



Version 14 : September 2020

# 2.5D Solids 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<sup>™</sup> 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<sup>™</sup> and VoluTurn<sup>™</sup> 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.

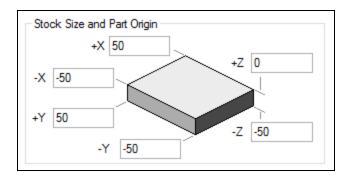
# 2.5D SOLIDS TUTORIALS

## About the Tutorials

This chapter contains step by step instructions for creating models for a variety of parts. The models in this chapter will be machined in the Machining Exercises so be sure to save them for later use.

## #1: 2.5D CAP

1. Create a new part named Cap.vnc with the mm dimensions shown.



- 2. Open the Solid Modeling palette.
- 3. Open the Create Solid palette.

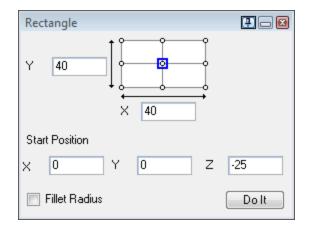
20 💏 🗇 🗞 😯 🗗 🗗

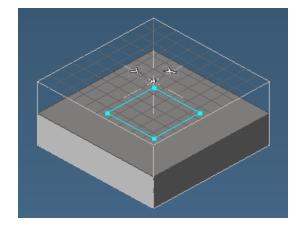
- 4. Open the Cuboid dialog.
- 5. Enter the data in the Cuboid dialog as shown and Click the Do it button (or press Ctrl+.).

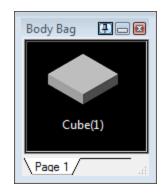
Cub	oid						🗜 🗕 🖬
							Dolt
Max	Х	50	Y	50	Ζ	-25	Stock Dim.
Min	Х	-50	] Y	-50	Ζ	-50	

Pressing the Stock Dim. button will enter most of the data so that only the Max Z field needs to be changed.

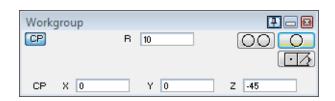
6. From the Geometry Creation palette , select Shape OA then rectangle and create the rectangle as shown. Change view to isometric (Ctrl+I).





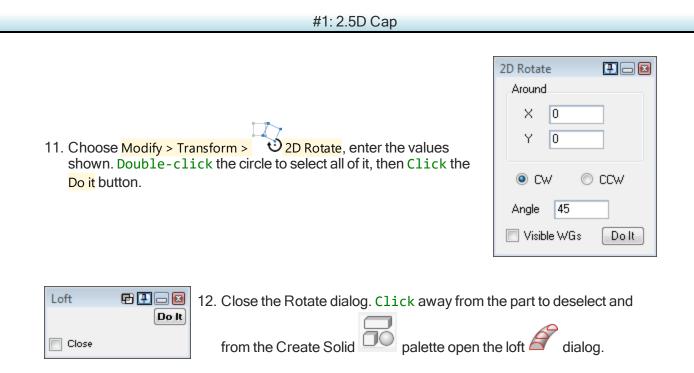


- 7. Double-click the cube to place it in the Body Bag.
- 8. Switch to the home view (Ctrl+H).
- 9. Create the circle ( ) shown.

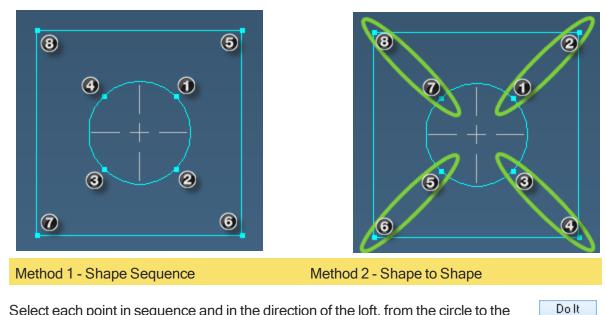


GeoEdit - Split	🥩 – 🗙
<ul> <li>At Parameter</li> <li>Equally spaced</li> </ul>	4
	Dolt

10. Select the circle and choose Plug-Ins > Split. Enter 4 for the number of sections then Click
Dolt (or press Ctrl+.).



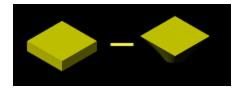
13. Ctrl+click the sync points as shown below.



Select each point in sequence and in the direction of the loft, from the circle to the square, Click Doit.

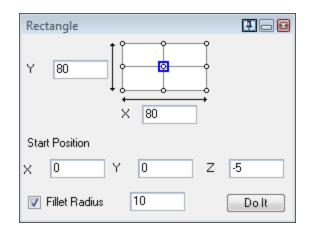
Alignment points are used to determine how the shapes will be aligned and blended. Alignment points <u>must</u> be selected in the right order. Alignment points can be selected in two ways, selecting alignment points from shape to shape or select a single shapes alignment points, in order, followed by the next shape in the same order.

14. Click the cube then Ctrl+click the loft shape. (Make sure Face selection is deselected to select entire body).

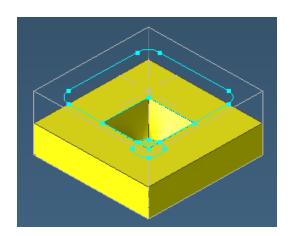


15. Subtract 🛱 the loft from cube.

16. Create a Rectangle with the Fillet Radius shown.



17. Click New CS from the CS list.

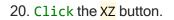




		6 🗉	- 🖸
	Comment	WFO	
<b>89</b>	XZ plane		
ew C.	5		
	<b>89</b>	Comment Series XY plane CS CS	<ul> <li>≫ XY plane</li> <li>₩ XZ plane</li> </ul>

18. Create CS2 and label it XZ plane.

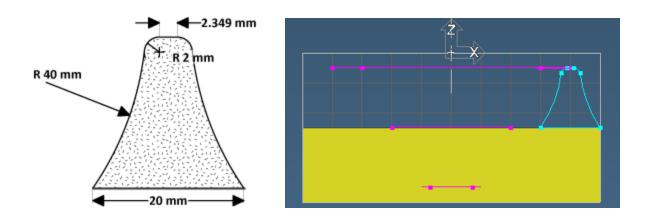




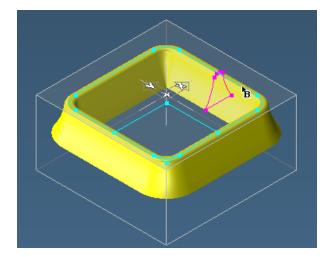


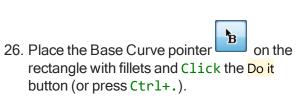
XZ

- 21. Switch to the home view (Ctrl+H).
- 22. Create the profile geometry in the XZ plane.



