emco group

GE FANUC 21
CONCEPT 155 TCM TURN
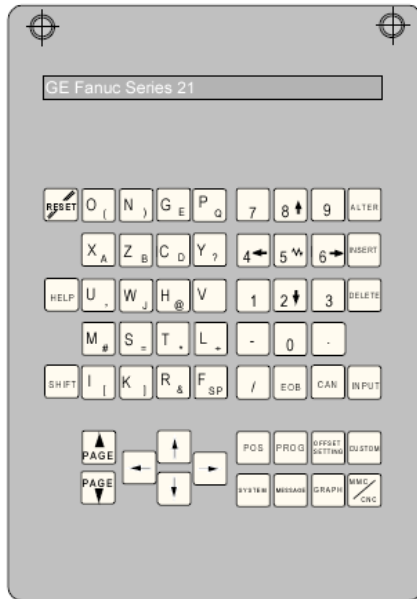# TEACHERS GUIDE

Training Index

Machine Components

Fanuc 21 Keypad

Fanuc 21 Soft Keys

EMCO Machine Control

| Operator Keys | Directional Keys | Spindle Keys | Accessory Keys | MODE Dial | Feed Override Dial |

The Fanuc 21 Screen

```
                                            OF 100%  ◄──── 1
PROGRAM                         O0001   N00000 ◄──── 3
  O0001 ( Demo ) ;
  N5
  %




                                            OS 100% T ◄──── 2
> _
EDIT   ****   ***   ***        20:44:33
       F3          F4          F5          F6          F7
( BG-EDT )( O SRH  )( SRH  ↓ )( SRH  ↑ )( REWIND )>
```

7
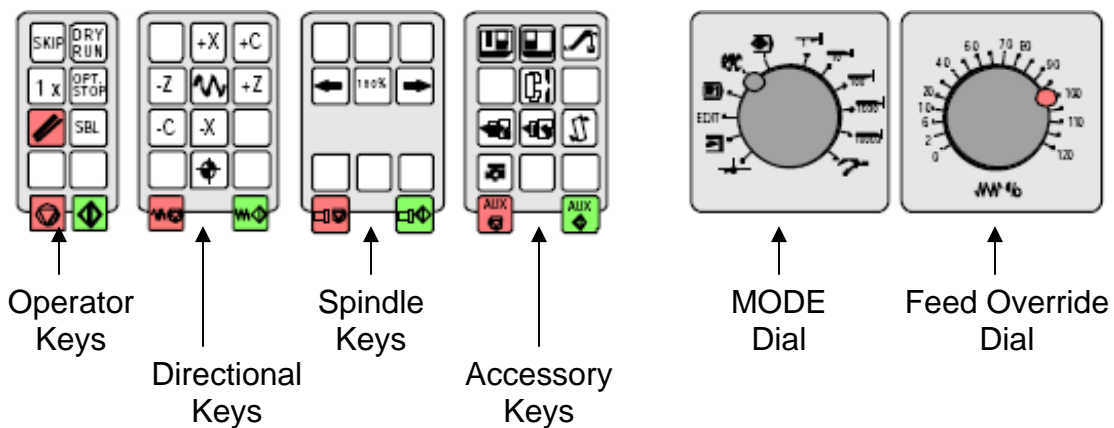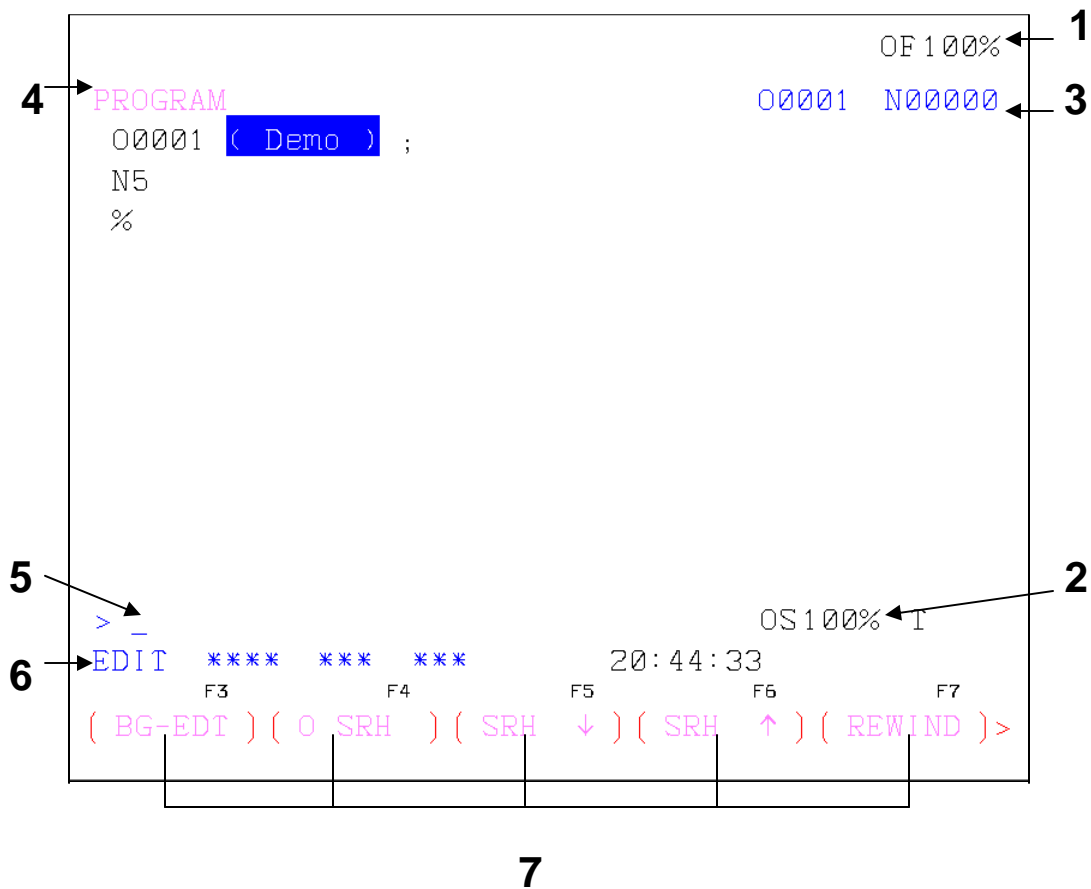
1. **Displays of Feed**

2. **Spindle Speed override**

3. **Display of Program and Number block**

4. **Display of active Screen**

5. **Entry line**

6. **Display of active Mode**

7. **Display of Soft key Functions**

FANUC 21 KEYS

RESET = cancels most alarms, resets program,

interrupts programs

DATA INPUT KEYS

Press a button for a letter / number needed. Use Shift for the second letter or symbol on that button.

CHANGE KEYS

ALTER = alter word (replace word)

INSRT = insert word, create new program

DELETE = deletes word / block or programs

INPUT = input offsets / words or numbers

CAN = deletes entries in the address one by one

EOB = end of block

CURSOR & PAGE KEYS

Page Up = pages up in a program or additional screens

Page Down = pages down in a program or additional screens
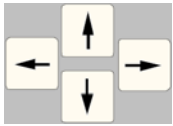
Cursor up = moves up one line or to left in the screen

Cursor left = moves left in the screen

Cursor right = moves right in the screen

Cursor down = moves down one line or to the right in the screen, search function, and calls up programs

FUNCTION KEYS (DISPLAY KEYS)

POS = displays actual, relative, machine positions

PROG = displays program, library page

OFFSET/ SETTINGS = displays wear, geometry work pages

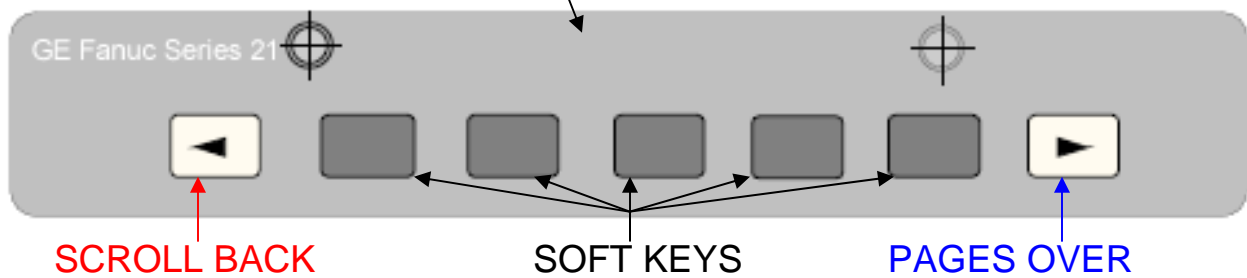**SYSTEM = displays parameters, diagnostic pages; use page up or down for optional pages**

**MESSAGE = displays operator & alarm messages**

GRAPH = displays 2–d graph simulation

SOFT KEYS

GE Fanuc Series 21

SCROLL BACK   SOFT KEYS   PAGES OVER
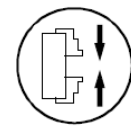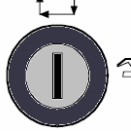
EMCO MACHINE KEYS

Operator Keys

SKIP = **Press skip for any block lines with (/) (Slash) before block number will be skipped**

DRY RUN = **Press for test run without spindle on and rapids only (remove raw material from vise)**

1 x = **(Single piece) for continuous mode active only on automatic material loading**

OPT. STOP = **(Optional stop) for programs with (m1)**

⫽ = **(Reset) cancels most alarms, resets program, interrupts programs**

S BL = **(Single block) reads one block line at a time**

⊘ = **(Cycle stop) program hold, feed hold**

◇ = **(Cycle start) program start**

Large Buttons and Keys

= **Additional Chuck Button**
Hand Mode is for moving machine around with door open and works in conjunction with the (Agreement button)

= **(Agreement button) used for open/closing door or to jog axis with the door open**

= **(Mode Key) Automatic & Hand Mode**
Hand Mode is for moving machine around with door open and works in conjunction with the (Agreement button)

= **(Cycle start) program start**

Note: Skip, Dry Run, Optional Stop, and Single Block will show at the top of the screen when pressed. When pressed again they will disappear and turn off.
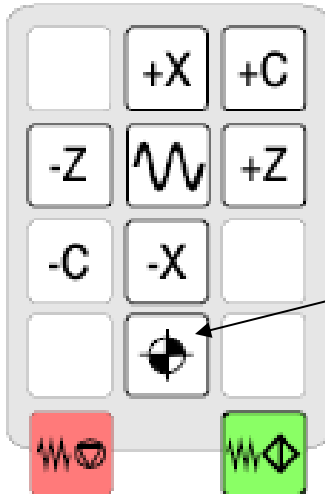
DIRECTION KEYS

These keys control axes directional movements

+4 & -4 = Additional axes

Reference all (Doesn't work for 55 Turn's)

Feed stop (Red) / Feed start (Green) works all modes but EDIT & ZRN
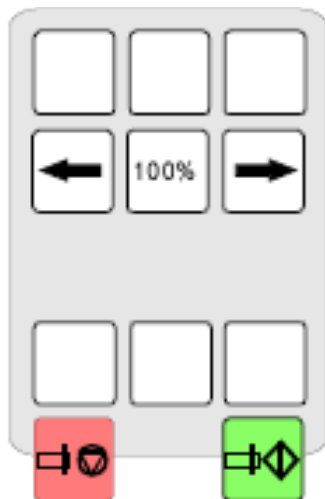
SPINDLE OVERRIDE KEYS

Arrow key pointing right increase the Spindle speed (120% high)

Arrow key pointing left decrease the Spindle speed (50% low)

100% key jumps speed to 100%

Spindle stop (Red) / Spindle start (Green)

Works all modes except EDIT & ZRN (Reference)
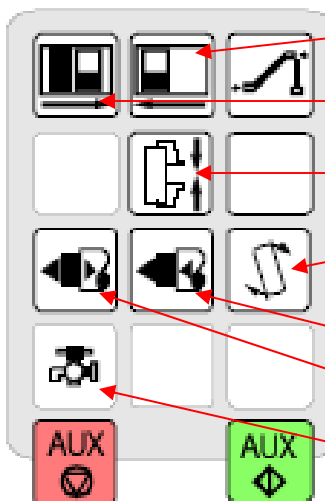
ACCESSORY FUNCTIONS

