between the two types of alloys. Microstructure evolution in these materials from the as-cast condition to the service-exposed condition is described elsewhere (Ref. 5). It was found that the atomic ratio of Nb to C is a key factor in determining the type of carbides formed during service exposure. The microstructure evolution process is summarized in Table 3 of Ref. 5.

In this investigation, the Gleeble®, a programmable thermal-mechanical simulator, was used to study the hot ductility behavior of service-exposed HP-Nb modified and 20-32Nb alloys during simulated repair welding thermal cycles. The implications on repair weldability are discussed.

Materials and Experimental Procedures

Materials. Heat-resistant HP-Nb modified (for simplicity, they are referred to here as HP-Nb alloys) and 20-32Nb alloys are the most commonly used cast high-temperature furnace tube alloys. The specification of HP-Nb alloys is described in ASTM A297 (Ref. 6); and the 20-32Nb alloy is covered under ASTM A351/A351M-05 (Ref. 7), but are usually identified by their trade names such as KHR32C (Ref. 8) and CR32W (Ref. 9). The compositions of the alloys evaluated in this study are provided in Table 1. The number of years of service exposure at approximately 815°C (1500°F) is also indicated in the table.

Characterization. Microstructure
characterization was performed on both service-exposed (EX) and simulated as-cast alloys (CA). Due to the difficulty in obtaining unexposed, as-cast material of similar composition, the EX alloys were remelted using a button melting apparatus to simulate the original as-cast microstructure. The button melting apparatus uses a tungsten torch with argon shielding to produce small cast samples.

The methods used for microstructure characterization and fractographic analysis included optical microscopy (OM) and scanning electron microscopy (SEM). SEM analysis was conducted in both the secondary electron (SE) and backscattered electron (BSE) modes. Composition analysis and line scan analysis were conducted using both Philips XL-30 ESEM FEG and FEI Sirion FEG microscopes equipped with X-ray energy-dispersive spectroscopy (XEDS). With the combination of SE, BSE, and EDS analysis, it is possible to make reasonable estimates of the precipitates and intermetallic phases that are present.

**Hot Ductility Testing.** Hot ductility behavior was studied using the Gleeble® 3800, which has been used extensively for studying the weldability of a wide variety of materials (Refs. 10–19). Hot ductility tests are essentially high-temperature tensile tests, but are conducted both “on-heating” and “on-cooling.” The test technique can provide the tensile properties of the HAZ microstructure during the weld thermal cycle. Therefore, it is considered an effective method to study the nature of HAZ cracking that occurs during welding or subsequent postweld processing (Refs. 19–22).

In this study, the hot ductility of each of the materials was determined by both on-heating and on-cooling tests, where the on-cooling behavior was determined after heating to a peak temperature ($T_p$) between the nil ductility temperature (NDT) and nil strength temperature (NST). Ductility is normally measured as the percentage of reduction of area (ROA) at a specific temperature. NDT and NST are two important points on the on-heating ductility curve. The ductility recovery temperature (DRT), the temperature at which some ductility is measured during cooling from $T_p$, is an important parameter during the on-cooling cycle.

For hot ductility testing, a test temperature and stroke (extension rate) are pre-programmed as shown schematically in Fig. 4. For on-heating tests, specimens are first heated up to the programmed temperature and held for 0.5 s to stabilize the temperature in the specimen. A stroke is then applied at the rate of 25 mm/s to pull the specimen to failure. For on-cooling tests, a peak temperature ($T_p$) needs to be determined. The $T_p$ employed in hot ductility tests may be any temperature below the bulk melting temperature of the material being studied. However, $T_p$ is normally chosen based on the tested NST. In this investigation, a temperature between NST and NST–10°C was used as $T_p$ for on-cooling tests.

Standard hot ductility samples were used in this investigation, as shown in Fig.

