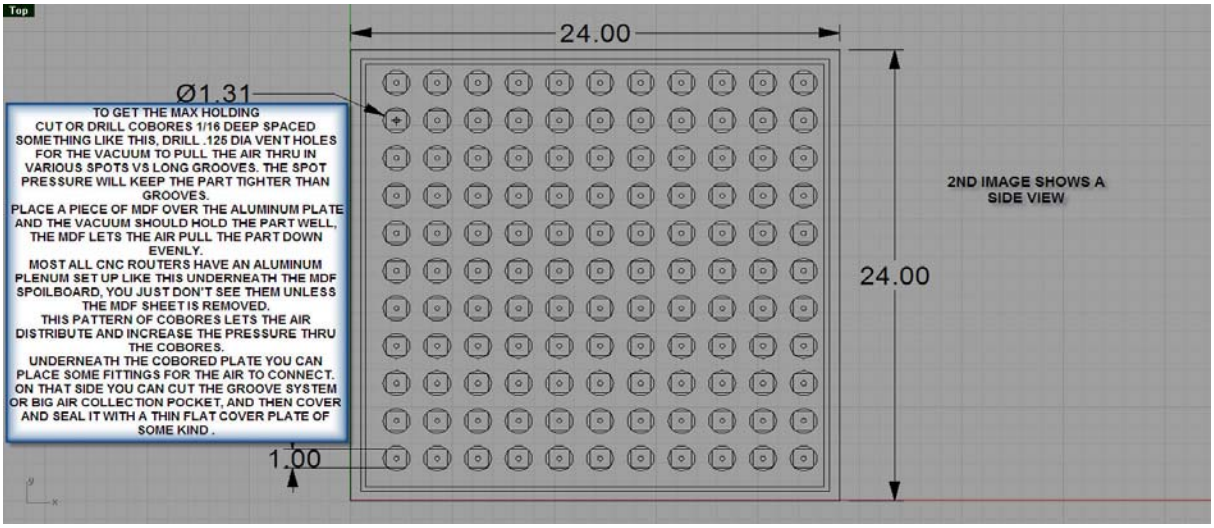
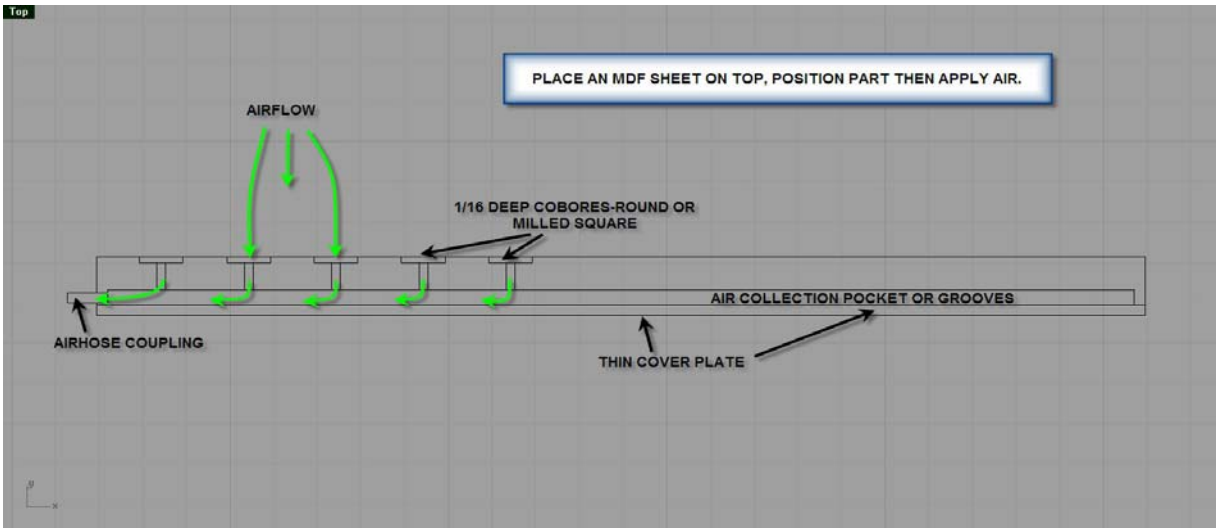
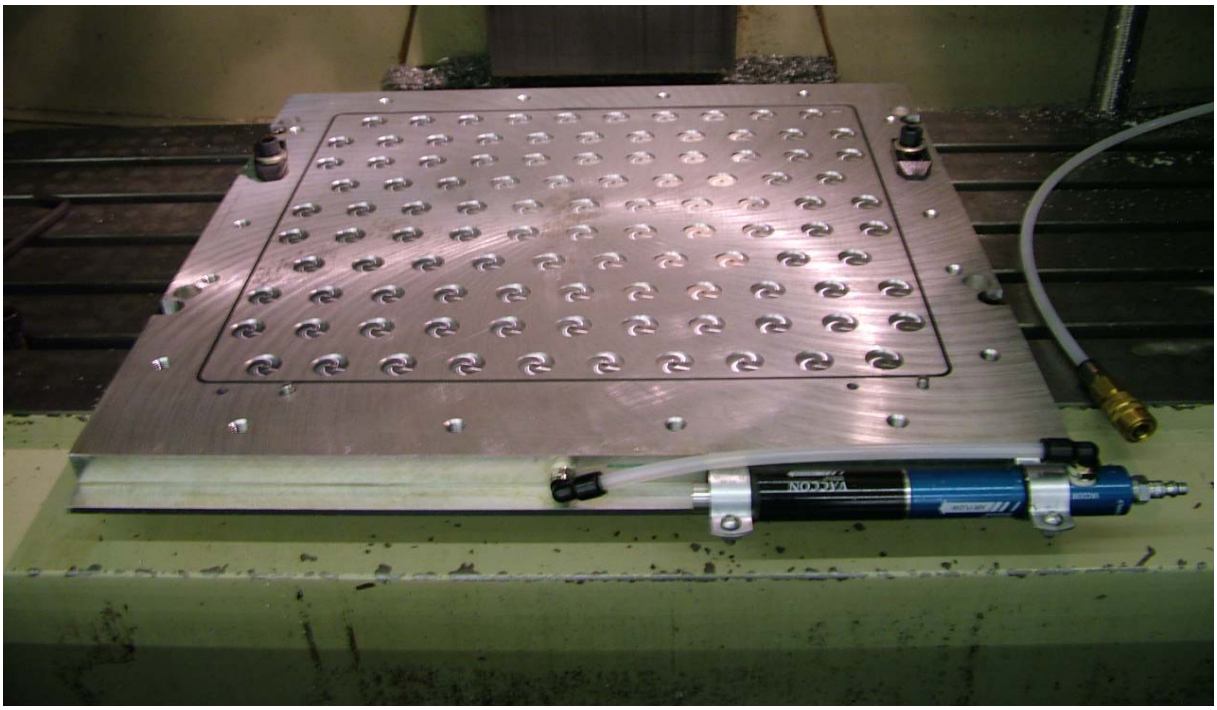
Here are sketches that explain the concept of a vacuum fixture (courtesy of Mike Gailey). I started with these, but modified the design to suit my application. The sketches say to use MDF on top as a spoil board, but this would not work for me because I planned to use my fixture in a standard VMC using water-based coolant. I decided to place my work piece directly on top of the fixture and to use a rope style rubber seal around the perimeter to seal the vacuum.