Arrow right door open

Arrow left door closed

Press once chuck open
Press again chuck closed

Press turret index's one time clockwise Each time pressed

Press tailstock moves backward

Press tailstock moves forward

Press once coolant on
Press again coolant off

Press auxiliary drives on (Green)
Press auxiliary drives off (Red)

MODE DIAL
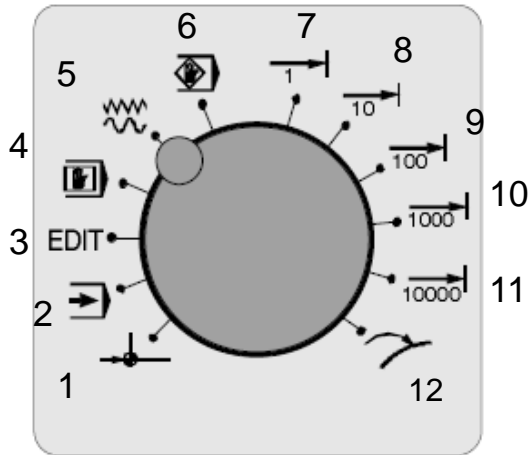
(1) **REF = Zero / Reference or Home mode**

(2) **MEM = Automatic mode for running a program**

(3) **EDIT = Edit mode for program changes or entering a new program**

(4) **MDI = Manual Data Input mode for manually running the machine**

(5) **JOG = Manual moving the axis in X, Z**

(6) **SIEMEN MODE (Not used on Fanuc)**

(7) **STEPS = .0001 or tenths**

(8) **STEPS = .0010 or thousands**

(9) **STEPS = .0100 or ten thousands**

(10) **STEPS = .1000 or hundred thousands**

(11) **STEPS = .1000 or hundred thousands**

(12) **SIEMEN MODE (Not used on Fanuc)**

FEED OVERRIDE DIAL
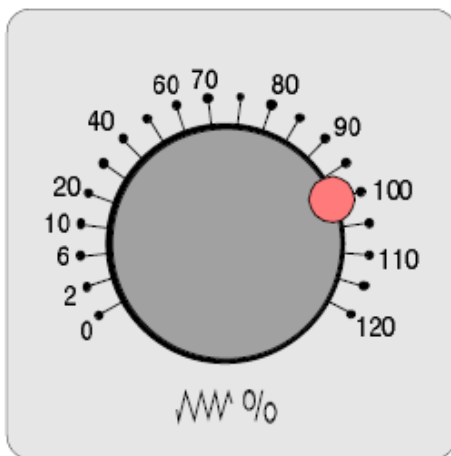
Controls feed for jogging in the X, Z Axis. Overrides from 0% to 120% of the programmed feed rate or the rapid rate
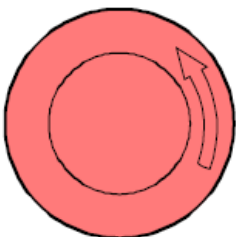
E Stop or Emergency Stop

Turning the Machine On/Entering Fanuc Software

Referencing the Machine

1. Press the **AUX** button [AUX] (This turns on the Auxiliary Drives)
2. Press the **Agreement** button (T) **Open** door then **Shut** door
   (This Initialize the safety circuits on the Machine door)
3. Move the MODE dial to REF position also know as Reference make sure your feed rate is not on "**0**"
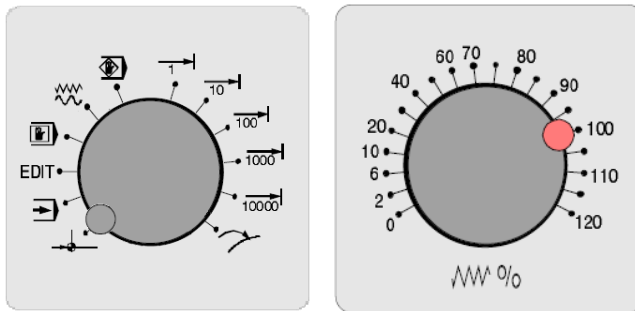
4. Make sure the Door is closed

5. Press the X+ (arrow pointing up) this references the X axis. (Wait until X is fully reference)

6. Press the Z- (arrow pointing left) this references the Z axis

OR

Press this

Button
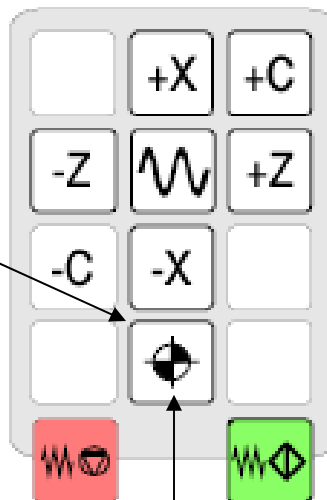
Reference all axis

Note: Every time you enter Fanuc 21 Software or Turn the Machine On you must reference the axis

WORK SHIFT
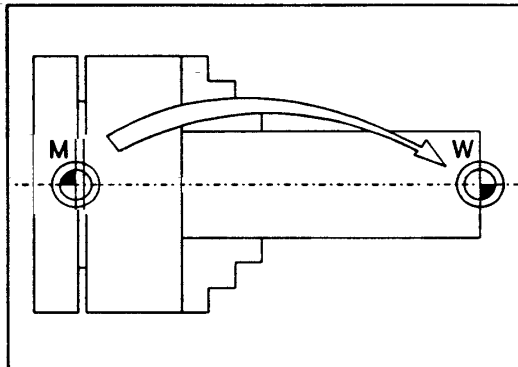
Zero offset from machine zero point M to workpiece zero point W

With EMCO lathes the machine zero "M" lies on the rotating axis and on the end face of the spindle flange. This position is unsuitable as a starting point for dimensioning. With the so-called zero offset the coordinate system can be moved to a suitable point in the working area of the machine.

The offset register offers one adjustable zero offset.

When you define a value in the offset register, this value will be considered with program start and the coordinate zero point will be shifted from the machine zero M to the workpiece zero W.

The workpiece zero point can be shifted within a program with "G92 - Coordinate system setting" in any number.
More informations see in the command description.

Absolute coordinates refer to a fixed position, incremental coordinates to the tool position.
The bracket values for X, -X, U, -U are valid for the PC TURN 50 because the tool is in front of the turning centre on this machine.

The Coordinate System

The X coordinate lies in the directions of the cross slide, the Z coordinate in the direction of the longitudinal slide.
Coordinate values in minus directions describe movements of the tool system towards the workpiece. Values in plus direction away from the workpiece,

Coordinate System for Absolute Value Programming
The origin of the coordinate system lies at the machine zero "M" or at the workpiece zero "W" following a programmed zero offset.
All target points are described from the origin of the coordinate system by the indication of the respective X and Z distances.
X distances are indicated as the diameter (as dimensioned on the drawing).

Coordinate System for Incremental Value Programming
The origin of the coordinate system lies at the tool mount reference point "N" or at the cutting tip after a tool call-up.
The U coordinate lies in the direction of the cross slide, the W coordinate in the direction of the longitudinal slide. The plus and minus directions are the same as for absolute value programming.
With incremental value programming the actual paths of the tool (from point to point) are described.
X distances are indicated as the diameter.

Work Shift:

Note: There are 2 main ways of doing this Education way or Industry way. Step 1 thru 3 is for the Education way; skip these steps if you are setting up Industry way; go to step 4.

1. Index to a empty ID location

   - Manually index by going to Jog Mode and Pressing Index button

   OR

   - Programming Index

     Rotate Mode Dial to MDI

     Press the PROGRAM display button
     Until top left of the screen shows **PROGRAM (MDI)**

     Type T0100 (if the ID location wanted is position 1)

     Press Input button

     Then press CYCLE START   **(Door must be closed)**

2. If the Dial is not in Jog rotate Mode Dial to Jog

3. Jog the TURRET to the face of the Work Piece & touch using the Direction keys.

   (Use piece of paper between TURRET and Work Piece)

   (Use the Feed override dial or Steps to approach at a slower feed)
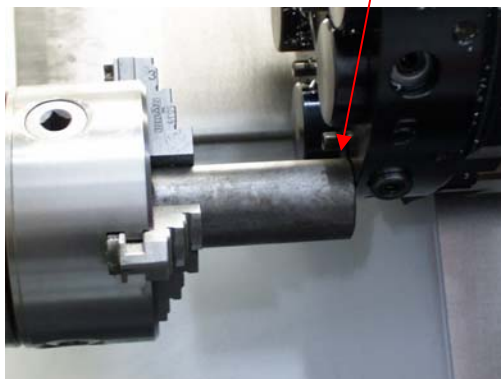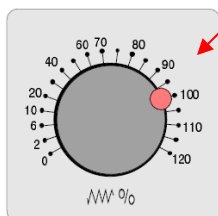
4. Press the OFFSET/SETT button until Work Shift page appears OFFSET SETT.

5. Make sure (Shift Value) Z is 0 if not cursor to Z under (SHIFT VALUE) and type 0 and Input

Note : Industry way skip steps 6 thru 8 but read the red print at the bottom of the page

6. The value that is in the ACTUAL POSITION (RELATIVE) Z type this value in (SHIFT VALUE) Z as a negative number

7. Then press INPUT button INPUT

8. Jog TURRET away from WORK PIECE using Z+

This value is the distance from the Spindle Nose to the end of the Work Piece

```
                                          OF 100%

WORK SHIFT                       O0000   N00000

     (SHIFT VALUE)               (MEASUREMENT)
   X      0.0000            X       0.0000
   Z      0.0000            Z       0.0000




ACTUAL POSITION  (RELATIVE)
   X      0.0000               Z       0.0000

> z-4.94_                         OS100%   T
 JOG  ****   ***   ***        11:37:18
       F3           F4        F5           F6          F7
(         ) (         ) (          ) ( +INPUT ) ( INPUT  )
```
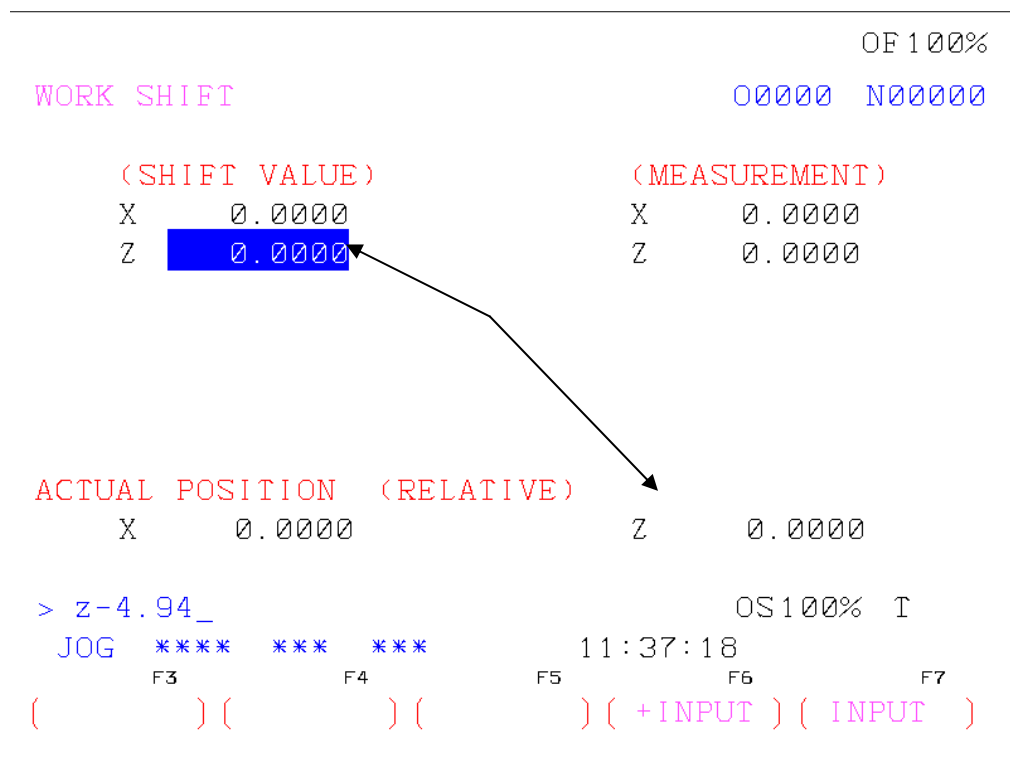
Note: Machine 0 is the turret face touching the spindle nose.