---

**Table 1 — Chemical Composition (wt-%) of Alloys Studied**

<table>
<thead>
<tr>
<th>ID</th>
<th>HP45Nb 9 year</th>
<th>HP50Nb 12 year</th>
<th>20-32Nb 3 year</th>
<th>20-32Nb 7 year</th>
<th>20-32Nb 15 year</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.41</td>
<td>0.38</td>
<td>0.09</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Mn</td>
<td>1.04</td>
<td>1.22</td>
<td>1.01</td>
<td>0.96</td>
<td>1.13</td>
</tr>
<tr>
<td>P</td>
<td>0.022</td>
<td>0.031</td>
<td>0.013</td>
<td>0.014</td>
<td>0.013</td>
</tr>
<tr>
<td>S</td>
<td>0.007</td>
<td>0.016</td>
<td>0.007</td>
<td>0.006</td>
<td>0.006</td>
</tr>
<tr>
<td>Si</td>
<td>1.15</td>
<td>1.56</td>
<td>0.91</td>
<td>0.87</td>
<td>0.95</td>
</tr>
<tr>
<td>Cu</td>
<td>0.026</td>
<td>0.1</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Mo</td>
<td>0.026</td>
<td>0.085</td>
<td>0.01</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Ni</td>
<td>33.55</td>
<td>33.67</td>
<td>33.6</td>
<td>33.4</td>
<td>33</td>
</tr>
<tr>
<td>Cr</td>
<td>25.58</td>
<td>25.11</td>
<td>19.9</td>
<td>19.9</td>
<td>20.2</td>
</tr>
<tr>
<td>Nb</td>
<td>0.9</td>
<td>1.37</td>
<td>1.36</td>
<td>1.33</td>
<td>1.19</td>
</tr>
<tr>
<td>Fe</td>
<td>Bal</td>
<td>Bal</td>
<td>Bal</td>
<td>Bal</td>
<td>Bal</td>
</tr>
</tbody>
</table>
5. Since some of the single thermal cycle hot ductility tests were conducted at relatively low temperatures, specimens with a reduced section at the mid-span were used to ensure that the sample would fail at the programmed temperature and at the preferred location. To prevent contamination of the fracture surface by high-temperature oxidation, tests were run in an argon atmosphere. The chamber was evacuated and backpurged twice with argon to prevent sample oxidation during testing.

To study material susceptibility to both ductility dip cracking and liquation cracking, standard hot ductility tests were performed over the temperature range from 500°C to the NST. The testing conditions are listed in Table 2.

**Results and Discussion**

### Gleeble Hot Ductility Test Results

In this study, the temperature differential between NST and DRT (NST-DRT) is used to quantify the degree of liquation cracking susceptibility as this is the temperature range in which continuous liquid networks are present in the microstructure (Refs. 23–26). The larger the NST-DRT temperature range, the greater is the liquation cracking susceptibility. The important temperatures determined by hot ductility testing are summarized in Table 3. The NDT for the solutionized 20-32Nb alloy was not obtained due to the limited supply of material.

As Table 3 implies, the service-exposed HP alloys are relatively resistant to HAZ liquation cracking as the (NST-DRT) range is less than 20°C. In contrast, the service-exposed 20-32Nb alloys had a (NST-DRT) ranging from 86° to 209°C, indicating a greater susceptibility to HAZ liquation cracking. Solution heat treatment at 1150°C for 6 h improved the overall hot ductility (Fig. 6), but increased susceptibility to HAZ liquation cracking as the NST-DRT increased from 86° to 260°C for the 15-year service-exposed 20-32Nb alloy.

The 20-32Nb alloys have lower carbon content (≈0.1 wt-%), and a lower fraction of embrittling phases, than the higher carbon HP alloys (≈0.4 wt-% C). For the service-exposed condition, the embrittling phases have been reported as Ni-Nb silicide and Cr-rich, M23C6 for both types of alloys (Refs. 3, 5). Based on carbon content, one might expect that the 20-32Nb alloys would have better ductility than the HP alloys. The hot ductility tests, however, showed results to the contrary. As shown in Fig. 7, the on-cooling ductility for the 20-32Nb alloy from 1000°C down to 600°C is less than 10%, while the ductility of the HP-Nb alloys in this same temperature range is between 10 and 20%.

The low on-cooling ductility observed in service-aged 20-32Nb alloys is related to the microstructure evolution during the service exposure and subsequent simulated on-heating and on-cooling thermal cycles. The microstructure during service exposure is discussed in detail elsewhere (Ref. 5). The microstructure changes dur-
Fracture stress is a material property, and is defined as the true, normal stress on the minimum cross-sectional area at the beginning of fracture (Ref. 29). Therefore, a material with a higher fracture stress can tolerate more restraint, which can be a form of heat shrinkage stress or any external applied stress during cooling. In the hot ductility tests, the dynamic loads were recorded by the data acquisition system. The maximum load at the test temperature indicated the beginning of fracture, since the load starts to drop once the fracture occurs. The fracture stresses at different test temperatures were calculated using the following equation:

$$\text{Fracture Stress} = \frac{F_{\text{max}}}{A_f}$$

where $F_{\text{max}}$ is the maximum load recorded, and $A_f$ is the cross-sectional area at the fracture surface.

The calculated fracture stresses vs. temperatures are plotted in Fig. 8. For the HP alloys, the fracture stress showed a similar trend of decreasing as the temperature increased on both heating and cooling tests. No degradation of fracture stress was observed during the on-cooling cycle. A green dotted line is used to represent the fracture stress behavior of the HP-Nb alloys.

