ZW3D Advanced Tutorial

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VoluMill

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ZW3D[™] V2023 CAM VoluMill

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Foreword

In this tutorial, we provide various case studies, which are from easy to difficult and combine theory with practice. We hope to improve users' 3D CAD/CAM skills and techniques with ZW3D.

The tutorial bases on our technical engineers' years of experience in the industry and ZW3D, which is the fruit of a lot of efforts and wisdom. We sincerely hope that the tutorial will do help to you, and your precious advice on it is highly welcomed.

There are three series for this tutorial: *Primary Tutorial, From Entry to Master Tutorial*, and *Advanced Tutorial*. From easy to difficult, they offer a step-by-step learning process that can meet different user needs.

Primary Tutorial series is for users who have little or no prior 3D CAD/CAM experience. If you are green hands of 3D CAD/CAM software, or if you are a new user of ZW3D, we recommend that you get started with this tutorial. Here you can learn the basic knowledge and concepts of ZW3D, rapidly master the simple operations and workflows of ZW3D, and practice simple cases.

From Entry to Master Tutorial series is for users with basic know-how of 3D CAD/CAM software. If you have experience in 3D CAD/CAM software and want to master common functions of ZW3D, we suggest that you start with this series. Here you can dig deeper into the functions and master more operations of ZW3D.

Advanced Tutorial series is for users with practical experience in 3D CAD/CAM software. If you hope to have a comprehensive command of ZW3D and get the complicated operations done independently, you can choose to learn this series. Here you can learn to use the software more flexibly and get rich experience to increase your efficiency.

What you are learning is **ZW3D CAM VoluMill**, an advanced tutorial.

Thanks for being our user! The ZW3D Team

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1 Introduction

Key Points:

- ♦ The benefits of VoluMill Technology
- ♦ The General Workflow while Using VoluMill in ZW3D

1.1 VoluMill Benefits

VoluMill for ZW3D is an add-on for ZW3D CAM. By avoiding sharp directional changes and controlling the rate of material removal, it can significantly extend tool life. VoluMill for ZW3D works with you to get your job done quickly and budget friendly.

The benefits are obvious.

- **Reduce 70%+ cycle time.** With VoluMill, rough milling performance is significantly increased in all materials.
- **Extend 800%+ Cutting Tool Life.** VoluMill toolpaths use smooth, flowing motion, eliminating sharp directional changes. This enables cutting tools to operate under ideal milling conditions throughout, regardless of a part's shape or complexity.

1.2 Start with VoluMill

ZW3D can generate 2X and 3X toolpaths with VoluMill technology. You can find the icons from the ribbon tab as below.



Notes:

1) VoluMill operations are available only after you activate the matched license.

2) This tutorial is based on ZW3D 2021 version, some functions or icons may not match the current version.

1.3 General Workflow

The general workflow of creating VoluMill toolpaths is shown as below.



Figure 2 General Workflow to Create VoluMill Toolpaths

STEP 01 Select a VoluMill operation (2X/3X).

STEP 02 Define CAM features.

STEP 03 Select a tool.

STEP 04 Adjust the parameters with the help of VoluMill Technology Expert.

STEP 05 Calculate toolpaths.

STEP 06 Verify the toolpaths until they are acceptable.

STEP 07 Define machine and controller parameters.

STEP 08 Post process NC code to file.



About this tutorial

Before you start with this tutorial, ensure that you have an understanding of all the basic 2X and 3X machining concepts of ZW3D. And it is highly recommended to go through the PDF resource **ZW3D_FromEntryToMaster_3X Machining**.

2 2X VoluMill

Key Points:

- Define the Profile Features
- ♦ Technology Expert
- ♦ Key Parameters
- ♦ Case Study

2.1 Getting Started

The model file for this chapter is located in ZW3D installation folder. The default path should be C:\Program Files\ZWSOFT\ZW3D 201X Eng (x64)\training\VoluMill Model\

2.1.1 Create a VoluMill 2X Operation

Click the icon *VoluMill 2x* from the 2X Mill ribbon tab, then you can create a 2X operation on the CAM tree.



Figure 3 Create a VoluMill2x Operation

2.1.2 Define the Profile Features

2X VoluMill operations can only generate toolpaths based on Profile features. In ZW3D, there are three types of profiles in total, as shown in the figure below. Remember that the *Part* and *Stock* types can be used in VoluMill2x operation, but the *Contain* type is only valid in 3X VoluMill operation.

