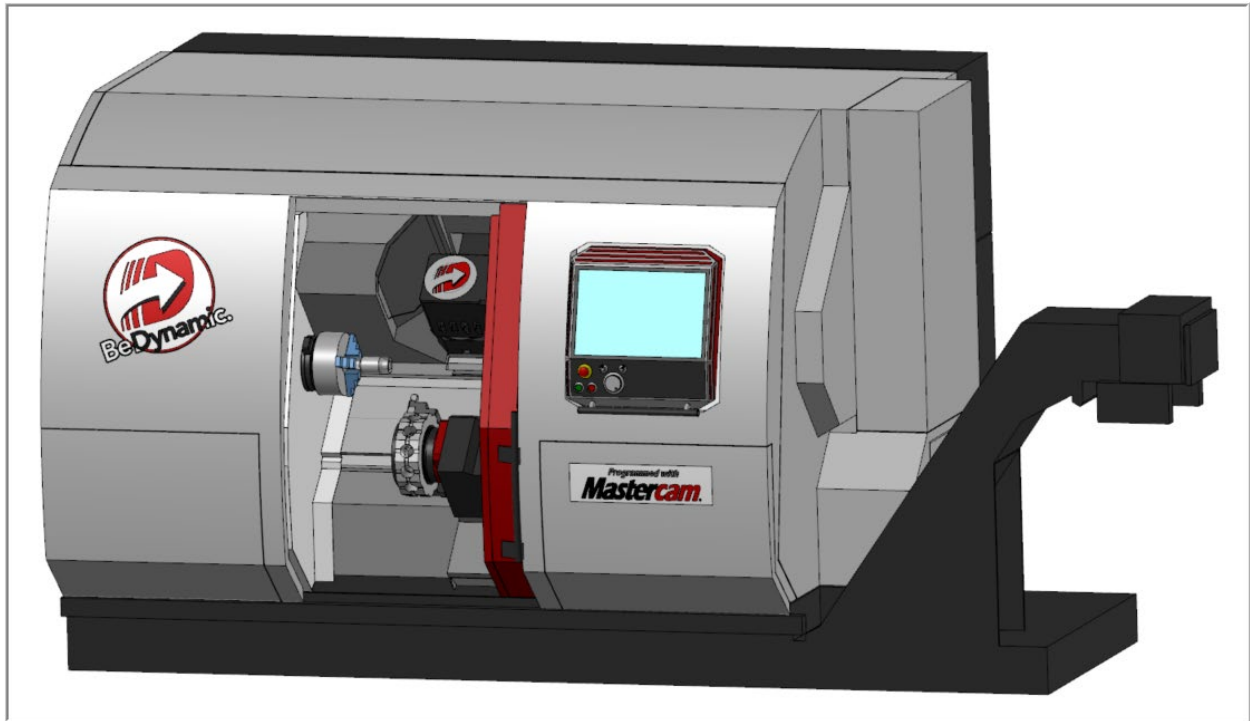


Mastercam 2023

TRAINING

GUIDE



MILL-TURN LESSON-1

Objectives

This lesson will start with the initial setup of Mill-Turn for Mastercam 2023. Following the Mill-Turn setup this lesson will step you through a quick Mill-Turn workflow example with some basic turning on the main and sub spindles. We will use both the lower turret and upper B-axis head for turning and will be using a POCO routine to transfer the stock from the main to sub spindle.

Initial set up of Mill-Turn for MasterCam:

Importing .machine files to correct location.
Add .machine file to Machine Type.

Job setup:

Make adjustments in the Job Setup for Mill-Turn.

Main spindle turning:

Face with lower turret.
OD rough with upper B axis head.
OD finish with lower turret.

POCO (Pick off cut off):

Transfer the part to the sub spindle.

Sub spindle turning:

Face with lower turret.
OD rough with upper B axis head.
OD finish with lower turret.

Syncing:

Syncing ops to create efficient programs and avoid crashes.

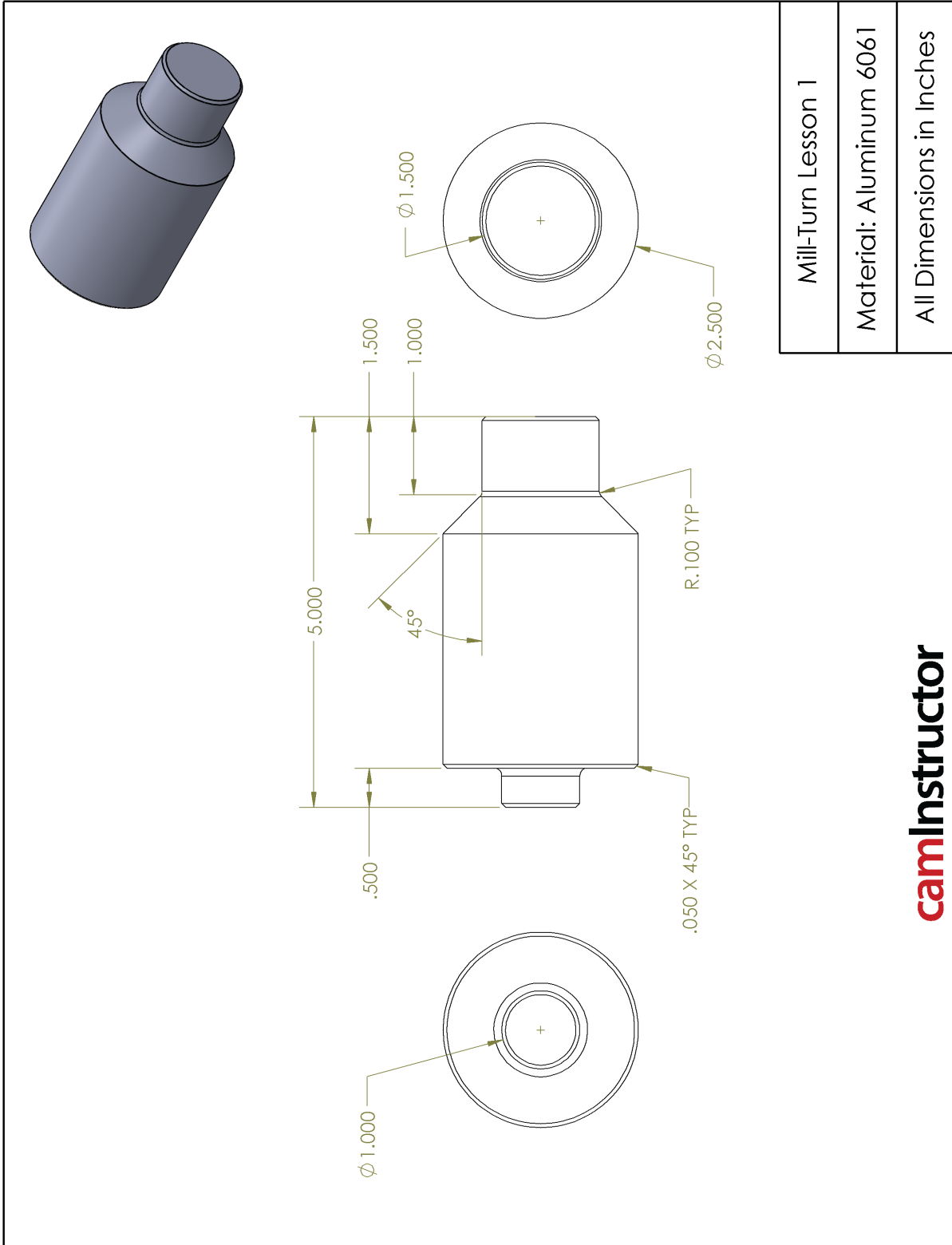
Simulation:

Final verification of the machining process using complete machine verification.

Posting:

Additional settings before posting and view code in dual stream

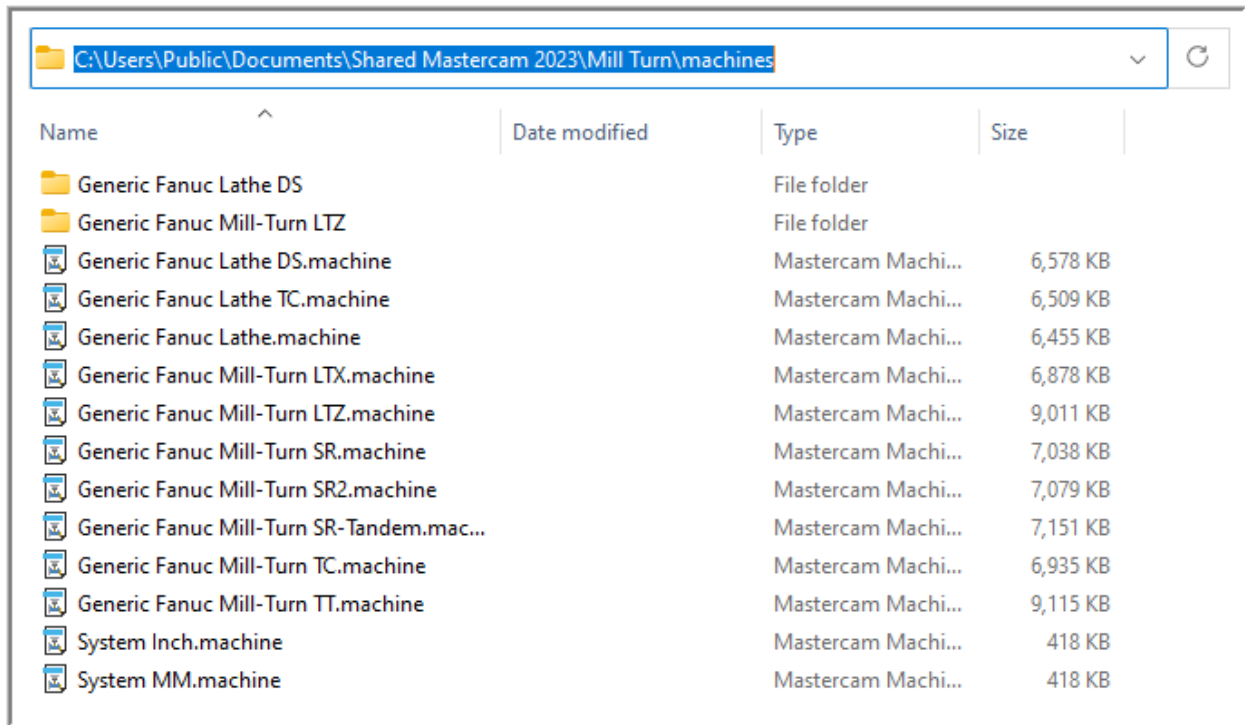
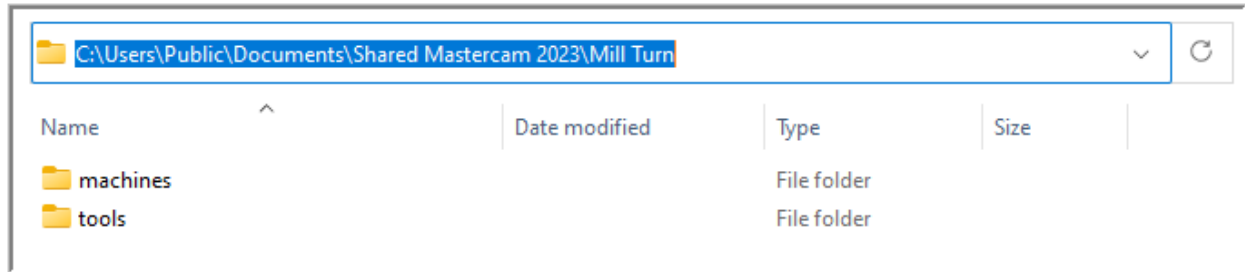
MILL-TURN LESSON-1 DRAWING



INSTALLING A MACHINE FOR MILL-TURN

☞ The **Generic Fanuc Mill-Turn LTZ** will be used in this lesson. You can use another suitable machine if desired.

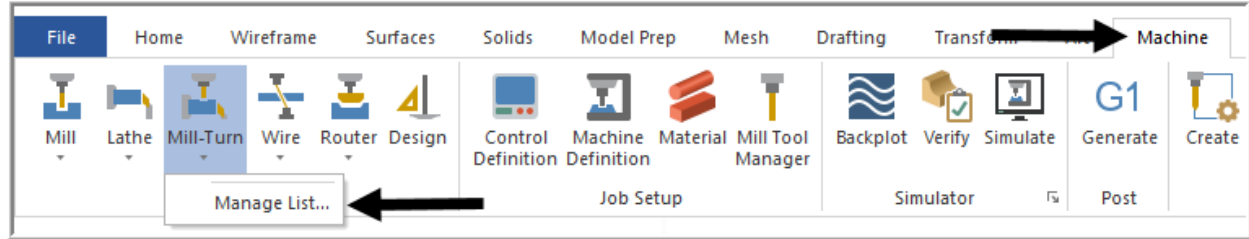
1. Copy .machine file/files into the **\\shared Mastercam 2023\Mill Turn\machines** folder if needed. Mastercam 2023 standard installation should include .machine files shown below.




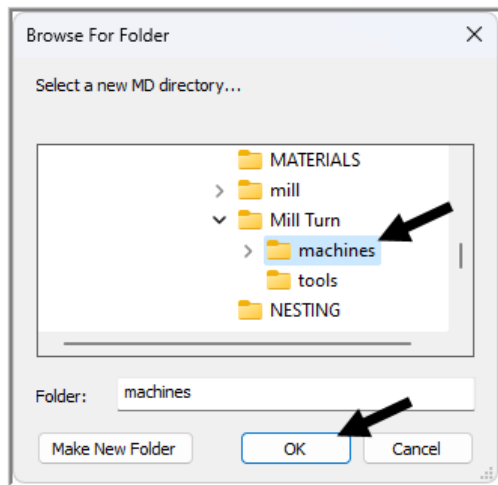
ADDING .MACHINE FILE

☞ For these lessons we will be using the Generic Fanuc Mill-Turn LTZ machine. The steps here will be the same no matter what machine you are using.

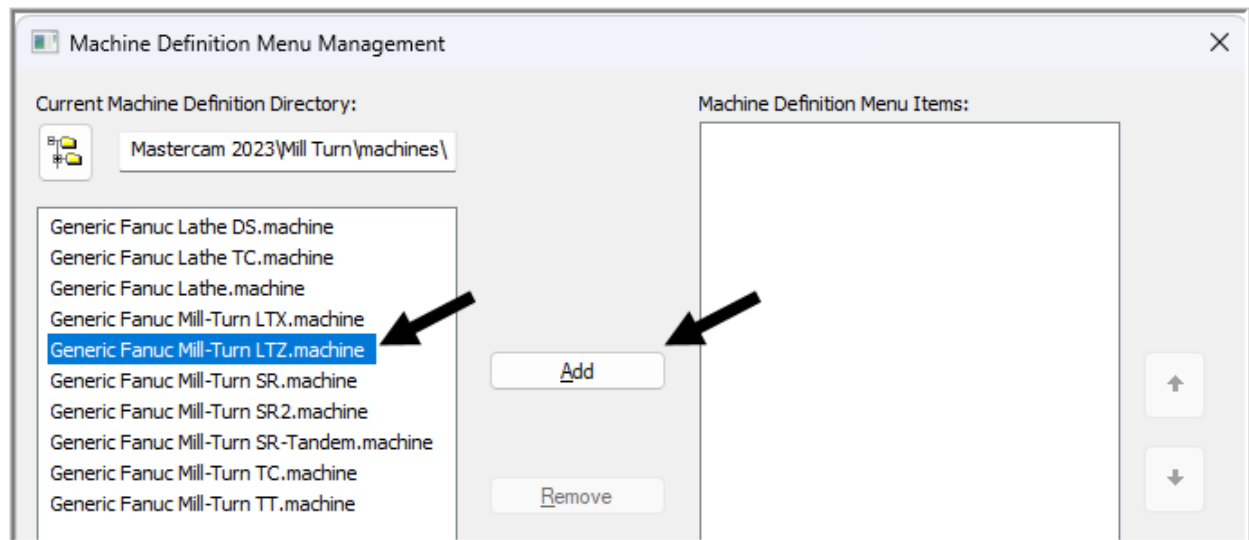
1. Open Mastercam and select **Machine > Mill-Turn > Manage list**



2. Click the **folder** button  in the top left corner and navigate to the **\\shared Mastercam 2023\Mill Turn\machines** folder if you do not see the Generic Fanuc Mill-Turn LTZ machine on the list.



3. Select the machine file and click **Add**.



4. Click **OK**. 

MILL-TURN LESSON-1- THE PROCESS

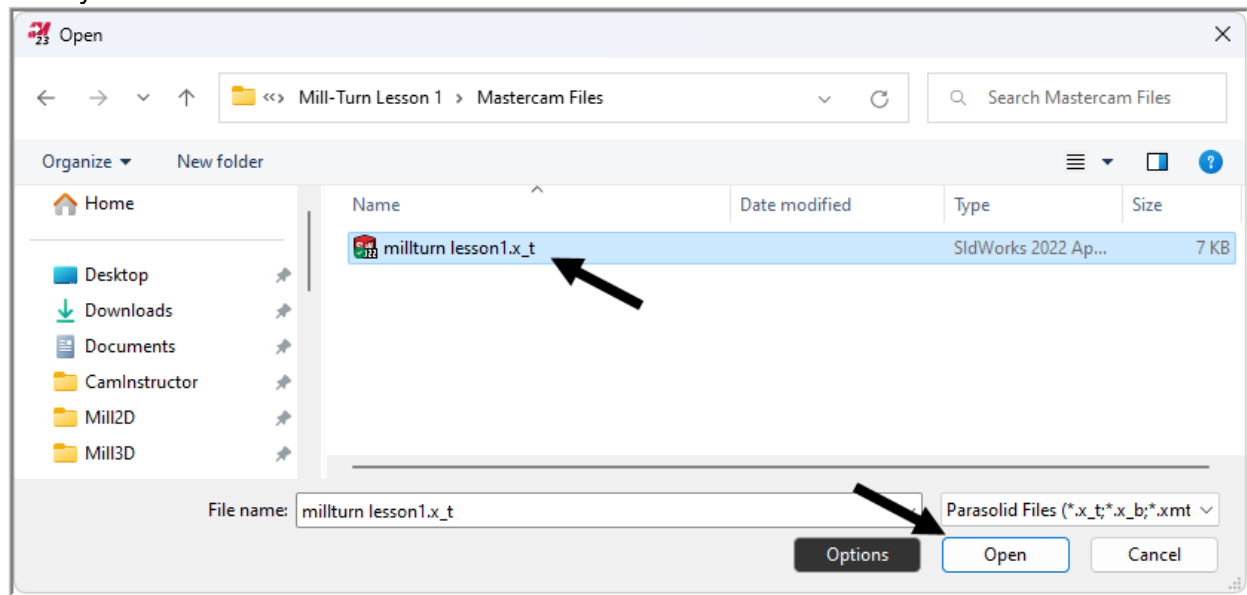
- TASK 1:** Import the solid model and select the machine type
- TASK 2:** Job setup
- TASK 3:** Main spindle turning
- TASK 4:** POCO (**P**ick **O**ff **C**ut **O**ff)
- TASK 5:** Sub spindle turning
- TASK 6:** Machine syncing
- TASK 7:** Machine simulation
- TASK 8:** Posting code

TASK 1:

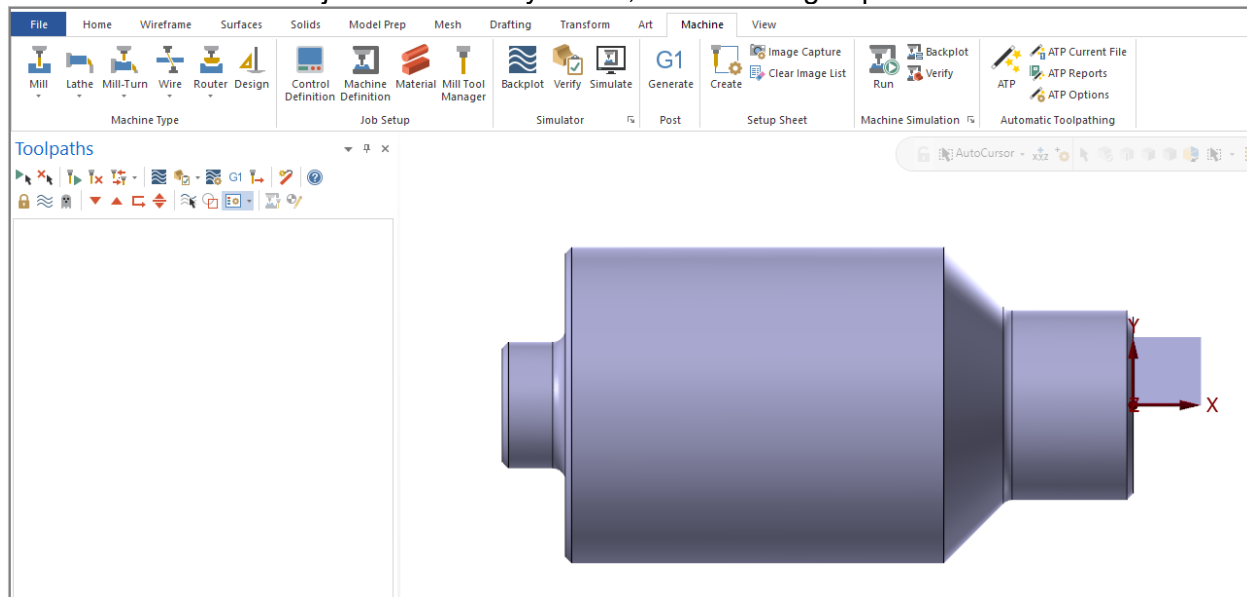
IMPORT THE SOLID MODEL AND SELECT MACHINE TYPE

☞ We will start Mastercam in a **blank document** then open our solid model followed by selecting our Mill-Turn machine from the Machine Type menu.