In contrast, all three service-exposed 20-32Nb alloys exhibited a much lower fracture stress over the entire test temperature range as compared to the HP-Nb alloys. For instance, at 900°C during the on-cooling test, the fracture stress obtained was 70 ksi for the HP-Nb alloys, but only 20 ksi for the 20-32Nb alloys. In the on-heating tests, the fracture stress remained relatively constant until the temperature reached 1100°C. Above 1100°C, the fracture stress decreased dramatically. This agrees with the on-heating hot ductility behavior observed: above 1100°C, the ductility suddenly dropped from more than 40% to 0% for the 20-32Nb alloys. A significant loss in fracture stress was observed in the on-cooling tests. Since all three 20-32Nb alloys exhibited similar trends in fracture stress, only the 15-year alloy was plotted. One red dotted line and one blue dotted line were used to simplify the trend of fracture stress on-heating and on-cooling of the service-exposed 20-32Nb alloys, respectively. The solutionized 20-32Nb alloy exhibited a comparable fracture stress to the service-exposed HP-Nb alloys, which implies similar fracture resistance between the service-exposed HP-Nb alloy and 20-32Nb alloy prior to service exposure.

**Fractographic Analysis**

Changes in material mechanical properties, in general, are associated with a microstructural change. The loss of on-cooling ductility and fracture stress of the 20-32Nb alloys was believed to be due to the microstructure evolution that occurred at elevated temperatures. To study the
cause of variations in ductility and fracture stress in these materials, hot ductility samples tested at 900° and 1100°C on both on-heating and on-cooling were subjected to fractographic analysis in the SEM. EDS spot and line scan techniques were used extensively to analyze the microconstituents on the fracture surface or in the microstructure. All the metallographically polished samples were examined in the unetched condition. The backscattered electron (BSE) detector in the SEM was used to provide phase contrast.

The two service-exposed HP alloys under investigation showed similar results regarding the ductility and fracture stress. The HP45Nb alloy was chosen for the fractographic analysis. The hot ductility results for the service-exposed 20-32Nb alloys are essentially the same regardless of the service exposure times.

On-heating at 900°C. When tested at 900°C on heating, both Cr-rich and Nb-rich particles were found in the service-exposed HP-Nb and 20-32Nb alloys (Figs. 9, 10). In the HP alloy, evidence of transformation from Ni-Nb silicide to NbC was also observed. In contrast, no such evidence was found in the service-exposed 20-32Nb alloys. This may be due to the higher carbon concentration in the service-exposed 20-32Nb alloys. The HP-Nb alloy was chosen for the fractographic analysis. The hot ductility results for the service-exposed 20-32Nb alloys are essentially the same regardless of the service exposure times.

On-heating at 1100°C. As compared to samples tested at 1100°C on heating, no significant changes regarding the type and morphology of constituents were found at the fracture area of the service-exposed HP alloy and solutionized 20-32Nb alloy when samples were tested at 1100°C on cooling. For the service-exposed 20-32Nb alloy, apparent liquation was observed around the Nb-rich particles (Fig. 12), which can be fully transformed NbC or a partially transformed component from Ni-Nb silicide. The high concentration of silicon around the particle (Fig. 13) increases the susceptibility to liquation. Once the liquation formed continuously around the dendrite boundary, a significant loss in on-cooling ductility of the alloy would be expected.

On-cooling at 900°C. At the on-cooling test temperature of 900°C, transformation from Ni-Nb silicide to Nb-carbides was observed in both service-exposed HP-Nb alloy and 20-32Nb alloy. Chromium-rich particles were observed in the HP-Nb alloy, but not in any of the other materials. Recrystallization occurred in the service-exposed 20-32Nb alloy — Fig. 14. No liquation was found in the HP alloy but liquation was evident in the service-exposed 20-32Nb alloy. Niobium-carbides were the only constituent
present in the solutionized alloy.

**Transformation from Ni-Nb Silicide to NbC**

The transformation behavior was studied using the SEM/EDS spot analysis and line scan technique. The spot analysis results revealed the particle (Fig. 15A) is rich in Si, Nb, and Ni, and can be characterized as Ni-Nb silicide. The dark lines in the pictures represent the position that has been analyzed due to "charging" of the sample by the electron beam. Nickel content has dropped to approximately the nominal composition. No carbon was detected in this particle. This is because the Cr-rich, M$_{23}$C$_6$ is of relatively low concentration in the alloy, and at this stage the concentration of carbon from the dissolution of the M$_{23}$C$_6$ is not high enough to be detected by the SEM. This signified the initial stage of the transformation from Ni-Nb silicide to Nb-carbide.

