MATERION

TECH BRIEFS

Welding ToughMet® Alloy

Welding provides the highest strength bond when joining ToughMet alloy to itself or to other metals. As with any joining process, properly prepared surfaces, selection of equipment and materials, and sound practice are key to insuring a reliable bond. Resistance, arc, electron beam and laser welding techniques can be applied to ToughMet alloy. With proper technique and heat treatment, it is possible to weld ToughMet alloy without a significant loss of strength in the weld zone.

ToughMet Alloy Metallurgy

ToughMet alloy is supplied in the fully hardened condition. The high temperature generated by the welding process (in excess of 800° F) will reduce its hardness and wear resistance. A post-weld aging heat treatment can increase strength and hardness in the weld zone, restoring its properties to about 75% of the original values. Recovery of its full strength can be accomplished only by a full heat treatment which should be done under the guidance of Materion Performance Alloys Technical Services.

Surface Preparation

Best results are obtained with a clean surface free of dirt, oil, paint, grease, tarnish, and oxide. Conventional cleaning, such as solvent or vapor degreasing, is effective in removing organic contaminants. Aggressive brushing, abrasive blasting, or acid pickling is required for contaminants such as oxides.

Gas Tungsten Arc Welding

ToughMet alloy can be welded using GTAW (aka TIG). The recommended electrode is 1/8" thoriated tungsten with a pointed tip (20-25 degree included angle). Preheat and interpass temperature should be limited to ~ 400°F. Welding grade argon is the recommended shielding gas, although helium or a 75% He- 25% Ar mixture can be used to provide a greater heat input. Use direct current and electrode- negative polarity. A recommended starting point for welding is 180-200 amps and a gas flow rate of 25 cfh. The surface should be brushed clean before and during the welding process.

Recommended filler metals include ToughMet alloy and Monel®. 0.0625" ToughMet alloy filler rod is sold through the Materion Warren Michigan Service Center as "XL WeldPak". This filler has some tendency to form porosity, so it is recommended that the weld pool be worked slowly to eliminate gas bubbles. Alternatively ERNiCu-7 rod, such as Special Metals Monel Filler Metal 60, can be used. This filler has proven effective for joining ToughMet alloy to steel.

With the XL filler, a post weld heat treatment of 700°F for 3 hours is recommended to harden the weld bead and the heat affected zone (HAZ). With the Monel filler, the 700°F, 3 hour heat treatment is effective in hardening only the HAZ. Do not heat treat ToughMet TS alloy tempers as this will overage the material and destroy the properties of the bulk.

Copper beryllium filler will provide the highest weld strength when heat treated. A post-weld heat treatment of 3 hours at 650° F will harden the weld to about 30 HRC. When using copper beryllium, please review Materion document "Safety Practices for Welding Copper Beryllium (SF1)."

Electron Beam Welding

EB welding can be applied to join almost any size, configuration and combination of metals. No filler is used. Dissimilar thermal conductivity alloys and different gauge strip present no problem when the beam is focused on the less conductive or thicker metal. The beam diameter and fusion zone can be as small as 0.04 inch (1 mm) with a 0.025 inch (0.6 mm) heat affected zone.

Laser Welding

Due to limitations in the laser welding process, this should only be used on sections thinner than 0.100" (2.5 mm). Nd:YAG and other near-IR lasers have proven more effective than CO_2 since the latter require keyhole welding which results in a great deal of porosity.

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