

Rotary Programming

...with Universal Rotary

HURCO[®]

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What is Universal Rotary?

The Universal Rotary program type is designed to operate on any 4- or 5-axis Hurco machine - regardless of the axis configuration.

The control will make the necessary movements based on the axes that it has available.

This means that Universal Rotary programs can be shared between many machines in the shop, and allows the operator to use whichever machine is available at the time...not just the machine that the program was run on previously.

Programming with Universal Rotary

PROGRAM PROPERTIES

DISP UNITS: INCHES

NAME: NONAME1.HVM

PATH:

MATERIAL: UNSPECIFIED

DESCRIPTION:

PROGRAM TYPE: TILT A, ROTARY C

WRITE PROTECTION:

- STANDARD
- ROTARY A
- ROTARY A, TILT B
- TILT A, ROTARY C
- ROTARY B
- TILT B, ROTARY C
- UNIVERSAL ROTARY**

Make sure the program type is set to Universal Rotary in Program Properties

- INPUT
- PROGRAM MANAGER
- PROGRAM PROPERTIES

CONVERSATIONAL SETTINGS

MATH ASSIST STYLE: ULTIMAX CLASSIC

CHECK CALC ASSIST INCONSISTENCIES: NO

DEFAULT CONVERSATIONAL PROGRAM TYPE: UNIVERSAL

DISPLAY MACHINE AXES FOR UNIVERSAL TY:

HD3 SAVE PROGRAM TYPE:

WARN BEFORE SAVING IN OLD FORMAT:

DATA BLOCK TOOL ENTRY:

FEED AND SPEED UPDATE: PROMPT REPLACE

Select the default program type when creating new HVM files.
PRESS MANUAL MODE, POWER, AND START CYCLE TO RESTORE POWER.

STANDARD	F1
ROTARY A	F2
ROTARY A TILT B	F3
TILT A ROTARY C	F4
ROTARY B	F5
TILT B ROTARY C	F6
UNIVERSAL	F7
EXIT	F8

Also, make Universal Rotary the default programming type in User Preferences

- AUXILLIARY
- UTILITY SCREEN
- USER PREFERENCES
- CONVERSATIONAL SETTINGS
- SET DEFAULT TO UNIVERSAL

Rotary Orientation Settings

BLOCK ROTARY PARAMETERS

ROTARY ORIENTATION

ORIGIN POINT		AXIS OF ROTATION	
X	<input type="text" value="0.0000"/>	VECTOR X	<input type="text" value="0.0000"/>
Y	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="0.0000"/>
Z	<input type="text" value="0.0000"/>	VECTOR Z	<input type="text" value="1.0000"/>

This tutorial explains each of the settings for the USER DEFINED rotary orientation

BLOCK ROTARY PARAMETERS

ROTARY ORIENTATION

ORIGIN POINT		AXIS OF ROTATION	
X	<input type="text" value="0.0000"/>	VECTOR X	<input type="text" value="0.0000"/>
Y	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="0.0000"/>
Z	<input type="text" value="0.0000"/>	VECTOR Z	<input type="text" value="1.0000"/>

You can also select a specific machine configuration from the menu.

NOTE: some AXIS dimensions (+/-) values may be reversed if this method is used.

Rotary Parameters are used to orient the cylinder

BLOCK	<input type="text" value="1"/>	ROTARY PARAMETERS	
ROTARY ORIENTATION		<input type="text" value="USER DEFINE"/>	
ORIGIN POINT		AXIS OF ROTATION	
X	<input type="text" value="0.0000"/>	VECTOR X	<input type="text" value="0.000"/>
Y	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="0.000"/>
Z	<input type="text" value="0.0000"/>	VECTOR Z	<input type="text" value="1.000"/>
CYLINDER RADIUS DATA		ZERO ANGLE	
TYPE	<input type="text" value="USE RADIUS STAR"/>	VECTOR X	<input type="text" value="0.000"/>
RADIUS	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="1.000"/>
		VECTOR Z	<input type="text" value="0.000"/>
TOOL VECTOR ANGLE TO CYLINDER AXIS	<input type="text" value="90.000"/>	OFF CL DISTANCE	<input type="text" value="0.0000"/>

Rotary Parameters are used to orient the cylinder

BLOCK	<input type="text" value="1"/>	ROTARY PARAMETERS	
		ROTARY ORIENTATION	<input type="text" value="USER DEFINE"/>
ORIGIN POINT		AXIS OF ROTATION	
X	<input type="text" value="0.0000"/>	VECTOR X	<input type="text" value="0.000"/>
Y	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="0.000"/>
Z	<input type="text" value="0.0000"/>	VECTOR Z	<input type="text" value="1.000"/>
CYLINDER RADIUS DATA		ZERO ANGLE	
TYPE	<input type="text" value="USE RADIUS STAR"/>	VECTOR X	<input type="text" value="0.000"/>
RADIUS	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="1.000"/>
		VECTOR Z	<input type="text" value="0.000"/>
TOOL VECTOR ANGLE TO CYLINDER AXIS	<input type="text" value="90.000"/>	OFF CL DISTANCE	<input type="text" value="0.0000"/>

Use a value of 1.000 for all settings in the six outlined fields (inside RED box).

Think of these settings as turning on a control BIT:
1 = ON
0 = OFF

Only one of each set of three fields should have a value of 1.000...the other two of each group should remain 0.000.

Axis of Rotation Settings

BLOCK	1	ROTARY PARAMETERS	
ROTARY ORIENTATION		USER DEFINE ▼	
ORIGIN POINT		AXIS OF ROTATION	
X	0.0000	VECTOR X	0.000
Y	0.0000	VECTOR Y	0.000
Z	0.0000	VECTOR Z	1.000
CYLINDER RADIUS DATA		ZERO ANGLE	
TYPE	USE RADIUS STAR ▼	VECTOR X	0.000
RADIUS	0.0000	VECTOR Y	1.000
TOOL VECTOR ANGLE TO CYLINDER AXIS		VECTOR Z	0.000
90.000		OFF CL DISTANCE	0.0000

The AXIS OF ROTATION settings are used to dictate the orientation of the cylinder for rotary programming on a particular machine (A-axis, C-axis, B-axis)

Place a value of 1.000 in the field for the axis that the rotary axis rotates around.

Rotary C-axis is shown in the example.

Axis of Rotation Settings

Since UNIVERSAL ROTARY programs are designed to run on ANY machine configuration, this setting must be changed if the machine configuration changes.

