AWS Conference on Joining Dissimilar Metals
Grosvenor Resort, Orlando, Florida
May 22-23, 2007

This two-day conference will cover topics such as:

- Failures Involving P91 Steel
- Dissimilar Weld Properties in AL-6XN, DH-36, and A514
- Dissimilar Metal Welding Microstructures
- Alternative Filler Metals for P91
- Nondestructive Examination of Dissimilar Welds
- Applications in the Chemical Process Industry
- CSC-Controlled Short-Circuit Transfer
- Friction Stir Welding
- Inertia Friction Welding
- Magnetic Pulse Welding
- Brazing with Reactive Foil
- Explosion Welding
- Ultrasonic Welding

Joining dissimilar metals is becoming more commonplace as the challenges are overcome by new technologies. This conference will address critical issues including material properties, weld properties, heat treatment, corrosion, the use of transition joints, service conditions, and practical considerations.

Where it is technically possible, industry requires metals and alloys to be joined to other materials. The joining of dissimilar metals is common in utilities, in oil and gas, in shipbuilding, in petrochemicals, and, of late, in the automotive industry, where there is a need to weld aluminum to steel.

But how do you do this? Is there some magic welding process that can be applied? Is there some new filler metal? Many engineers in the field have drawn blanks when it comes to this predicament. Where can they go for help? To one of their vendors? A research organization? A metallurgical consultant?

Another source is the conference the American Welding Society will be presenting on May 22-23 in Orlando, Florida. There, you can be brought up to date on many of the processes and metallurgy that work best on dissimilar metals.

The Conference on Joining Dissimilar Metals will bring together some of the best minds on this challenging, but rewarding, subject.

The keynote speaker will be Thomas W. Eagar, Professor of Materials Engineering and Materials Systems at Massachusetts Institute of Technology. Dr. Eagar is an expert himself in this area. He will present his own outlook based on his experiences as a consultant in the area.

One alloy that will receive particular attention will be P91, a relatively new steel that is finding broad use throughout utilities. Originally developed about 30 years ago by metallurgists at the Oak Ridge National Laboratory for the fast breeder reactor program, this steel has found many uses, the first of which was in heat-recovery steam generators (HRSG). There it was believed to have been able to reduce thermal fatigue and creep damage in main steam piping and superheaters. P91, a modified 9Cr-1Mo steel, has been replacing a great deal of 2¼Cr-1Mo steel, the traditional workhorse in the power field. Problems have been encountered along the way, especially when thls new steel has to be welded to stainless steels and even to 2¼Cr-1Mo. Nevertheless, a change from 2¼Cr-1Mo to the modified 9Cr-1Mo grade in an HRSG can reduce the wall thickness by 54% and the component weight by 65%. Jeff Henry of Structural Integrity Associates will provide a presentation on this dissimilar metal welding problem.

Still another problem in the power industry—the welding of low-alloy ferritic tubing and austenitic tubing in superheaters and reheaters—could be solved with the introduction of a new nickel-base filler metal. Kent Coleman of the Electric Power Research Institute will discuss this new filler metal.

Another relatively new material, AL-6XN, will be covered by Kim Tran, a researcher from the Naval Surface Warfare Center. This superaustenitic stainless steel has outstanding corrosion properties in marine environment, but it needs to be welded to other metals from time to time. Progress in this area will also be examined.

Developed by Allegheny Ludlum Corp., this nitrogen-bearing AL-6XN alloy contains 24% nickel and more than 6% molybdenum. Because of its superior corrosion resistance and strength, it can be used in thinner sections than the austenitic stainless steel it is replacing. Developed originally for seawater applications, AL-6XN is now starting to be used in the food and beverage, pulp and paper, and pharmaceutical industries. The Navy is especially interested in this alloy, and they have plans to use it on ships where it will have to be welded to steel trusses.

