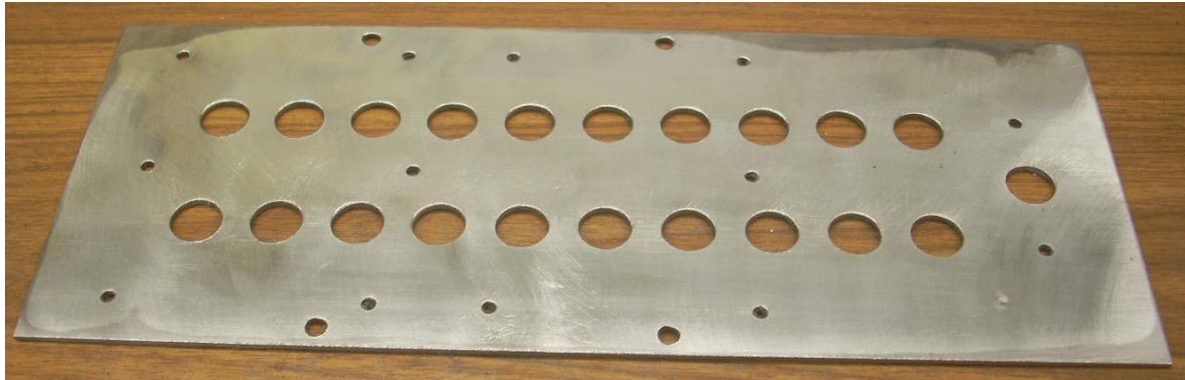# Machining a Plate

By R. G. Sparber

Copyleft protects this document.[1]

Recently I had the need to make this plate. It is 14 gage steel. I own a mill/drill equipped with a Digital Read Out which makes the task rather enjoyable. This article walks you through the job.

I will need to use an end mill, small drills, and a ½" drill. With planning, I can do all of this without having to raise or lower the mill head. Disturbing the head takes time and requires me to reestablish my XY reference point.

Here you see my drill chuck being trial fit. I own a very nice keyless chuck but it is too long.

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[1] You are free to copy and distribute this document but not change it.

On the left is the end mill I plan to use. On the right is my beloved, but too long, keyless chuck. My ½" drill held in the keyed chuck is too long but I can use a ½" collet for that operation.

I tested the drill chuck with the longest small drill attached.

OK, the end mill with holder fits.

Notice all of the clamps. At any time, I must have at least 2 clamps on the plate to minimize the risk of it being snatched by a cutter and flung across the room. I prefer to set the minimum at 3.

Also notice that the plate is resting on a piece of Medium Density Fiberboard. This lets me machine through the plate and not damage the cutter or table. The MDF's faces are parallel to within a few thousandths of an inch so plenty good for this application.

After rough sawing the plate to about 0.1" oversized and deburring, I dyed the perimeter and scribed layout lines to be sure I had enough margin on all sides.

Then I trial clamped it down and ran the cutter along the X axis to verify the alignment was good enough. Once clamped, the plate will not be moved again until I am done. In this way, all machined features will be referenced to the same point and axes.

You might be able to see the front scribe line.

I will start cutting on the back edge from right to left because I want to do "conventional" side milling. The cutting force opposes the movement of the table which prevents grabbing. Had I used "climb milling", the cutter would periodically grab at the plate and yank it faster into the edge.