A further transformation can be illustrated with Fig. 15B. Peaks in carbon and silicon were observed at the edge of the white particle. Within the particle, the Ni concentration dropped well below that of the matrix, but the Nb concentration still remained high. It is most likely that the formation of NbC would start at the edge of the original Ni-Nb silicide due to a high concentration of carbon. The observed transformation in Fig. 15B presents the second stage of the transformation from Ni-Nb silicide to NbC. In Fig. 15C, particles on the left side of the picture showed enrichment in carbon and niobium and depletion in Ni, Cr, and Fe, representing a complete transformation to NbC. The newly formed Nb-carbides are much smaller than the Ni-Nb silicide. It is likely that a Ni-Nb silicide particle would break down into several NbC particles as a consequence of the transformation. A high Si concentration was also expected around the transformed NbC, and is confirmed in Fig. 15C. As highlighted by a red circle, a peak in silicon was observed at the region between two NbC particles.

The phenomenon involving diffusion of Si and Ni to NbC during aging was previously studied by Patchett (Ref. 3). The transformation from Ni-Nb silicide to NbC during a simulated thermal cycle is the reverse reaction from the aging process as the thermal-dynamic condition favors the formation of NbC at higher temperature.
Repair Weldability

The service-exposed HP-Nb alloys exhibited good metallurgical stability, fracture stress, and on-cooling ductility, which could be related to acceptable repair weldability of this alloy. Reasonable repair weldability of service-aged HP-Nb alloy is also reported elsewhere (Ref. 27). In contrast, service-exposed 20-32Nb alloys showed severe susceptibility to liquation cracking and significant loss in on-cooling ductility and fracture stress. The susceptibility to liquation cracking was related to the combined effect of a high silicon concentration at the dendrite boundaries resulting from the dissolution of Ni-Nb silicide, and a NbC constitutional liquation mechanism. The loss in on-cooling ductility that resulted from these two mechanisms persisted from the peak HAZ temperatures of nearly 1300°C to below 900°C. After solution annealing at 1150°C for 6 h, the on-cooling hot ductility and the fracture stress of the 20-32Nb alloy was restored, but with an increase in liquation cracking susceptibility at high temperatures as the (NST-DRT) range increased to 260°C. This indicates that the extent of the HAZ in the 20-32Nb alloy exposed to the (NST-DRT) range must be minimized by increasing the temperature gradient in the HAZ during repair welding. This is
probably best achieved with low heat input practice (Ref. 28).

Summary

This paper presents the results of hot ductility testing of heat-resistant austenitic stainless steels, HP-Nb and 20-32Nb, that had experienced extended service exposure at 815°C (1500°F). Detailed metallographic and fractographic analyses were performed on hot ductility samples tested at 900°C and 1100°C, both on-heating to the NDT temperature and on-cooling from a temperature slightly below the NST.

The hot ductility tests revealed that the HP-Nb alloys had much better ductility and higher fracture stress than the 20-32Nb alloys over the entire range of test temperatures. No significant loss in either ductility or fracture stress occurred in the HP-Nb alloys during the on-cooling tests. The HP-Nb alloys also exhibited a narrow range between NST and DRT (less than 20°C), indicating good resistance to liquation cracking. In contrast, a significant degradation in both ductility and fracture stress was observed in the service-exposed 20-32Nb alloys during the on-cooling stress. The service-exposed 20-32Nb alloys are expected to have a high susceptibility to liquation cracking resulting from a large range between NST and DRT (up to 200°C). Recovery in overall ductility and fracture stress was observed only when the service-exposed 20-32Nb alloy was resolutionized, but this was accompanied by increased susceptibility to liquation cracking.

Fractographic analysis revealed that Cr-rich and Nb-rich particles coexisted in the fracture region of all the service-exposed HP45-Nb alloy specimens. Evidence of transformation from Ni-Nb silicide to NbC was also observed. No evidence of liquidation was observed in the HP45-Nb samples. In contrast, Cr-rich and Nb-rich phases coexisted only in the on-heating specimens of the service-exposed 20-32Nb alloy with only a Nb-rich phase present in the on-cooling samples. This indicated that the Cr-rich phase dissolved completely in the service-exposed 20-32Nb alloy at on-heating test temperatures above 1100°C. A significant amount of liquidation was observed in the on-cooling 20-32Nb samples, which was a direct result of the high concentration of silicon in the microstructure. The high concentration of silicon was the by-product of the transformation from Ni-Nb silicide to NbC, which decreased the local melting temperature significantly, leading to low on-cooling ductility by liquation at temperatures down to 1100°C.

The distinct difference in the hot ductility behavior and microstructure evolution during the simulated HAZ thermal cycle between the HP-Nb alloys and the 20-32Nb alloys indicates that service-exposed HP-Nb alloys have acceptable repair weldability and service-exposed 20-32Nb may be very difficult to repair unless a solution annealing heat treatment is performed.

Acknowledgments

This investigation was supported by the Research Members of the Edison Welding Institute through the EWI Cooperative Research Program. The material used in this study was provided by Syncrude in Alberta, Canada, and ExxonMobil.