- 23. Switch to XY plane.
- 24. Switch to the isometric view (Ctrl+I) and Double-click the cube base to place it in the Body Bag.
- 25. Select the profile and open the Sweep Solid dialog.





- 🗜 🗆 💌 Rectangle Y 30 27. Open the Rectangle dialog and enter the 30 Х following dimensions. Start Position -35 Y -35 Ζ -25 Х Fillet Radius Dolt
- Extrude 🖻 🖪 🗖 🖾 Do It Z 20 📝 Taper -10 Z-
- 28. Select the square and create the extrusion shown.





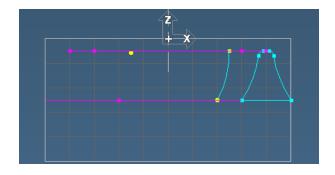
30. Switch to the XZ plane.

31. Create the points \* shown below.

Wor	rkgroup			🕂 🖃 🖾	Work
×	20	Y	-25	••	X 2
Z	0	Ρ	None		ΖC

Workgroup		<b>!</b> - <b>I</b>
X 20	Y -5	••
Z 0	P None	

32. Create the 40mm arc terminated between the two points as shown.



10

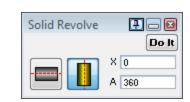
- 33. Select the arc and Revolve the arc with the following information.
- 34. Choose Modify > Transform> Translate and enter the following values.
- 35. Select the revolve and Click the Doit button.
- 36. Subtract

revolve from sweep.

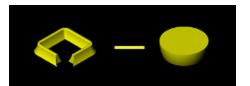


it.

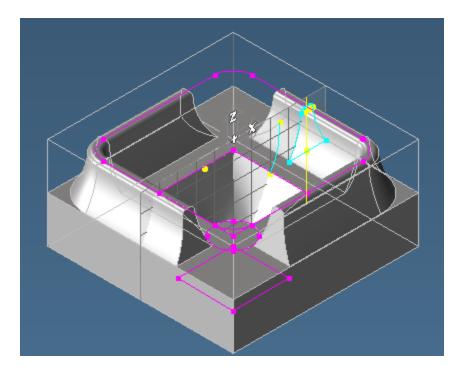
- 37. Select the sweep and Separate
- 38. Add the swept shapes to the modified cube.
- 39. Save the part file.



Translate	I - I
Offset Am	ount
×	40
Y	40
Z	0
🔲 Visible V	WGs Dolt







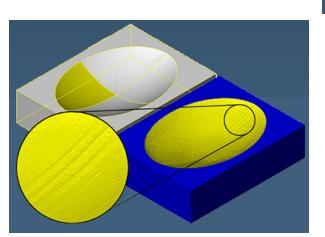
# **#2: BUILDING A SPHERICAL ELLIPSE**

## The Challenge

You need to create a concave elliptical where the lowest point is in the center.

# The Problem

The print specifies values for one quadrant of the 3D shape; this is how we might normally go about building the part, one quadrant at a time. We build the first quadrant and then create a Coons Patch between the geometry. We then duplicate and mirror the Coons Patch sheet over the X and Y center lines and stitch the sheets together. This result looks like the finished shape we want.



However, there is a problem with this model that cannot be clearly seen until the part is machined. If you turn on "Show Edges", you can see the intersecting lines running through the model. These intersecting lines run parallel to the X and Y axes at the centerline. When the part is machined, these lines will show up as if they have been magnified. The model, not the machining, is the cause of the problem.

Is this problem unique to GibbsCAM? No, this is the result of poor modeling techniques and will be reproduced in any other CAD or CAD/CAM system unless a better set of modeling techniques is used. GibbsCAM is machining the model exactly as it was built.

## The Solution

To create a single continuous 3D flowing shape we will create a "3 Point Arc" on the XZ CS, another "3 Point Arc" on the YZ CS and then Sweep a sheet over these two arcs. Create a 3 Axis Vertical Mill part, X:-40/+40, Y:-30/+30, Z:-20/0mm. Follow the steps below:

## <u>Step #1</u>

- 1. Create an XZ plane.
- 2. Create points at X-35, D0, Z0 then at X0, D0, Z-8 and lastly X+35, D0, Z0.

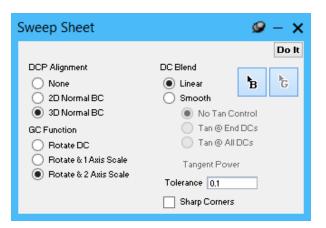
- 3. Select the points we just created.
- 4. Create a "3 Point Circle" (the circle will have a radius of 80.563mm).
- 5. Terminate the circle with the points at X-35 and X+35.

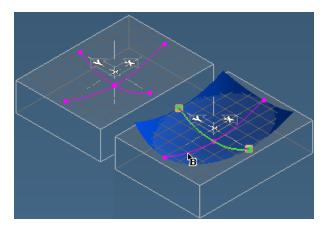
#### Step #2

- 1. Create a <mark>YZ</mark> plane.
- 2. Create points at Y-25, Z0, X0 then Y0, Z-8, X0 and Y25, Z0, X0.
- 3. Select the points we just created.
- 4. Create a "3 Point Circle" (circle will have a radius of 43.063mm).
- 5. Terminate the circle with the points at Y+25 and Y-25.