When I do cut this edge and Before moving the Y axis, I will zero my Y axis taking into account the diameter of the end mill. This establishes my Y axis zero point.
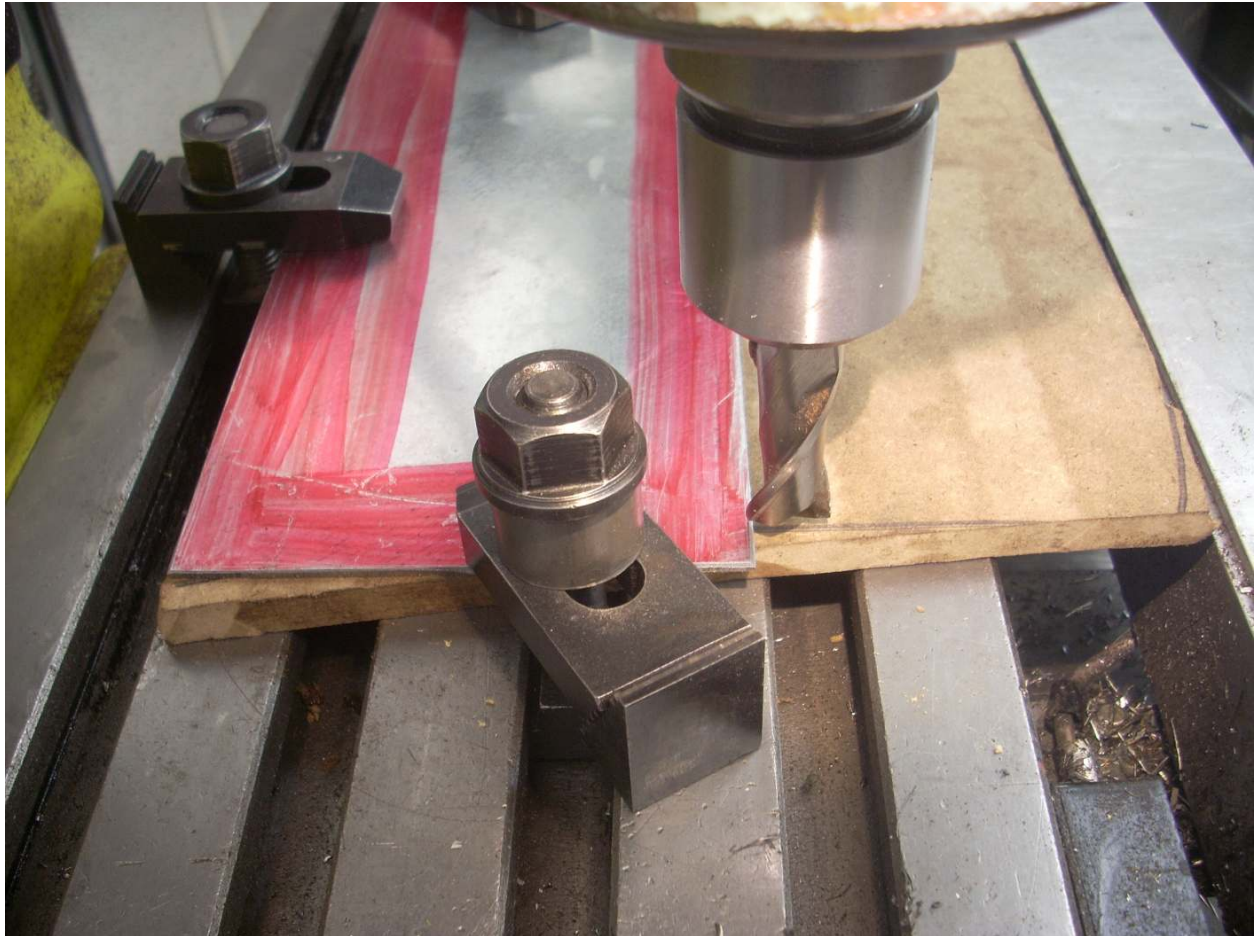
When I get to the left end of the back edge, I will start to feed the table in. The end mill then side cuts the left edge. I will move the clamps as necessary to stay out of the way of the cutters. This MUST be done with the machine off.

Before moving the X axis, I will zero my X axis taking into account the diameter of the end mill. This establishes my X axis zero point. My back left corner will then be my (0,0) point. All features will be machined relative to this point.

After finishing the left edge, I will start down the front edge. I will be going left to right so am will be doing conventional side milling. The exact position of the table along the Y axis is known from the shop drawing. I must remember to compensate for the diameter of the cutter since the cut edge will be the radius of the cutter away from the center of rotation.

I have two clamps to move before I can cut the right edge. This edge will be cut relative to my (0,0) point.

The pictures shown so far were my dry run passes. It is essential to trace out the cutter path to be sure there are no surprises. I do not want to have to move the plate once machining starts.