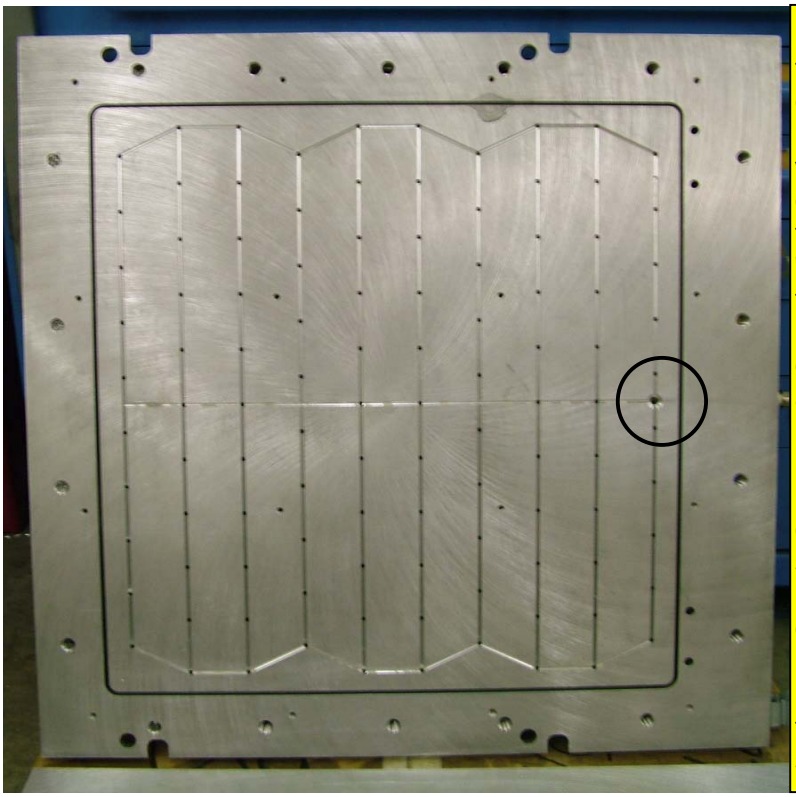
I suggest you give careful thought and planning to your fixture because it may come back and bite you later, as it did to me. I will elaborate later.





