# HCL

# CAMWorks 2022

# Continuous B Axis Turning Tutorial

**Topics Covered:**

- **Inserting Turn Finish Operations with Continuous B Axis Turning Settings**

- **Understanding how B Axis Turning Settings affect Toolpaths**

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**Product Version: CAMWorks 2022**

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# 1. TUTORIAL ON CONTINUOUS B AXIS TURNING

## Functionality of Continuous B axis Turning (Finishing)

This *Continuous B Axis Turning* option allows to continuously tilt the B axis head such that complex profiles on Turn/Mill-Turn part models can be machined using a single tool and only one operation. This functionality has been introduced in the *CAMWorks 2020 SP3* version and will be available in all CAMWorks versions from this version onwards.

The objective of this tutorial is to give a brief overview of the several parameters affecting the generation of a Turn finish toolpath with continuous B axis rotation.

## Topics covered in this Tutorial:

The following topics will be covered in the tutorial:

- Inserting Turn Finish Operations with Continuous B axis Turning Settings
- Understanding various parameters of B Axis settings.

## Step 1: Opening the Tutorial Part

1. Launch *CAMWorks* as an Add-in within *SOLIDWORKS/CAMWorks Solids.*

2. Open the part model **B-Axis-Tutorial-01.SLDPRT** from the following folder.

   ***Drive:\CAMWorksData\CAMWorks2022x64\Examples\Tutorial_Parts\Turn***

   This part model has already been partly programmed in CAMWorks and already has some features and operations generated.

3. Go to CAMWorks Feature tree and observe that some of the features have been generated.

   Observe that in order to completely machine OD feature 1 in one single operation, the Turn tool will have to be tilted.

4. Switch to the CAMWorks Operation tree and observe that the following operations and toolpaths have been generated:

   a. Face Finish1

   b. Turn Rough1

   c. Turn Rough2
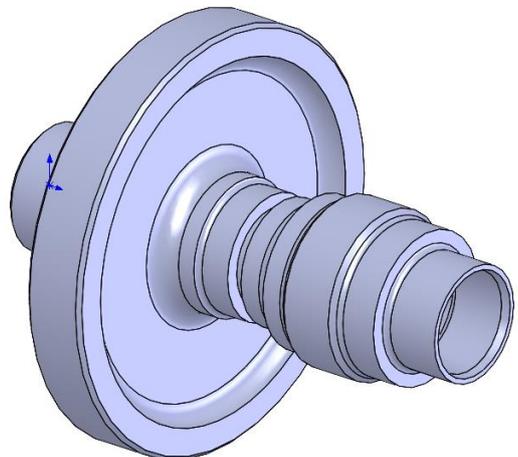


**B-Axis-Tutorial-01.SLDPRT**
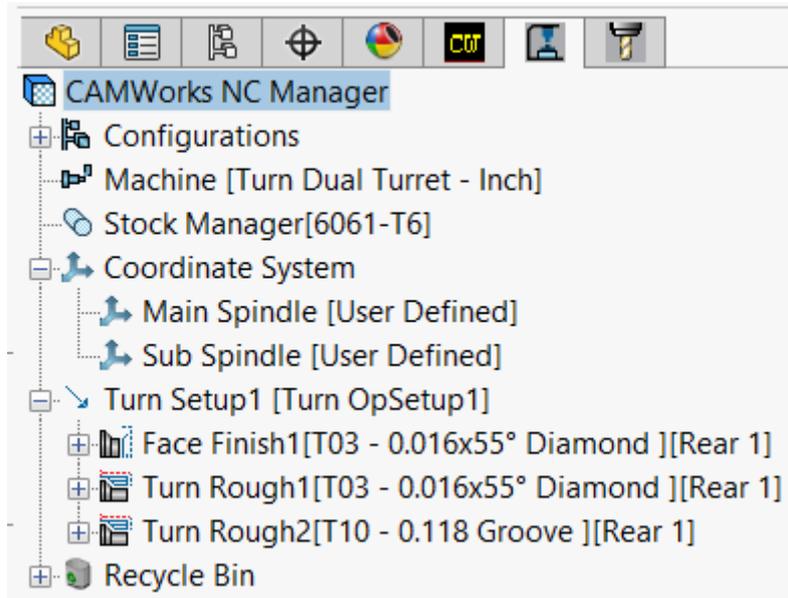
**Operations in the Operation Tree**

# Step 2: Interactively inserting a Turn Finish operation

In this step, we will interactively insert a Turn Finish operation.

1. In the Operation tree, right-click on *Turn Rough2* operation node and select insert a Turn Finish operation by selecting Turning Operations>>Turn Finish from the context menu.
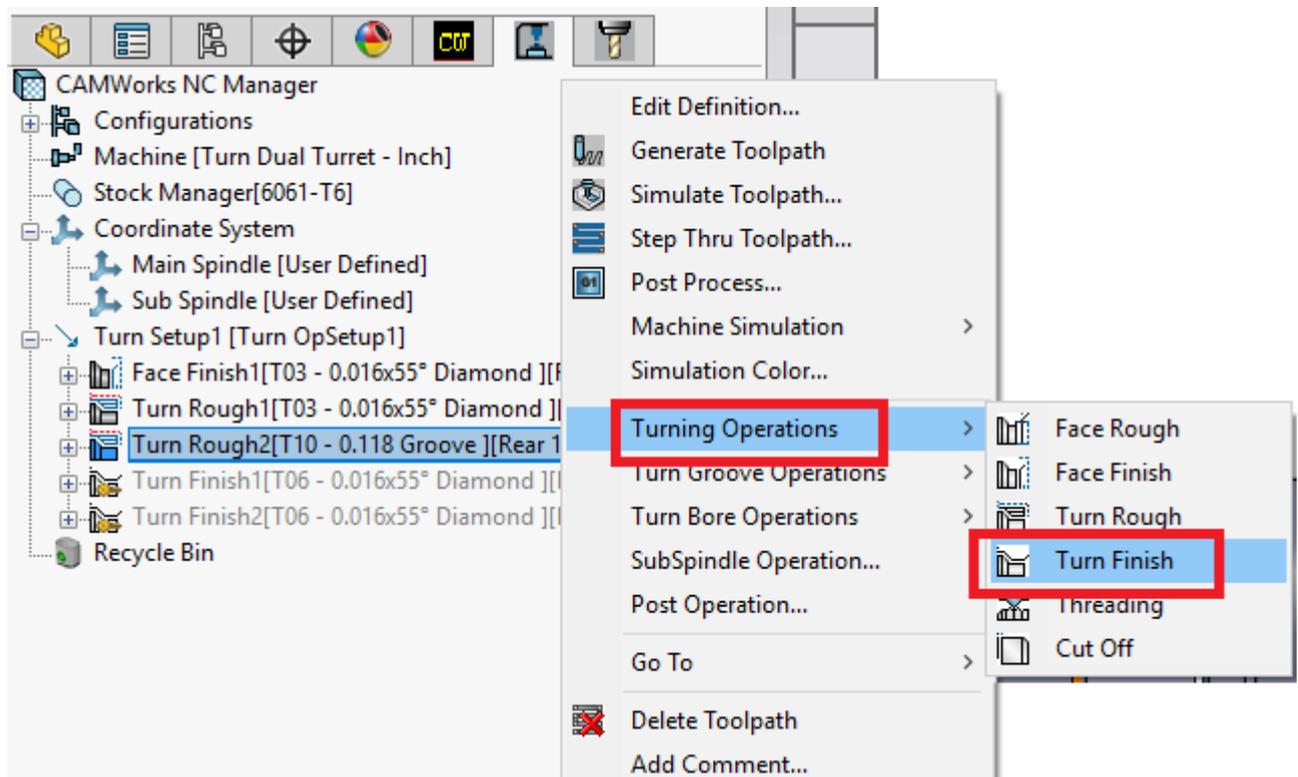


**Command to Interactively Insert a Turn Operation**

2. The *New Operation: Turn Finish* dialog box will be displayed.
   a. In the *Tool* tab of this dialog box, select the same tool which has been set in *Face Finish1* and *Turn Rough1* operations (i.e. *T03 – 0.016x55⁰ Diamond*).
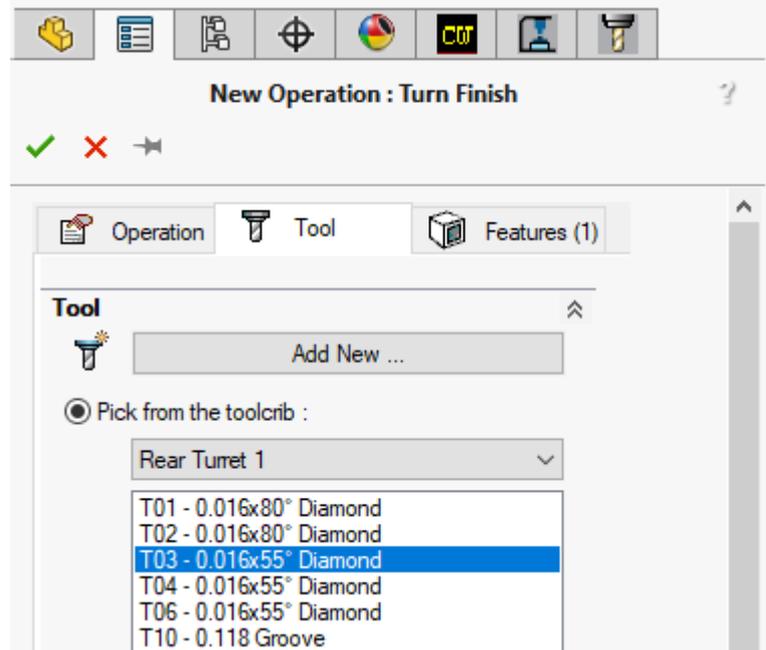