#### <u>Step #3</u>

- 1. Switch to the + XY plane.
- 2. Open the Surface Modeling palette.
- 3. Open the Sweep Sheet dialog.
- 4. Set the sweep options as shown.





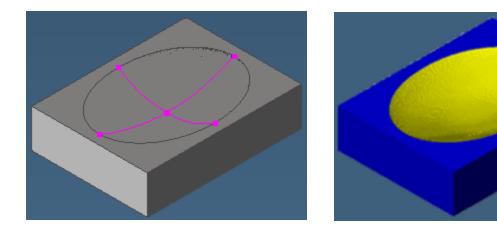
5. Place the base curve pointer on the curve shown and double-click the other curve as the drive curve.

6. Click the Do It button to create the sheet.



- 7. Create a cube based on the workspace stock dimensions.
- 8. Slice the cube with the swept sheet function.

Now you have a continuous shape which does not have quadrant intersections. Turn on Edge Selection and you will only see the edges of the spherical ellipse at the top surface of the body. There are no edges in the middle of the spherical ellipse like we saw with the quadrant building technique. You may machine as desired (the sample part uses a lace cut) and you will not see any lines in this area as you did before.



9. Save the file.

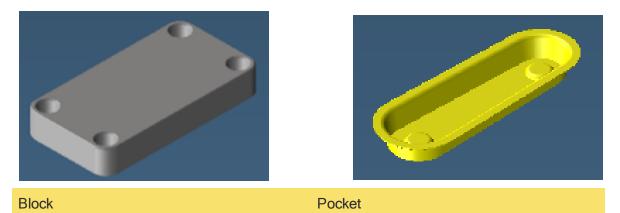
# **REPLACE HISTORY**

In this tutorial we are going to modify a model to create a pocket. We will machine the pocket with saved processes. After we machine the part we will import a new body that represents a redesigned pocket. Using Replace, we will recreate the model and redo the machining.

## **Part Creation**

1. Open part file Swap Example.vnc.

This part file has 2 bodies – Block and Pocket. Pocket is currently not visible as it is in the Body Bag.



## Saved Processes

The first thing we will do is make the saved processes available for use.

1. Open the Sample Parts\Solids\Required\SolidSurfacer\Swap & Replace folder and copy the Swap Processes folder to My Documents.

Placing the saved processes here will make it easy to find them when we need them.

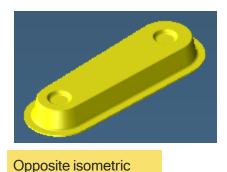
Change Process... Change Tool... Open Tool... Move To... 1. Right-click a Process tile and from the Find... menu choose Load Process List, then Set Folder. Save Process List... Load Process List Browse... ۲ This will now be the default location that Set Folder... processes can be loaded. 2 Ē Process Manager ~ Show Do It/Redo Small Icons ~ Large Icons Select Process Directory ✓ ♂ Search Swap Processes ( ) ▼ ↑ ↓ ≪ Documents → Swap Processes p ..... ? Organize 👻 New folder Name Date modified Size 2. Navigate to the My Documents/ Type No items match your search. Swap Process directory and click Select Folder. Folder: Swap Processes

Placing the saved processes here will make it easy to find them when we need them.

Select Folder

Cancel

## Unstitching and Subtracting "Pocket"



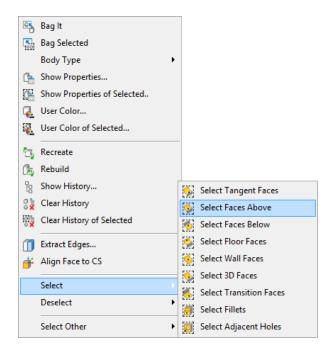
view (Ctrl+Alt+I)

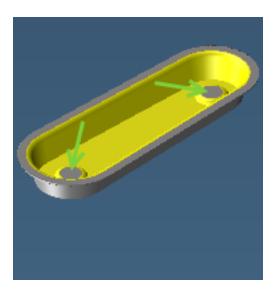
We are going to unstitch the body named Pocket to close off the shape, thereby creating a core. The interior topology is not important; it is the exterior shape we will be subtracting from the Block.

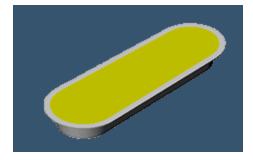
- 1. Turn on face selection and Right-click the bottom flat face of the pocket body.
- 2. Choose the Select > Select Faces Above option.

All faces inside the pocket except the flats on top of the bosses should be selected.

**Replace History** 







3. Select the two flat tops of the bosses, as shown above.

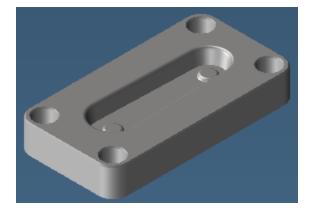
4. Click the Unstitch button.

This results in two solids.

5. Select and Delete the smaller of the two resulting solids.

We do not need the core that was created, but we need the filled pocket body.

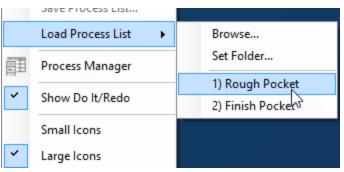
6. Subtract the filled pocket from the Block.



## Machining the Part

### Loading Processes.

1. Right-click the Process list and select Load Process List. This time the menu will display files in the folder we set.



- 2. Choose 1) Rough Pocket.prc. There will be a slight delay as the Tool and Process that comprise this pocketing process are loaded.
- 3. Select the faces in the pocket the same way we selected the faces for the unstitch. Create the toolpath.
- 4. Deselect the Operation tile and Clear the process tile.
- 5. From the Processes menu select Load and choose 2) Finish Pocket.prc and create the toolpath.
- 6. Render the operation.
- 7. Deselect the operations and place the model in the Body Bag.

