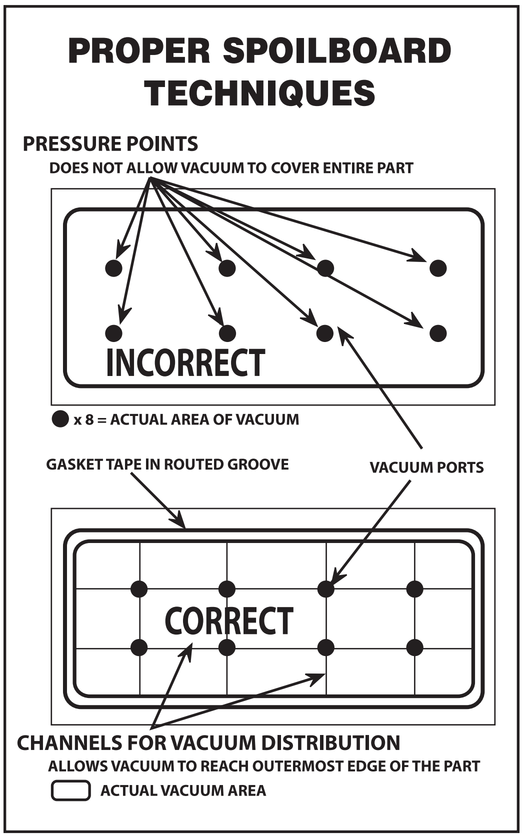
FIXTURING/SPOILBOARD TECHNIQUES

Many times CNC routers are set up almost perfectly with the right tools, elaborate vacuum systems, and somehow the method of holding parts on the table receives little attention as the key element in the operation. If there is anything that can really enhance the success of an application, it is the ability, to *properly* hold a part during the machining operation. There are many machines utilizing dedicated spoilboards to hold parts. The proper way to build a dedicated spoilboard is often misunderstood or cut short in the interest of time to construct them. Investing the time to do it correctly will pay dividends in the form of productivity. Many consider a spoilboard as an adequate fixture if it is just a piece of MDF or particleboard with self-stick weather-stripping and a few holes drilled inside the perimeter. While this type of fixture has worked a long time for many people, it does not often satisfy the demands made in high performance routing. If the router is going to run at production speed, the parts have to stay on the table or the tools are going to break!



DEDICATED SPOILBOARDS

There are many problems associated with this shortcut method. First, as the workpiece is suspended on the tape above the spoilboard, the part may vibrate causing holding problems, poor part finish, and tool breakage. The use of weather-stripping is totally inadequate.

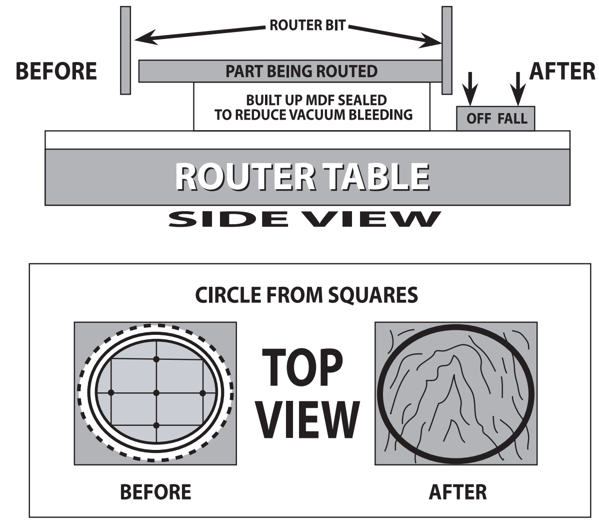
Weather-stripping is an open cell construction and after a short period of time, the tape will collapse and limit the gasket's effectiveness, especially with slightly warped parts. A quality closed cell gasket tape must be utilized to properly build a dedicated spoilboard. Closed cell does have a "memory" capability and is really important to avoid vacuum leaks and subsequent part movement. Some end-users go a step further by routing a groove to receive the vacuum tape. While this may allow the workpiece to contact the spoilboard, it also closes off the vacuum holes limiting the vacuum only to the area of these holes.

Better production techniques include routing a channel to receive the gasket and grooving the interior area of the gasket perimeter. The channel for the gasket tape is typically 1/2 of the thickness of the gasket tape. This allows the tape to be above of the spoilboard initially to assist in creating the seal on the workpiece. When the vacuum is applied, the gasket tape is forced into the channel allowing the workpiece to make contact with the "plate" of the table which provides better part registration and better part holding. Grooving or sectional pocketing of the interior area of the gasket perimeter allows the vacuum to reach the outermost portion of the part. This also allows a greater vacuum surface area. Without grooving, the interior of the vacuum area is equal to the area of the diameter of the holes once the part is vacuumed down onto the table. Now with the part contacting the "platen" providing surface adhesion and the vacuum area distributed throughout the part, you have the best chance to secure the part at production routing speeds. The workpiece contacting the "platen" is especially valuable when skin or tab cutting because of the consistent part registration.