Name profile 1							
Class	general				_		
Type	Part	Part 🔹					
Component	Part Contain	Part Contain					
File Stock							
Profiles Attributes							
p0	Tolerance		0.1				
	Offset		0				
	Open / Clo	se	Open		*		
	Join Metho	bd	Linear		*		
Reverse Di		r	No		•		
Modify Attributes Apply Attributes							
Add Pr		Remove	Profiles				
	01/	_					

Part: This type of profile is used to define the boundary of the work part to avoid the tool cutting.

Contain: This type of profile is used to constrain the cutting area, which is only valid in 3X VoluMill operation.

Stock: This type of profile is used to define the open edges of an open pocket in 2X VoluMill operation, which allows the toolpaths to cut across.



Create 3 profiles as below figures and calculate the VoluMill2x operation based on Profile 2 and Profile 3. The toolpaths are shown in Figure 8, illustrating the difference between Part and Stock type profiles.



Figure 5 Profile 1 (Inner Pocket Bounday)







Figure 7 Profile 3 (Boundary of the Bottom)





Difference Between Part and Stock Type Profile

2.1.3 Define the Tool

Define the tool **D10R0**, the parameters are shown as below.

Name D10R0	Туре	Mill * Su	btype End	 Add to Lib 	Load Tool Sha
		Tool Len (L)	50		
	;	Flute Len (FL)	50		
	Î	Angle (A)	0		
F	T ¦	Flutes (F)	4		
	FL	Radius (R)	0		
R - Land		Cutter Dia (D)	10		

Figure 9 Tool Paramaters

2.2 Operation Parameters

This chapter will explain the unique parameters of the VoluMill 2x operation. Regarding the same parameters in other 2x operations, please refer to the 2X milling tutorials.

2.2.1 Technology Expert

Technology Expert is a powerful tool which can provides recommended feed & speed parameters to maximize the performance of VoluMill high-speed machining. You can find the access to Technology Expert in *Primary* parameter tab.

💯 VoluMill2x 2		⊽ ⊠	
Type: VoluMill2x	▼ Basic		
Basic	Frame		
✓ Im Limiting	Speeds, Feeds	VoluMill2x 2	
Boundaries	Technol	ogy Expert	
✓ ≚ Link and Lead	Active Chip T	hickness Control	
Link	▼ Tolerance and Thick		
Display	Path Tolerance	0.025	
> 🖺 Advanced	Side Thick	0	
	Bottom Thick	0	
	▼ Cutting Steps		
	Stepover	% Tool Dia 🔹 60	
	Max Stepdown	6	
Reset	Calculate	OK Cancel	
🎈 ⊿ 🕅	a		

Figure 10 VoluMill2x Operation Parameters (Primary)

Technology Expert: Access to Technology Expert tool.

Active Chip Thickness Control: Redefine the parameters after using the recommended values from Technology Expert, so they are more suitable for the real machine.

The Technology Expert window is shown as below. The upper part of the window is used to define the attributes of the part and machine. And the lower part are the recommended values for operation parameters. Remember to check the boxes before applying them to the operation.

