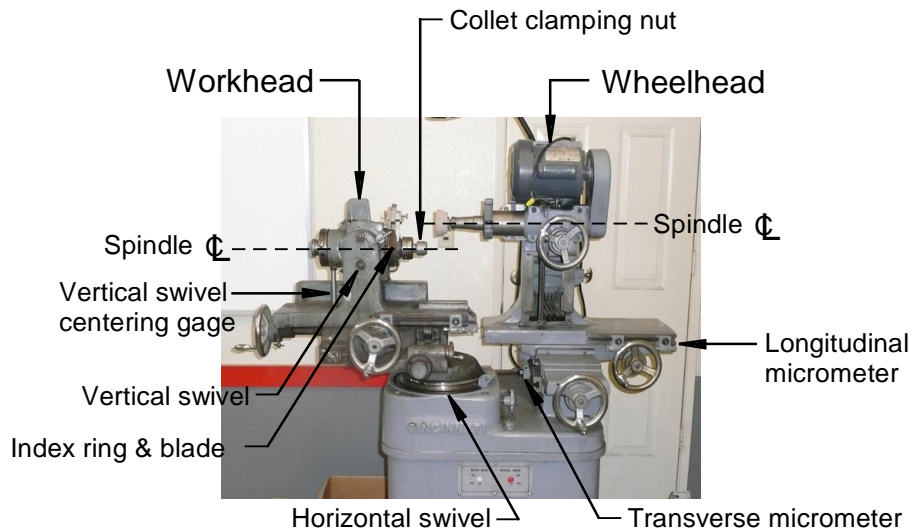# SHARPEN END OF END MILL

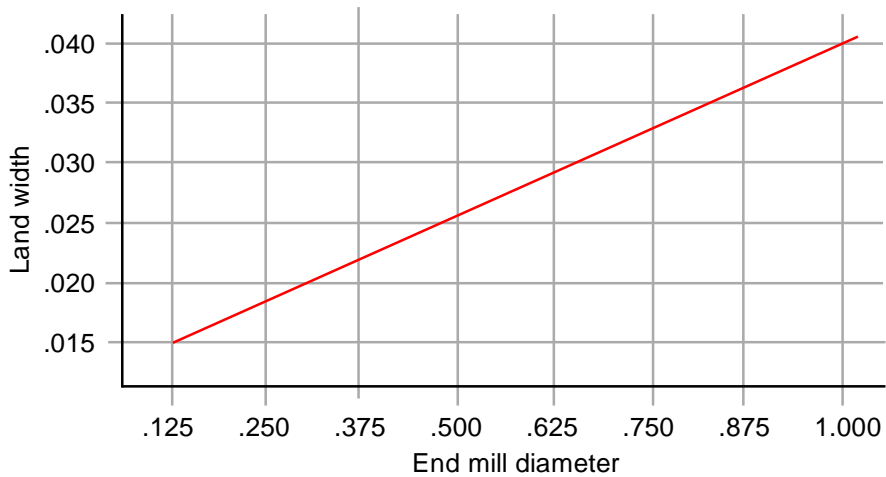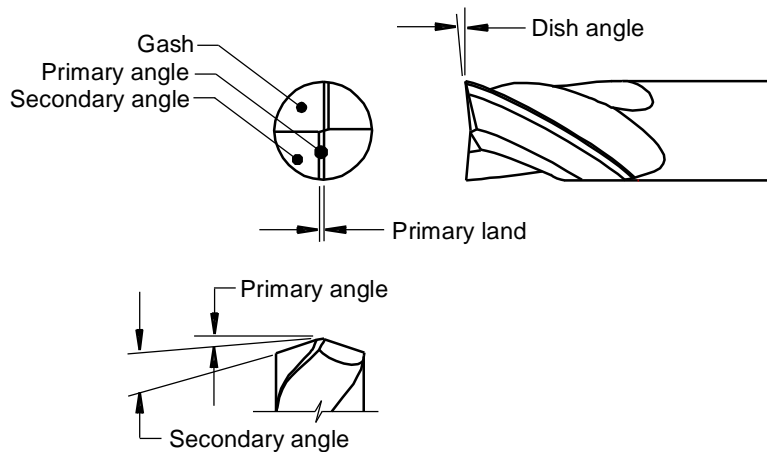## By George Pruitt

Revised 3-5-13

The following instructions are for sharpening the end of an end mill with a Monoset tool and cutter grinder.

