

SolidCAM 5 Axis Tutorial

Volume 3 – Beginner

Goals of the Tutorial

- To understand the side tilt definitions
- To understand the strategy of tilted through curve definition
- To understand different sub-tilt definitions
- To understand the gouge check definitions
- To understand the new strategy in perpendicular to curve



Port Inlet

Post Processor

NTU_MAZAK_MPOS

Machine Simulation

5AxMazakVariaxis630

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Click File > Open to open the SolidWorks part PORT_INLET_PART.SLDPRT.

Click SolidCAM > New > Milling.

5	🗊 SOL	IDWORKS	File Edit	View Inser	t Tools	Soli	dCAM Window Help 🧟	r 🖻 t 🔝 t 💰 🌭
	FF	iii	맖	T		-	New	Milling
ł	Design Study	Interference	Clearance	Hole	Measure		Open	Milling-STL
ł		Detection	Verification	Alignment	-		Save As	Turning
	Assem	bly Lavout	Sketch	Evaluate 📑	SolidCAM		Manage Templates	Mill-Turn

Accept the default part file name and path and Click **OK**.

New Milling Part CAM-Part/Model CAM-Part Use Model file directory					
Directory:	C:\Program Files\SolidCAM2012\PartFile	Browse			
Name:	PORT_INLET_PART				
Model name:	?\PartFiles\PORT_INLET_PART.SLDPRT	Browse			
Units O Metric O Inch					
	OK Cancel				

Select NTU_MAZAK_MPOS as our post processor. Leave the fields of Program Number and Subroutine number with the default



Click **Define** button in **Coordinate System** tab to set the coordinate system for

this part.

A dialog box with the following options appears:

- Mac CoordSys number
- Position
- Coordinate system definition options

Coordinate Syste	em	~
D	efine	
CoordSys	\$	•
Mac CoordSys number:	1	
Position:	1	
Define CoordSys op	otions	
Select f	face Coordinate System to current view	
•	4	

Click **Select Face** option in the **Define CoordSys options** section to define the main coordinate system.

In the **Place CoordSys origin to** section, select **Top center of model box** from the drop down.

Place CoordSys origin to	
Top center of model box	-

) Select the face as shown in the below image.



Click dot accept.

🕎 Click 🗹

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			9	
C L	oordSys Data	[
	Machine CoordSys num	iber:	1	
	Position: 1	X: 0	Y: 0 Z: 0	
	Shift			
	X: 0	Y: 0	Z: 0	
	Rotation around	W [0		
	X: 0	Y: 0	Z: 0	
			Edit CoordS	iys
	Default machining level	s		
	Front Radial Rea	ar		
	Tool start level	50	2	
	Clearance level	10	2	
	Part Upper level	0		
	Part Lower level	-1	.50	
	Tool Z-level	2	50	
	Create planar	surface	at Part Lower level	
		ОК	Cancel	
	Fixtures Coperations		Add Probe Add Milling Operation Add Machine Control Add Operation from Template	
		_	Add Operations from Process Template	
			Add Machining Process	
			Parallel Operations	
		601	GCode All	
			Calculate & GCode All	
		-		
		B	Simulate GCode Simulators	
			Tool path	
			Synchronize All	
			CAM tree view	
		3	Automatic Sorting	
			Undo Sorting	
	J		Machine Setup	
		3	Delete All	

Enter a value of 250 in the Z column.

Name:	Setup					
	Fixture	Table	x	Y	z	
AC 1 (1- Position)	None	🖶 Table	0.000	0.000	250	, **
٠						

Press the Enter key and then click **OK**.



Right click Setup > Add Milling Operation > Sim. 5-Axis Milling.

<mark>ල</mark> Target (target) දී Settings			
Machining Process			2D iMachining
Fixtures			3D iMachining
Setup			Face
			Profile
			Contour 3D
			Pocket
			Drilling
			Thread Milling
	Delete		Slot
	Edit		T-Slot
	Synchronize		Translated Surface
	Check Synchronization		ToolBox Cycles
	Add Probe		Pocket Recognition
	Add Milling Operation	•	Drill Recognition
	Add Machine Control		3D Drilling
	Add Operation from Template		Engraving
	Add Operations from Process Template		3D Milling
	Add Machining process	•	HCB
	Ž v		HSS
			HSM
	*		
			Sim. 5-Axis Milling
MOD MOD	lel Motion Study 1		SWARF Machining
SolidWorks 2012 x	64 Edition		Multi-Axis Drilling

The Operations Manager window opens.



Select **Perpendicular to curve** in the **Technology** section.