**Tool tab of New Operation: Turn Finish Dialog Box**

   b. In the *Options* group box of the *Operation* tab of this dialog box, ensure that the **Edit operation on creation** option is checked.
   c. Insert the new operation by clicking on the OK button ✓. The new Turn Finish operation will be added as an Operation node under *Turn Setup1* in the Operation tree.
3. As the **Edit operation on creation** option is checked while defining the operation, the *Operation Parameters* dialog box will be displayed. Within this dialog box, modify the parameters as follows:
   a. Edit the In the *Holder* page under *Tools* tab, set the *Back clear angle* and *Front clear angle* to 5 degrees.
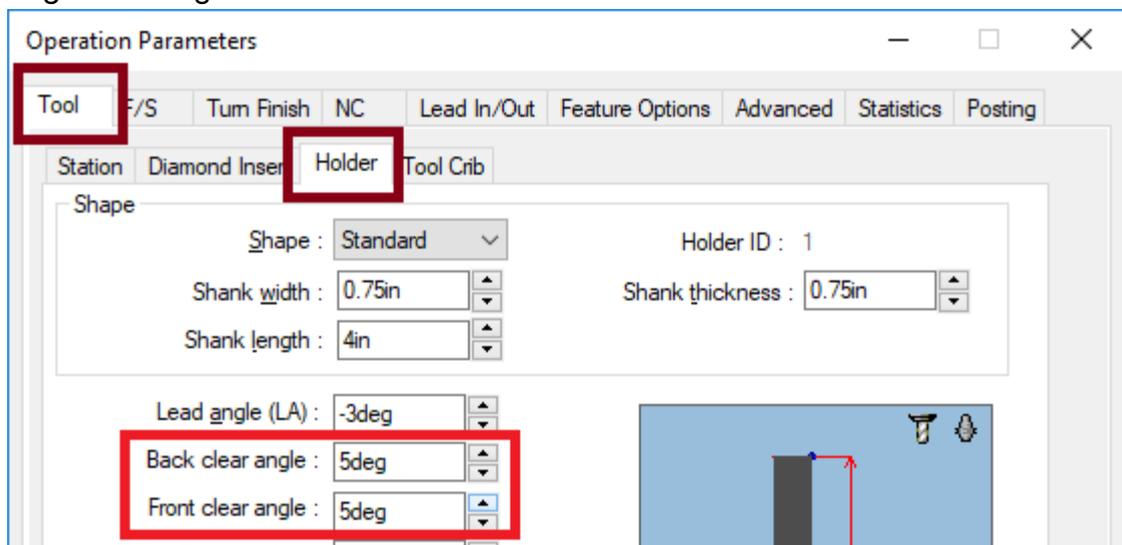


**Holder Page under Turn Tab of Operation Parameters dialog box**

b. Click on the *Turn Finish* tab. Enable the B Axis settings functionality by placing a check in the check box labelled ***Continuous B axis***.
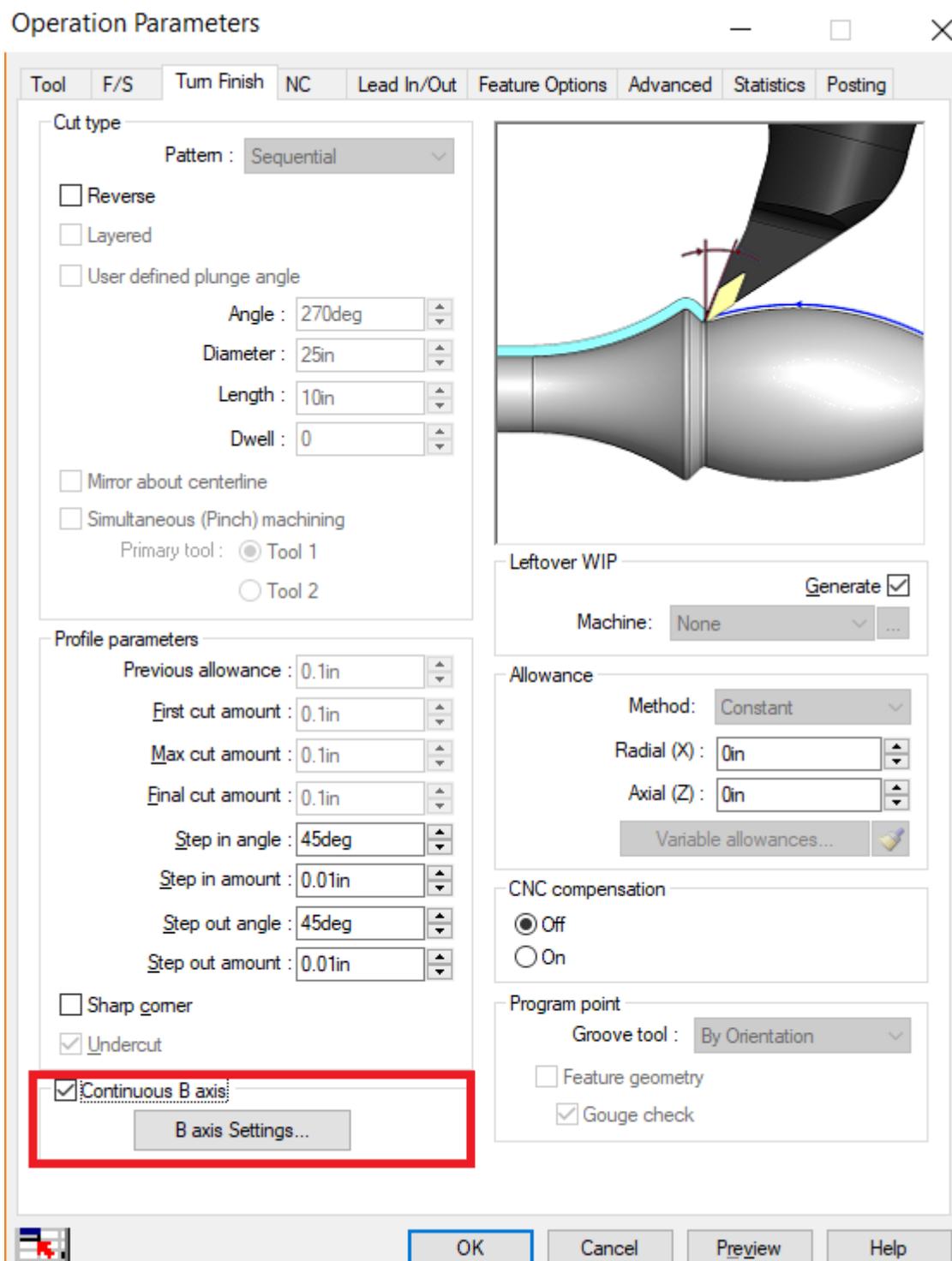


**'Continuous B Axis' check box in Turn Finish tab**

c. Click on the ***B axis Settings…*** below this checkbox in this tab. The *Continuous B Axis Settings* dialog box will be displayed.
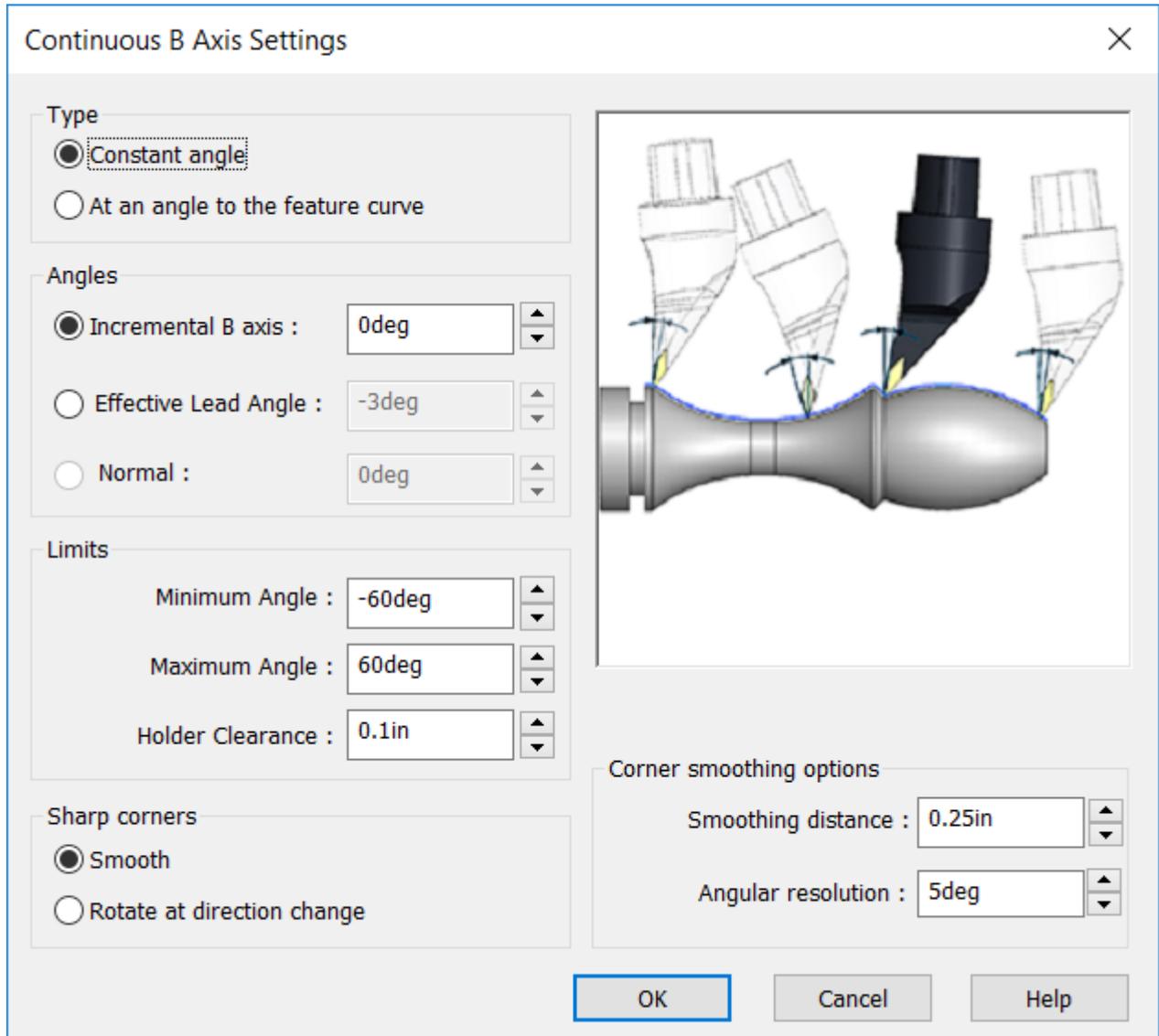
**Continuous B Axis Settings Dialog Box**

