

# AquaPLEX®

## Engineered Duplex Alloy

AquaPLEX is a revolutionary, engineered design for potable water heaters that combines duplex stainless-steel alloy with PVI's highly specialized and proprietary manufacturing process. The result is a long-lasting, reliable water heater with superior corrosion-resistance.

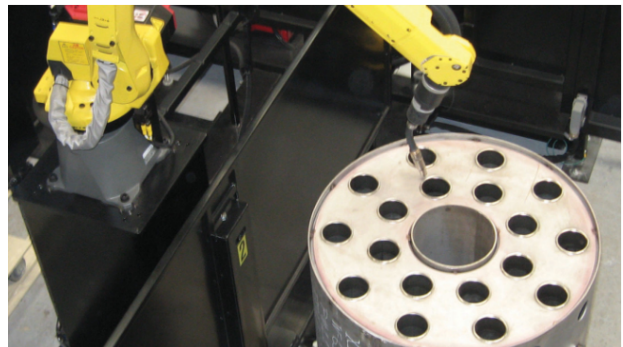
AquaPLEX involves special fabricating and welding processes in vessel construction. Laser and water-jet sheet cutting are used to minimize or eliminate exposure of the duplex stainless steel to extreme heat. Welding processes employ six-axis, robotic, synergic-pulse welding machines that automatically and instantly manage the arc current and voltage based on the welding speed to optimize the size and create high-quality, consistent welds.

Key to AquaPLEX's enhanced corrosion resistance is a post-fabrication **pickling and passivation process**, where the finished vessel is submerged in a temperature and concentration-controlled cleansing bath that returns the material to pristine condition. After removal from the bath, rinsed with purified water and exposed to air, the chromium in the AquaPLEX material reacts with oxygen to create a continuous, passive chromium oxide layer on its surface. This layer is permanent and prevents AquaPLEX from corroding when exposed to the dissolved oxygen and other aggressive elements found in all potable waters. This refined oxide layer is responsible for its long-lasting corrosion resistance.

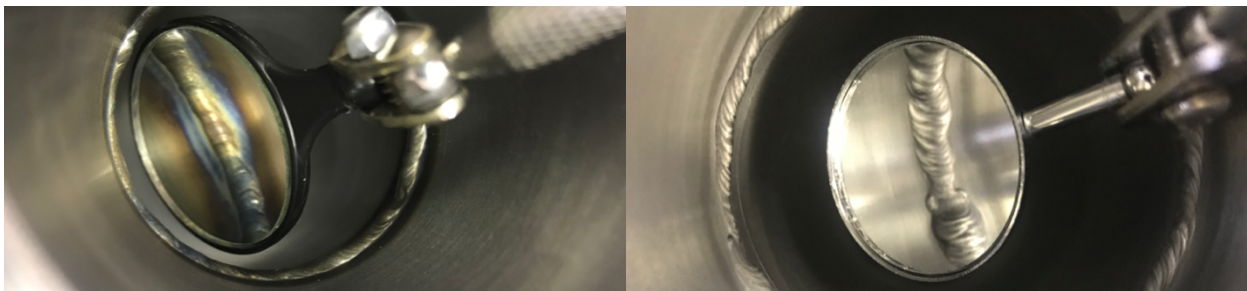
A superior material for typical potable water temperatures, AquaPLEX has no temperature limits and is suitable for continuous exposure to water temperatures approaching 200°F, as can occur with solar thermal heating and emerging heat pump technologies. Such temperatures would quickly erode tank linings like porcelain enamel (glass) or epoxy polymer. Note: Any water temperature limitations are dictated by ASME code or other safety certifications, and not the AquaPLEX vessel material.



