

Helpful Hints For Saw Users (H.S.S. Metal-Working Saws)

These are general suggestions for conventional machines on where to start, and must be varied to meet a particular application. We do not assume any liability in the following statements.

These STOCK saws will do the job. Variations, such as number of teeth, rake angle, clearance angle, bevel, side clearance, material, land, etc. may do it better, but set-up charges and lead time must be considered.

- SPEEDS** — With a good set-up the speeds in the table below should be attainable
- Reduce the speed for hard (over Rockwell c30) and abrasive materials, and for deep cuts.
 - Increase the speed for “free-machining” and non-ferrous metals.

Saws: M-2 Steel, Ground Teeth, 0° Rake Angle

| Material to be cut | Saw Diameter: | 1-3/4" | | 2-1/4" | | 2-3/4" | | 3" | | 4" | | Coolant |
|--------------------|---------------|--|--------|--------|--------|--------|--------|-------|--------|-------|--------|-------------|
| | | Teeth | R.P.M. | Teeth | R.P.M. | Teeth | R.P.M. | Teeth | R.P.M. | Teeth | R.P.M. | |
| Mild Steel | | 64 | 450 | 60 | 350 | 56 | 275 | 56 | 250 | 72 | 200 | Cutting Oil |
| Alloy Steel | | 64 | 200 | 60 | 175 | 56 | 150 | 56 | 125 | 72 | 100 | “ |
| Stainless Steel | | 64 | 200 | 60 | 175 | 56 | 150 | 56 | 125 | 72 | 100 | “ |
| Steel Castings | | 64 | 200 | 60 | 175 | 44 | 150 | 44 | 125 | 60 | 100 | “ |
| Steel Forgings | | 64 | 450 | 60 | 350 | 56 | 275 | 56 | 250 | 72 | 200 | “ |
| Monel | | 64 | 200 | 60 | 175 | 56 | 150 | 56 | 125 | 72 | 100 | “ |
| Aluminum | | 64 | 2000 | 60 | 1750 | 44 | 1350 | 44 | 1250 | 60 | 950 | Soluble Oil |
| Bronze | | 64 | 750 | 60 | 600 | 44 | 500 | 44 | 450 | 60 | 350 | “ |
| Yellow Brass | | 64 | 2500 | 60 | 2000 | 44 | 1600 | 44 | 1500 | 60 | 1100 | “ |
| Copper | | 64 | 1750 | 60 | 1350 | 44 | 1100 | 44 | 1000 | 60 | 750 | “ |
| Malleable Iron | | 64 | 350 | 60 | 250 | 56 | 200 | 56 | 200 | 72 | 150 | “ |
| Cast Iron | | 64 | 450 | 60 | 350 | 44 | 275 | 44 | 250 | 60 | 200 | Dry |
| Die Castings | | 64 | 2500 | 60 | 2000 | 44 | 1600 | 44 | 1500 | 60 | 1100 | “ |
| Brittle Plastics | | 64 | 1000 | 60 | 900 | 56 | 700 | 56 | 650 | 72 | 500 | “ |
| Flexible Plastics | | Use Set Teeth (Hub saw with maximum side clearance for very thin cuts) | | | | | | | | | | |

(There should be at least 2 teeth engaged in the cut.)

Increase Number of Teeth For:

- Thin Material
- Thin Cuts (under .025")
- Slow Spindle Speeds
- Hard Material
- Sandy Castings
- Thin Castings
- Work Hardened
- Hard Spots

Decrease Number of Teeth For:

- Chip Clearance and Tooth Strength (Consider MSL & SMF type saws.)
- Deep Cuts (over 1/4")
- High Speeds
- Free Cutting Material

FEEDS — will vary from .0002" to .002" per tooth. We suggest starting with the cutter described above and trying to arrive at the condition described under “Cutting Fluids” by varying the Feed and Speed. A straw color is the limit. The saw loses its temper when it starts turning blue.

CUTTING FLUIDS — (to cool, lubricate, and wash the chips away. Use Flood. Do not use Mist Units.)

Cutting Oil — Follow Manufacturer’s Instructions - or - use a 4% sulphur homogenized cutting oil.

Soluble Oil — Follow Manufacturer’s Instructions - or - use 40-1 solution of soluble oil — (Mix thoroughly in a 4 - 1 solution before adding to tank.) **Increase speed and feed until the lubricant starts to give off a slight vapor (smoke).** Frequently saws are run too slow, causing rubbing and premature wear.

DISH — (Side-Clearance or Hollow Grind) Increase it for stainless steel and tenacious metals such as copper, zinc, tin or lead.