d.  In the **Continuous B Axis Settings** dialog box, assign the following values/options to the parameters:
    i.     **Type**: Constant angle
    ii.    **Angles group box**
        •  Incremental B axis (0 Degrees) Or **Effective lead angle** = -3 degrees
    iii.   **Limits group box**
        •  Minimum Angle: -60 degrees
        •  Maximum Angle: 60 degrees
        •  Holder clearance: 0.1 inch
    iv.    **Sharp corners group box:** Select **Smooth** option
    v.     **Corner Smoothing Options group box**
        •  Smoothing distance: 0.25 inch
        •  Angular resolution: 5 deg

e. Click on the OK button within this dialog box to apply the changes and close the dialog box. The user interface will revert to *Turn Finish* tab.

f. Click on the *NC* tab. Observe that the default parameters set for the approach and retract moves.

g. On the **Lead In/Out** tab, set the **Leadin type** to **Parallel** with the below assigned values. Also, set the **Leadout type** to *Same as leadin*.

- Leadin amount:      0.125in
- Lead angle:          0 deg
- Leadin overlap:      0in
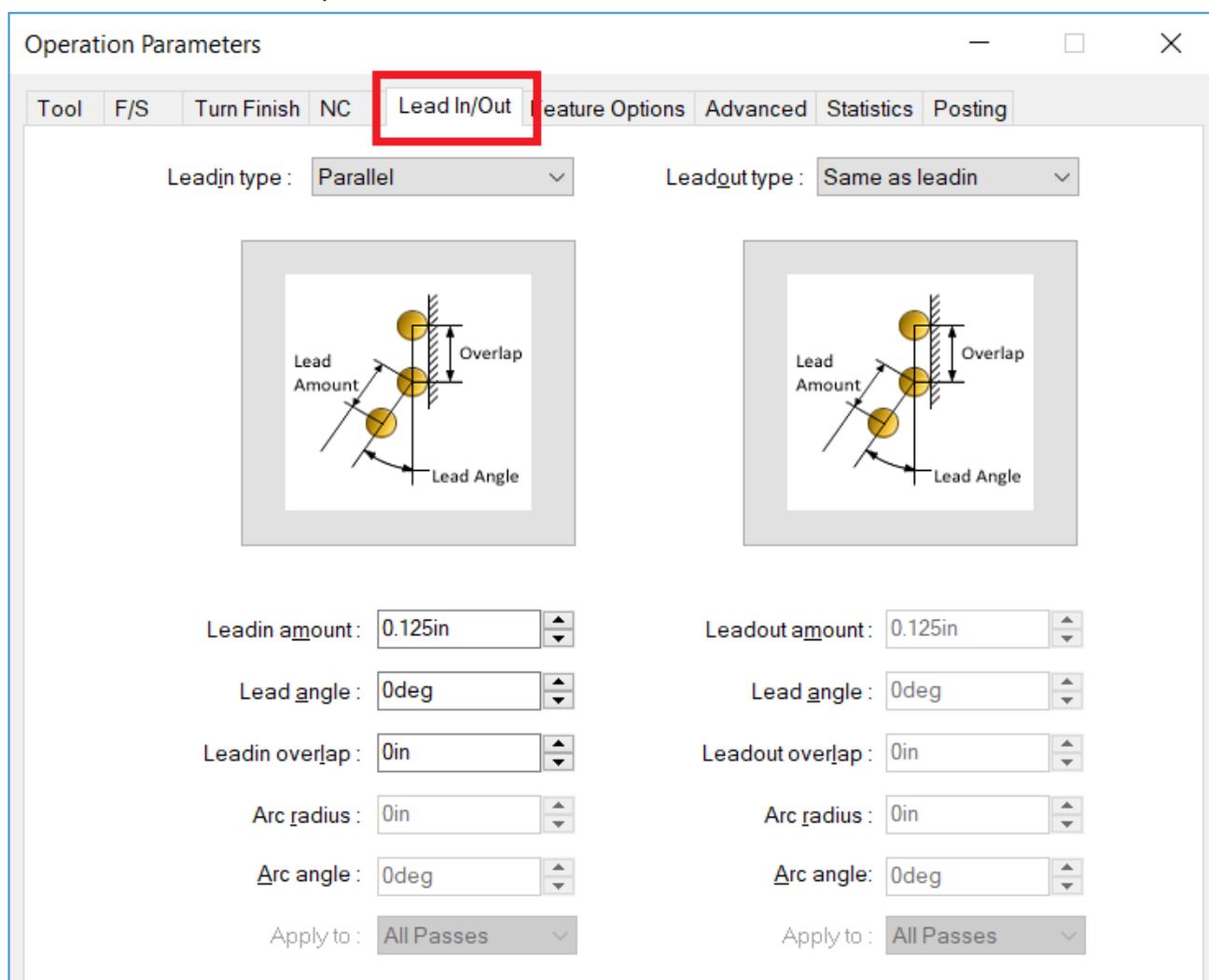


**Lead In/Out tab of Operation Parameters Dialog Box**

h. Click the OK button to apply the changes to the *Operation Parameters* dialog box and close the dialog box.

i. A warning message stating that tool parameters have changed will be displayed. It will prompt you to create a new tool or modify the existing tool. Click on the *Add* button to add a new tool to the Tool crib.
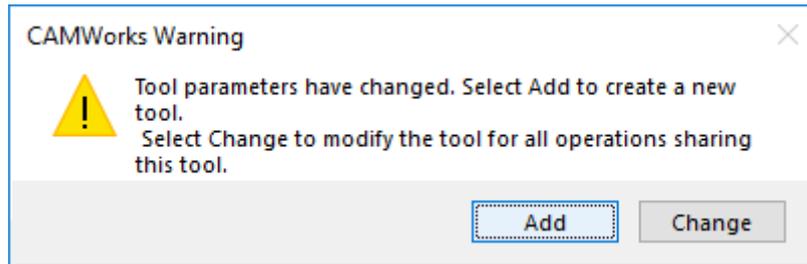
**Warning Message Displayed after changes to Tool Parameters**

# Step 3: Understanding how B Axis parameters affect Toolpaths

## How Cut Type Parameter set to 'Constant Angle' affects Toolpaths

1. On the *CAMWorks Command Manager*, click on the **Step Through Toolpath…** command to view the Step through simulation.