## Modifying the Part

#### **Importing the Changed Pocket**

We are now going to import a model that is a different pocket shape. We will use the Replace function to insert it where the filled Pocket body was used.

1. File> Import the file Large Cover.x\_t from the Swap & Replace folder.

۵		Import file				×
🛞 ⊝ 👻 ↑ ╟ « Solids → Tutorial P	arts - Required → SolidS	urfacer ⊧ Swap and	I Replace →	~ C	Search Swap and Replac	e ,o
Organize 🔻 New folder						
Name	Date modified 6/10/2015 10:04 AM 1/10/2003 6:30 PM	Type File folder X_T File	Size 37 KB			Select a file to preview.
File name:				~	Parasolid (*.x_t;*.xmt) Open	✓ Cancel

### **Replacing the Model History**

- 1. As with the smaller pocket shape, Right-click the bottom face and choose Select> Select Select Faces Above and then select the tops of the two bosses.
- 2. Unstitch the solid to fill it and Delete the smaller solid.

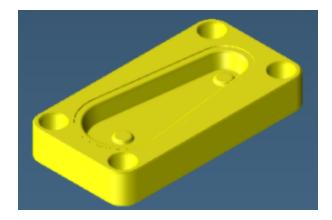


- 3. Double-click the graphic to extract the smaller filled pocket from the History of the Block.
- 4. Select the filled Large Cover solid then the smaller filled pocket. Click the Replace button.



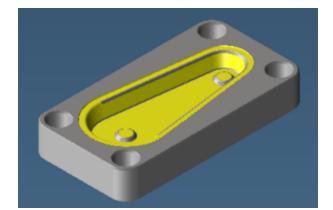
You will not see any changes but you may be wondering why we had to unstitch the larger pocket. Shouldn't we be able to just extract the original smaller body and replace that? The answer is, in this case, no. The modeler is not able to match up the faces of the two bodies. If we were using a function that was not face-dependent (translate, booleans, and so forth) we could just select the two original bodies and perform a swap or replace.

5. Right-click the Block model and choose Rebuild.



### **Redoing the Operations**

Now we will update the operations based on the new model.



 Select Edit > Redo All Ops and render the part.

2. Save the file; it is complete.

# **MACHINING SOLIDS**

## **About these Tutorials**

The part models for all of the following exercises were created in the Modeling Exercises chapter of this manual. If you have not gone through those exercises and created the solid models for these parts, you should do that now. We assume you are familiar with the interface and the principles presented in the Mill and Advanced CS Modules. If you are unfamiliar with that information please read through those manuals before attempting the following tutorials.

All parts in these exercises are assumed to be made of cast aluminum alloys. The feeds and speeds are all defaults, based on the CutDATA<sup>™</sup> values. The exercises do not provide a step for setting the material but if you have CutDATA, please set the part material when you open the part file. If you do not have CutDATA simply use the default material – stainless steel. The feeds and speeds may be set by clicking on the calculation buttons.

## **Pockets and Contours**

In this exercise, we will use a pocketing process to rough the part. The part will be finished using Contour operations on the whole body and selected faces.

## Part Setup

 Open the 2.5D Solids part Cap.vnc created in modeling exercises. Set the Global Settings in the Machining Preferences tab of the DCD as shown.

Vse Global Settings	for Solids
Part Rough Tolerance	0.25
Part Finish Tolerance	0.025
Fixture Tolerance	0.25
Fixture Clearance	2.5

- 2. Ensure that the part has a Clearance value of 15mm.
- 3. Create the following tool list.

#	Туре	Total Length	Diameter	Bottom Radius	# Flutes	Flute Length	Material
1	Face Mill	50mm	50mm	0mm	5	11.5mm	HSS
2	Rough EM	92mm	16mm	0mm	3	32mm	TiN Coated
3	Finish EM	66mm	10mm	2mm	3	16mm	TiN Coated

## Machining the Part

## #1, Face Milling

First we will Face Mill the part.

	Process #1 Roughing	✓ 平 – ×
1 Oueste this we used in a	Pocket     Mill Feature     Solids     Option       Face Milling     V     Material       Speed: RPM     9702       Entry Feed     2957	
<ol> <li>Create this roughing process with tool #1.</li> </ol>	Contour Feed       2957         Cut Width       750         Z Stock       0             Stock       0            Stock       Start Corner         Shape	0
	Cut Above Stock	<ul> <li>☑ Round Corners</li> <li>☑ Coolant</li> <li>☑ Flood</li> <li>☑ Pattern: 1: Hladina - WG 1</li> </ul>
	Comment	Mach. CS: 1: XY plane ~

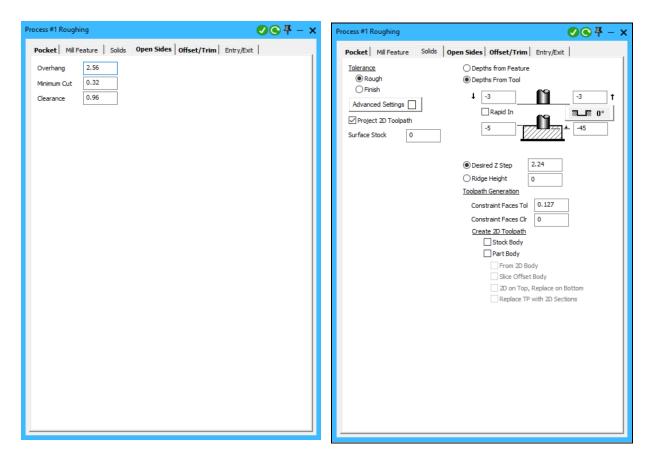
This will clear off the top of the part. Face Milling is not dependent on having a solid to machine. Face milling machines either selected geometry or the workspace stock.