Here you see the mess made by the end mill as it cuts a little of the MDF. Use a brush to remove the sawdust. There is a very ragged and sharp edge hidden in there.
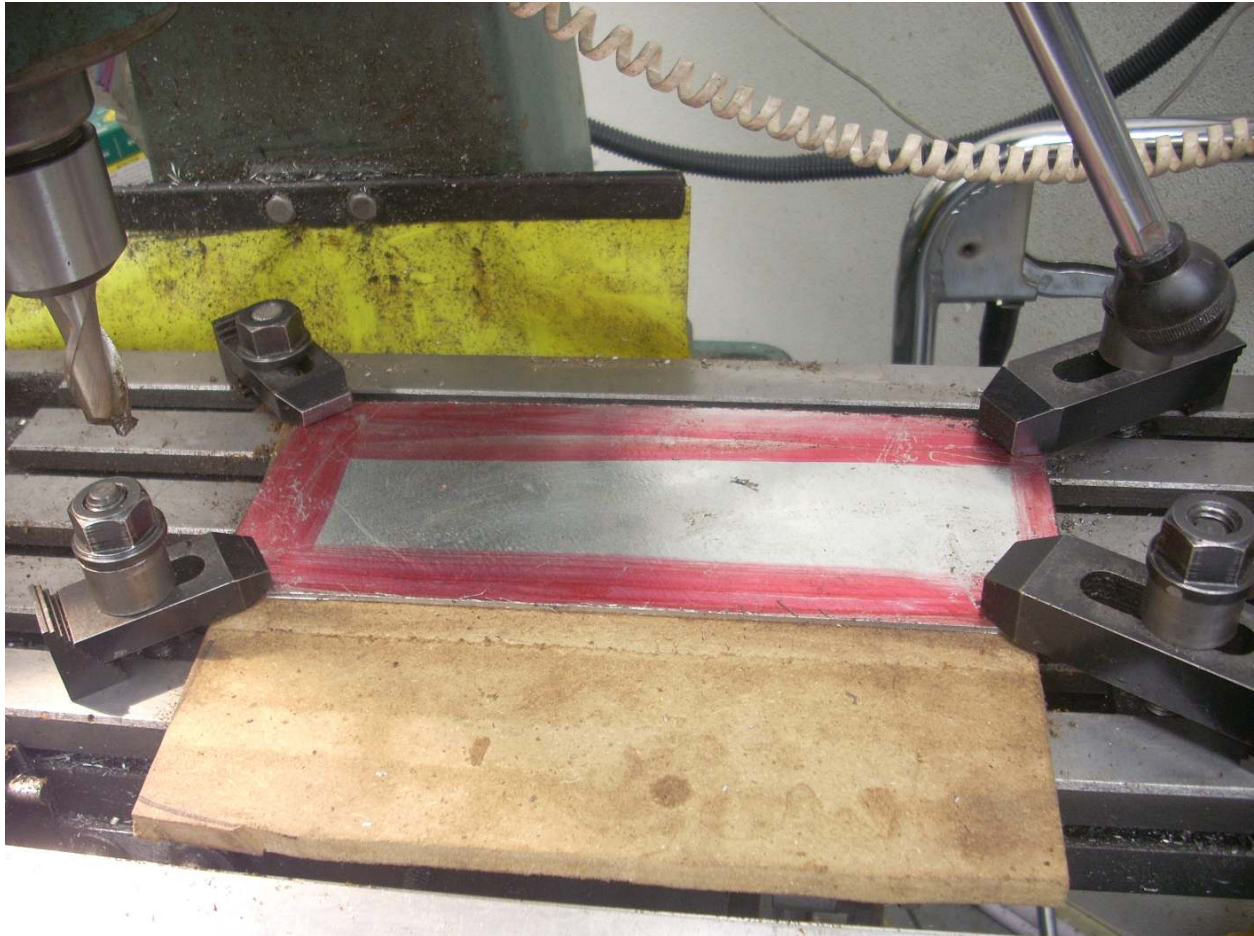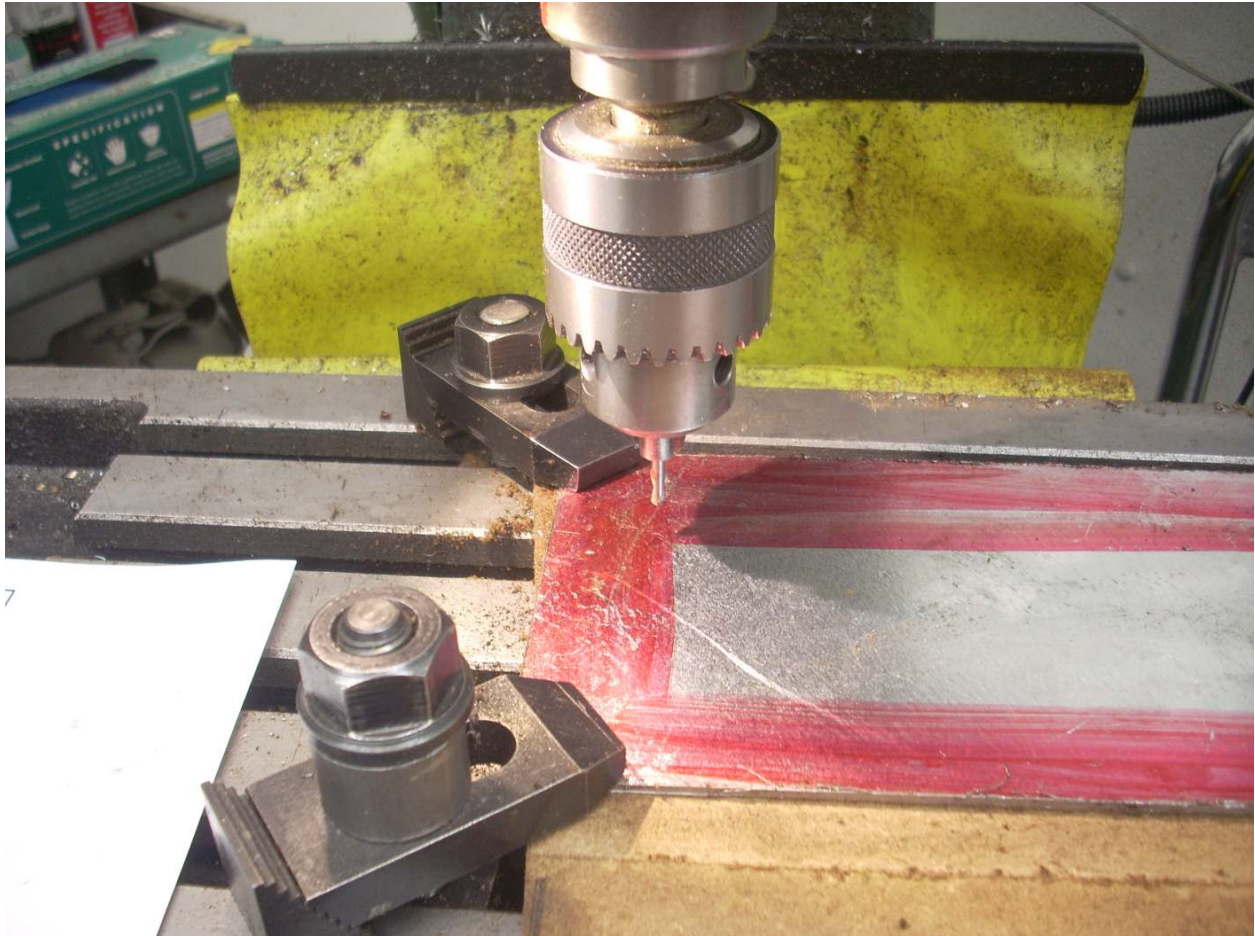
