

AL-6XN® FAQ

IS AL-6XN (UNS N08367) STAINLESS STEEL?

Both AL-6XN (UNS N08367) and 316L (S31603) are corrosion resistant iron-based stainless steel alloys. However, AL-6XN is a superaustenitic alloy with a higher concentration of nickel, chromium, molybdenum, and nitrogen, and a pitting resistance equivalent number (PREN) greater than 45. The result is a Super Alloy that is more corrosion resistant than 300 series alloys when exposed to chloride-induced media.

ARE ALL 6 MOLY MATERIALS THE SAME?

All 6 moly materials contains 6% molybdenum, hence, all 6 moly materials are similar in chemistry with lower levels of chromium, nickel, nitrogen, and copper. The key to material selection is component availability and welding compatibility. AL-6XN is readily available in all forms such as sheet, plate, round bar, pharmaceutical and sanitary tubing and fittings.

EXAMPLES OF 6 MOLY ALLOYS AVAILABLE IN THE MARKET:

- AL-6XN (UNS N08367)
- Ultra 6XN (UNS 08926)
- 254SMO (UNS S31254/1.4547)
- Alloy 926 (UNS 08926/1.4529)

WHAT TYPE OF APPLICATIONS ARE BEST SUITED FOR AL-6XN?

Due to high concentrations of molybdenum, chromium, and nickel, AL-6XN is the recommended alloys for the transmission of corrosive fluids through stainless steel in sanitary environments. Any application that experiences chloride-induced corrosion in the forms of pitting, crevice, or stress corrosion cracking may be a good candidate for replacement with AL-6XN. This alloy has been used successfully in a diverse range of industries:

BIOTECH AND PHARMACEUTICAL: Buffer solutions, chromatography lines, API, saline solutions

PERSONAL CARE: Shampoo, conditioner, toothpaste, deodorant/antiperspirant, body wash, liquid soap

HOME CARE: Fabric softener, detergent, cleaners

FOOD, DAIRY, AND BEVERAGE: Ketchup, tomato sauce, mayonnaise, soy sauce, barbecue sauce, chili sauce, breaker eggs/liquid eggs, soup, brine solutions, cheese, isotonic drinks

HOW CAN I JUSTIFY THE COST OF AL-6XN?

When a plant is calculating the ROI (return on investment) for AL-6XN they are looking for direct losses such as materials and labor costs, loss in production time/shutdowns, product loss, microbiological contamination, and service life. Installing AL-6XN at the beginning of a project will serve as a cost-effective best practice over 300 series alloys due to its lifetime value. Plants will not have to replace lower grade alloys that experience pitting and corrosion and other related side-effects repeatedly due to equipment failure and sanitary concerns. Instead AL-6XN can offer a one-time solution over the course of the system's lifetime.

HOW SIMILAR IS AL-6XN TO 254SMO STAINLESS STEEL?

Both alloys were developed to resist localized corrosion in seawater applications and are classified as 6 moly alloys. AL-6XN (UNS N08367) and 254SMO (UNS S31254) have a similar composition however, AL-6XN will outperform 254SMO for pitting resistance with a PREN of 45 and 42 respectively. For biotech, pharmaceutical, and hygienic/sanitary applications the main advantage of AL-6XN is the availability of tubing and fittings in appropriate finishes.

ARE THERE SPECIAL WELDING PROCEDURES THAT HAVE TO BE FOLLOWED?

Yes, there are two different approaches that should be considered when developing a weld procedure for AL-6XN. For sanitary tubing, GTAW is preferred with heat inputs similar to that of 316L stainless steel. The most common practice is the addition of a consumable insert ring in the weld point. The insert ring is used to over alloy the weld, which helps maintain integrity and corrosion resistance. Insert rings made from Hastelloy® C-22® are preferred for its 13% molybdenum content. An alternative method of welding is done autogenously (without insert ring). Welding done autogenously will require post weld heat treatments in order to maintain corrosion resistance properties.

AL-6XN[®] FAQ

WHAT IS A WELD INSERT RING?

Weld insert rings are used as filler metal when orbital or hand welding using the GTAW process. When consumed, the inserts purpose is to “over-alloy” the weld area. This over-alloying is needed to compensate for chemical segregation (primarily molybdenum) that takes place during the welding process. The filler alloy must have a higher molybdenum content than the AL-6XN alloy to compensate for alloy dilution upon cooling. CSI stocks insert rings produced from 13% molybdenum alloy (C22).

