MIDWEST
TUNGSTEN
SERVICE

Tips

Fabricating Tungsten Alloys

Refractory Metal Supply and Fabrication *ISO 9001:2008*

Machining our MT series heavy alloys and our tungsten-copper alloys will be similar to machining gray cast iron. Hardness of the heavy metal alloys runs 24 to 32 Rockwell C. The material is abrasive and will produce discontinuous chips. Our tungsten-copper becomes easier to machine as the copper content is increased. Likewise, the higher the tungsten content, more care must be taken when machining. For our MT heavy tungsten alloys, carbide tools are suggested for milling, turning and drilling.

Machining and Finishing

Coolant is optional and carbide inserts are recommended in most cases. Coolants should be non-alkaline and water soluble with high lubricity. As a result of the material characteristics, especially the low thermal expansion, very close tolerances and fine finishes can be held.

Turning and Boring - Carbide inserted cutters are suggested. Positive rake for turning, no rake to positive rake for boring.

Roughing - Cutting depth of .030"to .125" and .008" to .015" feed, at 200 to 300 SFM.
Finishing - .010" to.015"cutting depth and .004" to .010" feed at 250 to 400 SFM.

Tapping - Use high-speed steel or carbide, positive rake, two flute plug spiral point taps. Chlorinated oil, sulfonated oil, or tapping fluid may be used. Choose the coarsest thread possible. For large holes, a single point tool is best. For difficult situations, a slightly oversized hole may help. If this is not acceptable due to decreased thread engagement area, heating to 400°F can be beneficial.

Drilling - Carbide tooling is suggested. Increased clearance angles and automatic feeds will help to avoid binding and seizing. Carbide drills will give a better tool life. Surface treated high speed steel twist drill bits also perform satisfactorily. Use of coolant or lubricant is highly recommended. For small holes, pay particular attention to clearance and chip removal to avoid seizing or bit breakage.

Grinding - Use silicon carbide wheels of medium hardness. Diamond wheels should not be used due to rapid loading.

Milling - Carbide cutters are suggested. Premium grade cutters are highly recommended.

Roughing - feeds of .007" to .015" per tooth at speeds of 200 to 400 SFM
Finishing - feeds of .003" to .010" per tooth at speeds of 300 to 700 SFM

Best final surface finish can be obtained by using large nose radius inserts, high spindle speeds, light feed rates, and positive rake inserts.

Sawing or Cutting - When sawing, use a bi-metal blade; blade pitch to be relative to the thickness of the material. Alternatively, a segmented edge carbide blade can be used with low speed. Coarse blades can be run at low speeds, and finer blades run at higher speeds. Coolant can be used, but is not required. Material also can be cut using high-speed abrasive cutoff wheels.

EDM - both wire and sinker EDM work well with tungsten alloys, although rates are slow. Some grain removal and hydrogen embrittlement can occur on EDMed surfaces.

Thermal Cutting - laser cutting, plasma cutting, or oxy-fuel cutting should not be used to cut tungsten heavy alloy because of the high levels of oxidation that result and the possibility of thermal cracking.

Stress Relieving - can be accomplished on machined parts. We suggest heating at 600°F in air for two hours and cool in air or in a protective atmosphere at 900°F for 30 minutes.

Surface finishes - conversion coatings such as black oxide, chromate, phosphate, anodizing are not suitable for tungsten alloys. Plated coatings such as cadmium, nickel, or hard chrome are sometimes used. Organic coatings such as epoxy or acrylic may also be suitable for some situations. Baking of these coatings at appropriate temperatures is recommended to achieve full cure.

Joining

Mechanical Joining is the best option for joining tungsten alloy material using standard fasteners such as bolts and pins. Tungsten Alloys can also be threaded to mate to itself and function as fastening method.

Brazing is a good method of joining high density tungsten material to itself and to other materials. Joint strength is close to that of the parent material. A disadvantage is that it should be done in a controlled atmosphere, which is not available to all users, to prevent oxidation. Brazing can alter the chemistry of the material surrounding the joint. Low temperature solders will not effectively wet tungsten alloys.

Diffusion Bonding is an ideal way of joining tungsten alloy material to itself, but it has to be done by the material manufacturer. If parts are finished, there may some distortion during the process.

Silver Soldering is a practical and efficient method of joining high density tungsten material either to itself or to steel. Easy-Flo 45 (BAg-1) is commonly used. Typically .002" clearance between parts to be joined is required. As the part gets larger, more clearance is required. Parts should be as clean as possible (sandblasting is sometimes used). Both parts are fluxed and carefully heated until solder flows. A slow uniform cooling is recommended. Uneven cooling could set up stress in the joint and the material.

Shrink Fitting is another good method of joining high density tungsten material to steel. Depending on the size of the part, .005"/.007" interference per side is recommended. The tungsten alloy is chilled in dry ice or nitrogen while the steel is heated. When assembled, a slow cool is necessary while the parts are held by a locating pin or fixture.

We hope that this guide has been helpful in suggesting machining methods that are suitable for our tungsten alloy products. If you have questions on a particular applications, please feel free to contact us for more information. Midwest Tungsten Service carries a variety of tungsten alloy shapes, sizes, and composition in stock for immediate delivery. Material not in inventory can be made to order with a short lead time. Midwest Tungsten Service can manufacture finished parts to customer prints or specifications.

To get more information about our tungsten alloys and their properties, please visit our web site alloy page:

www.tungsten.com/alloy.html

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