Perpendicular to Curve Strategy

The Perpendicular to Curve feature allows you to create a toolpath perpendicular to a Lead curve (drive curve) on a selected Drive Surface. If the curve is a straight line, then the cuts are created parallel to each other. You can use a surface edge as the Lead Curve, or a curve that is on the surface. If the curve is not on the surface then it is projected onto the Drive surface to create the toolpath.



How does this strategy work

In the above picture you can see that the toolpath cuts are taken perpendicular to the lead curve. This is done by distributing points on the lead curve (Equal to the Step Over) and then taking the slices on the drive surface on each of these points by creating planes normal to the lead cuve at that point. The lead curve need not be the edge of the drive surface , it could be any curve and the cuts will be perpendicular to that curve.

Click Geometry.

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Click New icon under **Drive surface**.

Technology	Operation name:	Template
Perpendicular to curve 🔻	•	
CoordSys Geometry Tool Levels Tool path parameters Link Default Lead-In/Out Cool axis control Gouge check Clearance data Roughing and More Motion control Misc. parameters	Geometry Drive surface Show Lead curve Compared offset:	Area Type: Full, avoid cuts at exact edges • Extend/Trim Angle range 2D Boundary Round corners

Select the two faces as shown in the image.





Two curve options are available as shown in the image. One is the main one, other the smaller one is exactly oppo-site to it.





Select the smaller curve as shown in the image. Selecting the smaller curve

does not produce any air cuts.



Click 🗹 in the Chain List section.

Click 🖌 to return to the Operations Manager.

Select the **Type** as **Limit cuts by one or two points** from the drop down list in the **Area** section.

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\mathcal{I})

Click Points.

Type:				
Limit cuts by	one or two points			



 γ Select the point as shown in the image.



) Define the first margin as -0.3 in the **Z** field. This is needed as there is no way to define margins while selecting the two points option.









Click **OK** in the Limit Cuts Between 2 Points window.







Click 🐁 icon to add a new tool.

Select Lollipop Mill as our tool. This tool is the tool of choice for machining such geometries.

The image.

b Choosing tool for operation		
🗏 🗏 🖉 🏋 🎇		
Tool Nu▼ ID Num▼ User-d▼ 1 LOLLIPOP	Number ID number 1 Description	
	M Topology Tool Data iData Holder Shape Tool parameters	Coolant Tool Preset Tool Message
	Mm (a) Diameter (D): 25 Inch (b) Arbor diameter (AD): 25	AD .
	Length	n.
	Mm Total (TL): 175 Inch Outside holder (OHL): 150 Shoulder length (SL): 100 Image: Conical shoulder Cutting (CL): 21 H length: 150 150	
<>	Number of flutes: 12	
🐳 🛅 🗙 1+8 🖘	₽	Select Cancel

Select Holder.	Choosing tool for operation
\bigcirc	
	Tool Nu V ID Num Vumber ID number
🕥 Select BT 40 >	1 LOLLIPOP Description
^O BT 40 ER 32X60.	M Topology Tool Data iData V Holder Shape Coolant Tool Preset Tool Message
	Holders Shape Sti
Click Solact	Local Global Tool adaptor: BT40
Click Select.	
	Shape edt Holder overhang length: 30 Description
	** •

Click Levels.

Enter a value of 75 mm in the **Plane height** field.

💩 Perpendicular to curve			
Technology Perpendicular to curve	Operation name: 5X_PerpC_faces	Template	į
CoordSys Geometry Tool Levels Tool path parameters Link Tool axis control Gouge check Clearance data Roughing and More Motion control Misc. parameters	Clearance area Type: Plane In X In X In Y In Z User-defined direction dX = 0 dY = 0 dZ = 1 Plane height 75	Levels Retract distance Safety distance	20
Save Save & Calculate	Keep initial orientation until distance Distance: Angle step for rapid moves: Simulate GCode	Rapid retract	& Copy Exit

Click Tool path parameters > Sorting.

Technology	Operation name:	Template	
Perpendicular to curve 🔻	5X_PerpC_faces	-	
CoordSys	Surface quality Sorting	/	M Ad
Tool	Sorting	Tool contact point	
	Cutting method: Spiral	▼ Auto	-
Tool path parameters	Adva	nced Front shift:	0
Default Lead-In/Out	Direction of machining: Climb	▼ Side shift:	0
Gouge check	Cut order: Standard	-	
Roughing and More	Machine by: Lanes	•	
Misc. parameters	\checkmark Enforce closed contours		
4 III >>>	Flip step over		
	Start point		

Select **Spiral** as the **Cutting method**.

Click Tool axis control.

Select Tilted through curve as the Tool axis direction.