2. During Step through, observe that the tool tilts only in the area where the material cannot be cut by maintaining the user-defined lead angle. This occurs because the cut type was set to "Constant" in the *Continuous B Axis Settings* dialog box.
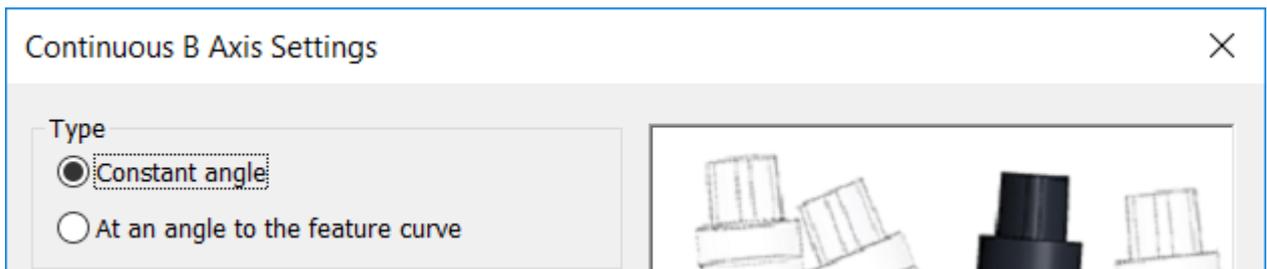


**Constant Angle option selected for Cut Type in Continuous B Axis Settings dialog box**



Tool tilts to cut the vertical segment
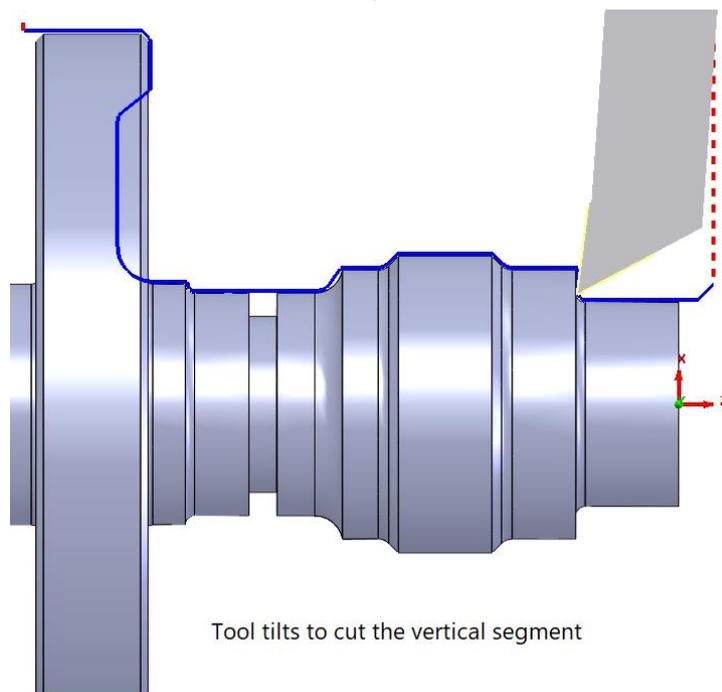
**Illustrative Image 1: Showcasing how tool tilts to cut the Vertical Segment of OD Profile**

No tilting as the material can be cut by
maintaining the user defined lead angle
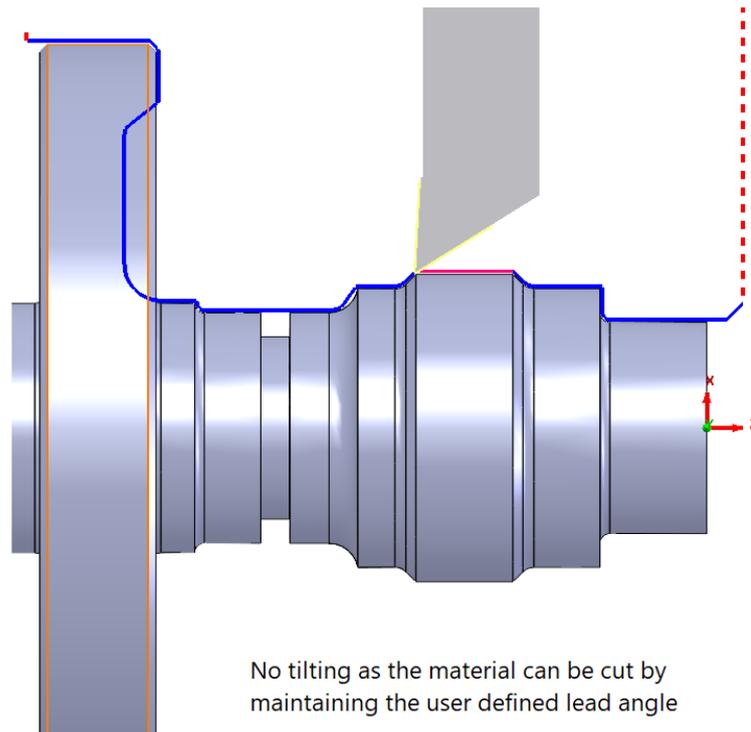
**Illustrative Image 2: Showcasing zero tilt for Turn tool as the Material can be cut by maintaining the User-defined Lead Angle**



Tool tilts to cut the undercut area
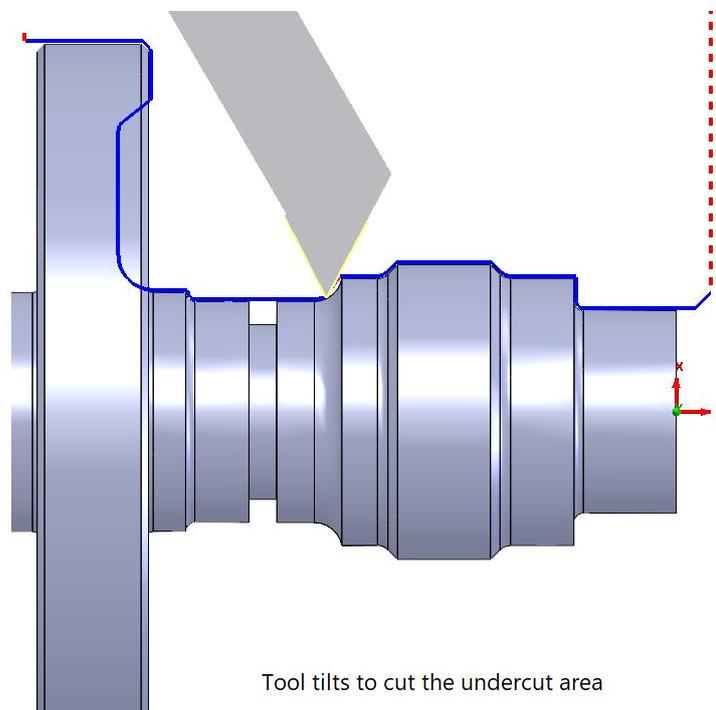
**Illustrative Image 3: Showcasing how Turn tool tilt to machine the Undercut Area of the OD Profile**

## How Max & Min Angle parameters affect Toolpaths

The values assigned to the Minimum Angle and Maximum Angle parameters in Limits group box of the *Continuous B Axis Settings* dialog box define the tilting limit of the B axis head. These values must be input as per the limits of the machine tool used for machining the part model.



**Limits group box in Continuous B Axis Settings dialog box**

## How Holder Clearance Parameter affects Toolpaths

The value assigned to the Holder Clearance parameters in *Limits* group box of *Continuous B Axis Settings* dialog box is used to keep the tool holder clear from the part face or stock face. Ensure that a suitable value is always provided so that there will not be any collision between the tool holder and the part model/ work-in-progress stock.

# Step 4: Generating another B Axis Turn Finish toolpath

1. Interactively insert another Turn Finish operation. In the Operation tree, right-click on *Turn Finish* operation you interactively inserted in Step 2 and select *Turning Operations>>Turn Finish* from the context menu.

2. The *New Operation: Turn Finish* dialog box will be displayed. In the *Operation* tab of this dialog box, within its *Operation Parameters* group box, select the **Copy from** option and then select the Turn Finish operation you interactively inserted in Step 2.

   The Turn Finish operation that you interactively inserted in Step 2 has B Axis Turning option enabled. You can copy the parameters of this Turn Finish operation to the new Turn finish operation to be
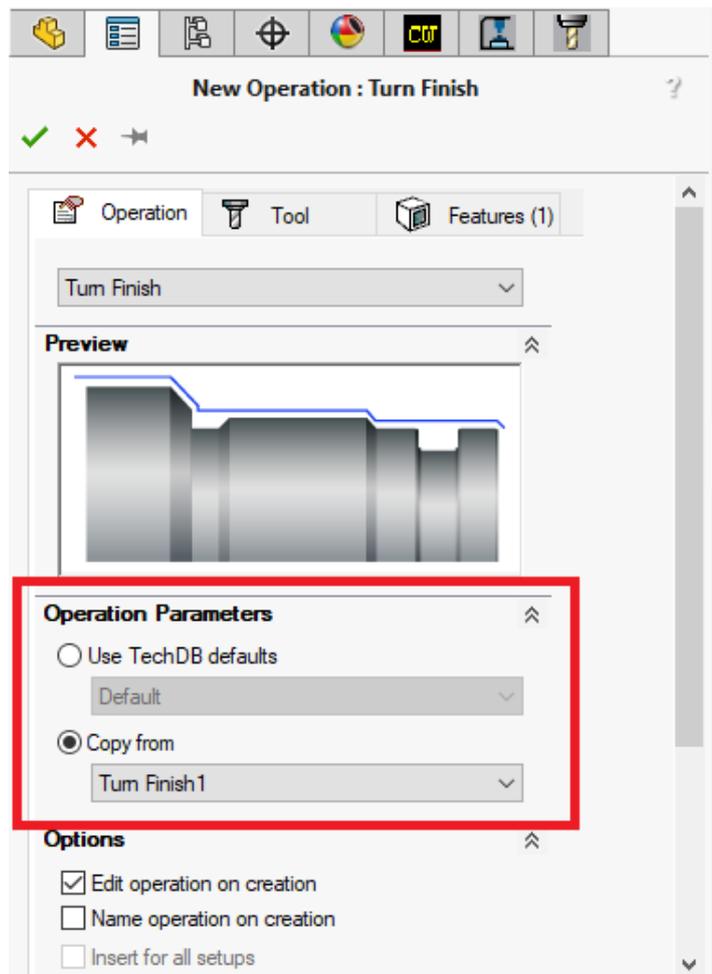


**Operation tab of New Operation Dialog Box**

interactively inserted. Doing so will reduce the number of parametric values associated with B Axis turning that need to be modified for obtaining a different result.

