

# Welding Stainless Steel Alloys

## Welding Stainless Steel Alloys

Understanding the Transition to Lower Nickel Alloys

January 30-31, 2008

EWI

Columbus, Ohio

**Wednesday, January 30**

### Registration (8:30-9:00 AM)

*Continental breakfast available at this time*

### Welcome and Introduction (9:00-9:10 AM)

### Trends in Stainless Steel Usage (9:10-9:40 AM)

**Alex Millar, Ryerson Tull**

With recent increases in nickel surcharges, the stainless steel market is experiencing significant changes in product usage, particularly involving 304 stainless material. This discussion will focus on the driving forces involved, industries that are affected, and stainless steel product alternatives that are available and are being examined for application.

### Understanding Stainless Steels (9:40-10:40 AM)

**Rick Jerzyk, Allegheny Ludlum**

*Metallurgy 101 - Weldability, Formability, Corrosion Resistance*

As end users contemplate use of lower and more stable cost materials as alternatives to the stainless alloys they have historically utilized, they must consider several critical selection criteria. This discussion will present basic stainless steel metallurgy and then review those criteria. Special emphasis will be placed upon the primary need that resulted in the initial selection of stainless steel – corrosion resistance.

### Break (10:40-11:00 AM)

### Important Aspects in the Weldability of Stainless Steels (11:00 AM-12:00 PM)

**Suresh Babu, The Ohio State University**

*Austenitic*

*Ferritic*

*Martensitic*

*Duplex*

*Precipitation Hardening*

This session will cover the physical metallurgy basics for stainless steels and their performance. The lecture will build on these basics to understand the weldability issues that may arise due to weld solidification and subsequent solid-state transformations. In addition, some of the aspects related to new fusion and solid-state welding processes will also be introduced. Some of the challenges faced by the need to reduce chromium in stainless steels will be addressed with some new developments being pursued by the Ohio State University. Finally, some of the on-line computational tools that can be used by the welding engineers to evaluate the weldability of stainless steels will be presented.

### Lunch (provided) (12:00-1:00 PM)

### Resistance Welding (1:00-1:45 PM)

**Warren Peterson, EWI**

*Spot, Seam, Projection*

*Transition from Austenitic Stainless Steel (300 series) to Other Stainless Steel Alloys*

Resistance welding in its various forms is well established for the manufacture of stainless steel components. These process variations include spot, seam, projection, etc. Resistance welding of stainless steel differs considerably from low carbon and mild steels. Particularly, stainless steels are characterized by higher resistances, more tenacious surface oxides, better hot strengths, etc. All these have effects on the various resistance welding processes. In this tutorial, the basic characteristics of resistance welding stainless steels will be discussed. This discussion will focus on how the specific characteristics of stainless steels affect processing requirements, as well as typical welding responses for these materials. In addition, the relationships between resistance weld processing and specific metallurgical issues associated with stainless steels (grain growth, DBTT variations, HAZ softening) will also be discussed.

### Arc (TIG, MIG) and Laser Welding (1:45-2:30 PM)

**Randy Dull, EWI**

*Transition from Austenitic Stainless Steel (300 series) to Other Stainless Steel Alloys*

Advances in arc welding and laser welding afford significant opportunities to improve welding productivity for a wide array of stainless steel alloys. These allow faster welding speed, reduced joint preparation, use of less filler wire than traditional welding techniques, and reduced distortion correction costs through lower heat input and distortion, either from increased welding speed in the case of laser welding, or through higher joint penetration in both arc welding and laser welding. These results can be achieved through use of penetration enhancing compounds (PEC) with GTAW, use of keyhole PAW, and use of high power density in laser welding to increase joint penetration. These processes can also be combined in tandem welding in the case of GMAW, or in hybrid welding in the case of laser/arc welding, or GTAW/PAW hybrid welding. These processes are all in current production-ready commercial packages, or have been demonstrated technically with a high readiness level for commercial exploitation.

### Break (2:30-2:45 PM)

*Agenda continues on next page*



**Welding of Dissimilar Materials (2:45-3:30 PM)**

**Suresh Babu, The Ohio State University**  
*Carbon Steel to Austenitic Stainless Steel*  
*Carbon Steel to Ferritic Stainless Steel*  
*Austenitic Stainless Steel to Ferritic Stainless Steel*  
*Various other combinations*

Dissimilar materials joining is an important aspect of any industrial fabrication. The lecture will introduce this concept based on the physical metallurgy principles introduced in the earlier seminar and build on the challenges and approaches to address the same. The corrosion aspects of such dissimilar joints will also be introduced. The role of computational material modeling tools to understand the long-term service of these dissimilar metal joints will also be presented.

