



Version 14 : September 2020

Mill/Turn Tutorials



Proprietary Notice

This document contains proprietary information of Cambrio Acquisition, LLC ("CAMBRIO") and is to be used only pursuant to and in conjunction with the license granted to the licensee with respect to the accompanying licensed software from CAMBRIO. Except as expressly permitted in the license, no part of this document may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language or computer language, in any form or by any means, electronic, magnetic, optical, chemical, manual or otherwise, without the prior expressed written permission from CAMBRIO or a duly authorized representative thereof.

It is strongly advised that users carefully review the license in order to understand the rights and obligations related to this licensed software and the accompanying documentation.

Use of the computer software and the user documentation has been provided pursuant to a CAMBRIO licensing agreement.

Copyright © 2021 CAMBRIO. All rights reserved. The Gibbs and GibbsCAM logos, GibbsCAM, Gibbs, Virtual Gibbs, and "Powerfully Simple. Simply Powerful." are either trademark (s) or registered trademark (s) of CAMBRIO in the United States and/or other countries. All other trademark(s) belong to their respective owners.

Portions of this software and related documentation are copyrighted by and are the property of Siemens Digital Industries Software.

Microsoft, Windows, and the Windows logo are trademarks, or registered trademarks of Microsoft Corporation in the United States and/or other countries.

Contains PTC Creo GRANITE® Interoperability Kernel by PTC Inc. All PTC logos are used under license from PTC Inc., Boston, MA, USA. CAMBRIO is an Independent Software Provider.

Portions of this software © 1994-2021 Dassault Systèmes / Spatial Corp.

Portions of this software © 2001-2021 Geometric Software Solutions Co. Ltd.

Contains Autodesk® RealDWG[™] kernel by Autodesk, Inc., © 1998-2021 Autodesk, Inc. All rights reserved.

DMG MORI Models provided in conjunction with GibbsCAM © 2007-2021 DMG Mori Seiki Co., Ltd.

Contains VoluMill[™] and VoluTurn[™] software by Celeritive Technologies, Inc. © 2007-2021 Celeritive Technologies, Inc. All rights reserved.

This Product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit (http://www.openssl.org/). This Product includes cryptographic software written by Eric Young (eay@cryptsoft.com).

Portions of this software © MachineWorks Ltd.

Portions of this software and related documentation are copyrighted by and are the property of Electronic Data Systems Corporation.

Other portions of GibbsCAM are licensed from GibbsCAM licensors, which may not be listed here.

MILL/TURN TUTORIALS

The following tutorials will demonstrate how to create milling and rotary milling operations on Mill/Turn parts. There is little lathe/turning work included in these exercises. All lathe operations are exactly the same as the standard lathe interface for Mill/Turn parts. It is assumed that you have already completed the Mill and Turning tutorials and are therefore have a basic knowledge of GibbsCAM.

EXERCISE 1: CLUTCH BASKET

In order to complete this exercise, you will need to have installed the Sample parts.

1. Open the Sample parts/Production/Tutorial Parts - Required/MillTurn Parts/Clutch Basket.vnc file.

In the Document Control dialog, the Machine selected is a CAxis Horizontal Lathe - Generic Shank. When one of the C Axis MDDs is used, four coordinate systems are automatically created by the system: ZX plane, XY plane, HY backside plane and YZ plane. These coordinate systems are used to properly position geometry in order to cut a standard Mill/Turn part. More functionality is available if Advanced CS is available.

All the tools required have already been defined.

About the Part

1. Open the CS list and Workgroup list from the commands palette.

Ø 🖥



2. Or from the status bar.



Wor	kgrou	ıp	9	x
		Comment	Туре	
1	- 🐲	Casting	•	
2	Ş	Teeth	a	
3	Ş	Drill & Cutouts		
Nei	w WG			

Workgroup 1

This workgroup is designated as revolved Part Stock in the WG info dialog. The geometry is defined in the ZX plane which is the standard plane for turning operations. This is the profile for the initial stock condition.



Workgroup 2



This workgroup contains geometry which will be used to create angled slots on the OD of the part.

Workgroup 3

This workgroup contains geometry defined which will be used to cut other slots on the OD of the part. There is also a point which will be used to create bolt holes on the front of the part.



Machining the Part

#1 Main Slots

1. Open the Tool list.

There are five tools in the tool list including a 2" Drill, 0.25" Rough Endmill, 1" Roundover Tool, 0.625" Spot Drill and 0.375" Drill.

