

## Cutter Radius Offset - Part 1

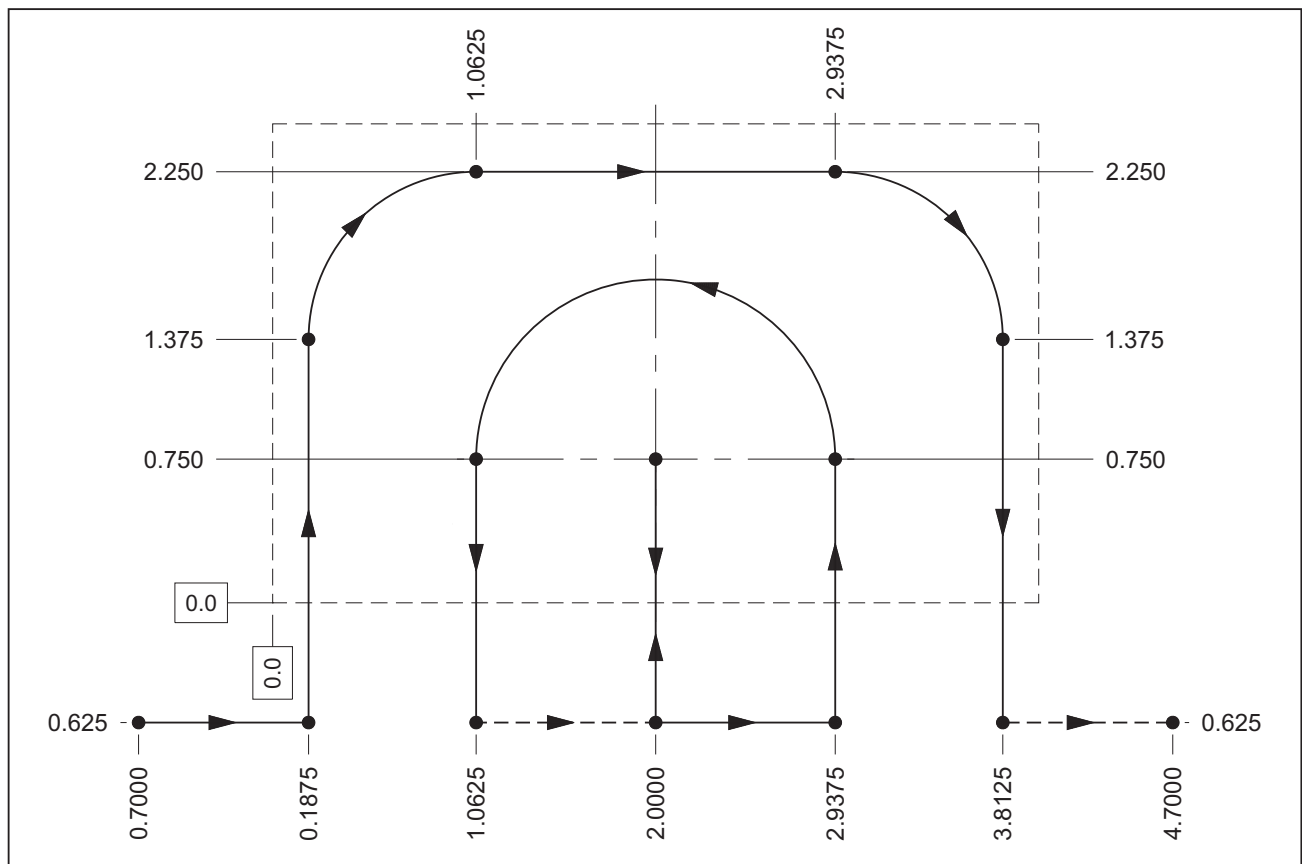
➡ Drawing Evaluation

The most important drawing requirements are the tolerances on the outside contour and in the open slot. In both cases, the tolerance is  $\pm 0.001$ , which also suggests a requirement for a quality surface finish. Based on these observations, two tools are the best selection:

- ❑ Tool 1 - T01 -  $\varnothing 1.0$  end mill - roughing operation
- ❑ Tool 2 - T02 -  $\varnothing 0.75$  end mill - finishing operation

The roughing tool will be used to cut the outside contour first, open up the slot, then cut the slot inner walls. Some stock will be necessary for the finishing cuts - 0.015 on the walls and 0.01 on the bottom. The finishing tool will follow the same toolpaths as the roughing tool, completing the part to drawing dimensions.

