Magnaloy Coupling Company

Technical Product Information

Couplings

Magnesium Machining Practices and Precautions

The possibility of fire when machining Magnesium is always a real concern. However, if proper precautions are taken, this risk can be reduced greatly.

Magnesium fires result from combustion fo the metal due to heat generation beyond the “Heat of Incipient Fusion”. A magnesium fire is very violent and burns with a bright white glow. It has the ability to extract oxygen from the atmosphere, liquids and damp powders, so extinguishing by suffocation is necessary. Use of water containing fluids for coolants is **NOT** recommended. In fact, coolants are not recommended or necessary in most cases. Where coolants are desired, only mineral oil based cutting fluids should be used.

The following list of safety precautions and machining tips for machining magnesium are recommended in conjunction with normal safety practices.

1. A Class D (Ansul, metal fire) Fire Extinguisher should be in the immediate vicinity of the machining activity.
2. Cutting tools should be kept sharp to prevent excessive heat generation.
3. Cutting tools should NOT be allowed to dwell on the magnesium part being machined. (this will result in the formation of very fine particles of magnesium which can be easily heated to combustion by friction from the cutting tool).
4. Generally, high speeds, heavy feeds and heavy depths-of-cut are recommended to help reduce the fire hazard by reducing heat generation and by the creation of heavy chips and turnings.

If a fire does result,confine it to a small area and smother it with the extinguisher media. Do not blast it and spread it over the area. For this reason, we use Dry Ansul Sand in moisture proof container for pouring directly on any small fire that may occur.

Following are the particulars on tool sharpening, feeds, speeds, and depths-of-cut recommended for magnesium. These cover the basic machining operations of Drilling, Reaming, Boring and Milling.

Drilling: ***Shallow-Hole drilling*** (depths less than 5 times the drill diameter) presents few problems and consequently, only a few modifications are necessary for high quality drilled holes.
Standard point angles of 118 degrees and chisel adge angles of 120 to 135 degrees which give a relief angle of approximately 12 degrees will give the best cutting action. It is extremely important, regardless of the type of drill used, that the cutting edges be kept SHARP. ***Deep-Hole drilling*** can be performed with great speed and precision due to the excellent machining characteristics of magnesium. To extract chips from the hole, it is recommended to use high-helix drills of 40 to 45 degrees. If standard drills of low helix angels are used, it will be necessary to withdraw the drill frequently to clear the chips. The standard drill point angle of 118 degrees is the most satisfactory. Drill speeds in the

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range of 75 to 400 surface feet per minute are satisfactory and higher speeds can be used. The feeds used in drilling magnesium should be heavier that those for other metals to ensure proper chip formation. Small drills work best with light feeds, as they give slightly coiled or ribbon-like chips which feed out through the drill flutes without jamming. Heavier fees should be used on large drills to prevent jamming of the chips. Some recommended feeds for a few drill diameters are:

Speeds and Feeds for Dilling Magnesium			
Drill Diameter (Inches)	**Speed (FPM)**	**Feed (IPR)**	
		Shallow Holes	**Deep Holes**
1/4	300	.004 to .030	.004 to .008
1/2	to	.015 to.040	.012 to .020
1	2,000	.020 to .050	.015 to .030

Reaming: Reams for magnesium should have fewer flutes than normal for best results. ***Under 1 inch diameter:*** four flutes and ***Over 1 inch diameter:*** six flutes are best. Reaming feeds used for brass and steel work satisfactorily on magnesium. A definite cut (approx. 1/32 inch on the diameter) should be taken to prevent compression of the metal resulting in undersized holes and poor surface finish. Cutting speeds commonly used in commercial practice vary from 100 to 400 feet per minute. High cutting speeds and medium feeds give the best finish and most accurate holes. The following table gives some recommended ream characteristics for use with magnesium.

Reamer Characteristic	Recommendation
Helix Angle	0 to 10 degrees
Rake Angle	5 to 8 degrees
Relief Angle	4 to 7 degrees
Clearance	15 to 20 degrees
Margin	.010 to .025 inch
Flutes	4 to 6

Boring and Turning: Lathe set-ups, with due consideration of the more careful chucking pressures for magnesiumand a slight difference in tool design, are similar to those used for brass or steel. It is important in all types of lather tools that the relief angles be sufficiently larger to eliminate rubbing of the tool flanks. Rake angles may vary considerabley, but best results are obtained on high-speed steel tools with side and back rake angles of 0 to 15 degrees. Carbide tipped tools should have slightly smaller rake angles to provide more support for the cutting edge. A wide range of cutting speeds, feeds and depths-of-cut are possible in turning and boring of magnesium. Depths-of-cut as high as .50 inch and feeds from .003 to .005 inch per revolution can be used. The depth-of-cut, of course, depends upon the amount of stock to be removed, but for all practical purposes, any depth of cut can be taken, providing the work is of sufficient size and is properly secured. Heavy feeds

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provide a very quick means of removing metal, but do not give the best surface finish. However, extremely fine feeds should be avoided as they tend to heat the work more than heavier cut. Cutting speed for magnesium up to 5,000 feet per minute are appropriate for turning or boring. The following table provides recommended depths-of-cut, feeds and cutting speeds for turning and boring. The general rule it to turn and bore magnesium as fast as the machine tool, fixtures and work will allow.

Speeds, Feeds, and Depths-of-cut for Turning and Boring Magnesium			
Operation	**Speed (FPM)**	**Feed (IPR)**	**Maximum Depth-of-cut (Inches)**
Roughing	300 to 600 600 to 1,000 1,000 to 1,500 1,500 to 2,000 2,000 to 5,000	.030 to .100 .020 to .080 .010 to .060 .010 to.040 .010 to .030	.500 .400 .300 .200 .150
Finishing	300 to 600 600 to 1,000 1,000 to 1,500 1,500 to 2,000 2,000 to 5,000	.005 to .025 .005 to .020 .003 to .015 .003 to .015 .003 to .015	.100 .080 .050 .050 .050

Milling: Milling operations provide an opportunity to take full advantage of the excellent machining characteristics of magnesium. Heavy fees and extremely high milling speeds can be used to remove metal rapidly with excellent surface finish. The following table illustrates some typical machining parameters with magnesium.

Speeds, Feeds, and Depths-of-cut for Milling Magnesium				
Operation	**Speed (FPM)**	**Feed**		**Depth-of-cut (Inches)**
		in/min	**in/tooth**	
Roughing	up to 900 900 to 1,500 1,500 to 3,000	10 to 50 10 to 60 15 to 75	.005 to .025 .005 to .020 .005 to .010	up to .500 up to .375 up to .200
Finishing	up to 900 900 to 3,000 3,000 to 5,000 5,000 to 9,000	.10 to 50 10 to 70 10 to 90 10 to 120	.005 to .015 .004 to.008 .003 to .006 .002 to .005	up to .075 .005 to .050 .003 to .030 .003 to .030