The Welding Accessory Experts™

# Weld Like A Pro™
# Joe Welder's Guide To Welding Titanium

Titanium, a metal as strong as steel but less than half its weight, is able to withstand extreme temperatures. These qualities initially made titanium popular for applications in the aerospace and defense industries, however, titanium's extraordinary corrosion resistance makes it a reliable, cost effective material for use in many other applications as well.

Titanium is often thought to be a difficult material to weld because it readily reacts with air, moisture, grease, and other metals, leading to brittle welds. With proper equipment and attention to detail, however, any professional fabricator can successfully weld titanium.

## PREPARING YOUR WELDING ENVIRONMENT

Because contamination is a concern, the fabrication of titanium demands attention to cleanliness not only of the base metal, but of the shop as well. Often fabricators working with titanium along with other metals, will set aside an area to be used only for titanium. The area should be free of air drafts, moisture, dust, grease and other contaminants. Ideally, a low dew point should be maintained as well.

## PREPARING MATERIAL TO BE WELDED

Joint surfaces must be smooth, clean and completely free of contamination. Use only a stainless steel brush which has been used only on titanium to prevent cross contamination from other metals.

Remove burn marks produced by grinding or mechanical filing with a carbide file.

Do not use a steel file, sandpaper or steel wool, which can leave particles in the base metal.

Clean the base metal prior to welding.

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Before welding titanium, it is important that weld joints and weld wire be free of mill scale, dirt, dust, grease, oil, moisture and any other potential contaminant. Foreign substances introduced into the titanium will degrade titanium properties and corrosion resistance.

Many fabricators use acetone as a cleaning agent, however, Arc-Zone.com recommends EZ Wipes™, specialized, pre-saturated lint-free fabric wipes that come in a convenient shop canister. One side is abrasive to loosen dried contaminates and the other side is smooth to reveal a cleaner polished surface. This is an acetone free cleaning agent, safe, easy to use, and can be disposed of in the regular trash.

Never use a chlorine-based cleaning solvent.

Minimize handling of cleaned titanium and use lint-free gloves.

Weld joints should be kept covered with paper or plastic to avoid re-contamination when not being welded.

## WELDING

Oxygen contamination is one of the most common reasons for sub-standard welds, and molten titanium weld metal must be protected from contamination by air. Also, any heat-affected zones as well as the root side of the weld need to be shielded until temperatures drop below 800°F (427°C).

Argon is the shield gas of choice for titanium welding, although in some specialty applications a combination of helium and argon is used. For some high-performance applications, you may want to consider cryogenic (liquid) argon because the tanks provide a very dry source of argon.

Always buy your gas from a trusted supplier, and make sure all the leads and fittings have been tested for leaks to ensure there is no oxygen contamination.

Use a high-quality TIG torch, checking all gas connections and supply hoses, ensuring there are no leaks. Also check torch insulators and o-rings for proper fit and seal.

Be sure to adjust the flow rate for optimum coverage and torch cooling without creating turbulence.

Use a 1" (25.4mm) large nozzle with a gas lens or gas flow straightener.

Titanium is sometimes welded in a purge chamber to surround the weld with shielding gas. However, this is not always a practical or economically viable solution.

Trailing shields attach to the trailing side of your TIG torch to supply additional shielding and protect the molten weld puddle. Generally trailing shields require a secondary gas source and are often custom-made for a particular torch and application, however there are some good off-the-shelf options available as well.

Arc-Zone carries a complete line of Precision Welding Technologies high-performance engineered trail shields, as well as other trailing devices.

A low-cost, high-quality alternative to trail cups and other purge welding devices is Arc-Zone's Monster™ Nozzle, a No.16 (1" / 25.4mm) orifice, 1-1/8" (28.5mm) long, constructed of non-conductive ceramic with fine and coarse replaceable screens secured by a stainless steel snap ring.

Always use a backup shield devices to protect the root side of the weld.

While many fabricators will make their own shielding devices and effectively weld titanium, these kinds of devices are difficult to replicate in demanding high-performance applications.

**TUNGSTEN**

Thoriated tungsten is often recommended for TIG welding titanium, however, 2% Ceriated or 2% Lanthanated tungsten are good non-radioactive alternatives. Always buy your tungsten from a trusted supplier to ensure quality, and grind your tungsten on a dedicated tungsten grinder, away from your clean welding environment.

Arc-Zone.com recommends the ArcTime™ brand tungsten, formulated with state-of-the-art alloys to deliver balanced migration and evaporation rates as well as outstanding ignition and re-ignition properties. For applications where the need to minimize variables is critical, Arc-Zone recommends pre-ground ICE-T™ formula electrodes, cryogenically treated to produce a more dense grain structure, delivering improved arc starting and electrode cycle times as much as ten times longer.

While the techniques and equipment used in welding titanium are similar to those required for other high-performance materials, such as stainless steels or nickel-base alloys, titanium, demands greater attention to cleanliness and auxiliary shielding than these materials.