The following illustration shows all cutting motions and the coordinates of each contour point. All dimensions are based on the part drawing:



## Programming Cutter Radius

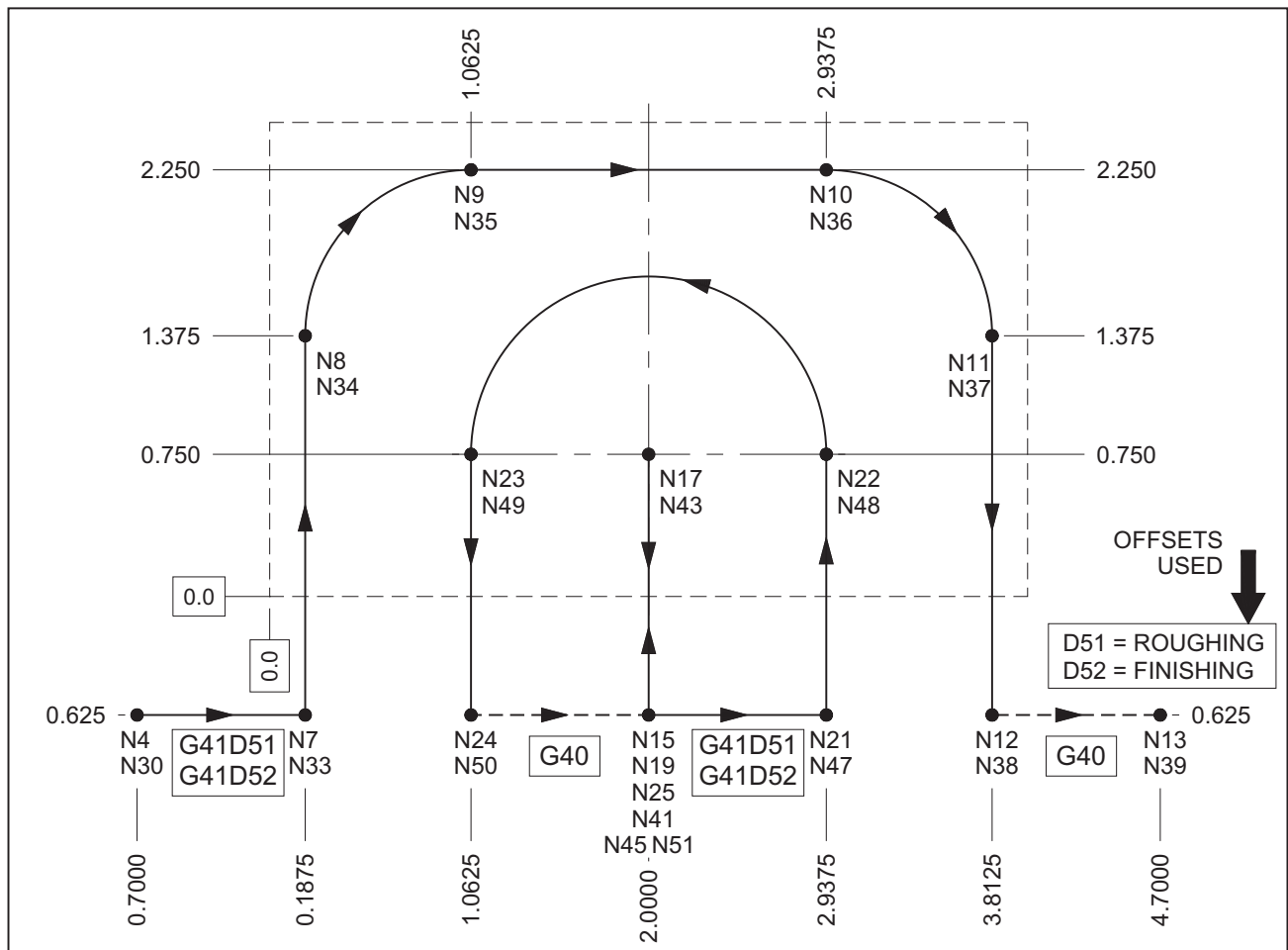
The cutter radius offset will be used for both roughing and finishing operations, with the exception of the slot startup, where no radius offset will be used. In all cases, climb milling mode will be also be used. For the purposes of this project, the nominal cutter diameter will be assumed for setting the offset values. In actual machining, the situation may be slightly different but based on the same principles.