1. Launch Mastercam.
2. Open the solid for Lesson 1. - **millturn lesson1.x_t**
If you have the online course download this file from the website.

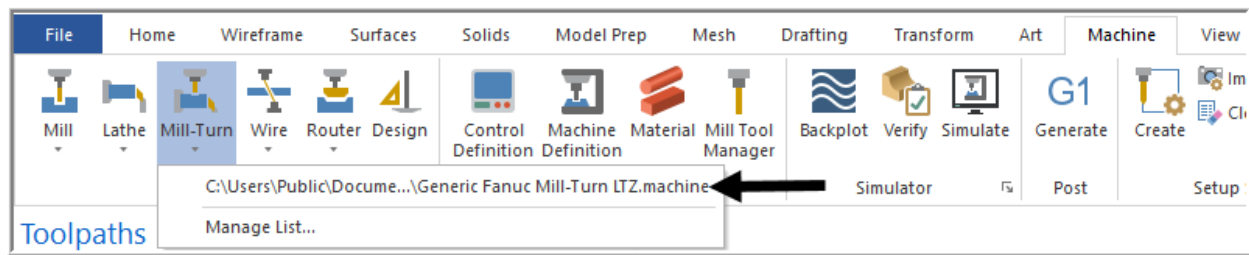


Note: You should have just the solid in your file, no machine group.

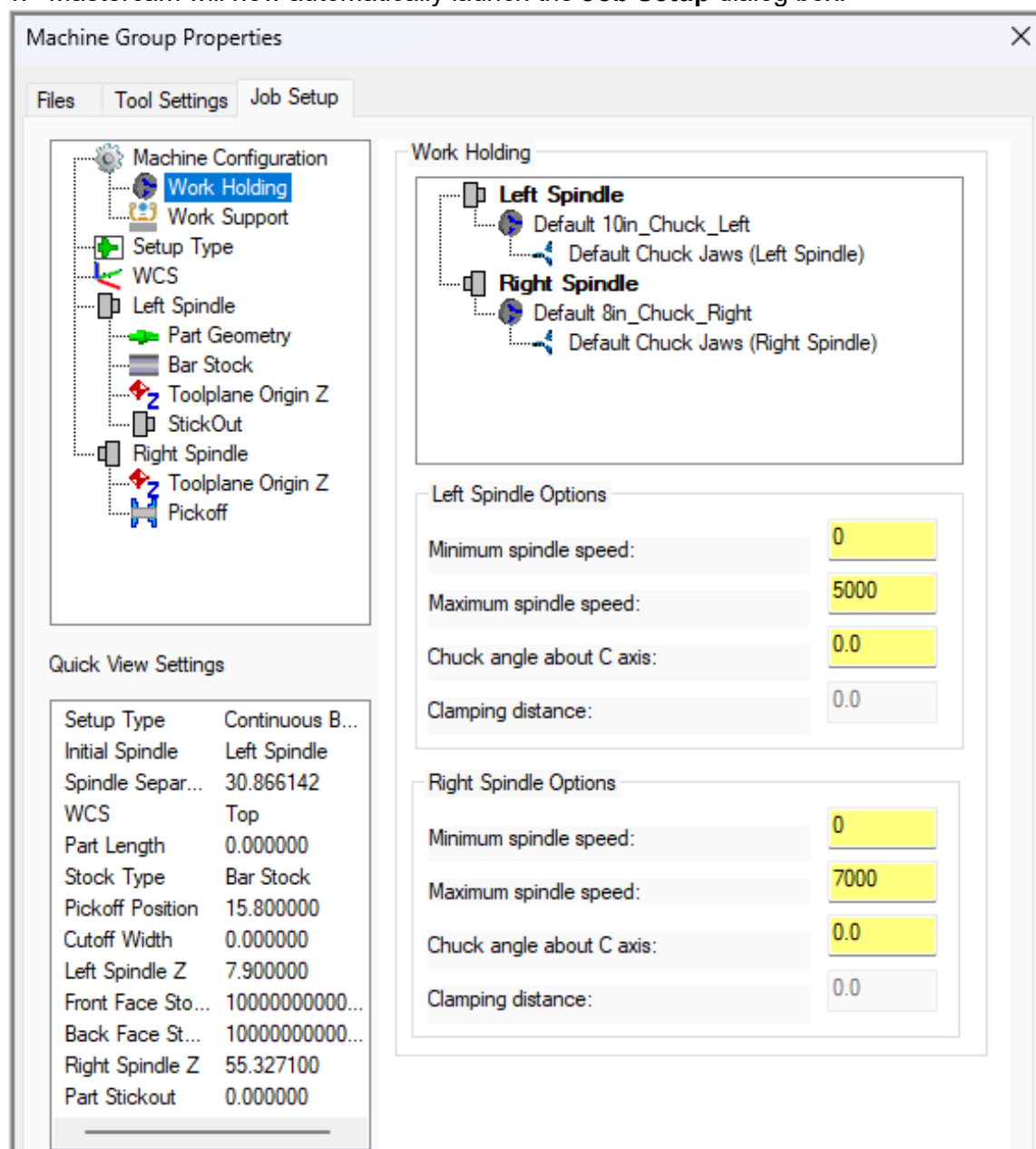


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3. Select the Mill-Turn machine. **Machine > Mill-Turn > Generic Fanuc Mill-Turn LTZ.machine**. Mastercam will now launch Mastercam Code Expert which we will be using later.



- If **Code Expert** opens, this can be minimized for now.
4. Mastercam will now automatically launch the **Job Setup** dialog box.



TASK 2: JOB SETUP

➤ In this task you will work through the Job Setup dialog.

To simplify job setup, Mastercam Mill-Turn uses a top to bottom series of steps. The order of these steps serves two main purposes.

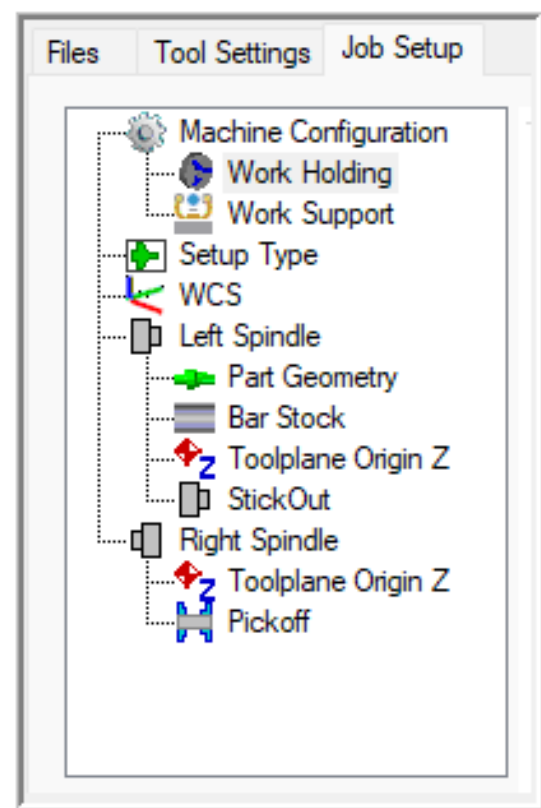
1. Makes it easier to for the end user and guide them through the process.
2. Help Mill-Turn automate the display of appropriate and logical parameters based on previous settings.

This interface workflow reduces the chance that a user will enter a parameter that does not make sense and limits instances of error.

The general Job Setup workflow:

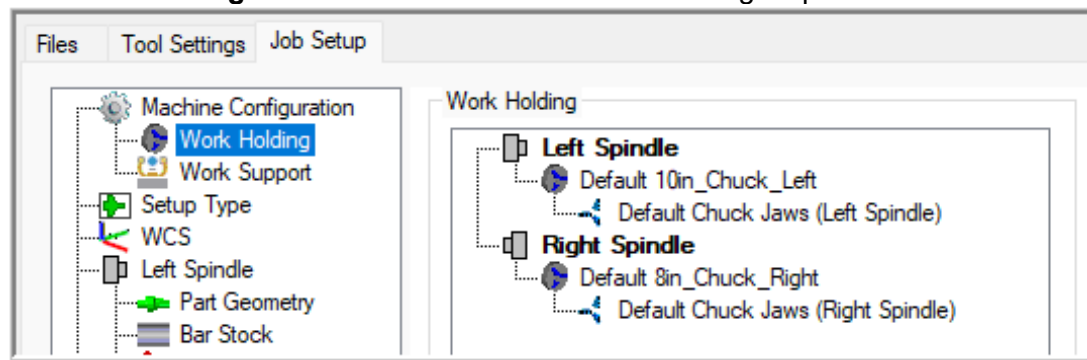
- Work Holding – Select chucks, jaws, and collets
- Work Support – Select steady rest when applicable
- Setup Type – Assign the spindle the work will start in and part handling
- WCS – Sets the Work Coordinate System
- Left Spindle
 - Part Geometry – Define your part
 - Bar Stock – Define the type of stock
 - Toolplane Origin Z – Set toolplane origin based on part geometry
 - Stick Out – Define bar stock projection from chuck face or jaws
- Right Spindle
 - Toolplane Origin Z – Set toolplane origin based on part geometry
- Pickoff – Set pickoff position and tool for cut off

Note: Left spindle and right spindle order are determined by the initial spindle selection under Setup Type.

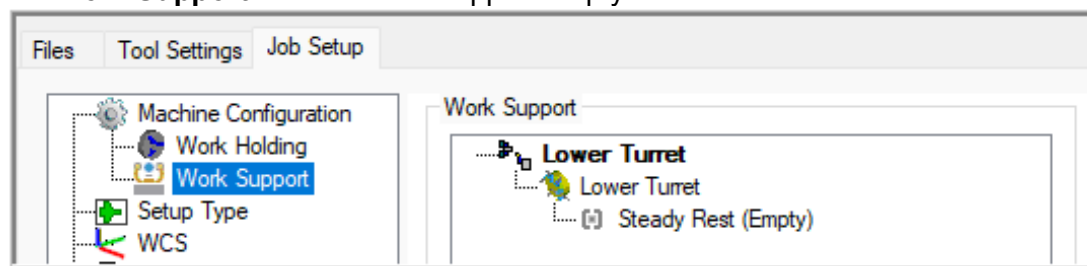


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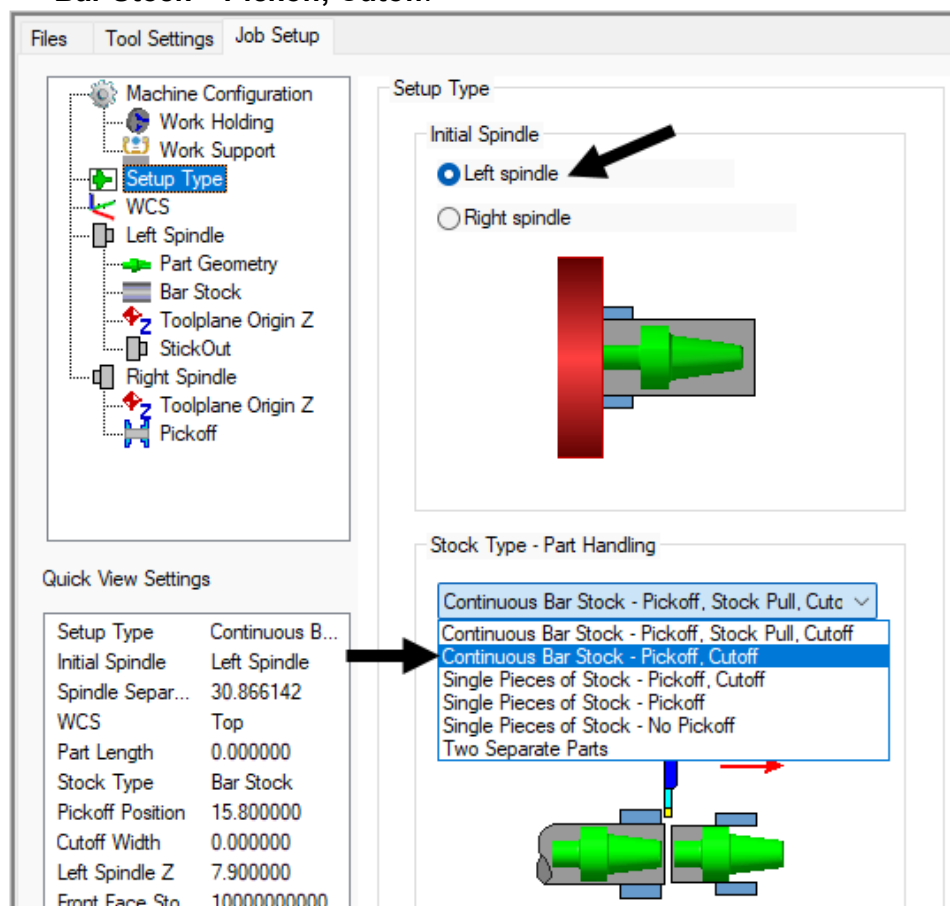
1. **Work Holding** – Use the default values for left and right spindle chucks.



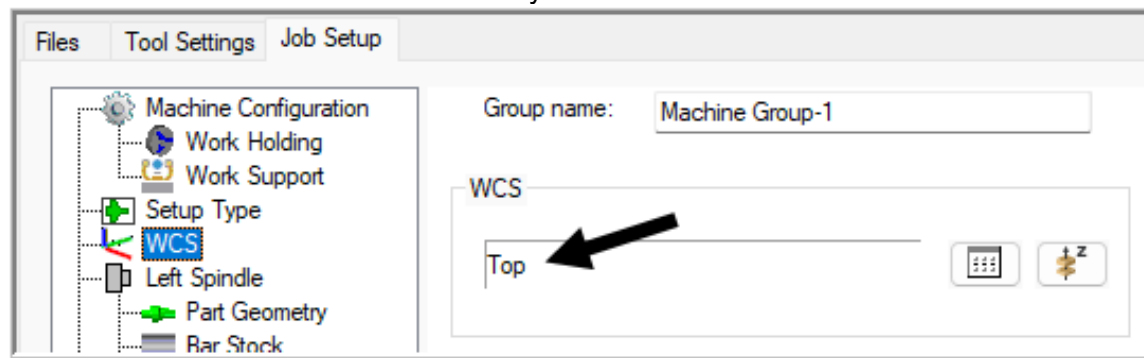
2. **Work Support** – Leave work support empty



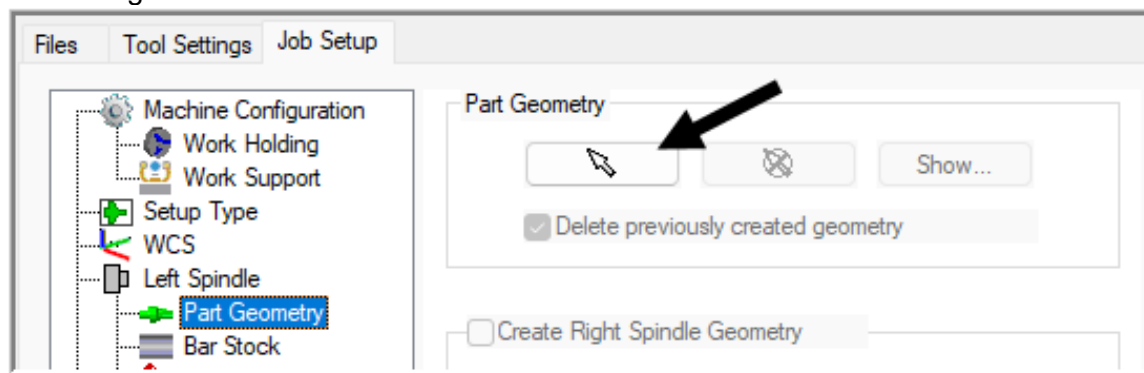
3. **Setup Type** – Initial Spindle set to **Left** and Stock Type – Part Handling set to **Continuous Bar Stock – Pickoff, Cutoff**.



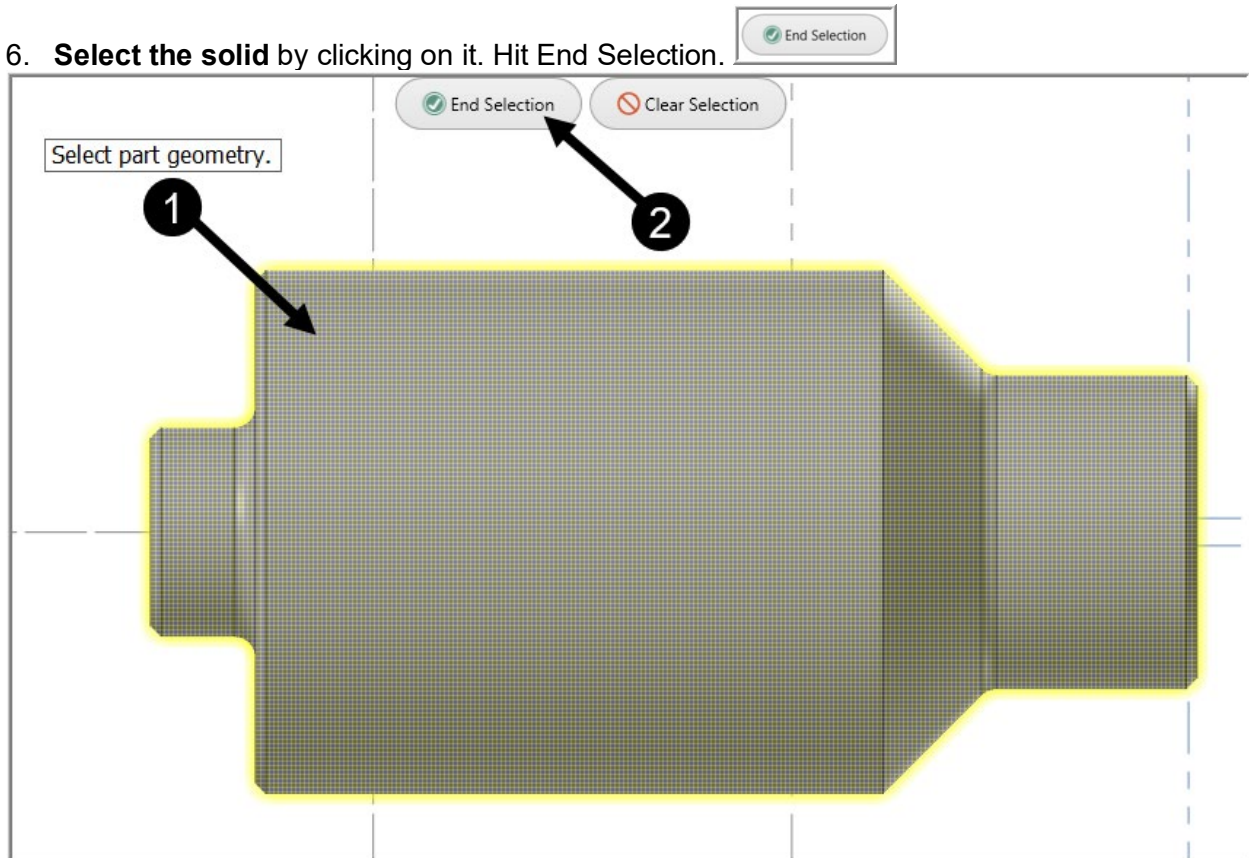
4. **WCS** - Ensure the work coordinate system is set to **TOP**



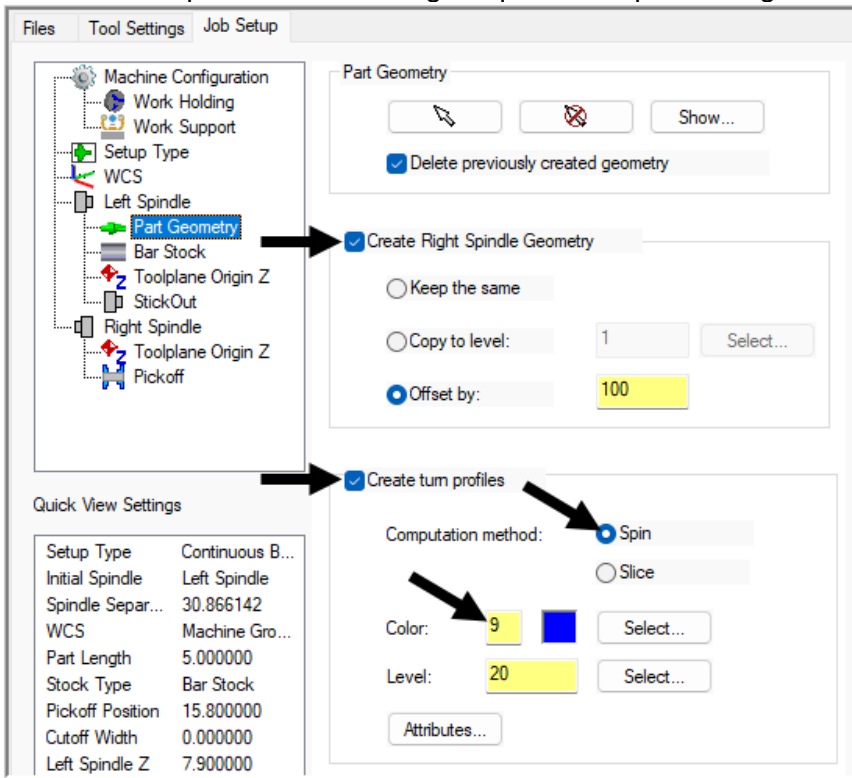
5. **Part Geometry** – Select your part model. Mastercam will pull dimensions from the model for other Job Setup settings. The model will also be used in simulation and in the Sync Manager.