**EWI Overview (3:30-3:45 PM)****EWI Tour (3:45-4:45 PM)**

See EWI's laboratory and testing facilities for joining processes, materials, design & integrity, nondestructive inspection, and more.

**Reception (4:45-6:00 PM)**

Drinks and hors d'oeuvres will be served.

**Thursday, January 31**

*Continental breakfast available beginning at 8:00AM*

**Corrosion Issues with Stainless Steel (8:30-9:15 AM)**

**Sheldon Dean, Dean Corrosion Technology, Inc.**  
*Effects of Welding and Other Manufacturing Processes*  
*Galvanization, Sensitization*

The corrosion resistance of stainless steels derives from the chromium and molybdenum content in the alloy. The function of nickel is to provide an alloy that can be fabricated to the desired form while retaining its corrosion resistance. The lower nickel alternative alloys can also have adequate corrosion resistance if their different metallurgical characteristics are recognized and dealt with during the design and fabrication process. Duplex stainless steels have lower nickel contents and have given good performance in many applications. Manganese containing austenitics have also been used for many years, but must be handled properly to avoid problems. The nickel free ferritic stainless steels are more difficult to weld and fabricate, but have application in some services. The problems that occur because of chromium carbide formation, sigma phase formation and the null ductility transformation are all more likely with these alloys, and can result from welding operations. This session will explore these issues and allow time for questions and discussion.

**Modeling/Numerical (9:15 - 10:15 AM)**

**Wei Gan, EWI**  
*Welding and Forming*  
*Springback Predictions*  
*N Value changes as Material Deforms*

Numerical modeling based on finite element method and computational thermodynamics has been valuable in improving the understanding of the welding and forming of stainless steel alloys. Topics to be covered include (1) integrated welding, forming and loading simulation, (2) prediction of springback, and (3) microstructural evolution during material deformation.

**Break (10:15-10:30 AM)****Cladding with Stainless Steel (10:30-11:00 AM)**

**Nate Ames, EWI**  
*Weldability, Advantages, etc.*

Historically stainless steels have been used for fabrication of corrosion critical components. With the recent upturn in stainless steel prices, many fabricators and end users are looking to cladding as a lower cost solution. This session discusses some of the methods for cladding as well as their advantages and disadvantages.

**Discussion and Industry Needs (11:00 AM -12:00 PM)**

**Nate Ames, EWI**  
 Nobody is better at anticipating the needs of industry than industry itself. This session will be a group exercise to allow attendees to gain insight from collective group experience on a variety of topics and manufacturing concerns.

**Adjourn (Noon)****To Register**

Pre-registration is required. For registration fee information and a link to online registration, please visit [www.ewi.org/workshop](http://www.ewi.org/workshop)

**Directions to EWI**

For directions to EWI, please visit:  
[www.ewi.org/pdf/company/map.pdf](http://www.ewi.org/pdf/company/map.pdf)

**Lodging**

Each conference attendee is responsible for making their own lodging arrangements.

A pre-negotiated corporate rate of \$74 per night is available at The Holiday Inn on the Lane (614-294-4848). The Holiday Inn on the Lane is the closest hotel to EWI. Be sure to ask for the EWI Group rate when calling for a reservation. For additional information please visit: <http://www.holidayinnosu.com>

For more information or a list of additional preferred hotels, please visit:  
[www.ewi.org/company/hotels.asp](http://www.ewi.org/company/hotels.asp)

**For Additional Information**

For questions about workshop content and speakers please contact Katie Levesque at 614-688-5054 or [katie\\_levesque@ewi.org](mailto:katie_levesque@ewi.org). For questions on event logistics please contact Brad Hudson at 614-688-5146 or [brad\\_hudson@ewi.org](mailto:brad_hudson@ewi.org).

**About EWI**

EWI is the leading engineering and technology organization in North America dedicated to the research and development of materials joining and welding. EWI provides materials joining assistance, contract research, consulting services and training to hundreds of members in the aerospace, automotive, government, energy and chemical, heavy manufacturing, medical and electronics industries.



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