MATERION

TECH BRIEFS

Weld Repair of MoldMAX V® Mold Material

Unlike copper beryllium, the copper nickel silicon alloy system does not weld readily or easily. WeldPAK® V filler metal is available, but should only be used to repair minor defects. To build up the surface, copper beryllium filler metal is required. Otherwise, the mold insert would need to be re-machined from a new piece of MoldMAX V.

SURFACE PREPARATION

Before welding, a clean surface is necessary. Remove tenacious oxides or other surface contaminants, such as any plastic residue, by wire brushing the mold. Use a suitable, nonflammable solvent to remove organic contaminants. Grind out cracks or unsound metal completely, making sure that the machined grooves have rounded bottoms and sloping side walls. Perform welding immediately after surface cleaning.

Figure 1. MoldMAX V block laser welded with WeldPAK V filler metal

PREHEATING

If the section size of the piece to be welded is larger than 0.25 inches, a preheating of the workpiece is necessary. Preheat the mold to a uniform temperature of 400 °F (200 °C) maximum.

WELDING WITH COPPER BERYLLIUM FILLER METAL

Gas tungsten arc welding (GTAW), also known as TIG welding, is best suited for sections up to 0.25 inches thick. Gas metal arc welding (GMAW), also known as MIG welding, is suggested for heavier sections.

TIG Welding

TIG welding is widely used for rebuilding worn mold surfaces and for minor cosmetic repairs. In this process, an electric arc is struck between a non-consumable tungsten electrode and the workpiece. A filler metal is used which is consumed during welding. The electrode should be a sharply pointed tungsten rod containing 2% thoria. Use low oxygen grade argon or helium gas as a shielding gas. Argon provides good control of arc, while helium permits deeper penetration. Pure argon is normally used for sections up to 0.0625 inches thick. Helium or a helium and argon mixture is typically used when hotter arcs are needed for larger section sizes. Maintain gas flow rate between 15 and 40 ft^3/hr.

If your welding shop has established procedures for welding C18000 or similar copper nickel silicon chromium alloys, use those welding parameters as a starting point for repair of WeldPak XL. Otherwise, a recommended starting point is 180-250 Amps for manual TIG welding and around 50-100 Amps for automatic TIG welding processes.

Weldpak® copper beryllium should be used as a filler rod. Available diameters from Materion Brush Performance Alloys include 1/16”, 3/32”, and 1/8”. The power source should be high frequency AC for manual welding, and DC, electrode negative for automatic welding

MIG Welding

In MIG welding, the electrode from which the arc is struck is consumed during welding. MIG welding is typically used for

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heavier sections and larger repair jobs. The power source is reverse polarity DC, electrode positive. An argon and helium gas mixture is preferred for welding thicker sections. Suggested welding parameters are 24 - 32 volts, 250 – 450 amps, and a 0.5 - 1.0 in^3/min wire feed rate.

WELDING WITH WELDPAK V FILLER METAL

WeldPAK V filler metal should only be used for repairing small cracks. It cannot be used to build up the surface. If the surface needs to be built up, copper beryllium filler metal should be used. Otherwise, the mold or mold insert would need to be freshly machined from a new piece of MoldMAX V.

TIG Welding

TIG welding using WeldPAK V is suitable for repairing of small, thin cracks only. The electrode should be a sharply pointed tungsten rod containing 2% thoria. Use low oxygen grade argon or helium gas as a shielding gas. Argon provides good control of arc, while helium permits deeper penetration. Pure argon is normally used for sections up to 0.0625 inches thick. Helium or a helium and argon mixture is typically used when hotter arcs are needed for larger section sizes. Maintain gas flow rate between 40 and 55 ft^3/hr. Use direct current negative polarity on the electrode.

Laser Welding

MoldMAX V readily laser welds with WeldPAK V, as shown in Figure 1. Laser welding is more precise than TIG welding and does not result in a heat affected zone around the weld.

POST WELD HEAT TREATMENT

MoldMAX V is not heat treatable to higher hardness after welding. However, if a weld repair was done with copper beryllium filler metal, Heat treat at 650 °F (315 °C) for 3 hours after welding to increase hardness of the weld bead. Please be aware that there will still be a heat affected zone of softer metal around the weld. The post weld heat treatment does not, however, restore the full hardness of the base metal.

VENTILATION

Provide adequate ventilation during welding copper beryllium since fumes are generated which may contain hazardous compounds.

SAFE HANDLING OF COPPER BERYLLIUM

Please refer to the Materion Corporation publications “Safety Facts 1 - Safety Practices for Welding Copper Beryllium“, “Safety Facts 6 - Safety Practices for Heat Treating Copper Beryllium Parts”, “Safety Facts 9 - Ventilation of Beryllium Dust-Generating Operations” and “Safety Facts 105 - Processing Copper Beryllium Alloys.”

Handling copper beryllium in solid form poses no special health risk. Like many industrial materials, beryllium-containing materials may pose a health risk if recommended safe handling practices are not followed. Inhalation of airborne beryllium may cause a serious lung disorder in susceptible individuals. The Occupational Safety and Health Administration (OSHA) has set mandatory limits on occupational respiratory exposures. Read and follow the guidance in the Material Safety Data Sheet (MSDS) before working with this material. For additional information on safe handling practices or technical data on copper beryllium, contact Materion Brush Performance Alloys, Technical Service Department at 1-800-375-4205.

REFERENCES

Welding Handbook, Vol. 4, Seventh Edition, Published by the American Welding Society, Miami, FL.

Welding, Brazing, Soldering, Brazing and Surfacing of Copper and Copper Alloys, Copper Development Association Inc., 1972.

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Welding Data Book, Penton/IPC Publishers, 1978/1979.

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