2. Open Tool #1 dialog.

 \mathbb{Z}

0 80°C

None

J 7

Þ

Tool Material

0 0

Ø

Ø P П

Ω

35°∨

 00
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0

HSS

Lolli Z -Ø

O rnd. R

0

sqr. t

✓ Tool ID #

The first operation will be to drill out the center of the part so the tool orientation for the first four tools is set to approach along the Z Axis. The tool orientation diagram will look like the following image.

This orientation designates a Z Axis approach which is the necessary orientation for front face operations.

3. Click the CAM button and double-click a Process tile.

Holes	
Entry/Exit Cyde: Feed In - Rapid Out Feed In - Feed Out Tap Rigid Tap Peck, Full Out Peck, Chip Breaker	-3.07735 -2.5 ↔ Z -2.5 ↔ Z
Material Speed: RPM 1000 Feed: Plunge 0.01 ipr Dwell 0 sec Clearance Peck 0.5 Retract 0.05	0 revs Prefer Canned Coolant Flood
	Mach. CS 1: ZX plane

耳

Spindle Dir Forwa

Straight Shank \sim

Use Dia

120

Elutes

Fool Length Offset #

mp. Offset # 5

4. Create a Lathe Holes process with the 2in Drill (Tool #1).

5. Create the toolpath.

The next operation to be created will be a Mill contour process.

#2 Main Slots

1. Click Clear to delete the holes process.

2. Double-click Process tile and choose a Mill Contour Process.



Clear

Choose the 1/4" Rough Endmill (Tool #2) If you hover over the suggested 2D Contour tool a brief tool summary is displayed enabling you to confirm this is indeed the correct tool.

2 D Contour Q.25% Hew Surface Contour New Profile New Profile New Profile New	Tile # 2 2 Diameter 0.25 Comer Rad 0 # Flutes 2 Rute Length 6 Length out of Holder 6
Contour Mill Feature Solids Open Sides Offset Entry/Exit Rotate Material	 Use the parameters shown in the Process dialog.

The tool orientation designates an X Axis approach which is the necessary orientation for OD operations.



- 4. Switch to Workgroup 3: Drill & Cutouts.
- 5. Switch to CS4: YZ plane.
- 6. Enter this information in the Rotate tab of the Contour Process.

Process #1 Contour	Ø⑤ቑ - ×
Contour Mill Feature Solids Open Sides Offset Entry/Exit	Rotate
Mach CS: 4: YZ plane \checkmark	
Positions Angle C	
O Polar and Cylindrical Milling	
Duplicate	
11 time(s)	
C 30	

This will create an operation that starts at C0 then gets rotated clockwise by 30° and machined 11 more times.

- 7. Select the geometry shown.
- 8. Set the machining markers as shown.





9. Create the toolpath.





#3-4 Bolt Holes

The next two operations will be a Multi-process operation.

1. Switch to CS2: XY plane.

	Process #1 Holes	🗸 – 🕂 🔊 🛇
For process #1. create this Hole process	Drill Hole Feature Bore Pre-Mill Mil Feature Rotate Entry/Exit Cyde: Dimension from Hole Feed In - Rapid Out Feed In - Feed Out Tap Rigid Tap Peck, Full Out Peck, Full Out Finish Mil Bore Helix Bore 	At Op End 0.625 -1.5 -1.8125 Load H1 D
with the .625" Spot Drill (Tool #4).	Material Transition Between Holes RPM 3000 Feed 10 Dwell 0 Clearance -1.5 Peck Vary Depth With Geo. Retract 1 Direction 1 Direction Pattern:	
		< >

Process #1 Holes	🖉 🔆 7 – 🗙
Drill Hole Feature Bore Pre-Mill Mill Feature Rotate	
Mach CS: 2: XY plane V	
Positions Angle C	
O Polar and Cylindrical Milling	
Duplicate	
5 time(s)	
C 60	

2. For

3. Enter this information in the Rotate tab.

rocess #2 Holes	Ø G 7 –
Drill Hole Feature Bor	e Pre-Mill Mill Feature Rotate
Entry/Exit Cycle: Feed In - Rapid Out Feed In - Feed Out Tap Rigid Tap Oracle Full Out	Dimension from Hole Dimension from Tool At Op End t 0 R 0 1 0 0 1 0 0 1 0 0 1 0 0
Peck, Full Out Peck, Chip Breaker Rough Mill Bore Finish Mill Bore Helix Bore	-1.5
	Transition Between Holes
Mater	Tal OR Level 0
RPM 3000 Feed 10	Absolute Z Hole Feature
Dwell 0	Vary Depth With Geo.
Peck	Reverse Order
Retract	☑ Coolant ☑ Flood
1 Direction	
	Pattern: 1: Casting V
Comment	<u>^</u>

In a Multi-process operation, the Rotate tab will copy the last-entered values for the process type into the next process in the list of the same type.