For example: the previous slide showed a C-axis machine configuration. This slide shows an A-axis machine configuration.

BLOCK	<input type="text" value="1"/>	ROTARY PARAMETERS	
ROTARY ORIENTATION		<input type="text" value="USER DEFINE"/>	
ORIGIN POINT		AXIS OF ROTATION	
X	<input type="text" value="0.0000"/>	VECTOR X	<input type="text" value="1.000"/>
Y	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="0.000"/>
Z	<input type="text" value="0.0000"/>	VECTOR Z	<input type="text" value="0.000"/>
CYLINDER RADIUS DATA		ZERO ANGLE	
TYPE	<input type="text" value="USE RADIUS STAR"/>	VECTOR X	<input type="text" value="0.000"/>
RADIUS	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="1.000"/>
TOOL VECTOR ANGLE TO CYLINDER AXIS		VECTOR Z	<input type="text" value="0.000"/>
<input type="text" value="90.000"/>		OFF CL DISTANCE	<input type="text" value="0.0000"/>

Zero Angle Settings

The ZERO ANGLE settings are used to determine where 0° is located on the cylinder.

In this C-axis machine example, the 0° location is at the 12 o'clock position...because from the center of the cylinder, the 0° is located in the positive Y-axis direction on the cylinder.

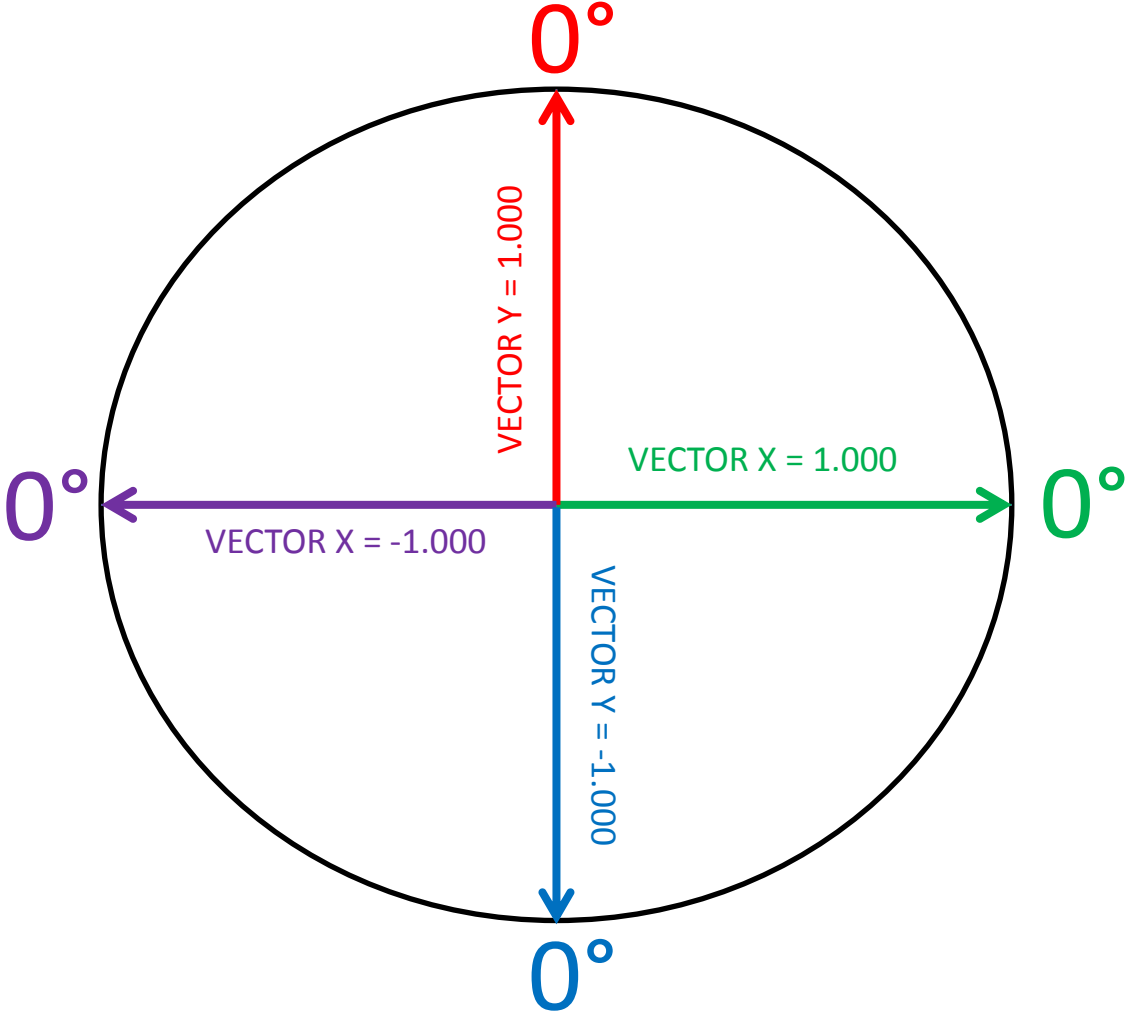
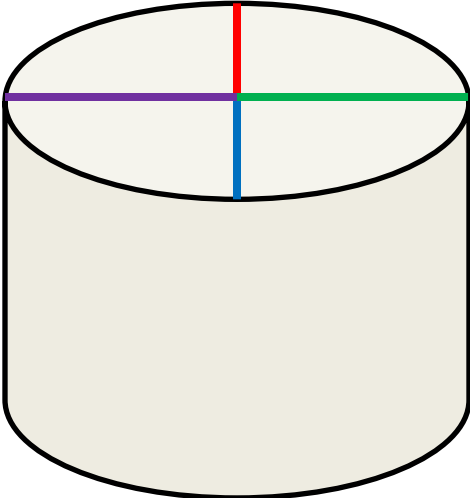
See following slides for diagram

BLOCK	1	ROTARY PARAMETERS	
ROTARY ORIENTATION		USER DEFINE ▼	
ORIGIN POINT		AXIS OF ROTATION	
X	0.0000	VECTOR X	0.000
Y	0.0000	VECTOR Y	0.000
Z	0.0000	VECTOR Z	1.000
CYLINDER RADIUS DATA		ZERO ANGLE	
TYPE	USE RADIUS STAR ▼	VECTOR X	0.000
RADIUS	0.0000	VECTOR Y	1.000
		VECTOR Z	0.000
TOOL VECTOR ANGLE TO CYLINDER AXIS	90.000	OFF CL DISTANCE	0.0000