A guide to determine the primary cutter angles are shown below for selected materials.

Low carbon steel ---------------------------- 5 to 7 degrees

High carbon and allow steels ------------- 3 to 5 degrees

Cast iron --------------------------------------- 4 to 7 degrees

Brass --- 10 to 12 degrees

Aluminum ------------------------------------- 10 to 12 degrees

In the machining hobby we generally machine low carbon steel, cast iron, brass and aluminum. Two flute end mills are sharpened to cut brass and aluminum (10 to 12 degrees). Multiple flute end mills are sharpened for steel and cast iron (5 to 7 degrees). The secondary cutter angle is 10 degrees greater than the primary angle. Primary land width should be between .015 and .030 depending on end mill size. The dish angle for all end mills should be 1 to 2 degrees.

Gash
Primary angle
Secondary angle

Dish angle

Primary land

Primary angle

Secondary angle

Land width

.040
.035
.030
.025
.020
.015

.125   .250   .375   .500   .625   .750   .875   1.000

End mill diameter

Grinding Wheel

The grinding wheel will generally be a 60 grit, H, I or J grade and vitified bond. The sharpest tool edge is generated by grinding away from the tooth edge. Grinding toward the tool edge is permissible but will require stoning the burr from the tool cutting edge. The grinding wheel must be trued and dressed to ensure proper tool sharpening.   Truing is generally done with a mounted diamond. Dressing is normally done with an abrasive stick.

Step 1 – A small hollow (concave) is required on the end face of the end mill. This is essential so the cutter only contacts the workpiece at the outer ends of the cutting teeth.   This feature is produced by grinding a dish angle on the end of the cutter. Rotate the workhead horizontal swivel to the specified dish angle and lock in place.
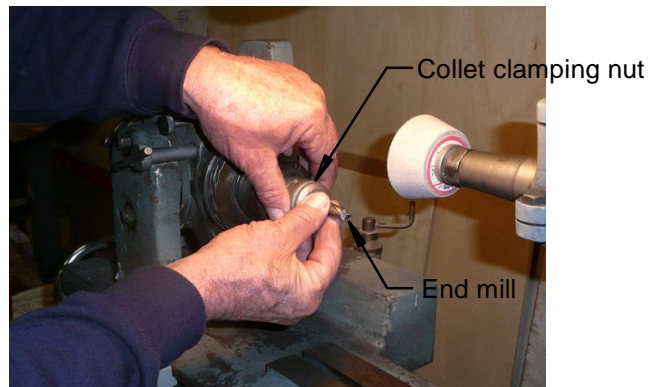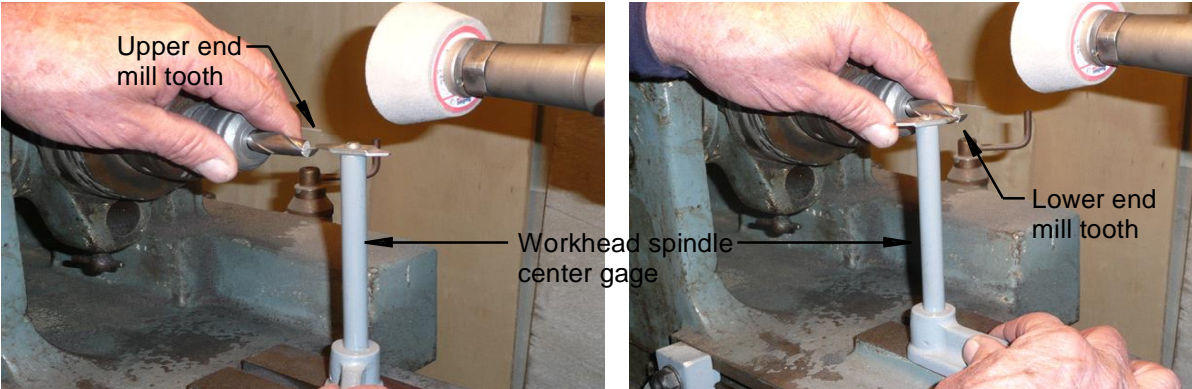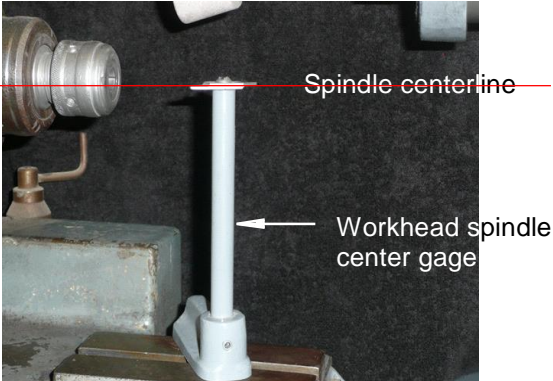

