



Mini Vacuum Table

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Introduction

Material hold down is vital to getting successful results from a CNC router. Vacuum systems allow for quick and secure hold down, but can add complexity and expense to the system. For repetitive part making a high pressure low volume vacuum system provides fast part changes in a small efficient package. This kit is designed to be as simple and economical as possible while maximizing the holding pressure for production applications.

Hardware

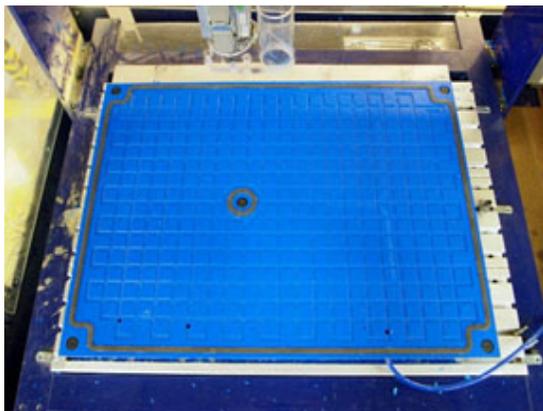
Part Name	Qty	Part #
Becker Vacuum Pump 0.3 hp		003991
Blue Poly ¼ vacuum tubing	3'	002704
HDPE Sheets (24 by 18 inch)	2 sheets	003971
Vacuum Gauge 0-30" Hg		000053
Push-in Connector 1/4 Tx1/4		002657
Street Tee ¼ NPT FMF		002612
Medium Density In-board Gasket		003693
Power cord with inline switch		004160

Vacuum Plate Design

The first step in using the vacuum is creating a custom vacuum plate specific to the part being produced. The primary components of the vacuum plate design are the gasket slot, the plenum grid, and the vacuum hole. Additionally, some parts or fastening methods may require blocked regions with an additional gasket.

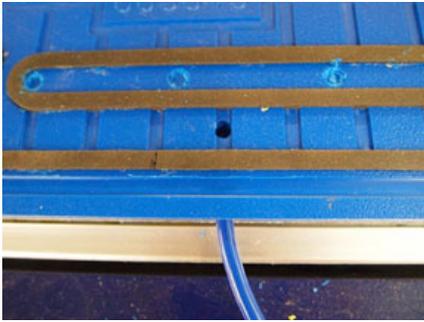
Gasket Slot

The gasket slot is a 1/4" wide by 3/16" deep groove that houses the neoprene gasket material. The outer edge of the slot should be inset about 1/8" from the edge of the part. Corners should have a radius of no less than 1/2".



Plenum Grid

The plenum grid allows a vacuum to occur within the area enclosed by the gasket. It's best made with the same 1/4" bit cut to a depth of 1/16". Spacing of the plenum grid should be approximately 1". The grid can extend to the gasket slot but should not extend past the outer edge.



Vacuum Hole

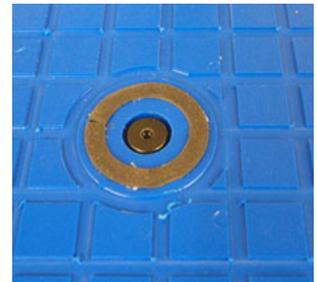
At least one 1/4" hole must be drilled to a depth of 5/16". Some applications will require more than one vacuum hole and airline for adequate airflow.

In a separate operation, drill a 1/4" hole in the side of the plate. These two holes must connect to allow airflow into the vacuum line.

Additional Gaskets

Each plate will need enough attachment locations to prevent warping and securely hold it during machining operations. It is best to screw the vacuum plate to the CNC table. For large pieces it can be helpful to add a hold down location inside the plenum area. Simply add a gasket slot around the hole.

Parts with large central through cuts will require an additional gasket. Offset the gasket slot 1/8" from the edge of the central profile. Alternatively, a thin layer of material (called an onion skin) could be left in the central region.



Vacuum Plate Mounting

There are two primary ways to mount vacuum plates. The intended use and tool type will influence the method to be used. In both cases the size and spacing of the mounting area should be taken into account when designing the vacuum plate.

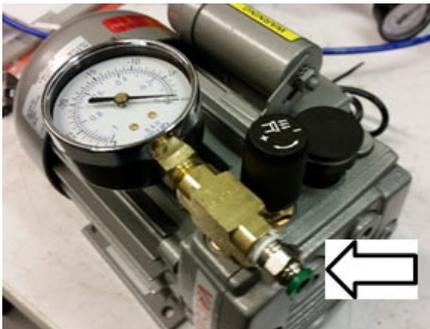
Direct to T-Slot Deck

This option applies to the Desktop tool and any tables that have been fitted with aftermarket T-slot rails. It is a good option for full time use of vacuum plates in production operations. Direct mounting allows quick swapping from one plate setup to another. Note that the T-slots on Desktop tools have 1/2 inch spacing so the plate hold down holes should be placed accordingly.

Vacuum Connection

Vacuum Placement

Position the vacuum near the tool to avoid excessive vacuum line length. Make sure it's located where the on/off switch can be easily manipulated.



Connect Vacuum Line

Insert one end of the vacuum line into the pump quick connect fitting. For later removal, push in on the plastic ring fitting and then pull out the vacuum line.

Route the vacuum line to the plate and trim to an appropriate length. The line should have some slack, but should not be excessively long to prevent vacuum loss.

Insert the vacuum line into the side hole on the plate. The tube should slide in with light resistance. Once the vacuum is activated the line will compress and seal.

Part Design Considerations

X and Y Zero Location

The zero location of the part can be at the standard table X, Y zero position or the corner of any specific jig. If doing the setup from the standard point, it's important to make sure the offset distance for the part matches the plenum area in real space. An air cut test can verify this offset. To do an air cut, zero the Z-axis using the ZZ command a set amount (often 1") over the normal Z zero level and run the part file.

If there are multiple fixtures on one table it can be helpful to zero to the bottom left corner and use the keypad memorized location buttons to get to the starting point for any specific jig.

Z Zero Location

Zeroing the part file to the base of the work (plenum top) will give the greatest control over depth of cut relative to the spoil board. This avoids excessive or insufficient through cuts. Additionally, a one-time zeroing operation on the vacuum plate will allow for slight variance in the thickness of the work stock during the entire part run.

Zeroing to the top of the material is best reserved for parts when the cutting depth into the material is critical. Examples of this include V carving, and precision machining. When setting up a part file this way, measure the work stock and program its thickness into the design software.

Note: When zeroing the bit to the top of the material, make sure the vacuum is on and the workpiece is flush with the vacuum plate. If this is not done, the compression of the gasket will alter the Z height.

Through Cuts

The part file should not have any through cuts into the plenum area. Piercing the plenum area will greatly reduce the vacuum pressure holding down the workpiece. This could result in the workpiece coming loose while the machine is cutting causing faulty parts, broken bits, and flying debris. Refer to the "Additional Gaskets" section to review plate design options.

Tabs

Tabs are short sections of material left that hold the workpiece to the scrap after a through cut. This prevents scrap from kicking out, potentially damaging the workpiece or bit. Because the vacuum supplies most of the holding power, tabs do not need to be as numerous or large as when using screws or clamps for hold down.

Operation

Once set up, the vacuum system is very simple to use. Place the workpiece on the plate, ensuring that the entire gasket is covered. Turn on the vacuum. The piece should pull down against the neoprene gasket to be flush with the plate. Test the seal by pushing sideways on the workpiece. Once the workpiece is in place and tested, the part file can be run. When the file is complete, turn off the vacuum to release pressure and remove the workpiece.

