MATERION

TECH BRIEFS

EDM of Copper Beryllium Mold Materials (Moldmax HH®, MoldMAX LH® & PROtherm®)

EDM of copper beryllium (MoldMAX and PROtherm) can be performed safely and effectively using conventional processes and equipment that are commonly used for EDM of steel. However, because copper beryllium has much greater thermal conductivity (a significant advantage in molding plastics) compared to steel, the actual EDM operation requires more input energy. To obtain optimum results with copper beryllium, the EDM parameters will require processing adjustments compared to steel. EDM of copper beryllium can usually be done at 80 - 100% of the penetration rate for steel while maintaining a smooth surface and acceptable electrode life.

Like steel, the EDM of copper beryllium produces a thin layer of recast metal on the worked surface. But unlike steel, this layer is ductile and does not lead to polishing problems or cracking of the mold. The thickness of the affected layer in copper beryllium, which can be controlled by adjusting the machining parameters, is typically in the range of 1-10 μm. Because the thickness of the layer is insignificant, it has no measurable effect on mold performance. In addition, thermal stress cracking during EDM of copper beryllium is not a problem because of the material's unique ability to evenly dissipate the thermal energy of the EDM process

DIE SINKING

Following are recommendations that produced the best combination of metal removal rate (MRR), tool wear ratio (TWR), and surface condition in our die sinking evaluation. These values will vary somewhat depending on your design, equipment, and electrode selection; they should be used as a starting point for determining the parameters that are most suitable for you.

Many EDM references recommend "standard" polarity (electrode negative) for EDM of all copper alloys. Our testing, however, exhibited better performance with the "inverted" (electrode positive) polarity.

Recommended EDM Parameters for Copper Beryllium	
Voltage	220 V
Current	50 A
Pulse On-time	32 µsec
Duty Factor	50%
Electrode Gap	305 µm
Electrode Polarity	Positive
Electrode Material	Copper

Using these parameters to machine 19 mm diameter cavities into a 13 mm thick plate with a Mitsubishi M35KC7+G70 machine, the following results were obtained. The copper electrode was center flushed using Commonwealth EDM 244 dielectric fluid.

EDM Performance			
	MRR		TWR
	g/min	in^3/hr	
MoldMAX	.82	.36	.33
PROtherm	.54	.22	.87

MRR is the metal removal rate.
TWR is the ratio of electrode wear to workpiece removed by EDM.

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Following are the effects of variations in the machining parameters on EDM performance:

		MRR	TWR	Roughnes
On-time	**+ -**	- -	- +	+ -
Current	**+ -**	+ -	- +	+ -
Duty Factor	**+ -**	+ -	+ -	+ -
Polarity	**+ -**	+ -	- +	- +

Explanation: If the on-time is increased (+), this results in a decrease (-) in MRR, a decrease in TWR, and an increase in the surface roughness

The following observations were made during the machining trials using different electrode materials:

EDM Electrode Effects Compared to Copper	
Copper Tungsten	Decreased TWR, no effect on MRR or surface
Graphite (POCO-EDM-3)	Increased TWR, increased MRR, unstable at high currents and low ontimes, rougher surface

Pure copper electrodes generally provide the best combination of electrode durability and cost. Pure copper is used in most copper beryllium EDM applications. Tungsten copper provides better tool life, but it is more difficult to machine. The price of tungsten copper is significantly greater than pure copper. In general, tungsten copper electrodes provide better results in deep, narrow cavities that are difficult to flush.

WIRE EDM

From testing done on a Charmilles Wire EDM machine with soft brass and brass-on-copper wires:

For Maximum Machining Speed			
		MoldMAX	PROtherm
Capacitance	µF	3.3	3.3
Current	A	48	48
Pulse Duration	µsec	1.6	1.6
Frequency	kHz	25	29

For Smoothest Surface			
		MoldMAX	PROtherm
Capacitance	µF	0.3	0.3
Current	A	8	12
Pulse Duration	µsec	1.6	1.6
Frequency	kHz	17	20

SAFE HANDLING OF COPPER BERYLLIUM

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.

Safety precautions should always be followed in EDM any material to prevent worker exposure to hazardous materials. EDM of copper beryllium produces fine metallic particles. To prevent airborne exposure to these particles, the workpiece should be fully immersed in dielectric fluid and adequate flow should be maintained to effectively flush the EDM swarf from the electrode area. The EDM equipment should be operated to minimize vaporization of the dielectric fluid. Local exhaust ventilation during EDM is recommended to control exposure to dielectric mist and metal particulate. During machine maintenance, the accumulated chips must be handled in a manner to prevent workplace air contamination. Disposal of machining chips should be done in compliance with local regulations. Contact Brush Wellman for MSDS's or additional safe handling information. Please refer to the Materion Corporation publications “Safety Facts 5 - Safety Practices for Electrical Discharge Machining Copper Beryllium”, and “Safety Facts 105 - Processing Copper Beryllium Alloys.”

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