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Seam Welding Monitoring System Based on Real-Time Electrical Signal Analysis

A new approach to in-line seam welding quality evaluation is presented

BY MASSIMO LANZONI, MIRKO SALOMONI, AND BRUNO RICCO

ABSTRACT

This paper presents a novel welding quality evaluation approach based on the analysis of electrical signals. The method has been implemented in an automatic system developed using field-programmable gate array (FPGA) acquisition boards and custom software. The system has been implemented in an industrial machine to detect faults in tinplate welding. Experimental results show that the system is characterized by high sensitivity and high speed. Furthermore, it needs simple conditioning electronics and tuning procedures. The system is suitable for network operation and remote control.

Background

Industrial machines are generally parts of complex production systems where product quality must be automatically evaluated by means of several checks during intermediate fabrication steps. In recent years, the importance of reliable quality evaluation has greatly increased due to the reduction in production gain margins.

In this context, a typical step of a production line, which is sometimes responsible for important faults, is welding. Therefore, nondestructive and automatic methods to monitor welding quality are normally implemented. Depending on welding type and speed, the following methods are based on different techniques: visual (Refs. 1–5), ultrasonic inspection (Ref. 6), electrode distance (Ref. 7), and electrical (Refs. 8–13).

Unfortunately, in the case of the seam welding machines considered in this paper, none of the available techniques is applicable.

Visual inspection is based on the use of template matching techniques; in particular, images are captured after the welding process is completed, and processing algorithms are used to compare them with reference images (for example, Ref. 1, computing the cross correlation between the target image and a portion of the acquired one). In some cases, where faults may lead to catastrophic results, costly X-ray or γ-ray inspections are made, and the shape of the image density profile along the weld interface is analyzed (Ref. 3). These techniques, however, can be applied only when welding process times are compatible with the duration of suitable image processing. Furthermore, visual techniques are not applicable when the welding area is not visible, as is the case of interest for this work.

An alternative visual technique is based on the analysis of the welding temperature (Refs. 2, 5), measured in real time using an infrared sensor and welding torch control. In this context, however, at least one side of the welding area must be visible, and again this is not the case of the seam welding machines, where both sides of the welding point are masked by the welding tool.

Another parameter that can be observed for quality monitoring is the electrode displacement during welding (Ref. 7). Such a technique, however, is applicable only when the welding electrodes and the parts to be welded are fixed during the operation, which is not the case considered in this paper where the electrodes (hence, also the welding point) are constantly moving along a line.

In the specific case of seam welding, a fault is represented by a missing welded point segment, possibly due to a variety of reasons (misalignments of the parts to be welded, border defects, dust or oil on the welding area, and so on). In some cases (i.e., welding of cans), this type of defect may result in gas or liquid leakage, unacceptable in cans for pressurized gas (that must have zero welding defects) or only partially tolerable in cans for solids of high-viscosity liquids.

Modern seam welding machines can work at high speed (several m/s) and produce welding dots with dimensions in the order of 1 mm. As a result, thousands of welding dots per second must be analyzed and processed in real time. To monitor their quality at full speed, all the techniques mentioned previously (Refs. 1–7) are not applicable because they do not meet measurement speed and/or spatial resolution specifications. In particular, no method based on visual inspection (Refs. 1–5) can be used because a) welding takes place between two surfacing edges of thin plate; b) welding rollers mask the welding area; and c) complex signal processing algorithms are not compatible with the machine speed.

Furthermore, ultrasonic techniques such as those illustrated in Ref. 6 are also not applicable because a) the part to be inspected is not fixed with respect to a probe; and b) the resolution is too low.

As an alternative, real-time monitoring of seam welding quality can be achieved by capturing the waveform of welding current and electrode voltage to be compared with correct references, because defects produce anomalous electrical behavior.

This technique has been successfully implemented in the case of spot welding (Refs. 8–13) where electrodes remain in the same position during the whole welding period, lasting several inverter cycles (from 6 to 10). Because the inverter frequency is 60 Hz, under such conditions, the time interval available for measure-

KEYWORDS

Process Monitoring
Resistance Seam Welding Quality
Welding Defects and Flaws
Signal Processing
Real Time
Virtual Instrumentation
ments corresponds to 100–160 ms, and the shape of the resistance vs. time (in practice as a function of the inverter periods) is used (Refs. 10, 12) to decide about welding quality by comparing it with experimental or simulated reference data. Unfortunately, this approach is not applicable to the case of seam welding of interest in this work, essentially because the electrodes are moving along a (welding) line, and several points need to be welded in a short time. Each weld takes place in a single inverter semiperiod, near the current maximum value. Therefore, because in our case the inverter frequency is about 1 kHz, the resistance (or a related parameter) must be analyzed in a few hundreds of microseconds; thus, only a single (effective) resistance value, instead of a whole waveform, can be taken.

In this regard, a major point of our results is that they clearly show this information is sufficient to effectively detect defective welding.