Zero Angle Settings

C-Axis

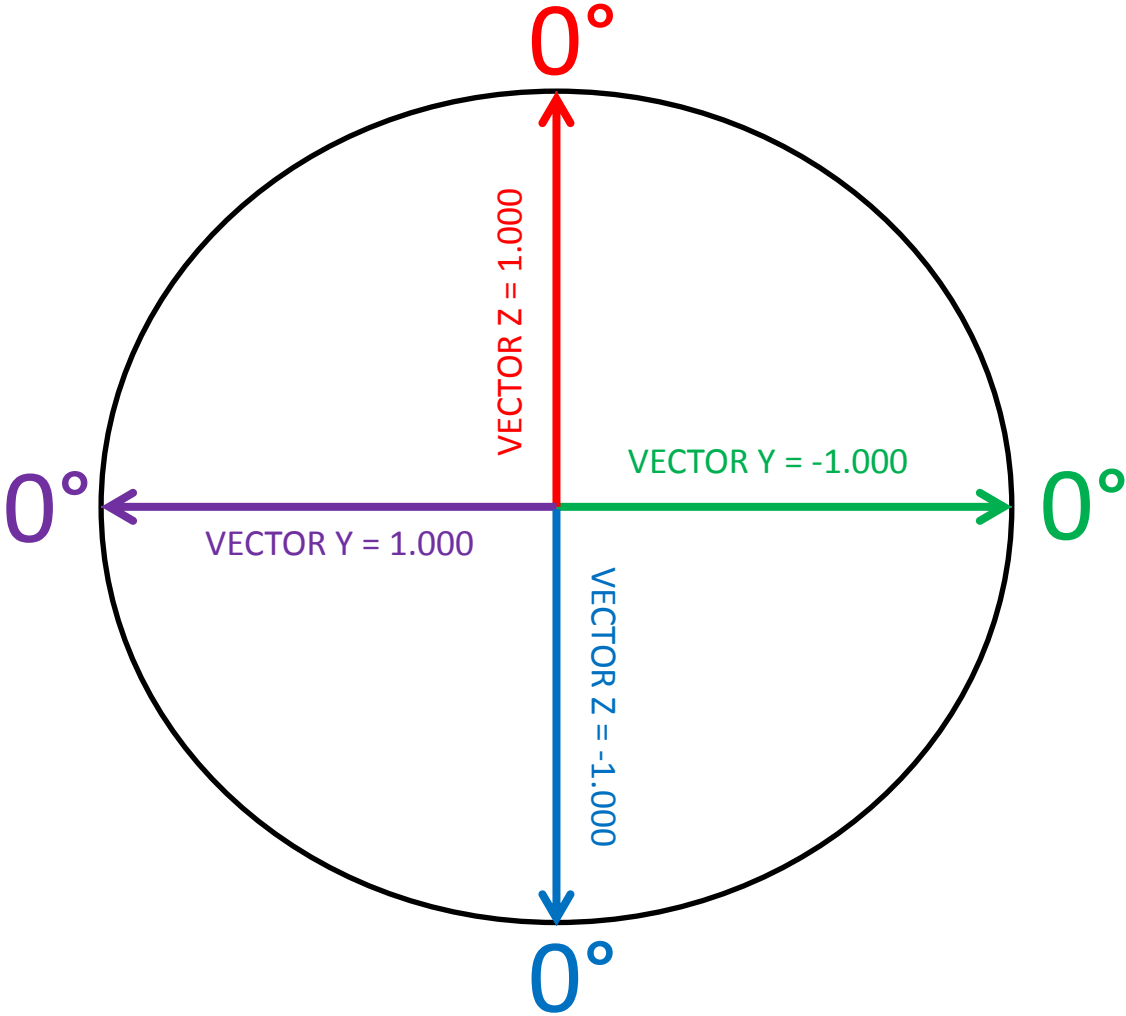
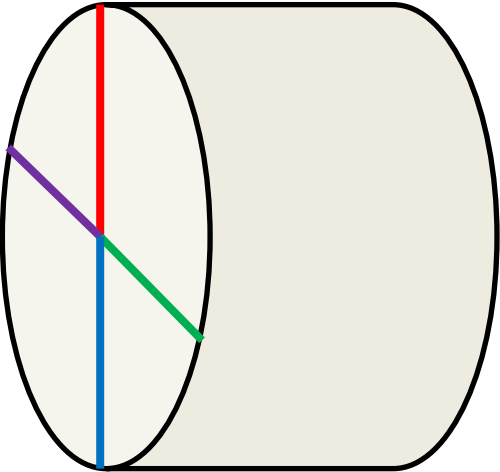
- VECTOR X = 1.000
- VECTOR X = -1.000
- VECTOR Y = 1.000
- VECTOR Y = -1.000



