

Technical Newsletter from  
**ADOR WELDING LIMITED**  
Formerly Advani - Oerlikon Ltd.

## IMPROVE PRODUCTIVITY DURING WELDING OF STRAIGHT CHROME STAINLESS STEELS - PART II: FERRITIC STAINLESS STEELS

In the last issue we had detailed the welding of martensitic stainless steels. In this issue we will discuss the welding of ferritic stainless steels which are also a part of the straight chrome stainless steels.

### WHAT ARE FERRITIC STAINLESS STEELS?

Ferritic stainless steels are basically iron carbon alloys containing chromium in the range of 17-30% and relatively low carbon levels. The presence of high percentage of chromium and low percentage of carbon prevents the formation of austenite at elevated temperatures. Because of this, the room temperature structure remains ferritic.

### WHAT ARE THEIR UNIQUE PROPERTIES?

The ferritic stainless steels have the following properties in general.

- Ferritic structure at room temperature
- Magnetic and hence attracted by magnets
- Non-hardenable and so during cooling lesser tendency to crack

## Product Update

**BETACHROME 17Cr**

**BETANOX D**

**BETANOX D Mo**



- An electrode for welding of Ferritic Martensitic Chrome steels
- Weld beads are smooth, uniform and of excellent appearance
- Excellent arc stability and low spatter loss
- Weld metal properties can be achieved through proper preheating and Post heat treatment

**CHAMP 400**

- Poor toughness, in general
- Excellent resistance to chloride stress corrosion cracking, resistance to pitting and crevice corrosion in chloride media, resistance to oxidation at high temperature
- Excellent elevated temperature properties
- Poor weldability

The above will show that ferritic grades have unique properties because of which they become the candidate material for certain critical applications like stress corrosion service etc. Advanced ferritic grades are also available with improved weldability and other properties.

### WHAT ARE THE POPULAR GRADES AND THEIR COMPOSITIONS?

GRADE	TYPICAL COMPOSITION
430	0.06C-17Cr
446	0.10C-25Cr
405	0.05C-14Cr-0.2Al

### THEIR WELDING BEHAVIOR

As indicated above, the ferritic grades contain large amounts of chromium which renders the formation of austenite impossible even at high temperatures. So during heating and cooling the stainless steel remains ferritic throughout. No transformation to hard phases and so no pre-heating etc. But there can be other issues which require careful evaluation.

- **Grain coarsening and subsequent loss of toughness:** This happens due to welding heat and also because of the poor conductivity of stainless steels; control of heat input is therefore essential. In base materials grain refiners like Ti, Al is also added to restrict the coarsening effect
- **475°C embrittlement:** This happens when these steels are exposed to temperature ranges of 400-500C and this reduces the toughness of the material. Controlling the heat input can help in reducing this embrittlement



- Three phase inverter based, high efficiency and high power factor DC Welder
- Enhanced Reliability due to SMD technology

### CHAMPTIG 300AD



- Large Input Supply voltage range with under/over voltage, single phase protection
- Higher Efficiency & Power Factor

### CHAMPMULTI 400



- Champ Multi 400 (SSPW) specially proven for root pass/hot pass and

- **Formation of sigma phase:** Long soaking periods in the temperature range of 540-850C can produce sigma phase which is a hard and brittle phase. It not only affects the toughness but also the corrosion properties
- **Notch sensitivity:** With higher percentages of Cr, the material becomes brittle
- **High temperature embrittlement:** This happens when the steel is cooled rapidly from 1100C which is because of the super saturation of ferrite with carbon

### WELDING PROCESSES AND SELECTION OF CONSUMABLES

For welding of ferritic stainless steels processes like SMAW, SAW, GTAW and GMAW are suitable. SMAW is very popular and the other processes like GMAW and GTAW are used for superior grades of ferritic stainless steels. Ferritic stainless steels can be welded with matching composition or with austenitic type welding consumables.

GRADE	WELDING CONSUMABLES
430, 405,	E430 or E309
Ferritic grades to MS	E309

Both types of welding consumables have some advantages and some disadvantages as detailed below.

MATCHING COMPOSITION WELD METAL	AUSTENITIC TYPE WELD METAL
Matching corrosion properties	Corrosion properties will not match
Toughness will require improvement through alloy additions, grain refining, post weld annealing heat treatment etc.	Toughness is good
Less distortion	More distortion
Embrittlement possibility	No possibility of embrittlement
Not suitable for Cr percentages above 23%	Suitable for higher percentages of Cr
Less costly than austenitic type	Costly compared to ferritic type

### PREHEAT AND INTER PASS TEMPERATURES

- filling/capping of cross country pipeline welding applications
- High efficiency and high power factor – resulting energy saving upto 30%



ADOR Institute of  
Welding Technology



Course for Quality Assurance  
& Control of Welding (QA-1)  
12<sup>th</sup> - 15<sup>th</sup> July 2010

Refresher Course in  
Welding Technology (SC-1)  
2<sup>nd</sup> - 7<sup>th</sup> August 2010

Course for  
Welding Procedures &  
Qualifications (QA-2)  
16<sup>th</sup> - 18<sup>th</sup> August 2010

Certification Course for  
Welding Inspector (QC-1)  
4<sup>th</sup> - 9<sup>th</sup> Oct. 2010

Hands on training for  
Welders / Operators

Normally ferritic grades can be welded without preheat. However, when the Cr content increases, preheat becomes essential. For steels containing more than 25% Cr, preheat and inter pass temperature of 150-200°C is employed. In case of thicker plates, again preheat is required.

### WELDING PROCEDURE

The welding procedure should take care of the following aspects:

- Use basic coated electrodes when selecting matching consumables
- Use of minimum heat input
- Lowest size of electrode possible should be used
- Weld with Stringer beads and shortest possible arc

### POST WELD HEAT TREATMENT

Ferritic stainless steels are normally subjected to a variety of heat treatments, when a matching filler metal is used, for a variety of purposes like grain refinement, improving toughness, removing embrittlement etc. There are guidelines available for choosing them and proper selection should be made after consulting these guidelines.

### ADOR WELDING LTD. ELECTRODES

We have in our range both matching and austenitic type of electrodes for welding ferritic grades of stainless steels. They are as given below. Please click on the brand name to know more about the electrodes.

AWS TYPE	OUR BRAND NAME	FOR WELDING
E430-15	<a href="#">BETACHROME 17CR</a>	430, 405
E309, E309Mo	<a href="#">BETANOX D.</a> <a href="#">BETANOX D Mo</a>	ALL GRADES TO THEMSELVES AND TO CARBON STEELS

### CONCLUSION

Welding of ferritic stainless steels is an important activity in many industries since these materials are used in some critical service conditions. A good understanding of the behavior of this material

will help in choosing the correct consumable and welding procedure which is essential for achieving tough, corrosion resistant weldments.

Please contact us at [cmo@adorians.com](mailto:cmo@adorians.com) for suggestions on selecting consumables and pre and post weld treatment for ensuring defect free welds to increase productivity.



Project Engineering Solutions



ADOR Institute of Welding Technology



Welding & Cutting Solutions



Centre for Engineering Excellence



*WELDERS TO THE NATION*  
**ADOR WELDING LIMITED**  
(formerly known as Advani - Oerlikon Ltd.)



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