NEVER put a value in SHIFT VALUE X

TOOL OFFSETS

Tool Offsets
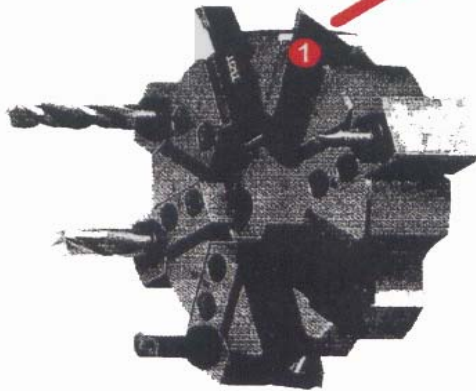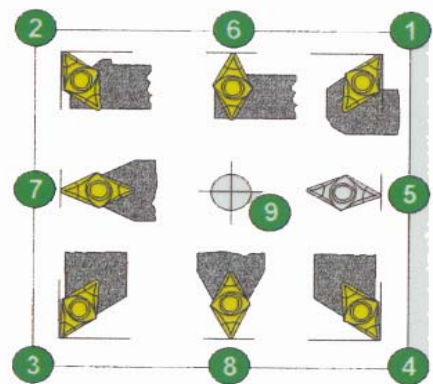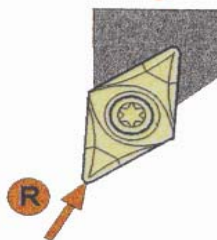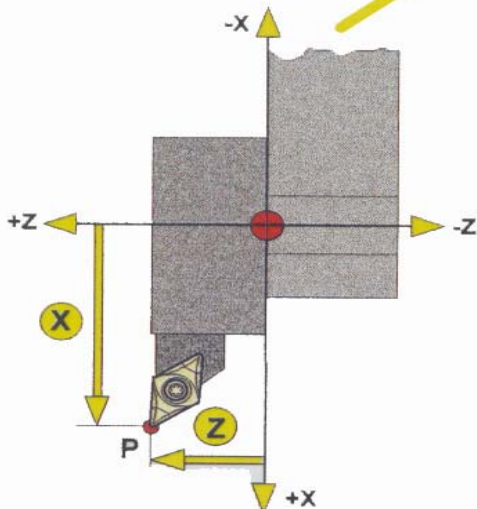
1. Index the TURRET to the tool being measured

   - Move the MODE Dial to MDI position

   - Press Program button until PROGRAM (MDI) is at the top left of the screen

   - Type tool number then press INPUT button [INPUT]

     Example: T0200

     A. For scratching type S1000 M03 press INPUT button [INPUT]

        S = Spindle speed   M03 = spindle on clockwise

   - Press CYCLE START [◇] (make sure door is closed)

2. Move the MODE Dial to JOG position

3. Jog TOOL TIP to the WORK PIECE & touch TOOL TIP to the DIAMETER of the WORK PIECE using the Direction keys.

   (Use the Feed override dial or Steps to approach at a slower feed)

4. Press the OFFSET/SETT button until Geometry page appears `OFFSET SETT.`

5. Type X and the Diameter being scratched

   Example: X1 (If the diameter being scratch is 1"dia.)

6. Cursor down and over to highlight the G0 X location for the tool that is being measured

   (Picture below shows tool 2 is being measured)

7. Then press soft key for `F4 ( MEASUR )`

8. Jog TURRET away from WORK PIECE using X+

This value is the distance from an I.D. Tool Station to the Tool Tip

```
                                                    OF100%
   OFFSET / GEOMETRY                      O0000  N00000
      NO.        X              Z              R      T
   G01        0.0000        0.0000        0.0000  0
   G02        0.0000        0.0000        0.0000  0
   G03        0.0000        0.0000        0.0000  0
   G04        0.0000        0.0000        0.0000  0
   G05        0.0000        0.0000        0.0000  0
   G06        0.0000        0.0000        0.0000  0
   G07        0.0000        0.0000        0.0000  0
   G08        0.0000        0.0000        0.0000  0
   ACTUAL POSITION   (RELATIVE)
       X       0.0000              Z      0.0000

   > 1.097_                            OS100%  T
    JOG  ****  ***  ***          11:38:33
        F3           F4         F5         F6           F7
   ( NO.SRH )( MEASUR )( INP.C. )( +INPUT )( INPUT  )>
```

9. Jog TOOL TIP to the end of the WORK PIECE & touch TOOL TIP to the FACE of the WORK PIECE using the Direction keys.

(Use the Feed override dial or Steps to approach at a slower feed)

10. Press the OFFSET/SETT button until Geometry page appears OFFSET SETT.

11. Type Z and 0 for reading from work shift 0

    Example: Z0

12. Cursor down and over to highlight the G0 Z location for the tool that is being measured

    (Picture below shows tool 2 is being measured)

13. Then press soft key for [MEASUR] F4

```
                                         OF 100%
 OFFSET / GEOMETRY              O0000  N00000
    NO.       X             Z            R     T
 G01       0.0000        0.0000       0.0000 0
 G02       0.0000        0.0000       0.0000 0
 G03       0.0000        0.0000       0.0000 0
 G04       0.0000        0.0000       0.0000 0
 G05       0.0000        0.0000       0.0000 0
 G06       0.0000        0.0000       0.0000 0
 G07       0.0000        0.0000       0.0000 0
 G08       0.0000        0.0000       0.0000 0
 ACTUAL POSITION   (RELATIVE)
     X     0.0000              Z     0.0000

 >                              OS100%  T
  JOG  ****  ***  ***      11:39:22
        F3          F4         F5        F6          F7
 ( NO.SRH )( MEASUR )( INP.C. )( +INPUT )( INPUT  )>
```

Note: Industry way the value for Z will be a large value
(This is the distance from spindle nose to the program 0 / front of the work piece)

15

14. R is the Tool Tip Radius
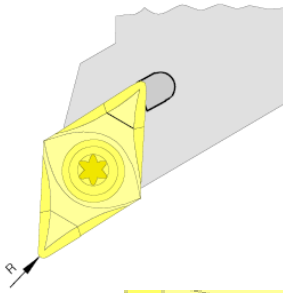
Note: Most insert packages or tool holders specify this value. If cutter comp is not used then the R value is not used

Type in the value for the tip radius

Emco tooling radius

55° insert = .015   Parting Off or Groove = .003

80° insert = .032   35° insert = .010

Threading insert = .001
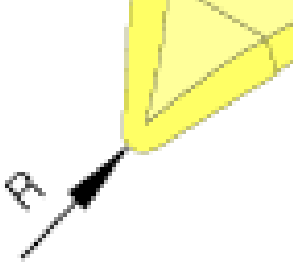
15. T for cutter comp cutting direction
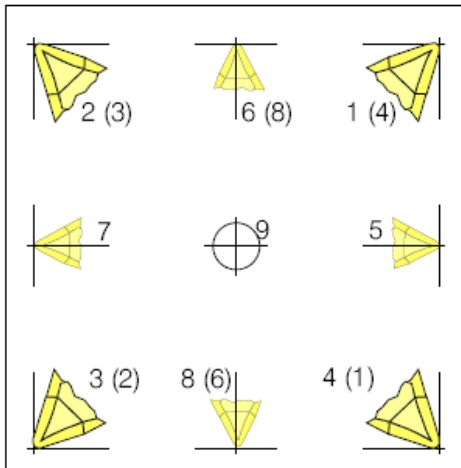
Note: **The T is Direction that the Tool Points. Tool doesn't need to look like Tool in the picture**

All machines that have a turret on the bottom will also use the bracket #'s. Machines with turret on top will use regular #'s

16. Jog TURRET away from WORK PIECE using Z+

17. Repeat steps for all OD tools (STEPS 1-16 starting on pg 14)

Note: The T is Direction that the Tool Points. Tool does not need to look like Tool in the Picture

Live Tool Offsets

1. Index the TURRET to a Axial Tool

   - Move the MODE Dial to MDI position

   - Press Program button until `PROGRAM (MDI)` is at the top left of the screen

   - Type tool number then press INPUT button `INPUT`
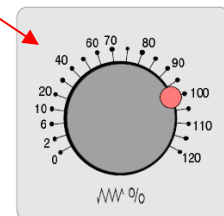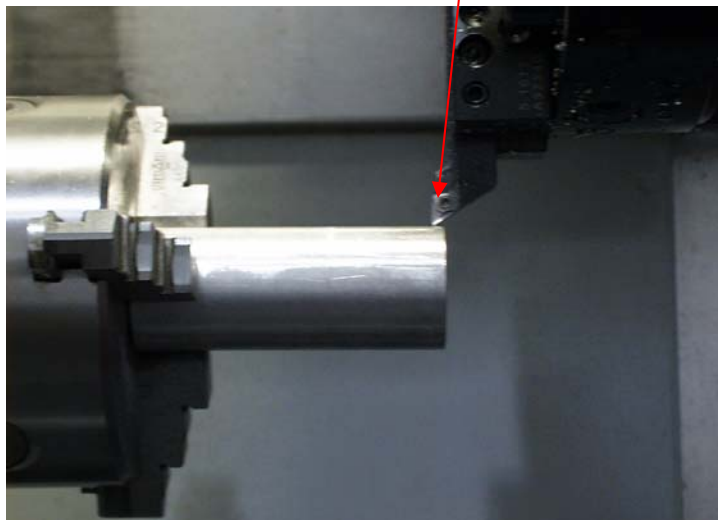   Example: T1100

   - Press CYCLE START ◇ (make sure door is closed)

2. Move the MODE Dial to JOG position

3. Jog TOOL TIP (Z axis) to the end of the WORK PIECE & touch TOOL TIP to the FACE of the WORK PIECE using the Direction keys.

(Use the Feed override dial or Steps to approach at a slower feed)

4. Press the OFFSET/SETT button until Geometry page appears [OFFSET SETT.]

5. Type Z and 0 for reading from work shift 0

    Example: Z0

6. Cursor down and over to highlight the G0 Z location for the tool

    that is being measured

    (Picture below shows tool 11 is being measured)

7. Then press soft key for [**F4** MEASUR]

```
                                                    OF 100%
 OFFSET / GEOMETRY                          O0000  N00000
    NO.         X                Z              R       T
 G09         0.0000           0.0000         0.0000 0
 G10         0.0000           0.0000         0.0000 0
 G11        -0.7875           0.0000         0.0000 0
 G12         0.0000           0.0000         0.0000 0
 G13         0.0000           0.0000         0.0000 0
 G14         0.0000           0.0000         0.0000 0
 G15         0.0000           0.0000         0.0000 0
 G16         0.0000           0.0000         0.0000 0
 ACTUAL POSITION   (RELATIVE)
      X      3.2283              Z      3.1890

 > Z0_                                    OS100%  T
 EDIT  ****   ***   ***           07:33:12
        F3          F4        F5          F6          F7
 ( NO.SRH ) ( MEASUR ) ( INP.C. ) ( +INPUT ) ( INPUT  )>
```
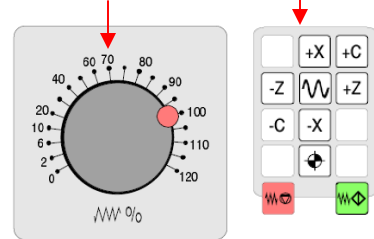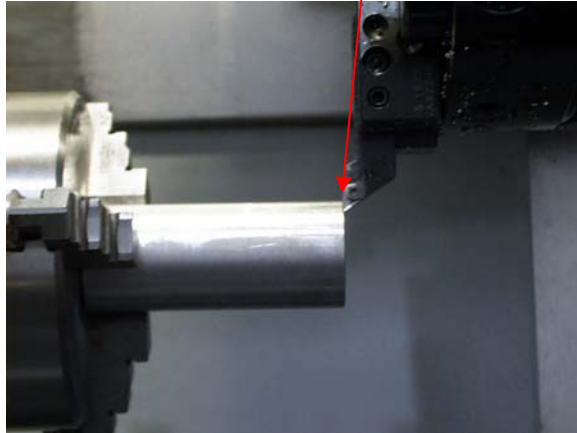
8. The X will be 20mm neg. (-.7874 inch) type this in then press

    INPUT button [INPUT] this is read as a Diameter value.