Zero Angle Settings

A-Axis

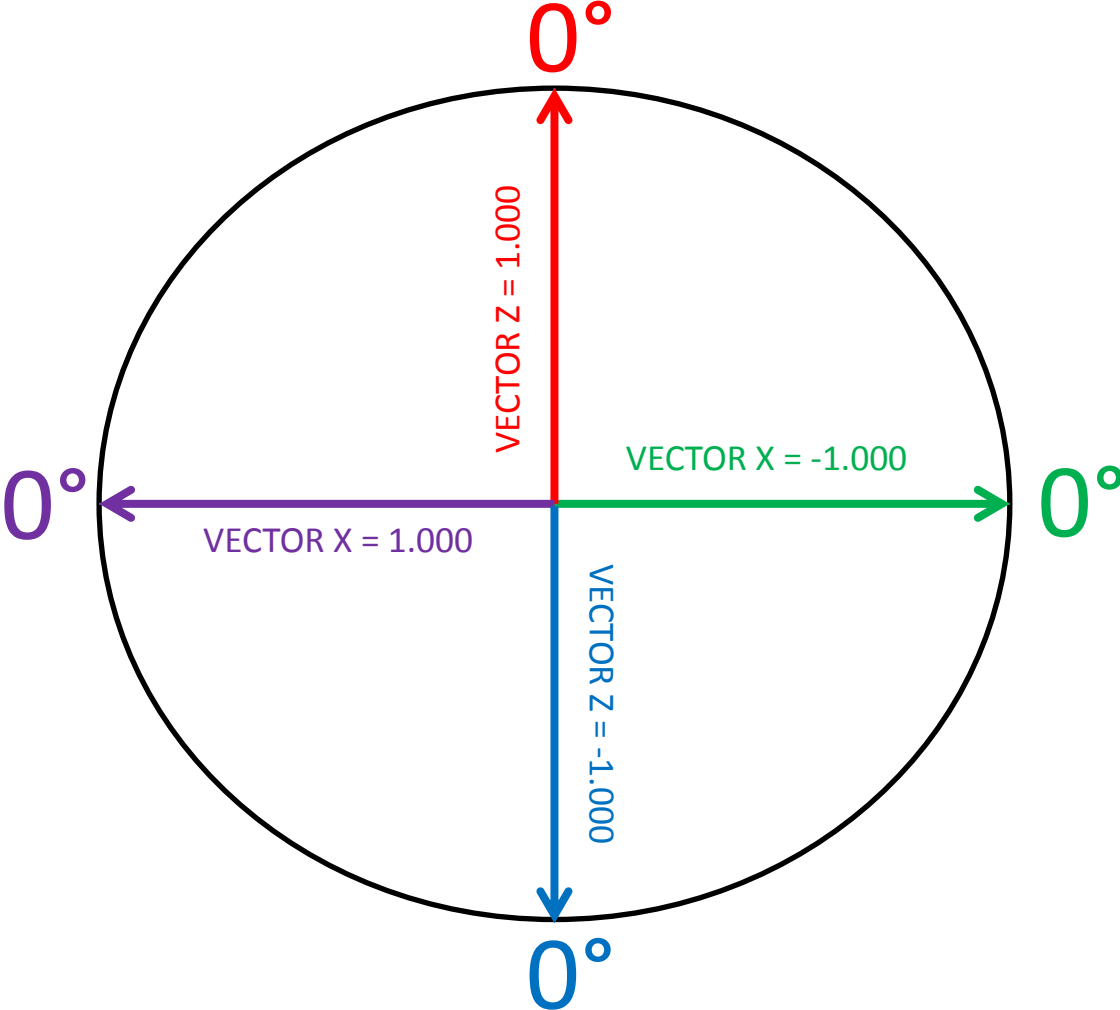
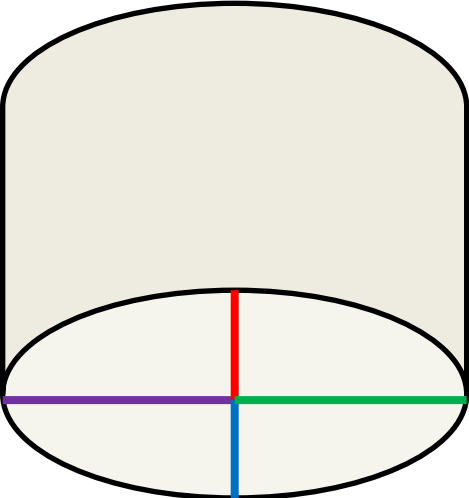
- VECTOR Y = -1.000
- VECTOR Y = 1.000
- VECTOR Z = 1.000
- VECTOR Z = -1.000



Zero Angle Settings

B-Axis

- VECTOR X = -1.000
- VECTOR X = 1.000
- VECTOR Z = 1.000
- VECTOR Z = -1.000



Cylinder Origin Point Settings

The ORIGIN POINT is used to define the center of the cylinder, if the center is not the part zero location.

Enter absolute values into the field to define the exact XYZ center point of the cylinder that the rotary features are to be machined on.

The cylinder does NOT need to be located on the centerline of the axis.

BLOCK	<input type="text" value="1"/>	ROTARY PARAMETERS	
ROTARY ORIENTATION		<input type="text" value="USER DEFINE"/>	
ORIGIN POINT		AXIS OF ROTATION	
X	<input type="text" value="0.0000"/>	VECTOR X	<input type="text" value="0.000"/>
Y	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="0.000"/>
Z	<input type="text" value="0.0000"/>	VECTOR Z	<input type="text" value="1.000"/>
CYLINDER RADIUS DATA		ZERO ANGLE	
TYPE	<input type="text" value="USE RADIUS STAR"/>	VECTOR X	<input type="text" value="0.000"/>
RADIUS	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="1.000"/>
TOOL VECTOR ANGLE TO CYLINDER AXIS		VECTOR Z	<input type="text" value="0.000"/>
<input type="text" value="90.000"/>		OFF CL DISTANCE	<input type="text" value="0.0000"/>

Cylinder Radius Data Settings

The CYLINDER RADIUS DATA settings are used to determine the Z-axis start point for each block. If the default setting is used, the RADIUS START location in each block will be used.

If USER DEFINED is used, then the operator will be allowed to enter a value in the RADIUS field...and that will be used for each feature machined.

BLOCK	<input type="text" value="1"/>	ROTARY PARAMETERS	
ROTARY ORIENTATION		<input type="text" value="USER DEFINE"/>	
ORIGIN POINT		AXIS OF ROTATION	
X	<input type="text" value="0.0000"/>	VECTOR X	<input type="text" value="0.000"/>
Y	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="0.000"/>
Z	<input type="text" value="0.0000"/>	VECTOR Z	<input type="text" value="1.000"/>
CYLINDER RADIUS DATA		ZERO ANGLE	
TYPE	<input type="text" value="USE RADIUS STAR"/>	VECTOR X	<input type="text" value="0.000"/>
RADIUS	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="1.000"/>
TOOL VECTOR ANGLE TO CYLINDER AXIS		VECTOR Z	<input type="text" value="0.000"/>
<input type="text" value="90.000"/>		OFF CL DISTANCE	<input type="text" value="0.0000"/>

Tool Vector Angle Settings

The TOOL VECTOR ANGLE field is used to position the tool to the correct orientation for machining.

For most needs, the tool should be perpendicular (or oriented 90° to the cylinder).

When programming ROTARY MILLING functions, this positioning will happen automatically - NO ROTARY POSITION block is necessary.