In the case of seam welding, the approach based on analysis of voltage and current presents several specific and critical problems. First of all, as mentioned previously, analysis speed is much higher than in spot welding and requires dedicated high-speed signal analysis circuits. In this context, the conventional analog approach to signal analysis has several disadvantages because a) the system design is expensive, necessarily customized for a specific machine, difficult, and expensive to modify; and b) accurate and critical tuning is normally required. Alternatively, signals can be sampled and digitally processed in real time, but high-performance embedded systems based on digital signal processing (DSP) or field-programmable gate array (FPGA) devices are needed to meet machine speed specifications. Compared with its analog counterpart, the digital approach allows the mod-
ification or fine tuning of the system simply by acting on the system software, ideally without machine stopping, or the need of special equipment as well as trained personnel.

This paper improves the field introducing a new approach based on the combination of high-performance analog signal conditioning circuits and off-the-shelf advanced digital acquisition boards. The result is an advanced monitoring system featuring on-board signal processing that can be programmed with a high-level language (LabVIEW™). Consequently, algorithm modifications are simple and do not involve specific instrumentation. Furthermore, because the whole system is managed by a personal computer (PC), networking, remote control, and updating can be easily implemented.

To describe the developed system, this paper is organized by giving a brief description of the welding machine used as a target for this work; describing the architecture and main elements of the monitoring system; providing some details about software implementation; showing some experimental results; and ending with a final discussion.

**Operation of the Welding Machine**

The welding machine considered in this work is able to produce a sequence of welding points, called nuggets, along the edge of a tinplate suitable for can fabrication. The principle of the welding operation is illustrated in Fig. 1.

The tinplate is bent to form a cylinder, then the surface edges are welded by means of a couple of rolling electrodes connected to a power inverter. When the superimposed edges pass under them, high current flows between the rolling electrodes; thus, the temperature of the tinplate rises locally to high values, and welding takes place.

During this process, several types of inaccuracies localized in the border of the tinplate may lead to incorrect or missing welding. In particular, the presence of dust or oil can locally increase the resistance, modifying the electrical behavior of the system; holes in the tinplate can allow direct contact between electrodes; and random variations of the tinplate thickness, misalignment of the border to be welded, and/or local imperfections can significantly change the values of measured resistance. In all these cases, the mechanical characteristic of the nuggets produced in the defective area are different than the reference values and the results are weak. In all the cases mentioned, variations in the electrical behavior of the system during welding are produced. Structures appear in the waveforms of the current and the voltage between electrodes that can be used for fault detection.

Figure 2 presents a schematic representation of the electrical power circuit of the seam welding machine considered in this work.

A power inverter produces a dual polarity pulse width modulation (PWM) voltage signal to drive the primary coil of a power transformer (PT). The primary peak current is in the order of 50 to 150 A and is monitored by means of the current transformer (TA). The secondary of the PT is connected to the rolling electrodes, and the voltage across these (essentially the voltage drop on the resistance in the welding point) is monitored by means of sliding contacts. Welding current and voltage difference across the rollers are the two signals to be analyzed for welding quality evaluation. Their typical waveforms are shown in Fig. 3. As can be seen, in spite of the impulsive behavior of the voltage across the rollers,
the welding current has a smoother shape due to the large inductance associated with the coils of the PT and secondary load. The peak value of the current flowing in the PT primary is in the order of 50 A, corresponding to a peak welding current of 2000-4000 A depending on the operating conditions (tinplate thickness, welding speed, and so on).

Because a nugget is produced both when the current reaches a maximum and minimum value, in the (typical) case of Fig. 3B, the duration of the welding period is about 0.7 ms.

In our monitoring system, the waveforms of Fig. 3 are sampled at 200-k samples/s; thus, a double set of about 140 samples must be processed in less than a welding period (0.7 ms). Such a high processing speed can be reached only by means of dedicated analog circuits or high-speed mixed analog/digital electronics.

As already anticipated, the latter options were chosen, which offer many advantages such as reduced custom design of both hardware and software, networking capabilities, and low cost.

The Proposed System

The monitoring system of this work, consisting of a high-speed section for real-time signal processing and digital unit for the management of defective cans, is based on a new family of acquisition boards featuring on-board FPGA devices able to perform real-time signal processing defined by algorithms written in a special version of LabVIEW™.

Figure 4 gives a schematic representation of the system.

A Windows®-based PC is used for system management, operator interface, network connection, data collection, and storage. The PC is equipped with a NI 7830 PCI acquisition board featuring a FPGA device that can be programmed to process in real time both analog and digital signals at 40 MHz clock rate, corresponding to a clock period of 25 ns. The hardware blocks inside the FPGA can be organized for parallel processing of several signals.

In our system, analog signals from the
sensors (few, but needing time-consuming sampling and AD conversion) and many digital signals are processed in parallel. This allows performance of a whole sampling (AD conversion and partial processing cycle) in less than 200 clock periods (i.e., 5 μs in total), resulting in a 200-k cycles/second continuous operation of the algorithm.