2. Create the toolpath.

## #2-3, Pocketing

1. Create this Roughing process with tool #2.

Process #1 Roughing		Ø ● 平 – ×
Pocket Mill Featur	e Solids	Open Sides Offset/Trim Entry/Exit
Offset Speed: RPM Entry Feed Contour Feed Cut Width Entry And Exit O Line 90° Radius	Material       9702       2957       2957       8	<ul> <li>○ Depths from Feature</li> <li>③ Depths From Tool</li> <li>↓ -3 ↑</li> <li>□ Rapid In 0°</li> <li>-5 ↓ -45</li> <li>Z Step</li> <li>Desired Actual # Passes</li> <li>2.24 2.222 18</li> <li>☑ Retracts Ø Depth First Ø Prefer Subs</li> </ul>
<ul> <li>90° Line</li> <li>Advanced</li> <li>Pocket Stock ±</li> <li>Island Stock ±</li> <li>Z Stock</li> <li>Overlap</li> <li>Spring Passes</li> </ul>	0 0 0 0 0 0 0	✓ Retracts       ✓ Depth First       ✓ Prefer Subs         Do not hit flats       ✓         Auto Plunge       ✓         ✓ Round Corners       Break       0         □ CRC On       ✓ Climb         ✓ Coolant       ✓
Use Stock Use Stock Ignore Prior Outermost Sha Comment	Tool Profiles ape As Boss	Pattern: 1: Hladina - WG 1 Mach. CS: 1: XY plane

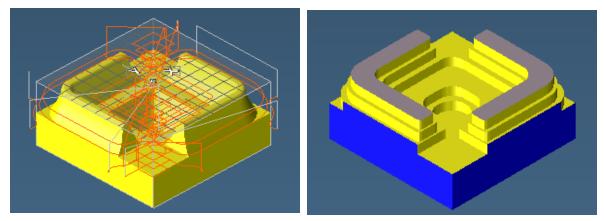


When all of the options are set, create the operation.

The Use Stock option will trim the toolpath to the stock condition. Since this is an open pocket we can get some drastically different results. If you wish to see the difference, try re-doing the operation with Use Stock off.

The Rough tolerance setting allows us to generate toolpath faster with looser tolerances. This will be fine since we are going to finish the surface in the next group of operations.

2. Create the toolpath and render.



This process creates two operations.

### #4-5, Contouring

We will now do the first of two sets of contour operations to finish the profile.

 Create this Contour process with tool #3.

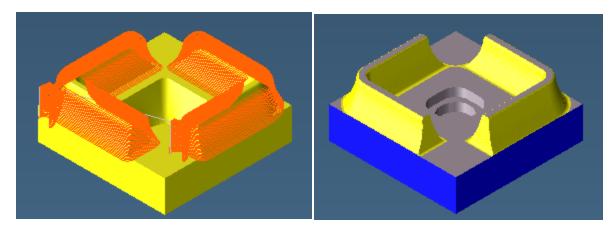
The Desired Z Step determines how smooth the wall will be. Alternatively, the Ridge Height option can be used to specify the part's smoothness. Often the rendered part is far more accurate in showing any scallops that are on the part than our eyes can discern.

Contour Mill Feature	Solids Open Sides Offset Entry/Exit
Cutting Direction	O Depths from Feature
Climb	Depths From Tool
Conventional	1 -3 <b>M</b> -3 1
Tolerance	↓ <u>-3</u> <u>-3</u> 1
Rough	Rapid In 💦 🕅 💦 🛛 🖓
Finish	-5 777 ± -25
Advanced Settings 📔	
Project 2D Toolpath	
Surface Stock 0	Desired Z Step 0.7
	Ridge Height 0

rocess #1 Contour		🖉 👁 ቸ –
Contour Mill Featur	re Solids	Open Sides Offset Entry/Exit
Speed: RPM Entry Feed Contour Feed Entry And Exit © Line 90° Radius 90° Line 0 90° Line Advanced No. of Extra Offsets	Material	<ul> <li>○ Depths from Feature</li> <li>③ Depths From Tool</li> <li>↓ -3 ↓ -3 ↓ 1</li> <li>□ Rapid In ↓ -25</li> <li>Z Step</li> <li>Desired Actual # Passes</li> <li>0.7 0.69 29</li> <li>○ Retracts Ø Depth First Ø Prefer Subs</li> <li>□ Ramp Down □ Back &amp; Forth</li> </ul>
Extra Stepover Stock ±	0	Do not hit flats
Z Stock Overlap Spring Passes	0	Auto Plunge  V Round Corners Break
Use Stock	Tool Profiles	☑ colant ☑ foodnt ☑ Flood
Comment		□ Pattern: 1: Hladina - WG 1 Mach. CS: 1: XY plane
		< >

2. Create the toolpath and render.

This operation produces smooth toolpath that wraps around the walls of the part. When rendered your part will look similar to the image to the right. Because we specified Depth First, the toolpath is completed around one wall before rapiding over and machining the other.



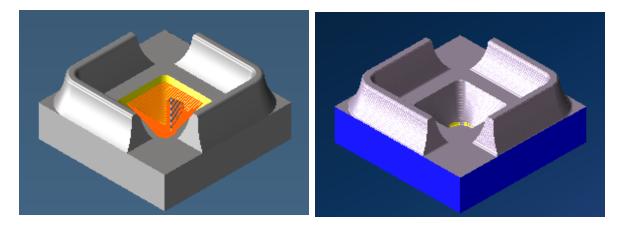
#### #6, Contour

The last operation will contour the inner pocket.