6. **Select the solid** by clicking on it. Hit End Selection.



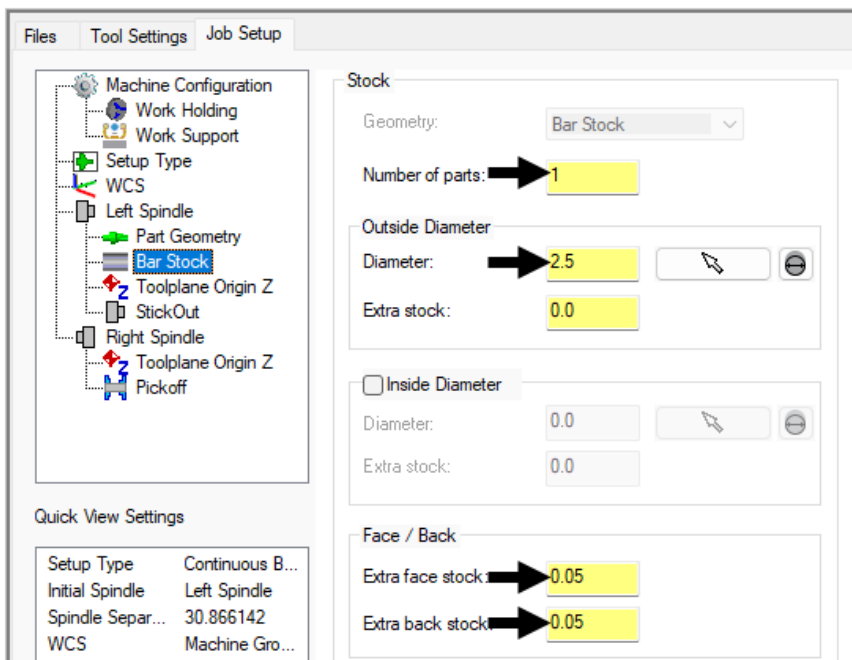
7. **Enable** the options to **Create Right Spindle Geometry** and **Create turn profiles**. For the geometry, select **Offset by** and enter **100**. This will put this model on the same level as the original model +100. So, if the original is on level 1 the created model will be on 101. For the **turn profile**, set computation method to **Spin** and set the **Level to 20**. Changing the color for the turn profile to something unique will help to distinguish it later.



Spin: The part geometry is rotated around an axis. The profile is generated from the furthest extents of the spin.

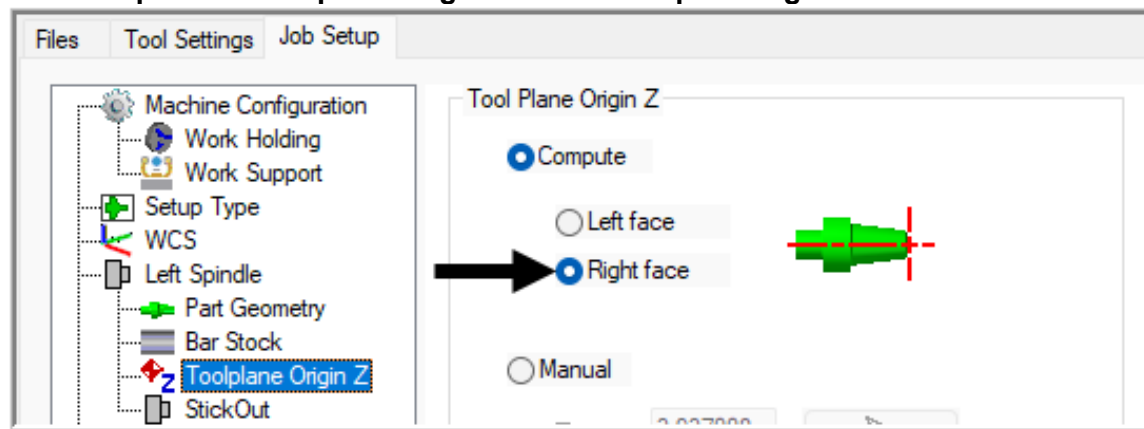
Slice: The part geometry is sliced in the lathe ZX (WCS XY) plane. The profile is limited to what the slice encounters and may not include the full extents of the part geometry.

8. **Bar Stock** – You can set your **stock type, number of parts, outside diameter, inside diameter** and amount of **extra stock** here. Set the **number of parts to 1**. Mastercam will read the OD from the model and round up to the next closest stock size. We are not going to turn the **OD** so set it back to **2.50**. Add **0.05 extra stock** to the **face** and to the **back**.

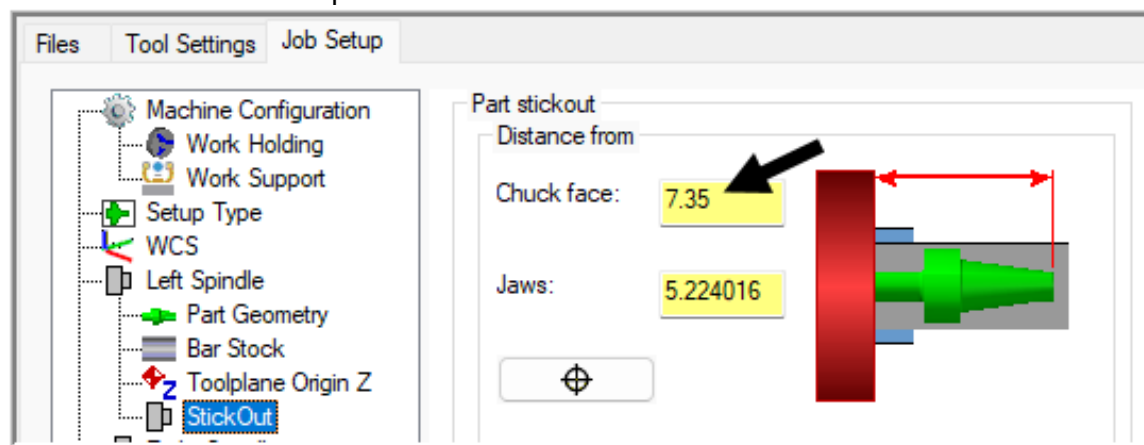


Geometry selection is based on previous choices made in Job Setup. Since we have selected continuous bar stock – pickoff, cutoff in setup type we are limited to bar stock geometry.

9. Left Spindle – Toolplane origin Z. Set to Compute>Right Face.



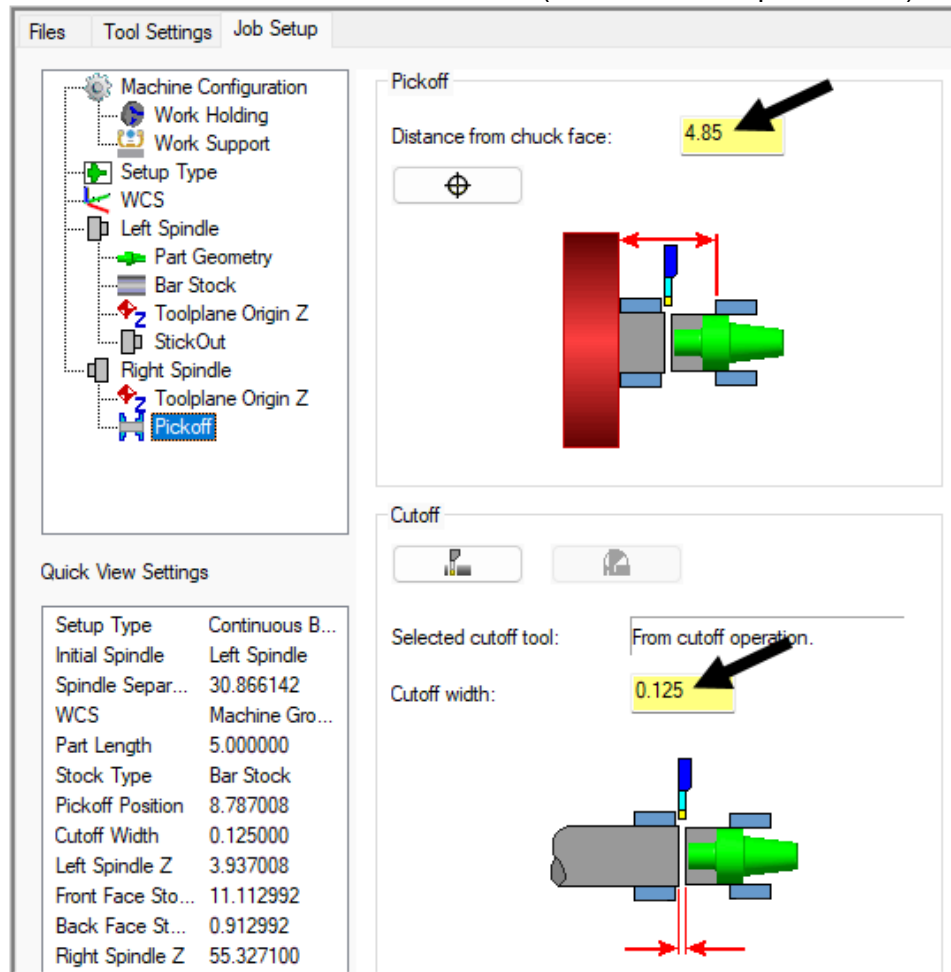
10. **Stickout** is calculated from the face of the chuck or jaw. We want the entire part outside of the chuck so we can turn and part off in one setup (no additional pulls). Part length is 5.00, 0.05 stock on front and back face, 0.125 part off blade, 1.750 jaw length and 0.375 clearance results in a part Stickout of **7.35**. Enter this value in the **Chuck Face:** box.



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11. **Pickoff** – We need to calculate our pick off point. The diameter on the left is 0.50 long, plus the chamfer of 0.050 so we need to be sure to stay clear of that. We should be safe grabbing the part close to the mid-point. The left face is at 7.35 (our previous setting) and if we subtract half the length of our part ($7.35 - (5.0/2) = 4.85$). Enter this value in the **Distance from chuck face**.

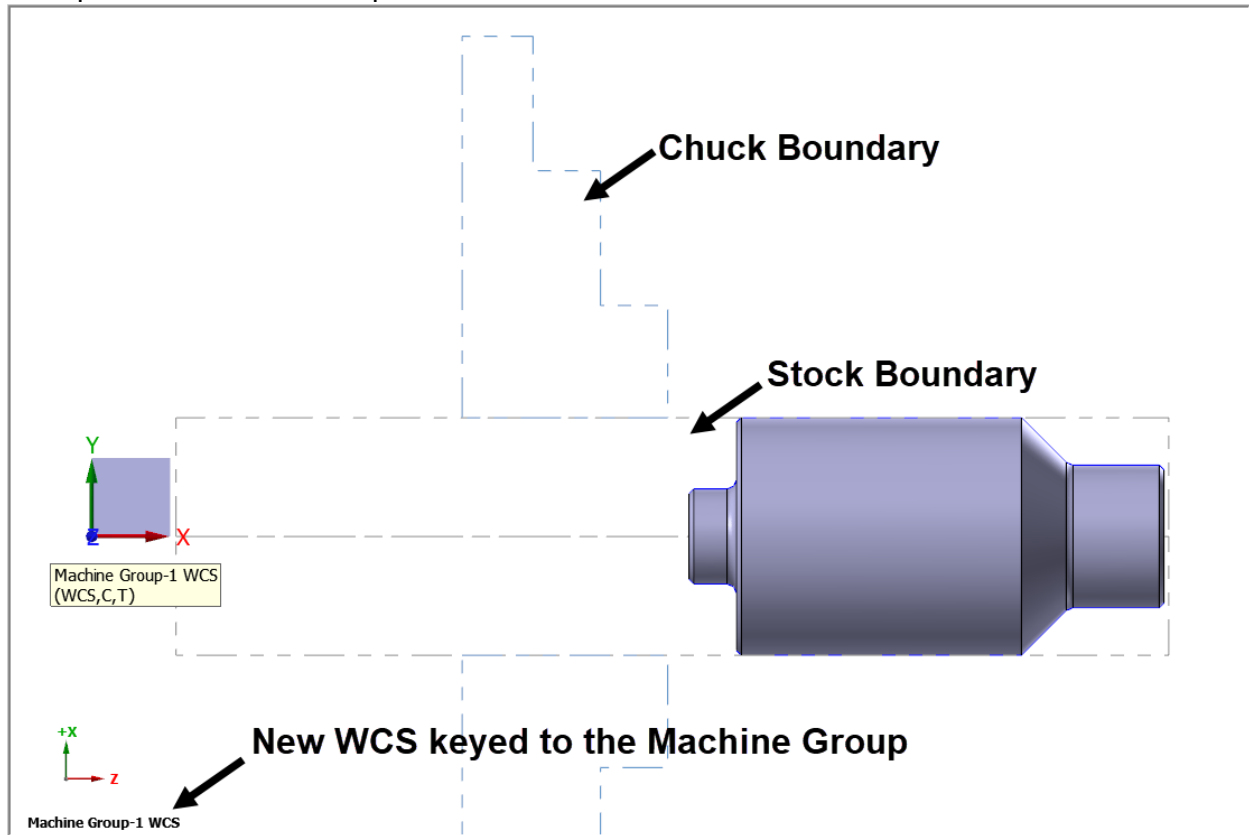
Cutoff – set the cutoff width to 0.125 (the width of our part off tool).



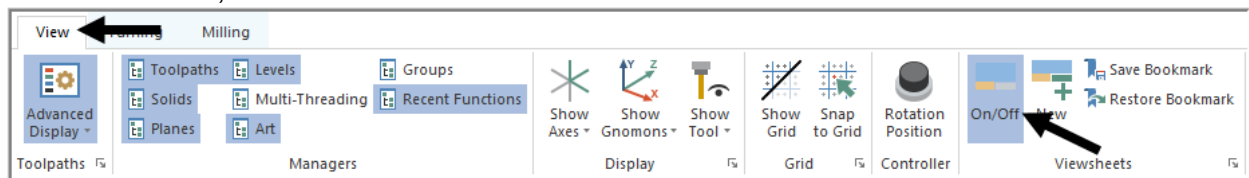
12. Click **Ok** to complete the Job Setup.



13. **Review of Job Setup Results.** Look at what Mastercam has done so far because of the Job Setup inputs. Mastercam creates a **new WCS** which is a copy of WCS-Top and has the origin set at machine zero as defined in your machine setup. You can also see **chuck** and **stock boundaries** on **both spindles** as well as the new solid. These are generated using inputs from the Job Setup.

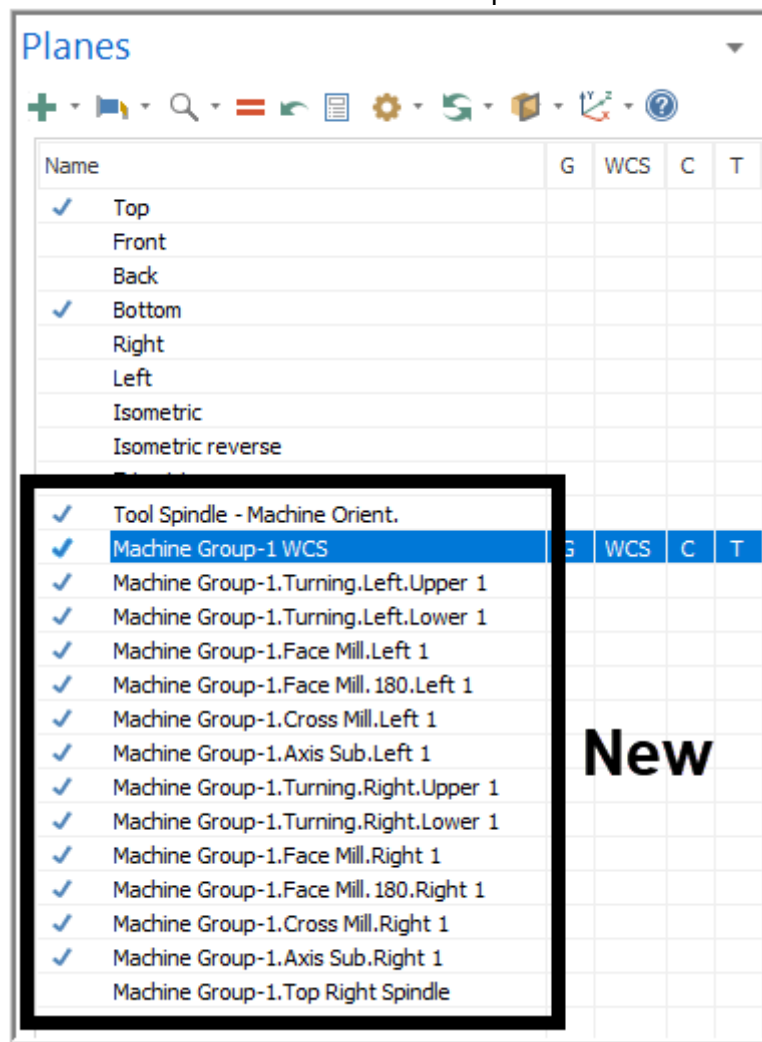


14. Mastercam will also **create view sheets** for each spindle. You may need to turn viewsheets on. To do so, **View > Viewsheets > On/Off**

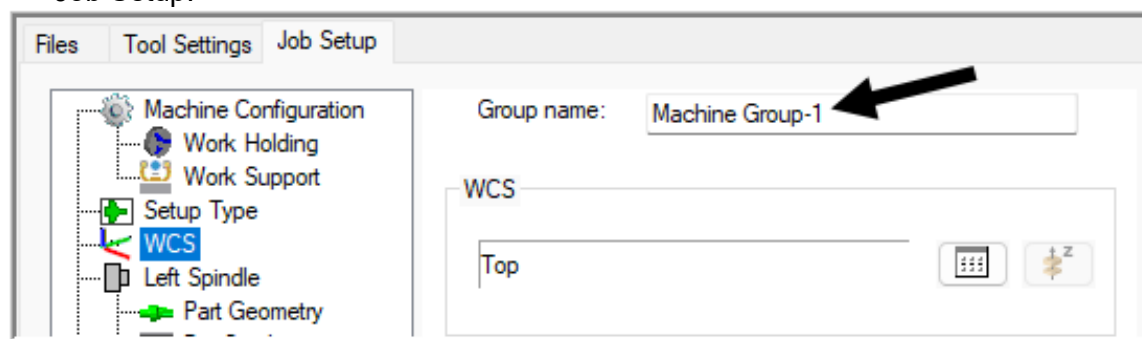


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15. Mastercam also **creates planes** that relate to standard programming orientations for both the main (left) and sub (right) spindles. The origins of these planes are keyed to the locations selected in the Job Setup.



16. The **names** of the views, WCS and Viewsheets are **keyed** to the **Group name** entered in Job Setup.

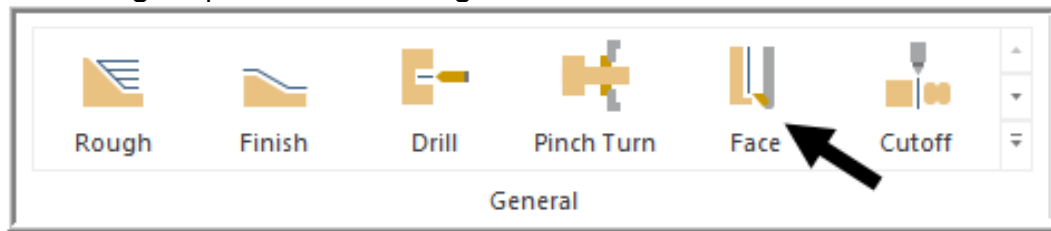


17. **Save** your file as **MillTurnLesson1**. 

