39-09 Solution

Groove Milling

Study the comments in the program(-s) to see how the main program(-s) and the subprogram(-s) interact.

➔ 39-09-A PROGRAM

```
(39-09-A - GROOVE MILLING)
(MAIN PROGRAM FOR FOUR GROOVES)
(ONE CUT ONLY PER GROOVE)

(T01 - 7 MM DIA CENTER CUTTING END MILL)
(FULL WIDTH AND FULL DEPTH CUTTING)

N1 G21
N2 G17 G40 G80
N3 G90 G54 G00 X50.0 Y10.5 S600 M03          (GROOVE A START LOCATION XY)
N4 G43 Z5.0 H01 M08                          (INITIAL CLEARANCE POSITION)
N5 G01 Z2.0 F200.0                           (START OF DEPTH - 2.0 ABOVE PART)
N6 M98 P6001                                 (CUT GROOVE A IN 1 PASS)
N7 G90 G00 Z2.0                              (RETRACT ABOVE PART AT GROOVE A)
N8 X140.0                                    (MOVE TO GROOVE B)
N9 M98 P6001                                 (CUT GROOVE B IN 1 PASS)
N10 G90 G00 Z2.0                             (RETRACT ABOVE PART AT GROOVE B)
N11 Y75.5                                    (MOVE TO GROOVE C)
N12 M98 P6001                                (CUT GROOVE C IN 1 PASS)
N13 G90 G00 Z2.0                             (RETRACT ABOVE PART AT GROOVE C)
N14 X50.0                                    (MOVE TO GROOVE D)
N15 M98 P6001                                (CUT GROOVE D IN 1 PASS)
N16 G90 G00 Z5.0 M09                         (RETRACT ABOVE PART AT GROOVE D)
N17 G28 Z5.0                                 (MACHINE ZERO RETURN Z AXIS)
N18 G28 X50.0 Y10.5 M05                      (MACHINE ZERO RETURN XY AXES)
N19 M30
%

O6001 (SUBPROGRAM FOR CUTTING WITH T01)
(START FROM ABSOLUTE Z2.0 AND CUT TO ABSOLUTE DEPTH Z-6.5)
N101 G91 G01 Z-8.5 F60.0
N102 X25.5 F80.0
N103 G03 X9.0 Y9.0 I0 J9.0
N104 G01 Y26.0
N105 G03 X-9.0 Y9.0 I-9.0 J0
N106 G01 X-51.0
N107 G03 X-9.0 Y-9.0 I0 J-9.0
N108 G01 Y-26.0
N109 G03 X9.0 Y-9.0 I9.0 J0
N110 G01 X25.5
N111 M99
%
```

This method of programming is correct, but machining results will be fair at best. The tool width is equal the groove width, and the cut takes place at the full depth of the groove. This kind of machining does not produce a quality groove.

Study the solution for the second version of this project - it covers a precision groove milling.