3. In the *Options* group box of the *Operation* tab, ensure that the **Edit operation on creation** option is checked.

4. Insert the new operation by clicking on the OK button ✔.

5. The new Tun Finish operation will be added to the Operation tree and the *Operation Parameters* dialog box for this operation will be displayed. Click on the *Turn Finish* tab of this dialog box. Click on the **B Axis settings...** button at the bottom of the tab.

6. Clicking this button will invoke the *Continuous B axis Settings* dialog box.

7. In the *Type* group box, change the type to **At an angle to the feature curve**.

8. In the *Angles* group box, select the **Normal** option. Let the value assigned to this parameter remain set to zero.
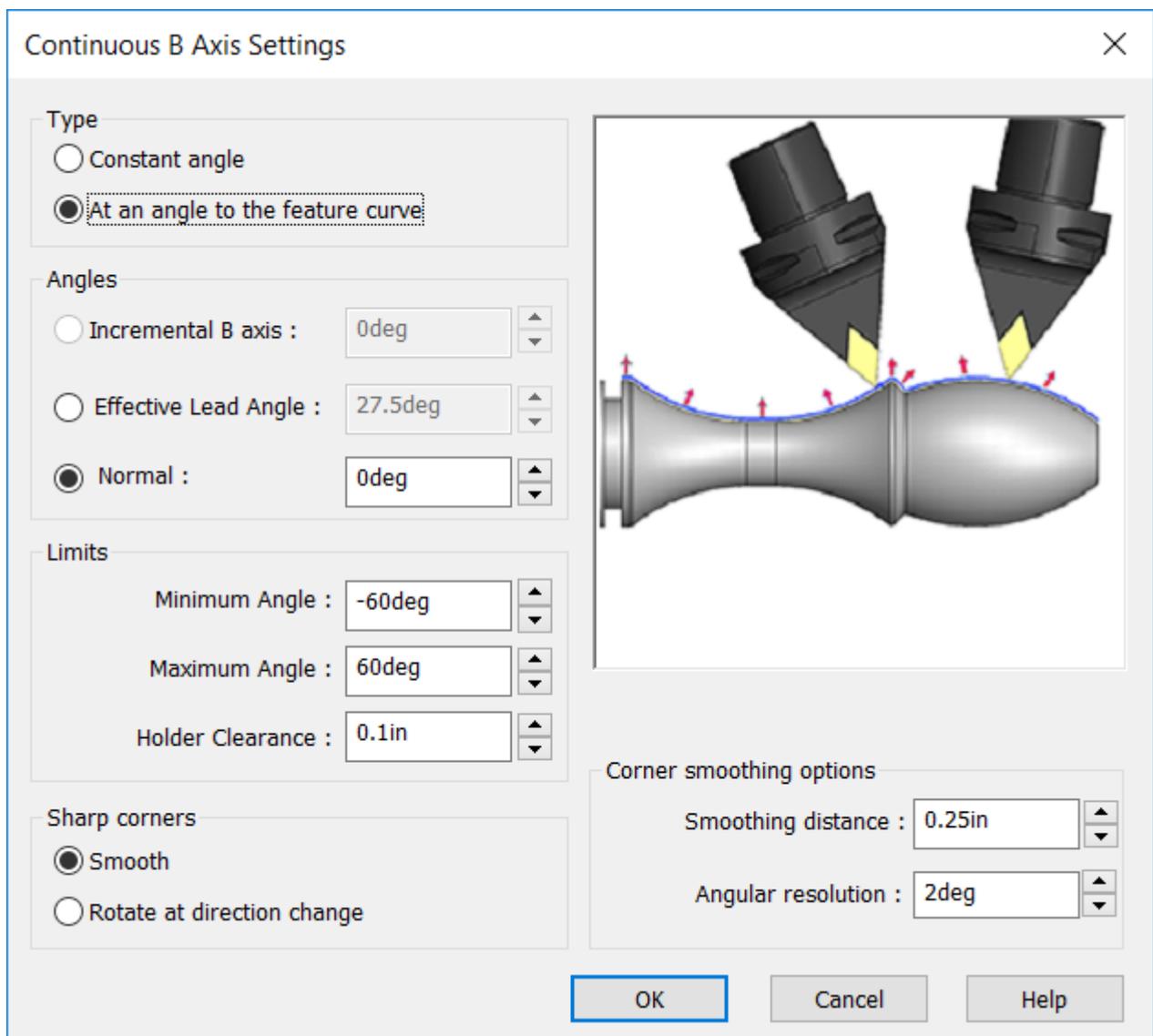


**Continuous B Axis settings Dialog Box**

9. Click on the OK button to apply the changes and close the dialog box. The user interface will revert to the *Turn Finish* tab.

10. Click on the *Lead In/Out* tab. On this tab, set the **Leadin type** to **Parallel** and input the below shown values to the parameters in this tab.
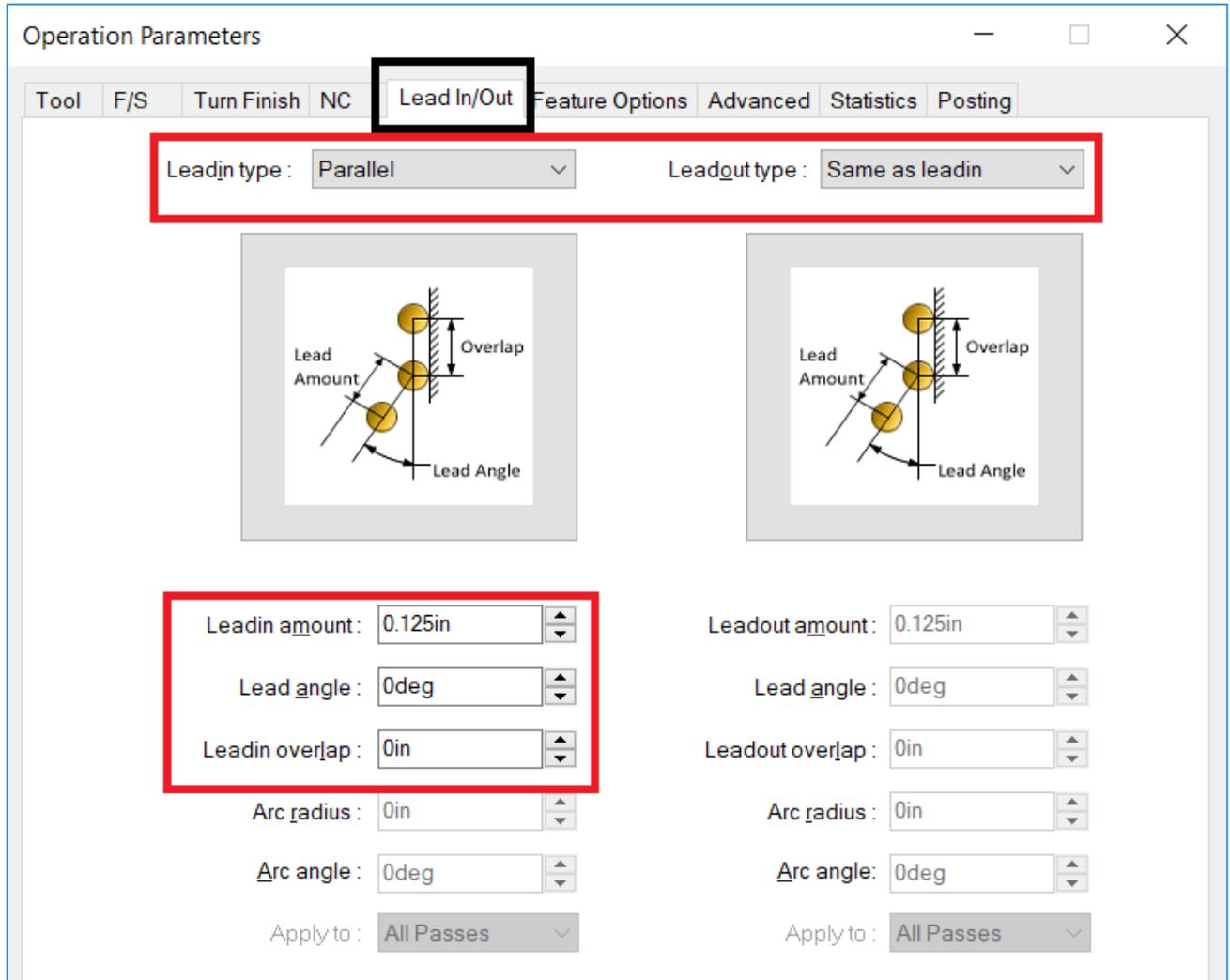


