

FABRICATION NEWS – July 1, 2023

BOARDMAN NEWSLETTER:

Your positive feedback to the newsletter we've sent out over the years is greatly appreciated. As STEWARDS for your Custom Fabrication needs, providing valuable education to the marketplace and building strong relationships is our primary focus. We promise to be your custom fabrication resource.

We hope you find this newsletter beneficial as we share tips in the pressure vessel design and construction process.

If there are any topics you would like us to address, please let us know

What temperature to PWHT a clad vessel?

Occasionally, a situation arises where you may be asking yourself; does a clad vessel need PWHT? Should I base the temperature of the PWHT on the backer material or the clad material? The information below will help you answer those questions.

Do you need to PWHT at all?

- PWHT for service can usually be omitted since the purpose of the clad material is to protect the pressure retaining backer material from corrosion.

If the backer material is required to PWHT per code due to thickness, have you considered your liner material based on the required PWHT temperature for the backer material?

- Some commonly used austenitic stainless steels such as 304 and 316 will become sensitized if held in temperature ranges between 900 – 1500°F. This process known as sensitization is the act of chromium escaping to the grain boundaries as shown in Figure 1 below. This can result in accelerated rates of intergranular corrosion for what is supposed to be the corrosion resistant barrier for your carbon or low alloy substrate.

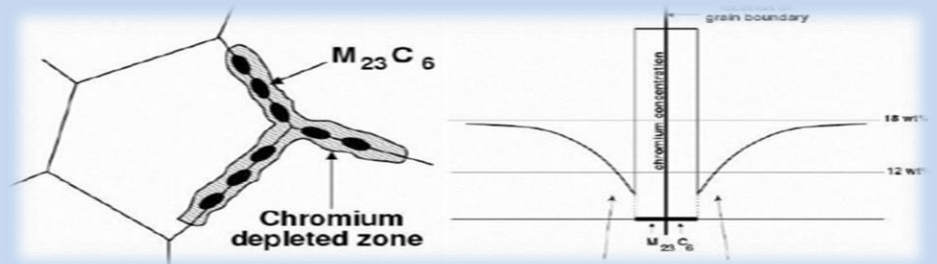
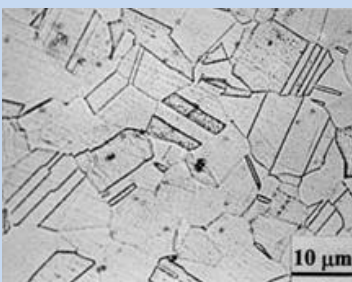
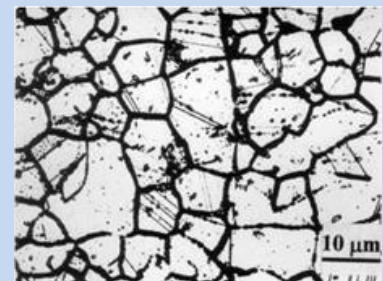


Figure 1 – [Rolled Alloys](#) (November 28th, 2022 article “*what is sensitization and how to avoid it?*”)

You should select your PWHT temperature based on the pressure retaining backer material. You would not want to PWHT a P1 backer material with a Monel 400 liner to 1300 - 1350°F. While that may be the preferred temperature for Monel, you could be exceeding the lower transformation temperature for your carbon steel. This can cause a host of issues including soft welds as well as increasing the probability of deformation of the pressure vessel during PWHT.



These photographs show a non-sensitized microstructure on the left and a sensitized microstructure on the right.



Question 1: I cannot get away from PWHT for code, what now?

Consider using a clad liner that is suitable for being post weld heat treated in temperature range of the backer material. If Austenitic material is your best option... consider using stabilized grades such 321, 347 or 316Ti which are stabilized with titanium, niobium. The addition of these stabilizers acts to provide protection from sensitization, by carbides forming with these elements instead of chromium because titanium and niobium have a greater attraction to carbon.

Question 2: What About “L” grades?

Another option is to utilize low-carbon stainless steel. Many stainless grades have a low-carbon version, such as 304L and 316L, that restricts carbon to a 0.03% maximum. Restricting carbon to such a low limit minimizes the quantity of carbon available for the precipitation of grain boundary carbides. Low-carbon grades are preferred to avoid sensitization.

Question 3: Are there any other alloys that can be selected to avoid sensitization?

As the old saying goes, *When in doubt, Inco out.* High nickel alloys such as Inconel, Hastelloy, and even Monel retain excellent corrosion resistance properties throughout a wide range of temperatures. There is a higher upfront cost for these alloys but the added length of service could be enticing to some!



BOARDMAN’S PRESSURE VESSELS FOR THE 21ST CENTURY ENGINEERING SEMINAR

Boardman is COMMITTED TO EDUCATION for our clients and our employees. On April 10-11, we hosted 20 engineers from 10 different clients from around the country. Attending were a combination of engineers from EPC’s and End-Users, as well as inspectors from an End-User. That combination, along with our fabrication team, created a unique dynamic with different perspectives throughout the design and fabrication of a pressure vessel. It was a highly engaged group and we greatly appreciate the engagement of all who attended. We cannot forget to congratulate the winners of our welding competition. We look forward to hosting our 2024 seminar on April 9-10, 2024. Please reach out if you are interested using the contact information below. We can provide the full feedback from past classes upon request.



OUR 2ND ANNUAL ASME SECTION IX TRAINING COURSE WILL BE HELD OCT 24-25. REACH OUT TO TARAN WAGNER (TWAGNER@BOARDMANINC.COM) FOR MORE INFORMATION

We would love to hear from you and have an opportunity to quote your next project

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