Technology	Operation name:	Template
Morph between two boundary curves	•	
CoordSys	Output format:	Interpolation
Tool	5 Axis 🔻	Max. angle step: 3
Tool path parameters	Tool axis direction:	Angle range
Tool axis control	Tilted through curve	Limits
Roughing and More	Curve tilt type:	Tilt curve
Misc. parameters	From start to end	Show
4	Angles	
	Fixed tilt angle: 0	

Select the Feature Manager Design Tree icon to switch on the curve.



Technology	Operation name:	Template
Morph between two boundary curves	•	-
CoordSys	Output format:	Interpolation
	5 Axis 💌	Max. angle step: 3
Tool path parameters	Tool axis direction:	Angle range
Tool axis control	Tilted through curve	Limits
Clearance data	Curve tilt type:	Tilt curve
Motion control	From start to end	Show
4	Angles	
	Fixed tilt angle: 0	

Click the New icon under **Tilt curve** to define the new curve.

Select as shown in the image. Ensure that the selection is from top to bottom, as is the direction of the arrow.





In the **Curve tilt type** select **From start to end**. This tilt type is used to force the tool axis to always follow the tilt curve from start of the curve to the end of the curve. This is the most used tilt type for machining ports.



echnology	Operation name:	Template
Morph between two boundary curves		
CoordSys	Output format:	Interpolation
Tool	5 Axis 🔹	Max. angle step: 3
Link	Tool axis direction:	Angle range
Tool axis control	Tilted through curve	Limits
Roughing and More	Curve tilt type:	Tilt curve
Misc. parameters	From start to end	Show
	Angles	
	Fixed tilt angle: 0	
Save Save & Calculate	Simulate GCode	Save & Copy Exit

Click **Simulate** once the tool path is calculated.

S	

Click the Play icon.

Rest Material SolidVerify RapidVerify Machine Simulation SolidVerify for 3D Host CAD 2D 3D Show data Show tool Hidden lines Show tool frequency: Stop on next Clear Colors Simulation speed Image: Show tool image: Sh	Simulation		P	X
Show data Show tool Hidden lines Show tool frequency: Stop on next Clear Colors Simulation speed	Rest Material Machine Simula Host CAD	SolidVerify ation Solid 2D	Rap dVerify	idVerify for 3D 3D
Stop on next Clear Colors	Show data Hidden lines Show tool frequ	ency: 1	iow too	
	Stop on next	eed	Colo	
		••••		



 \uparrow The simulated toolpath looks like this:

You can see that a retract is coming through the part & would cause a major crash on the machine. We need to fix this.

Select the **Exit** icon to exit machine simulation.



Technology	Operation name:	Template
Perpendicular to curve 🔻	5X_PerpC_faces	
CoordSys	Approach/Retract Links	
Tool	First entry From dearance area	Don't use Lead-In 🔻
Link Default Lead-In/Out	Start from home position	
Tool axis control	Last exit	
Motion control	Back to dearance through tube center	Don't use Lead-Out
4	Return to home position	
A	Home position	
	X 0 Y 0 Z 250	

Select Back to clearance through tube center as the Last exit.

Perpendicular to curve	
Technology	Operation name: Template
Perpendicular to curve 🔻	5X_PerpC_faces
CoordSys	Approach/Retract Links
Tool	First entry
Tool path parameters	From dearance area
Link Default Lead-In/Out	Start from home position
Gouge check	Last exit
Motion control	Back to dearance through tube center Don't use Lead-Out
Misc. parameters	Return to home position
A	Home position
	X 0 Y 0 Z 250
Save Save & Calculate	Simulate GCode Save & Copy Exit

Click Save & Calculate.

Click Simulate.

Click the Play icon.



The simulated toolpath looks like this:



The tool is now retracting out through the center without causing any gouges to the part. This is a new retract option that was added in SolidCAM and is exclusively used for machining port geometries.



Click Machine Simulation.









Right click the tool path > Add Milling Operation > Sim.5- Axis Milling.

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SOLIDWORKS File Edit Viev		Add Probe		• & • Ø • 💽 •
📲 🔮 iMachining 🔹 🍙 3		Add Milling Operation		
Probe 🍘 2.5D 🔹 🎻 E		Add Marking Operation		
可 Recognition 🔹 🚜 3		Add Machine Control		3D IMachining
Assembly Layout Sketch Ev		Add Operation from Template		Face
🕲 🖆 😫 🧶		Add Operations from Process Template		Profile
CAM-Part (PORT_INLET_PART) Machine (NTU_MAZAK_MPOS) Coardbus Mapper		Add Machining Process	Þ	Contour 3D
Coordsys manager Stock (stock) Target (target)		Create Template		Pocket
Settings		Edit		Drilling
Machining Process		CC-d-		Thread Milling
	GUI			Slot
		Calculate		T-Slot
		Calculate in parallel		Translated Surface
		Calculate & GCode		ToolBox Cycles
		Tool Sheet		Pocket Recognition
		Synchronize	•	Drill Recognition
		Tool path	•	3D Drilling
	6	Simulate		Engraving
		GCode Simulators	•	3D Milling
		Transform		HSR
		Split		HSS
		File		HSM
		Info		Sim. 5-Axis Milling
		Operation Group	+	SWARF Machining