Part Material: Low silicon Aluminum, Brass, Copper Hardness Scale: Brinell(HB) Hardness: 300 Cutter Diameter: 10 Number of Flutes: 4 Flute Length: 50 Tool Length: 50 Coating: Uncoated Fixture Rigidity: Poor Spindle Taper: 30 Taper Holder Type: Endmill Holder Max Feed Rate: 2000 Recommendations: Conservative Recommendations: 376.991 Spindle Speed: 12000 Spindle Speed: 2000 Recommended parameters (Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Feed Rate: 4655.6 MMPM Recommended parameter to check the bo on the left if you want to applice to applic	🖗 Technology Expert			Ģ	23	
Hardness Scale: Brinell(HB) Material Attributes Hardness: 300 Cutter Diameter: 10 Number of Flutes: 4 Flute Length: 50 Tool Length: 50 Coating: Uncoated Fixture Rigidity: Poor Spindle Taper: 30 Taper Holder Type: Endmill Holder Max Spindle Speed: 12000 Recommendations: Conservative Spindle Speed: 376.991 Spindle Speed: 376.991 Spindle Speed: 12000 Recommended parameters: Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Feed Rate: 0.0972 MMPF* Recommended parameters Feed Rate: 2 Plunge Spindle Speed: 6000 Represent Rate: 232.8 Plunge Feed Rate: 233.8 Yenge Spindle Speed: 300 Punge Spindle Speed: 20	Part Material:	Low silicon A	luminum, Brass	, Copper	-	
Hardness: 300 Cutter Diameter: 10 Number of Flutes: 4 Flute Length: 50 Tool Length: 50 Coating: Uncoated Fixture Rigidity: Poor Spindle Taper: 30 Taper Holder Type: Endmill Holder Max Spindle Speed: 12000 Max Feed Rate: 20000 SurfaceSpeed: 376.991 Spindle Speed: 12000 Spindle Speed: 12000 SurfaceSpeed: 376.991 Spindle Speed: 0.0972 MMPP** Feed Rate: 4665.6 MMPM** Plunge Spindle Speed: 6000 Plunge Feed Rate: 2332.8 MMPM** Plunge Feed Rate: 2332.8 MMPM** Stepover 3 Max Stendown 20	Hardness Scale:	Brinell(HB)			-	Material Attributes
Cutter Diameter: 10 Number of Flutes: 4 Flute Length: 50 Tool Length: 50 Coating: Uncoated Fixture Rigidity: Poor Spindle Taper: 30 Taper Holder Type: Endmill Holder Max Spindle Speed: 12000 Recommendations: Conservative SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Spindle Speed(*): 12000 Spindle Speed: 376.991 Syndle Speed: 0.0972 Max Feed Rate: 0.0972 Spindle Speed: 12000 Recommended parameters (Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Feed Rate: 0.0972 MMPM * Recommended parameter to check the bo on the left if you want to ap them in the operation. Plunge Spindle Speed: 0000 Plunge Feed Rate: 2322.8 Plunge Feed Rate: 2322.8 MMPM * 3 Plunge Feed Rate: 2322.8 <t< td=""><td>Hardness:</td><td>300</td><td></td><td></td><td>⊐∥J</td><td></td></t<>	Hardness:	300			⊐∥J	
Number of Flutes: 4 Flute Length: 50 Tool Length: 50 Coating: Uncoated Fixture Rigidity: Poor Spindle Taper: 30 Taper Holder Type: Endmill Holder Max Spindle Speed: 12000 Recommendations: Conservative SurfaceSpeed: 376.991 Spindle Speed(*): 12000 SurfaceSpeed: 376.991 Spindle Speed(*): 12000 SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Pionge Spindle Speed: 2 Pionge Spindle Speed: 2 Pionge Spindle Speed: 232.8 MMPM * 3 Plunge Feed Rate: 2332.8 Plunge Feed Rate: 2332.8 Plunge Feed Rate: 2332.8 Max Stendown 20	Cutter Diameter:	10				
Flute Length: 50 Tool Length: 50 Coating: Uncoated Fixture Rigidity: Poor Spindle Taper: 30 Taper Holder Type: Endmill Holder Max Spindle Speed: 12000 Max Feed Rate: 20000 Recommendations: Conservative SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Spindle Speed(*): 12000 Spindle Speed(*): 376.991 Spindle Speed(*): 12000 Spindle Speed(*): 12000 Plunge Spindle Speed: 2 Plunge Spindle Speed: 232.8 Plunge Feed Rate: 2332.8	Number of Flutes:	4				Tool parameters inheri
Tool Length: 50 Coating: Uncoated Fixture Rigidity: Poor Spindle Taper: 30 Taper Holder Type: Endmill Holder Max Spindle Speed: 12000 Recommendations: Conservative Recommended parameters (Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Recommended parameters (Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Feed Rate: 4665.6 MMPM * Feed Rate: 2 Plunge Spindle Speed: 6000 Plunge Spindle Speed: 6000 Plunge Feed Rate: 2332.8 MMPM * 3 Max Stepdown 20	Flute Length:	50				from the tool, which are editable here