Dr. Damian Kotecki, the former president of the American Welding Society and currently Technical Director for Stainless and High Alloy Product Development at The Lincoln Electric Company, will show how the useful Welding Research Council 1992 diagram can be used to predict microstructures in stainless steel welds. This diagram is especially valuable in the prediction of weldability between different stainless alloys, such as austenitics to ferritics.

Two existing processes, explosion welding and inertia friction welding, already have outstanding track records in dissimilar metal joining. Explosion welding attracted international attention when it was used to produce shaped transition joints for the U. S. Coast Guard so aluminum superstructure could be welded to steel decking on cutters. There will be presentations on both of these processes.

Several newer processes, including high-power ultrasonic welding and magnetic pulse welding, will also be discussed. Karl Graff from the Edison Welding Institute will be on hand to discuss the new world of ultrasonic welding. Formerly, this process was used to join very thin metals, but this newer version opens the door for its use in industies where heavier gages are commonplace. The process is being used, for example, to weld aluminum to steel.

William Arbegast will be the spokesman for friction stir welding. This process works very well in the joining of various joining combinations, especially wherever aluminum and titanium are involved. Arbegast is on the faculty of the South Dakota School of Mines and Technology, and he is also the head of the new National Science Foundation's Friction Stir Processing Consortium which includes the five universities involved in the FSW research efforts. The others are the University of South Carolina, Brigham Young University, Wichita State University, and the University of Missouri-Rolla. Several dozen sponsors from industry and government are also members of this consortium.

And last but not least, Dr. Timothy Weihs will talk about his own invention, a patented foil, which will make soldering and brazing all that much easier. Dr. Weihs is a professor at Johns Hopkins University and also the president of Reactive NanoTechnologies, the company that makes and markets the new foil.

TUESDAY, MAY 22

CONTINENTAL BREAKFAST 8:00 AM – 9:00 AM

WELCOME REMARKS 9:00 AM – 9:20 AM

Robert Irving, Conference Chair;
William Newell, Conference Co-Chair

KEYNOTE ADDRESS: DEALING WITH DIVERSITY IN THE JOINING OF DISSIMILAR METALS

9:20 AM – 10:00 AM
Thomas W. Eagar, Professor, MIT, Cambridge, MA

As product life cycles increase, and the need for fuel-efficient lightweight structures increases, designers are specifying higher-strength metals, as well as a greater diversity of metals. Fabrication of lightweight structures in an economically efficient manner poses significant challenges, since our favored fusion welding processes are simply not practical (or possible) for many combinations of metals. Meeting these challenges requires greater expertise of the fabrication engineer, and earlier involvement in the product design process.

DISSIMILAR METAL WELD FAILURES INVOLVING GRADE 91 STEEL

10:00 AM – 10:40 AM
Jeff Henry, Structural Integrity Associates, Inc., Chattanooga, TN

There have been some unique failures in dissimilar metal welds in piping and tubing. In one instance, failure occurred when 1¼ Cr steel was welded to Grade 91 using a 2¼ Cr filler metal. Failures have also been detected when the Grade 91 steel has been welded to austenitics using a NiFeCr filler metal. Solutions to these problems are being investigated.

MORNING BREAK 10:40 A.M. – 11:00 A.M.

ADVANCES IN FRICTION STIR WELDING AND APPLICATION TO DISSIMILAR METAL JOINING

11:00 A.M. – 11:40 A.M
Wiiliam J. Arbegast, NSAF Center for Friction Stir Processing , and Advanced Materials Processing and Joining Center, Rapid City, SD

Current friction stir welding research into the joining of dissimilar metals has shown that both "within family" and "out-of-family" alloys can be successfully joined.