1. Modify the existing Contour process as shown.

Process #1 Contour		✓ 平 – ×
Contour Mill Feature	e   Solids   <b>O</b>	pen Sides Offset Entry/Exit
Speed: RPM Entry Feed Contour Feed Entry And Exit © Line 90° Radius 90° Radius 90° Line 90° Line Advanced No. of Extra Offsets Extra Stepover Stock ± Z Stock Overlap Spring Passes Use Stock Use Stock Ignore Prior T	Material           9702           2957           2957           1           3           0           0           0           0           0           0           0           0           0           0           0           0           0	<ul> <li>Depths from Feature</li> <li>Depths From Tool</li> <li>-22</li> <li>-22</li> <li>Rapid In</li> <li>-25</li> <li>-25</li> <li>-45</li> </ul> Z Step Desired <ul> <li>Actual</li> <li># Passes</li> <li>0.7</li> <li>0.69</li> <li>29</li> <li>Retracts</li> <li>Depth First</li> <li>Prefer Subs</li> <li>Ramp Down</li> <li>Back &amp; Forth</li> <li>Do not hit flats</li> <li>Xuto Plunge</li> <li>Cutter Radius Comp. On</li> <li>Coolant</li> <li>Flood</li> </ul>
		Pattern:     1: Hladina - WG 1       Mach. CS:     1: XY plane
Comment		0

- 2. Turn on face selection mode.
- 3. Select the faces of the angled pocket.
- 4. Create the toolpath and render.



#### 5. Save the part.

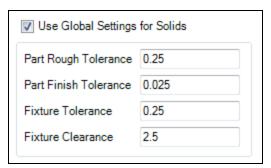
## #2: The Hot Punch

The Hot Punch will only have one operation – a projected engraving operation. The part consists of a stock body. We will create a text shape and project the contour toolpath onto the model.

## Part Setup

### **Document Control Dialog**

1. Open the Hot Punch.vnc part. Set the global settings in the Machining Preferences tab of the DCD as shown.



2. Ensure that the part has a Clearance value of 15mm.

### Tool List

1. Create the following tool.

	Туре	Total Length	Diameter	Corner/Tip	# Flutes	Flute Length	Material
1	3.15mm Center Drill	31.5mm	3.15mm	118°	2	1.9mm	Carbide Solid

## **Creating Operations**

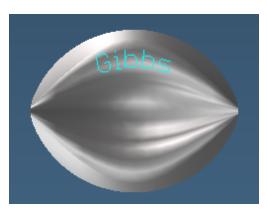
### #1: Engraving

We will create text and engrave the top face of the part. The contouring process provides for centerline machining of all selected shapes which include text and artwork. Contouring operation toolpaths can be projected on to sheets and bodies.

We will need to create text geometry that can be machined. The system can create spline geometry from any TrueType font. You may need to set the directory that contains the fonts for your system. There is a Font Directory item in the Preferences>File submenu which allows you to designate a directory that contains your system fonts. The Moorpark TrueType font used in this exercise is shipped with each order.

Text Creation		E 🖬 🗆 🖻
Text Spacing Center Pt. X 0 Y -19 Z 0	Text Flow Moorpark P \$6.5	Angle 90 Radius 35
Gibba		Dolt

- 1. Open the Text Creation dialog from the Shape palette in the Geometry Creation palette.
- 2. In the Text Flow tab select the clockwise arc.
- 3. In the Text Flow tab enter the information shown.
- 4. Click the Do It button to create the text.



5. Select the text geometry.

If you have any problems with text creation, refer to the Text Creation Exercise in the Geometry Creation Manual.

Process #1 Contour	✓ 즉 平 – ×
Contour   Mill Feature   Solids   Open Sides   Offset   Entry	//Exit
Material     Opepths from Feature       Speed: RPM     105       Entry Feed     1656       Contour Feed     1656       Entry And Exit     0	5 t 
Extra Stepover Stock ± 0 Z Stock -0.5 Auto Plunge	# Passes 2 th First Prefer Subs & Forth Break 0
Spring Passes     0     Cutter Radius Comp. O       Use Stock     Image: Colored col	n
Pattern: 1: Workg Mach. CS: 1: XY plan Comment	

6. Create this Contouring process with tool #1.

When more than one shape is selected prior to creating a contouring process, the system automatically assumes that you are doing engraving. When this is the case, several of the items in the Contouring Process dialog will be grayed out. The Z Stock option is used in this case so that the engraving toolpath will cut into the selected body. The toolpath generated by the operation will be shifted down along the Z axis only by the amount specified. The toolpath itself will be projected onto the surface of the body and then will be shifted down in Z to cut into the body.

Z Stock -0.5

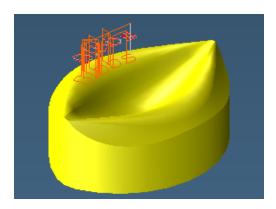
Contour Mill Feature	Solids Open Sides Offset Entry/Exit
Cutting Direction	O Depths from Feature
Olimb	Depths From Tool
<ul> <li>Conventional</li> </ul>	↓ 0 <b>5</b>
Tolerance	
Rough	Rapid In 📈 🕅 🖓 🛄 🕅 🖉
() Finish	0 777777777777777777777777777777777777
Advanced Settings	
Project 2D Toolpath	
Surface Stock 0	Desired Z Step     40
	Ridge Height 0
	Toolpath Generation
	Gen 3
	○ Gen 2
	Constraint Faces Tol
	Constraint Faces Clr
	Create 2D Toolpath
	Stock Body
	Part Body
	From 2D Body Slice Offset Body
	2D on Top, Replace on Bottom
	Replace TP with 2D Sections
	Use for machining solids to generate analytic
	toolpath.

7. In the Solids tab enter the information shown.

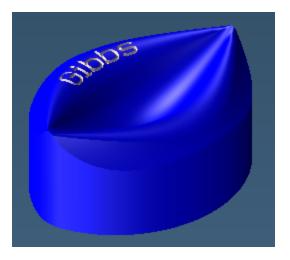
#### 8. Ctrl+click the model.

The text and the model should both be selected. When 2D geometry and a solid or sheet are selected for the cut shape of a process, the toolpath will be a projection of the 2D toolpath onto the body or sheet.





- 9. Create the toolpath
- 10. Render the operation.