    (The live tool positions 1,3,5,7,9,11 are offset negative 20mm

    diameter from the even positions 2, 4, 6, 8, 10, 12)

Note: Both Education / Industry ways are the same in the X direction
Industry way the value for Z will be a large value

9. R is Radius for an End Mill

Note: If cutter comp is not used then the R value is not used

RAD.

10. T for cutter comp cutting direction
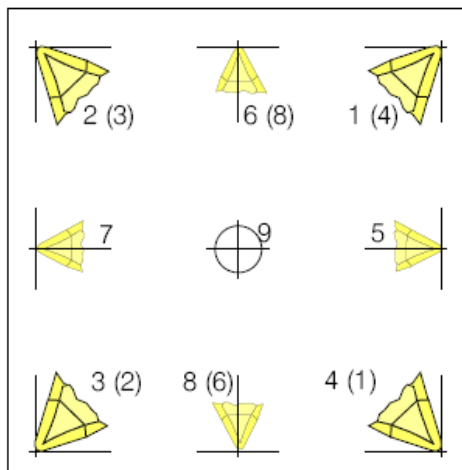
Live tools use 0 on Emco Education Fanuc Machines

11. Jog TURRET away from WORK PIECE using Z+

12. Repeat steps for all Axial Live tools

(STEPS 1-11 starting on pg 18)

1. Index the TURRET to a Radial tool

   - Move the MODE Dial to MDI position

   - Press Program button until PROGRAM (MDI) is at the top left of the screen

   - Type tool number then press INPUT button INPUT

     Example: T1100

   - Press CYCLE START ◇ (make sure door is closed)

2. Move the MODE Dial to JOG position

3. Jog TOOL TIP to the WORK PIECE & touch TOOL TIP to the DIAMETER of the WORK PIECE using the Direction keys.

(Use the Feed override dial or Steps to approach at a slower feed)

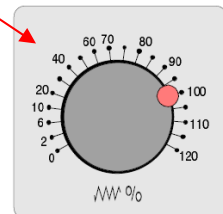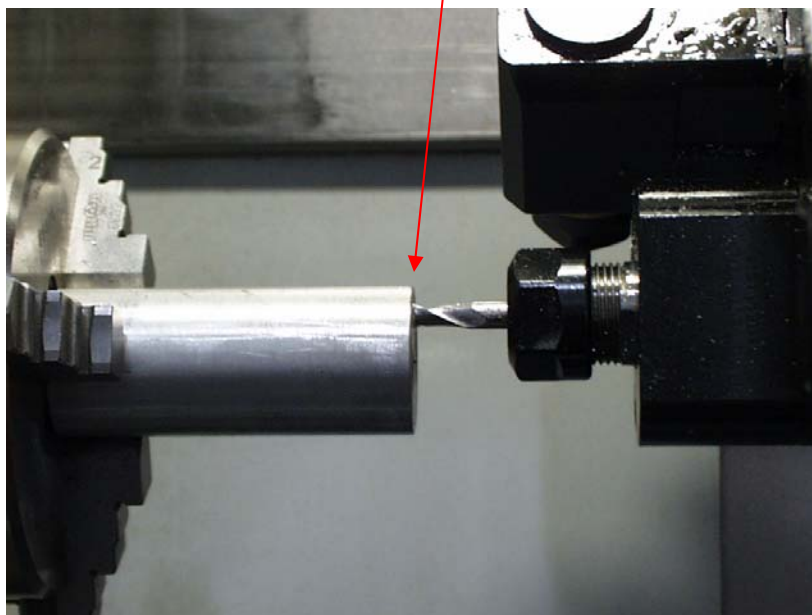4. Press the OFFSET/SETT button until Geometry page appears ⌐OFFSET SETT.⌐

5. Type X and the Diameter being scratched

Example: X1 (If the diameter being scratch is 1"dia.)

6. Cursor down and over to highlight the G0 X location for the tool that is being measured

(Picture below shows tool 9 is being measured)

7. Then press soft key for ⌐ MEASUR ⌐ (F4)

8. Jog TURRET away from WORK PIECE using X+

This value is the distance from an I.D. Tool Station to the Tool Tip

```
                                                    OF 100%

OFFSET ╱ GEOMETRY                          O0000  N00000
   NO.          X              Z              R       T
 G09         0.0000        0.0000         0.0000 0
 G10         0.0000        0.0000         0.0000 0
 G11         0.0000        0.0000         0.0000 0
 G12         0.0000        0.0000         0.0000 0
 G13         0.0000        0.0000         0.0000 0
 G14         0.0000        0.0000         0.0000 0
 G15         0.0000        0.0000         0.0000 0
 G16         0.0000        0.0000         0.0000 0
ACTUAL POSITION   (RELATIVE)
     X     3.2283                Z     3.1890

> X0_                                     OS100%  T
EDIT  ****  ***  ***        07:28:54
       F3          F4          F5          F6          F7
( NO.SRH ) ( MEASUR ) ( INP.C. ) ( +INPUT ) ( INPUT  )>
```

Industry Way Only; Education way skip steps 9-15

9. Jog TOOL TIP to the end of the WORK PIECE & touch TOOL DIAMETER to the FACE of the WORK PIECE using the Direction keys.

   (Use the Feed override dial or Steps to approach at a slower feed)

10. Press the OFFSET/SETT button until Geometry page appears

    OFFSET SETT.

11. Type Z and 0 for reading from work shift 0

Example: Z0

12. Cursor down and over to highlight the G0 Z location for the tool that is being measured

(Picture below shows tool 9 is being measured)

13. Then press soft key for

    F4
    (MEASUR)
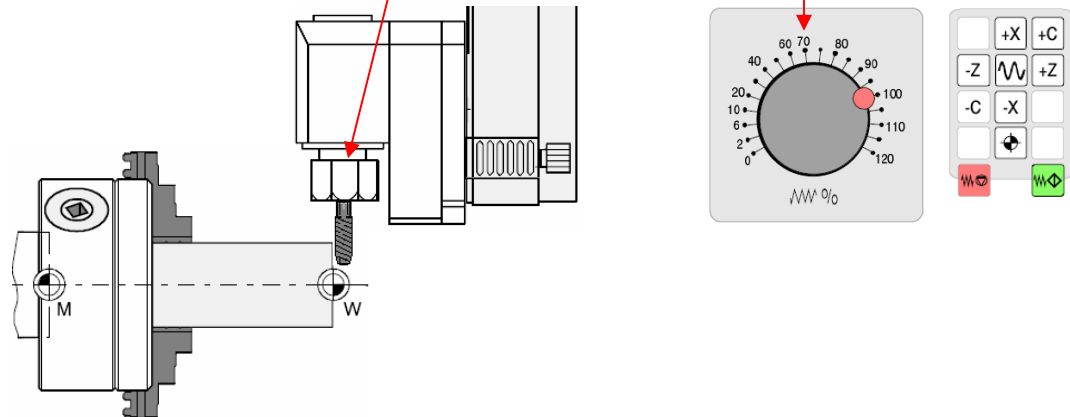
```
                                      OF100%
 OFFSET / GEOMETRY            O0000  N00000
   NO.      X           Z          R     T
 G09      2.1580      0.0000      0.0000 0
 G10      0.0000      0.0000      0.0000 0
 G11     -0.7875      3.1890      0.0000 0
 G12      0.0000      0.0000      0.0000 0
 G13      0.0000      0.0000      0.0000 0
 G14      0.0000      0.0000      0.0000 0
 G15      0.0000      0.0000      0.0000 0
 G16      0.0000      0.0000      0.0000 0
 ACTUAL POSITION  (RELATIVE)
     X    3.2283           Z     3.1890

 > Z0_                        OS100%  T
 EDIT  ****  ***  ***        07:36:13
        F3        F4       F5      F6        F7
 ( NO.SRH ) ( MEASUR ) ( INP.C. ) ( +INPUT ) ( INPUT )>
```

14. Type in - and the radius of the tool being used

Example: Using a ¼ inch drill or end mill   `> -.125_`

15. Press the soft keys for   `F6`
`( +INPUT )`

Education Way Only; Industry way skip step 16

16. **For Z type in 2.0078 inch which is (51 mm)**

2.0078 inch
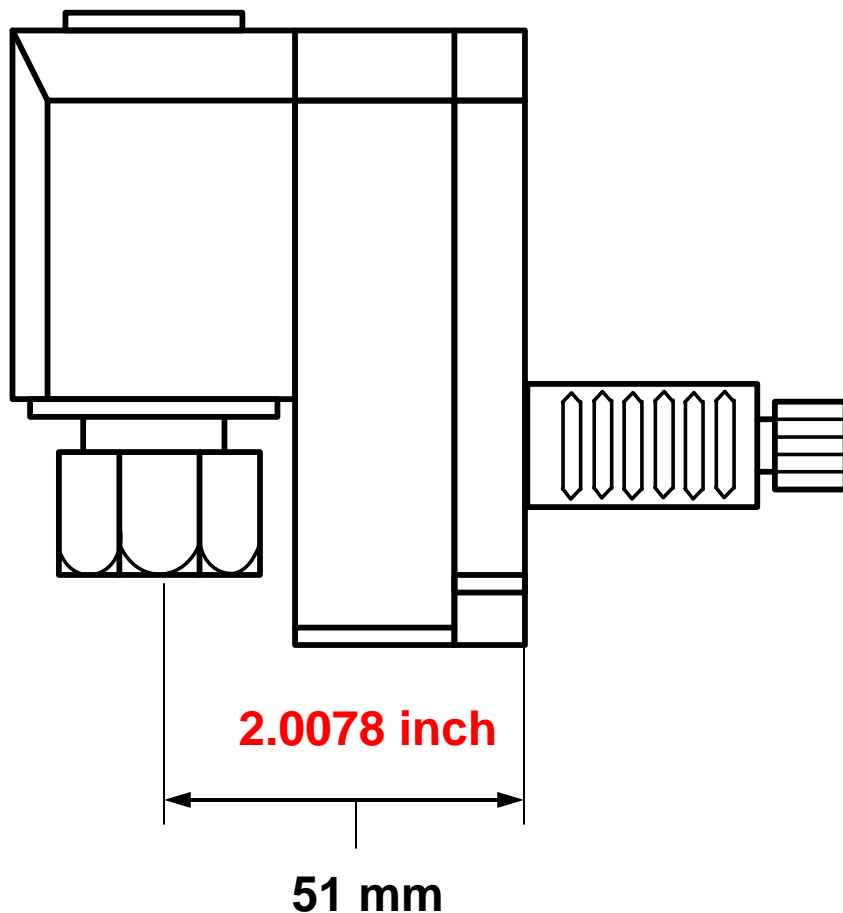
51 mm

Note: If you are using one of the plugs on the tool turret to set

Workshift subtract 12.1mm (.476) from the 51mm (2.0078)