Therefore, within a welding period of 0.7 ms, 140 16-bit digital samples of the analog signals are acquired and processed. This performance is sufficient to obtain suitable accuracy in welding quality evaluation, hence high resolution in defect detection.

A suitable signal conditioning stage has been designed to a) amplify analog signals from the sensors to fit the dynamics of the AD converters present on the FPGA board; and b) shift the level of the 24-V signals from digital sensors and actuators placed on the welding machinery to transistor-transistor logic (TTL) compatible levels. The gain of the top-quality amplifiers used for the analog channel can be varied to optimize the system for the particular machine to be monitored. Furthermore, the accuracy of signal sampling and conversion guarantees the effectiveness of the analysis even if the input signals do not completely span the converter dynamics. This is important from the point of view of system flexibility, because different signals (due to differences in tinplate thickness, welding current, and so on) can be treated without the need to adjust the conditioning amplifiers gain to any specific case.

As for software, the operator/network interface and system management program are written in LabVIEW™. The same holds for the FPGA program (slave), that, however, must be compiled and transferred to the FPGA before system operation.

Figure 5 shows a block diagram of the FPGA algorithm that represents the core of our system.

Two parallel data flows are implemented exploiting the parallel execution capability of the FPGA device. Starting when a new trigger event is detected (i.e., the current crosses the zero line while rising or falling), a new data collection is started. A loop consists in parallel sampling and conversion of the analog signals and sampling of digital inputs (can transport encoder pulses, new can synchronization signal, and so on). At each loop, the analog samples are stored and digital signals are processed. At the end of the welding period (i.e., when a new trigger event is detected), the collected analog samples are evaluated to obtain the nugget quality factor (QF) expressed by the average conductance (i.e., the reciprocal of the resistance) during a single welding period. The QF, determined by the current and voltage waveform during welding, is automatically compared with operator-defined limits, and if these are exceeded, a fault signal is produced and the faulty can is ejected. To avoid errors due to random noise superimposed to the current signal, a Schmitt trigger (realized via software) is used to detect the trigger event.

Product quality standards can be easily defined by the operator choosing the number of tolerable faults that depends on the application, because, for example, cans for aerosol normally require zero defects while those for solid contents are more tolerant. To manage this parameter, the operator can easily define/modify the limits for defect detection. This manual and empirical calibration is necessary because in real production environments, the process tolerances as well as the intrinsic randomness in fault nature and entity may easily lead to a different variance in a statistical data of good nuggets. Therefore, in some cases, the sensitivity of the system must be suitably adjusted to compensate for uncertainty in material characteristics.

To implement the ejection function by counting the transport encoder pulses, the FPGA algorithm evaluates the position of the welded cans within the transport system after the welding rollers and generates an expulsion command when a faulty can reaches the right position in front of the ejective system — Fig. 6.

As can be seen in Fig. 6, a number of cans, depending on transport speed and tinplate format, is normally present within the transport system at the output of the welding point. Therefore, a set of registers containing the position of every can is required. These registers store the number of pulses of the transport encoder from the end of the welding and must be incremented (in parallel) at every encoder pulse. The eject system is activated if the can in the ejection position (corresponding to the fixed distance from the welding rollers) has been recognized as defective. Because real-time operation is needed, a portion of the FPGA is dedicated to updating and sampling the register's status.

Therefore, the FPGA is able to automatically manage both welding analysis and defective can ejection.

Furthermore, the quality of all the nuggets of the last welded can is stored in an internal memory, and the data can be transferred to the host program, without affecting the system operation, exploiting the direct memory access (DMA) option. These data provide important information to the operator (tinplate quality, adjustments to the machinery setup, and so on). The main LabVIEW™ program (host), running on a PC, is dedicated to service tasks such as data collection and visualization, operator interface, network connection, and remote control of the monitor system. The main program panel allows the operator to view the data (of course, in compact form) concerning a set of cans.
The minimum, maximum, and average values of QFs measured for each nugget of a single can are shown.

As stated above, the host program is able to manage data storage in the hard drive of the PC. Furthermore, the operator can store significant sets of analysis parameters corresponding to various situations of can size, tinplate characteristics, etc. These sets of parameters can be transmitted to the FPGA via the internal PCI bus without affecting the measurement speed.

**Experimental Results**

The proposed system has been successfully implemented in commercial welding machines. Different prototypes have been applied to machines presenting different characteristics such as the output waveform of the PWM inverter.

As already mentioned, the system speed is sufficiently high to allow data transfer from the FPGA to the main program via a DMA channel. Thanks to this feature, the operator can verify the distribution of QF values along the weld interface of a single can — Fig. 7. This is important to optimize the analysis, because nuggets near the borders present slightly different quality values compared to those in the center of the can. This leads to a widening of the min.-max. window and decreased analysis sensitivity.

