# WORK HOLDING STRATEGIES

To get a clean and accurate cut with the CNC router, the workpiece must be held so it does not move. Two forces act on the workpiece as it is being cut – lateral and vertical. Several different strategies can be employed to resist these forces – vacuum, adhesive or mechanical.

## VACUUM

Vacuum work holding relies on atmospheric pressure acting upon the surface area of the workpiece, as well as friction between the workpiece and the spoil board. Slick workpieces are much harder to hold than rough ones. Small parts are also more difficult to hold. Normally vacuum hold down is used with full sheets of plywood or particle board. The spoil board is usually MDF. The vacuum can be pulled through the MDF, since it is quite porous.

In order for vacuum hold down to work, leaks must be minimized. This includes leaking along the edges of the spoil board. The edges can be painted to seal them when the spoil board is prepared, or adhesive tape can be placed on the edges to seal them. Plywood is rarely flat. It often resembles a potato chip, being warped in multiple directions. To 'pull a vacuum' on plywood, it must be pressed down and have tape applied all the way around the perimeter. The tape must bridge the gap between the plywood and the spoil board. Tape is not usually required for particle board, especially if it is coated with melamine.

During cutting, if cuts are made clear through the workpiece, vacuum will begin leaking through the cut area. If this area becomes large enough, the vacuum pressure will become to weak to resist the cutting forces or the warp of the workpiece and the cut piece will move. Tabs can be used to keep the small cut piece attached to the entire workpiece to prevent movement. Another strategy is to leave an 'onion skin' on the workpiece. With this strategy the cuts do not go all the way through the workpiece, but a skin of about .005" is left. This prevents vacuum leaks and keeps the parts attached to the entire workpiece. A flush cutting router is used to trim the pieces. This strategy works best with a 3/8" or larger bit.

## ADHESION

Adhesive work holding employs either double stick tape or adhesive tape and super glue. Double stick tape is quick and easy, but not very strong. I usually use this in conjunction with stop blocks placed around the perimeter of the workpiece to prevent lateral movement. Adhesive tape and super glue gives a firmer hold. It better prevents lateral movement, but it can fail if the cutting forces are too large, or the cut part is too small. Tabs can be used to help hold the cut part in position. I normally use this method with thin workpieces (3/8" or thinner) and 1/8" diameter bits. A 'downcut' bit can be used to prevent the uplift forces from the router bit. Shallower cuts (diameter of the bit, max) helps lessen the uplift force as well.

To use the super glue and adhesive tape:

- Place wide tape strips on the spoil board that match strips on the workpiece.
- Put dots or a line of super glue on the spoil board tape, being careful to keep it well away from the edges
- Carefully position the work piece over the spoil board tape as press firmly for 30 seconds
- Stops can be placed around the perimeter for extra holding force

**MECHANICAL**

The most secure hold down strategy is mechanical, either clamping or using screws through 'scrap' areas of the workpiece. **This method is only to be used on the small, red router**. Several cautions accompany screws as the hold down method:

- Only use screws 3/8" to ½" longer than the thickness of the workpiece. Do not use 'really long' screws.
- Drill large enough holes in the workpiece so the screws 'slip through' the holes. Otherwise, the screws will grip the workpiece, and will hold it up away from the spoil board.
- Use enough screws to hold the workpiece flat on the spoil board. (I normally use one screw in each corner of the workpiece)

Clamps can be used for workpieces that do not have 'scrap' areas. Several cautions apply here:

- When screwing clamps to the spoil board, do not use overly long screws.
- Ensure that the clamps do not intrude into the cut path of the router bit.
- Set the 'safe height' in SheetCAM to a larger value than the height of the clamp above the workpiece.
- Consider using some stops along with clamps to prevent lateral movement of the workpiece.

When the entire surface of the workpiece will be milled, a combination of methods can be employed. Double stick tape along with stop blocks is a common method. The tape resists vertical cutting forces, while the stop blocks resist lateral forces.

Live edge slabs require multiple strategies as well:

- First use shims to support the slab level on the spoil board
- Then place stop blocks around the perimeter of the slab. Block with beveled edges can be used to provide hold down force to the slab.
- Drive wedges between the slab and the stop block to tighten the grip on the slab.
- The weight of the slab is great enough to counteract any uplift force from the cutter. Since the cutting teeth are perpendicular to the face of the slab, very little uplift force is generated.

Sometimes creative strategies are needed. Just remember to:

- Not use overly long screws
- Ensure that the 'safe height' of rapid moves is greater than the height of any clamps used
- Employ some method to counteract both the vertical and horizontal cutting forces
- Make shallower cuts to reduce cutting forces, especially with larger diameter bits