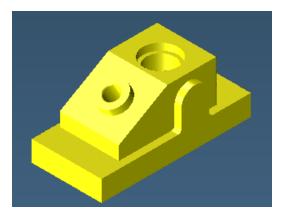
## #3: The Base

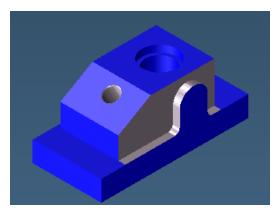
## About the Part

This part is intended to help you become familiar with two important tools - the Profiler and using constraint shapes and faces.

1. Open the part file Base.vnc.

This part has an existing stock condition and two groups of operations including two drilling operations and a roughing operation. Drilling in 2.5D Solids, as with the standard Mill package, is accomplished with geometry or the Hole Wizard so we do not need to go over the Holes process.





The roughing operation uses a combination of containment faces to achieve the desired results. Let's look at how this works.

### Part Setup

The part should be ready for you to apply operations to it but to be safe we will go over certain aspects.

 Ensure that the part is using a 5 Axis Vertical Mill MDD, that the Clearance Plane is set to 350mm and that the Global Settings in the Machining Preferences tab are as shown.

Use Global Settings	for Solids
Part Rough Tolerance	0.2
Part Finish Tolerance	0.05
Fixture Tolerance	0.15
Fixture Clearance	0.5

The part has four tools as detailed below.

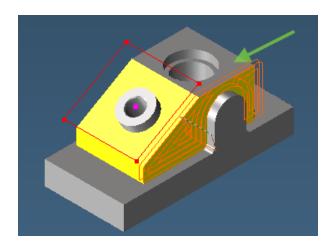
#	Туре	Total Length	Diameter	Bottom Radius/Tip	# Flutes	Flute Length	Material
1	Drill	260mm	80mm	90°	2	n/a	TiN Coated
2	Drill	260mm	40mm	118°	2	n/a	TiN Coated
3	Rough EM	121mm	25mm	0mm	3	45mm	TiN Coated
4	Finish EM	72mm	10mm	0mm	3	22mm	TiN Coated

## Machining the Part

## Op 3, Roughing

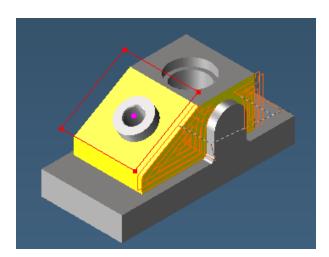
1. Double-click operation #3.

2. Turn on Face Selection and deselect the top flat face as shown.



3. Redo (Ctrl+,) the operation.

The results are very different. By deselecting the face we have told the system that face is a constraint and we cannot machine by it.



4. Reselect the top face and Re-do the operation to return it to its original state.

### Ops 4-6, Rough and Contour

We will now create a roughing and contouring process group to machine the angled face.

1. Switch to CS2.

Pocket Mill Feat	re <b>Solids</b> 0	Open Sides Offset/Trim Entry/Exit Rotate
Offset	∼ Material	<ul> <li>Depths from Feature</li> <li>Depths From Tool</li> </ul>
Speed: RPM	873	↓ 60 60 Rapid In 0°
Entry Feed Contour Feed	399	0 + -19.685
Cut Width Entry And Exit C Line 90° Radius	12.5	Z Step Desired Actual #Passes 10 9.843 2
90° Line  Advanced	0	Retracts     Depth First     Prefer Subs     Do not hit flats
Pocket Stock ± Island Stock ± Z Stock	1	Auto Plunge V
Overlap Spring Passes	0	Round Corners Break  CRC On  Climb  Coolant
		Flood
Outermost Sł	r Tool Profiles	□ Pattern: 1: Workgroup001 ∨
Comment		

2. Create this roughing process with tool #3.

The Surface Z and Depth Z values are acquired by interrogating the top of the circular boss and the large flat angled face. If your machining CS is set to something other than CS 2 you may get different results.

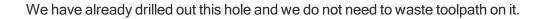
Process #1 Roughing 🛛 🖉 😋 🐺 –	× Process #1 Roughing ♥● ₹ - ×
Pocket         Mill Feature         Solids         Open Sides         Offset/Trim         Entry/Exit         Rotate           Tolerance         Opepths from Feature         Opepths from Feature         Openths From Tool         Finish         60	Pocket       Mill Feature       Solids       Open Sides       Offset/Trim       Entry/Exit       Rotate         Approach Z:       Depths from Feature         Absolute
Project 2D Toolpath  Surface Stock  0	Retract Z: Rapid In Absolute 0 -19.685
Desired Z Step     10     Ridge Height     0     Ioolpath Generation     Constraint Faces Tol     0.127	Absolute  V Feature Depth Z:
Constraint Faces Clr 0 <u>Create 2D Toolpath</u> Stock Body Part Body From 2D Body	Absolute  Mach. CS: Absolute  Mach. CS: 3: XZ plane
Slice Offset Body 2D on Top, Replace on Bottom Replace TP with 2D Sections	Reset All to Absolute

3. Create this contour process with tool #4.

Process #1 Contour	Process #2 Contour
Contour Mill Feature Solids Open Sides Offset Entry/Exit	Contour Mill Feature Solids Open Sides Offset Entry/Exit Rotate
Material     © Depths from Feature       Speed: RPM     500       Entry Feed     50       Contour Feed     100       Entry And Exit     -17       Une     18       90° Radius     Z Step	Material     O Depths from Feature       Speed: RPM     17762       Entry Feed     1774       Contour Feed     1774       Entry And Exit     -17       O Line     90° Radius
O     O	
No. of Extra Offsets       0         Extra Stepover       Image: Constraint of the state of the sta	No. of Extra Offsets       0         Extra Skepover       Ramp Down         Stock ±       0         Z Stock       0         Overlap       0         Spring Passes       0         Use Stock       Ø         Image: Image Prior Tool Profiles       Ø
□ Pattern: 1: Workgroup Mach. CS: 1: XY plane	□Pattern: 1: Workgroup001 ∨
Comment	Comment

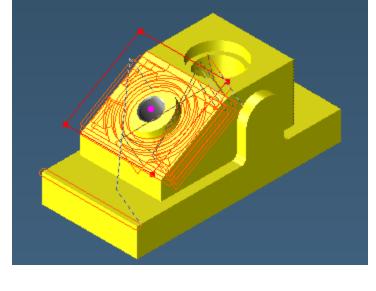
As usual, the rotations information is automatically acquired.