boundary curves		-
Geometry Geometry Geometry Geometry Levels Tool path parameters Link Link Link	ometry Drive surface	Area Type: Full, avoid cuts at exact edges
Tool axis control	Start edge curve	Number of cuts: Extend/Trim
< >		Angle range 2D Boundary
Misc. parameters	End edge curve Show Drive surface offset:	Angle range 2D Boundary Round corners

The Operations Manager window opens.

The Morph Between Two Curves feature creates a morph toolpath between two leading curves. Morph means that the generated toolpath gradually interpolates between the two curves and it is evenly spread over the surface. When selecting the two curves, the geometry should be selected directly from the drive surfaces.

Ø	Click Geometry . The geometry remains the same.
Ð	Select faces from the drop down list.
\bigcirc	Click New icon under Start edge curve .

Select the curve as shown in the image.



Click **Yes** in **OK to accept** pop up window. The OK to accept message will ap pear only if this option is selected under "SolidCAM Settings ==> CAM Messages".

Ѷ Click 🗹



Technology	Operation name:	Template
Morph between two boundary curves	•	
CoordSys	Geometry	Area
Tool	Drive surface	Type:
	faces	Full, avoid cuts at exact edges
Link Default Lead-In/Out	Start edge curve	Number of cuts:
Gouge check		
Motion control	Show	Extend/Trim
Misc, parameters		Angle range
Ð	Show	2D Boundary
	Drive surface offset: 0	Round corners
•		

Select the curve as shown in the image.



Click **Yes** in **OK to accept** pop up window.



Select the **Type** as **Limit cuts by one or two points** from the drop down list in the **Area** section.

	Area Type: Limit cuts by one or two points
Click Points .	Points





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Define the first margin again as -0.3 in the Z field.

	Limit Cuts Between 2	Point	S					X
		X =	-108.8624	Y =	86.837988	Z =	-0.3	Data
	•	X =	0	Y =	0	Z =	0	Data
Click Data.						0	к	Cancel



Click **OK** in the Limit Cuts Between 2 Points window.



Click **Select** as we will use the same tool.

Tool Nu ID Num User-d I 1 LOLLIPOP	Number ID number	
	M Topology Tool Data iData Holder Shape Cook Tool parameters	ant Tool Preset Tool Message
	Mm Diameter (D): 25 Inch Arbor diameter (AD): 25	
	Length Mm Total (TL): 175 Inch Outside holder (OHL): 150 Shoulder length (SL): 100 Conical shoulder Cutting (CL): 21 H length: 150	CL
•	Number of flutes: 12	Select <u>C</u> ancel

Click Levels.

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Enter a value of 75 mm in the **Plane height** field.

echnology	Operation name:	Template	
Morph between two boundary curves	5X_MC_faces		
CoordSys	Clearance area	Levels	
Tool	Type: Plane 💌	Retract distance	20
Tool path parameters	🔘 In X	Cafaty diatance	2
Link	© In Y t	Salety distance	-
Tool axis control	In Z		
Gouge check	O User-defined direction		
Roughing and More	dX= 0 dY= 0 dZ= 1		
Misc. parameters	Plane height 75		
	Keep initial orientation until distance		
	Distance: 0		
	Angle step for rapid moves: 5	Rapid retract	

Click Tool path parameters > Sorting.

echnology	Operation name:	Template	
Morph between two boundary curves	5X_MC_faces	🖬 🖻	9
🕀 CoordSys	Surface quality Sorting		🗹 Advanc
🛇 Geometry	burrace quarty borrang		
🛐 Tool	Sorting	Tool contact point	
🛓 Levels	Cutting method: Spiral	 Auto 	-
Tool path parameters	Advanced	Front shift:	0
Default Lead-In/Out			
Tool axis control	Direction of machining: Climb	Side shift:	0
🚰 Gouge check	Out and any Et and and		
Clearance data	Cut order:		
	Machine by: Lanes	-	
Motion control			
Misc. parameters	✓ Enforce closed contours		
4	Flip step over		
	C Start point		

Select Spiral as the Cutting method.

Click Tool axis control.