Coating: Uncoated Fixture Rigidity: Poor Spindle Taper: 30 Taper Holder Type: Endmill Holder Max Spindle Speed: 12000 Max Feed Rate: 20000 Recommendations: Conservative Recommended parameters (Checked values will be applied to operation) The maximum speed and for of the machine SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Recommended parameters (Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Plunge Spindle Speed: 0.0972 MMMPM * Recommended parameters (Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Plunge Spindle Speed: 0.0072 Plunge Spindle Speed: 6000 Plunge Feed Rate: 2332.8 Max Stendown 20	Tool Length:	50				
Fixture Rigidity: Poor Spindle Taper: 30 Taper 30 Taper: 30 Taper Holder Type: Endmill Holder Max Spindle Speed: 12000 Max Feed Rate: 20000 Recommendations: Conservative Recommended parameters (Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Recommended parameters (Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Feed Rate: 4665.6 MMPF * Feed Rate: 4665.6 MMPM * Feed Rate: 2 Plunge Spindle Speed: 6000 Plunge Feed Rate: 2332.8 MMPM * Stepover 3	Coating:	Uncoated			-	
Spindle Taper: 30 Taper Holder Type: Endmill Holder Max Spindle Speed: 12000 Max Feed Rate: 20000 Max Feed Rate: 20000 Recommendations: Conservative Recommended parameters (Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Recommended parameters (Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Recommended parameters 0.0972 MMPF * Feed Rate: 4665.6 MMPM * Feed Rate: 2 Plunge Spindle Speed: 6000 RPM * Plunge Feed Rate: 2332.8 MMPM * Stepover 3	Fixture Rigidity:	Poor			•	Status of coating, fixt
Holder Type: Endmill Holder Max Spindle Speed: 12000 Max Feed Rate: 20000 Recommendations: Conservative Recommended parameters (Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Plunge Spindle Speed: 0.0972 MMPM * Plunge Feed Rate: 4665.6 MMPM * Plunge Feed Rate: 2332.8 MMPM * Stepover 3	Spindle Taper:	30 Taper			•	holder type.
Max Spindle Speed: 12000 RPM Image: Spindle Speed: 20000 MMPM Image: Spindle Speed: The maximum speed and for of the machine Recommendations: Conservative Image: Spindle Speed: Image: Spindle Speed: The maximum speed and for of the machine SurfaceSpeed: 376.991 SMM Image: Spindle Speed: Image: Spindle Spind	Holder Type:	Endmill Hold	er		•	
Max Feed Rate: 20000 Recommendations: Conservative Recommended parameters (Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Plunge Spindle Speed(*): 0.0972 MMPF * Feed Rate: 4665.6 MMPM * Feed Rate: 4665.6 MMPM * Plunge Spindle Speed: 6000 RPM * Plunge Spindle Speed: 6000 RPM * Stepover 3	Max Spindle Speed:	12000		RPM	-	• The maximum speed and fe
Recommendations: Conservative The method (conservative aggressive) to generative aggressive aggressive) to generative aggressive aggressive aggressive aggressive aggressive aggressive	Max Feed Rate:	20000		MMPM		of the machine
Recommended parameters (Checked values will be applied to operation) SurfaceSpeed: 376.991 Spindle Speed(*): 12000 RPM Feed Rate: 4665.6 MMPF Feed Rate: 4665.6 MMPM Feed Rate: 2 Plunge Spindle Speed: 6000 RPM Plunge Feed Rate: 2332.8 MMPM Stepover 3	Recommendations:	Conservative			-	The method (conservative
SurfaceSpeed: 376.991 Spindle Speed(*): 12000 Fee d per Tooth: 0.0972 MMPF * Feed Rate: 4665.6 MMPM * Engage Angle: 2 Plunge Spindle Speed: 6000 RPM * Plunge Feed Rate: 2332.8 MMPM * Stepover 3	Recommended parameters	(Checked valu	es will be applie	d to operati	on) —	recommended values.
Spindle Speed(*): 12000 Feed Part Tooth: 0.0972 Feed Rate: 4665.6 MMPM * Feed Rate: 2 Plunge Spindle Speed: 6000 Plunge Spindle Speed: 6000 Plunge Feed Rate: 2332.8 MMPM * Stepover 3	SurfaceSpeed:	376.9	91	SMM	-	
Feed per Tooth: 0.0972 Image Feed Rate: 4665.6 Image Angle: 2 Image Spindle Speed: 6000 Image Feed Rate: 2332.8 Image Spindle Speed: 3	Spindle Speed(*):	12000		RPM	-	
 Feed Rate: Feed Rate: Engage Angle: Plunge Spindle Speed: 6000 RPM Plunge Feed Rate: 2332.8 MMPM Stepover 3 	Feed per Tooth:	0.097	2	MMPF	-	Recommended parameter
 Engage Angle: Plunge Spindle Speed: 6000 RPM Plunge Feed Rate: 2332.8 MMPM Stepover 3 	Feed Rate:	4665.0	5	MMPM	-	Remember to check the bo
Image Spindle Speed: 6000 RPM Image Feed Rate: 2332.8 MMPM Image Stepover 3	Engage Angle:	2				on the left if you want to ap them in the operation
Image Feed Rate: 2332.8 Image Feed Rate: 2332.8 Image Feed Rate: 3 Image Feed Rate: 20	Plunge Spindle Speed:	6000		RPM	-	the operation.
Stepover 3 Image: Stepdown 20	Plunge Feed Rate:	2332.	3	MMPM	-	
Max Stendown 20	Stepover	3				
	Max Stepdown	20				
		OK	Cancel	App	У	