LARGE-AREA SOLDERING AND BRAZING OF DISSIMILAR MATERIALS WITH A NOVEL HEAT SOURCE

11:40 A.M. – 12:20 P.M.
Dr. Timothy P. Weihs, Reactive NanoTechnologies, Inc., Hunt Valley, MD

Bonding large components with solder or braze is typically very challenging when the two materials are dissimilar and have differences in expansion coefficients. High stresses develop on furnace-cooling from melting temperatures, and fracture or debonding can occur. This is particularly common when soldering or brazing ceramics to metals. Using a reactive foil as a local heat source, one can overcome this problem and can solder and braze without heating the components significantly. Multiple examples of large-area bonding of metals and ceramics will be presented, with particular emphasis on sputter targets and armor plates.

LUNCH (PROVIDED) 12:20 P.M. – 1:30 P.M.

CSC-CONTROLLED SHORT CIRCUIT TRANSFER—A NEW GMAW PROCESS THAT SOLVES OLD WELD PROBLEMS

1:30 P.M. – 2:10 P.M.
Tom Rankin, ITW Jetline Engineering, Irvine, CA

This presentation will feature a new GMAW transfer process where both the wire feed and power source outputs are coordinated to deliver high travel-speed welds on a variety of thin materials. Applications that support the benefits of the process will be presented, along with the important process parameters. The process is being used to join various dissimilar metals, including aluminum to stainless steel.

REFRESHMENT BREAK 2:10 P.M. – 2:30 P.M.

TENSILE PROPERTIES EVALUATION OF DISSIMILAR WELDS IN AL-6XN, DH-36, AND A514 GR. 2 PLATE

2:30 P.M. – 3:10 P.M
Kim N. Tran, Naval Surface Warfare Center Carderock Division (NSWCCD), West Bethesda, MD

The objective of this work was to evaluate the mechanical properties of dissimilar welds in AL-6XN, DH-36, and A514 Gr plate to provide recommendations for filler materials to maximize joint strength. The presentation will include a background and rational for the work, including material selection and potential application. A majority of the presentation will focus on the welding fabrication, mechanical properties evaluation, results, and recommendations.

MAGNETIC PULSE WELDING: DESIGN AND ANALYSIS

3:10 P.M. – 3:50 P.M.
Dr. James R. Dydo, Advanced Computational and Engineering Services, LLC (ACES), Gahanna, OH

Magnetic pulse welding (MPW) has been used to produce welds successfully between highly dissimilar metals in a full range of geometric configurations. Results indicate that simulation techniques are critical in determining the precise input current and impact angle necessary for the desired joint integrity. Optimization of the geometric configuration results in increased weld cross-sectional area and reduced equipment loads.

WEDNESDAY, MAY 23

CONTINENTAL BREAKFAST 8:00 AM – 9:00 AM

PREDICTION OF DMW MICROSTRUCTURES

9:00 AM – 9:40 AM
Dr. Damian J. Kotecki, The Lincoln Electric Company, Cleveland, OH

The WRC 1992 Diagram can be used to predict dissimilar metal weld microstructures for stainless steel filler metals. Examples related to cladding and joining are considered. Issues covered include dilution, achievement of ferrite in the deposit, and avoidance of martensite in the deposit.

EXPLOSION WELDING—A HIGHLY VERSATILE WELDING TECHNOLOGY

9:40 AM – 10:20 AM
John G. Banker, DMC Clad Metal, Boulder, CO

Applications will be discussed, including nickel alloys-to-steel, aluminum-to-steel, titanium-to-steel, and titanium-to-aluminum.

REFRESHMENT BREAK 10:20 AM – 10:40 AM

ALTERNATIVE FILLER MATERIALS FOR DMWs INVOLVING P91 MATERIALS

10:40 AM – 11:20 AM
Kent Coleman, Electric Power Research Institute, Charlotte, NC

In the late 1980's the domestic utility industry suffered from dissimilar weld failures between low-alloy ferritic tubing and austenitic tubing in superheaters and reheaters. EPRI performed extensive research into the problem and found that nickel-based filler metals provided significant service-life improvements over 309 SS filler metals. A new nickel-based filler metal was also developed that provided similar thermal expansion properties to the low-alloy base metal.