1 - 2 Degrees

Step 2 – Adjust workhead to horizontal position using the wheelhead vertical swivel centering gage and lock in place.   The workhead center line is now parallel to the wheelhead center line.
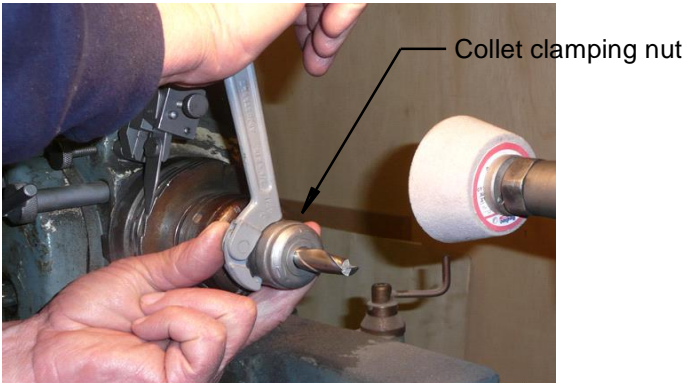

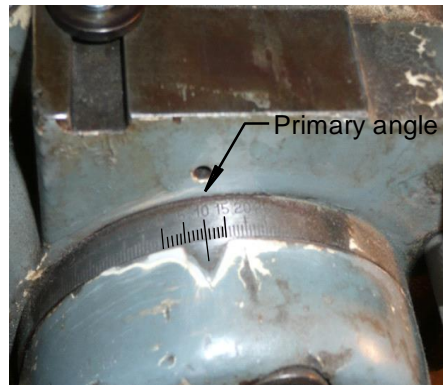Step 3 – Place end mill in the collet. Hand tighten collet clamping nut.

Step 4 – Using the workhead spindle center gage, adjust the end mill cutting edges to be parallel to the table.

Step 5 – Tighten the collet clamping nut to secure the end mill for grinding.

Step 6 – Rotate workhead vertical swivel to the primary cutter angle and lock in place.

Two flutes 10 - 12 degrees
Multiple flutes - 5 - 7 degrees

Step 7 – Adjust the grinding wheel vertical location to be approximately at center line of the end mill cutting edge height. Turn grinding wheel on and bring the grinding wheel in contact with the end mill. Make minimum contact.
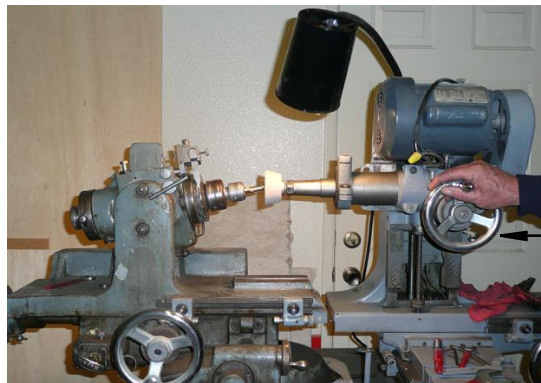

Step 8 – Adjust the right longitudinal micrometer against the stop and lock in place.


