1. Alloy 22 weld insert rings.

6 Moly Alloys are susceptible to chemical segregation in the weld area and therefore subject to preferential corrosion attack in severe corrosive environments. In the case of welds, if post weld heat treat is not an option, to compensate and offset the segregation of the molybdenum within the heat-affected zone of field welds, three different types of consumables are recommended by the manufacturers of 6 Moly Alloys. These are Inconel 625, Alloy C-22, or Alloy C-276. Each of these is a nickel Alloy with higher levels of molybdenum than 6 Moly Alloys. Inconel 625 contains 9% Mo, Alloy 22 contains 13% Mo, and Alloy C-276 contains 16% Mo. Alloy 22 has the highest chromium content (22%) of these, which also gives it the best corrosion resistance of the three.

In an independent study “Welding of AL-6XN with Hastelloy Alloy 22 Inserts” performed for Amgen, Inc. and carried out by Purity Systems, Inc and Diede Precision welding, Inc. dated September 15, 1998, further evidence in the form of corrosion tests was presented to support the use of a “flat washer” design insert fabricated from ALLOY 22 material. This commissioned report concluded with the recommendation to adopt the ALLOY 22 flat washer design over the Inconel 625 for all future projects.

2. 6 Moly welded to 316L stainless steel.

Although 6 Moly and 316L stainless steel can easily be welded using standard welding practices for austenitic stainless steel, strictly from a corrosion resistance viewpoint it is not recommended that this joining be made if avoidable. Whenever joining two different materials together it is important to consider the galvanic potential between the two materials. 6 Moly contains higher levels of chromium, nickel, and molybdenum then 316L stainless steel making it the cathodic material with a higher potential then the anodic 316L. When joining these two materials together by welding in the presence of an electrolyte (the liquid product) an exchange of current between the anode and cathode is achieved. As the voltage between the two materials flow, molecular particles of the anodic material (316L) is also removed with the voltage flow. The higher the potential difference between the two materials, the quicker the failure by consumption of the anode will be achieved. As the anode is consumed and therefore becomes smaller, the larger the potential difference becomes increasing the speed by which the anode is consumed.

In addition, the use of a Alloy weld ring further enhances the galvanic differential between the Alloy 22 insert ring and 316L and 6 MO materials creating a higher galvanic differential between the Alloy 22 and 316L material, and creating a galvanic differential between the 6MO and Alloy 22 that did not exist. Therefore, welding of 6MO to 316L, if required does not require a weld insert ring and is in fact detrimental to the corrosion resistance of the joint.

In order for galvanic corrosion to take place there must be four things present. 1. Cathode – a more noble metal where electrons from the anode are consumed 2. Anode- a less noble metal where metal is lost and electrons are produced, 3. Electrolyte – a solution which allows the flow of Ions, 4. Metallic path - which conducts electrons from the anodic site to the cathodic site. Should any of the components be missing galvanic corrosion cannot occur.

Although clamp joints still cannot eliminate the potential for galvanic corrosion, when welding the two materials together and as stated previously, chemical segregation of the molybdenum and chromium will occur in both materials when welded. Due to the chemical composition of these materials during

weld segregation, 316L becomes even less noble when coupled by welding then if the two materials are joined together by clamping or bolting. In addition, chromium is also depleted in the heat-affected zone of the weld area increasing the odds for crevice corrosion to occur under oxides on the surface of the weld areas.

Should you have further questions, and I may be of assistance, please do not hesitate to call me at 417-827-2526, or email me at the address listed below.

Sincerely,

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