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TECHNICAL DATA

MACHINING TUNGSTEN

Forming and Stamping:

Tungsten can be fabricated into many simple shapes and configurations. It can be folded, bent, formed, spun, flow-turned, sheared, stamped, punched, and riveted. On the other hand, tungsten is a strong, hard, crack-sensitive metal that is usually brittle at room temperature. It requires special handling and skill beyond that necessary for most metals and alloys.

The most important rule to remember when working with tungsten is that it must be formed or cut at temperatures well above its transition temperature. Failure to follow this rule will generally result in cracked or laminated parts. Care should be taken to insure that the metal remains at this temperature throughout the entire forming process. The use of cold tooling which rapidly chills the metal can be as harmful as not preheating the material.

The Following Basic Rules Apply to Almost All Fabricating Techniques:

1. Tungsten should be fabricated well above its transition temperature.
2. Tungsten must not be heated above its recrystallization temperature unless the resulting brittle structure is of no consequence.
3. Tungsten is a notch sensitive material. The elimination of all stress-risers prior o fabrication is always a good practice.
4. Tungsten has directional properties that relate to the rolling direction. Whenever possible, bends should be made perpendicular to the rolling direction of the sheet.
5. Cutting edges should always be kept sharp, and clearances should be kept as small as possible.
6. Bending radii should be as generous as possible.

Joining:

Joining tungsten to itself or to other metals should be undertaken with caution and an understanding of the limitations involved. Tungsten can be welded to itself. However, the resulting weldment is always recrystallized and hence brittle. Even the use of a W/Re filler rod does not eliminate the brittleness of the metal adjacent to the heat-affected zone. On the other hand, if a leak-tight high temperature joint is required, welding is the only solution.

For joints that do not have to be leak-tight but require good high temperature mechanical strength, the use of either tungsten or tantalum rivets has proven quite satisfactory. Tantalum rivets, while not as strong as tungsten rivets, are much easier to head. Tungsten rivets take more skill to head, but are the most satisfactory.

If tungsten parts which are not to be exposed to very high temperatures are to be joined, brazing is preferred to welding. As long as the braze material has a melting point below the recrystallization temperature of tungsten (under 2200 ^{o}F), embrittlement can be avoided. Copper or silver alloys containing small proportions of nickel or iron are suitable for these applications.

Machining and Grinding:

Tungsten can be machined by turning, milling, or drilling. For thick-walled parts, slight preheating of the work to 400 ^{o}F is sometimes helpful, otherwise a highly chlorinated oil such as trichloroethylene is used.

Using a C-2 Type Carbide Tool, a Suggested Geometry is:

Side Angle:10 ^{o}
End Cutting Edge Angle:3 ^{o} to 10 ^{o}
Back Rake:0 ^{o}
Clearance:3 ^{o} to 5 ^{o}
Nose Radius: ^{1}/32" to ^{1}/16" Radius
Cutting Speed:100 to 200 RPM

The final shaping of tungsten parts is frequently done by grinding. Silicon carbide wheels with a hardness of J to L and a grain size of 100 to 120 have proven useful for most applications. Since tungsten is hard and brittle, surface checking can be a problem unless adequate cooling is used. An oil emulsion type coolant is recommended.