- 5. Select the point shown.
- 6. Create the toolpath then clear the process list

4. For process #2, create this Holes process

with the .375in Drill (Tool #5).

#5 Teeth

- 1. Switch to CS4: YZ plane.
- 2. Switch to WG2: Teeth.

Material Speed: RPM 5000 Entry Feed 10
Contour Feed 20 Entry And Exit 0 90° Radius 0 90° Line 0 0 Advanced 0 No. of Extra Offsets 0 Extra Stepover 5tock ± Stock ± 0 Overlap 0 Spring Passes 0 Use Stock 0 Ignore Prior Tool Profiles

Ø€ ∓ ->
otate

3. Create this Mill Contour process with the

Roundover Tool (Tool #3).

4. Enter this information in the Rotate tab.

This will create a contour operation that starts at C90° and repeats 39 times in 9° intervals.



5. Click the line as shown

- 6. The markers should extend past the stock geometry.
- 7. Double-click the eye icon for the WG1.

۰

This will help you to properly place the markers.





8. Create the toolpath.

9. Render the operations.





10. Save the part.

EXERCISE 2: COUPLING

This exercise gives examples for using front face milling and rotary milling operations on mill/turn parts.

1. Open the Coupling.vnc file.

The Machine selected is a CAxis Horizontal Lathe - Generic Shank. The file contains all the necessary geometry and tools to machine this part.

About the Part

1. Open the Workgroup list.





The Workgroup list has four workgroups which contain the geometry for different elements of the part. The Type column shows images of the type of geometry that is contained in each workgroup.

Workgroup 1

The first workgroup, Casting, (designated as Part Stock - revolved •) in the WG info dialog. When the part is rendered the initial stock condition will be based on this geometry.



Workgroup 2



This geometry (designated as geometry, not wrapped) will be used to contour a flange on the front face of the part. This workgroup also contains points which will be used to create bolt holes on the front and back flanges of the part.

Workgroup 3

This geometry will be used to create flat slots and holes on the OD of the part.



Workgroup 4



This geometry (designated as geometry, wrapped **C**) is defined in the YZ plane, which will be used to create a radial slot on the OD of the part.

Machining the Part

#1-2 Front Flange Bolt Holes

The first set of machining operations will create bolt holes on the front face of the part.

- 1. Switch to WG2: Front Flange.
- 2. Switch to CS 2: XY plane.
- 3. Open the Tool list.

There are a total of eleven tools in the Tool list.

The first set of operations will be machining the face of the part so the tool orientation for the first four tools is set to approach along the Z Axis.

4. Open Tool #1.

Note the tool orientation diagram. This orientation designates a Z Axis approach which is the necessary orientation for front face operations.

5. Open the Process and Operation tiles.



Process #1 Holes 🛛 🖉 🔍 🐺 —	<
Drill Hole Feature Bore Pre-Mill Mil Feature Rotate Entry/Exit Cyde: © Freed In - Rapid Out © Treed In - Rapid Out © Imension from Hole © Imension from Tool © Freed In - Feed Out 0 </td <td>6. For process #1, create this Hole process with the .375" Spot Drill (Tool #1)</td>	6. For process #1, create this Hole process with the .375" Spot Drill (Tool #1)

7. Enter this information in the Rotate tab.

Process #1 Holes	🖉 🔆 🐺 – 🗙
Drill Hole Feature Bore Pre-Mill Mill Feature Rotate	1
Mach CS: 2: XY plane ~	
Positions Angle C Polar and Cylindrical Milling	
Duplicate Time(s)	
C 90	

If you have Advanced CS, use the Mach CS list to designate the XY plane.