Figure 11 Technology Expert

The recommended parameters can be redefined by *Active Chip Thickness Control* window. You can set object to recalculate (Chip Thickness by default). Change any parameters that are not greyed out and click *Calculate*, then other ones will get updated.

			Chip	Thickness Ile Speed(RPM)			
Active Chip Thickness Control Calculate the:			Feed Stepo	Rate(MMPM)		Ģ	23
			Chip	Thickness	*		
Parameters							
Spindle Speed:	1000	RPM	-	Surface Speed:	31.4159	SMM	Ŧ
Feed Rate:	250	MMPI	M T	Feed per Tooth:	0.0625	MMPF	Ŧ
Stepover:	6			%of Tool Dia:	60.00		
Chip Thickness:	0.0625			Material Removal Ra	ate: 9		
			C -1				
			Cali	culate			
				ОК	Cancel	Арр	ly

Figure 12 Active Chip Thickness Control Window

2.2.2 Key Parameters

Most parameters of VoluMill2x are the same as other 2X operations. The key parameters are listed as below.

💯 VoluMill2	2x 2					₽ %
Vol	uMill2x		▼ Z			
> 📑 Prima	ng	≡	Тор			
♥ Path S > ≚ Link a	etting nd Lead	-	Bottom			
Reset]		Calculate		ОК	Cancel
		۳	3	łę		1

Figure 13

e 13 VoluMill2x Operation Parameters (Limiting)

Notes:

The VoluMill2x operation calculates the toolpaths based on profiles, so it is recommended to set the top or bottom position manually.



Figure 14 VoluMill2x Operation Parameters (Path Setting)

% Minimum Radius: Define the minimum radius (5-45% of the tool radius) of the toolpaths when milling a sharp corner or a narrow area.

$\langle \mathbf{x} \rangle$	\supset	
% Minin	num Radiu	IS

Figure 15 % Minimum Radius

😨 VoluMill2x 2		Ģ	23
Type: VoluMill2x	▼ Link		
> 🖬 Limiting	Inherit Clear Z	No	•
Path Setting	Clearance Z	100	
Link and Lead	Floor Clearance	0.25	
Link Lead In	Plunge Length	2.5	
 Display Advanced 	▼ Lead In		
	Engage Type	Helix	
	Engage Angle	3	
Reset	Calculate	OK Cano	el
🔋 ⊿ 🕅	3		

Figure 16 VoluMill2x Operation Parameters (Link and Lead)

Inherit Clear Z: Define whether to use the same clearance height as the general one or not. If set to **No**, the following **Clearance Z** option is available.

Clearance Z: Define the clearance height only applied in this operation.

Floor Clearance: Define the height of the helical move that is used when entering or exiting a cut. Only nonnegative values are allowed. If a positive value is entered, repositioning moves between cuts will take place above the already- machined floor. If zero is entered, the tool will drag across the already-machined floor during these moves. In this case, set the Traversal Feed Rate parameter (see the following figure) to be no greater than the cutting feed rate to help ensure more consistent tool marks on the floor.

🖉 VoluMill2x 2 🖙						
Speeds		Feed rates				
Units	RPM *	Units	MMPM *			
Rough	850	Rough	430			
Finish	7684	Finish	995.85			
Rapid	100.00%	Rapid	Rapid			
Step-over (%)	100.00%	Step-over (%)	100.00%			
Plunge (%)	3842.00	Plunge (%)	497.93			
Engage (%)	100.00%	Engage (%)	60.00%			
Retract (%)	100.00 %	Retract (%)	300.00%			
Traversal (%)	100.00%	Traversal (%)	Percent * 100.00%			
Slotcut (%)	100.00%	Slotcut (%)	40.00%			
Slowdown (%)	100.00%	Slowdown (%)	60.00%			
	Or*	iona' "%" - plie ' to				