Here's a picture of the finished fixture mounted in our VMC. The black rectangular groove around the circular pockets was milled with a 1/8 ball-nose end mill, about .090" deep. I have a 1/8 diameter EPDM rubber cord tucked into the groove. It is soft enough to fully compress with vacuum applied to the fixture. There is an identical grove in the bottom of the plate, which seals the vacuum chamber between the two plates. I used neoprene rubber cord in this groove for longevity. There really isn't a chamber; I milled a network of groves to connect all the vent holes.



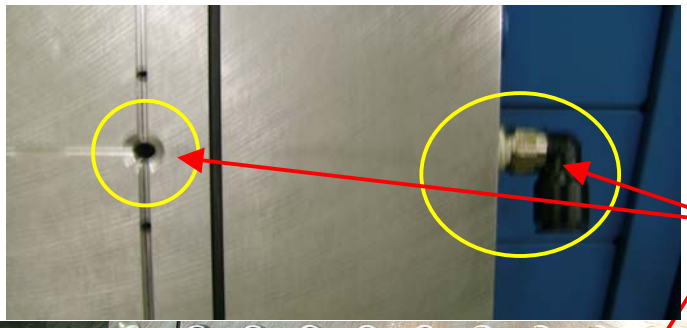


Here's a picture of the bottom of the main fixture plate. The connecting grooves don't need to be too extensive. In fact, for a venturi style vacuum pump like the one I used, it is beneficial to keep the total volume of the vacuum "chamber" to a minimum - less air for the pump to evacuate resulting in a quicker clamp time. My fixture generates full holding power within a few seconds.

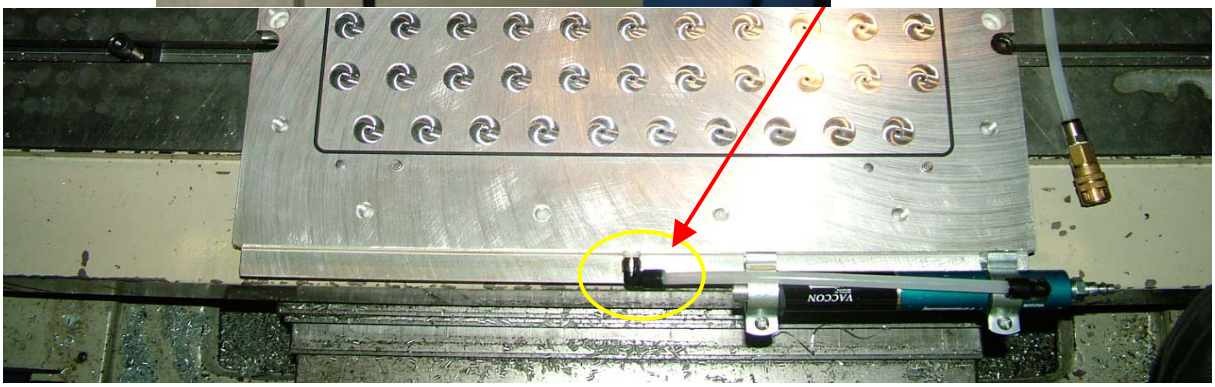
For the grooves I used a 1/8" ball nose end mill 0.062" deep. For the o-ring I went 0.125" deep and stepped it over .014" because the neoprene o-ring material is 0.139" dia.