Length is preset from tool manufacture (WTO), provided by

EMCO Maier

17. R is Radius for an End Mill

Note: If cutter comp is not used then the R value is not used

RAD.
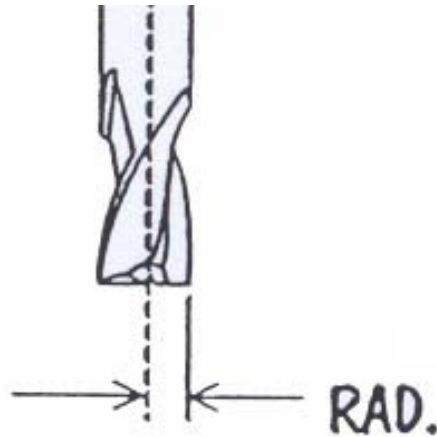
18. <u>T</u> for cutter comp cutting direction
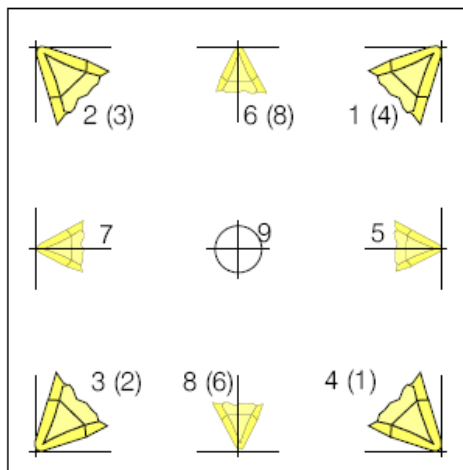
Live tools use 0 on Emco Education Fanuc Machines

19. Jog TURRET away from WORK PIECE using Z+

20. Repeat steps for all Radial Live tools

(STEPS 1-17 starting on pg 21)

Program Training

Program O0001
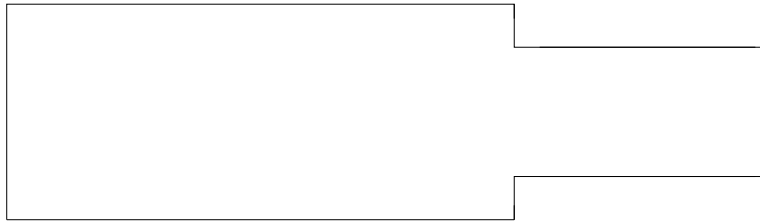
Program O0002
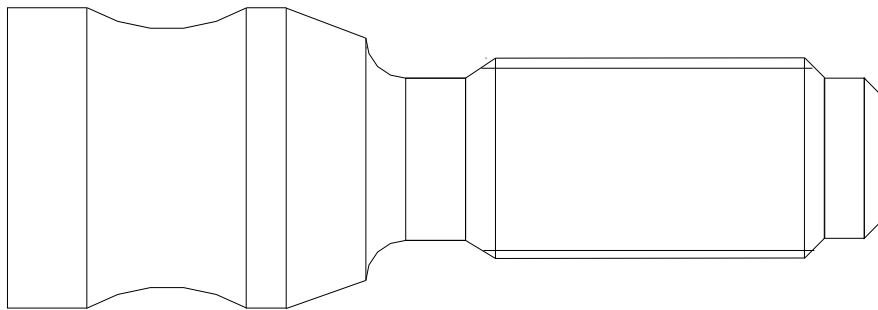
Program O0003
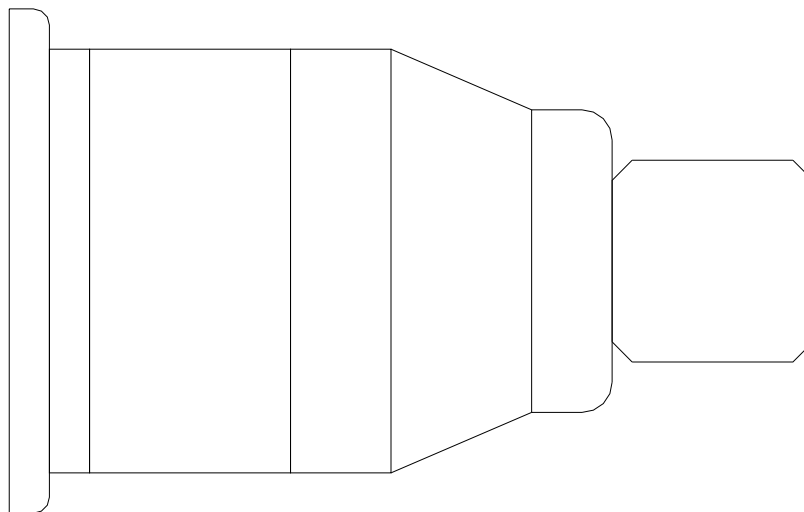
Change the Mode Dial to Edit
Press the Program Button
To do functions on this page
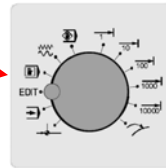
PROG

- ## INSERT A NEW PROGRAM

  1. Press letter o then a program number between 1- 8999

  2. Press insert button   INSERT

     Example: O0001 OR O1

- ## CALL A EXISTING PROGRAM UP

  1. Press letter o then program number in the directory

  2. Press cursor down button   ↓

- ## INSERT A WORD

  1. Press letter then number

  2. Press insert button   INSERT

     HINT: When inserting a word to the left of the highlighted word the new word will be placed

     Example: **N5 G01 X 0.25; G01** is the word being inserted

- ## INSERT END OF BLOCK

  1. Press the (EOB) button   EOB

  2. Press insert button   INSERT

     HINT: at the end of each number line needs an End Of Block looks like a Semicolon **(;)**

     Example: N5 G01 X1.00 F.003;

NOTE: IN EDIT & IN PROGRAM USE INSERT

      USE INPUT FOR ALL OTHER SCREENS AND MODES.

Change the Mode Dial to Edit
Press the Program Button
To do functions on this page
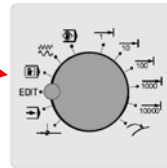
PROG

- ## DELETE A PROGRAM

  1. Press letter o then program number

  2. Press delete button DELETE

     Example: <u>O</u>0001 OR <u>O</u>1

- ## DELETE ALL PROGRAMS

  1. Press letter o plus the – & 9999

  2. Press delete button DELETE

     Example: <u>O – 9999</u>

- ## DELETE A WORD

  1. Highlight the Word

  2. Press delete button DELETE

- ## DELETE A BLOCK OR LINE NUMBER

  1. Type the number line and highlight the number line

  2. Press delete button DELETE

- ## CANCEL MISTYPED WORD (Backspace)

  1. Press cancel button CAN

     HINT: In the ADRS. (Address) at the lower left of the screen is
     the word & numbers that has been typed in. Before
     pressing insert or input check if what was typed in is
     correct. If not press cancel until error is erased and retype

Change the Mode Dial to Edit
Press the Program Button
To do functions on this page

PROG
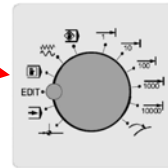
- ## ALTER A WORD

  1. Highlight the word needed altered type the change

  2. Press alter button ALTER

- ## SEARCH FOR NUMBER BLOCK

  1. Press letter n and the number of the block

  2. Press cursor down button ↓

- ## SEARCH FOR WORD

  1. Type in word & number

  2. Press cursor down button ↓

- ## SEARCH FOR LETTER

  1. Press letter

  2. Press cursor down button ↓

HINT: This goes to the first (G). Follow steps 1 & 2 cursor goes to the next (G)

Groups of G codes

There are 3 groups of G-Codes; Emco Group uses the C group of G-Codes.
In relation to the other two Groups the only differences is the # for the G-Code

Gr.		Command			Function
		A	B	C	
0	+	G04	G04	G04	Dwell
	+	G07.1	G07.1	G07.1	Cylindrical Interpolaton
	+	G10	G10	G10	Data setting
	+	G11	G11	G11	Data setting Off
	+	G28	G28	G28	Return to reference point
	+	G70	G70	G72	Finishing cycle
	+	G71	G71	G73	Stock removal in turning
	+	G72	G72	G74	Stock removal in facing
	+	G73	G73	G75	Pattern repeating
	+	G74	G74	G76	Deep hold drilling, cut-in cycle in Z
	+	G75	G75	G77	Cut in cycle in X
	+	G76	G76	G78	Multiple threading cycle
	+	G50	G92	G92	Coord.syst.set., Spindle speed limit
1	·	G00	G00	G00	Positioning (rapid traverse)
		G01	G01	G01	Linear interpolation clockwise
		G02	G02	G02	Circular interpolation clockwise
		G03	G03	G03	Circular interp. counterclockwise
		G90	G77	G20	Longitudinal turning cycle
		G92	G78	G21	Thread cutting cycle
		G94	G79	G24	Face turning cycle
		G32	G33	G33	Thread cutting
2		G96	G96	G96	Constant cutting speed
	·	G97	G97	G97	Direct spindle speed programming
3	·	-	G90	G90	Absolute programming
		-	G91	G91	Inkremental programming
5		G98	G94	G94	Feed per minute
	·	G99	G95	G95	Feed per revolution
6		G20	G20	G70	Inch data input
		G21	G21	G71	Metric data input
7	·	G40	G40	G40	Cancel cutter radius compensation
		G41	G41	G41	Cutter radius compensation left
		G42	G42	G42	Cutter compensation right
10	·	G80	G80	G80	Cancel cycles
		G83	G83	G83	Drilling cycle
		G84	G84	G84	Tapping cycle
		G85	G85	G85	Reaming cycle
11	·	-	G98	G98	Return to initial plane
		-	G99	G99	Return to withdrawal plane
16		G17	G17	G17	Plane selection XY
		G18	G18	G18	Plane selection ZX
		G19	G19	G19	Plane selection YZ
21		G12.1	G12.1	G12.1	Polar Coordinate Interpolation ON
		G13.1	G13.1	G13.1	Polar Coordinate Interpolation OFF

Example

G70 in the C group is programming in inches

G20 in the A & B group is programming in inches

Both are exactly the same but the G #

Survey of commands G-CODES (Group C): Mostly used

Model	**G00**	**Rapid traverse**
Model	G01	Linear interpolation in working feed
Model	G02	Circular interpolation, clockwise
Model	G03	Circular interpolation, counter-clockwise
Non-Model	G04	Dwell, active block by block
Model	G7.0	Cylindrical Interpolation OFF
Model	G7.1	Cylindrical Interpolation
Model	G10	Data Setting
Model	G11	Data Setting Off
Model	G12.1	Polar Coordinate Interpolation On
Model	G13.1	Polar Coordinate Interpolation Off
Model	G17	Plane Selection XY
Model	**G18**	**Plane Selection ZX**
Model	G19	Plane Selection YZ
Non-Model	G28	Approach reference point
Model	**G40**	**Deselect cutter radius compensation**
Model	G41	Cutter radius compensation left
Model	G42	Cutter radius compensation right
Model	**G70**	**Dimensions in inch**
Model	G71	Dimension in millimeter
Non-Model	G72	Finishing cycle
Non-Model	G73	Longitudinal turning cycle
Non-Model	G78	Multiple Thread cutting cycle
Model	**G80**	**Deselect drilling cycles**
Model	G83	Drilling cycle
Model	**G90**	**Absolute value programming**
Model	G91	Incremental value programming
Model	G92	Set coordinates zero point / speed limitation
Model	G94	Feed in inch/min
Model	**G95**	**Feed in inch/rev**
Model	G96	Constant cutting speed (Surface Footage)
Model	**G97**	**Constant speed**
Model	**G98**	**Return to start plane**
Model	G99	Return to withdraw plane

Bold print = is the Default codes that are on at all times until changed
Note: Most CONTROLS only take up to 4 G codes per line

Survey of commands M- CODES : Mostly used
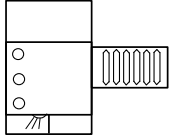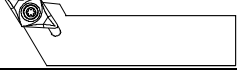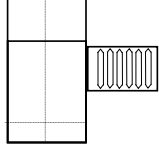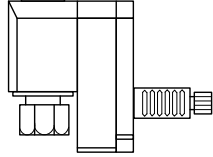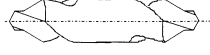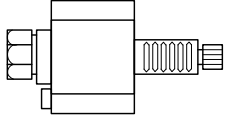
M00   Programmed stop unconditional
M02   Main program end, new start of program
M03   Spindle ON clockwise
M04   Spindle ON counter clockwise
M05   Spindle OFF
M13   Driven Tool On Clockwise
M14   Driven Tool On Counterclockwise
M15   Driven Tool Off
M20   Tailstock sleeve backward
M21   Tailstock sleeve forward
M25   Release clamping device
M26   Close clamping device
M30   Main program end with new start of program
M52   C-axis On
M53   C-axis Off
M71   Blow-off ON (cleaning clamping device)
M72   Blow-off OFF
M98   Subroutine called up
M99   Subroutine end
Only one M-command per Block

