

## WELDING CONSIDERATIONS

Titanium and titanium alloys can be welded by gas tungsten arc, gas metal arc, plasma arc and electron beam welding processes. Titanium is a reactive metal and is sensitive to embrittlement by oxygen, nitrogen, and hydrogen, at temperatures above 500°F (260°C). Consequently, the metal must be protected from atmospheric contamination. This can be provided by shielding the metal with high purity inert gas in air or in a chamber, or by a vacuum of at least 10<sup>-4</sup> torr. During arc welding, the titanium should be shielded from the atmosphere until it has cooled below about 800°F (430°C). Adequate protection by auxiliary inert gas shielding can be provided when welding in air, but ventilation and exhaust at the arc should be carried out in such a manner that the protective atmosphere (arc shielding and backing) are not impaired. For critical applications, the welding should be done in a gas tight chamber thoroughly purged of air and filled with high purity inert gas.

The titanium metal should be free of thick oxide and chemically clean prior to welding, as contamination from oxide, water, grease, or dirt will also cause embrittlement.

Titanium welding rods should be chemically clean and free of heavy oxide, absorbed moisture, grease, and dirt. The welding rod should be kept in the inert gas during welding, and the oxide at the tip, formed upon cooling, should be removed before using the rod.

Titanium can be successfully fusion welded to zirconium, tantalum, niobium, and vanadium, although the weld metal will be stronger and less ductile than the parent metals. Titanium should not be fusion welded to other commonly welded metals such as copper, iron, nickel, and aluminum, as brittle titanium intermetallic alloys are formed which produce extremely brittle welds.