*Figure 1: 50,000 psi Water Jet Cutting with no heat signature*



*Figure 2: TIG Welding in progress with 6-axis Robotic*



*Figure 3: Stainless Steel without Pickling and Passivation (left); AquaPLEX Pickling and Passivation (right)*

## AquaPLEX Duplex (LDX 2101) Stainless Steel vs. 316L Stainless Steel

The onset of stress corrosion cracking is one of the most common reasons for stainless equipment failure, instigated mainly by the presence of chlorides. Because duplex contains dual micro grain structures including the ferritic grain structure, it imparts a greater resistance to chloride stress corrosion cracking when compared to 316L (an austenitic grain structure stainless steel). Figure 4 shows the effectiveness of LDX 2101 when compared with 316L in a boiling chloride solution.

Localized corrosion, such as pitting and crevice attack, are also encountered in chloride containing environments. A numerical relationship between pitting resistance and alloying content has been developed to compare stainless steels, known as PRE<sub>N</sub>, Pitting Resistance Equivalent - the higher the number, the better the pitting resistance. Figure 5 compares the PRE<sub>N</sub> for LDX 2101 with other common stainless steels.

Solution	Alloy	
	316L	LDX 2101
26% NaCl (1000 hrs)	Fail	Pass
40% CaCl <sub>2</sub> (500 hrs)	Fail	Pass

Figure 4: Stress Corrosion Cracking Resistance  
U-bent samples in boiling chloride solution

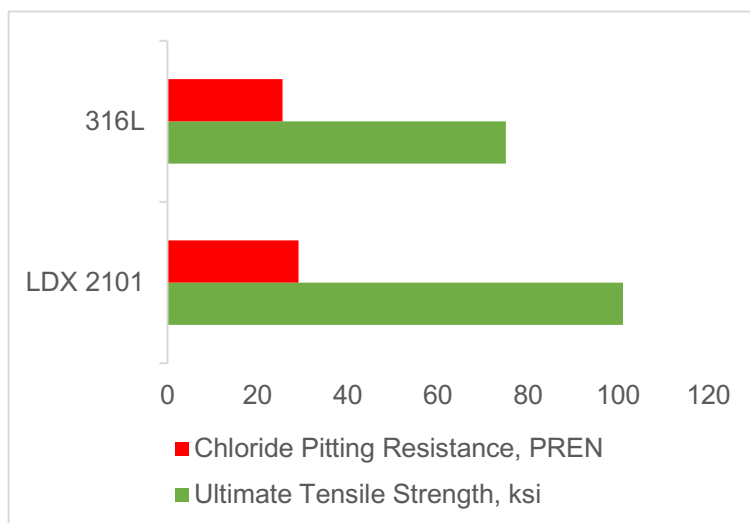


Figure 5: Tensile Properties - Cold Rolled Plate < 0.25" thick

Another advantage of nitrogen-enriched duplex stainless steels is their higher strength levels in comparison to conventional 300 series stainless steels, which allows for construction of units with thinner cross-sections, resulting in lighter weight and better heat transfer.

PVI collaborated with a team of world-class engineers and scientists to assist in the material selection, product design, welding technology, vessel fabrication, chemical processing, testing, and overall manufacturing processes for AquaPLEX. Its resistance to aqueous corrosion is what enables PVI to provide an industry-leading warranty and produce a superior water heater with greater longevity and reliability.

Author:

Raiyan Nazim

Product Manager, PVI

The source for the information and visual aids above can be found at the following links:

[https://www.rolledalloys.com/shared-content/technical-resources/alloy-comparison/LDX-2101-V-S-316L\\_AC\\_US\\_EN.pdf](https://www.rolledalloys.com/shared-content/technical-resources/alloy-comparison/LDX-2101-V-S-316L_AC_US_EN.pdf)

[https://www.rolledalloys.com/shared-content/technical-resources/databooks/LDX-2101\\_DB\\_US\\_EN.pdf](https://www.rolledalloys.com/shared-content/technical-resources/databooks/LDX-2101_DB_US_EN.pdf)

[https://www.neonickel.com/wp-content/uploads/2014/09/alloy\\_performance\\_guide1.pdf](https://www.neonickel.com/wp-content/uploads/2014/09/alloy_performance_guide1.pdf)

<https://www.pvi.com/solutions/aquaplex-technology>

<https://www.flickr.com/search/?text=duplex%20stainless%20steel>