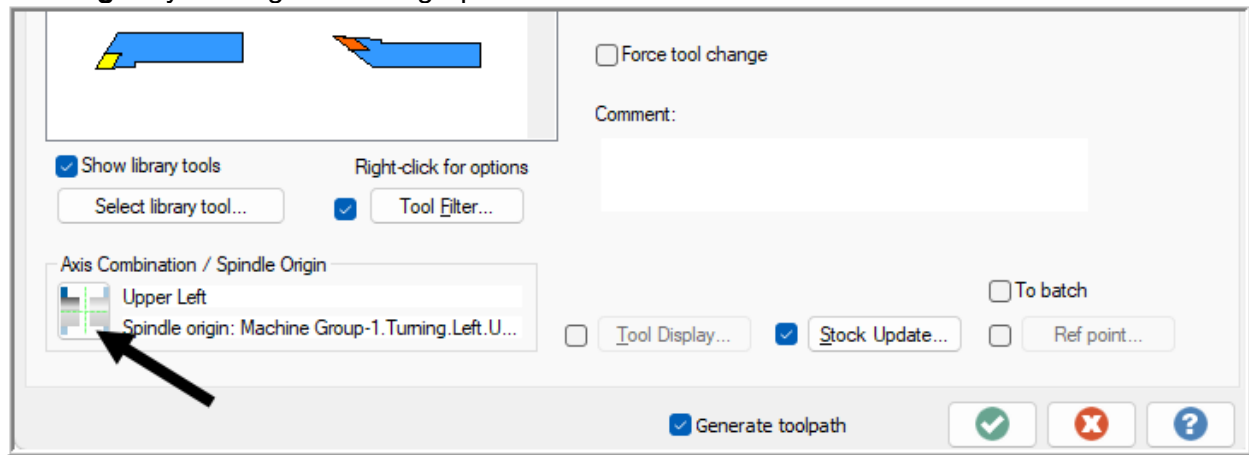
TASK 3: MAIN SPINDLE TURNING

☞ In this task you will face the part and turn the OD profile in the main (left) spindle.

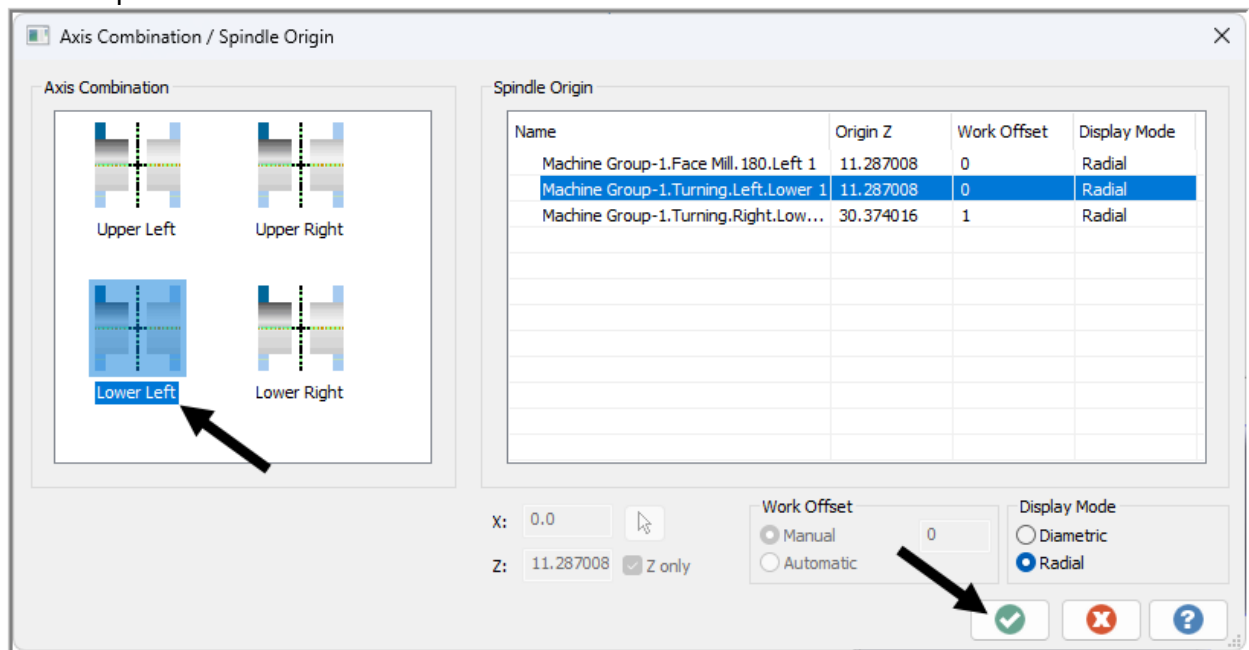
1. Facing the part. Select **Turning > Face**



2. When the **Lathe Face Properties** window opens, select **Axis Combination / Spindle Origin** by clicking the small graphic.

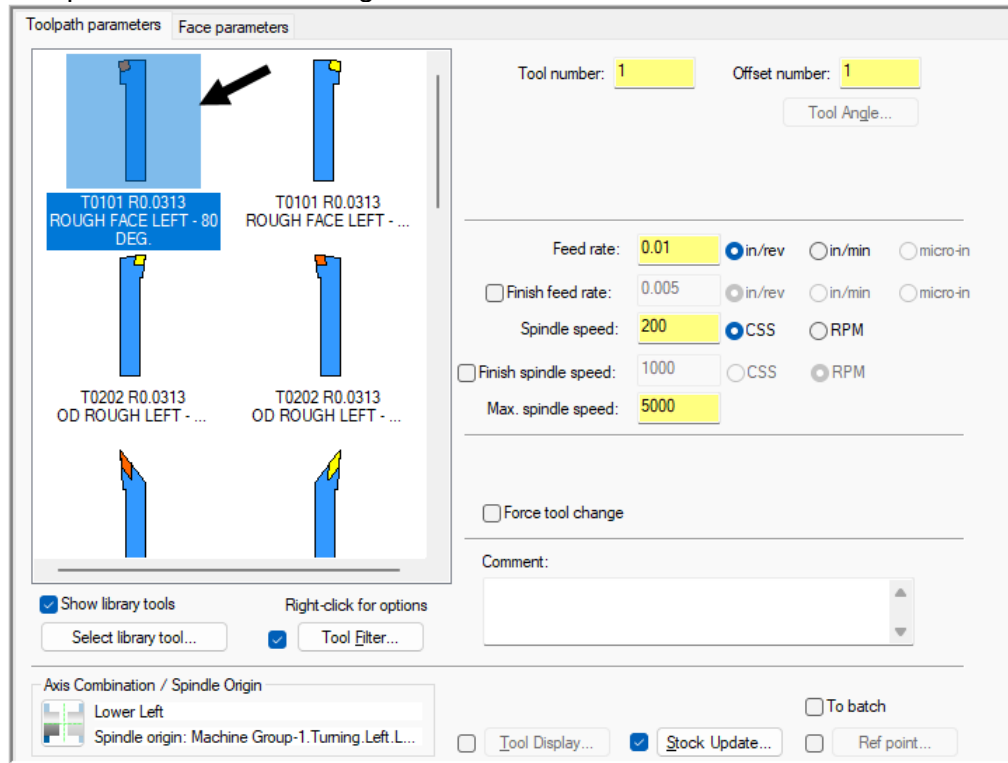


3. This will open the Axis Combination / Spindle Origin window. **Select Lower Left** as we will be using the lower turret to turn on the main (left) spindle. Then hit the **green checkmark** to accept.



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- On the **Lathe Face Properties** window choose **T0101**. We will not spend time adjusting speeds and feeds. Using defaults will suffice for these lessons.

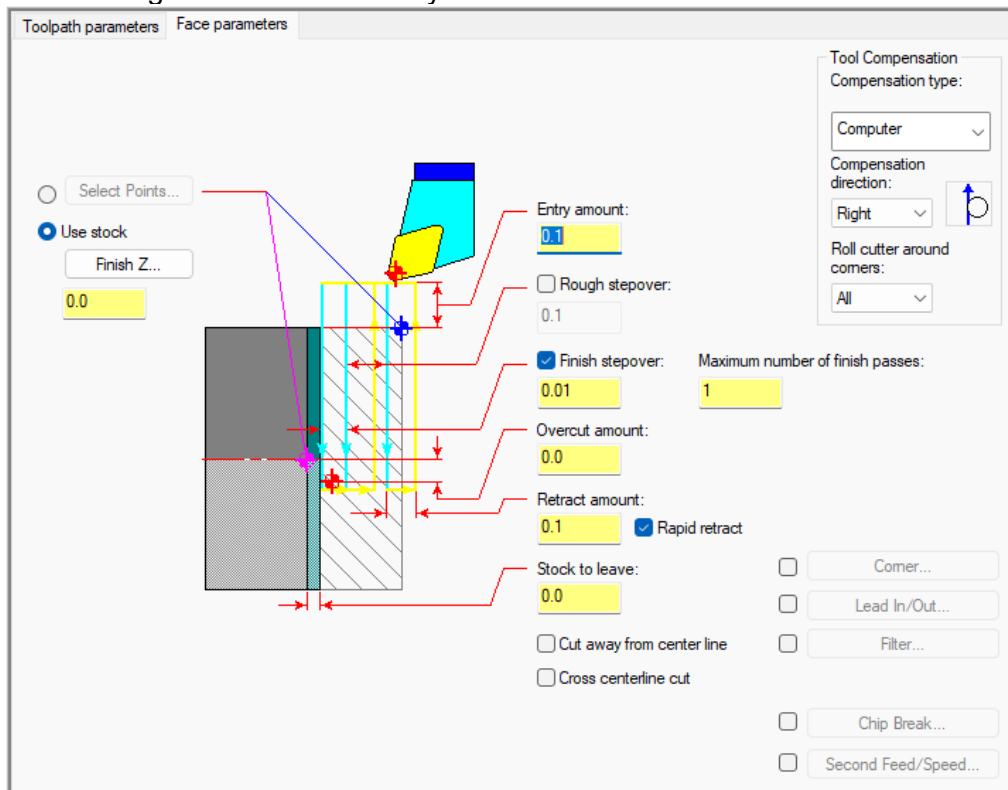


Insert colour

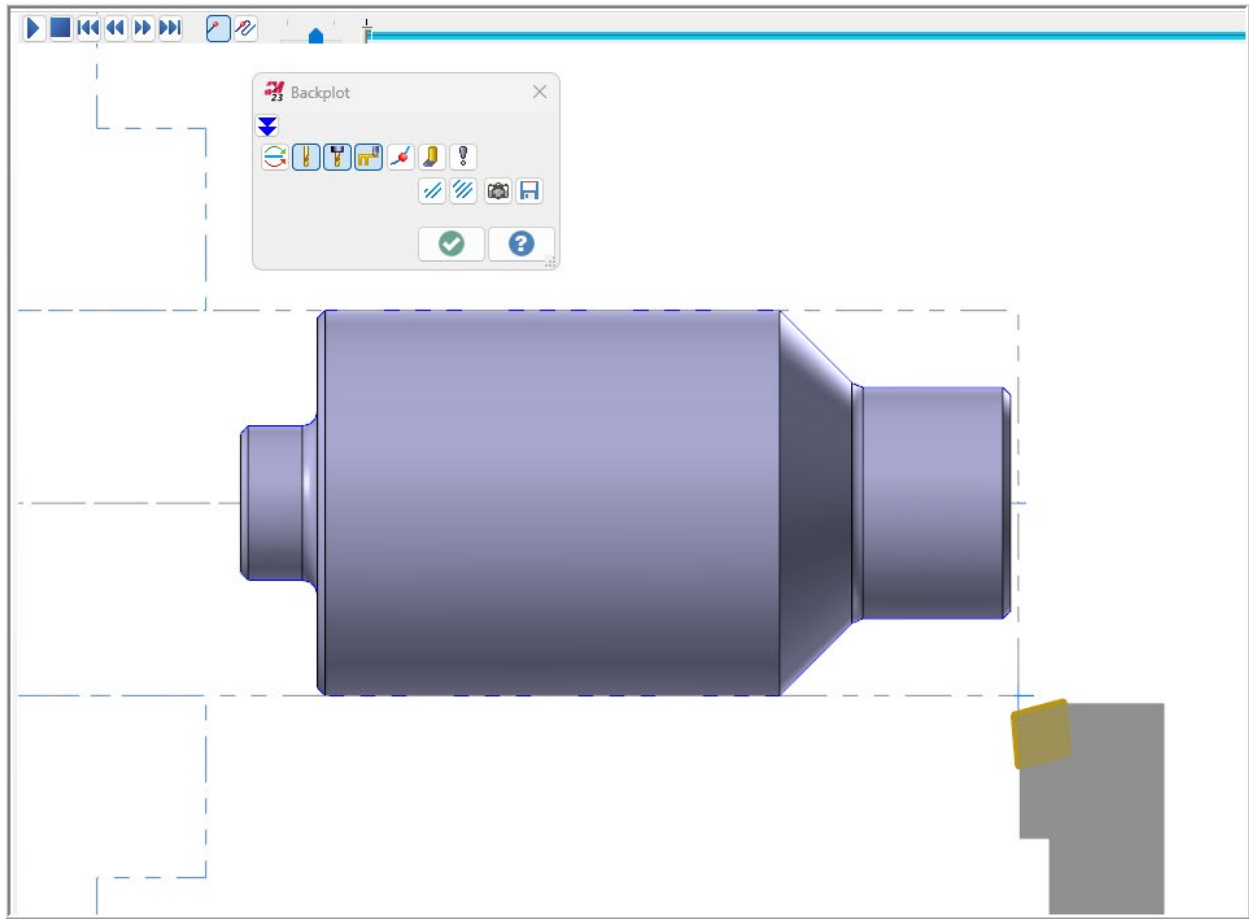
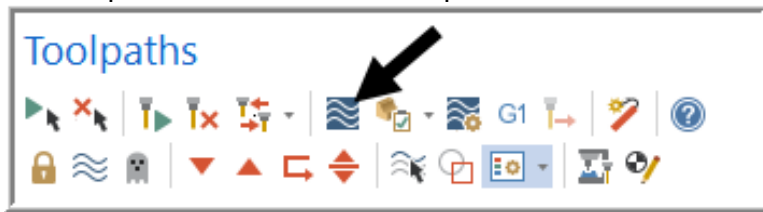
Orange – insert is facing down

Yellow – insert is facing up

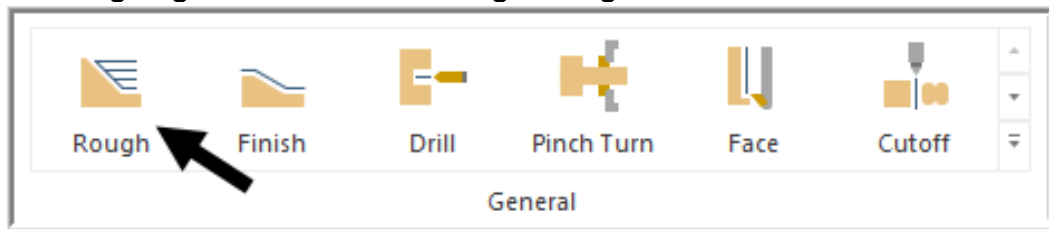
Note: The default settings on the **Face Parameters** page will work for our setup. No need to make changes here. Check that yours are the same. Click **Green Checkmark**.



5. You can do a quick **backplot** to check your toolpath now. However, we will hold off on the complete verification until all ops are done.

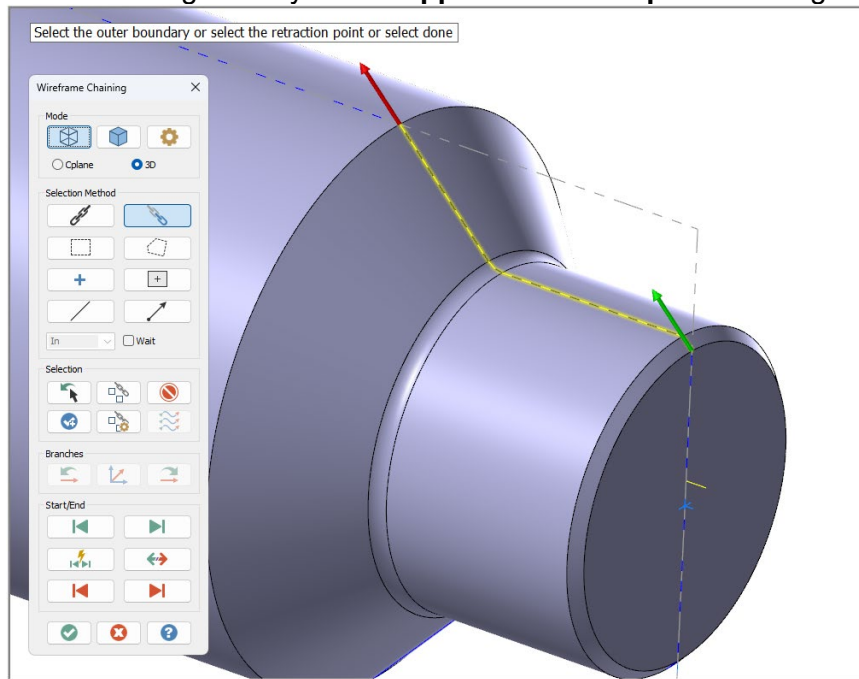


6. **Roughing the OD.** Select **Turning > Rough...**

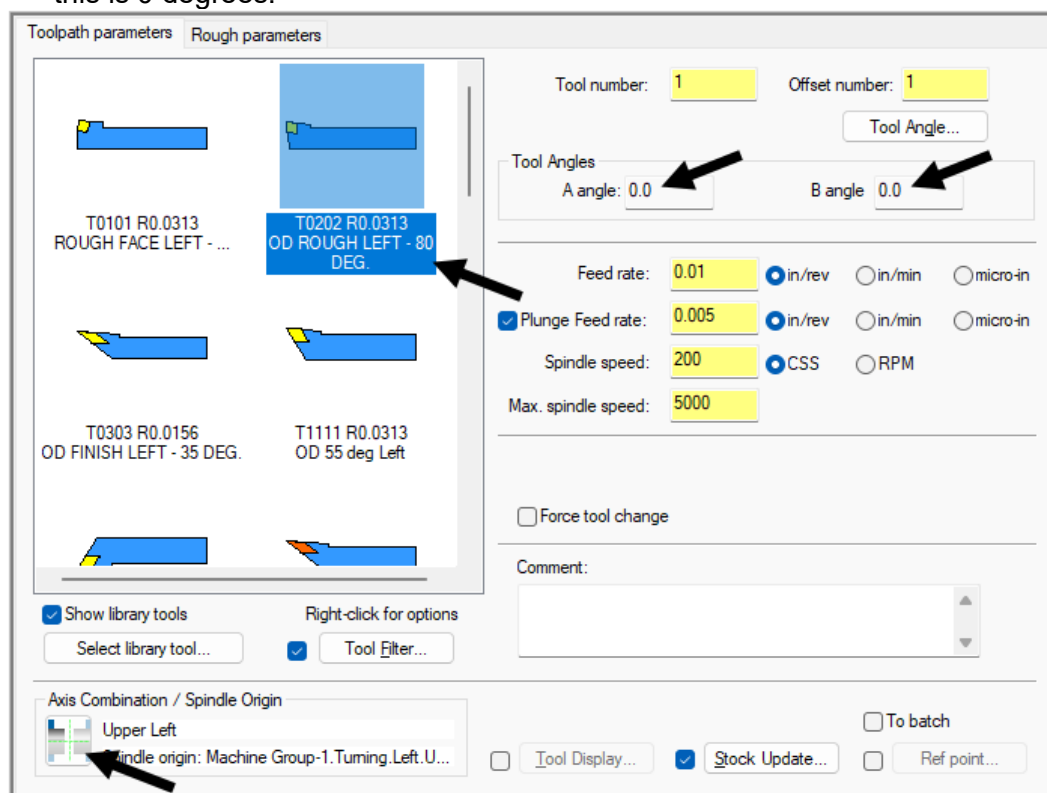


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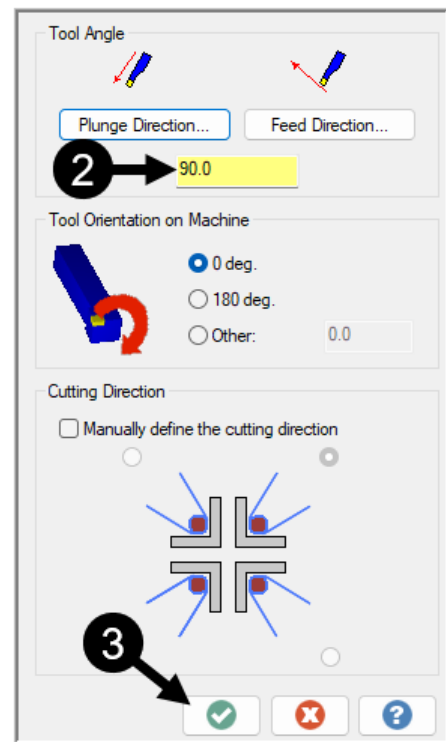
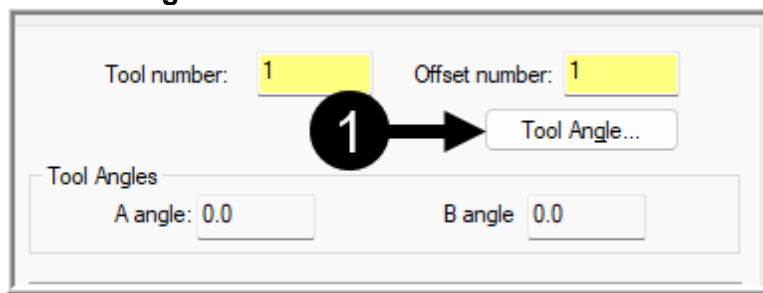
- Chain from the 0.05 chamfer to the intersection of the taper and the OD. Make sure you chain the geometry on the **upper side of the part**. Hit the green check to accept.



