Adjustable**Reamers**
by TOOL**FAB**

PROPER USE, ADJUSTMENT, SHARPENING & GRINDING INSTRUCTIONS

Proper Use

A reamer is primarily an end-cutting tool for finishing holes within close limits. It is designed to remove only a small amount of stock. Never use a reamer as stock-removing tool.

The hole should be prepared for reaming by previous drilling or boring operations that have removed all but a few thousandths of an inch of the stock.

The stock left in the hole for finish reaming should not exceed .012 inch on the diameter. When heavy feeds are used, removal of only .003 inch to .004 inch on the diameter is preferable.

Reaming is a sizing or scraping operation. Consequently, a reamer cuts slightly larger than its diameter in direct proportion to the amount of stock removed. Attempts to remove too much stock will result in over-sized or rough holes.

Reaming speeds should be kept relatively low. Low speed gives the chips a chance to curl away and permits the reamer to cut freely , instead of tearing the metal. Excessively high reaming speeds cause chatter. When necessary, to obtain high production rates, the feed can be stepped up more safely than the speed.

Most of the stock left for reaming is removed by the lead. The hole is sized by the full diameter at the cutting point. From this point back, and the blade is tapered for clearance.

Adjustment

Adjustment of McCrosky Adjustable Reamers is quick and simple. Just follow the six steps below:

1. Grip the reamer in a vise. Loosen the screws just enough to take the extreme locking tension off the blades (1/8-turn is sufficient). Tap the blades ahead with a hammer and soft punch.
2. With a spanner wrench, turn the blade collar so that it moves toward the blades (3/4-turn = .003˝ expansion on the diameter; one turn = .005˝; 1-1/2 turn = .008˝).
3. With a spanner wrench, advance the locking collar until it bears firmly against the blade collar.
4. Tap the blades back against the blade collar with a soft hammer.
5. Loosen the screws a half-turn and then re-tighten them by tightening one screw after another only a slight amount at a time so as to distribute the locking pressure evenly. After the screws have been completely set, tighten the locking collar again and tap all blades lightly against the blade collar with a soft hammer. The adjusted reamer is now ready to be sharpened (see sharpening instructions below).
6. After sharpening the reamer to the correct diameter, grind off the ends of the blades until they extend only half the thickness of a blade beyond the reamer body.

Sharpening

Sharpening of a reamer consists of three distinct grinding operations: circular grinding, backing-off, and putting on the lead. All sharpening should be done on precision grinding machines to keep the cutting edges concentric, thus ensuring that all the blades cut evenly. Tool Fab offers this service to you – see the **Tool Refurbishment Services** section of this catalog.

The reamer should be circular ground in a cylindrical grinder. This operation gives the blades a slight back taper for clearance in the hole.

Backing off and putting on the lead should be done on a cutter grinder. A cup or dish wheel should be used and the reamer should be mounted so that the wheel will turn against the cutting edge.

Grinding for general-purpose use

In most shops handling short runs on a variety of work, the reamer must be a general-purpose tool, sharpened with a simple grind so that the reamer can pass from job to job without regrinding.

This grind can be used when the nature of the work does not justify developing a special grind to suit a particular job. It is also suitable for rough reaming steel and tough bronze.

The back-taper diameter is less than the cutting diameter by .001˝ for each 1˝ of blade length. Blades are backed off close to an edge and the lead angle must also be relieved to permit the lead to cut freely. The diameter across the heel of the blades is .003˝ to .005˝ less than the cutting diameter.