ULTRASONIC WELDING OF DISSIMILAR METALS

11:20 AM – Noon
Dr. Karl Graff, Edison Welding Institute, Columbus, OH

The solid-state bonding of the ultrasonic metal welding process makes it admirably suited for joining a range of dissimilar materials, including various combinations of copper, aluminum, nickel, and magnesium alloys, as well as gold-silver-platinum combinations widely used in electronic interconnections. Recent developments have shown it possible to join other alloy combinations involving titaniums and stainless steels. The current status of the technology in joining a broad range of dissimilar metals will be reviewed.

LUNCH (PROVIDED) Noon – 1:00 PM

THE WAY WE WERE—NDE FROM THE BEGINNING

1:00 PM – 1:40 PM
Mike L. Turnbow, Tennessee Valley Authority, Chattanooga, TN

This talk will discuss the history of nondestructive evaluation from its beginnings a century ago until the present. Particular emphasis will be on NDE as it has been used in the inspection of dissimilar metal welds. Personnel supply and qualification, including a discussion of some of the more recent NDE technical advancements, will also be highlighted.

APPLICATIONS OF DISSIMILAR JOINT METALLURGY IN THE CHEMICAL PROCESS INDUSTRY

1:40 PM – 2:20 PM
David Oulton, NOVA Chemicals (Canada) Ltd., Ontario, Canada

A presentation of the innovative application of dissimilar joint weld metallurgy in the design, fabrication, and repair of pressure equipment in the chemical process industry.

INERTIA FRICTION WELDING

2:20 P.M. – 3:20 P.M.
Al Wadleigh, Interface Welding, Carson, CA

Inertia friction welding is used to join solid as well as tubular components. In dissimilar metal welding, the process is often used to produce bimetallic transitions for such applications as stainless steel to aluminum or stainless steel to titanium fittings for the cryogenic industry and copper to stainless steel in nuclear piping systems. On the Space Shuttle and deep space programs, there are several bi-metal transitions. The original fuel cell cap is a friction-welded bi-metal component of stainless steel and aluminum. The process allows designers to put the correct metal at the desired location for cost savings and functionality.

CONFERENCE REGISTRATION FEES

CONFERENCE CODE: COJDM

AWS members: $550 • Nonmembers: $680

Each nonmember attendee will receive a two-year complimentary membership in AWS. Registration includes all conference sessions, two continental breakfasts, two lunches, and refreshment breaks. The registration fee does not include hotel accommodations. Hotel accommodations are subject to hotel regulations and are the responsibility of the attendee.

LOCATION AND ACCOMMODATIONS

Grosvenor Resort in the Walt Disney World Resort
1850 Hotel Plaza Blvd.
Lake Buena Vista, FL 32830-2202

Phone: 800-624-4109 (Outside North America: 407-828-4444) Fax: 407-828-1292

Take advantage of the specially negotiated rate of $99 for single and double occupancy. This special rate is also extended to you three days before the conference and three days after the conference (depending on hotel availability). Be sure to mention the *American Welding Society*. The deadline for reservations at this special price is April 22, 2007. Each reservation must be guaranteed with a major credit card. Any room reservations must be cancelled by 5 days in advance of the arrival date and must be done directly with the hotel. Valet parking is $9 per vehicle/per day unlimited access.

ACCOMMODATIONS FOR THE DISABLED

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GUARANTEE

AWS guarantees that you will leave the conference a satisfied customer. If for any reason you are not satisfied, please send a letter as soon as possible to John Ospina, AWS Conferences and Seminars, 550 NW LeJeune Road, Miami, FL 33126.

CONFERENCE REGISTRATION FORM

FOUR EASY WAYS TO REGISTER:

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3. **FAX form: 305-648-1655**. Fax one copy per registrant.
4. **Mail registration form to:**
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Note: Registrant information needed for each registrant

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You may send a substitute with no additional fee. No refunds are given for no-shows.

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