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	💩 Morph between two boundary c	curves	
Select Tilted	Technology Morph between two boundary curves	Operation name:	Template
through curve as the Tool axis	CoordSys Cometry Tool	Output format:	Interpolation Max. angle step: 3
direction.	Tool path parameters	Tool axis direction: Tilted through curve	Angle range
	Clearance data Clearance data Clearance data Motion control Misc. parameters	Curve tilt type: From start to end	Tilt curve
		Angles Fixed tilt angle:	
	Save Save & Calculate	Simulate GCode	Save & Copy Exit

Click New icon under **Tilt curve**.

Select the curve as shown in the image. Remember the direction of the curve.









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Technology	Operation name:	Template
Morph between two boundary curves	5X_MC_faces	-
CoordSys Geometry Tool Levels Tool path parameters	Output format: 5 Axis	Interpolation Max. angle step: 3
Clearance data	Tool axis direction: Tilted through curve	Angle range
Roughing and More Motion control	Curve tilt type: From start to end	▼ IIt curve Contour4 ▼ Show
A	Angles Fixed tilt angle:	
	la	

Select From start to end as the Curve tilt type.

Click Gouge check.

Morph between two	Operation name: 5X_MC_faces	Template
C CoordSys C CoordSys Geometry III Tool Levels Tool path parameters Victoria	Gouge 1 Gouge 2 Gouge 3 Gouge 4	Geometry Prive surfaces
Default Leaden/Out Tool axis control Gouge check Gouge check	 ✓ Tool shaft ✓ Tool tip 	Use STL file Check surfaces 1
Misc, parameters	Strategy Moving tool away Retract Towards Cut Center	Stock to leave: 0 Tolerance: 0.01

Select the **Enable/Disable** check box.

Ensure that only the **Drive surfaces** check box is selected in the **Geometry** section.

Select Moving tool away and Retract Towards Cut Center.

What this gouge check does it to push the toolpath to the centre of the geometry so that it does not gouge the geometry anymore. This would ensure that the tool sticks to the geometry without gouging the part surfaces.



Click Save & Calculate.

Click **Simulate** once the tool path is calculated.

The Machine simulation now looks something like this as shown in the video.



The machine simulation still has gouges which need to be fixed.

Click the Exit icon to exit the machine simulation.



Click **Exit** from the Operations Manager.

echnology	Operation name:	Template	
Morph between two boundary curves	5X_MC_faces	-	
CoordSys	Gouge 1 Gouge 2 Gouge 3 Gouge 4		
Geometry	Enable /Disable		
<u>EU</u> 100	Tool	Geometry	
Levels	Holder	Drive surfaces	
Tool path parameters			
Link	Arbor	Check surfaces	
Default Lead-In/Out		_	
Tool axis control	Tool shaft	Use STL file	
Gouge check	To al Ka	Check surfaces 1	
Clearance data			
📕 Roughing and More			···· ·
Motion control		Show	
Misc. parameters	Strategy		
4 III	Musice test surger		
	Moving tool away		
2	Retract Towards Cut Center	 Stock to leave; 	0
		Tolerance:	0.01
3			

We will now fix the gouges by changing the angle of the tilt curve. To do this we need to edit the primary sketch of the curve and change the angle.



Right click > Edit sketch.





You can see that this curve has an angle of 30 degrees.

This angle controls the tilt of the tool, how deep it can go and to which areas it can go. Let us reduce this angle.



- Double click the angle and enter a value of 20 in the Modify window.
- \bigcirc

Press the Enter key on your keyboard to accept the new value.









The synchronization symbol appears on contour 4 and we will have to rebuild this contour.

SolidCAM is smart enough to understand which geometry has changed and puts the rebuild symbol only on the geometry which needs to be rebuilt.





Right click **contour 4** > **Synchronize**.



 \bigcirc Right click > **Calculate** the tool path.





Right click > **Simulate** the tool path.



The simulated tool path looks like this:



You can see that there are no collisions now and the tool path looks clean. The angle of curve plays a major role in determining how deep the tool can get into the port without causing any kind of collisions.

Let us now look at machining another port which is octagonal in shape. Lets switch on the sketch for our next tool path.



Info

Operation Group

Sim. 5-Axis Milling.. SWARF Machining.. The Operations Manager window opens.



Click Geometry.

Click the new icon under **Drive surface**.

Select all the surfaces of the octagonal curve as shown in the image.





Select the **Auto-constant Z** radio button in the **Auto-to** section, so that the entire chain on the Z level is picked up.



- Click **Yes** in the **OK to accept** pop-up window.
- Change the Name as Octo_Top.

Click 🖌

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Click the new icon under End edge curve.