The T01 will use offset D51 for roughing, and T02 will use offset D52 for finishing. Based on the nominal tool diameters, the setting of the offset value at the CNC machine should be as follows:

- D51 = 0.5000 for  $\varnothing 1.0$  end mill
- D52 = 0.3750 for  $\varnothing 0.75$  end mill

If these settings are used, the roughing tool will leave no stock and the part will be cut to size. The tolerances will be almost impossible to achieve. In order to leave the 0.015 stock on the walls, the size of the offset has to be adjusted. In order to leave *more* stock, the offset value has to *increase* by the stock, to 0.515. The offset for finishing does not change. Keep in mind that the D51 offset controls the rough width of the contour *and* the slot, offset D52 controls their finished width.

The previous illustration has been enhanced by corresponding block numbers in the program as well as the motions where the particular offset is applied.



The following program shows the cutter radius offset for each tool, matching the earlier illustrations:

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(30-05 - CUTTER RADIUS OFFSET - SINGLE OFFSET FOR EACH TOOL)
(D51 FOR ROUGHING = 0.5150)
(D52 FOR FINISHING = 0.3750)

N1 G20                                     (T01 - 1.0 DIA END MILL - ROUGHING)
N2 G17 G40 G80 T01
N3 M06
N4 G90 G54 G00 X-0.7 Y-0.625 S3000 M03 T02
N5 G43 Z0.1 H01 M08
N6 Z-0.29                                 (0.01 STOCK ON CONTOUR DEPTH)
N7 G01 G41 D51 X0.1875 F12.0             (START OF CONTOUR - G41 D51 APPLIED)
N8 Y1.375 F10.0
N9 G02 X1.0625 Y2.25 R0.875
N10 G01 X2.9375
N11 G02 X3.8125 Y1.375 R0.875
N12 G01 Y-0.625
N13 G00 G40 X4.7                         (END OF CONTOUR - G40)
N14 Z0.1
N15 X2.0
N16 Z-0.24                               (0.01 STOCK ON SLOT DEPTH)
N17 G01 Y0.75                           (ROUGH OUT SLOT CENTER)
N18 G00 Z0.1
N19 Y-0.625
N20 Z-0.24                               (0.01 STOCK ON SLOT DEPTH)
N21 G01 G41 D51 X2.9375                 (START OF SLOT - G41 D51 APPLIED)
N22 Y0.75
N23 G03 X1.0625 R0.9375
N24 G01 Y-0.625
N25 G00 G40 X2.0 M09                   (END OF SLOT - G40)
N26 G28 Z1.0 M05
N27 M01

N28 T02                                 (T02 - 0.75 DIA END MILL - FINISHING)
N29 M06
N30 G90 G54 G00 X-0.7 Y-0.625 S3250 M03 T01
N31 G43 Z0.1 H02 M08
N32 Z-0.3                               (CONTOUR FULL DEPTH)
N33 G01 G41 D52 X0.1875 F12.0           (START OF CONTOUR - G41 D52 APPLIED)
N34 Y1.375 F8.0
N35 G02 X1.0625 Y2.25 R0.875
N36 G01 X2.9375
N37 G02 X3.8125 Y1.375 R0.875
N38 G01 Y-0.625
N39 G00 G40 X4.7                       (END OF CONTOUR - G40)
N40 Z0.1
N41 X2.0
N42 Z-0.25                               (SLOT CENTER CLEANUP)
N43 G01 Y0.75
N44 G00 Z0.1
N45 Y-0.625
N46 Z-0.25                               (SLOT FULL DEPTH)
N47 G01 G41 D52 X2.9375                 (START OF SLOT - G41 D52 APPLIED)
N48 Y0.75
N49 G03 X1.0625 R0.9375
N50 G01 Y-0.625
N51 G00 G40 X2.0 M09                   (END OF SLOT - G40)
N52 G28 Z1.0 M05
N53 X-1.5 Y10.0
N54 M30
%
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**The offsets in this program will work correctly only if the drawing tolerances for the outside contour and the inside slot have the *same* range ( $\pm 0.001$  in the example). That is not always the case.**