Used Addresses

A   Angle
C   Chamfer, Axis Position data
F   Feed rate, thread pitch
G   Path, movement function
I, K   Circle parameter
U, W   Incremental, cycle parameter
M   Miscellaneous, machine function
N   Block number 1 to 9999, macro call out
O   Program number 1 to 9499
P   Dwell, subroutine, cycle parameter
Q   Cutting depth, cycle parameter
R   Radius, retraction, cycle parameter
S   Spindle speed
T   Tool called out
X, Z   Position data in absolute

Need one of each tool and holder / collet's

Position	Part #	Discription	Picture
T0202	A8Z 240	Radial tool holder VDI 16, M4	
	271 050	Finishing tool left	
	271 056	Indexable inserts for aluminum	
T0404	A8Z 230	Radial tool holder VDI 16, M3	
	271 110	OD-threading tool right	
	271 115	Indexable inserts for OD-threading, right	
T0909	A8Z 480	Radial milling holder VDI 16	
	152 760	⌀.236" ESX 16 COLLET (6.0mm)	
	573 770	Center drill, HSS (6mm)	
T1111	A8Z 470	Axial milling holder VDI 16	
	152 760	⌀.236" ESX 16 COLLET (6.0mm)	
	764 304	ø6 mm / shank- ø6 mm	

Program screen & Edit mode
To edit / change a program / insert new programs & input or output excising programs & offsets

Program screen & MDI mode
To manually program the spindle speed / move the axis (X,Z) to a specified location and or Index to a certain tool

Note: Material is 2011-T3 Alum, All feeds & speeds are programmed for this type of Aluminum

Program <u>O0001</u>
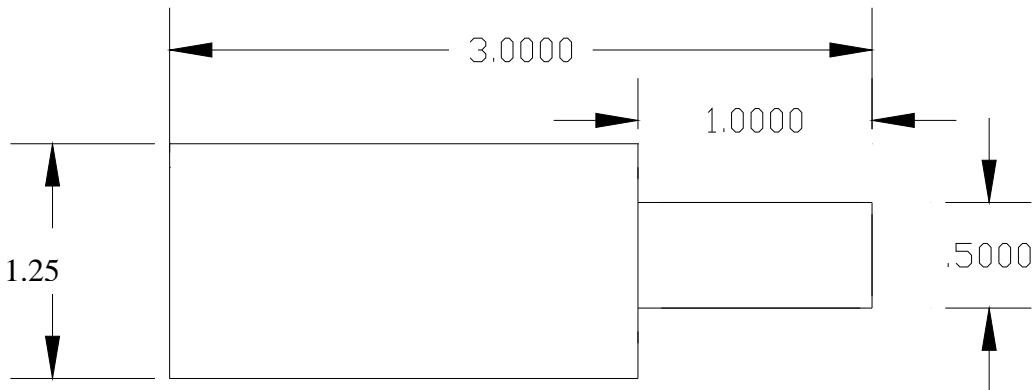
G73   U = Depth of Cut   R = Retract Value

G73   P = First Block number of the Contour (Block number after the 2nd G73)

          Q = Last Block number of the Contour   F = Feed rate for cycle

(Facing in a cycle)

O0001 (Demo 1)……………………………..	Label Line Only
N5 (3 x 1.25 alum)….....................................	Part Label Optional
N10 G40 G70 G80 G90..................................	Default G Codes
N15 G95 **G96** G98...	sfpm
N20 G0 G28 U0 W0………………….………	safe move
N25 T0202 S700 M4 (Finish Tool 55°)……….	Tool, Speed, Direction
N30 G0 X1.25 Z.1……………………………	start point of cycle
N35 G73 U.06 R.03…………………………..	cycle parameters
N40 G73 P45 Q65 F.004……….….............	cycle begin / end lines
N45 G0 X0…………………………………..	first line of cycle
N50 G1 Z0.0……………………………….…	Z to Face of part
N55 X.5………………………………………	1st diameter of contour
N60 Z-1.0…………………………………….	length of contour
N65 X1.25………………………….…..……	diameter of contour
N70 G0 G28 U0 W0..………………………	safe move
N75 M30…………………………….………	end of program

2D Simulation

1. Press Graph button on the Display Keys for the Graph screen to appear

```
                                              OF 100%

   GRAPHIC PARAMETER                  O0001  N00000

     WORK LENGTH          W  =          0.0000
     WORK DIAMETER        D  =          0.0000
     PROGRAM STOP         N  =               0
     AUTO ERASE           A  =               1
     LIMIT                L  =               0
     GRAPHIC CENTER       X  =          0.0000
                          Z  =          0.0000
     SCALE                S  =          0.000
     GRAPHIC MODE         M  =               0



   > _                                 OS 100%  T
     JOG  ****  ***  ***          20:21:13
          F3           F4          F5           F6           F7
   [ G.PRM ] [         ] [ GRAPH  ] [         ] [          ] >
```

Note: There are only 4 values you can change on this page the rest of
      them change by the values you will enter. This graph only works
      with an active program and runs only the current program selected

2. Work Length W = Overall length of stock in the Z direction this is a + value

3. Work Diameter D = Overall diameter of stock in the X direction + value

4. Graphic Center X = any area you wish to see past X0. Usually only if a
                      Drill or a Tap is being used place a – value to see the
                      tool movements for X pasted 0
          Example -.100 is a common value entered

5. Graphic Center Z = this value is always a negative number and this is the
                      area you wish to view. The longest Z- number in the
                      program is normally used here

6. Press the Soft key Graph for Simulation screen

```
                                                        OF 100%

              S        0.000                    O0001  N00000
                                                  X      0.0000
      X                                           Z      0.0000
      ↑



                                                 →Z
                                            OS100%  T
     JOG   ****   ***   ***          20:36:48
           F3            F4          F5            F6            F7
   [ G.PRM  ] [         ] [ GRAPH  ] [          ] [          ] >
```
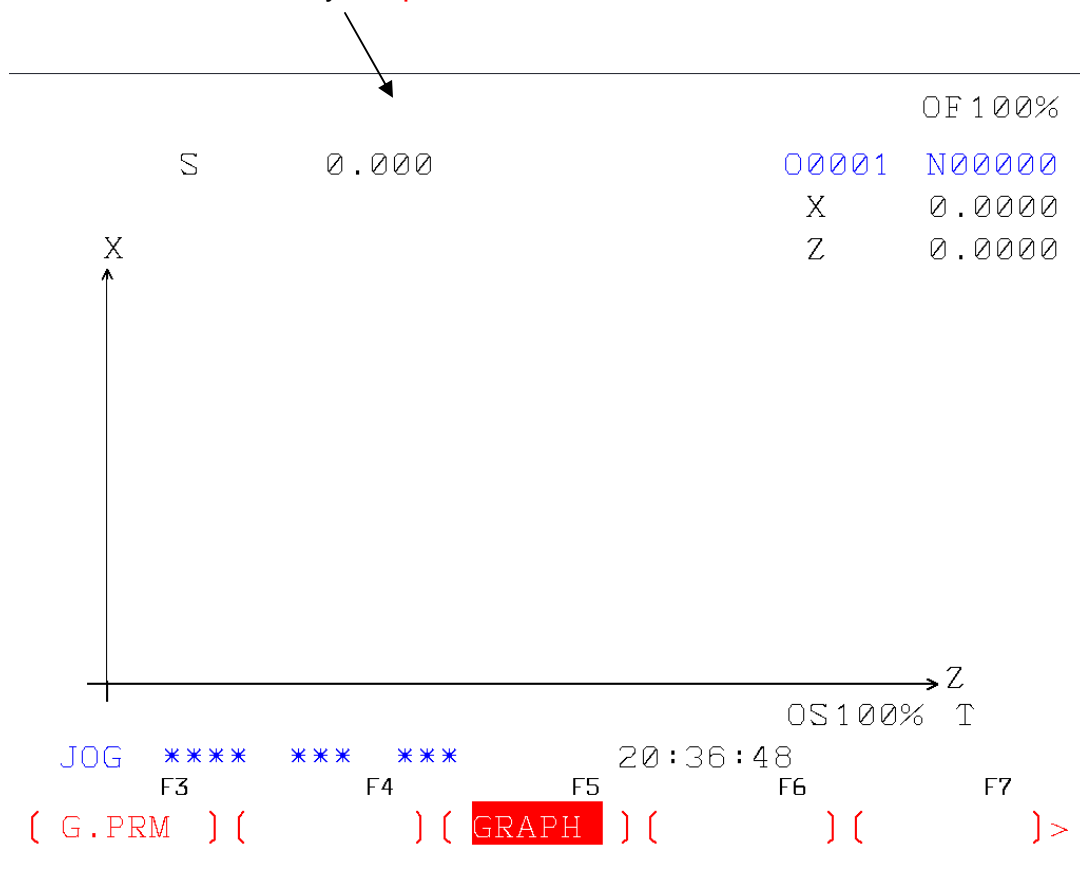
7. Now press Cycle start and you will see the tool movements of the program

- **Changing I/O to floppy drive** (Only need to do this once stays default)

    1. Move the Mode Dial to **EDIT**
    2. Press **System** on the display keys
    3. Page down until you see Parameter (Manual)
    4. Cursor down to the I/O

    5. Type A (for the Floppy Drive) press Input key

Other Drives useable: B (Drive), C (Drive), P (Printer), 1, 2 (Com Ports)

Note: If you want to use USB use C and then follow instruction in the Appendix

- **Output Program from Fanuc software to Drive unit**

    1. Press the **Program** on the display key
    2. Type program number to be send out
       Example: letter O and program number
       (O0002) or (O2)

    3. Press the right Arrow key on the Soft keys
    4. Press Punch then press Exec

- **Output Offsets from Fanuc software to Drive unit**

    1. Press the **Offset/Sett** display key
    2. Press (OPRT)
    3. Press the right Arrow key on the Soft keys
    4. Press Punch then press Exec

- **Input Program into Fanuc Software from Drive unit**

    1. Press the **Program** display key

    2. Type program number to be read
       Example: letter O and program number
       (O0002) or (O2)

    3. Press the right Arrow key on the Soft keys
    4. Press Read then press Exec

- **Input Offsets into Fanuc Software from Drive unit**

    1. Press the **Offset/Sett** display key

    2. Press (OPRT)

    3. Press the right Arrow key on the Soft keys
    4. Press Read then press Exec

Running a Program

Note: If the correct program # is at the top right corner of the screen then skip step 3 only and press reset for step 3

1. Rotate the Mode dial to Edit

2. Press the Program button   PROG

3. Call up Program to be run / cut
   (Example O1 for program 1)

4. Rotate the Mode dial to MEM

5. If screen is not in PROGRAM CHECK then press program button until this is at the top left of the screen   PROG

6. Press the Single Block button for the program to run one line at a time.   SBL

Note: Use one hand on the feed override dial slowly increasing it and the other pressing cycle start and close to the reset button
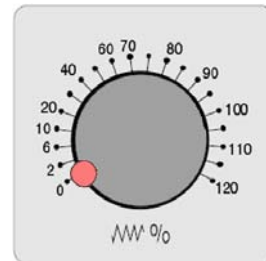
7. Press Cycle Start and continue
(Once the program have moved in the safe called out locations for X, Z and looks right; you can take single block off and run the program)

8. Press Cycle Start one more time
(If there is more than one tool; before the next tool use single block to check the offsets locations for X, Z then continue at step 8 again)