ocess #2 Holes	✓ S H 4 -
Drill Hole Feature Bore	Pre-Mill Mill Feature Rotate
Entry/Exit Cyde: © Feed In - Rapid Out O Feed In - Feed Out Tap Rigid Tap O Peck, Full Out O Peck, Chip Breaker O Rough Mill Bore O Finish Mill Bore	Dimension from Hole Dimension from Tool At Op End 0.2 R R At Op End 0.2 T 7.806 0.336
O Helix Bore	-1.142 -1.142
Material RPM 2000 Feed 100 Dwell 0 Clearance Peck Rebract 1 Direction	Transition Between Holes Image: Constraint of the sector of the secto
	Pattern: 1: Turning V
6	Part Station 1: Main Spindle V
Comment	0



8. For process #2, create this Holes process with the .1875" Drill (Tool #2).

10. Create the toolpath then clear the process list

9. Select the point shown.

#3-5 Back Flange Bolt Holes

1. For process #1, create this Holesprocess with the .375" Spot Drill (Tool #1).

ocess #1 Holes	ØG曜 平 -
Drill Hole Feature Bore	Pre-Mill Mill Feature Rotate
Entry/Exit Cycle:	Dimension from Hole Dimension from Tool At Op End 3.25 R 0.25 -2.533 -3.75 -3.825
Helix Bore Material RPM 3000 Feed 10	Transition Between Holes
Clearance Peck Retract	☑ Vary Depth With Geo. ☐ Reverse Order
	Pattern: 1: Turning V
Comment	Part Station 1: Main Spindle

Process #1 Holes	
Drill Hole Feature Bore Pre-Mill Mill Feature	Rotate
Mach. CS: 2: XY plane	
Position Angle C 0	
💿 Polar & Cylindrical Milling	
Duplicate	
7 time(s)	
C 45	

2. Enter this information in the Rotate tab.

 For process #2, create this Holes process with the 1/4" Spot Drill (Tool #3).

 For process #3, create this Holes process with the .375" Rough Endmill (Tool #4).

ocess #2 Holes	Ø©₽₽-×
Drill Hole Feature Bore	Pre-Mill Mill Feature Rotate
Entry/Exit Cyde: Feed In - Rapid Out	 Dimension from Hole Dimension from Tool
Feed In - Feed Out Tap Rigid Tap Peek Full Out	↓ -3.25 <u>R</u> At Op End -3.25 † 0.25
Feck, Chip Breaker Rough Mill Bore Finish Mill Bore Utility Bore	-3.75 • -3.825
O Helix Bore	Load H1D
	Transition Between Holes
Material	R Level -3.25
RPM 3000	O Part Clearance 12
Feed 10	O Absolute Xr O Hole Feature 0
Classage	✓ Vary Depth With Geo.
Clearance	Reverse Order
Peck	☑ Coolant
Retract	Flood
	Pattern: 1: Turning V
	Part Station 1: Main Spindle 🗸
Comment	\$

Process #3 Holes	⊘ເ⊑∓->
Drill Hole Feature Bore Pre	e-Mill Mill Feature Rotate
Entry/Exit Cyde: O Feed In - Rapid Out Feed In - Feed Out Tap D Rigid Tap	○ Dimension from Hole ④ Dimension from Tool ↓ -3.25 At Op End -3.25 1-3.25 1-3.25 1
Pedc, Full Out Pedc, Full Out Pedc, Chip Breaker Rough Mill Bore Finish Mill Bore Helix Bore	-3.75
Material 2000 Feed 100 Dwell 0 Clearance Peck Retract 1 Direction	Load H1 D Transition Between Holes R.Level -3.25 Part Clearance 12 Absolute Xr 0 Hole Feature 0 Vary Depth With Geo. Reverse Order Coolant Flood
	Pattern: 1: Turning V
Comment	Part Station 1: Main Spindle



5. Select the point shown.



6. Create the toolpath.

7. Render the operations.





If your rendered image has a cutaway section removed, click the Stock Cutaway icon on the render palette until it is a complete cylinder.