Figure 17 Traversal Feed Rate Parameter

🖗 VoluMill2x 2			₽ %
VoluMill2x	Advanced Feed Control	ol	
> 🛉 Primary			
> 🔳 Limiting	Enable AFC	Yes	-
🧶 Path Setting	Adjust Feed Rate for Helix	Plunge Yes	•
> Link and Lead	Adjust Feed Rate for Ram	n Plunge Ves	-
冒 Display	Aujust recurrate for harr	printinge res	
> 🔄 Advanced			
Reset	Calculate	ОК	Cancel
💡 🚺 🛍	3		1

Figure 18 VoluMill2x Operation Parameters (Advanced)

Enable AFC: Define whether to apply Automatic Feed Control (AFC) or not. AFC function enables ZW3D to auto-adjust the feeds along the toolpaths according to cutting areas and path shapes.

Adjust Feed Rate for Helix/Ramp Plunge: Define whether to apply AFC on Helix or Ramp plunge or not. These options are available when *Enable AFC* is *Yes*.

2.3 Case Study

This chapter will show a simple example on how to create a VoluMill2x operation.

STEP 01 Open the part file *VoluMill_Case_01.Z3* and go to CAM level.

STEP 02 Click the Ribbon *VoluMill2x* to create a 2X VoluMill operation.

STEP 03 Add Profile 1 created in previous chapter into the CAM features.

STEP 04 Select the tool **D10R0** created in previous chapter.

STEP 05 Open Technology Expert and apply all the recommended values.

STEP 06 Set the top and bottom points as Figure 20. Keep other parameters as default.

STEP 07 Calculate the toolpaths. The result will be shown as Figure 21

💯 Technology Expert		▽ ×				
Part Material:	Low silicon Aluminum, Bra	ss, Copper 🔹				
Hardness Scale:	Brinell(HB)	•				
Hardness:	300					
Cutter Diameter:	10					
Number of Flutes:	4					
Flute Length:	50					
Tool Length:	50					
Coating:	Uncoated	•				
Fixture Rigidity:	Better	-				
Spindle Taper:	30 Taper	•				
Holder Type:	Endmill Holder	•				
Max Spindle Speed:	12000	RPM *				
Max Feed Rate:	20000	MMPM *				
Recommendations:	Conservative					
Recommended paramete	rs (Checked values will be appl	ied to operation) –				
SurfaceSpeed:	376.991	SMM ×				
☑ Spindle Speed(*):	12000	RPM *				
Fee I per Tooth:	0.1377	MMPF *				
✓ Feed Rate:	6609.6	MMPM *				
Ingage Angle:	2					
Vunge Spindle Speed	6000	RPM *				
Vunge Feed Rate:	3304.8	MMPM *				
	3					
🗹 Max Stepdown	20					
	OK Cancel	Apply				

Figure 19 Apply Recommended Values by Technology Expert







Figure 21 Toolpaths

3 3X VoluMill

Key Points:

- ♦ Available Features and Key Parameters
- \diamond Case Study

3.1 Available Features

Normally, both Part and Stock are necessary for 3X VoluMill operations to generate toolpaths. Besides, users can also add Solid, Surface and Profile features in to limit the cutting area for a better result.

The way to apply these features works as the same as other 3X operations, so this chapter won't explain these features in detail.

The model file for this chapter is located in ZW3D installation folder. The default path should be *C:\Program Files\ZWSOFT\ZW3D 201X Eng (x64)\training\Volumill model*



Figure 22 Availabe Features for 3X VoluMill

3.2 Operation Parameters

The Technology Expert tool is also available in VoluMill3x operation. It has the same functionality as in VoluMill2x operation. Other unique parameters of VoluMill3x operation are explained in detail as below figures show.

💯 VoluMill3x 1		₽ 🛛
Type: VoluMill3x	▼ Basic	
Basic	Frame	
Tolerance and Steps	Speeds, Feeds	VoluMill3x 1
Boundaries	Technology Expert	
Check Path Setting	Active Chip Thickness Control	
Link and Lead	▼ Tolerance and Thick	
🛃 Lead In	Path Tolerance	0.025
Display	Surface Thick	0
Advanced	Addition Side Thick	0
	▼ Cutting Steps	
	Stepover	% Tool Dia 🔻 30
	Max Stepdown	20
Reset	Calculate	OK Cancel
💡 🔽 🕅	😺 💘	

Figure 23 VoluMill3x Operation Paramters (Primary)

Additional Side Thick: Additional thickness will be left on the side walls after the operation is done, besides the value set in *Surface Thick* option.