Additional measures should be taken to seal the spoilboard material if porous material like MDF is used. By sealing the spoilboard, you minimize the chance of leakage and direct all available vacuum to holding the workpiece. Sealers such as polyurethane, sanding sealer, and rubberized coatings should be applied after the channeling and grooving is complete. Sealing the spoilboard will also help stabilize the spoilboard so that it will remain flat throughout its life.

RAISED SPOILBOARDS

Raised spoilboards are another type of fixturing that works quite well for routing parts such as circles from squares where the scrap or off-fall is of such a size to be potentially harmful to the tool and the operator when it is cut free. This is often encountered in parts where a two-pass operation is performed. Such is the case with a bar stool top where a first pass would rough out the part with a chipbreaker tool and a final pass would be taken with a 3-edge finisher or a shape tool if a shaped edge is required. A raised spoilboard would make sure that the off-fall would not interfere with the first or the second tool and that the off-fall would be free and clear of the tool path.



ALLOWS WASTE PARTS OFF FALL TO DROP CLEAR OF TOOL
COMMON EXAMPLES; LIDS, SEAT BOTTOMS, CHAIR PARTS

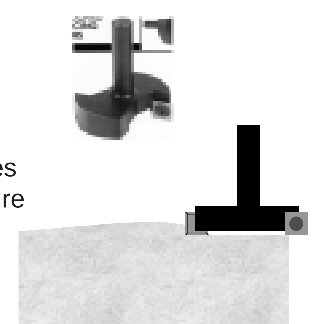
FLOW THROUGH VACUUM

Flow through, which is also referred to as high volume or suck through, is another technique gaining in popularity due to minimal set-up time. This method relies on LDF (Low Density Fiberboard) or MDF (Medium Density Fiberboard) porous enough to allow a large vacuum pump of 16-40 HP to actually draw through the board. This method is not effective on all machines due to special design of the vacuum plenum that distributes the volume throughout the surface of the table. This method is popular with cabinet and store fixture operations where short run parts of sheet goods materials are common. It is also used for sheet plastics machining. And lastly, it has become the staple operation of the upholstered furniture manufacturers and boat manufacturers allowing numerous parts to be cut and up to 80% yields from single sheets of plywood. This method can be successfully employed but can be problematic with small parts. Consequently, the cutting of wood parts utilize downcut spirals to intentionally pack the chips into the cut and minimize vacuum loss through the open table area created by routing. This strategy sustains more heat in the tool but allows the packed chips to minimize movement by acting as space fillers until the cutting cycle is completed. Many times smaller diameter tools such as 3/8" and 1/4" will allow reduction of open table, as well as minimized cutting pressure. For example, the open table and lateral pressure from a 1/2" tool is reduced by 25% when 3/8" tools are used. Additional methods of reducing part movement when dealing with small parts in a flow through operation is tab and skin cutting which will be further explained later in the Programming Techniques section. Basically in both processes a portion of the original material is left to aid in holding the parts together.

SURFACING SPOILBOARDS

- **REASONS**

Humidity swells MDF making if difficult to machine thin sheet stock. Warped surfaces reduce holding pressure when using vacuum. Unable to tab or skin cut parts on a warped table

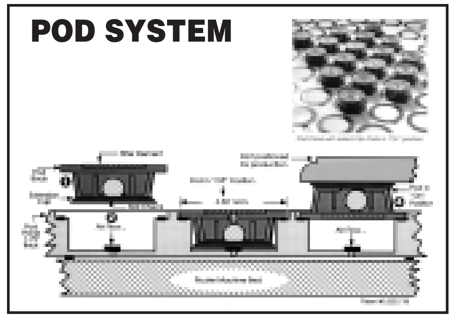


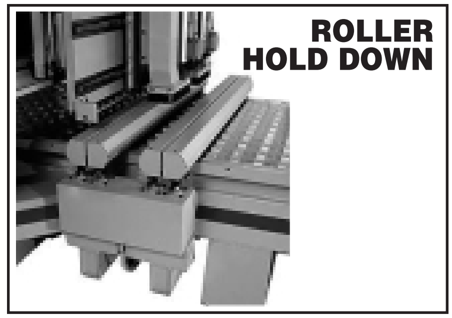
When cutting parts using the flow through method, it is best to surface the top and bottom of the board with a large diameter spoilboard surfacing tool. This allows for increased porosity as well as equal registration over the entire surface area of the table. The resurfacing not only levels the board, but also eliminates the routing grooves made during the process of machining parts. The more the board is surfaced the better the porosity and flow, which is essential in this type of spoilboard. Onsrud Cutter offers Spoilboard Surfacing Cutters (series90-000) for resurfacing the table at very high feed rates covering a large 2-1/2" to 4" area in each pass. These tools utilize indexable inserts that allow the tools to be easily renewed by turning the inserts. Finally, increased vacuum power to the work are can be attained by taping the edge of the spoilboard, sealing the edge with rubberized paint, and covering unused areas with scrap or thin plastic sheet. This aids in minimizing leakage, which is the enemy of the flow through system that thrives off high volume of vacuum.

