

Crossing Slots

The completed project has been proven with the following program:

(33-07 - CROSSING SLOTS)

(T01 - 1.0 DIA SPOT DRILL - 90 DEG)

N1 G20

N2 G17 G40 G80 G49 T01

N3 M06

N4 G90 G54 G00 X0.75 Y-0.75 S700 M03 T02

N5 G43 Z1.0 H01 M08

N6 G99 G82 R0.1 Z-0.27 P300 F5.0

(DEPTH = ONE HALF OF CHAMFER DIAMETER)

N7 X5.0

N8 G00 G80 Z1.0 M09

N9 G28 Z1.0 M05

N10 M01

(T12 - 27/64 TAP DRILL)

N11 T02

N12 M06

N13 G90 G54 G00 X5.0 Y-0.75 S500 M03 T03

N14 G43 Z1.0 H02 M08

N15 G99 G83 R0.1 Z-1.3767 Q0.6 F8.0

(MINIMUM DEPTH MUST BE 1.0+POINT LENGTH)

N16 X0.75

N17 G00 G80 Z1.0 M09

N18 G28 Z1.0 M05

N19 M01

(T03 - 1/2-13 NC TAP)

N20 T03

N21 M06

N22 G90 G54 G00 X0.75 Y-0.75 S200 M03 T04

N23 G43 Z1.0 H03 M08

N24 G99 G84 R0.5 Z-1.0 F15.385

(FEEDRATE = RPM / TPI)

N25 X5.0

N26 G00 G80 Z1.0 M09

N27 G28 Z1.0 M05

N28 M01

(T04 - 5/8 DIA ROUGHING END MILL)

N29 T04

N30 M06

N31 G90 G54 G00 X1.875 Y0.5 S650 M03 T05 (TOP MIDPOINT OF VERTICAL SLOT)

N32 G43 Z1.0 H04 M08

N33 Z-0.4

(SLOT DEPTH 0.01 LESS)

N34 G01 Y-6.75 F3.0

(VERTICAL SLOT - COMPLETED)

N35 G00 Z1.0

N36 X-0.5 Y-1.875

(LEFT MIDPOINT OF HORIZONTAL SLOT)

N37 Z-0.4

(SLOT DEPTH 0.01 LESS)

N38 G01 X6.25

(HORIZONTAL SLOT - COMPLETED)

N39 G00 Z1.0 M09

N40 G28 Z1.0 M05

N41 M01

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(T05 - 5/8 DIA FINISHING END MILL)
N42 T05
N43 M06
N44 G90 G54 G00 X6.25 Y-1.875 S700 M03 T01 (RIGHT MIDPOINT OF HORIZONTAL SLOT)
N45 G43 Z1.0 H05 M08
N46 Z-0.41 (SLOT FULL DEPTH)
N47 G01 G41 Y-1.499 D51 F3.0 (HORIZONTAL SLOT - TOP CONTOUR APPROACH)
N48 X-0.5 (HORIZONTAL SLOT - TOP CONTOUR CUTTING)
N49 Y-2.251 (HORIZONTAL SLOT - BOTTOM CONTOUR APPROACH)
N50 X6.25 (HORIZONTAL SLOT - BOTTOM CONTOUR CUTTING)
N51 G00 G40 Y-1.875 (HORIZONTAL SLOT - COMPLETED)
N52 Z1.0
N53 X1.875 Y0.5 (TOP MIDPOINT OF VERTICAL SLOT)
N54 Z-0.41 (SLOT FULL DEPTH)
N55 G01 G41 X1.499 D51 (VERTICAL SLOT - LEFT CONTOUR APPROACH)
N56 Y-6.75 (VERTICAL SLOT - LEFT CONTOUR CUTTING)
N57 X2.251 (VERTICAL SLOT - RIGHT CONTOUR APPROACH)
N58 Y0.5 (VERTICAL SLOT - RIGHT CONTOUR CUTTING)
N59 G00 G40 X1.875 (VERTICAL SLOT - COMPLETED)
N60 Z1.0 M09
N61 G28 Z1.0 M05
N62 G28 X1.875 Y0.5
N63 M30
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Answer to the question:

➡ Only **ONE** offset is required for the finishing of both slots and all walls. There are two related reasons:

1. The tolerances are defined from the edge of the part - they do *not* indicate a slot width
2. The range of tolerances is opposite of each other

➡ What does it all mean?

The following explanation is for the vertical slot, but applies equally to the horizontal slot. Although the *nominal* dimensions were used in the program, the goal during machining will be the *middle* tolerances. The offset D51 used in the program will have an initial setting of 0.3125 ($\varnothing 5/8$ end mill used - $D51 = 0.3125$).

Now, consider this example:

After machining, the left wall of the slot is measured at 1.495, which is a 0.005 shift to the left from its middle tolerance. As the same cutting tool is applied to both walls, the right wall will also be shifted to the left by the same amount (0.005), and the measured dimension will be 2.245.

The D51 offset value has to be adjusted, so the next part is within tolerances. Since the offset has to be adjusted to the right, the offset amount is *increased* by 0.005. Now, the offset D51 stores the amount of 0.3175.

Another part is machined - and measured. The left wall of the slot is now 1.500 - a perfect size. What about the right wall? That wall is now also 0.005 further to the right, which means from the previous 2.245 dimension, it is now 2.250 - another perfect size. Try to evaluate this program and understand it thoroughly.

 **Reference:**

Chapter 33 - Slots and Pockets
 Chapter 30 - Cutter Radius Offset
 Chapter 30 - Practical Example Milling