BLOCK	1	ROTARY PARAMETERS		
ROTARY ORIENTATION		USER DEFINE ▼		
ORIGIN POINT		AXIS OF ROTATION		
X	0.0000	VECTOR X	0.000	
Y	0.0000	VECTOR Y	0.000	
Z	0.0000	VECTOR Z	1.000	
CYLINDER RADIUS DATA		ZERO ANGLE		
TYPE	USE RADIUS STAR ▼	VECTOR X	0.000	
RADIUS	0.0000	VECTOR Y	1.000	
		VECTOR Z	0.000	
TOOL VECTOR ANGLE TO CYLINDER AXIS		90.000	OFF CL DISTANCE	0.0000

Off Centerline Distance Settings

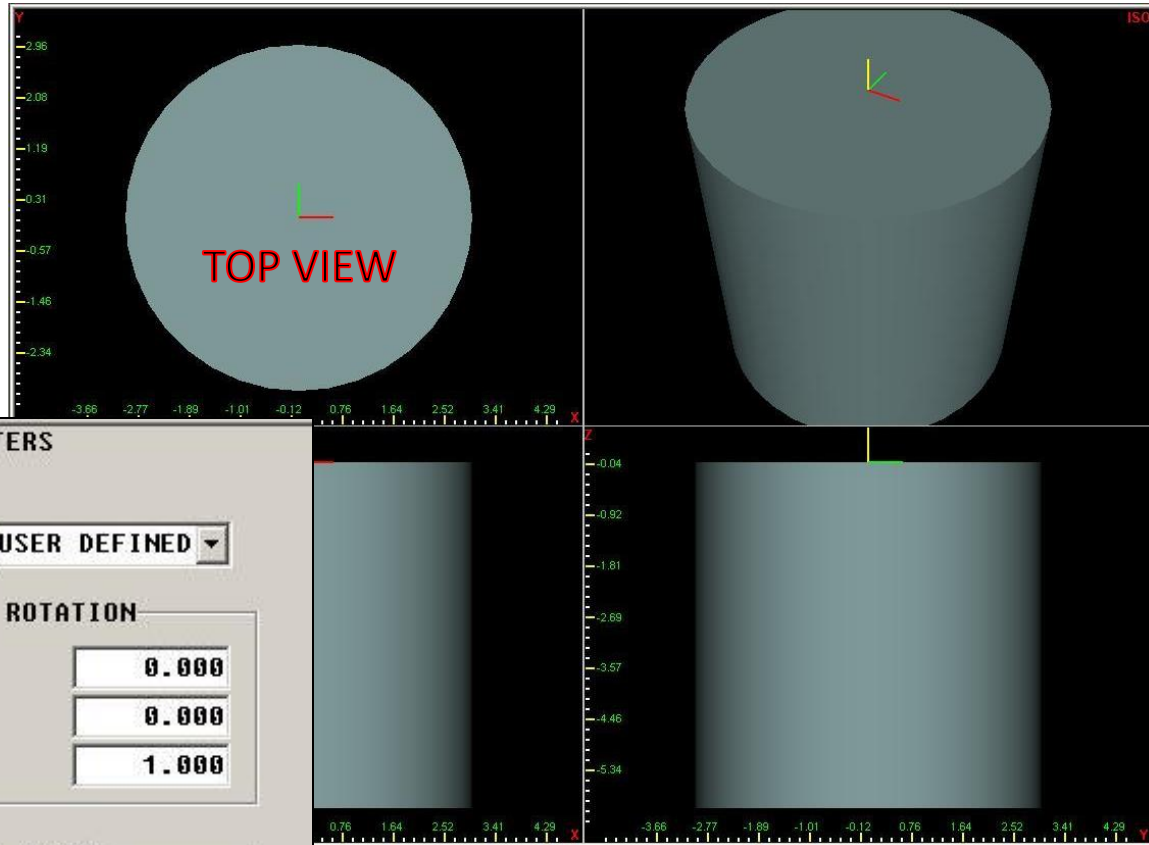
BLOCK	<input type="text" value="1"/>	ROTARY PARAMETERS	
		ROTARY ORIENTATION	<input type="text" value="USER DEFINE"/>
ORIGIN POINT		AXIS OF ROTATION	
X	<input type="text" value="0.0000"/>	VECTOR X	<input type="text" value="0.0000"/>
Y	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="0.0000"/>
Z	<input type="text" value="0.0000"/>	VECTOR Z	<input type="text" value="1.0000"/>
CYLINDER RADIUS DATA		ZERO ANGLE	
TYPE	<input type="text" value="USE RADIUS STAR"/>	VECTOR X	<input type="text" value="0.0000"/>
RADIUS	<input type="text" value="0.0000"/>	VECTOR Y	<input type="text" value="1.0000"/>
		VECTOR Z	<input type="text" value="0.0000"/>
TOOL VECTOR ANGLE TO CYLINDER AXIS	<input type="text" value="90.000"/>	OFF CL DISTANCE	<input type="text" value="0.0000"/>

The OFF CL DISTANCE field can be used to pull the tool off of the centerline of the cylinder when machining.

A positive or negative value can be used, depending on needs.

Machine Configuration Settings

- *Typical C-Axis Machine Configuration*
- *0° is at 3 O'clock Position*



BLOCK UNIVERSAL ROTARY PARAMETERS

ROTARY ORIENTATION

ORIGIN POINT

X	<input type="text" value="0.0000"/>
Y	<input type="text" value="0.0000"/>
Z	<input type="text" value="0.0000"/>

AXIS OF ROTATION

VECTOR X	<input type="text" value="0.000"/>
VECTOR Y	<input type="text" value="0.000"/>
VECTOR Z	<input type="text" value="1.000"/>