Note the 1/4" hole drilled 5/8" deep to intersect with the vacuum port shown on the next page.

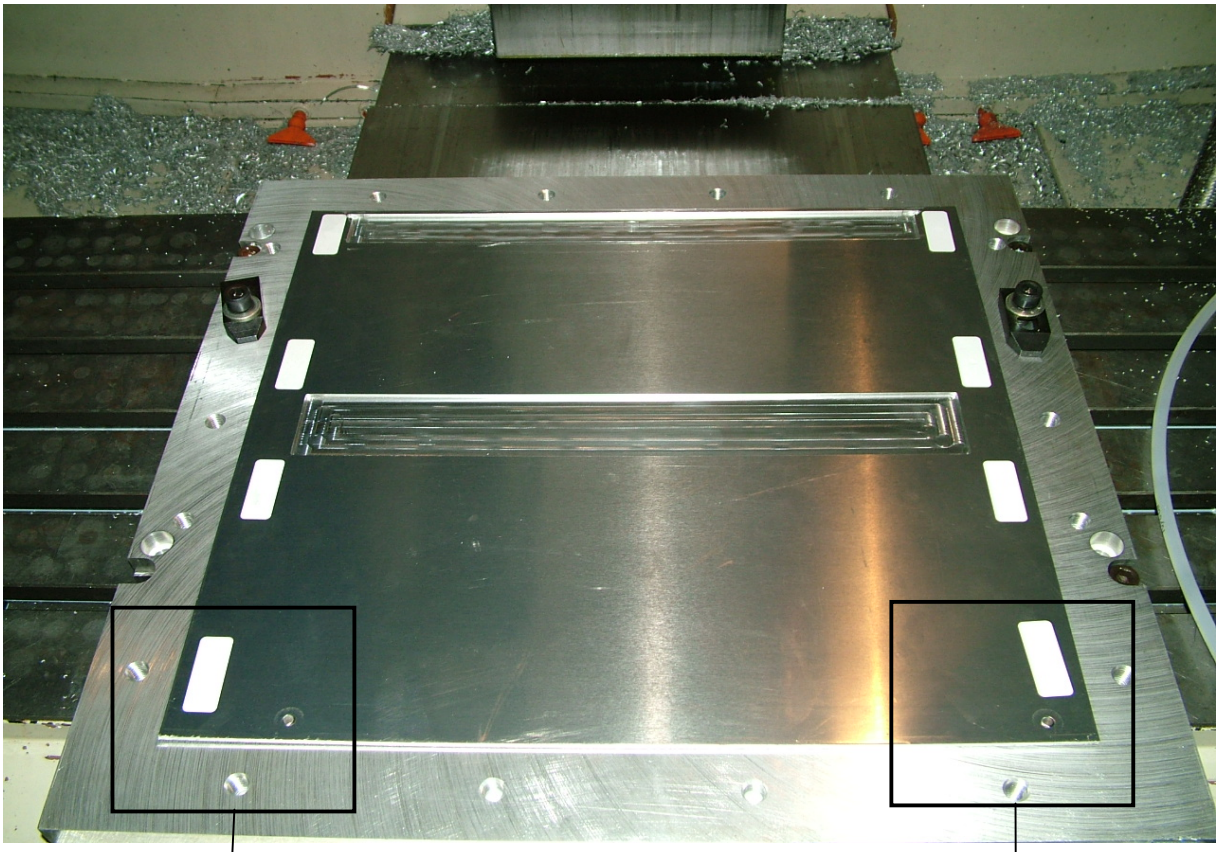
Another couple of pics of the fixture detailing where the intake port is. This hole was drilled and tapped by hand - no great precision necessary, just be careful to avoid breaking into any opening which would cause a vacuum leak!



Vacuum intake port and connecting hole in bottom of fixture.