#6 Front Flange Contour

1. Create this Contour process with the 1/2" Face Mill (Tool #4).

Contour Mill Featur	e Solids	Open Sides Offset Entry/Exit
Speed: RPM Entry Feed Contour Feed	Material 3000 10 20	O Depths from Feature ③ Depths From Tool ↓ 0.1 □ Rapid In □ □ □ □ □ □ □ □ □ □ □ □ □ □ □
Line	0.05	
90° Radius O 90° Line O Advanced	0.23	Z Step Desired Actual #Passes 0.3 0.3 1
No. of Extra Offsets Extra Stepover	0	□ Retracts ☑ Depth First ☑ Prefer Subs □ Ramp Down □ Back & Forth
Stock ±	0	Do not hit flats 🗸 🗸
Z Stock	0	Auto Plunge $$
Overlap Spring Passes	0	Cutter Radius Comp. On
Use Stock	Tool Profiles	☑ Coolant ☑ Flood
		Pattern: 1: Workgroup Mach. CS: 1: XY plane
Comment		

Process #1 Contour			
Contour Mill Feature So	olids Open Sides	Entry / Exit	Rotate
Mach. CS: 2: XY plane			
🔘 Position 🛛 Angle C			
Polar & Cylindrical Milling			
Duplicate			
0 time(s)			
C 0			

2. Enter this information in the Rotate tab.

The Polar & Cylindrical Milling selection is only available when this option is installed. The Polar & Cylindrical Milling option provides for C Axis rotary interpolation.

3. If Polar & Cylindrical Milling is unavailable, select Position.

This will create the identical toolpath, although it will require Y Axis moves. Not all Mill/Turn machines support the Y Axis; your machine may not be able to cut this toolpath.



4. Place the Machining Markers as shown.

5. Create the toolpath.



OD Milling

#7-8 Flats

The first set of milling operations will face mill a flat at 45° angles on both sides of the 2.0" diameter of the casting.

- 1. Switch to the CS4: YZ plane.
- 2. Switch to WG3: OD Flat Slots.

Notice that the geometry for these operations is created flat in the YZ plane. These shapes will actually be cut at 45° planes, but are positioned as if they will cut without any rotation. When

creating cut shape geometry for OD operations, the geometry should be created as if it were being machined at a position C0 (no rotation). The rotation is accomplished when the toolpath is generated.

You should also note that the remaining tools in the tool list are all set up to cut OD operations. Therefore, the tool orientation diagram designates an X Axis approach, which is used to machine the OD.

Process #1 Contour

✓
●
■
=
×

3.	Create this Mill Contour process with the 1.5" Face Milling tool (Tool #5).	Contour Mil Feature Solds Open Sides Offset Entry/Exit Material Opeptis from Feature Image: Contour Feed Image:	
	Process #1 Contour Contour Mill Feature Solids Open Sides Entry / Exit Rotate Mach. CS: 4: YZ plane • <	 4. Enter this information in the Rotate tab. 	

The toolpath will be created at a 45° angle from the C0 position.

5. Now create an identical operation #2 to machine the opposite 45° plane. The only change that we need to make is in the rotation angle.

6. Change the Position value in the Rotate tab.

Process #1 Contour						
Contour Mill Feature Solids Open Sides Entry / Exit Rotate						
Mach. CS: 4: YZ Plane						
Position Angle B 45						
O Polar & Cylindrical Milling						
Duplicate						
0 time(s)						
в						



- 7. Place the Machining Markers as shown.
- 8. Create the toolpath.

(the

9. Render the operations.

Y-Axis Machines

#9-10 Gasket

The next operations will contour a gasket on the flats. The machining of the gasket and the subsequent pockets require Y Axis tool moves.

1.	Create this Contour process with the 0.0625" Ball Endmill (Tool #6).

Process #1 Contour			
Contour Mill Feature Solids	Open Sides	Entry / Exit	Rotate
Mach. CS: 4: YZ plane			
Position Angle C -45			
Polar & Cylindrical Milling			
Duplicate			
0 time(s)			
C 0			

2. Enter this information in the Rotate tab.

3. Place the Machining Markers as shown.

4. Create the toolpath.

Again, we will perform an identical operation on the opposing 45° flat.

5. With the previous Contour process change the Position angle in the Rotate tab.

Process #1 Contour							
Contour	Mill Feature	Solids	Open Sides	Entry / Exit	Rotate		
Mach. CS:	4: YZ pla	ine	•				
Position	n Angle	C -45					
💿 Polar &	Cylindrical Millir	ng					
Duplicate	,						
0	time(:	s)					
C 0							

The machining markers should be positioned exactly as they were for the previous operation.