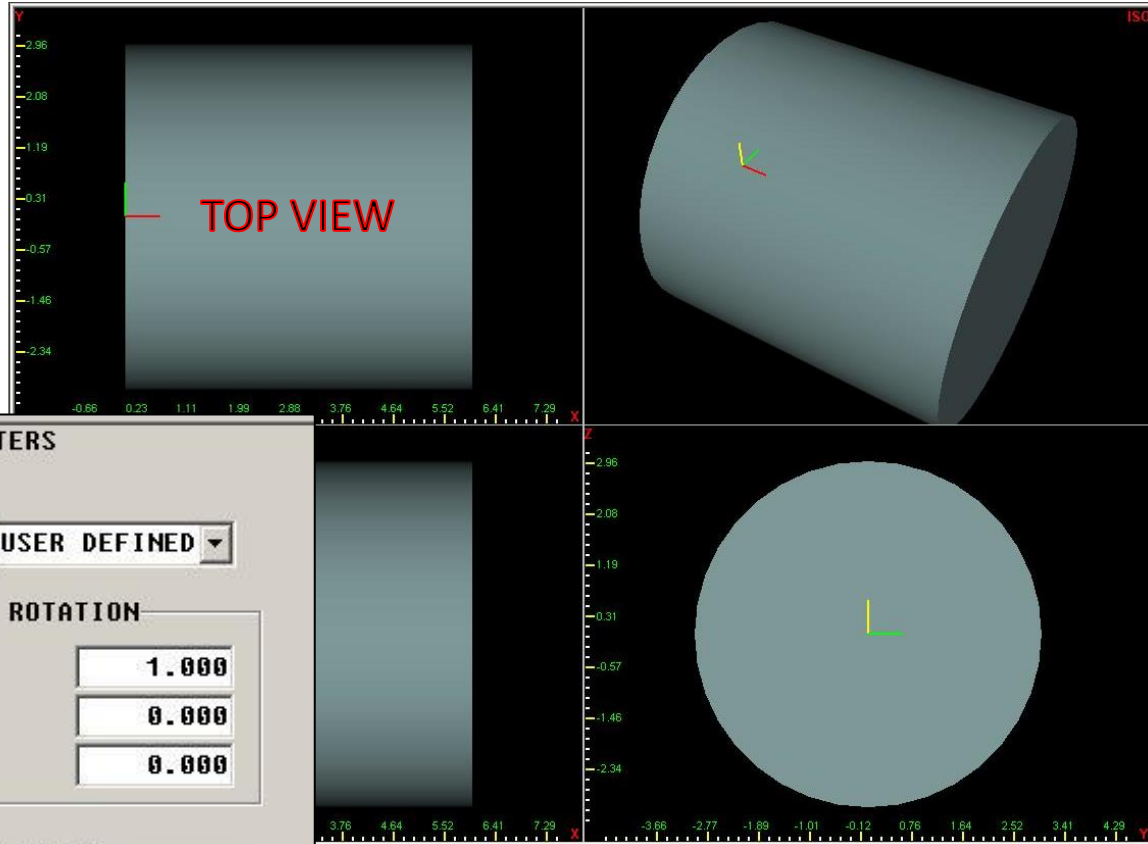
ZERO ANGLE

VECTOR X	<input type="text" value="1.000"/>
VECTOR Y	<input type="text" value="0.000"/>
VECTOR Z	<input type="text" value="0.000"/>

OFF CL DISTANCE

Machine Configuration Settings

- *Typical A-Axis Machine Configuration*
- *0° is at 12 O'clock – top of cylinder*



BLOCK UNIVERSAL ROTARY PARAMETERS

ROTARY ORIENTATION

ORIGIN POINT

X	<input type="text" value="0.0000"/>
Y	<input type="text" value="0.0000"/>
Z	<input type="text" value="0.0000"/>

AXIS OF ROTATION

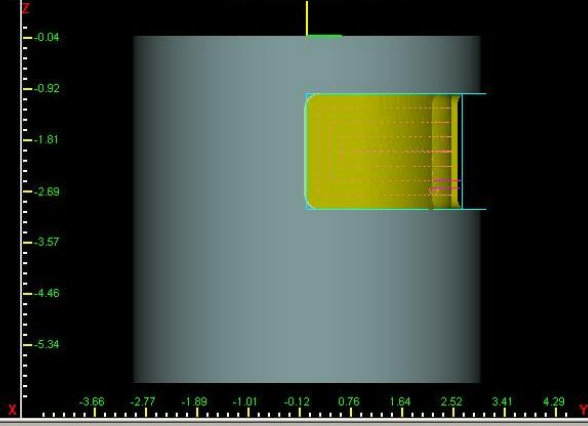
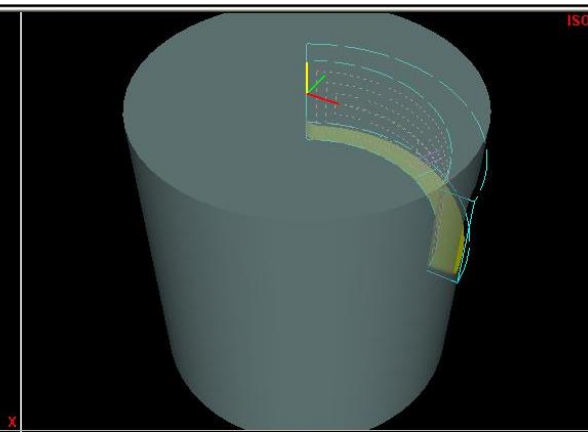
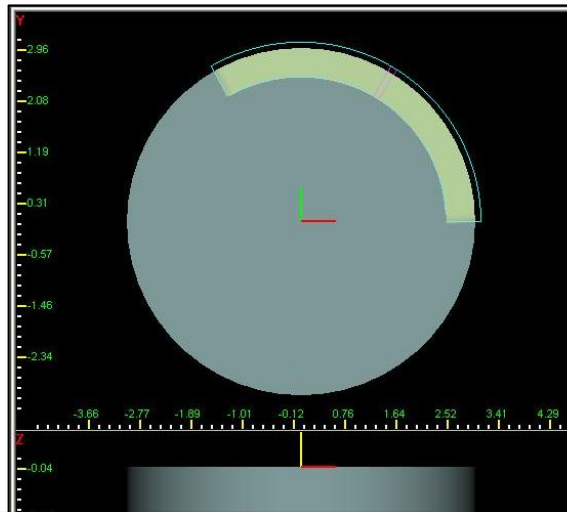
VECTOR X	<input type="text" value="1.000"/>
VECTOR Y	<input type="text" value="0.000"/>
VECTOR Z	<input type="text" value="0.000"/>

ZERO ANGLE

VECTOR X	<input type="text" value="0.000"/>
VECTOR Y	<input type="text" value="0.000"/>
VECTOR Z	<input type="text" value="1.000"/>