39-09-B PROGRAM

In the second version, the roughing tool is smaller than the groove width, and its purpose is only to open up each groove. A ∅5 mm finishing tool will complete each groove, one wall at a time.

```
(39-09-B - GROOVE MILLING)
(MAIN PROGRAM FOR FOUR GROOVES)
(RADIUS OFFSETS D52 AND D53 SHOULD HAVE THE SAME SET VALUE ...)
(... UNLESS NEEDED FOR FINE DIMENSIONAL ADJUSTMENT OF GROOVE WIDTH)

(T01 - 6 MM DIA CENTER CUTTING END MILL)
(ROUGH DEPTH WILL BE 6.25 - 0.25 LEFT FOR FINISHING)
N1 G21
N2 G17 G40 G80 T01
N3 M06
N4 G90 G54 G00 X50.0 Y10.5 S600 M03 T02      (GROOVE A START LOCATION XY)
N5 G43 Z5.0 H01 M08                          (INITIAL CLEARANCE POSITION)
N6 G01 Z0.25 F200.0                          (START OF ROUGH DEPTH - 0.25 HIGHER)
N7 M98 P6001 L5                              (ROUGH GROOVE A IN 5 PASSES)
N8 G90 G00 Z5.0                              (RETRACT ABOVE PART AT GROOVE A)
N9 X140.0                                    (MOVE TO GROOVE B)
N10 G01 Z0.25 F200.0                         (START OF ROUGH DEPTH FOR GROOVE B)
N11 M98 P6001 L5                             (ROUGH GROOVE B IN 5 PASSES)
N12 G90 G00 Z5.0                             (RETRACT ABOVE PART AT GROOVE B)
N13 Y75.5                                    (MOVE TO GROOVE C)
N14 G01 Z0.25 F200.0                         (START OF ROUGH DEPTH FOR GROOVE C)
N15 M98 P6001 L5                             (ROUGH GROOVE C IN 5 PASSES)
N16 G90 G00 Z5.0                             (RETRACT ABOVE PART AT GROOVE C)
N17 X50.0                                    (MOVE TO GROOVE D)
N18 G01 Z0.25 F200.0                         (START OF ROUGH DEPTH FOR GROOVE D)
N19 M98 P6001 L5                             (ROUGH GROOVE D IN 5 PASSES)
N20 G90 G00 Z5.0 M09                         (RETRACT ABOVE PART AT GROOVE D)
N21 G28 Z5.0 M05                             (MACHINE ZERO RETURN Z AXIS)
N22 M01                                      (OPTIONAL STOP)

(T02 - 5 MM CENTER CUTTING END MILL)
(FINISH DEPTH WILL BE 6.5)
N23 T02
N24 M06
N25 G90 G54 G00 X50.0 Y75.5 S850 M03 T01     (GROOVE D START LOCATION XY)
N26 G43 Z5.0 H02 M08
N27 X50.0 M98 P6002                          (FINISH TWO CONTOURS - GROOVE D)
N29 X140.0 M98 P6002                         (FINISH TWO CONTOURS - GROOVE C)
N29 Y10.5 M98 P6002                          (FINISH TWO CONTOURS - GROOVE B)
N30 X50.0 M98 P6002                          (FINISH TWO CONTOURS - GROOVE A)
N31 M09
N32 G28 Z5.0
N33 G28 X50.0 Y10.5 M05
N34 M30
%

O6001 (SUBPROGRAM FOR ROUGHING WITH T01)
(START FROM Z0.25 - EACH DEPTH IS 1.3 MM 5X REPEATED)
(ABSOLUTE DEPTH WILL BE Z-6.25)
N101 G91 G01 Z-1.3 F80.0                     (1.3 IS ONE FIFTH OF 6.5)
N102 X25.5 F100.0
N103 G03 X9.0 Y9.0 I0 J9.0
N104 G01 Y26.0
N105 G03 X-9.0 Y9.0 I-9.0 J0
N106 G01 X-51.0
N107 G03 X-9.0 Y-9.0 I0 J-9.0
N108 G01 Y-26.0
N109 G03 X9.0 Y-9.0 I9.0 J0
N110 G01 X25.5
N111 M99
%
```

```
O6002 (SUBPROGRAM FOR FINISHING WITH T02)
(FINISH THE SMALLER CONTOUR USING OFFSET D52)
N201 G90 G01 Z-6.0 F200.0
N202 Z-6.5 F50.0
N203 G91 G41 X3.5 D52 F75.0
N204 G03 X-3.5 Y3.5 I-3.5 J0
N205 G01 X-25.5
N206 G02 X-5.5 Y5.5 I0 J5.5
N207 G01 Y26.0
N208 G02 X5.5 Y5.5 I5.5 J0
N209 G01 X51.0
N210 G02 X5.5 Y-5.5 I0 J-5.5
N211 G01 Y-26.0
N212 G02 X-5.5 Y-5.5 I-5.5 J0
N213 G01 X-25.5
N214 G03 X-3.5 Y-3.5 I0 J-3.5
N215 G40 G01 X3.5
(FINISH THE LARGER CONTOUR USING OFFSET D53)
N216 G41 X-3.5 D53
N217 G03 X3.5 Y-3.5 I3.5 J0
N218 G01 X25.5
N219 G03 X12.5 Y12.5 I0 J12.5
N220 G01 Y26.0
N221 G03 X-12.5 Y12.5 I-12.5 J0
N222 G01 X-51.0
N223 G03 X-12.5 Y-12.5 I0 J-12.5
N224 G01 Y-26.0
N225 G03 X12.5 Y-12.5 I12.5 J0
N226 G01 X25.5
N227 G03 X3.5 Y3.5 I0 J3.5
N228 G40 G01 X-3.5
N229 G90 G00 Z5.0
N230 M99
%
```