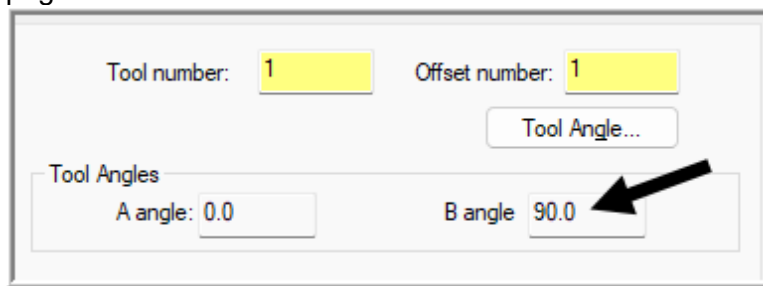
- The roughing will take place with the Upper Turret (B-axis head). Select an appropriate tool for OD roughing. Check that the **Axis Combination/Spindle Origin** is set to **Left Spindle Upper Turret**. The tools in the library are shown in the toolchange position, for our machine this is 0 degrees.



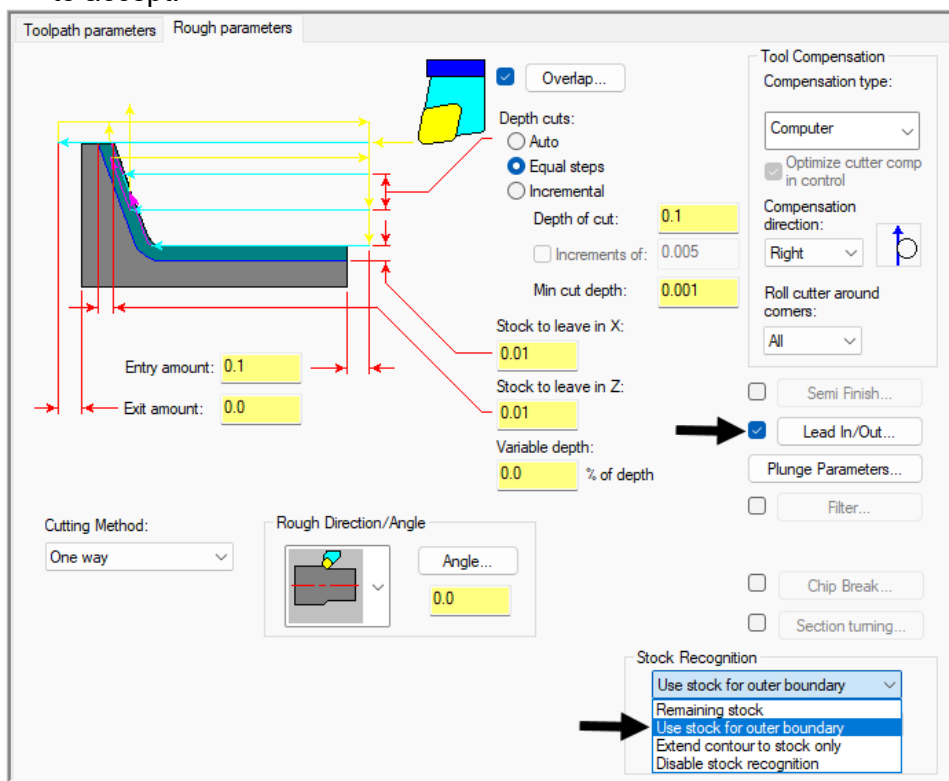
9. Since we are turning the OD, we need to set the **Tool B Angle at 90.0** for the correct orientation. Press the Tool Angle button at the top left. In the new menu, enter **90.0** for the **Tool Angle** and then click **OK**.



Notice the updated angle back in the Tool Parameters page.

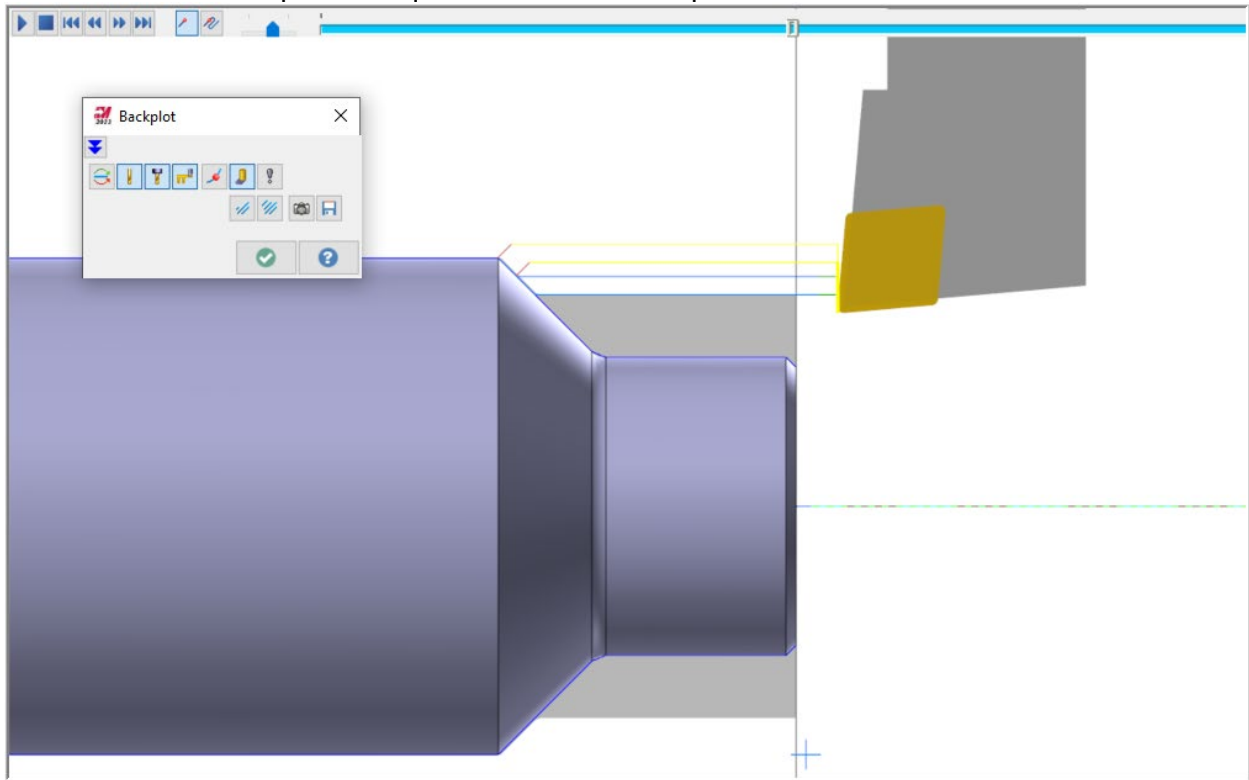


10. **Roughing Parameters.** Use the default settings. **Enable Lead In/Out** and set to appropriate values. Set Stock Recognition to **Use stock for outer boundary**. Green check to accept.

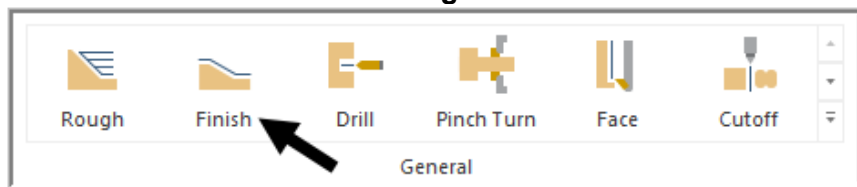


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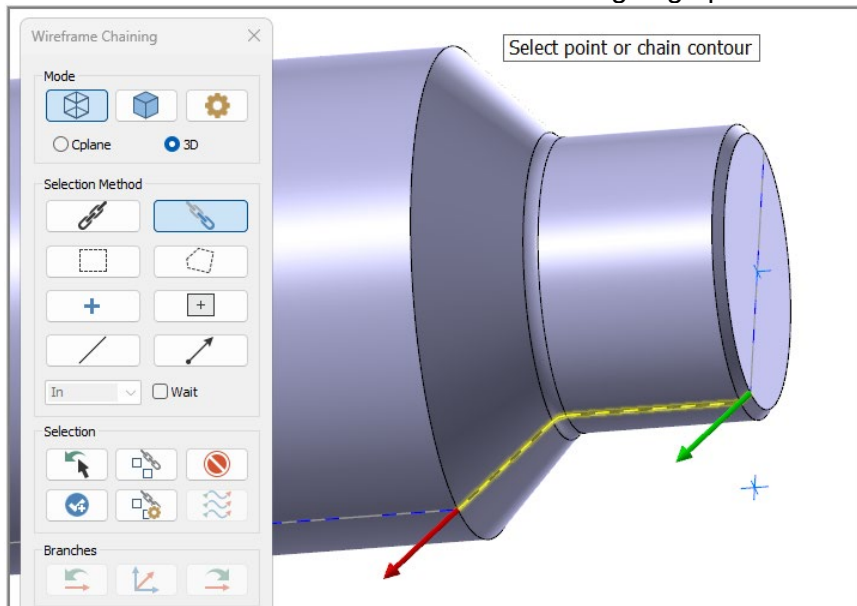
11. You can run backplot for a quick visual of the toolpath.



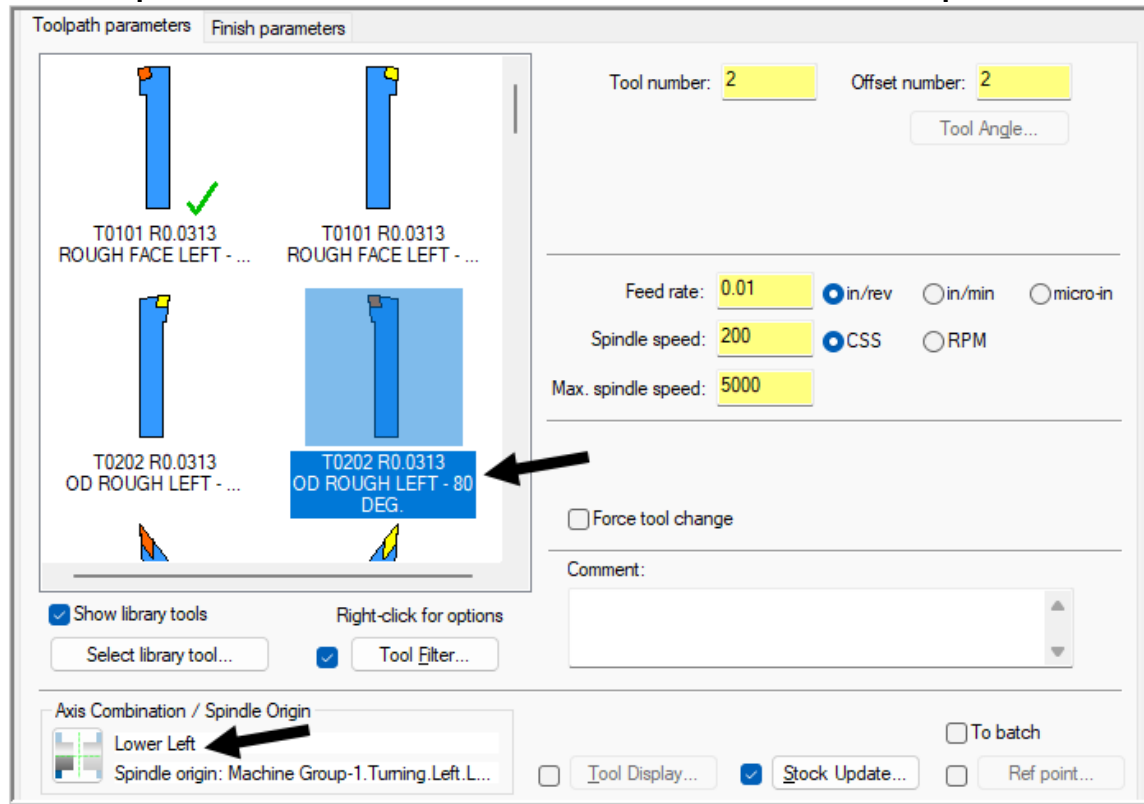
12. Finish the OD. Select Turning > Finish...



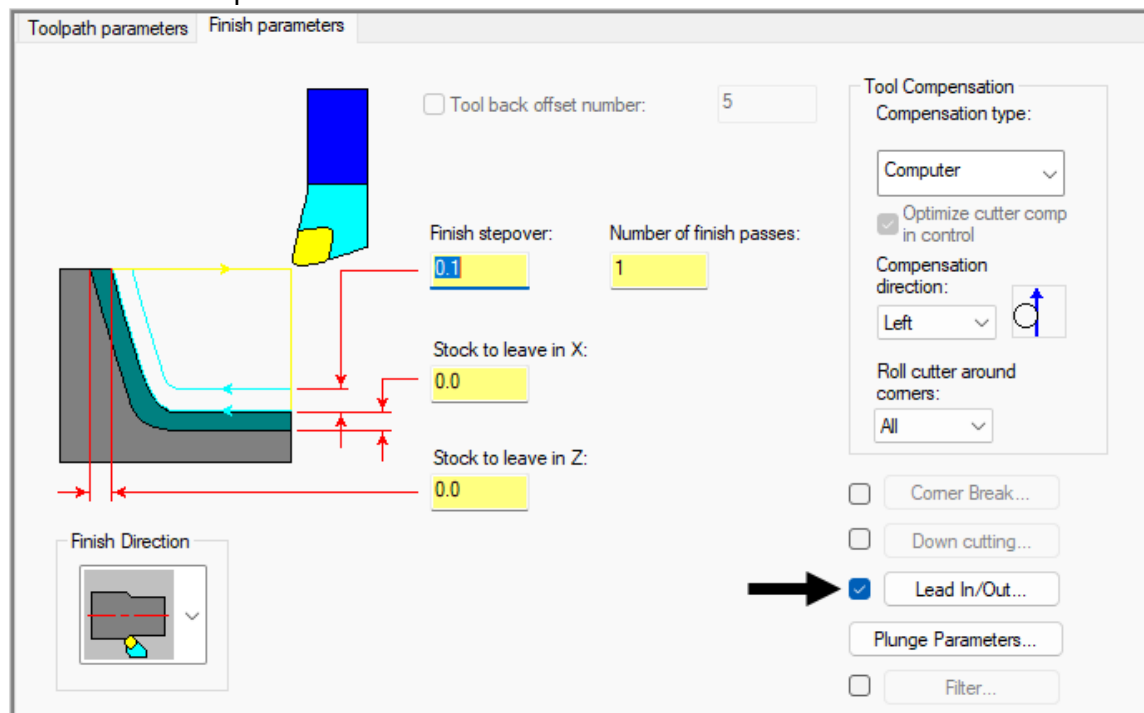
13. The lower turret will be used to finish the OD, select geometry on the **lower side of the model**. Chain the same section as the Roughing op. Green check to accept the chain.



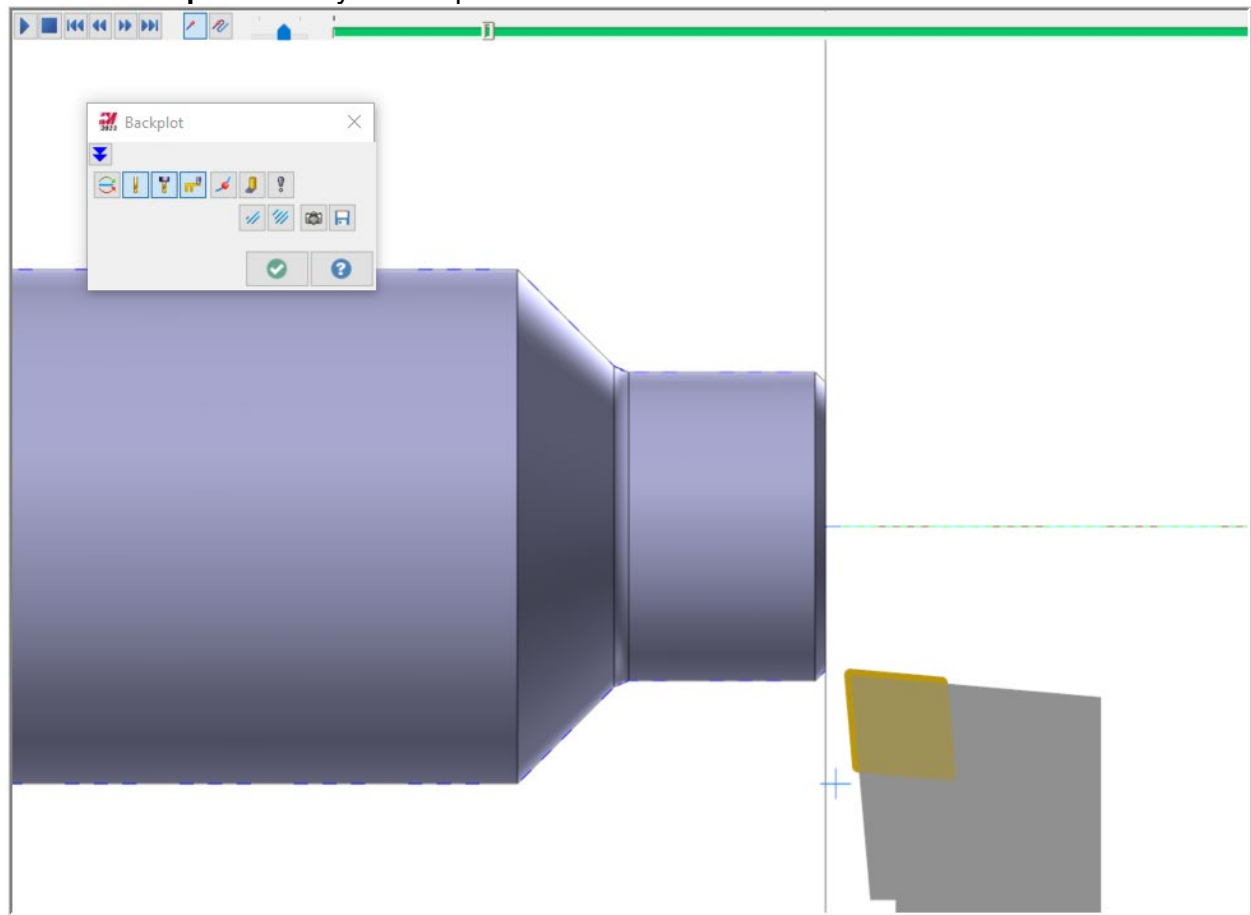
14. **Lathe Finish Properties.** Select a finish turning tool and check Axis Combination is set to **Left Spindle Lower Turret** and Turret Index Position is set to **Left spindle**.




15. **Finish Parameters.** Default setting are good. Check that **Lead In/Out is enabled** and are set to appropriate values, keep in mind the tool orientation when setting your leads. Green check to accept.



16. Run **Backplot** to verify the toolpath.

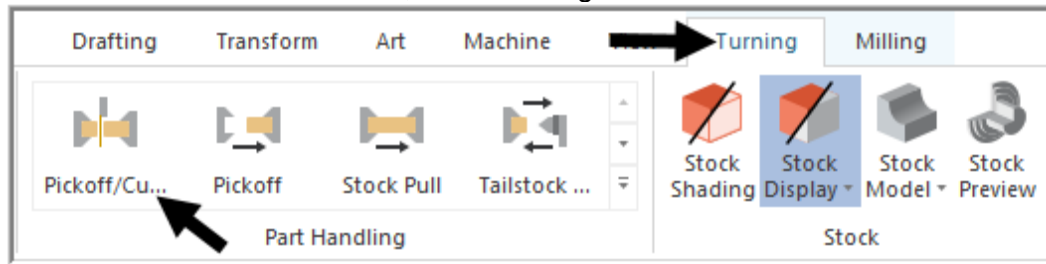


17. **Save** your file. 