Program <u>O</u>0001 using C/R's
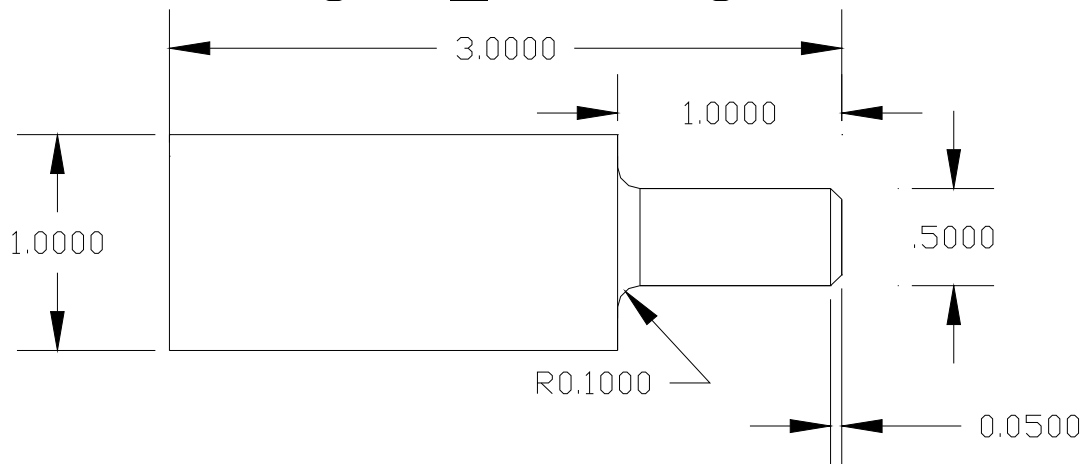

G73   U = Depth of Cut   R = Retract Value

G73   P = First Block number of the Contour (Block number after the 2nd G73)

           Q = Last Block number of the Contour   F = Feed rate for cycle

(Facing in a cycle)

O0001(Demo 1)

N5 (3.25 x 1" alum)

N10 G40 G70 G80 G90

N15 G95 **G96** G98……………...............sfpm

N20 G0 Z2.0……………………………..safe move

N25 T0202 S550 M3 (Finish Tool 55°)

N30 G0 X1.0 Z.1…………….……………start point of cycle

N35 G73 U.03 R.015………………………..cycle parameters

N40 G73 P45 Q65 F.004……………........cycle begin and end lines

N45 G0 X0………………………….……….first line of cycle

N50 G1 Z0.0……………………….……….movement to face of part

N55 X.5 C.05……………………………..1st diameter of contour

N60 Z-1.0 R.1………………….…………length of contour

N65 X1.0………………………….…..…..diameter of contour

N70 G0 Z2.0……………………….………safe move

N75 M30……………………………….……end of program

Program <u>O</u>0002
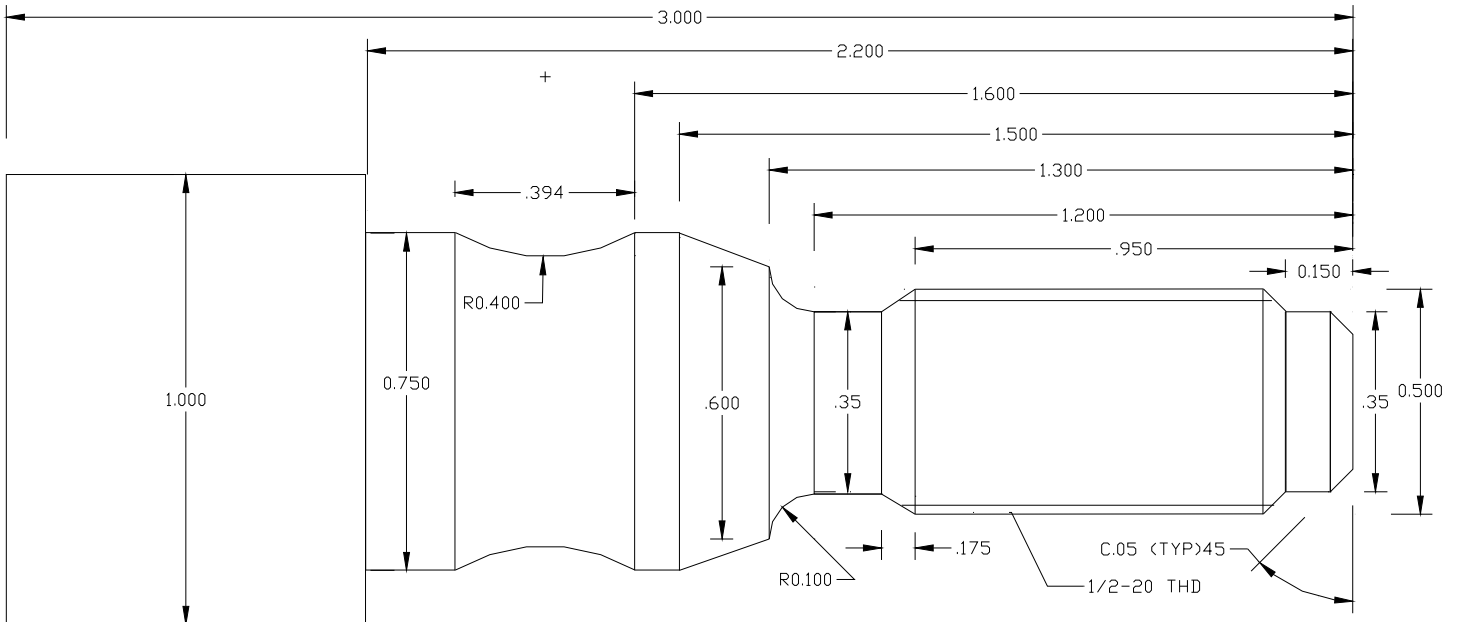
G73   **U** = Depth of Cut   **R** = Retract Value

G73   **P** = First Block number of the Contour (Block number after the 2nd G73)
   Q = Last Block number of the Contour   **U** = Allowance for Finish cut in X
   W = Allowance for Finish cut in Z   **F** = Feed rate for the cycle

HINT:

The X **BEFORE** G73 example (X 1.25) should be (=) to or (>) than X at the **END**

of the Cycle. X at the end of the cycle determines stock size

G72   **P** = First Block number of the Contour (Block number after G73)
   Q = Last Block number of the Contour

HINT:

BEFORE the G72 call a spindle **SPEED** higher and **FEED** rate lower

If possible change tool to a 55 degrees for FINISHING & 80 degree for

ROUGHING

G78 CYCLE MULTIPLE
Example for 1/2 20 thread

1ST G78

P = Is 6 Digits divided in 2 Digit groups

P = 1st two digits is number of FINISH PASSES   01

      2ND two digits is PULL OUT ANGLE   00

      3rd two digits is angle of the THREADS   60 degrees

Q = Minimum cutting DEPTH   0020 (Micro IN)

R = Finishing OFFSET   .001

2nd G78

X = Minor DIA.   X .434

Z = Length of THREAD from (0) call out   Z -1.05

P = Depth of THREAD Radial   0330 (Micro IN)

Q = First cutting DEPTH   0120 (Micro IN)

F = Thread PITCH   .050

Micro IN is the value without the decimal point

Example: .1000 is shown as 1000 (show all 4 place values)

HINT:
Threading

$$\frac{1}{TPI} = \frac{1}{20} = (F) \ .05$$

IPM = RPM X PITCH

$$RPM = \frac{IPM}{PITCH} = \frac{50}{.05} = 1000 \ RPM \qquad 78 \text{ is max for a Concept 55 Machine}$$

Make sure the X value before the G78 is larger than the MAJOR Diameter and the Z is at least 2 times the PITCH before cutting threads

      Example: N100 G0 X.55 Z.1 ;   THIS IS THE START POINT FOR G78
               N105 G78 ;

Program O0002

O0002 (Demo 2)
N5 (Stock 3.25 x 1 alum)
N10 G0 Z2
N15 G96 T0202 S550 M3 (Finish Tool 55°)
N20 G0 X1.1 Z.1…………………………………..Safe start for Facing
N25 Z0..……………………………………….Face of part
N30 G1 X-.02 F.002...………………………Facing past Zero
N35 G0 X1.0 Z.1…………………………………Start point of cycle
N40 G73 U.04 R.02…………………………Cycle parameters
N45 G73 P50 Q115 U.01 W.005 F.004.….Cycle finish offsets
N50 G0 G42 X.2…...…………………………Turning CRC on
N55 G1 Z0……………………………………Face of part
N60 X.35 C.05
N65 Z-.15
N70 X.5 C.05
N75 Z-.950
N80 X.35 Z-1.125
N85 Z-1.3 R.1
N90 X.6
N95 X.75 Z-1.5
N100 Z-1.6
N105 G2 X.75 Z-1.994 R.4
N110 G1 Z-2.2
N115 G1 X1.0
N120 G0 G40 X1.1…...……………………..Cancel CRC
N125 S700 F.002
N130 G72 P50 Q120
N135 G0 Z2 …………………………………Safe Index Pos
N140 G97 S560 M3 …………….………...Threading Speed in RPM
N145 T0404 (Threading Tool Right Hand)
N150 X.55 Z.1……………………………….Start Pos. Thread Cycle
N155 G78 P010060 Q0020 R.001……..….Threading cycle
N160 G78 X.434 Z-1.125 P0330 Q0120 F.05
N165 G0 Z2 ……...……………………………Safe Return
N170 M30.…………………………………End of Program

1. To make a program tie together use M98 this calls out Sub programs or Sub routines.
   Example: M98 P010001

2. After M98 P is identified with 6 digits.
   - The First 2 digits is the number of times program is to be repeated
   - The next 4 digits is the program number without the letter <u>O</u>

3. Programs that are being used as a Sub Programs must end with M99 instead of M30.

4. All programs can be used as Sub Programs or Main Programs M99 means program is Sub, M30 means program is a Main

5. A main Program can also use M99 at the end.
   - Program is being used to repeat without cutting multiple parts.
   - This is mainly used for Demo's for just seeing Tool movements.

TEST FOR SUB PROGRAMS
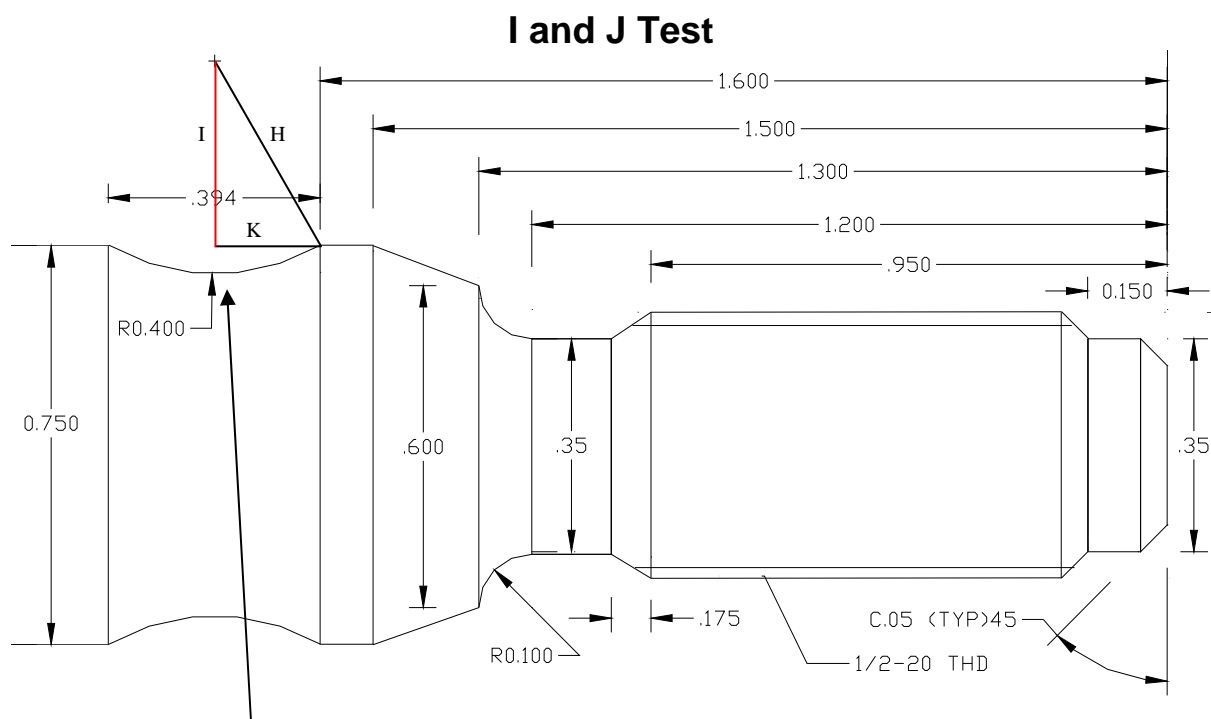
O0005 (Tie Programs)
N5 (Stock 3.25 x 1 alum)
N10
N15
N20
Changing Item
Note: Change the end of O0001 and O0002 to M99 for running them
     as SUB PROGRAMS