Technology Morph between two	Operation name:	Template
CoordSys CoordSys CoordSys CoordSys Levels Tool path parameters Link Cool path parameters Cool path control Gouge check Roughing and More Motion control Motion control	Geometry Drive surface Cota_Port	Area Type: Full, avoid cuts at exact edges Number of cuts: Extend/Trim
< m >	Show	Angle range 2D Boundary Round corners

Select	t all the edges one by one as shown in the image.	
Features Sketch Evaluate fig (a) a fig (b) a fig (c) a	Dimkpert [SolidCAM Part [SolidCAM Operations] Percent Part.	
Chain List	OK to accept? Yes Don't ask again	
Curve + Close Comers Dop Point to point Arc by points Auto-general Auto-constant Z		
Add Detas 2 Multi-chain Add Options Plane: XY Spline 0.005		

Click Yes in the OK to accept pop-up window.

🕙 Click 🗹

Select the **Type** as **Limit cuts by one or two points** from the drop down list in the **Area** section.

points



Click Data.







Click **Select** as we will use the same tool.

so Choosing tool for operation		
🗏 🗏 🗏 🦉 🏋 🙀		E F 🏷
Tool Nu VID Num Ulser-d VID Num	Number ID number Description	
	M Topology Tool Data iData Holder Shape Cooland	Tool Preset Tool Message
	Mm Diameter (D): 25 Inch Arbor diameter (AD): 25	- AD
	Length Total (TL): 175 Inch Outside holder (OHL): 150 Shoulder length (SL): 100 Conical shoulder Cutting (CL): 21 H length: 150 Number of flutter: 12	
<		
🍀 🛅 🗙 1+8 🖘	₽	Select Cancel

Click Tool path parameters > Sorting.

echnology	Operation name:	Template	
Morph between two boundary curves	5X_MC_faces	.	Q
CoordSys	Surface quality Sorting		🔀 Advan
Tool	Sorting	Tool contact point	
Levels	Cutting method: Spiral	▼ Auto	•
Link	Advance	ed Front shift:	0
Tool axis control	Direction of machining: Climb	Side shift:	0
Gouge check	Cut order: Standard	•	
Roughing and More	Machine by: Lanes	•	
Misc. parameters	✓ Enforce dosed contours		
4 111	Flip step over		
	Start point		

Select Spiral as the Cutting method.

Click Link.

Click 📟

🤊 Select	Viorph between two boundary c Technology Morph between two boundary curves	Operation name: 5X_MC_Octa_Port	
Use Lead-In in the First en- try section.	CoordSys Geometry Tool Levels Tool path parameters Default Lead-In/Out	Approach/Retract Links First entry From dearance area Start from home position	•
	Gouge check Gouge check Roughing and More Motion control Misc. parameters	Last exit Back to dearance area Don't use Lead-Out Return to home position	•
		Home position X 0 Y 0 Z 250	
	Save Save & Calculate	▼ Simulate GCode Sav	e & Copy Exit



🖏 Click 💻

Clear the **Use default Lead-Out** check box.

Enter a value of 50 in the **Arc diameter/Tool diameter %** field.

Click OK.

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Lead-Out		X
Use default Lead-C	Dut	
Lead parameters		
Type:	Tangential arc 🔹	1
	Flip	
Tool axis orientation:	Fixed •	
Max. angle change:	4	
Use the		
Width	Length:	
20	20	
Arc sweep	Arc diameter/Tool diameter %:	
90	50	
Height:	0	OK Cancel
Feed rate %	100	

Select Back to clearance through tube center in the Last exit section.

chnology	Operation name:	Template	
Morph between two boundary curves	5X_MC_Octa_Port	.	
CoordSys	Approach/Retract Links		
Tool	First entry		
Levels	From clearance area	▼ Use Lead-In	◄
Tool path parameters	Start from home position		
Tool axis control Gouge check Guge check Guge and More Roughing and More Motion control Misc. parameters	Last exit Back to dearance through tube center	▼ Use Lead-Out	•
	Return to home position		
H	Home position		
	X 0 Y 0 Z 2	50	



Select the curve as shown in the image.





Click Gouge check.





echnology	Operation name:	Template
Morph between two boundary curves	5X_MC_Octa_Port	-
CoordSys	Gouge 1 Gouge 2 Gouge 3 Gouge 4	1
Geometry	- Tenable /Disable	
	Tool	Geometry
Tool path parameters	Holder	V Drive surfaces
	Arbor	Check surfaces
Default Lead-In/Out		
Tool axis control	Tool shaft	Use STL file
Gouge check	Tool tip	Check surfaces 1
Clearance data		
Roughing and More		
Motion control		Show
Misc. parameters	Strategy	
4	Moving tool away	—
	Retract Towards Cut Center	 Stock to leave:
		Tolerance: 0.01



Click Save & Calculate.