The perimeter of the plate has now been machined. In preparation for drilling, I have added a forth clamp. These clamps have been positioned to avoid most of the holes to be drilled.
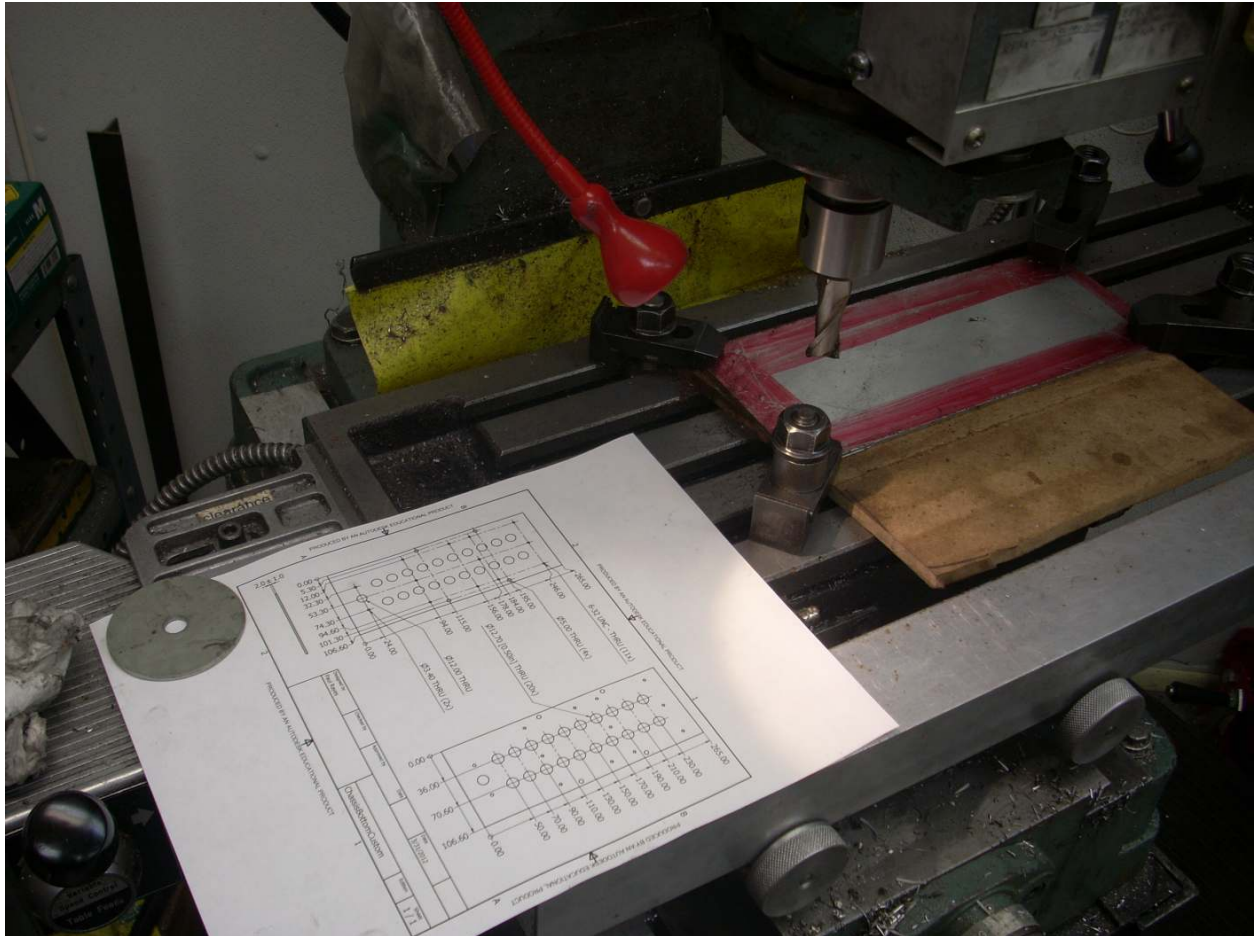
The shop drawing was placed right on the mill table. I want to minimize the chance of making a mistake.