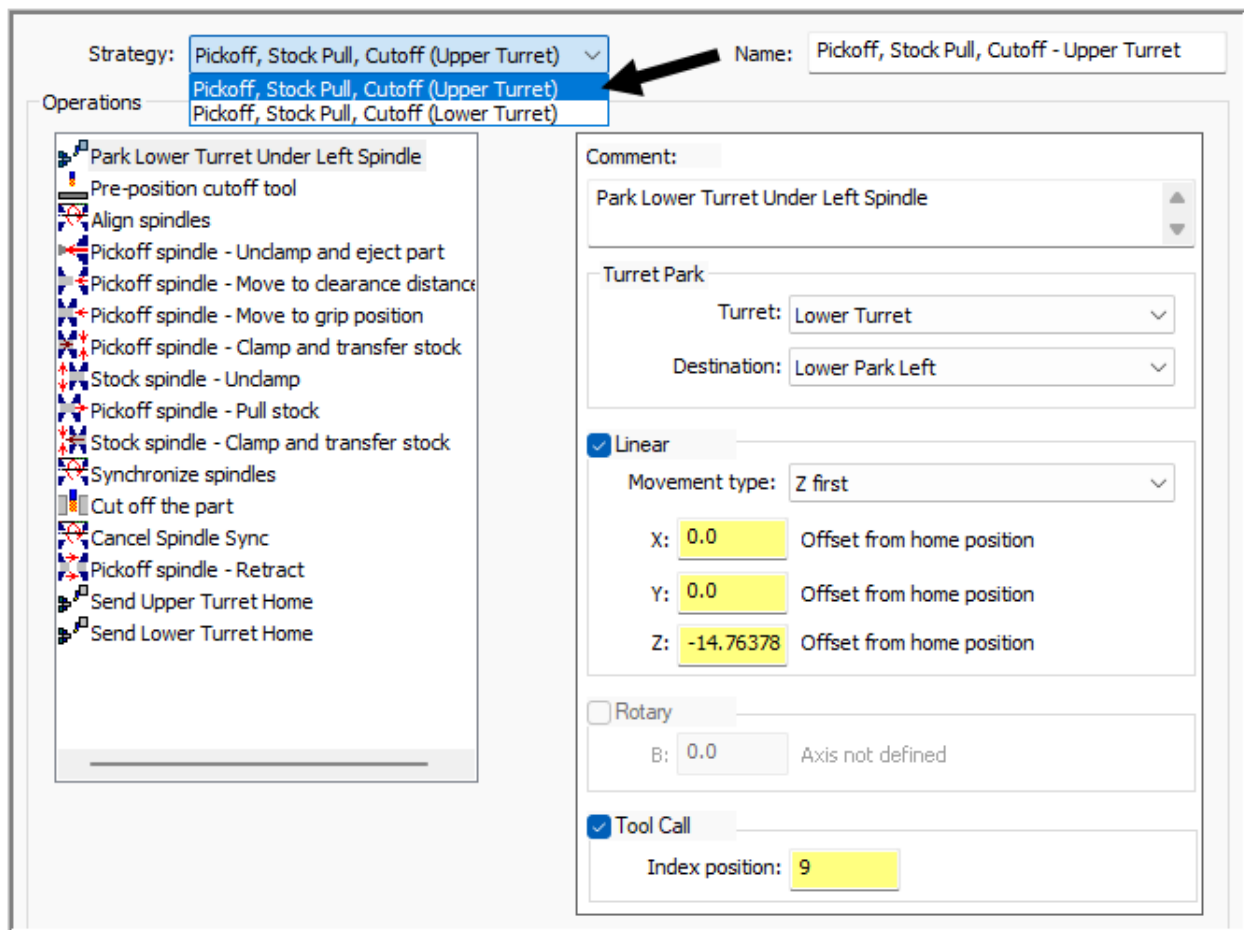
TASK 4:
POCO – PICK OFF CUT OFF

☞ In this task you will cut the part off and transfer it to the sub (right) spindle.

1. From the menu bar select **Turning > Pickoff/Cutoff** found under the **Part Handling** section. This will launch the Pick off, Cut off dialog box.

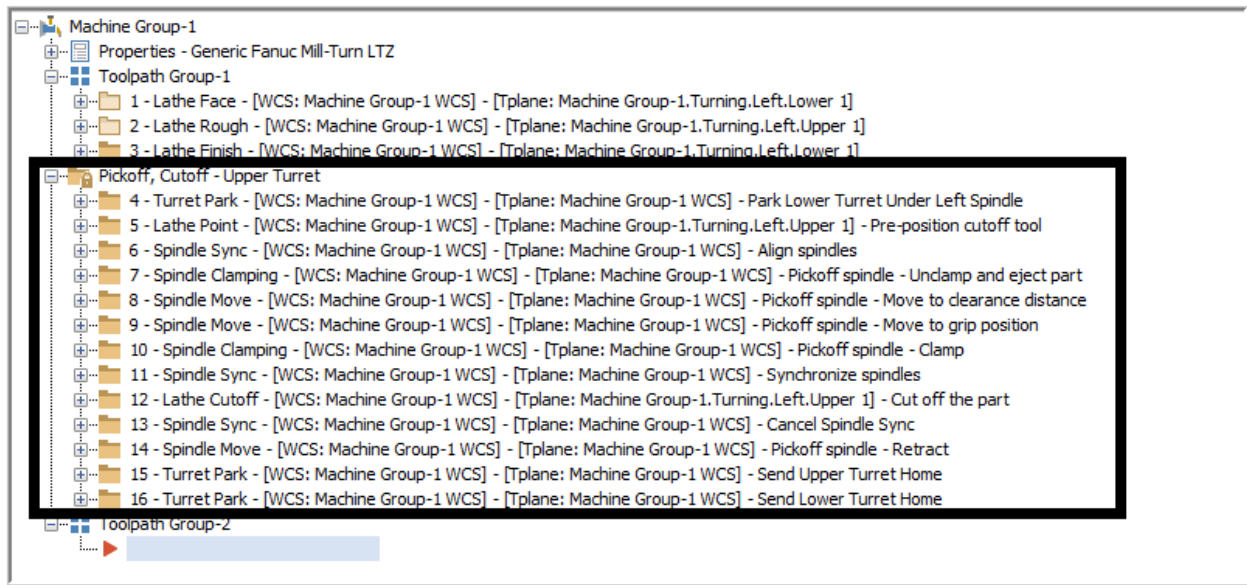


2. **Pickoff, Cutoff.** Since the cutoff operation will be using a tool in the upper turret (B axis head) set the Strategy to **Pickoff, Cutoff (Upper Turret)**. Changes can be made to the operations parameters if needed, however the events and their order cannot be altered. Users can define their own strategies if specific part handoff sequences are needed. These new strategies will appear in the Strategy list. Green check to accept and create the POCO routine.

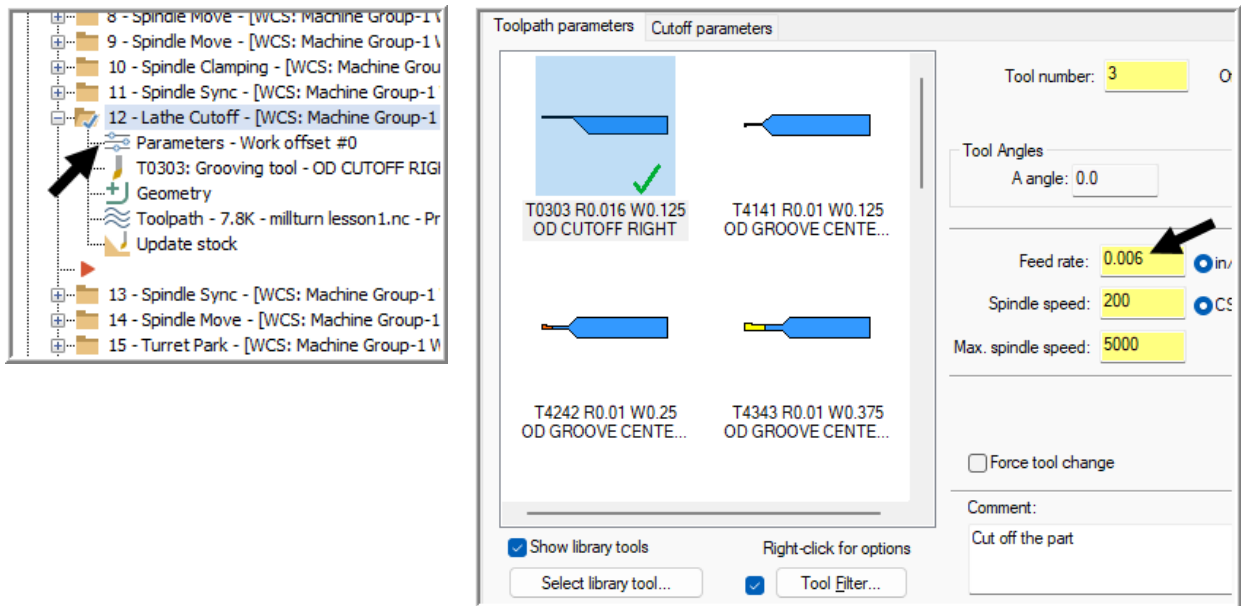


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- 3. **Results of POCO dialog input.** Mastercam creates the handoff operations. None of these created ops can be deleted or moved. This safeguards against unintentional changes that could result in machine crashes.



- 4. **Edit Part-Off Op** Just like in the POCO dialog input menu, each op's parameters can be adjusted. For example, if we want to change the feed rate of the part off tool, select op 12's Parameters and edit the **Feed rate** to **0.006**. Click **OK**.

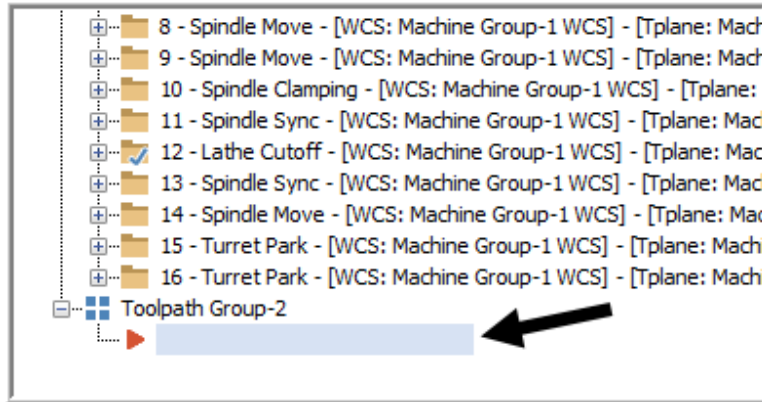


- 5. **Save your file.**

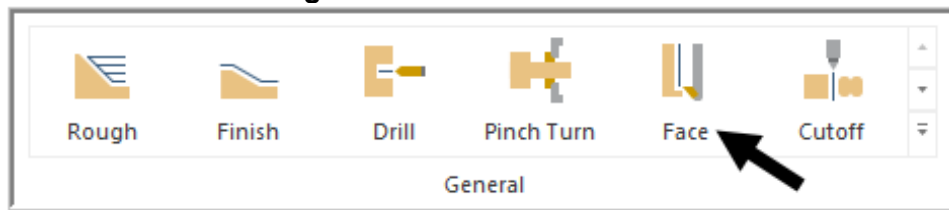
TASK 5: SUB SPINDLE TURNING

☞ In this task you will face the part and turn the OD profile in the sub (right) spindle.

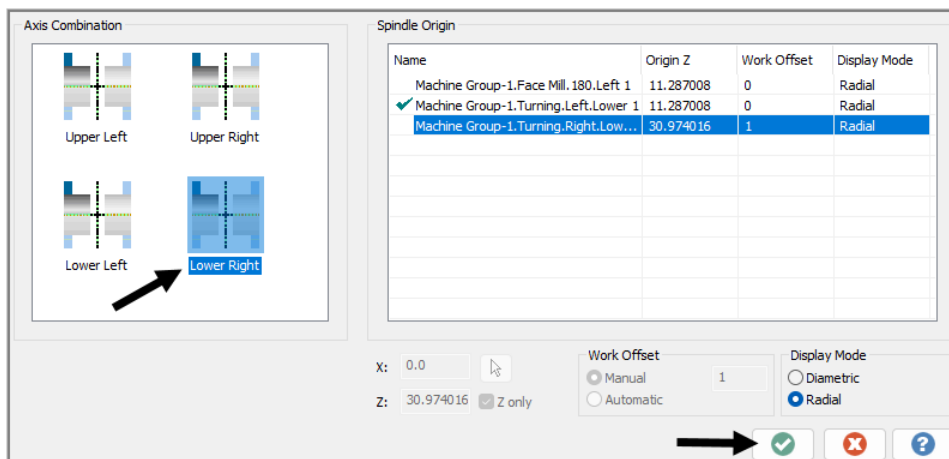
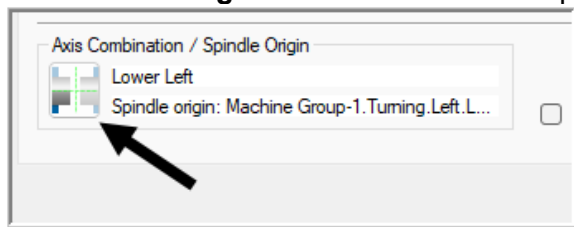
1. **Facing the part.** Before starting the sub spindle turning make sure the **red arrow** is in the correct position. It should be directly below **Toolpath Group-2**.



2. Then select **Turning > Face...**

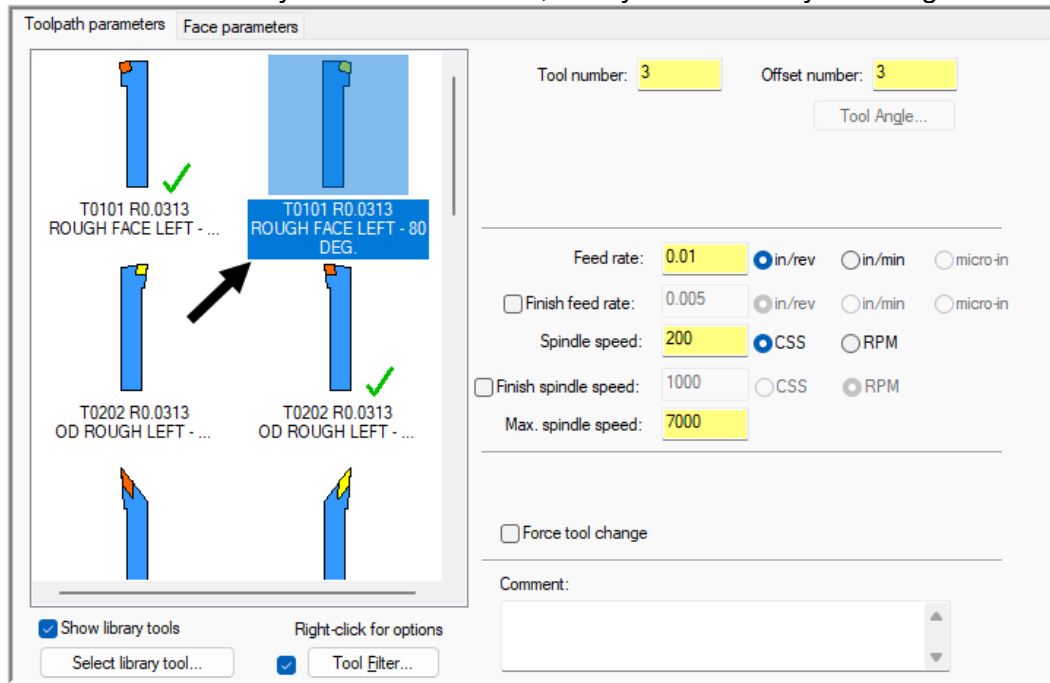


3. When the **Lathe Face Properties** window opens, select **Axis Combination/Spindle Origin** by clicking the small graphic. This will open the Axis Combination/Spindle Origin window. **Select Lower Right** as we will be using the lower turret to turn on the sub (right) spindle. Then hit the **green checkmark** to accept.

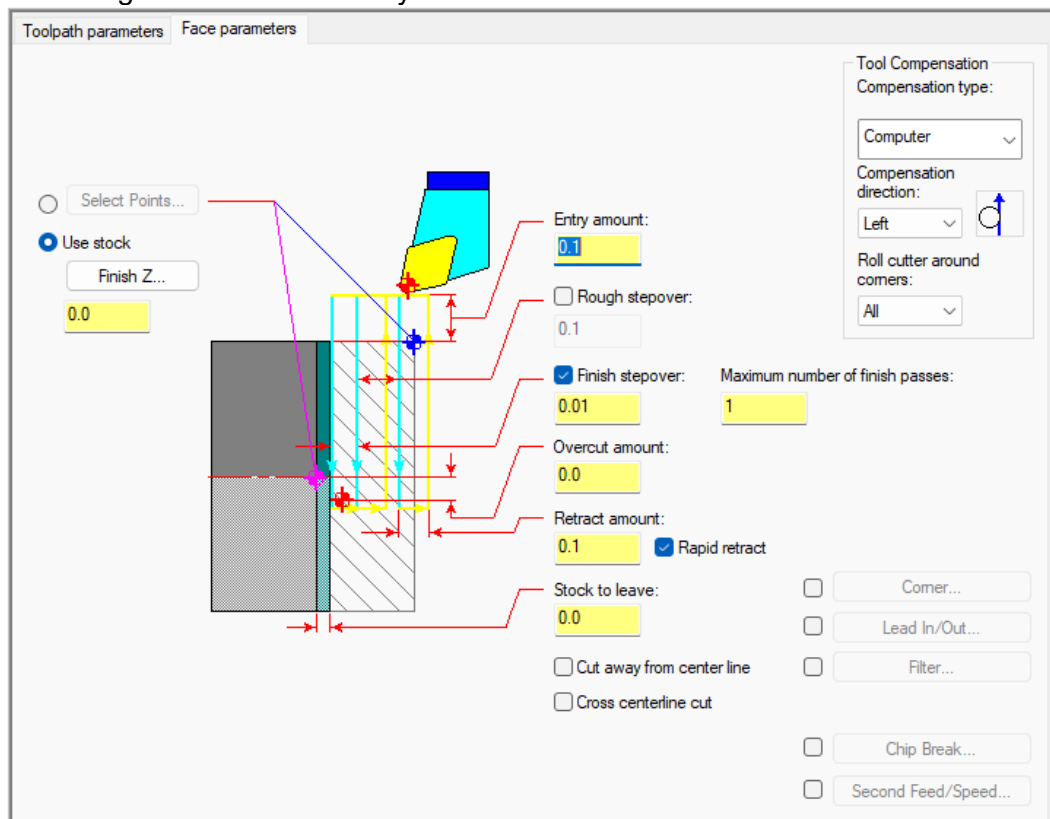


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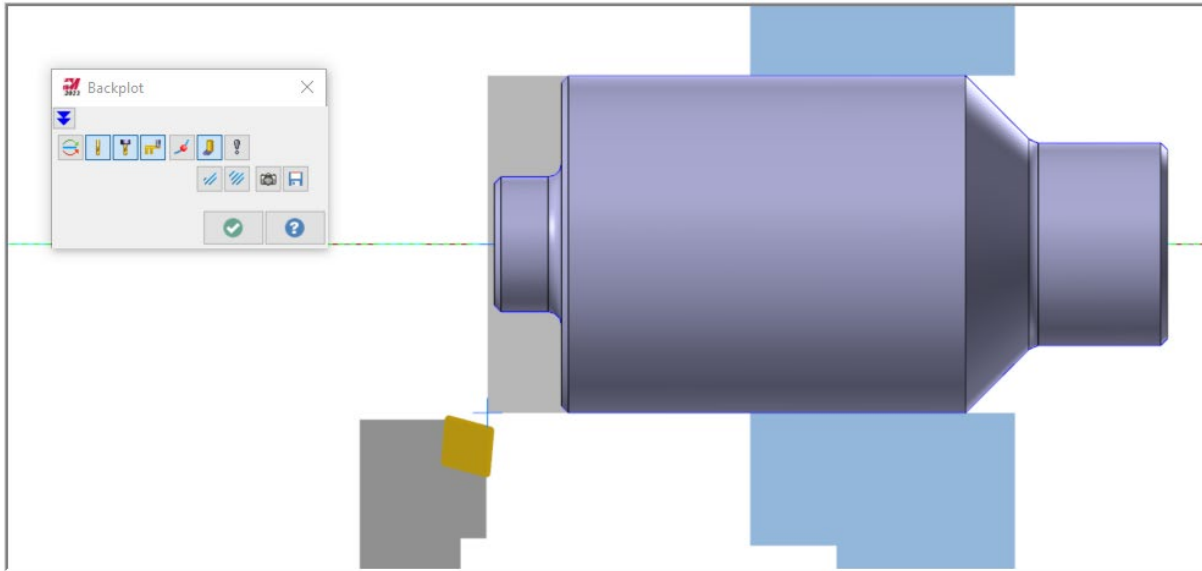
4. On the **Lathe Face Properties** window choose a tool that works on the right spindle. You must select a different tool than used on the lower turret left spindle as they will be facing opposite directions. The same lower turret tool cannot face on the left and right spindles. **Note:** Based on your actual machine, it may be necessary to change tool numbers.



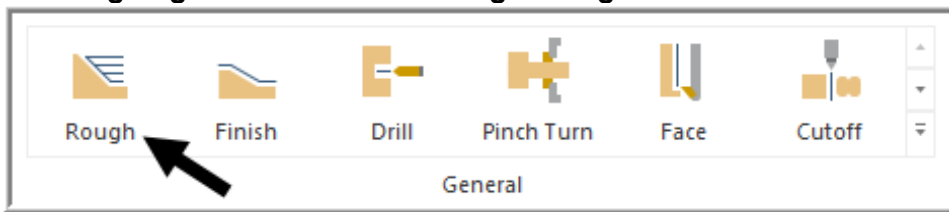
5. The default settings on the Face Parameters page will be sufficient. No need to make changes here. Check that yours are the same.