6. Create the toolpath.

#11-16 OD Drilling

The next group of operations are drilling operations which will spot drill, drill and tap the four holes surrounding the gasket. These drilling operations will be performed on both 45° flats like the previous sets of operations.

1. For process #1, create this Mill Holes process with the 1/4" Spot Drill (Tool #9).

Process #1 Holes	⊘⊙₽₽->
Drill Hole Feature Bore F	Pre-Mill Mill Feature
Entry/Exit Cycle: Feed In - Rapid Out Feed In - Feed Out Tap Rigid Tap Peck, Full Out Peck, Full Out Peck, Chip Breaker Rough Mill Bore Finish Mill Bore	Dimension from Hole Dimension from Tool At Op End 1.05 1.05 1.05 1.05 1.05 1.05 0.75 0.56474
O Helix Bore	Transition Between Holes
RPM 3000 Feed 10 Dwell 0 Clearance Peck Retract 1 Direction	Absolute Z Vary Depth With Geo. Reverse Order Coolant Flood
	Pattern: 1: Workgroup Mach. CS: 1: XY plane
Comment	 ✓

Process #1 Holes	
Drill Hole Feature Bore Pre-Mill Mill Feature	Rotate
Mach. CS: 4: YZ plane 🗨	
Position Angle C -45	
Polar & Cylindrical Milling	
Duplicate	
0 time(s)	
C 0	

2. Enter this information in the Rotate tab.

3. For process #2, create this Holes process with the 0.1875" Drill (Tool #7).

4.	For process #3, create this Holes process
	with the 0.1875" Tap (Tool #8).

ocess #2 Holes	✓ C 🛱 – ×
Drill Hole Feature Bore Pr	re-Mill Mill Feature
Feed In - Rapid Out	Dimension from Tool
Feed In - Feed Out Tap Rigid Tap Peck, Full Out	4 1.05 R At Op End 1.05 t 0.201
 Peck, Chip Breaker Rough Mill Bore Finish Mill Bore 	1 0.5 0.44198
O Helix Bore	
RPM 3000 Feed 10 Dwell 0 Clearance Peck Retract ✓ 1 Direction	Load H1 D Transition Between Holes I.05 Part Clearance Absolute Z Hole Feature Vary Depth With Geo. Reverse Order Coolant Flood
	Pattern: 1: Workgroup V Mach. CS: 1: XY plane V
Comment	

Process #3 Holes			Ø©₽₽-×
Drill Hole Feature	Bore Pre	e-Mill Mill Feature	
Entry/Exit Cyde: Feed In - Rapid Out Feed In - Feed Out Tap Rigid Tap Peck, Full Out Peck, Chip Breaker Rough Mill Bore Finish Mill Bore Heitx Bore	:	O Dimension from Hole Dimension from Tool L105 R 0.75	At Op End 1.05 t 0.25 t 0.5 t 0.4869 t
Bore RPM Tap % Dwell Clearance Peck Retract 1 Direction	Material 3000 10 0	Transition Between Holes Image: Transition Between Holes Image: Transition Between Holes Image: Transition Between Holes Image: Transition Between Holes Image: Absolute Z Image: Hole Feature Image: Vary Depth With Geo. Reverse Order Image: Coolant Image: Flood	Load H1D
Comment		Pattern: 1: Workgro Mach. CS: 1: XY plane	
			×

5. Select the four holes shown.

- 6. Create the toolpath.
- Change the Position to 45° in all the Rotate tabs.
 Make sure you do this for all three processes.
- 8. Create the toolpath.
- 9. Render the operations.

#17 -18 Pockets

The final set of operations that will machine this area of the part will pocket out the area inside the gasket. Again, this set of operations requires Y Axis interpolation, which may not be supported by your Mill/Turn machine.

1.	Create this Roughing process with the	
	1/4" Finish Endmill (Tool #10).	

Process #1 Roughing		⊘ ⊜₽-×
Pocket Mill Featu	re Solids	Open Sides Offset/Trim Entry/Exit
Offset Speed: RPM	Material 3000	O Depths from Feature Depths From Tool 1.05 A I.05 A Rapid In Rapid In
Entry Feed Contour Feed Cut Width	10 20 0.325	0.75
Entry And Exit Une 90° Radius © 90° Line Advanced Pocket Stock ± Island Stock ± Z Stock Overlap Spring Passes	0 0 0 0 0	Z Step Desired Actual # Passes 0.75 0.75 1 Retracts Depth First Prefer Subs Do not hit flats Auto Plunge Round Corners Break 0 CRC On Climb Coolant Flood
Use Stock Use Stock Ignore Prior Comment	r Tool Profiles ape As Boss	Pattern: 1: Workgroup Mach. CS: 1: XY plane

