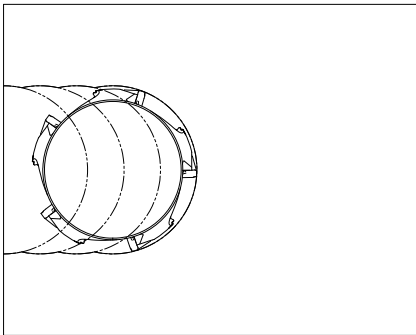# Technical Tip #132 – Efficiently Machining a Slot with the Z-Axis Plunge Mill

There are several different ways to machine a slot using the Z-axis plunge mill:

Slotting top view: The stepover is at the cutter centerline and not the periphery:

Figure 1

In this application, the cutter diameter and slot width are the same. When machining a typical slot, movements are feeding down and straight back up (Z+) in the same axis. The down and back movement has a negative impact on the insert radii (cutting edge) and can lead to premature failure of the nose radii. Figure 1 shows the rapid travel in the Z+ direction, which highlights the spiral of the insert/cutter operating at a high feed.

Using a cutter with a smaller width than the slot width enables the insert/cutter to be removed without contacting the workpiece, when (G00) rapid motion is used to retract the tool from the component. This type of cutter can be used across various types of machines.

Example: a vertical three-axis machine will serve to illustrate key points:

Assume a 2.00" (50mm) diameter cutter is being used to machine a slot that is 2.50" (63mm) wide.

First, align the cutter with the center of the slot on the component and define the stepover that is required. Move the Y-axis into position for the first cut and take the first pass to a depth in the Z-axis. When it reaches the bottom of the slot, program a two-axis move to retract the cutting edge from the workpiece.

Figure 2:
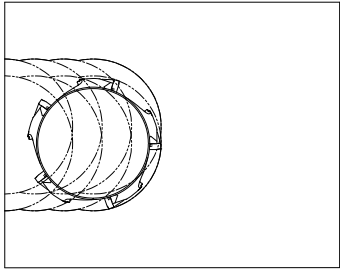
The two-axis move will move the Z-axis in a plus direction at 45° (.010") 0,25mm away from the component. The Y-axis will also move away from the workpiece by the same amount at the same angle. The cutter now can be retracted from the component, and the insert will not rub during retract.

Slotting with a smaller cutter:
Example: Using a 2.00" cutter to machine a slot 2.75" wide.
With this example it is possible to move away from the material on the retraction in the X and Y +(Z+) axes at 45° small increments. On the first pass, the cutter path is defined to the left or right of centerline, then follows the path from the sketch below. Watch that the stepover does not exceed the insert edge length.
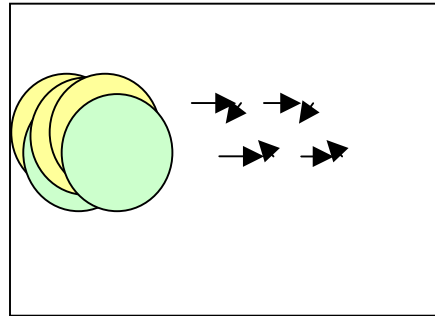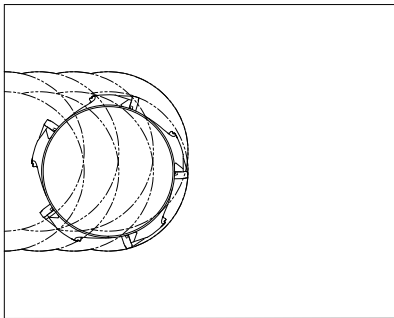
Move the cutter to the left of the slot, define the new position, and take the cut. When reaching the depth required, a two-axis move would have to occur, Z+ and X axis for (.010") 0,25mm at 45° to move away from the wall of the component .
The rapid Z+ can now take place, as the insert/cutter has moved away from the workpiece. Repeat the process on the other side of the slot, remembering that the X-axis move needs to be moving in the opposite direction. Note: It is better to start the process at the center of the slot. After the slot has been defined, you no longer need to put the cutter on the center path. Passes on both sides are creating the slot width and enabling clearance for the subsequent moves to enable the insert/cutter to move away from the side walls of the material.