Figure 7 presents the typical results of the analysis of nuggets along the weld interface of a single can welded using the waveforms presented in Fig. 3B. As can be seen, the QF is almost constant with the exception of a few nuggets located near the center of the can where a defect has been encountered, presenting QF exceeding the maximum threshold (red horizontal line) set by the operator. In any case in the figure, border nuggets (normally presenting slightly abnormal QF values) have acceptable QFs; in others, the threshold is exceeded. In any case, the operator can decide to exclude from the analysis border nuggets or apply for a different decision threshold.

In general, the welding regions can be subdivided in different areas to be analyzed with different sets of parameters. A typical subdivision of practical interest is the beginning, center, and end of the cans, with the borders featuring different values with respect to the center. In this way, the effects of the cans’ borders on the final quality evaluation can be eliminated using specific sets of threshold values.

The operator also has the possibility of masking the analysis of the first and last nuggets. This feature is important to avoid mistakes due to the fact that the voltage waveform across the welding rollers is not synchronous with the beginning of the tinplate to be welded. Thus, the first and last nugget may feature incomplete welding; hence, their values must be discarded.

Figure 8 shows typical results of the analysis of a set of cans. Each point of the curves in this plot represents a synthetic evaluation of the QF analysis of a whole set of nuggets within a can. The yellow line represents the average of the QF values. As can be seen, the average is almost constant from sample to sample. On the contrary, defects produce an abnormal value of the maximum or minimum QFs (red and green curves, respectively).

Through the main panel, the operator can easily set boundary levels for can selection calibrating the position of the maximum and minimum horizontal lines (thus, selecting an allowed range for QF values). In addition, the lack of tinplate to be welded can be easily recognized because QF assumes values well above the maximum limit (red horizontal line). This condition can be detected by comparing the minimum QF detected (green curve) with a third threshold level (blue horizontal line). If this latter is found below min QF, the system can immediately inhibit the welding machine inverter.

In the same way, insulation between rollers (not shown in the figure) can also be detected. Because this situation is also potentially dangerous for the PWM inverter, the FPGA immediately asserts a disable digital line that will be reset at the beginning of the next can.

The same analysis performed on a set of cans welded using quasi-sinusoidal current waveforms gives similar results in spite of the fact that the voltage across the rollers features a high number of pulses, hence the noise induced on the measuring system is higher.

Noise produces peaks in the current waveform and extra peaks in the voltage waveform. However, the analysis is not affected because the differential amplifiers used in the analog front end have a low slew rate limiting the effect of pulse noise. As a result, in the normal case (no faults), the QF presents only slightly higher dispersion around the mean value than the values obtained in the case of Fig. 3A. Thus, small defects are not masked by the noise.

Figure 9 shows a typical defect safely detected by the system of this work. In the case of the measurements presented in this section, the speed of the tinplate was 1.3 m/s, resulting in a distance between nuggets of 0.9 mm. Therefore, the defect shown in Fig. 9 results in two defective nuggets at most.
System Features

Calibration

The system developed in this work does not require critical calibration procedures. The main operation is to optimize the gain of the amplifiers used in the conditioning circuit to account for the characteristics of the particular machine where the monitor is installed. In fact, the signal at the output of the TA transformer can vary within a large interval depending on the machine, and the same holds for the voltage across the welding electrodes. Therefore, to exploit the acquisition board AD converter (ADC) dynamics, the peak values of the amplified signals must be maintained at about 80% of the converter range.

A further calibration concerns the synchronization of the transport and acquisition systems to be achieved, varying the delay between a mechanically produced electrical trigger and the beginning of the acquisition.

Both these procedures are made easy by the execution of special calibration programs.

Human Interface

The human-machine interface of the system presented in this paper has been carefully designed to allow nonskilled operators to perform basic operations by means of easy-to-use commands implemented on a touch screen.

Of course, operators with higher skills can log on the system and access extended features such as statistics and calibration procedures.

Network Integration

The monitor system of this work is suitable for network integration in the manufacturing system. The main program is written in LabVIEW™, which provides an integrated Web server allowing remote control. The system can be completely controlled from a remote workstation running any Web browser. This feature is useful for effective surveillance of the plant from a single location or to improve remote assistance in the case of faults.

Conclusions

This work presented a welding monitoring system able to detect faults in real time and with high sensitivity.

The system is based on measurements and processing of electrical signals from sensors placed on the welding transformer and electrodes.

Working prototypes of the system have been developed using commercial acquisition systems and high-quality conditioning electronics. Such prototypes have been implemented on commercial machines with excellent results.

The system is able to perform accurate analysis in real time and allows remote assistance, management, and data collection.

The system is based on widely available components and can be easily extended to include additional sensors.

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