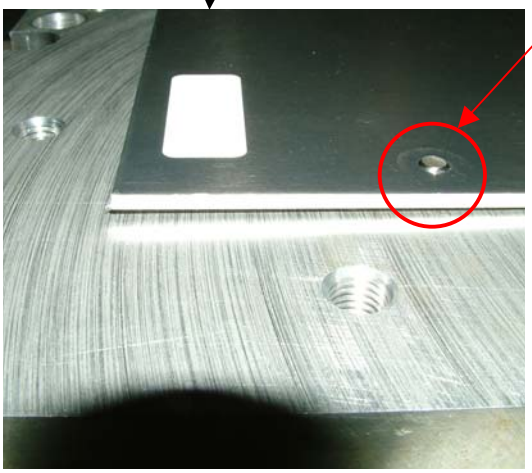
Here's a picture of the bottom plate. Just a .250" thick piece of precision ground aluminum with mounting holes and slots machined into it. I used precision ground stock to ensure parallelism. I used 8-32 screws to hold the plates together.

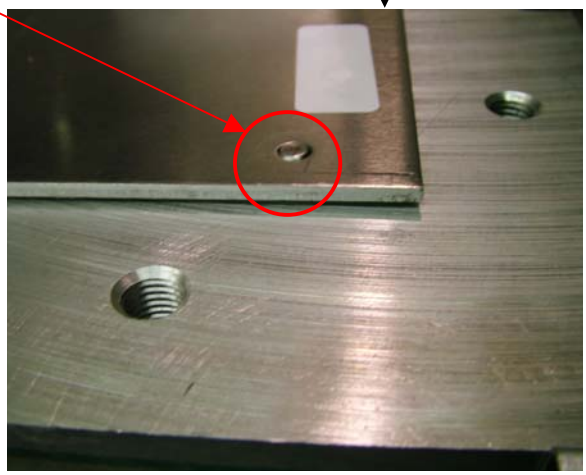


Here's a part laid on the fixture. This part is already machined as evidenced by the two pockets, which are .120" deep in the .156" thick material. Notice the curvature inherent in the part. Total bow is .050 - .100" across the part, a distance of about 20".

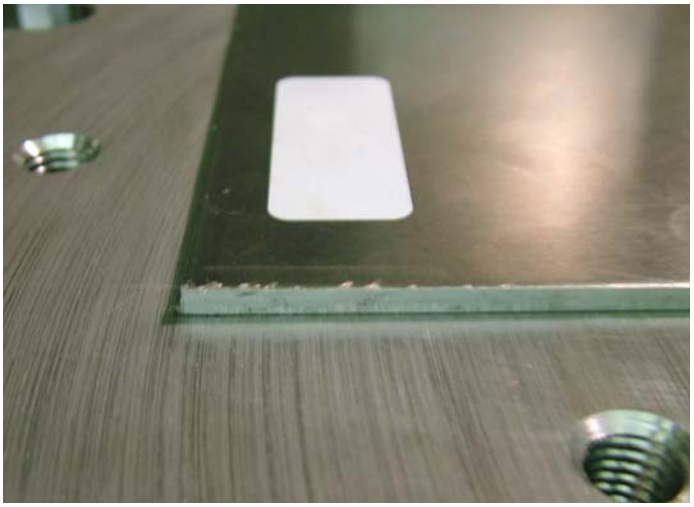
The white rectangular shapes are tape I applied to cover holes that are milled through the blank. This is one area where I didn't plan well enough ahead. Will elaborate some more later.