😨 VoluMill3x 1				
Type: VoluMill3x	▼ Cutting Control			
Basic	Cut Direction	Climb *		
Interance and Steps	Allow Zigzag	No *		
✓ Imiting	Cut Order	Region First 🔹		
Boundaries	Cavity Only	No *		
Path Setting	Final Step Height	No • 0.5		
> ≚ Link and Lead	Hit Flate	Add Depth of Cut		
Display		Add Deptil of Cat		
> 🛃 Advanced	% Minimum Radius	45		
Reset	Calculate	OK Cancel		
💡 🗾 🛍 😻 🖳 🔚				



Cavity Only: This option should be used when machining a cavity from material with a flat top surface. The benefit is that stock need not be defined separately. See Figure 25for details.

Final Step Height: This option is used to control the height of the steps that will remain. Instead of making a shallow depth of cut across the entire part to leave smaller steps, VoluMill first machine larger steps and then automatically re-machine them to leave smaller steps. Thus the tool can remove the bulk of material most efficiently and still leave smaller steps for a semi-finish or finish toolpath. See Figure 26 for details.

Hit Flats: This option is used to control how flat surfaces, that are not coincident with any depth of cuts or final step heights, are machined. See Figure 27 for details.









Figure 27 Hit Flats Option

3.3 Case Study

STEP 01 Open the model file *VoluMill_Case_02.Z3* and go to CAM level.

STEP 02 Click the Ribbon *VoluMill3x* to create a 3X VoluMill operation.

STEP 03 Add the part and a stock into the CAM features.

STEP 04 Select the tool **D10R0** created in previous chapter.

STEP 05 Open Technology Expert and apply all the recommended values.

STEP 06 Set the Final Step Height and Hit Flat options as Figure 29. Keep other parameters as default.

STEP 07 Calculate the toolpaths. The result is shown as Figure 30.

😨 Technology Expert		~			
Part Material:	High Silicon Aluminum(4% to 13% si)				
Hardness Scale:	Brinell(HB)	•			
Hardness:	300				
Cutter Diameter:	10				
Number of Flutes:	4				
Flute Length:	50				
Tool Length:	50				
Coating:	Uncoated				
Fixture Rigidity:	Better	•			
Spindle Taper:	30 Taper				
Holder Type:	Endmill Holder	•			
Max Spindle Speed:	12000	RPM *			
Max Feed Rate:	10000	MMPM *			
Recommendations:	Conservative	•			
Recommended parameters (Checked values will be applied to operation) –					
SurfaceSpeed:	376.991	SMM *			
🗹 Spindle Speed(*):	12000	RPM *			
Feec per Tooth:	0.10098	MMPF *			
🗹 Feed Rate:	4847.04	MMPM *			
🗹 Engage Angle:	2				
🗵 🖡 lunge Spindle Speed:	6000	RPM *			
🗹 🖡 lunge Feed Rate:	2423.52	MMPM *			
C Stepover	3				
🗹 I 1ax Stepdown	20				
	OK Car	ncel Apply			



😨 VoluMill3x 1		X
Type: VoluMill3x	▼ Cutting Control	
> 😭 Primary Y 🗊 Limiting	Cut Direction	Climb •
Boundaries	Allow Zigzag	No *
Dath Satting	Cut Order	Region First 🔹
> Link and Lead	Cavity Only	No 🔻
Display	Final Step Height	Yes 🔻 1
> 🖆 Advanced	Hit Flats	Cut after Lower Depth 🔹
	% Minimum Radius	45
Reset	Calculate	OK Cancel
💡 🚺 👣	3	

Figure 29 Final Step Height and Hit Flats Options



Figure 30 VoluMill3x Toolpaths

4 Epilogue

Thank you for your valuable time.

In this tutorial, we've shown you how to create 2X and 3X VoluMill toolpaths with the key parameters explained in detail. We hope this tutorial can help you understand the way to apply VoluMill in ZW3D.

This tutorial is based on ZW3D 2021 version, some functions or icons may not match the current version. If you have any suggestions or questions about this tutorial, please contact us at

ZW3D Global Website: https://www.zwsoft.com

ZW3D Support Team: sales@zwsoft.com