OFF CL DISTANCE

Typical C-Axis Machine Configuration



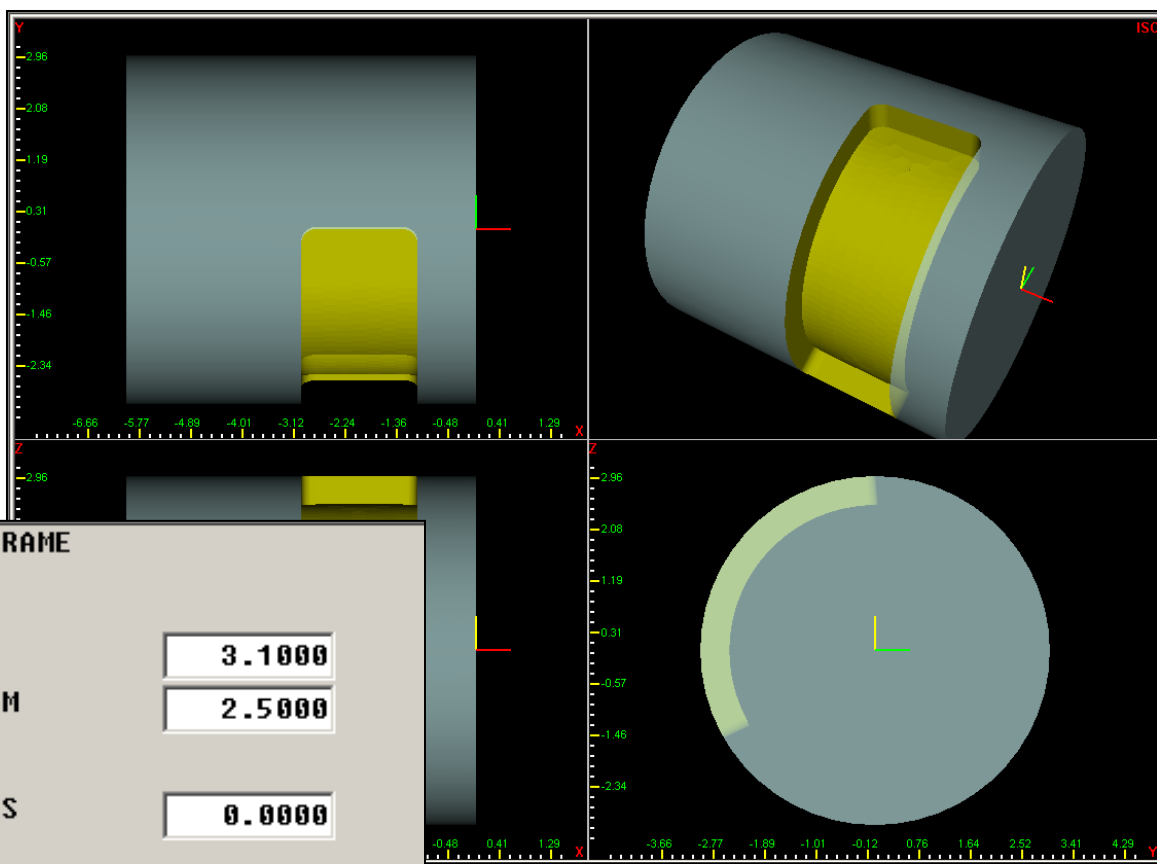
BLOCK **UNIVERSAL ROTARY MILL FRAME**

AXIS START	<input type="text" value="-1.0000"/>	RADIUS START	<input type="text" value="3.1000"/>
ANGLE START	<input type="text" value="0.000"/>	RADIUS BOTTOM	<input type="text" value="2.5000"/>
AXIS LENGTH	<input type="text" value="-2.0000"/>	CORNER RADIUS	<input type="text" value="0.0000"/>
ANGLE LENGTH	<input type="text" value="120.000"/>		

ROUGHING | **FINISHING** | SFQ

TOOL	<input type="text" value="1 END MILL, dia. 0.5000"/>		
MILLING TYPE	POCKET BOUNDARY ▾		
POCKET TYPE	OUTWARD ▾	POCKET OVERLAP (%)	<input type="text" value="50"/>
MILL FEED	<input type="text" value="110.0"/>	PECK DEPTH	<input type="text" value="0.1000"/>
SPEED (RPM)	<input type="text" value="9167"/>	PLUNGE FEED	<input type="text" value="20.0"/>

Typical Rotary A-Axis Machine Configuration



BLOCK **UNIVERSAL ROTARY MILL FRAME**

AXIS START	<input type="text" value="-1.0000"/>	RADIUS START	<input type="text" value="3.1000"/>
ANGLE START	<input type="text" value="0.000"/>	RADIUS BOTTOM	<input type="text" value="2.5000"/>
AXIS LENGTH	<input type="text" value="-2.0000"/>	CORNER RADIUS	<input type="text" value="0.0000"/>
ANGLE LENGTH	<input type="text" value="120.000"/>		

ROUGHING | **FINISHING** | SFQ

TOOL	<input type="text" value="1 END MILL, dia. 0.5000"/>		
MILLING TYPE	POCKET BOUNDARY ▾		
POCKET TYPE	OUTWARD ▾	POCKET OVERLAP (%)	<input type="text" value="50"/>
MILL FEED	<input type="text" value="110.0"/>	PECK DEPTH	<input type="text" value="0.1000"/>
SPEED (RPM)	<input type="text" value="9167"/>	PLUNGE FEED	<input type="text" value="20.0"/>

Just by changing the cylinder orientation in Rotary Parameters - the same program will run

Tool Vector Angle Settings

BLOCK	<input type="text" value="1"/>	UNIVERSAL ROTARY MILL FRAME	
AXIS START	<input type="text" value="-1.0000"/>	RADIUS START	<input type="text" value="3.1000"/>
ANGLE START	<input type="text" value="0.000"/>	RADIUS BOTTOM	<input type="text" value="2.5000"/>
AXIS LENGTH	<input type="text" value="-2.0000"/>		
ANGLE LENGTH	<input type="text" value="120.000"/>	CORNER RADIUS	<input type="text" value="0.0000"/>