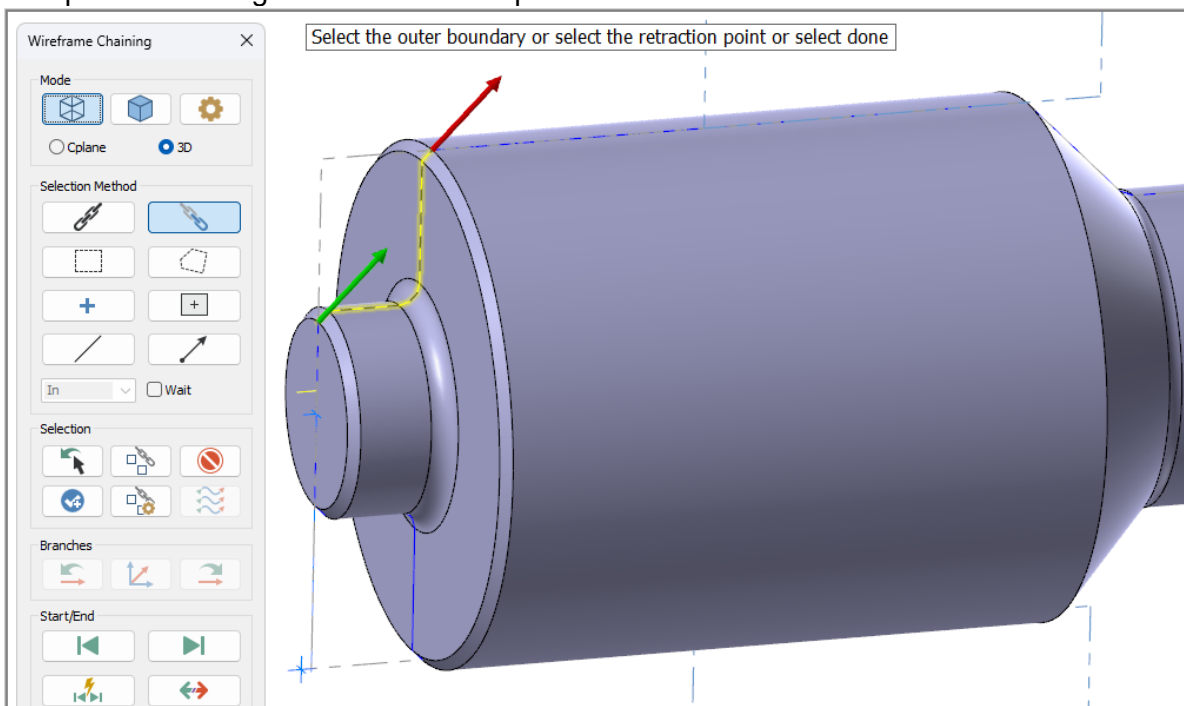
6. You can do a quick **backplot** again to check your toolpath. Select just the sub spindle facing op and run.



7. **Roughing the OD.** Select **Turning > Rough...**

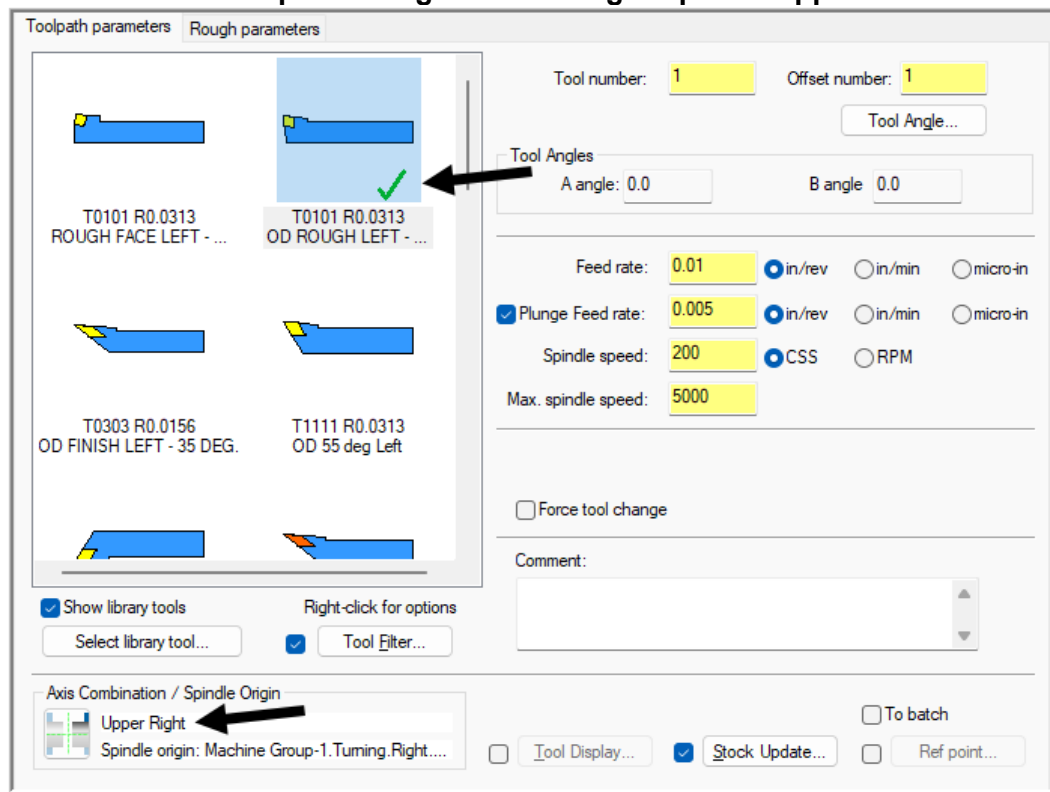


8. **Chain the geometry.** Start from the 0.05 chamfer on the 1.00" diameter then to the end of the 0.05 chamfer in the 2.50" diameter. Make sure you **chain the geometry on the upper side** of the part. Also be sure to chain the geometry on the **part that is in the sub** (right) spindle. Hit the green check to accept.

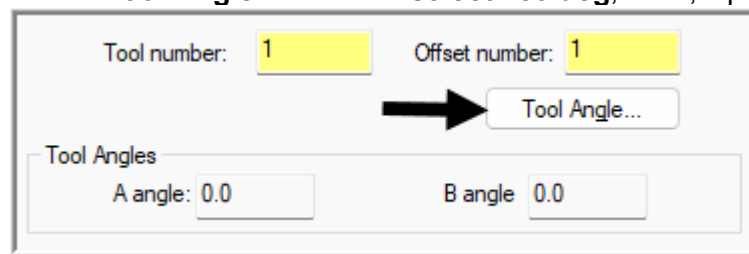


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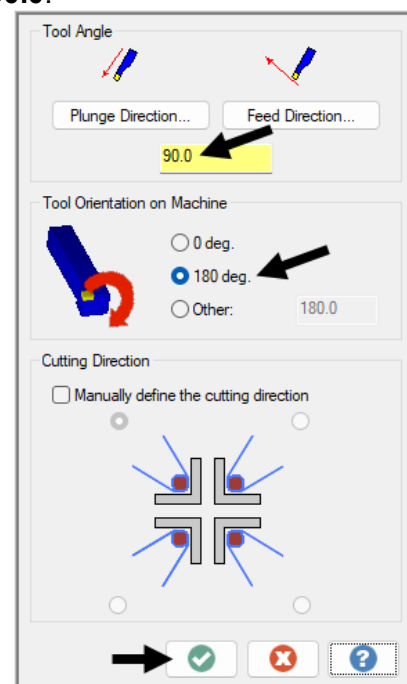
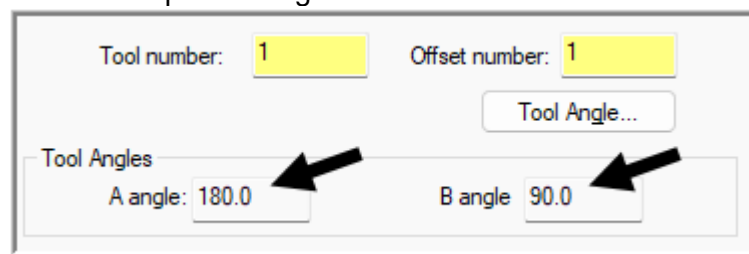
9. The roughing will take place with the **Upper Turret (B-axis head)**. Select the same OD roughing tool as used on the main spindle (note the green check). Check that the **Axis Combination / Spindle Origin** is set to **Right Spindle Upper Turret**.



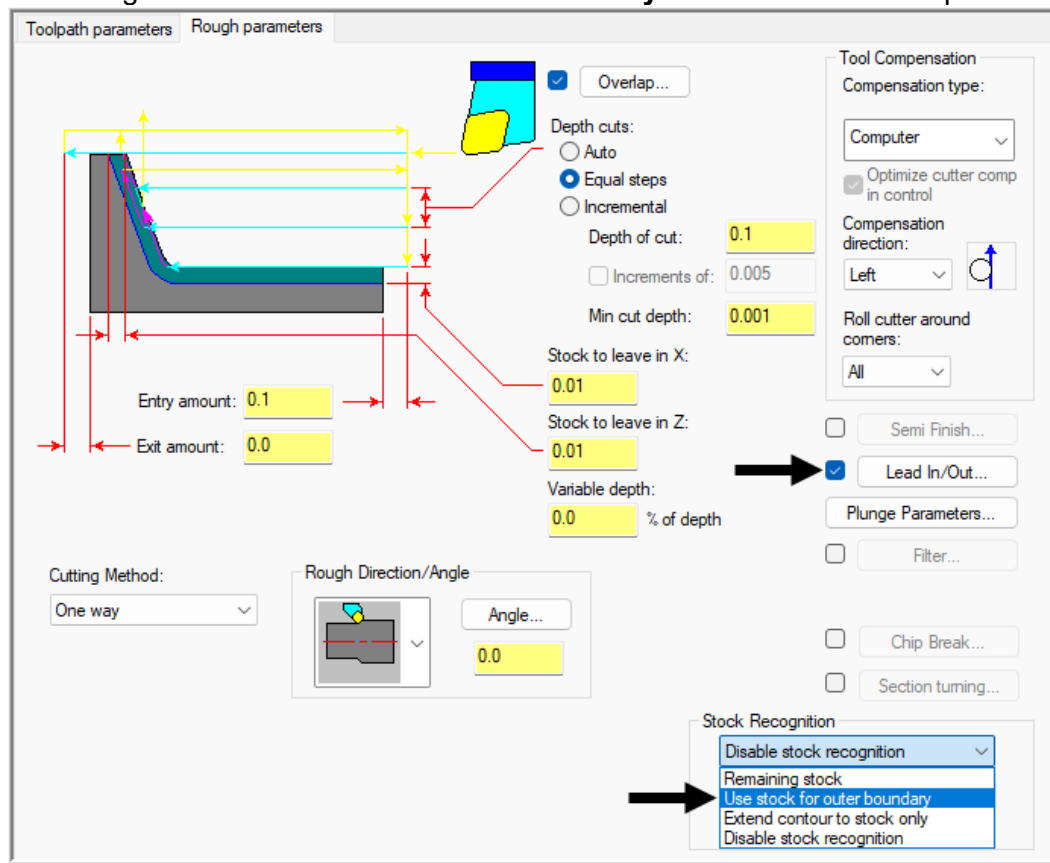
10. Since we are turning the OD on the sub (right) spindle, we need to set the **Tool B Angle at 90.0** (same setting used for main spindle) and **Tool A Angle set at 180.0**. The A angle controls which direction the turning tool faces (main or sub side). To set Tool A Angle click the **Tool Angle** button and **select 180 deg.**, for B, input **90.0**.



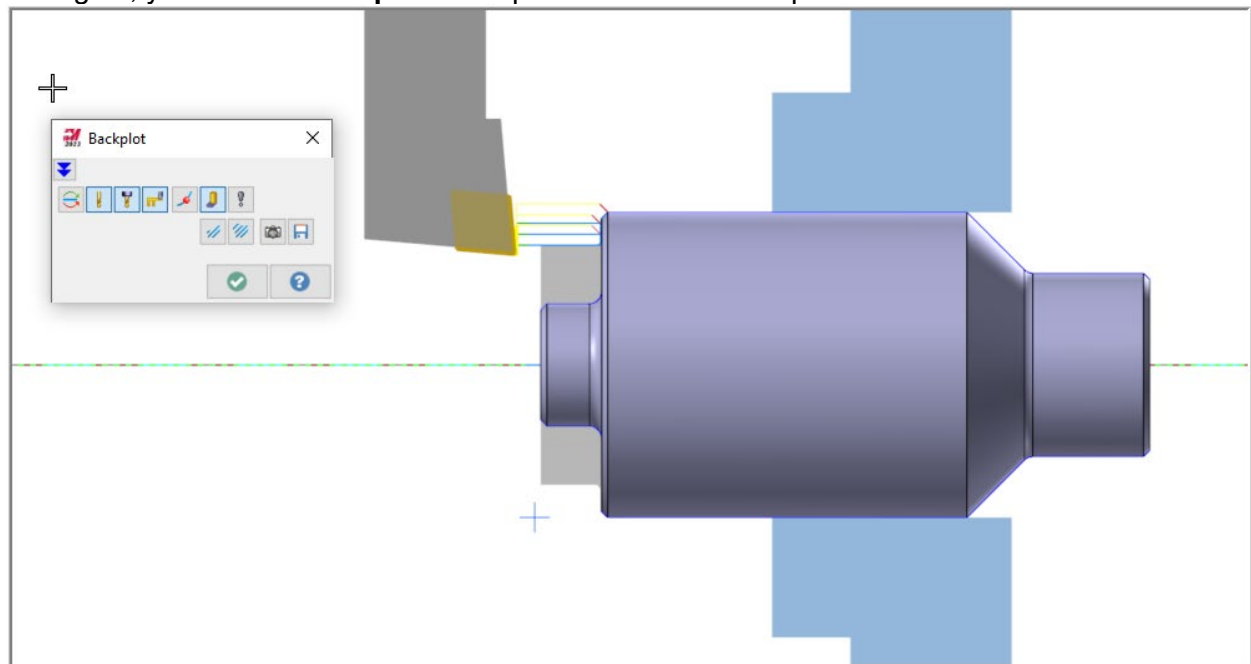
Notice the updated angles.



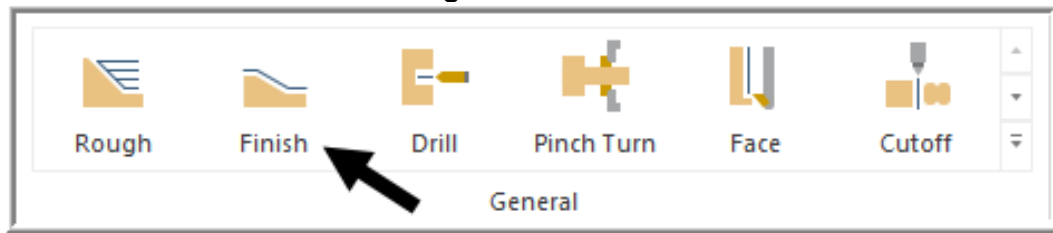
11. **Roughing Parameters.** Use the default settings. **Enable Lead In/Out** and set to appropriate values, keeping in mind we are turning on the sub spindle. Set Stock Recognition to **Use stock for outer boundary**. Green check to accept.



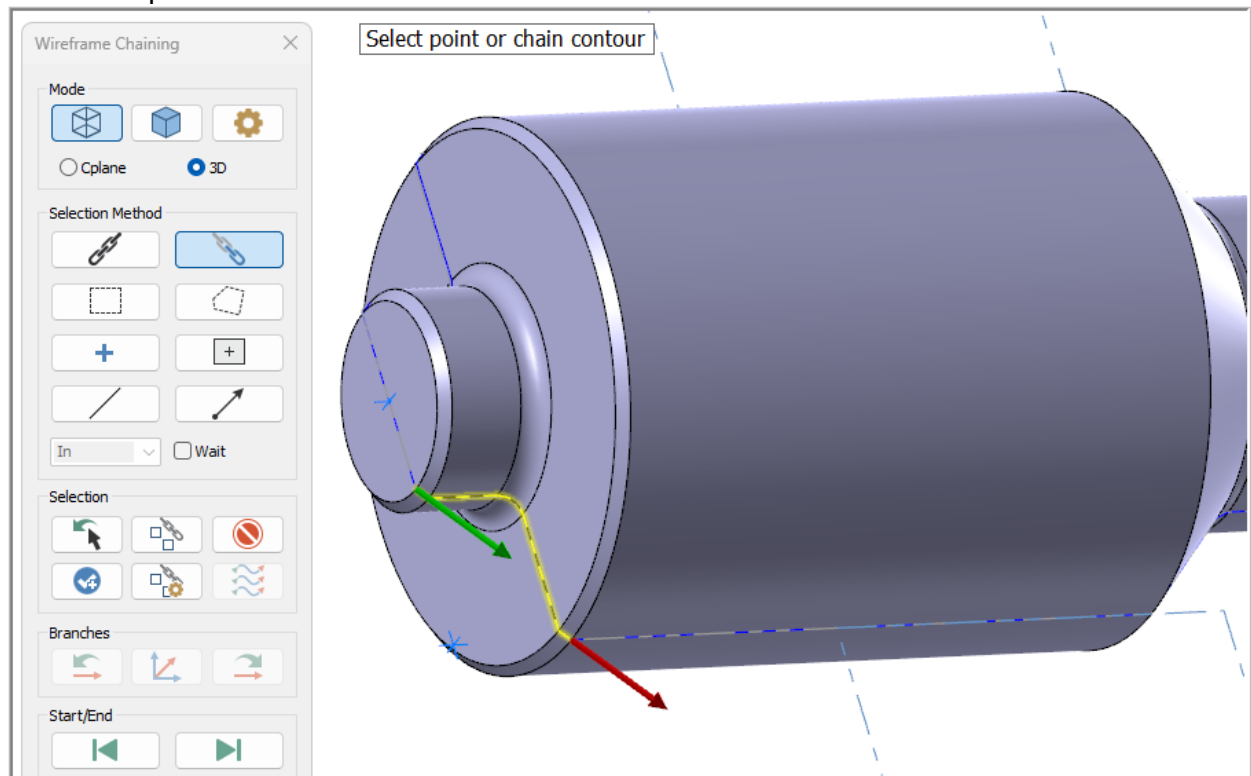
12. Again, you can run **backplot** for a quick visual of the toolpath.



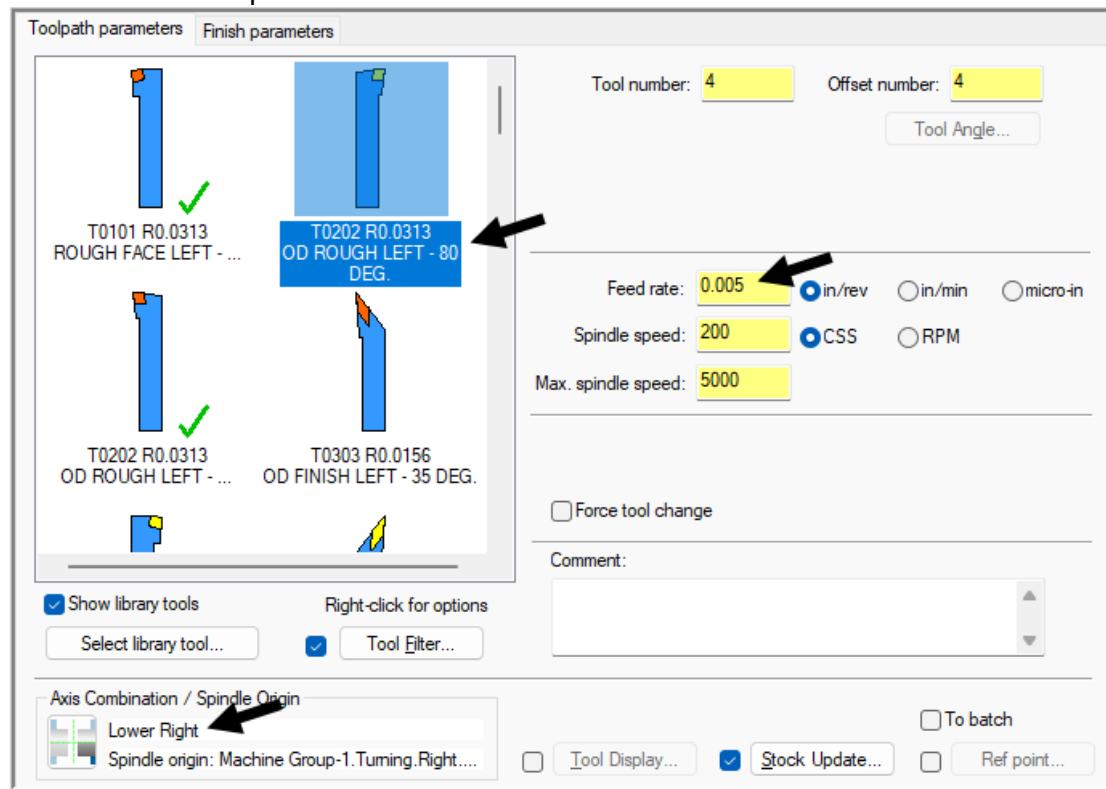
13. Finish the OD. Select Turning > Finish...