After cutting a feature, I check it off on the drawing.

I used an 1/8" spotting drill on each small hole before going to the small drill. This doubled my effort but insures that the drill does not wander as it starts to cut.

With all of the small holes done, I removed the chuck and installed a ½" collet. Then I put in my ½" drill. It is stiff enough not to wander much. These large holes are for passing wires so their exact location is not critical.

One of the holes was a little smaller than ½" and I did not have a collet to hold it. Instead, I drilled the pilot hole on the mill. When all done with the plate, I removed it from the mill and brought it to my drill press.

Along with the clamp, I was lightly holding the plate so I could tell if it started to move. If the drill did snatch the plate, I would be out of the way. The large clamping surface plus downward force worked well and the last hole was cut without commotion.

The plate has been machined but not deburred yet. That *is* red dye and not blood.
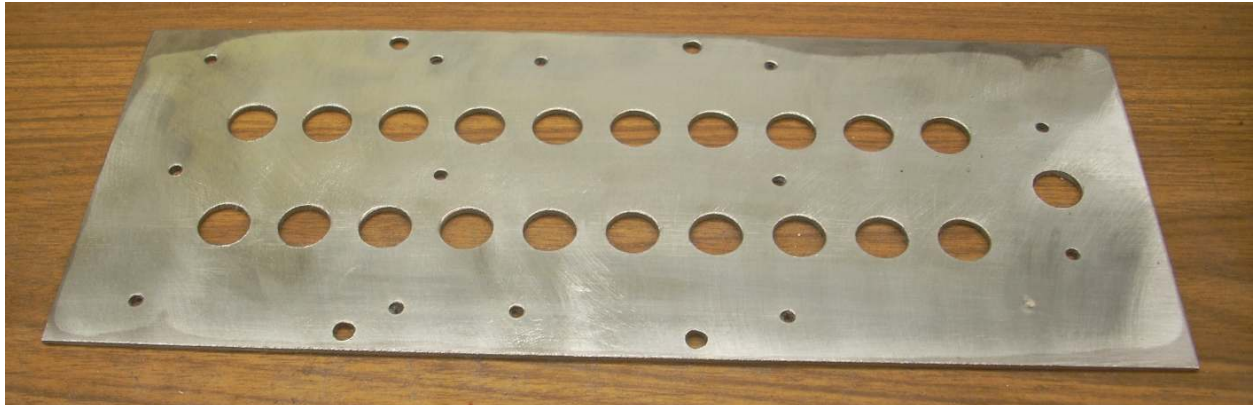
I chose to use my belt sander and a wire wheel to deburr the plate. It should take a coat of paint nicely.

I welcome your comments and questions.

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