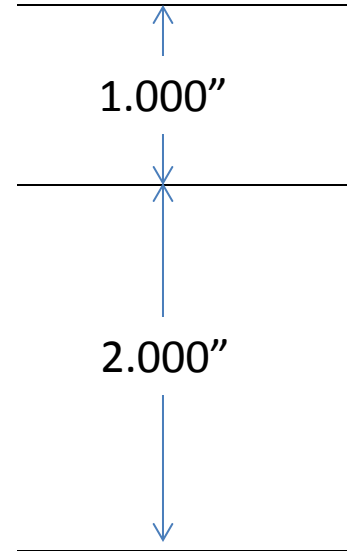
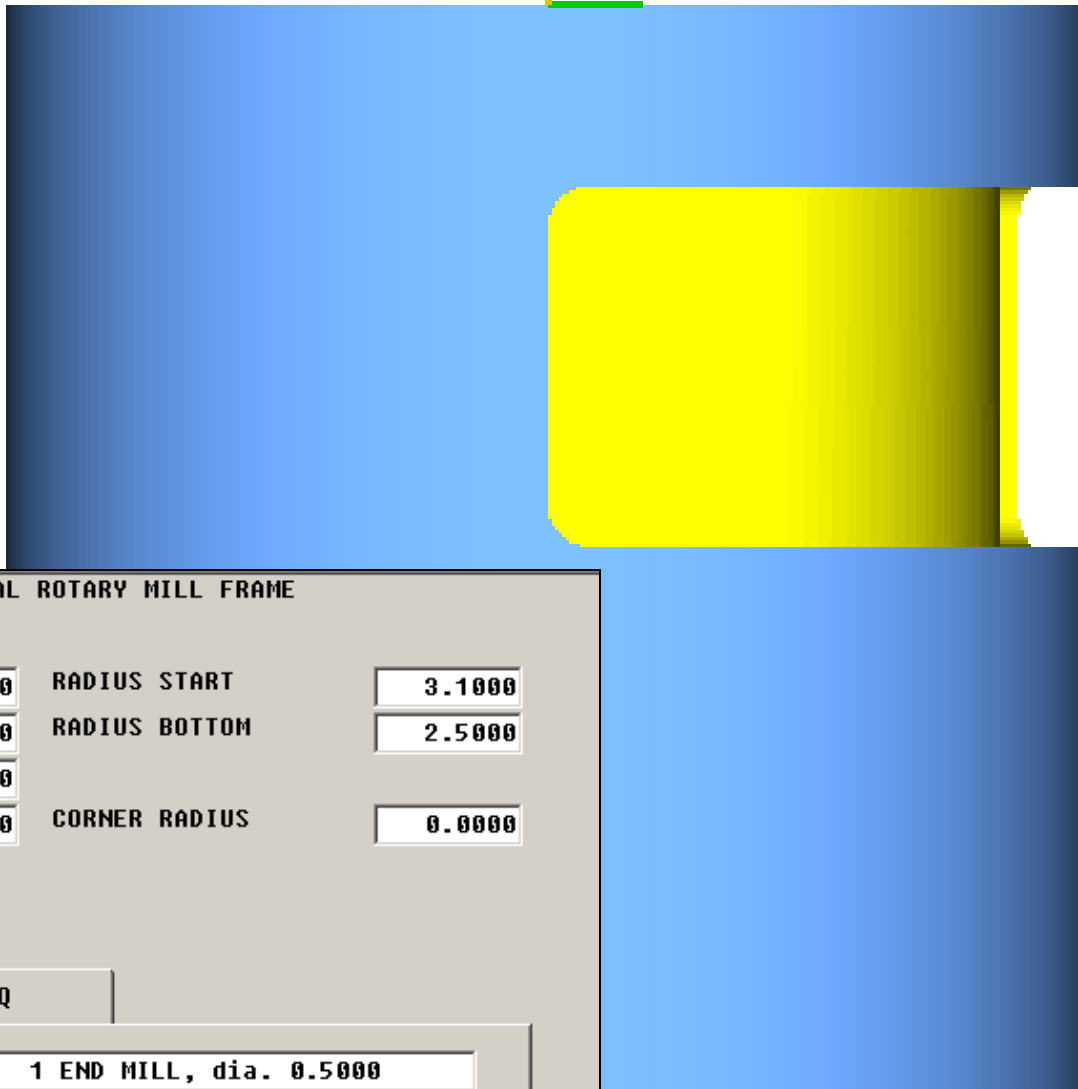
ROUGHING FINISHING SFQ

TOOL	<input type="text" value="1 END MILL, dia. 0.5000"/>		
MILLING TYPE	<input type="text" value="POCKET BOUNDARY"/>		
POCKET TYPE	<input type="text" value="OUTWARD"/>	POCKET OVERLAP (%)	<input type="text" value="50"/>
MILL FEED	<input type="text" value="110.0"/>	PECK DEPTH	<input type="text" value="0.1000"/>
SPEED (RPM)	<input type="text" value="9167"/>	PLUNGE FEED	<input type="text" value="20.0"/>

AXIS fields are distances along the cylinder length where features are located.

ANGLE fields are degrees around the circumference of the part – where does a feature start, and how far and what direction does it wrap.

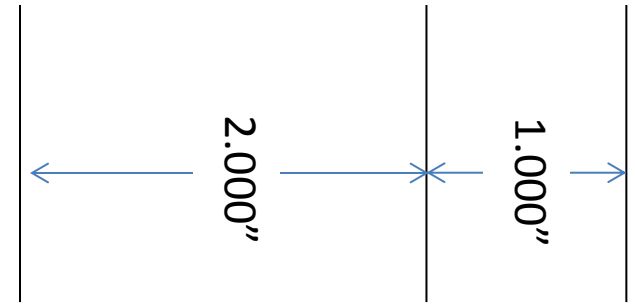
RADIUS START & BOTTOM are distances programmed from the center of the cylinder.



BLOCK	1	UNIVERSAL ROTARY MILL FRAME	
AXIS START	-1.0000	RADIUS START	3.1000
ANGLE START	0.000	RADIUS BOTTOM	2.5000
AXIS LENGTH	-2.0000	CORNER RADIUS	0.0000
ANGLE LENGTH	120.000		
ROUGHING FINISHING SFQ			
TOOL	1 END MILL, dia. 0.5000		
MILLING TYPE	POCKET BOUNDARY		
POCKET TYPE	OUTWARD	POCKET OVERLAP (%)	50
MILL FEED	110.0	PECK DEPTH	0.1000
SPEED (RPM)	9167	PLUNGE FEED	20.0

Rotary C-Axis Machine Configuration

Rotary A-Axis Machine Configuration



BLOCK	1	UNIVERSAL ROTARY MILL FRAME	
AXIS START	-1.0000	RADIUS START	3.1000
ANGLE START	0.000	RADIUS BOTTOM	2.5000
AXIS LENGTH	-2.0000	CORNER RADIUS	0.0000
ANGLE LENGTH	120.000		
ROUGHING FINISHING SFQ			
TOOL	1 END MILL, dia. 0.5000		
MILLING TYPE	POCKET BOUNDARY		
POCKET TYPE	OUTWARD	POCKET OVERLAP (%)	50
MILL FEED	110.0	PECK DEPTH	0.1000
SPEED (RPM)	9167	PLUNGE FEED	20.0