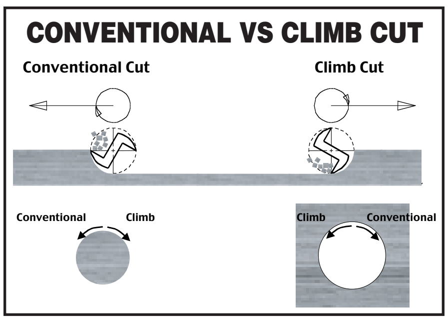
OTHER TYPES OF HOLDDOWN SYSTEMS

Within the realm of vacuum systems a fixturing process that is sometimes seen is the Pod System which utilizes a raised approach to alleviate the aforementioned problems with off-fall. Also, this system allows the operator to change the configuration of the part setup by flipping pods on top or underneath the work area to accommodate the travel of the cutter and duplicate the desired pattern. The system is somewhat limited in terms of vacuum area and almost always necessitates the use of downcut or neutral effect tools to avoid pushing parts off the pod. These systems are commercially available, but some firms have manufactured homemade versions to accommodate individual needs and save cost. The Pod System is extremely prevalent in Point-to-Point machines.

In the area of mechanical holddown, the Roller Holddown is probably the most predominately utilized in conjunction with CNC routing. This mechanism has rollers, which travel the length of the work area holding down specific areas as the individual part is machined. It may be assisted with flow through vacuum, but most times the roller holddown is the sole agent to eliminate part movement. This type of machine and holddown procedure is very prevalent in the manufacturing of upholstered furniture and boat parts.







PROGRAMMING TECHNIQUES

CLIMB AND CONVENTIONAL CUTTING

In most cases, conventional cutting provides the best edge provided the right tool geometry to cut a specific material has been selected. This applies mainly to man-made board products. If you are cutting solid wood where multidirectional grain patterns have to be considered, it is often necessary to employ climb cutting thereby limiting the chip the tool can remove at one time and reducing splintering. In CNC routing with right hand rotation tooling, climb cutting occurs as the perimeter of the workpiece is routed in a clockwise direction. Routing the same workpiece in a counter clockwise direction represents conventional cutting. The whole process is reversed when making internal cuts on the part. When workpiece finish is substandard, check the scrap as a comparison. If the scrap finish is better, change the direction of feed.

OSCILLATING TO IMPROVE TOOL LIFE

When cutting laminated materials such as plywood, laminated MDF or particleboard with a decorative surface such as melamine, glue lines represent the biggest threat to tool life. These glue lines are more abrasive than the surrounding material and tend to cause focused wear at a single point on the tool thereby prematurely degrading one or more of the areas of the edge. The remedy for this situation, provided a dedicated spoilboards or a pod system is in use, is to ramp the tool up and down through each tangent of the part insuring the glue line is never focused on one spot of the tool for any length of time. This will increase the life of the tool substantially while not actually reducing cycle times. The method of dropping the “Z” axis when the tool starts to get dull is highly ineffective. By the time you realize the edge is chipped, it is already too late to recalibrate the “Z” axis and the tool will leave lines in subsequent parts. Note that some software manufacturers offer the preferred approach in the form of “automatic tool oscillation”.

SKIN CUTTING PARTS

Skin cutting is a method of cutting parts where the tool cuts most of the way through the part leaving a thin “skin” attached to the larger sheet. Typically skin thickness is .020 - .030” requiring that the spoilboard must be surfaced flat before machining parts. This method is commonly employed in small parts that cannot adequately be held individually by vacuum. Such is the case with lettering or narrow parts where gasketing is impossible. This method also allows for faster loading and unloading of the machine as parts come off in the same quantity as went on the machine. This method is often employed in solid wood where after the parts come off the router they are passed through a wide belt sander to remove the “skin” and sand the parts free. Sometimes the parts are just broken apart and then routed on a table router with a flush trim bit or sanded to eliminate the skin. On some high accuracy routers routing plastic sheet on properly surfaced spoilboards, the skin may be limited to only the masking.