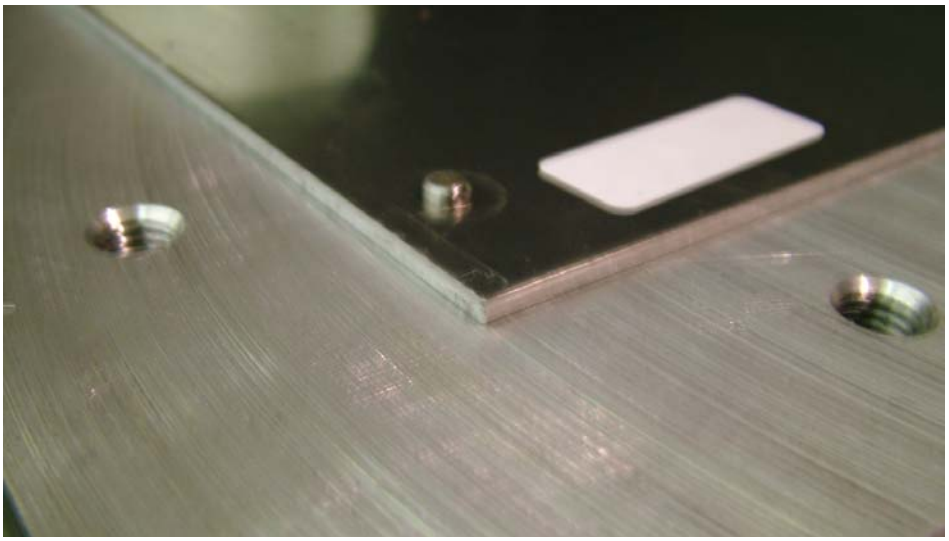
The two holes are locating dowels for gaging the blank on the fixture.

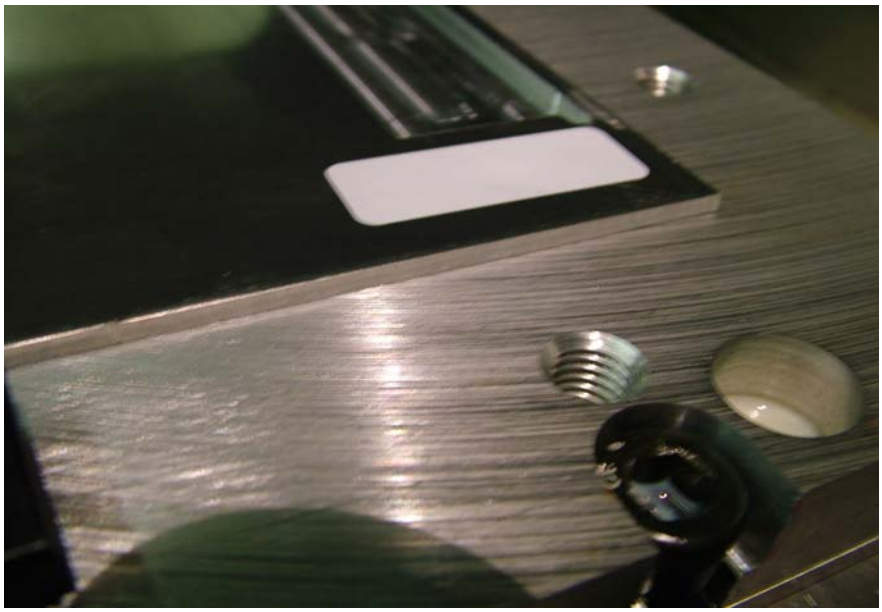




A few different views of the part pulled down flat after the vacuum was applied. You CANNOT pull the part off with your bare hands!