MOUNTING OF SAWS — Breakage — Wobble — Rubbing: These problems may be caused by the way the washers are mounted on either side of the saw. — Washers drive the saw, in the absence of a driving key, and must always be clean, flat and bur-free. A speck of dirt will let the saw wobble and cut oversize. If a saw breaks, it may score the washers. Check marks around the saw hole for: Dirt, Shiny Spots (as small as a pinpoint, indicating chips imbedded under the washers), and Circular Skid Marks, which indicate the nut is not tight. — Thin saws should especially be supported by washers as large as possible. — Nut must be wrench-tight. — If the saw blade pauses momentarily in its rotation while the feed advances, it will break. — Washers must be of equal diameter or they will flex out the dish and cause one side of the teeth to rub.

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TEETH — Deep cuts and soft material require fewer teeth (for chip clearance) and stronger teeth (landed). — Thin material requires more teeth (at least 2 teeth engaged in cut). — Hard materials and narrow slots (under .025") likewise require more teeth. — Alternately beveled teeth keep chips from sticking in the cut and in the tooth gullets. — Rake Angles: On center for iron and steel, 5° negative for yellow brass, from 5° to 10° positive for other soft materials.

BREAKAGE — In addition to causes noted under "MOUNTING OF SAWS": Teeth break when starting a cut at too fast a feed, spindle bearings worn, drive belts loose or sheaves worn, indexing before saw has cleared the slot, work-piece not tight, or the saw is dull (even the best eventually wear out).

KEYWAYS — No keyways are furnished on saws under .020". Thin saws will warp in the heat treating and grinding processes. Locked up between good supporting washers, they will run true.

HUBS — will allow maximum side clearance when attempting to cut wood or plastics. They are helpful when spacing saws on an arbor.

RESHARPENING — In addition to grinding the tips of the teeth, all marks must be removed from the sides of the teeth. This can be done by grinding the diameter below the marks or, as we do, by grinding the tips and clean-up grinding the sides. Either way the thickness is reduced because of the hollow grind that is necessary for even the shallowest of cuts.

VIBRATION AND CHATTER — Arbor bent or worn undersize. — Work-piece improperly supported, particularly watch on thin material. — Teeth too coarse/fine. — Speed too slow. — Climb milling, "Up-milling" is preferred, but climb milling may help on small parts to keep them from being ripped from the clamping fixture. It may also reduce the bur. — Dull tool / Wrong clearance angles. — Feed too slow.

EXCESSIVE WEAR — Seizing: Not enough coolant in the right place. — Not enough side clearance. — Cutter speed too fast and feed too slow. The work may glaze and the saw will rub.

TOLERANCES — are expensive, don't over-specify.

STEELS — M-2 is the best if the set-up is proper. We do have available saws from M-42 along with various surface treatments such as Titanium Nitride.

SUGGESTION — If a saw is working well, send it to us and we will duplicate it. — If a saw is not working well, send us a used blade. We can some times make recommendations from the marks on the saw.

Helpful Hints For Saw Users (Mica Undercutting Saws & V-Cutters)

COMMUTATOR UNDERCUTTING

After the commutator has been satisfactorily resurfaced, the mica insulation separating the copper segments must be undercut. Undercutting is one operation that is most easily accomplished with the armature removed from the machine. Various tools are available, however, that enable undercutting to be performed on a commutator "in place" without undue hardship.

Of the various undercutting practices used, only the two most common methods will be discussed herein.

There are three basic types of slots that can be produced by the use of circular cutters. The U-slot, the V-slot and the Compound-angle slot.

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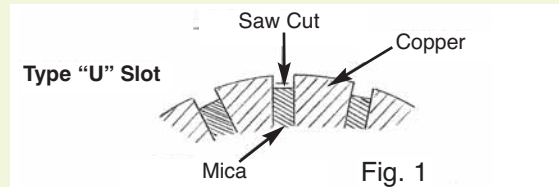


Helpful Hints For Saw Users

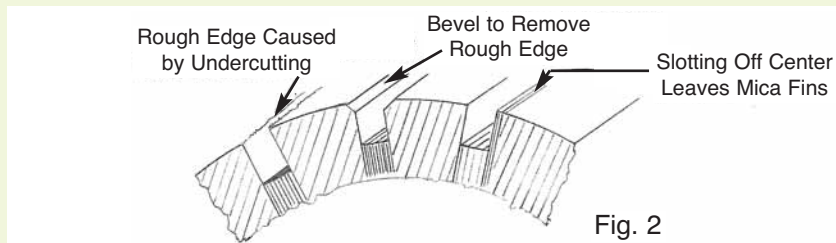
(Mica Undercutting Saws & V-Cutters) (Continued)

U-SLOT

The U-slot (as shown in Fig. 1) is generally preferred if the slots are accessible for easy cleaning. These slots have the advantage, if done carefully, of being effective until the commutator has worn down the full depth of the undercut. The slot should be cut to a depth of 1/32 (.032) inch, or not more than 3/64 (.046) inch. If cut too deep, accumulated dust will not be thrown out by the centrifugal action of the rotating commutator.