**Lead In/Out tab of operation Parameters**

11. Click the OK button to apply the changes to the *Operation Parameters* dialog box and close the dialog box.

12. The newly inserted Turn Finish operation (*Turn Finish2*) will be listed at the last operation node under **Turn Setup1** in the Operation tree. Right-click on the operation and select *Generate Toolpath* command on the context menu.
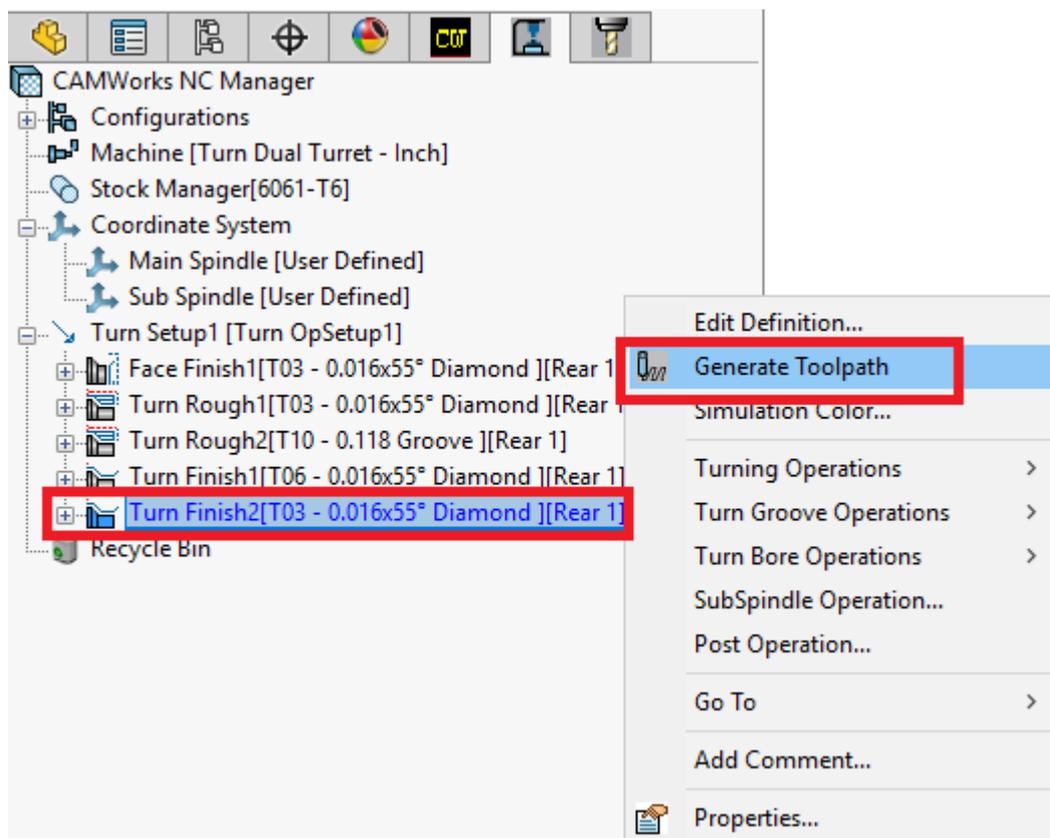
**'Generate Toolpath' command on Context Menu for Operation Node in Operation Tree**

13. The toolpath for the selected Turn Finish operation will be generated. Right-click on this Turn Finish operation once again and select **Step Thru Toolpath…** command 📇 on the context menu.
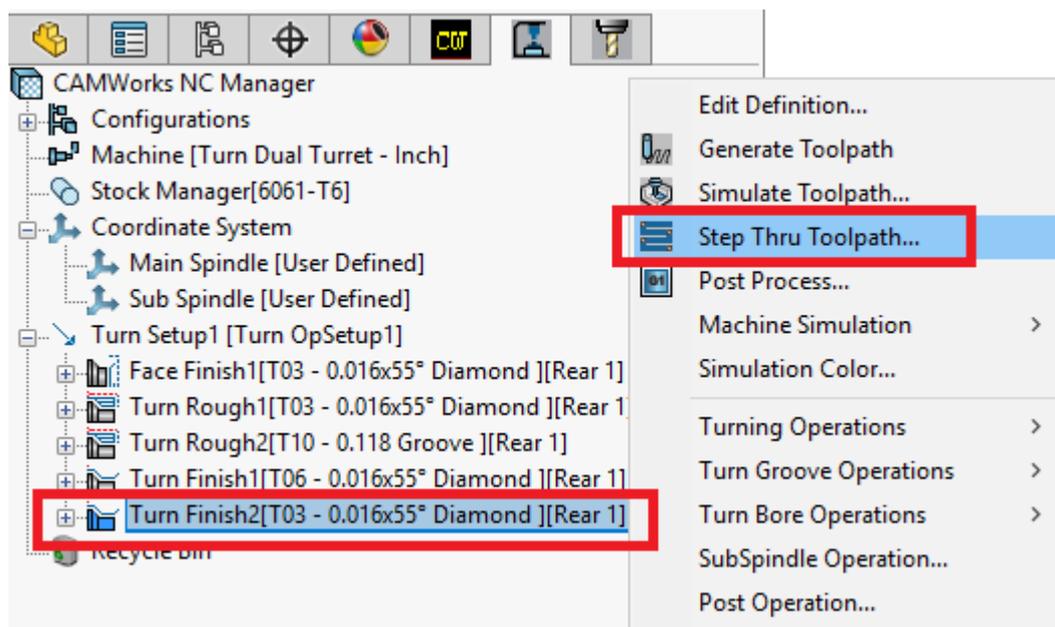


**'Step Thru Toolpath' command on Context Menu for Operation Node in Operation Tree**

14. The ***Step Through Toolpath*** dialog box will be displayed. Proceed with step through toolpath simulation and observe the toolpath.

    The following illustrative images showcase how the tool tilts while machining the various segments of the OD profile in order to maintain the user-defined Normal Angle.



Tool tilts to maintain the user defined normal angle
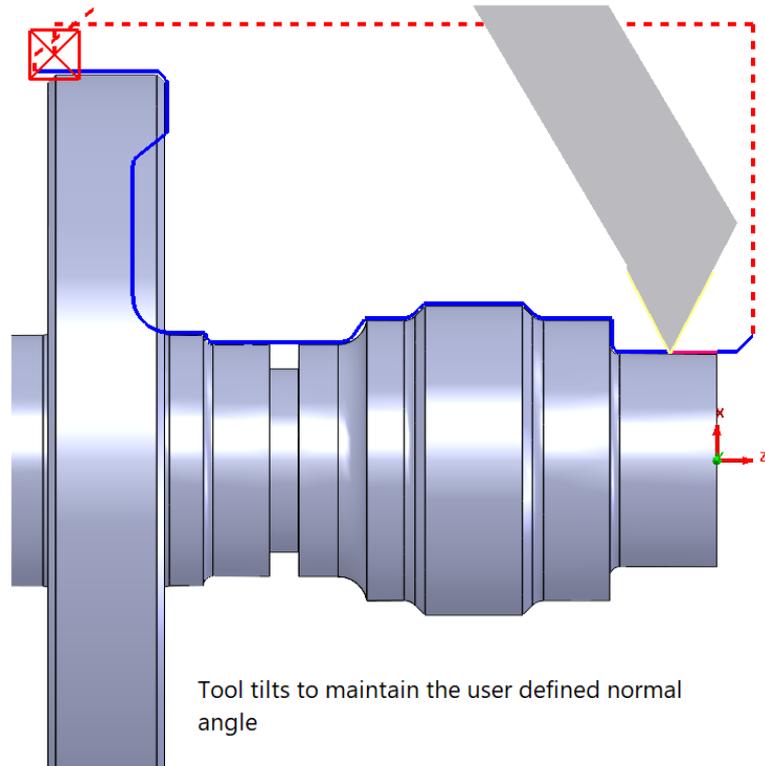
**Illustrative Image 4: Step Through of B Axis Turning toolpath showcasing how Tool Tilts to maintain the user-defined Normal Angle**

Tool tilts to maintain the user defined normal
angle
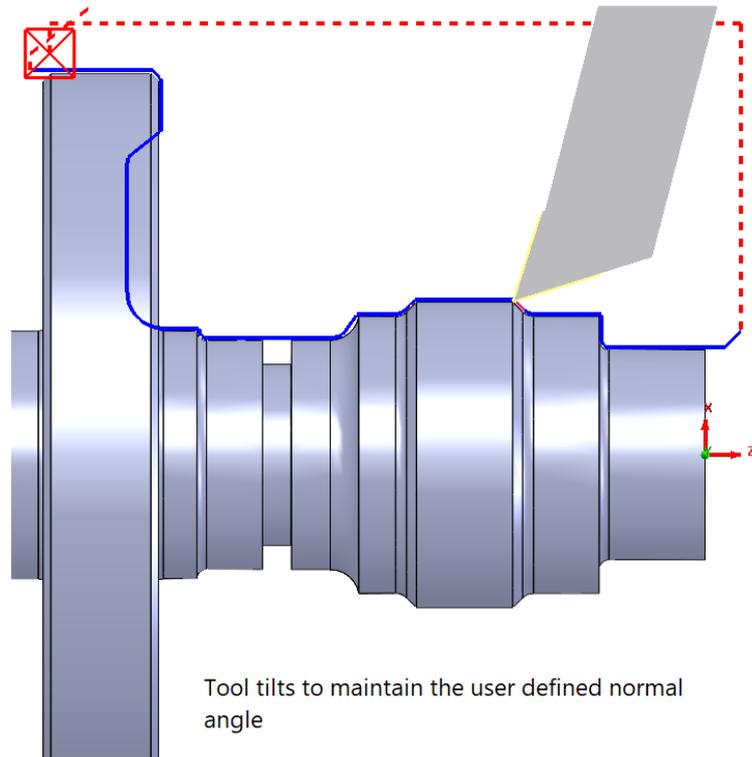
**Illustrative Image 5: Step Through of B Axis Turning toolpath showcasing how Tool Tilts to maintain the user-defined Normal Angle**



