

Material Selection Resources

TITLE: Selection of Duplex 2205 over Stainless steel 316L

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Background:

L.J. Star supplies high quality Duplex stainless steel 2205 sight windows to various industries. The duplex 2205 sight windows are superior to 316L in corrosion resistance and other fabrication properties. Unfortunately, there is some misinformation being spread in the industry regarding the corrosion resistance of duplex alloys. A large amount of data exists on the WEB, (e.g. Nickel Institute web site and IMO website) that shows the superior performance of duplex alloys. This report provides a brief summary of the corrosion resistance of duplex alloys compared with 316L stainless steel.

Corrosion resistance: Duplex stainless steels exhibit a high level of corrosion resistance in most environments where the standard austenitic grades are useful. However, there are some notable exceptions where they are decidedly superior. This results from their high chromium content, which is beneficial in oxidizing acids, along with sufficient molybdenum and nickel to provide resistance in mildly reducing acid environments. The relatively high chromium, molybdenum and nitrogen also give them very good resistance to chloride pitting and crevice corrosion. Their duplex structure is an advantage in potential chloride stress corrosion cracking environments. Duplex alloys are more resistant to chloride stress corrosion cracking than Types 304 and 316.

Pitting and Crevice Corrosion Resistance

The high chromium, molybdenum and nitrogen contents in duplex grades provide very good resistance to chloride-induced localized corrosion in aqueous environments. All but the very lowest alloyed duplex stainless steels are far superior to Type 316 in this respect. Depending on the alloy content, some duplex grades are among the best performing stainless steels. Because they contain relatively high chromium content, duplex stainless steels provide a high level of corrosion resistance very economically. A comparison of pitting and crevice corrosion resistance for a number of stainless steels in the solution annealed condition as measured by the ASTM G 48 procedures (10% ferric chloride) is given in Figure 1. Critical temperatures for materials in the as-welded condition would be expected to be somewhat lower. Higher critical pitting (CPT) or crevice corrosion temperatures (CCT) indicate greater resistance to the initiation of these forms of corrosion. The CPT and CCT of 2205 are well above those of Type 316. This makes 2205 a versatile material in applications where chlorides are concentrated by evaporation, as in the vapor spaces of heat exchangers or beneath insulation. The CPT of 2205 indicates that it can handle many brackish waters and de-aerated brines. It has been successfully used in seawater applications where the surface has been maintained free of deposits through high flow rates or other means. Figure 2 shows the CCT as a function of PRE number.

Summary:

There is no doubt that duplex 2205 has superior corrosion resistance than 316L in many chloride containing environments. The author has been involved with many applications where duplex 2205 replaced 316L because of better corrosion performance.

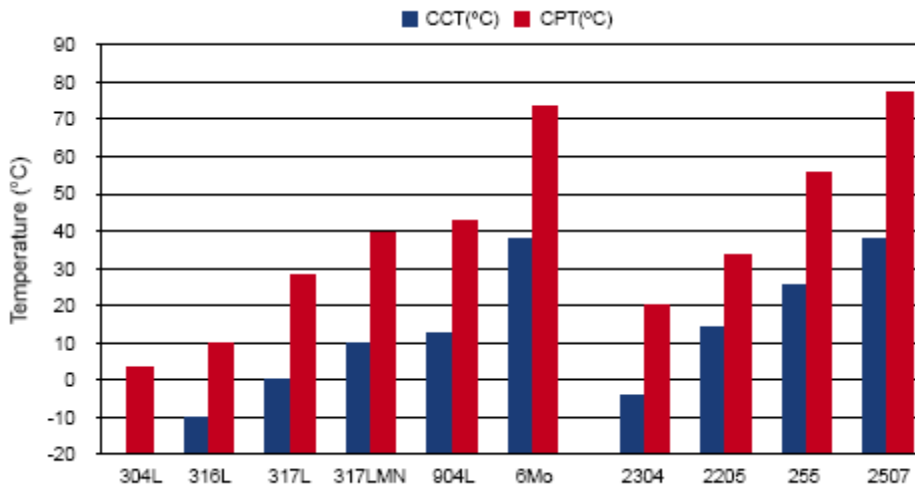


Figure 1. Critical Pitting and Crevice Corrosion Temperatures for Unwelded Stainless Steels in the Solution Annealed Condition (evaluated in 10% ferric chloride by ASTM G 48)

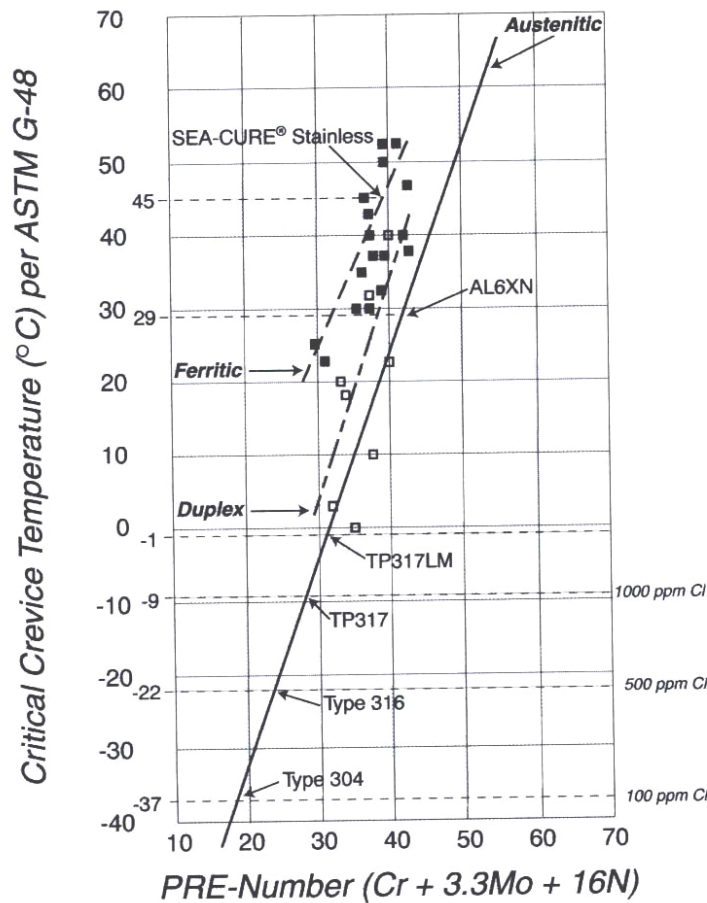


Figure 2. Critical crevice temperature as a function of PRE number.