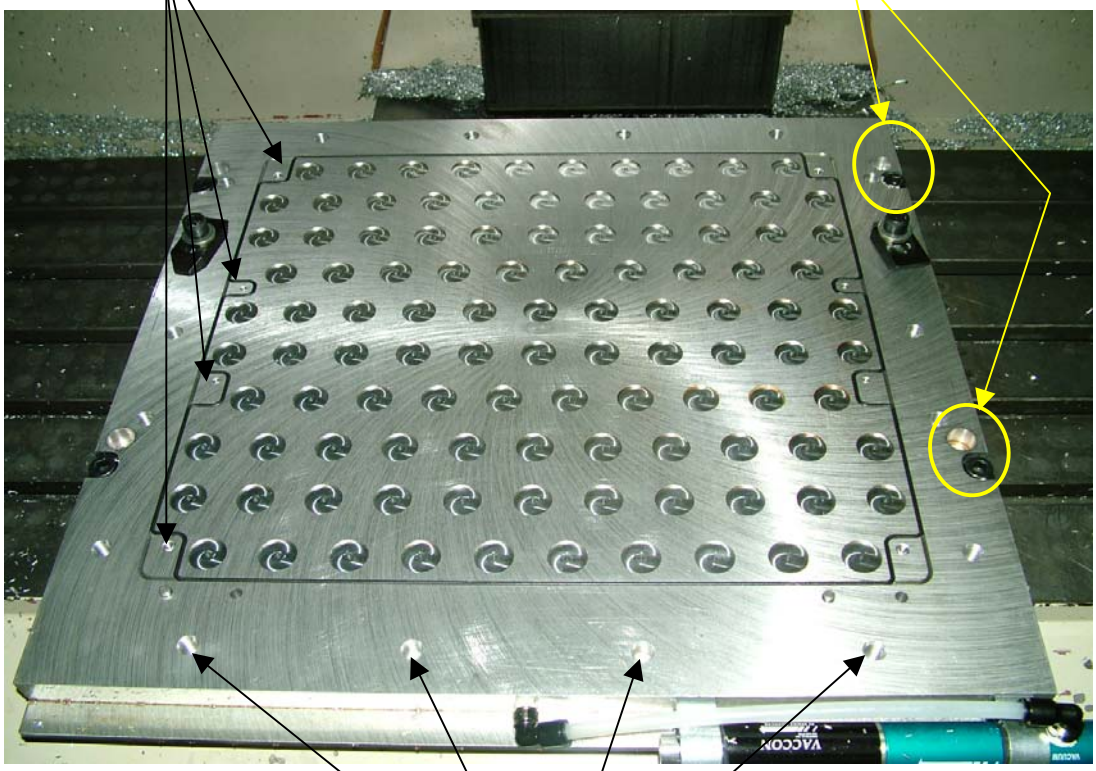


OK here's some more details to consider when designing a vacuum fixture.
For your benefit I am illustating some things I could have avoided if I had planned better.

I re-milled the seal groove to go around the holes that get drilled through the blank. This way the vacuum seal is not broken, and no tape is necessary to seal the holes on the blank, as in the pics on the previous page.

I could have avoided re-milling the groove with better planning.

In regards to the fixture mounting holes, I did not properly take into account how the part would be layed out on the fixture. I had to mill new slots that would allow me to push the fixture back in order to reach the full area needing machining on the blank (the holes that get drilled through the blank - not shown in the pics).



I drilled and tapped a series of 1/2-13 holes around the perimeter for clamping, because I wasn't sure how much holding power the fixture would have. Actually I only needed two (where the clamps are in the pic). The clamps are NOT for holding the part down flat, but rather just keep the part from moving sideways under a milling load.

What's the problem with the extra holes? They fill with coolant and splash back into your face when blowing the part off.

Another view of the part on the fixture. After re-milling the seal groove, the tape covering the holes in the blank was not necessary.

This is the Venturi Vacuum pump purchased from http://www.mcmaster.com/
The p/n is 9997K27 @ $204.00

It is rated at 28" Hg with a free Air CFM of 20.0

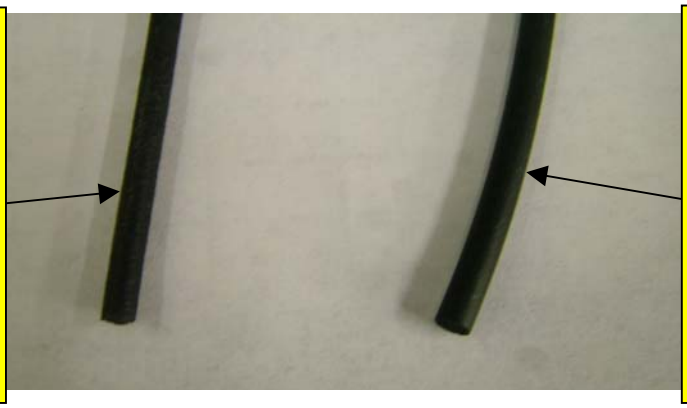
I was really surprised it would draw the part down so firmly!

These are samples of the 1/8" dia. rubber seals also purchased from http://www.mcmaster.com/

Top seal under piece part:

mcmaster p/n 8605K41

@ $10.95 / 100 feet Weather-Resistant EPDM Foam Rubber Cord 1/8" Diameter, 100' Length



Seal between the two fixture plates:

mcmaster p/n 12975K33 @ $.23 / ft.

Neoprene O-Ring Cord Stock 1/8" Fractional Width, .139" Actual Width