Tool tilts to maintain the user defined normal
angle
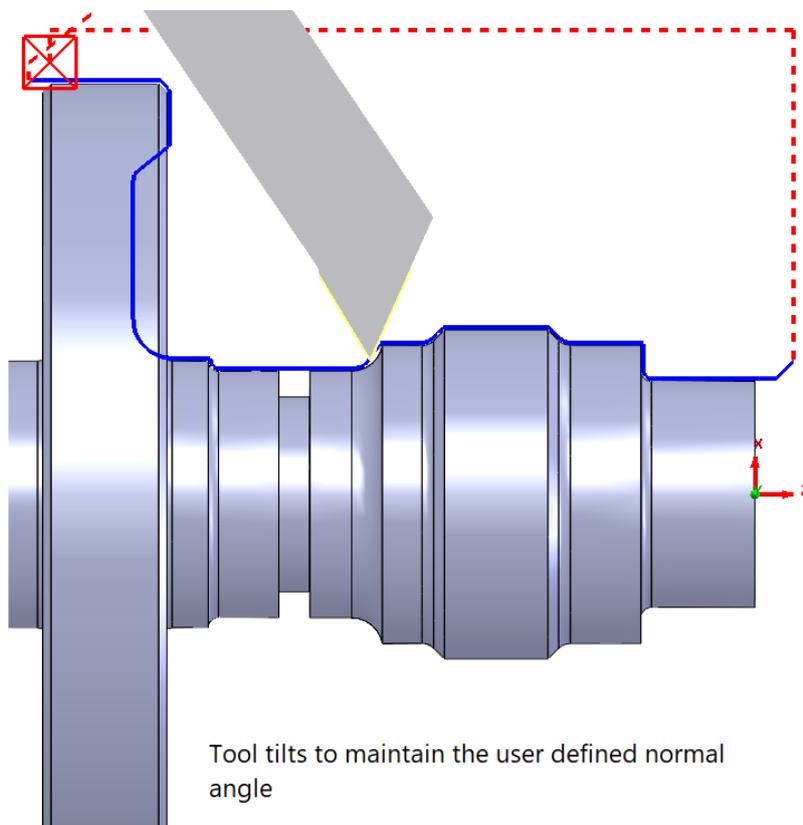
**Illustrative Image 6: Step Through of B Axis Turning toolpath showcasing how Tool Tilts to maintain the user-defined Normal Angle**

# Step 5: Additional Parameters associated with B Axis Turn Finish toolpath

## Holder Clearance

1. Execute the Step through Toolpath command once again and observe the tool at the position shown below.
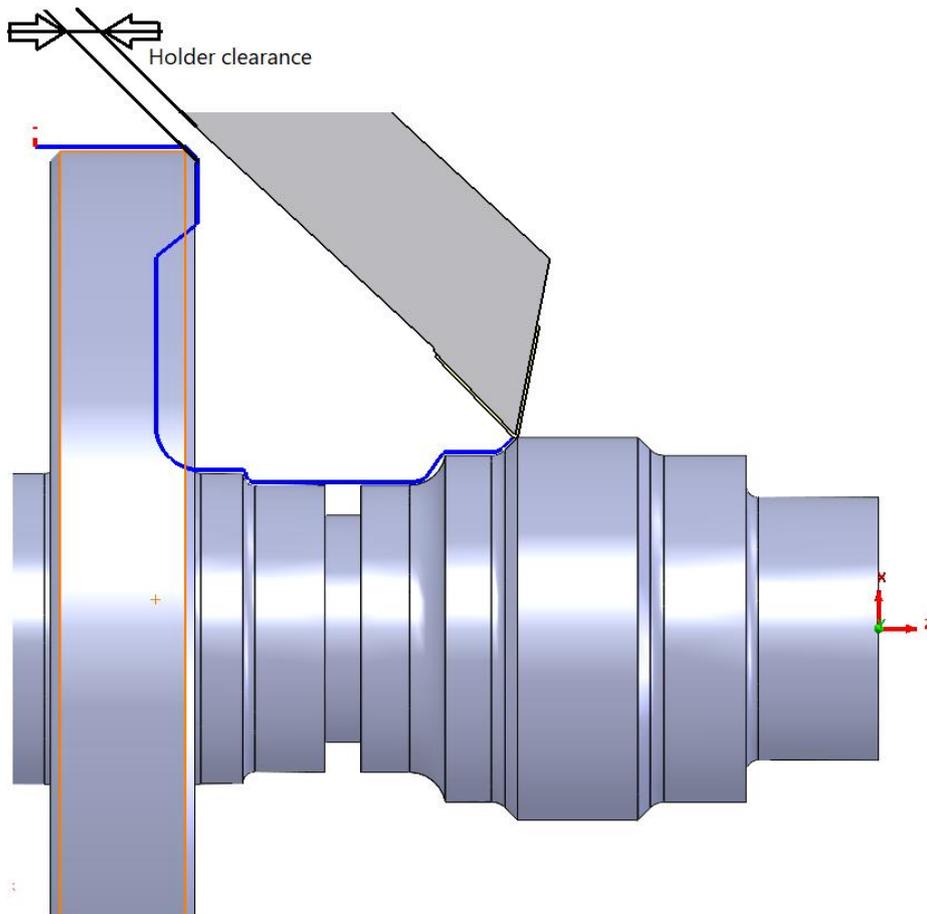


**Illustrative Image 7: Step Through of B Axis Turning toolpath showcasing how Holder stays clear of the part geometry**

2. Observe that the holder stays clear from the part geometry. This is achieved by setting the holder clearance.
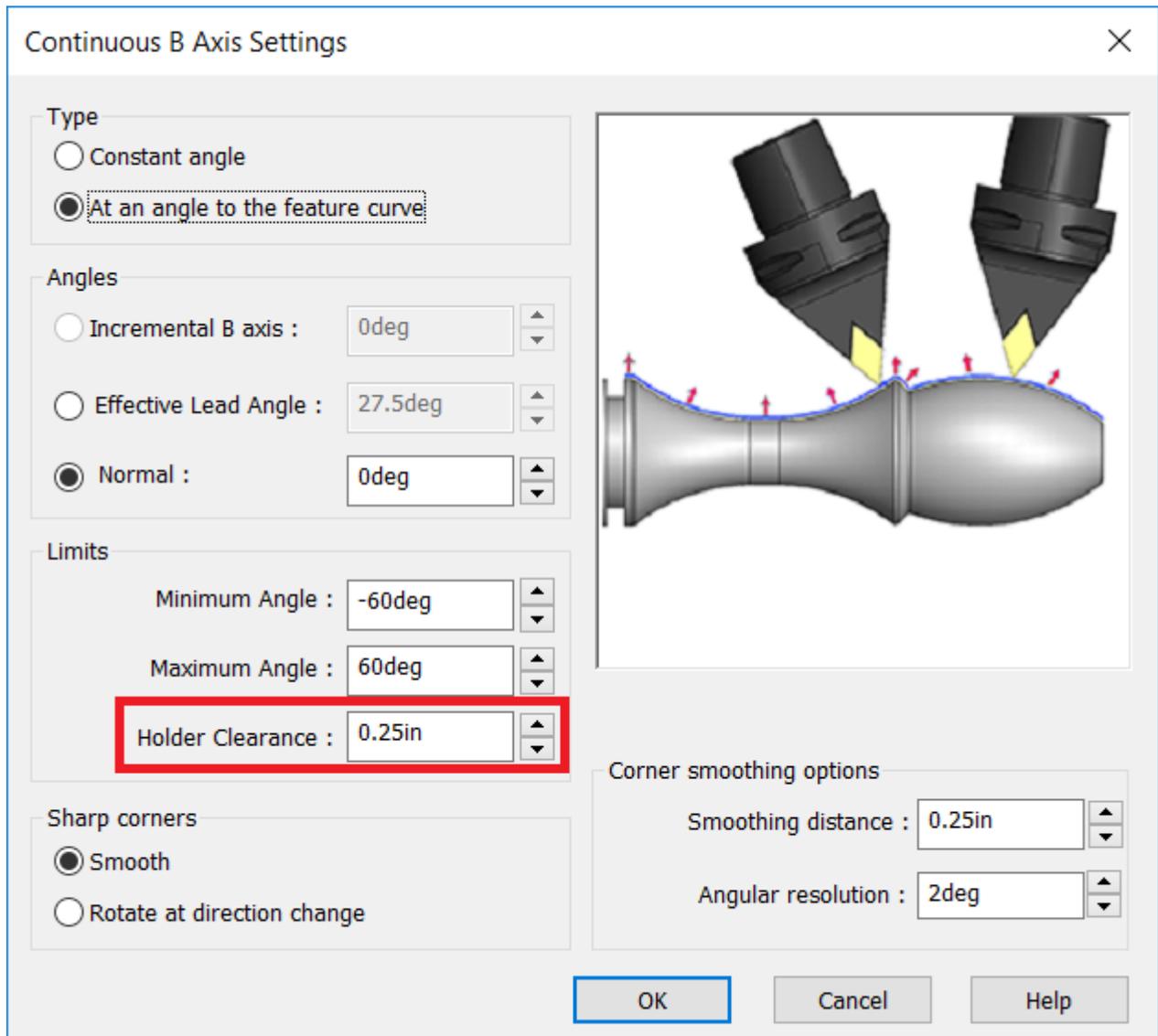
**Holder Clearance parameter in Continuous B Axis Settings Dialog Box**