CAN I WELD AL-6XN TO 316L STAINLESS STEEL?

The short answer, is yes! You can weld AL-6XN to 316L.

Theoretically, it is suggested that welding AL-6XN alloy to a 300 series stainless steel is not recommended. However, in reality AL-6XN alloy and 316L stainless steel are welded frequently. This can easily be done using standard welding practices for austenitic stainless steel.

Typically, when welding AL-6XN to 316L a consumable weld insert ring is recommended.

However, keep in mind that the corrosion resistance can be degraded by making this joint if the conditions are extremely corrosive for the 300 metal. Depending on the severity of the service and if it is a borderline application between AL-6XN and 316L, the mixing of the two metals in the melt most likely would not be attacked.

WHAT IS GALVANIC CORROSION?

In general, whenever welding two different metals together, it is important to consider the galvanic potential between the two materials.

The higher the potential difference between the two materials, the quicker the failure by consumption of the anode. As the anode is consumed and therefore becomes smaller in comparison to the cathode, the larger the potential difference becomes, further increasing the rate of corrosion.

CAN GALVANIC CORROSION OCCUR BETWEEN AL-6XN AND 316L?

If the intended service is very corrosive, then yes, the heat affected zone just past the weld on the 316L side is more likely to be preferentially attacked. However, the AL-6XN side remains unaffected as long as the application stands good for AL-6XN.

AL-6XN contains higher levels of chromium, nickel, and molybdenum than 316L stainless steel, making it the cathodic material with a higher potential than the anodic 316L. When these two materials are joined together by welding in the presence of an electrolyte (the liquid product), an exchange of current between the anode and cathode is achieved. Chemical segregation of the molybdenum and chromium will occur in the heat-affected zone of the weld area. As the current flows between the two materials, the anodic material (316L) is consumed and becomes less noble and creates the potential for galvanic corrosion.

CAN I WELD AL-6XN TO 904L?

Yes, both alloys can be welded together. We recommend developing a weld procedure using C-22 weld insert rings to enhance corrosion resistance properties.

IS IT TRUE THAT 904L MATERIAL DOESN'T REQUIRE A WELD INSERT RING?

No, 904L (UNS N08904) is in the super austenitic alloy family which requires over alloying filler metals when welding without post weld heat treatment. Reference ASME BPE section MJ 2.1.1 and MM 5.4 for details of welding requirements.

CAN I WELD AL-6XN BY HAND?

Yes, using the same cleaning, handling, and welding procedures used with 316L stainless steel. Use over-alloying insert rings when welding without post weld heat treatment.

AL-6XN® FAQ

HOW DO I CUT AL-6XN TUBING?

AL-6XN tubing can be cut using the same tools used to cut 316L tubing. We recommend an orbital tube saw such as a George Fischer saw and the same blades used to cut 316L (CSI part number: CSI035). Speed is your enemy when cutting AL-6XN. Run the blade RPM as low as possible and advance the blade more slowly than you would cutting 316L and use plenty of lubrication (CSI part number: GF-PS8).

DO I NEED TO PASSIVATE A SYSTEM CONSTRUCTED OF AL-6XN?

Yes, according to studies comparing AL-6XN and 316L stainless steel and the benefits of passivation, corrosion resistance is improved by passivating the surface. AL-6XN will form a passive surface on the steel just like 316L. As with any system, cleanliness is key. It is important that any oxides from welding, oils, cutting fluids, etc. be removed after installation in order for the passive surface to form to its full potential, therefore giving the best overall protection and corrosion resistance.

HOW MUCH LONGER CAN I EXPECT A SYSTEM FABRICATED FROM AL-6XN TO LAST OVER 316L?

It is difficult to give an exact time frame when asked how much longer a system will last over 316L. There are many variables with formulas and processes changing over time that include product time of contact and cleanability processes. However, if everything remains constant and the system is well maintained, we have seen 316L systems fail within 12 months or last in excess of 9 years when replaced with AL-6XN alloy. We cannot guarantee success in every application, however, proper installation and maintenance is key to extending the life of any system.