astura Colida				
earrie polius	Open Sides	Offset/Trim	Entry / Exit	Rotate
4: YZ plane				
Angle C -45				
frical Milling				
time(s)				
	4: YZ plane Angle C -45 Irical Milling time(s)	4: YZ plane Angle C 45 Irical Milling time(s)	4: YZ plane Angle C 45 Irical Milling time(s)	4: YZ plane Angle C -45 Irical Milling time(s)

2. Enter this information in the Rotate tab.

3. Select the inner shape.

- 4. Create the toolpath.
- 5. Change the Position to 45° in the Rotate tab.
- 6. Create the toolpath.
- 7. Render the operations.

Rotary Milling

#19-20 Radial Slot

This final operation will complete the machining of this part is a radial slot that will be machined on the bottom side of the part. In order to create accurate toolpath you will need the Rotary Milling option.

1. Change to WG 4: OD Radial slot.

First, we need to wrap the geometry and then rotate it into position on the bottom of the part.

- 2. Right-click WG #4 and choose WG Info.
- 3. Select Wrapped.

4. In the floating menu, turn on Wrap WGs.

Viewing the geometry from the front face will clearly show how the geometry is wrapped at a given diameter.

⊕-

5. Select the wrapped shape.

6. Choose Modify > Translate.

When the system is in radial mode, some of the Modify dialogs allow for radial input--an angle of rotation and a radius value.

Translate		I - 🛙		
Offset Ar	Offset Amount			
×	180			
Y	0			
Z	0			
Visible WGs Do It				

7. Translate the geometry as shown.

The geometry should be positioned radially at the bottom of the part as shown in the following picture.

8. For process #1, create this Mill Roughing process with the 1/4" Finish Endmill (Tool #10).

Pocket Mill Fea	ture Solids C	open Sides Offset/Trim Entry/Exit
Offset	\sim	O Depths from Feature
	Material	Depths From Tool
Speed: RPM	3000	↓ 1.05 1.05
Entry Feed	10	
Contour Feed	20	0.75
Cut Width	0.125	
Entry And Exit		Z Step Desired Actual # Passon
90° Radius		0.75 0.75 1
90° Line	0	Retracts Depth First Prefer Subs
○ Advanced		Do not hit flats
Pocket Stock ±	0	Auto Plunge 🗸
Island Stock ±	0	
Z Stock	0	
Overlap	0	Round Corners Break 0
Spring Passes	0	CRC On Climb
		Coolant
		M LIOOG
Use Stock		Pattern: 1: Workgroup \lor
Material Onl	у	Mach. CS: 1: XY plane \lor
Ignore Pri	ior Tool Profiles	
Comment	nape As 0055	

Process #1 Roughi	ing				Ē	I) - 🛛
Pocket Mill F	eature Solids	Open Sides	Offset/Trim	Entry / Exit	Rotate	L
Mach. CS:	4: YZ plane	-				
O Position	Angle B 0					
Polar & Cylind	rical Milling					
Duplicate						
0	time(s)					
BO						

9. Enter this information in the Rotate tab.

10. For process #2, create this Mill contour process with the 0.1875" Finish Endmill (Tool #11).

Process #2 Contour		✓ ○ <
Contour Mill Feature	Solids Op	oen Sides Offset Entry/Exit
Speed: RPM Entry Feed Contour Feed Entry And Exit © Line 90° Radius 0 90° Line 0 Advanced No. of Extra Offsets Extra Stepover Stock ± Z Stock Overlap Spring Passes Use Stock 0 Material Only 1 Jgnore Prior T	Material 3000 10 20 0.05 0.25 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	 Depths from Feature Depths From Tool 1.05 ↑ Rapid In 2 Step Desired Actual # Passes 0.125 0.125 1 Retracts Depth First Ø Prefer Subs Ramp Down Back & Forth Do not hit flats Auto Plunge Coultant Goalant Flood
Comment		Pattern: 1: Workgroup V Mach. CS: 1: XY plane V
		~

12. Render the operations.

11. Select the wrapped geometry and create the toolpath.