## How Minimum and Maximum Angle Parameters Affect B Axis Toolpaths

1. Execute the Step Thru Toolpath command  once again for *Turn Finish2* operation. Observe the maximum and minimum rotary positions of the tool.
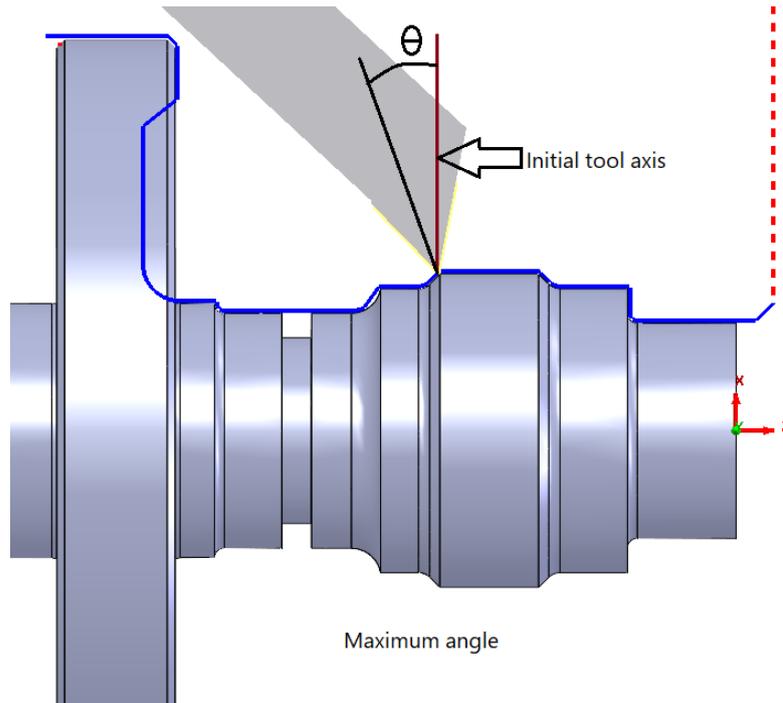
**Illustrative Image 8: Step Through of B Axis Turning toolpath showcasing Maximum Rotary Position of Tool**
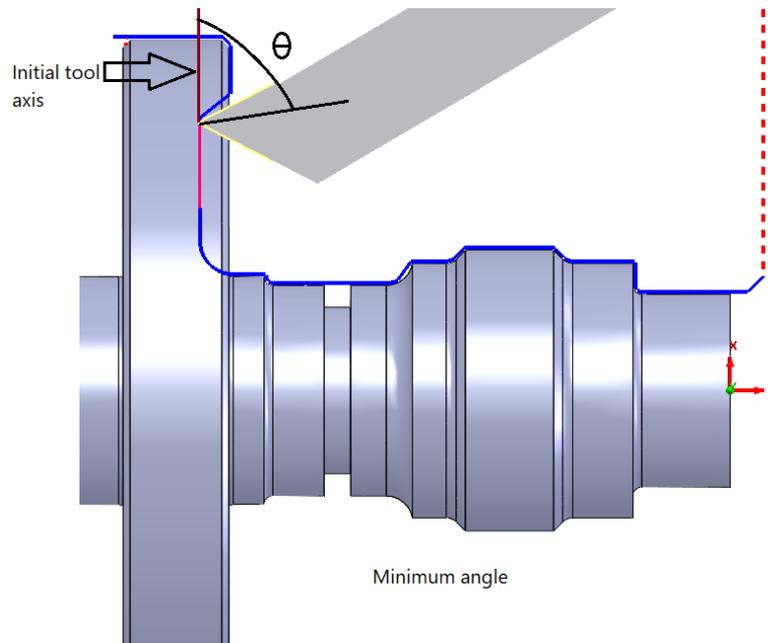


**Illustrative Image 8: Step Through of B Axis Turning toolpath showcasing Maximum Rotary Position of Tool**

2. Double-click on the *Turn Finish2* operation node in the CAMWorks Operation tree. The *Operation Parameters* dialog box will be displayed.

3. Within this dialog box, click on the *Turn Finish* tab. Click on the B Axis Settings button at the bottom of this tab.

4. The *Continuous B Axis Settings* dialog box will be displayed. Within this dialog box:

   i.  Modify the value of the *Minimum Angle* to -30 degrees.

   ii.  Modify the value of the *Maximum Angle* to 30 degrees.

5. Click OK to apply the changes and close the *Continuous B Axis Settings* dialog box.

6. Close the *Operation Parameters* dialog box.

7. Right-click on the *Turn Finish2* operation node in the CAMWorks Operation tree and execute the Generate Toolpath command from the context menu. This action will regenerate the toolpath.

8. Execute the Step Thru Toolpath command ⚏ once again for *Turn Finish2* operation. Observe the new limits of rotary positions for the tool. Also, observe the changes to the toolpath in the undercut area.



Minimum angle= -60 deg
Maximum angle= 60 deg
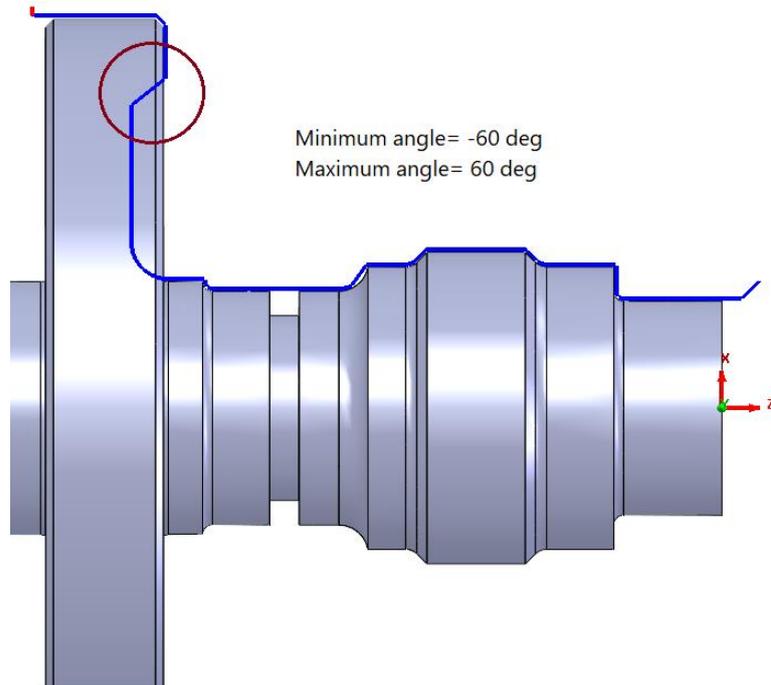
**Illustrative Image 9: Step Through of B Axis Turning toolpath showcasing Maximum & Minimum Rotary Position of the Tool**

Minimum angle= -30 deg
Maximum angle= 30 deg
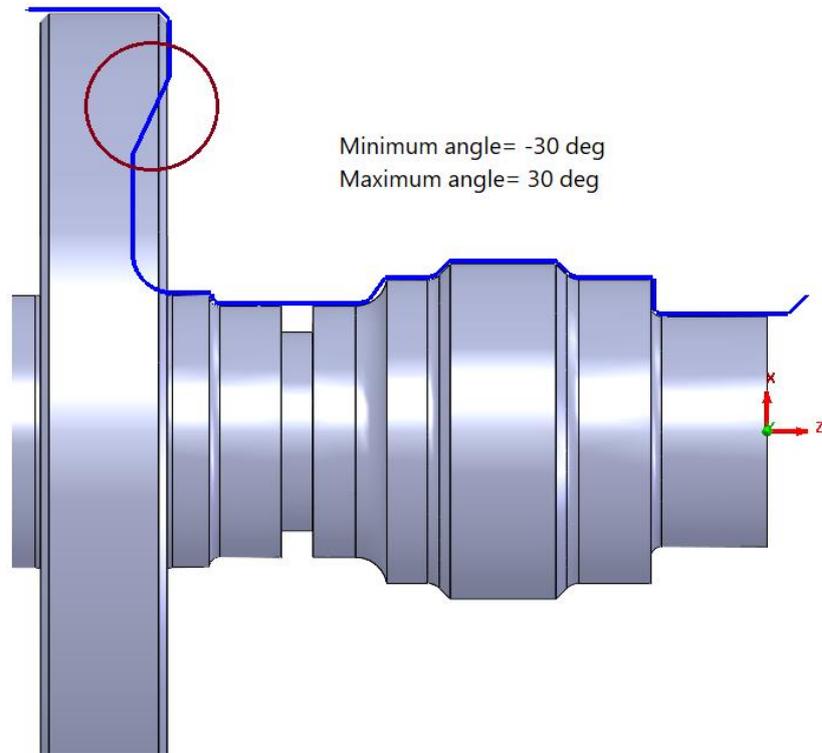
**Illustrative Image 10: Step Through of B Axis Turning toolpath showcasing Maximum & Minimum Rotary Position of the Tool**

9.  The angular limits must be set after considering the machine tool limitations. The angular limits assigned will impact the areas being machined by the current B Axis Turning toolpath.

10. Exit the Step Through dialog box.

11. Save the changes made to the part file and close it.