When using a circular cutter, the width of the cutter is chosen to exceed slightly the thickness of the mica. It is recommended that the **SAW THICKNESS** be figured on the basis of the mica thickness plus .003" (.08mm). This will allow the saw to remove the full width of the mica plus .0015" (.04mm) of copper on each side of the mica slot. If unable to determine the mica width, the use of a feeler gauge can best determine the required saw thickness. Consequently, some copper is cut or dragged off the bar during undercutting, (as shown in Fig. 2).



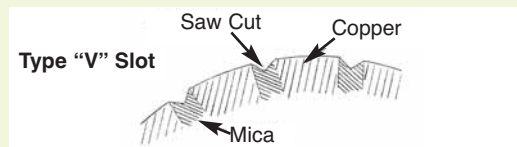
In addition to leaving a jagged edge projecting from the commutator bar, the edge of the bar becomes somewhat work-hardened and hence will not wear down uniformly. Therefore, the edges of the bars must be chamfered by using a suitable slotting file or a specialty shaped scraper. ** See Martindale slotting scrapers. **

A chamfered face of approximately 1/64 inch is usually adequate to remove any roughness or edge hardening that could be disturbing to the brush faces.

V-SLOT

V-slots keep slots free from dust accumulations at low speeds, and do not require a separate operation for chamfering of the bar edges. V-slots are usually made with either a slotting file, or a "V" tooth circular cutter.

Usual practice is to use a circular cutter having an included angle between cutting edges such that a cut made 1/16 inch deep will also leave 1/32 inch free copper above the mica. The "V" tooth circular cutter are available with 40°, 50° or 60° angles between the cutting edges.



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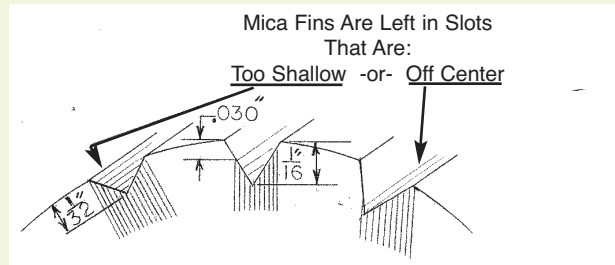
Helpful Hints For Saw Users

(Mica Undercutting Saws & V-Cutters) (Continued)

To obtain a 1/16 inch deep cut with 1/32 inch free copper above the mica, the following table may be used:

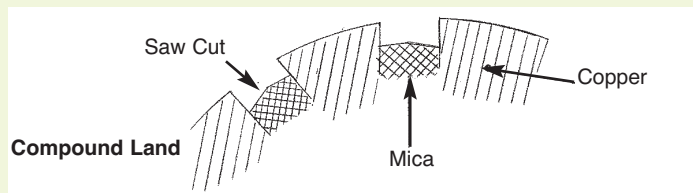
| Thickness of Mica | Angle of "V"-cutter |
|-------------------|---------------------|
| .023 inch | 40° |
| .029 inch | 50° |
| .036 inch | 60° |

The necessity of accurately centering the circular cutter on the mica is readily apparent. Mica fins in V-slots being wedge-shaped, are more difficult to remove than the fins of uniform thickness left at the sides of U-slots by inaccurate centering of the circular cutter.



COMPOUND LAND

The teeth on the compound land mica saw are alternately ground to a special taper which reduces the impact on each individual tooth and produces chips of just slightly over half the width of the mica slot thereby eliminating the tendency to clog. When undercutting with a compound land saw the bottom of the slot will appear to be flat. However, as a result of the reverse taper on alternate teeth, the slot will have a slight pyramid or convex surface. This type of saw operates cooler and cleans better thereby prolonging the saw life with resulting economy to the user.



After a commutator has been undercut, it should be very carefully inspected to assure that all copper particles have been removed, that the bars have been carefully chamfered, and that all sharp edges and burrs have been eliminated. Then each slot should be individually checked and reworked as necessary to remove any traces of fin or side mica.

Finally, the surface should be lightly polished with a fine-grain commutator stone. **A more popular method is the use of a rubber bond cleaning stone, which will properly finish the surface and leave the proper filming required.



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11/07