The lead angle is 45°. This angle is suitable for removing varying amounts of stock, permits reaming close to a shoulder, and makes starting the reamer

Reaming speeds for various materials

TABLE A

Surface speed, surface feet per minute (SFM)

MATERIAL TO BE REAMED	HIGH-SPEED STEEL	CARBIDE
Aluminum	750	1500
Brass, soft	125	475
Bronze, hard	100	325
Bronze, very hard	40	170
Cast Iron, soft	65	200
Cast Iron, hard	40	175
Cast Iron, chilled	N/A	150
Malleable Iron	85	310
Steel, soft	75	200
Steel, medium	65	165
Steel, hard	40	125

TABLE B

Constants for converting surface speed (SFM) to spindle speed (RPM)

REAMER DIAMETER (inches)	CONSTANT	REAMER DIAMETER (inches)	CONSTANT
3/4	5.08	4	0.95
7/8	4.38	4-1/4	0.89
1	3.82	4-1/2	0.84
1-1/8	3.40	4-3/4	0.80
1-1/4	3.06	5	0.76
1-1/2	2.54	5-1/4	0.72
1-3/4	2.18	5-1/2	0.69
2	1.91	5-3/4	0.66
2-1/4	1.70	6	0.63
2-1/2	1.53	6-1/4	0.61
2-3/4	1.39	6-1/2	0.58
3	1.27	6-3/4	0.56
3-1/4	1.17	7	0.54
3-1/2	1.09	7-1/4	0.52
3-3/4	1.02	7-1/2	0.50

HOW TO USE ABOVE TABLES

Problem: Determine the RPM for reaming a 2-inch hole in hard cast iron using a reamer fitted with carbide-tipped blades.

Solution: From Table A, hard cast iron using carbide-tipped blades, SFM=175. From Table B, a reamer 2 inches in diameter has a constant of 1.91.

Calculation: 175 x 1.91 = 334 RPM

in the hole easier. Length of the lead is 1/16″, which is just enough to let the reamer start cutting easily.

Basic grind with two leads, with variations for different metals

When reamers have a slight second lead angle (behind the stock-removing 45° lead) they produce a smoother finish and can cut at heavier feeds than a reamer ground with a 45° lead only. The slight angle of the second lead causes the blade to cut a very thin chip at the point where the lead breaks into the full diameter of the reamer, eliminating tear marks and producing a smooth finish.

The grind has a second lead angle behind the main lead angle. Varying this angle makes the grind suitable for reaming various metals. An angle of 3° produces the proper cutting action for reaming cast iron, soft bronze, aluminum, and most of the nonferrous metals. An angle of 5° or more produces the proper cutting action for reaming steel, malleable iron or semi-steel, and prolongs tool life without seriously affecting the finish.

The 45° lead should not be longer than is necessary to allow the reamer to start easily in the hole. A length of 1/32″ to 1/16″ is usually sufficient.

The length of the second lead angle must also vary for different metals. For steel it should be kept short, approximately 1/16″. This short length is necessary to prevent formation of a wide chip. For cast iron, soft bronze and aluminum, length can be increased to as much as 1/4″. Both lead angles should be relieved to permit the reamer to cut freely.

The back-taper diameter should be .001″ less than the cutting diameter depending on the size of the reamer and the kind of metal. Soft, stringy metals require maximum clearance on the heel.

The land helps guide and steady the reamer in the hole and aids in eliminating chatter. For cast iron and bronze, a land width from .005″ to .015″ is recommended; for steel and copper, .020″ to .030″. For aluminum, the blades should be backed off to an edge, with practically no land.

When a relatively wide land is used, the maximum back-taper should be used to definitely provide clearance in the hole. Any adhering of the chips to the land–producing a rough hole–indicates that the land is too wide and should be reduced.

Lipping blades for reaming soft, stringy metals

Lipping the blade to produce a chip rake improves the reaming of soft, stringy metals such as in steel tubing, steel forgings, copper, aluminum, and other non-ferrous alloys.

The rake may follow a straight line, but it should meet a radius at the bottom to curl the chip. The rake angle increases with the softness of the metal being reamed. For steel tubing and steel forgings the rake angle should be about 5°; for copper and aluminum workpieces, it can be as much as 10°. If the reamer "picks up" on the cutting edge or produces a torn surface or rough hole, the lip should be increased. Careful experimentation by the user will develop the degree of lip best suited to an individual job.