Click **Simulate** once the tool path is calculated.

Click Host CAD.	Simulation
	2D Rest Material SolidVerify BabidVerify SolidVerify for 3D
	Machine Simulation Host CAD 3D
	Show data Show tool
	Hidden lines
	Show tool frequency: 1
	Stop on next Clear Colors
	Simulation speed

The simulated tool path looks like this:

You can see that the tool is trying to use the geometry of the surfaces and create a tool path. The tool is going up and down at a lot of places resulting in an uneven tool path. We need to fix this issue.



Click the exit icon.

Click Simulate once again in the Operations Manager.

Simulation	Ş	\mathbf{X}		
2D Rest Mat	erial Soli	dVenify		
Machine Simulation	Host CAD	3D		
Show data Hidden lines Show tool frequency:	Show too			
Stop on next Clear Colors Simulation speed				
		Ó		
		▲		

Click Machine Simulation.

The simulated tool path looks like this:



There are no gouges but the tool path does not look very smooth. Let's Fix this.



Click the exit icon.

Click **Exit** to exit the Operations Manager.

echnology	Operation name:	Template
Morph between two boundary curves	5X_MC_Octa_Port	• 🖬 📽 👘 🚺
CoordSys	Gouge 1 Gouge 2 Gouge 3 Gouge 4	
Tool	✓ Enable/Disable	
Levels	Tool	Geometry
Tool path parameters	Holder	Drive surfaces
Link	Arbor	Check surfaces
	Tool chaft	Lice STI file
Course check	V TOOISHATC	
Clearance data	✓ Tool tip	Check surfaces 1
Roughing and More		
Motion control		Show
Misc. parameters	Charles and	
4 III	Strategy	
	Moving tool away	-
-	Retract Towards Cut Center	Thesh to leave 0
	Reduct forma da cut certai	Stock to leave:
		Tolerance: 0.01
8		





Right click > **Copy** the tool path.



Right click > **Paste** the tool path.

 2.5D 3D Machining Recognition Second Vis Sketch Add Operation from Template Add Operation from Process Template Add Operations from Process Template Add Operations from Process Template Add Operations from Process Template CoordSys Manager Stock (stock) Tool Machining Process Calculate Calculate in parallel Calculate & GCode Tool Sheet Source Study Study Study Study Machining Process Calculate in parallel Calculate & GCode Tool Sheet Synchronize Tool path Study Study Machine Corup Transform Split File Info Operation Group Cound for Cound Change Submachine to Change Tool Change Tool Data 	SOLIDWORKS File Edit	Vi	ew Insert Tools SolidCAM Window Help	9
Add Operations from Template Add Operations from Process Template Add Machining Process Create Template Add Machining Process Create Template Add Machining Process Create Template Edit Edit Calculate Calculate in parallel Calculate & GCode Calculate & GCode Tool Sheet Synchronize Tool path Stupe Machine Stupe Machine Stupe Coorde Simulators Machine Stupe Machine Stup Machine Stup Mach	2.5D • 🗢 3D • Machining • Recognition •		Add Probe Add Milling Operation Add Machine Control	,
Machine (NTU_MAZA CoordSys Manager Stock (stock) Target (target) Statings Tool Retures Operations Sociup	Issembly Layout Sketch		Add Operation from Template Add Operations from Process Template Add Machining Process	,
Bis Stock (slock) Coll Bis Stock (slock) Goil GCode Settings Calculate Machining Process Calculate in parallel Calculate in parallel Calculate & GCode Settings Tool Sheet Stock (stock) Synchronize Mac 1 (1- Position) Synchronize Mac Stop Stock (stock) Stop Stock (stock) Stop Stock (stock) Mac 1 (1- Position) Synchronize Mac Stop Stock (stock) Stop Stock (stock) Stop Stock (stock) Stop Stop Stop </td <td>- De Machine (NTU_MAZAI - CoordSys Manager</td> <td></td> <td>Create Template</td> <td></td>	- De Machine (NTU_MAZAI - CoordSys Manager		Create Template	
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Simulate GCode Simulators Transform Split File Info Operation Group Documentation (DPP) Machine Setup Change Submachine to Change Tool Change Tool Data Rename Cut Copy Paste	■ Q SX_PerpC_		Tool path	,
Transform Split File Info Operation Group Documentation (DPP) Machine Setup Change Submachine to Change Tool Change Tool Data Rename Cut Copy Paste		8	Simulate GCode Simulators	,
Operation Group > Documentation (DPP) > Machine Setup > Change Submachine to > Change Tool > Change Tool Data > Rename Cut Cut Copy Paste >			Transform Split File Info	
Machine Setup			Operation Group Documentation (DPP)	•
Change Submachine to Change Tool Change Tool Data Rename Cut Copy Paste		ß	Machine Setup	•
Rename Cut Copy Paste			Change Submachine to Change Tool Change Tool Data	,
Paste			Rename Cut Copy	
			Paste	



We can see that the dummy surface is a circle driven along the curve. It uses the same guide curve that was used to create the octagonal surface.