I and J Test

Find the I and J for the arc in the picture

A^2 (K leg)$+ B^2$ (I leg) $= C^2$ (H radius)
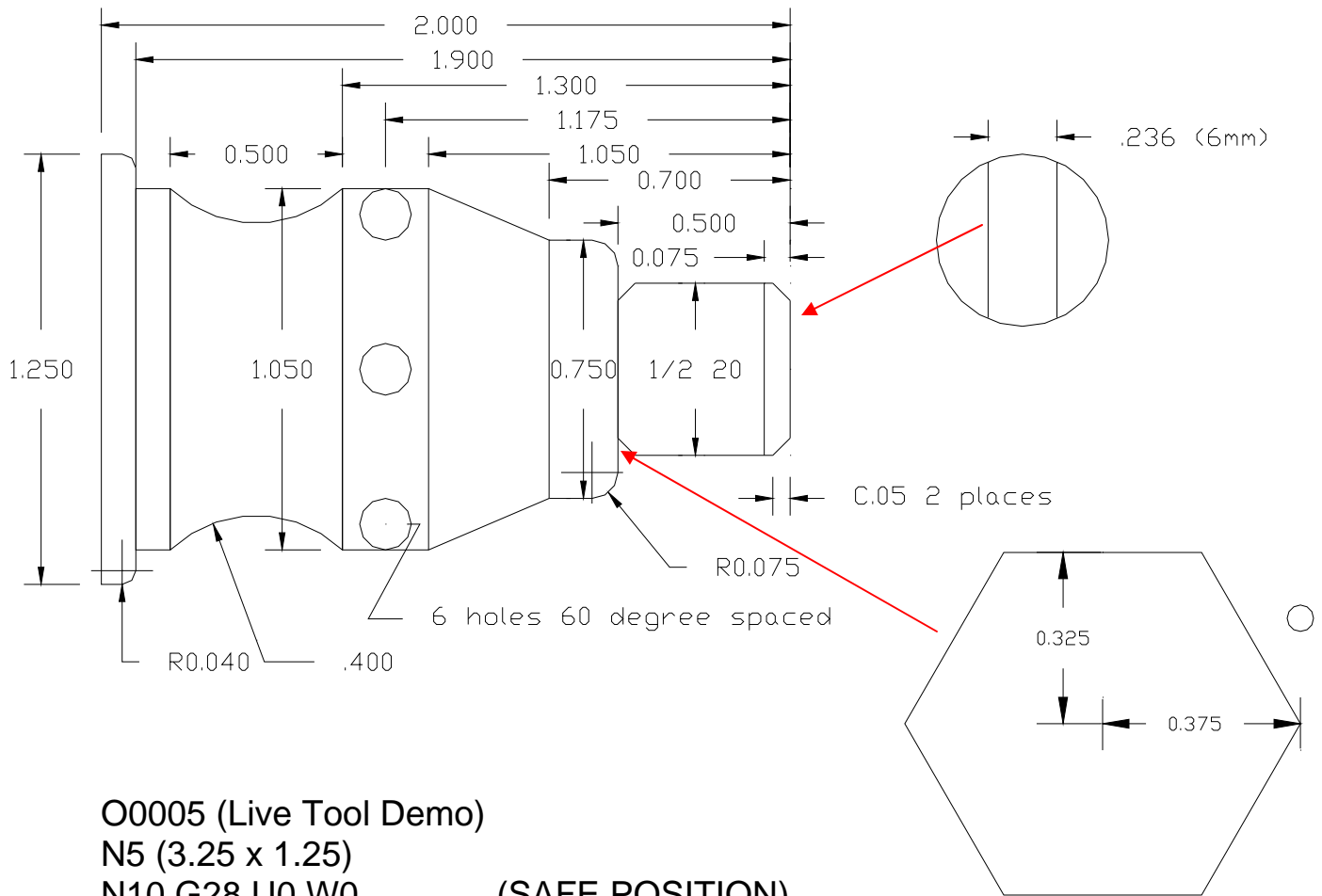
$$S \quad \frac{O}{H}$$

$$C \quad \frac{A}{H}$$

$$T \quad \frac{O}{A}$$

Sally Can Tell Oscar Has A Hat On Always

SINE   COSINE   TANGENT

Program O0005

O0005 (Live Tool Demo)
N5 (3.25 x 1.25)
N10 G28 U0 W0   (SAFE POSITION)
N15 T0202   (FINISHING TOOL LEFT HAND)
N20 G96 S700 M4
N25 X1.3 Z0   (FACING)
N30 G1 X-.02 F.003
N35 G0 X1.25 Z.1
N40 G73 U.1 R.05   (ROUGHING CYCLE)
N45 G73 P50 Q110 U.01 W.005 F.004
N50 G0 G42 X.3
N55 G1 Z0
N60 G1 X.5 C.05
N65 Z-.4
N70 X.45 Z-.5
N75 X.75 R.075
N80 Z-.7

N85 X1.05 Z-1.1
N90 Z-1.3
N95 G2 X1.05 Z-1.8 R.400
N100 G1 Z-1.9
N105 X1.25 R.04
N110 Z-2.0
N115 G0 G40 X1.26
N120 S900 F.002
N125 G72 P50 Q115   (FINISHING CYCLE)
N130 G28 U0 W0   (SAFE INDEX MOVE)
N135 G97 T0404 S1000 M3   (THREADING TOOL RIGHT HAND)
N140 G0 X.55 Z.2
N145 G78 P010060 Q0020 R.001   (THREADING CYCLE)
N150 G78 X.414 Z-.45 P0330 Q0100 F.05
N155 G28 U0 W0
USING THE C-AXIS AS A Y-AXIS
N160 M5
N165 T1111   (6 mm END MILL in AXIAL HOLDER)
N170 M52   (TURN ON C AXIS)
N175 M13   (LIVE SPINDLE ON CLOCKWISE)
N180 G97 S1500   (DIRECT RPM)
N185 G28 C0   (REFERENCE C AXIS)
N190 G12.1   (PCI ON)
N195 G0 X1.3 Z-.7 C0   (SAFE MOVE)
N200 G1 G41 X.750 C.2 F.008   (CRC ON)
N205 G1 C0 F.004   (POSITION 1)
N210 X.375 C-.325   (POSITION 2)
N215 X-.375   (POSITION 3)
N220 X-.750 C0   (POSITION 4)
N225 X-.375 C.325   (POSITION 5)
N230 X.375   (POSITION 6)
N235 X.750 C0   (POSITION 7)
N240 C-.200   (SAFE MOVE)
N245 G1 G40 X.9 C-.4   (CRC OFF)
N250 G13.1   (PCI OFF)
N255 G0 X.9 Z-.25 M15   (LIVE SPINDLE OFF)
N260 M53   (C-AXIS OFF)

USING THE C-AXIS AS DEGREES

```
N265 M52                          (C-AXIS ON)
N270 M13                          (LIVE SPINDLE CLOCKWISE)
N275 G97 S1500                    (DIRECT RPM)
N280 G28 C0                       (REFERENCE C-AXIS)
N285 G0 X.8                       (MAKING SLOT ON THE FRONT OF PART)
N290 C90                          (TURN C IN DEGREES)
N295 G1 X0 F.003
N300 G0 C270                      (TURN C IN DEGREES)
N305 G1 X.8
N310 G28 U0 W0
N315 T0909                        (CENTER DRILL IN RADIAL HOLDER)
N320 G97 S1800                    (LIVE SPINDLE CLOCKWISE)
N325 G0 X1.1                      (MAKING DRILLED HOLES AROUND PART)
N330 Z-1.2
N335 C60                          (DEGREES)
N340 G1 X.65 F.003
N345 G0 X1.1
N350 C120                         (DEGREES)
N355 G1 X.65
N360 G0 X1.1
N365 C180                         (DEGREES)
N370 G1 X.65
N375 G0 X1.1
N380 C240                         (DEGREES)
N385 G1 X.65
N390 G0 X1.1
N395 C300                         (DEGREES)
N400 G1 X.65
N405 G0 X1.1
N410 C360                         (DEGREES)
N415 G1 X.65
N420 G0 X1.1 M15
N425 M53                          (C-AXIS OFF)
N430 G28 U0 W0
N435 G97
N440 T0404 S1000 M3               (THREADING TOOL RIGHT HAND)
N445 G0 X.55 Z.2                  (DEBURRING THREADS)
N450 G78 P010060 Q0330 R.001
N455 G78 X.414 Z-.45 P0330 Q0100 F.05
N460 G28 U0 W0                    (SAFE MOVE)
N465 M30
```
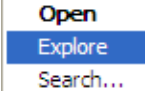
Appendix

Changing Drive to USB Port

1. **Close out the SW (software)**

   - **Press** **to allow you to exit**

   - **Press** SKIP **and** **together to exit the Software**

2. **Make sure USB is plug into port**

3. **Open Explorer**

   - **Right Click on Either My Computer, My Documents or any Folder on the Desktop**

   - **Move mouse to** **(Explorer)**

   - **Left Click**

   - **If you right clicked on My computer skip to step 4 if not then Left Click on My Computer**
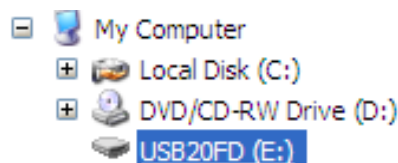
4. **Copy Drive directory**

   - **Click on you USB drive**

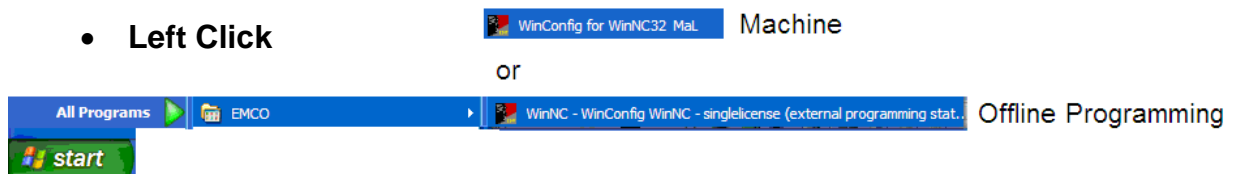   - **At the top of the active screen or page in the Address copy or remember drive info**
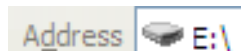
   - **Close the active screen or page using either Alt and F4 or** **at top of the active screen**
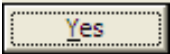
5. Setting up WinConfig

- **Left Click on Green Start button on Desktop**

- **Move mouse to All Program or Programs**

- **Move mouse to EMCO**

- **Move mouse to WinNC-WinConfig WinNC or WinNC32 – Singlelicense or MultipleLicense or Mal (Machine)**

- **Left Click**   WinConfig for WinNC32 MaL   Machine

   or

   All Programs ▶ EMCO   ▶   WinNC - WinConfig WinNC - singlelicense (external programming stat..   Offline Programming

   start

6. In Winconfig

- **Left Click on** [INI] **(INI) button**

- **Double Left Click on** Directories **(Directories)**

- **Left click on white box**

   Import / Export directory

- **Either Press Ctrl and V (this will paste in the info) or type in USB directory**

- **Left Click on** OK **(OK)**

- **Left Click on** ✕ **(Close)**

- **Left Click on** Yes **(Yes) to save the changes**

7. Restart SW (software)

- **Left Click on Green Start button on Desktop**

- **Move mouse to All Program or Programs**

- **Move mouse to EMCO**

- **Move mouse to WinNC with this** 🖥 **icon on it**

- **Left Click**

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