Bring the grinding wheel toward the front of the machine until the grinding wheel makes contact with the center of the end mill. Lock the transverse micrometer stop. Reverse the grinding wheel movement until the grinding wheel clears the end mill.

Step 9 – It is helpful to color the area you will be grinding with a felt tip pen. This allows you to see and measure the area you have ground. Mark the complete end of the end mill with a felt tip pen.
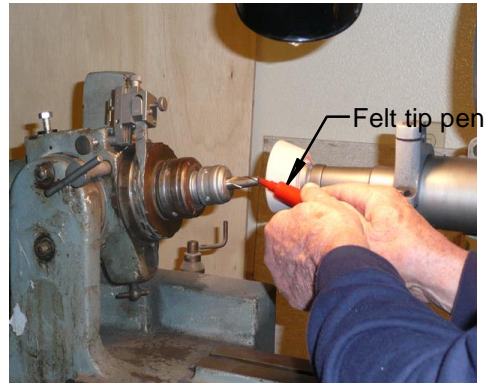

Step 10 – Grind .002 material from the end mill cutting edge using the longitudinal micrometer adjustment.

Step 11 – The workhead has an indexing ring to allow the cutter to be rotated to the proper angle to grind the additional cutting edges on the end mill.
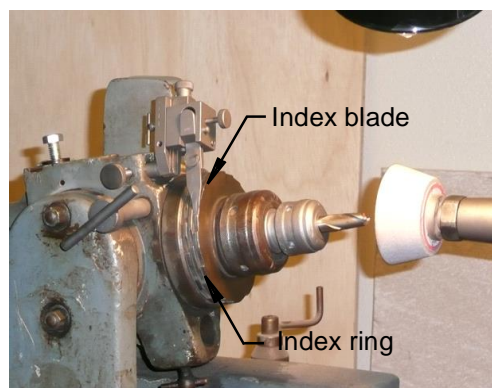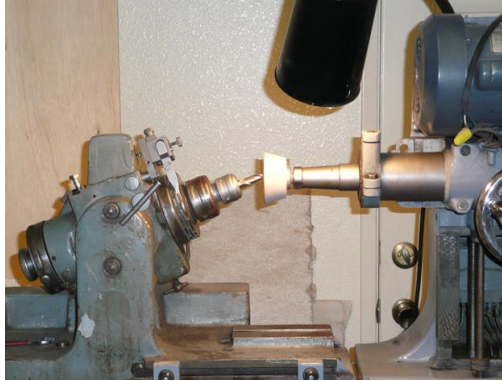

 Rotate the workhead spindle 180 degrees using the index ring and blade (for 2 flute end mill). Lock the spindle.   Grind the second cutter edge.
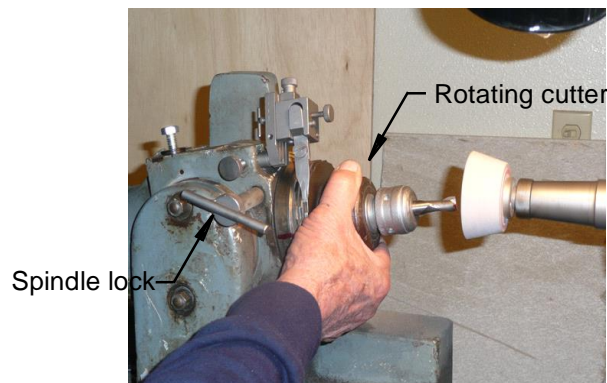
Continue this process at .002 increments until the primary cutter edges are completely ground and sharp at the intersection with the outside diameter of the end mill.

Step 12 – If the width of the primary land is within the specified width, the sharpening process is complete.

Step 13 – If the primary land exceeds the specified width, a secondary angle 10 degrees greater than the primary angle is ground on the end of the end mill to narrow the primary land to the proper requirements. Repeat steps 6 through 11 to produce the correct primary land width.

The sharping process is complete.