4. Select All (Ctrl+A) the entire model, then deselect the two faces that define the hole in the boss.



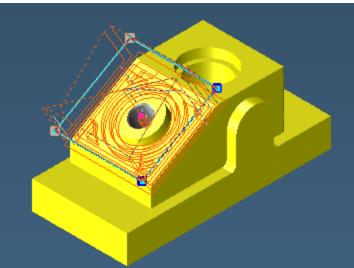
5. Create the operations.

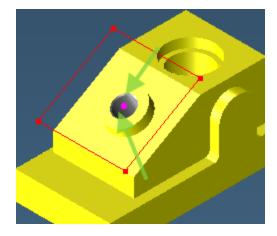
You can see that we have some toolpath that is not necessary. We forgot to select the constraint geometry.



 Ctrl+double-click on the "air" geometry and redo (Ctrl+,) the operation.

These results are more desirable.





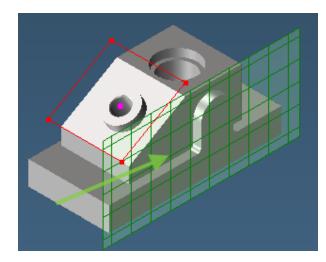
## Op 7, Contouring with the Profiler

The last thing we will do is use the Profiler to machine a selected area of the part. Operation #3 leaves stock on the rounded wall.

- 1. Switch to the XZ plane.
- 2. Activate the Profiler.
- 3. Turn off the Coordinate system grid.

You will find it easier to see and work with the Profiler if the CS grid is off.

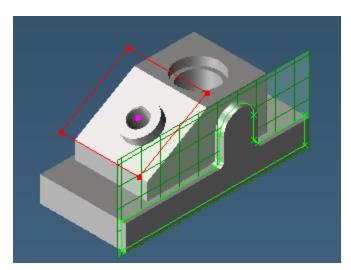
- 4. Right-click the profile grid and choose Profiler Depth.
- 5. Interrogate (Alt+click) the face shown and Click the Apply button.



	Profiler Depth 🛛 🖉 🗖 🞽
	Depth -19.685
	Radius
	Apply
J	
١f	

ortunately at this depth the Profiler does not see the rounded wall. We will have to manually move the Profiler.

6. Click anywhere on the Profiler's grid and drag the Profiler to a location in the center of the rounded wall, as shown above.





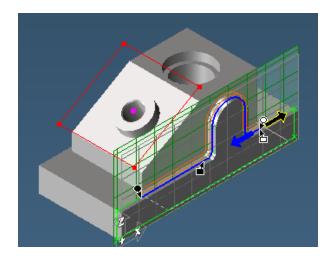
cess #1 Contour	🗸 — 平 🔊 🛇	
Contour   Mill Feature   Solids   (	Dpen Sides Offset Entry/Exit Rotate	
Material       Speed: RPM     7762       Entry Feed     1774       Contour Feed     1774       © Line     1       90° Radus     3       0 90° Line     0       Advanced     0       No. of Extra Offsets     0       Extra Stepover     0       Stock ±     0       Qverlap     0       Spring Passes     0       Use Stock     Ignore Prior Tool Profiles	<ul> <li>Depths from Feature</li> <li>Depths From Tool</li> <li>60</li> <li>Rapid In</li> <li>0</li> <li>10</li> &lt;</ul>	7. Create a shown. The Final interrogat for the Pro

7. Create a Contour process with tool #4 as shown.

The Final Z depth can be acquired by interrogating the same face we tried to use for the Profiler depth.

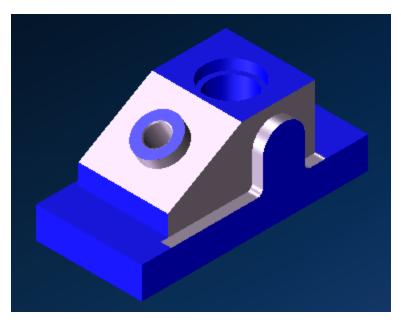
Process #1 Contour	✓ 목 – ×	Process #1 Contour	× - 平 🔊 🛇
Contour Mill Feature Solids	Open Sides Offset Entry/Exit Rotate	Contour Mill Feature	Solids Open Sides Offset Entry/Exit Rotate
Cutting Direction Climb Conventional	○ Depths from Feature     ⑧ Depths From Tool     ↓ 60	Approach Z: Absolute ~	○ Depths from Feature
<u>Tolerance</u> © Rough O Finish Advanced Settings	Rapid In         □	Retract Z: Absolute V	Rapid In
Project 2D Toolpath Surface Stock 0	Desired Z Step     10     Ridge Height     0     Toolpath Generation	Top Surface Z: Absolute	
	Gen 3     Gen 2     Constraint Faces Tol     Constraint Faces Clr	Feature Depth Z: Absolute ~	
	<u>Create 2D Toolpath</u> ☐ Stock Body ✓ Part Body ☐ From 2D Body	Mach. CS: Absolute ~	Mach. CS: 3: XZ plane 🗸
	Slice Offset Body 2D on Top, Replace on Bottom Replace TP with 2D Sections Use for machining solids to generate analytic toolpath.	Reset All to Absolute	

8. Click the Profiler and set the machining markers as shown, then create the operation.



You may find it necessary to go to the Home view to get the markers in the correct location.

9. Render the operations.



10. Save this part.

# **PART PRINTS**

# Spherical Ellipse