Click the SolidCAM Manager icon.





Right click > **Edit** the tool path.

Click Geometry.

Click the new icon under Drive surface.

echnology	Operation name:	Template	
Morph between two boundary curves	5X_MC_Octa_Port_1		
CoordSys Geometry Tool Levels Tool path parameters Link Default Lead-In/Out Gouge check Roughing and More Koughing and More	Geometry Drive surface Characteristic of the surface of the surfac	Area Type: Limit cuts by one or two points Points Number of cuts: Extend/Trim	
	End edge curve contour7 • Show	Angle range 2D Boundary	

We will use the cylinder. As the cylinder is hidden inside the solid model, it is difficult for us to select the geometry. We will therefore select it from the design model.

~	📭 PORT_INLET_PART-3 (Default <display state-2="">)</display>
S Expand the feature manager.	-@ Sensors
0	Annotations
CIICK DOIVINIT SURFACE.	
	–⊗ Plane3
You can see that it is already selected.	–∔ Origin
,	🔄 🚯 (f) CAM<1> (Default< <default>_Appearance Di</default>
Faces *	🕂 🗣 (f) DesignModel<1> (Default< <default>_Displa</default>
Show direction for	-@ Sensors
highlighted faces only	🕂 🖾 Annotations
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	- \$ ≣ Material <not specified=""></not>
	→⊗ Top Plane
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	Boss-Extrude1
	-X Plane1
	- Fee (-) Sketch 2

⊢⊗ Plane2

We must ensure that the direction of the surface is proper because we need to machine the inside of the tube.



You can see that the arrow is indicating the correct direction.

🕎 Click 🗹



Click the new icon under the **Start edge curve**.

Technology	Operation name:	Template	
Morph between two boundary curves	5X_MC_faces1		
CoordSys CoordSys Geometry Tool Levels Tool path parameters	Geometry Drive surface Show Geometry faces1 (ms)	Area Type: Limit cuts by one or two points Points	
Tool axis control	Start edge curve Coto_Top Show End edge curve Contour7 Show	Number of cuts: 1 Extend/Trim Angle range D Beurdron:	
	Drive surface offset: 0	Round corners	

We will select the edge of the dummy surface as our curve.



We will select the end edge of the dummy surface as our curve.

Select the surface as shown in the image.



Click 🖌



We have now finished selecting the surface to be machined. In this strategy, we have allowed the tool path to be generated in the tube, and now we will run the gouge check.



Click Gouge check.



Select the **Check surfaces** checkbox.



The gouge check is done on the highlighted surfaces that are shown in the image.



Once the tool finds the gouges, it will move the tool away till it retracts towards the cut center so that all the gouges disappear. This will result in a gouge free tool path.

With this strategy, we are effectively projecting a tool path on these octo surfaces in such a way that no gouges remain.





Click Save & Calculate.

Click Simulate once the tool path is calculated.

echnology	Operation name:	Template	
Morph between two boundary curves	5X_MC_faces1	•	
😧 CoordSys	Gouge 1 Gouge 2 Gouge 3 Gouge 4		
Tool	C Enable/Disable		
V Levels	Tool	Geometry	
Tool path parameters	Holder	Drive surfaces	
Link	Arbor	Check surfaces	
Tool axis control	✓ Tool shaft	Use STL file	
Gouge check	✓ Tool tip	Check surfaces 1	
Roughing and More		🖉 🗐 Octa	Port 💌
Motion control		Show	
Misc. parameters	Strategy		
	Moving tool away	-	
2	Retract Towards Cut Center	 Stock to leave: 	0
		Tolerance:	0.01

The simulated tool path looks like this:



The tool path is looking much better as it has taken the circular tool path and projected it on these octagonal surfaces.



Run the machine simulation to check if there are any gouges.

Select the curve.

R





Change the angle from 35 to 20 degrees as shown in the image.





File... Info Right click > **Simulate** the tool path.



Nun the machine simulation.

The simulated tool path looks like this:

You can see that the gouges have disappeared.

The guiding curve plays a very important role in determining the tilt of the tool into the geometry. We could machine a different surface which was much smoother and then project the tool path onto the surfaces inside. This results in a smoother tool path.

End of the volume