

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

IMPROVE PRODUCTIVITY DURING WELDING OF STRAIGHT CHROME STEELS - PART 1: MARTENSITIC STAINLESS STEELS

INTRODUCTION

Stainless steels do not rust in air or corrode in contact with certain corrosive media. The ability of stainless steel to resist corrosion is due to high chromium content (minimum of 12%) in the steel. Chromium forms an oxide film on the metal surface which shields it from attack by atmosphere or corrosive substances. The shining surface is due to chromium in the steel. The chromium content varies between 11% and 27% (the minimum is 12% and it goes even up to 32% in 312 grades); the corrosion resistance varies with the corrodant, structure of the SS and the chemistry of the SS; the 18% Cr stainless steel is resistant to general corrosion while the higher percentage Cr stainless steel is ferritic and is resistant to stress corrosion. Stainless steels which do not contain nickel or contain it in insignificant quantities (below 2%) are called straight chrome steels.

There are many groups of stainless steels like austenitic, ferritic, martensitic, duplex, super duplex etc. The ferritic and

Product Update

BETACHROME 13Cr



- For welding of Ferritic Martensitic Chrome Steels & Steel Castings
- Weld metal is of radiographic quality

BETANOX D



- Welding of AISI 309 type, joining SS to low alloy steels or carbon steel
- Excellent electrode which has excellent corrosion & oxidation resistance in continuous up to 110@c

CHAMPTIG 300AD

martensitic grades contain only chromium and are commonly referred to as straight chrome steels, as mentioned above. The different groups of stainless steels differ in their composition, properties and corrosion resistance. So they are to be used in specific environments for which they are suitable. They also differ in their weldability and call for suitably designed procedures to produce sound welds that will perform well in service. In this article we will discuss how to obtain defect free weld when welding one grade of straight chrome steels - the martensitic stainless steels.

WHAT ARE MARTENSITIC STAINLESS STEELS?

Martensitic stainless steels are stainless steels containing primarily about 12Cr and 0.2C. Actually there is a specific relation between C and Cr and that has to be maintained. Addition of other alloying elements may require changes in the percentages of C and Cr to obtain a martensitic structure. They solidify as martensite under normal cooling and exhibit martensitic structure at room temperature.

HOW DO THEY DIFFER FROM AUSTENITIC GRADES?

The austenitic grades like the 300 series are the most popular stainless steels. The martensitic grades which are in the 400 series are less popular and they differ from austenitic grades in many ways.

- These steels are hardenable unlike austenitic grades
- Poor weldability, ductility and toughness
- These grades are magnetic unlike austenitic grades
- Thermal conductivity is higher than austenitic grades but thermal expansion is lesser
- Good general corrosion resistance
- Harder than austenitic grades and hence better wear resistance, erosion resistance

WHAT ARE THE POPULAR GRADES AND THEIR



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

CHAMPTIG 303AD



- Single / Three phase inverter based, High efficiency and High Power Factor AC/DC TIG Welder
- Advanced inverter technology optimized ARC performance

THYROLUXE 401

COMPOSITIONS?

The martensitic grades fall in the 400 series of compositions. Some of the popular base material grades and their typical compositions are as given below. The martensitic grades find usage in applications where general corrosion resistance together with wear resistance is required like hydro power plant turbine blades, pumps, valves, etc.

GRADE	Typical composition
410	0.13C-12Cr
420	0.16C-13Cr
CA6NM	0.06C-13Cr-4Ni-0.5Mo
CA15	0.14C-12Cr-1Ni-0.5Mo

HOW ABOUT THEIR WELDING BEHAVIOR?

As indicated earlier, the martensitic grades harden during cooling because of martensite formation. So in welding the martensitic stainless steels, number of precautions are required similar to welding of carbon and low alloy steel; these includes preheating, slow cooling and post weld heat treatment. The austenitic grades of stainless steels do not require preheat and post weld heat treatment but the martensitic grades require preheating and post weld heat treatment. The table given below will give general guidelines for preheat and post weld heat treatment which is normally based on the carbon content of the stainless steel.

CARBON CONTENT	PREHEAT DEG C	PWHT
<0.05	120	OPTIONAL
0.05-0.15	204	RECOMMENDED
>0.15	315	REQUIRED

The ASME recommends a min preheat of 204°C for P6 group, which pertains to straight chrome steels. Just as in the



- Choice of heavy duty model to take care of both welding & gouging (for 600 A model only)
- Superior performance; proven even for critical stove pipe welding

CHAMPMULTI 400



- Inverter based digitally controlled synergic GMAW, self shielded FCAW and MMA welding outfits
- High efficiency and high power factor – resulting energy saving upto 30%

ADOR Institute of
Welding Technology



Certification Course for
Welding Inspector (QC-1)

case of welding carbon and low alloy steels, because of martensite formation, the martensitic stainless steels are susceptible to hydrogen induced cracking and use of low hydrogen electrodes is recommended. So in effect, to obtain defect free welds and avoid rework,

- Use preheat, high inter pass temperature, slow cooling, post weld heat treatment
- Use low hydrogen electrodes

SELECTION OF CONSUMABLES

The martensitic grades of stainless steels can be welded either with matching composition electrodes or with austenitic grade electrodes. The table below lists the advantages and disadvantages of using the 2 types of consumables.

MATCHING COMPOSITION CONSUMABLES	AUSTENITIC TYPE CONSUMABLE
Hardenable and hence preheat, PWHT required	Non harden able and hence no preheat, PWHT
Matching corrosion properties	Corrosion properties not matching
Good wear properties	Wear properties not as good
Not suitable for dissimilar steels welding	Suitable for dissimilar steels welding
Weld deposit susceptible to cracking	Weld deposit generally not susceptible to cracking
Economical	Will be costlier than matching composition electrodes

ADOR WELDING LTD. ELECTRODES

We have in our range both matching and austenitic type of electrodes for welding martensitic grades of stainless steels. They are as given below.

AWS TYPE	OUR BRAND NAME	FOR WELDING

7th-12th June 2010

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

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

Hands on training for Welders / Operators

E410-15	<u>BETACHROME 13Cr</u>	403,410,414, 416, 420, CA15, CA40
E410NiMo-15	<u>BETACHROME 13/4LB</u> <u>BETACHROME 13/4</u>	CA 6NM
E309, E309Mo	<u>BETANOX D,</u> <u>BETANOX D Mo</u>	ALL GRADES TO THEMSELVES AND TO CARBON STEELS

The addition of alloying elements such as Ni, Mo helps in making the stainless steel tougher and it also improves the weldability. Our electrode Betachrome 13/4 deposits weld metal with enhanced impact properties even after heat treatments. Please click on the name of respective electrode to know more about its applications and characteristics.

CONCLUSION

Martensitic stainless steels find applications in typical industries because of their unique properties. Welding of these steel is therefore a necessity and maintaining the desired properties is also a challenge. This can be achieved by understanding the material behavior and following the carefully designed welding procedures.

In the next issue of eWeldone, we will discuss in detail another grade of straight chrome steels: the ferritic stainless steels.

Please contact us at cmo@adorians.com for more details on this subject and for help in selecting the right consumables for these applications.



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.)



www.adorwelding.com

cmo@adorians.com

Contact us