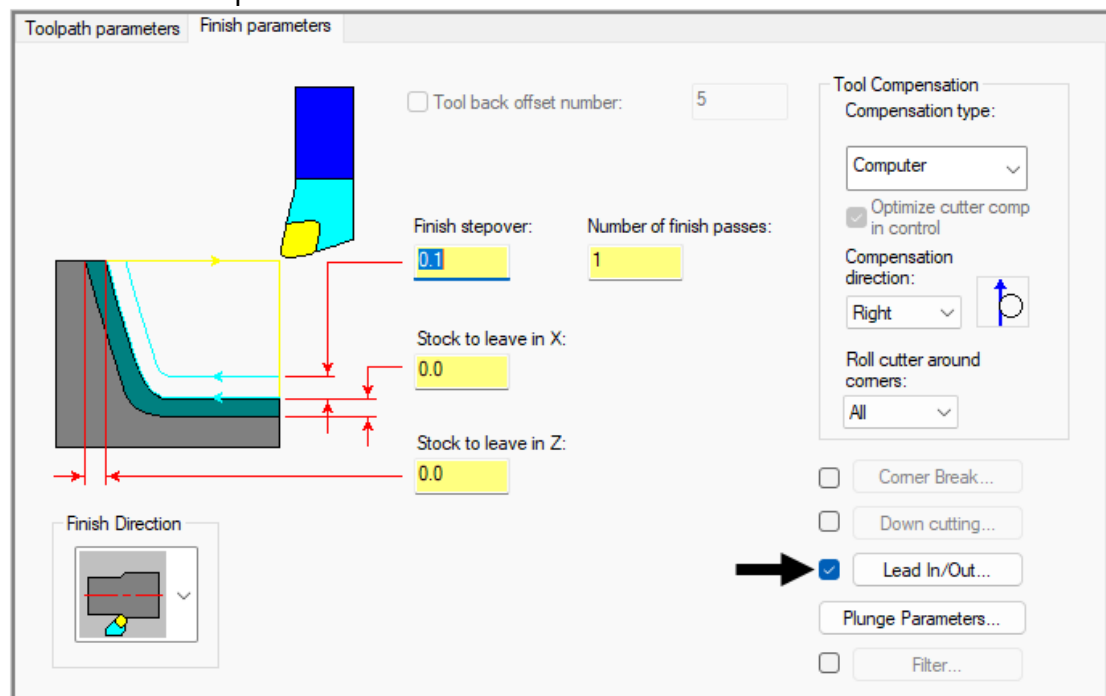
14. **Chain Geometry.** Since we will be using the lower turret to finish the OD, select geometry on the **lower side of the model**. Chain the same section as the Roughing Op. Green check to accept the chain.



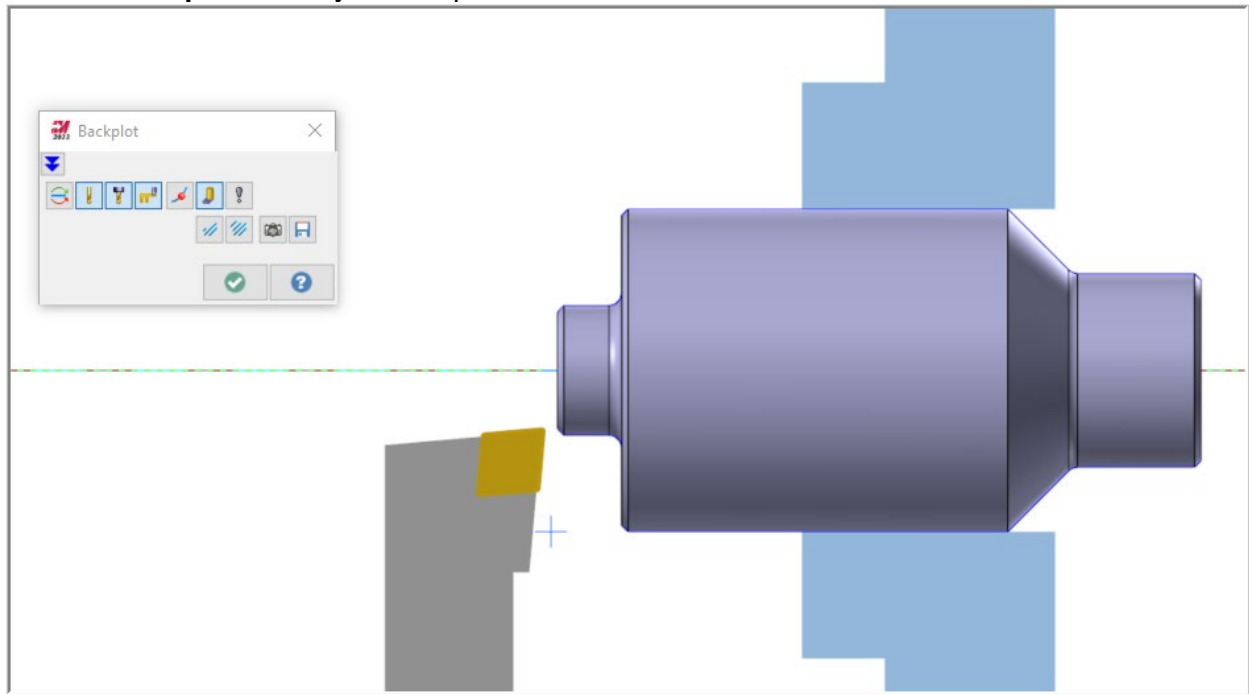
15. **Lathe Finish Properties.** Select a finishing tool with the correct orientation for the right spindle. Axis Combination should be set to **Lower Right** and feedrate set to .005 for finishing. As with the lower turret facing operations, the same tool orientation cannot be used for both spindles.




16. **Finish Parameters.** Default settings are good. Check that **Lead In/Out is enabled** and are set to appropriate values, keep in mind the tool orientation when setting your leads. Green check to accept.



17. Run **Backplot** to verify the toolpath.

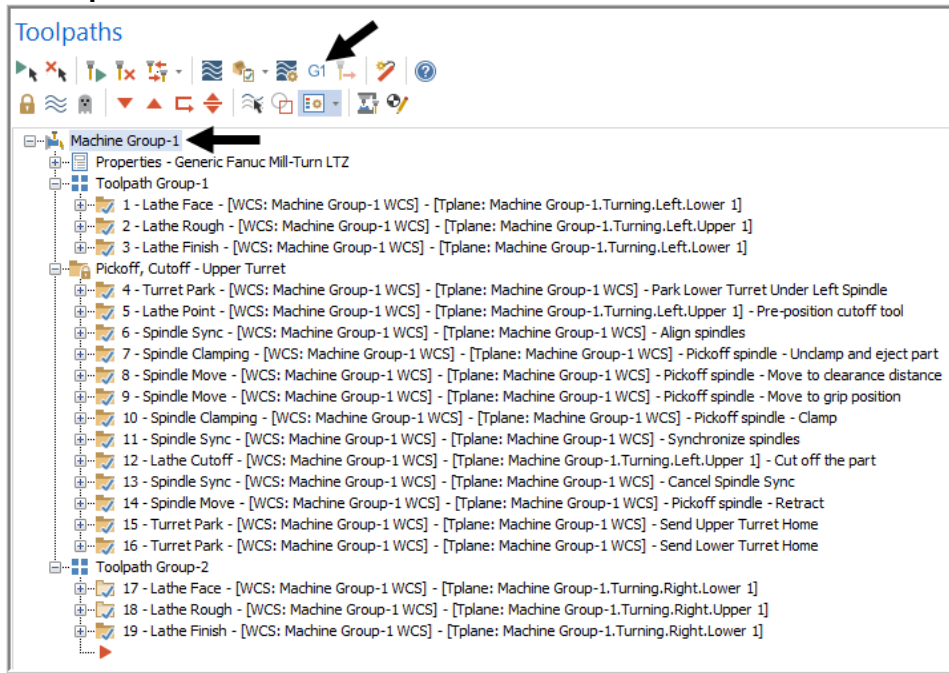


18. **Save** your file. 

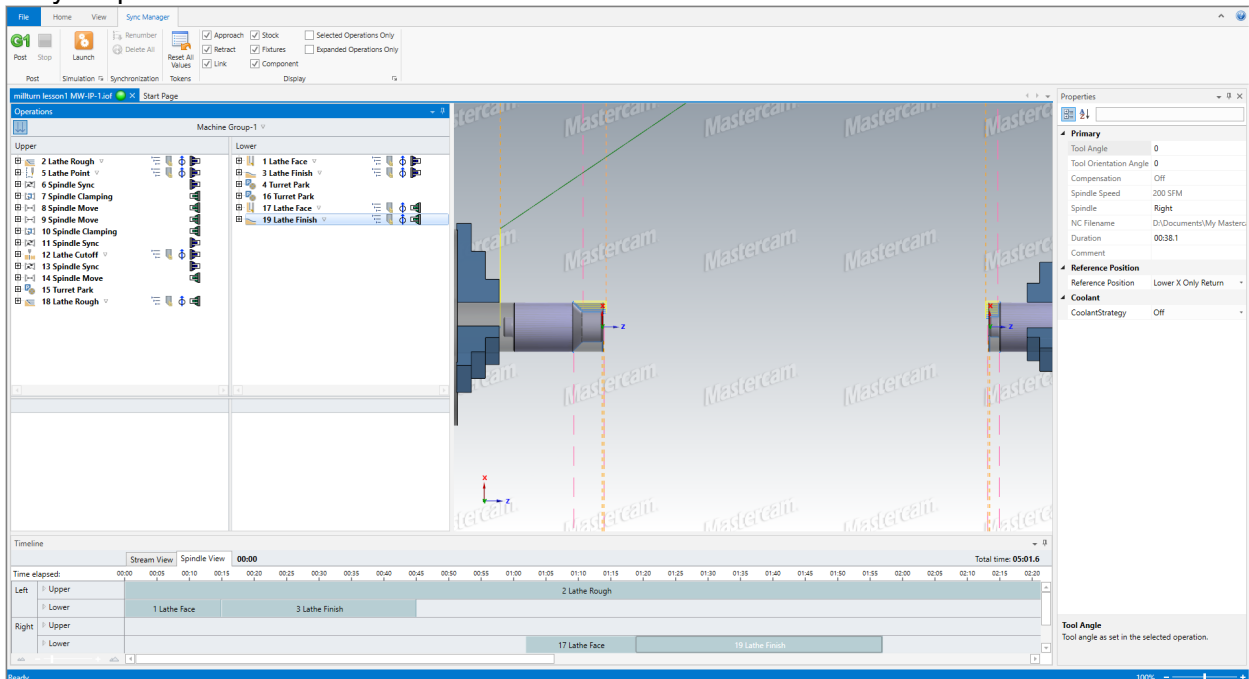
TASK 6: MACHINE SYNCING

➔ In this task you will work in Mastercam Code Expert to set the machine syncs.

1. Select the **Main Viewsheet-1** to display both spindles. In the **Operations Manager** left click Machine Group -1 to **select all operations**. Select the **Post Selected Operations** button. This will generate the IOF file and open a Sync Manager window in **Mastercam Code Expert**.

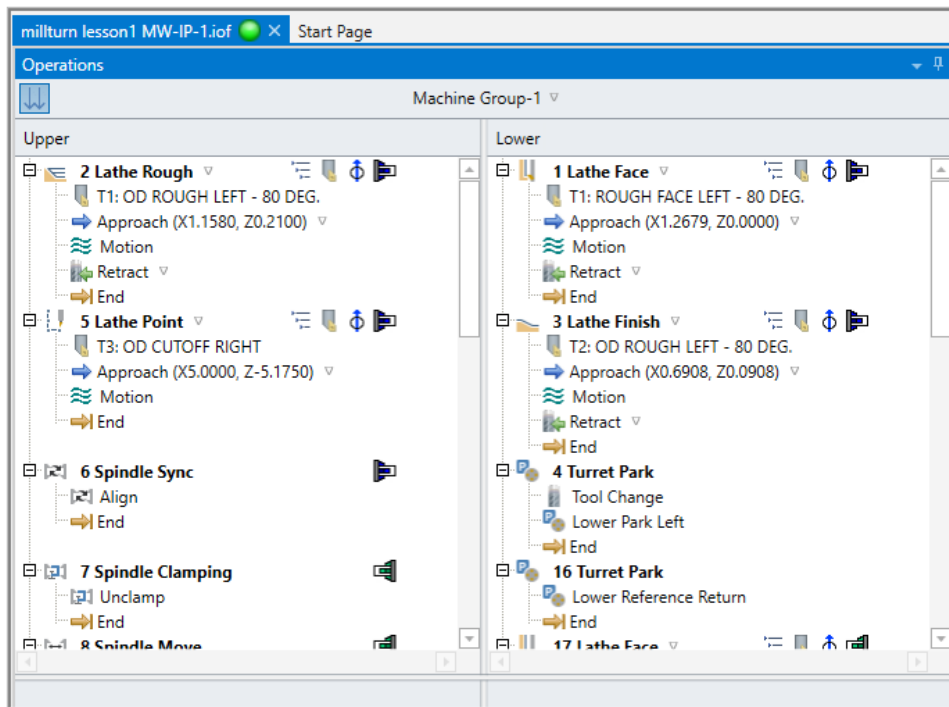
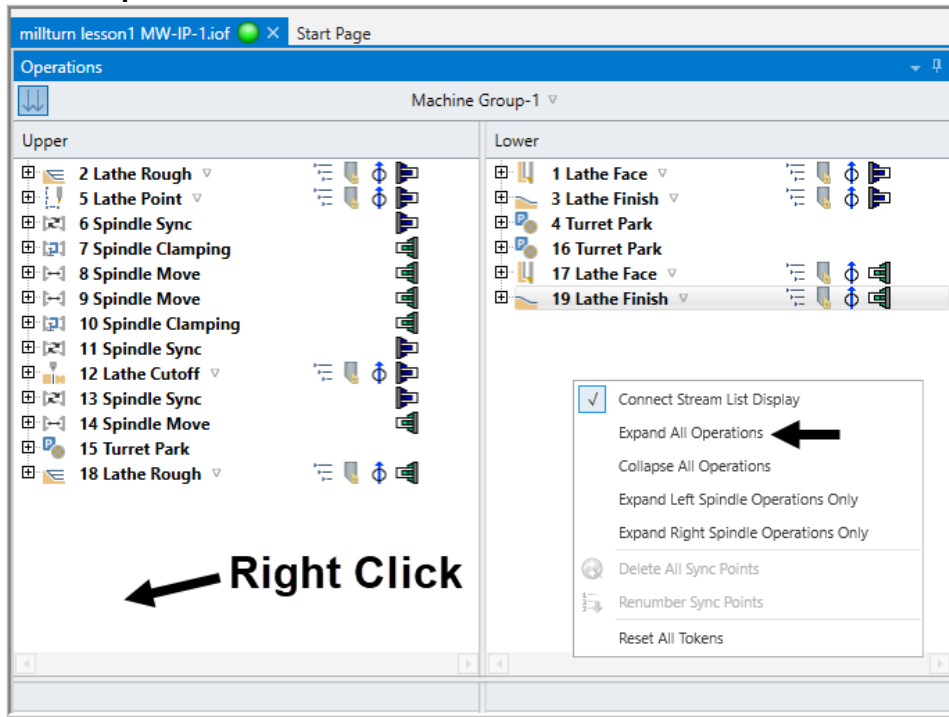


2. **Code Expert.** All the menus in Code expert can be moved, docked, hidden, or resized to your preference.

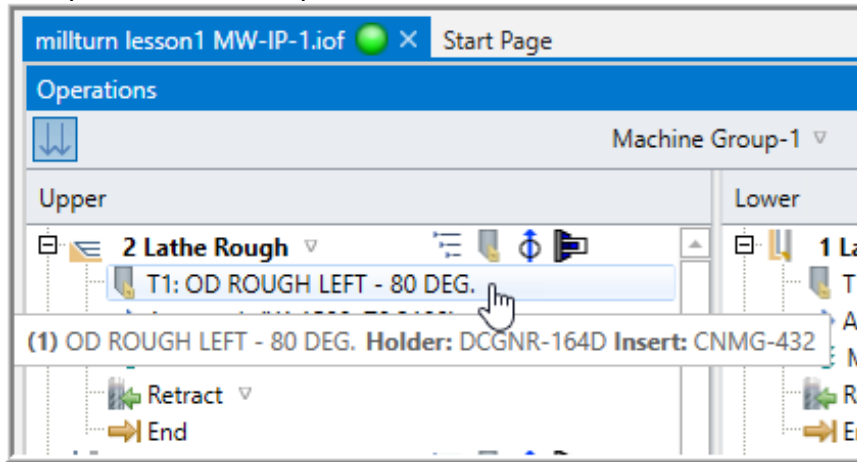


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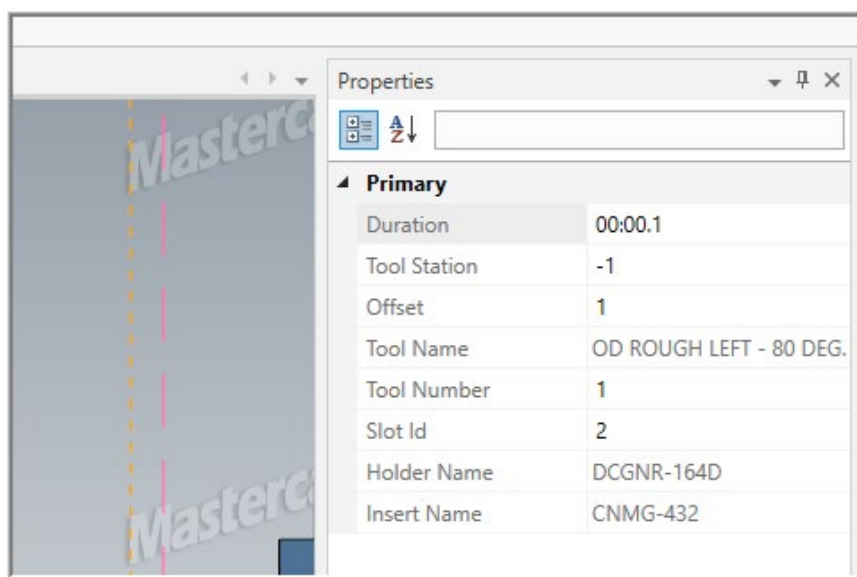
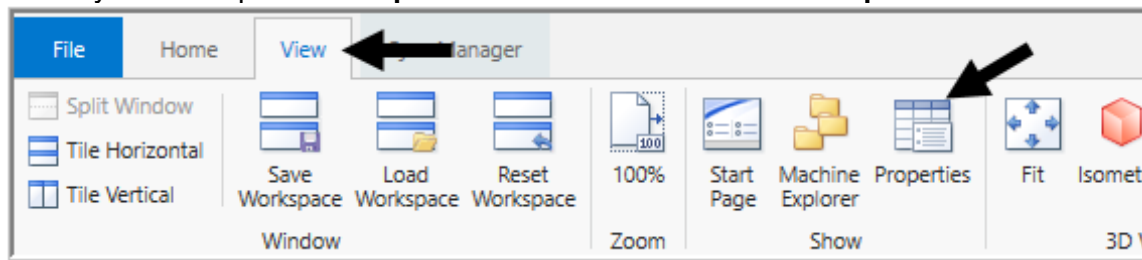
- Once you have all your menus set, **right click** on the **Operations Menu**, and select **Expand All Operations**.



- You can put your cursor on each line in either stream and Code Expert will display some additional information about that object. Some lines will also include a pulldown menu with additional settings/options. In the **Upper Stream, hover over the tool** in the **Lathe Rough** operation. Code expert shows additional information about the Holder and Insert.

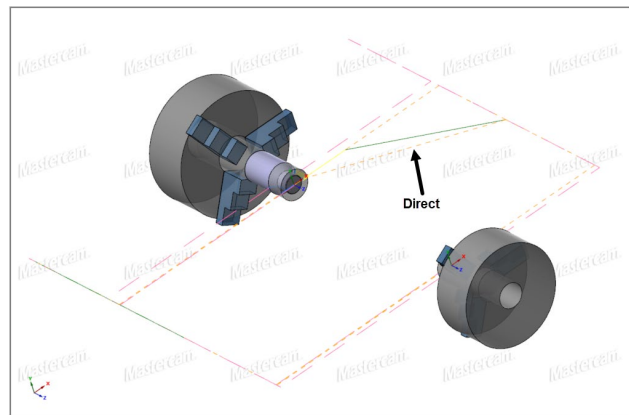
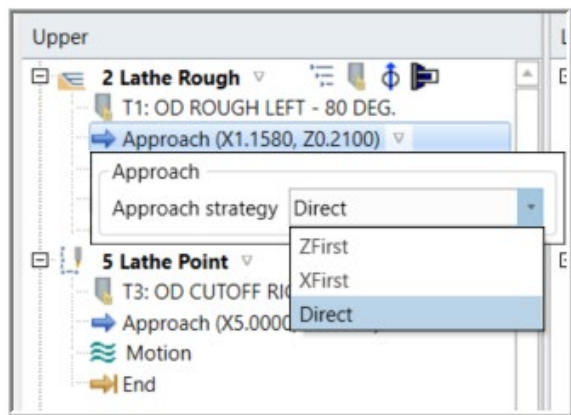
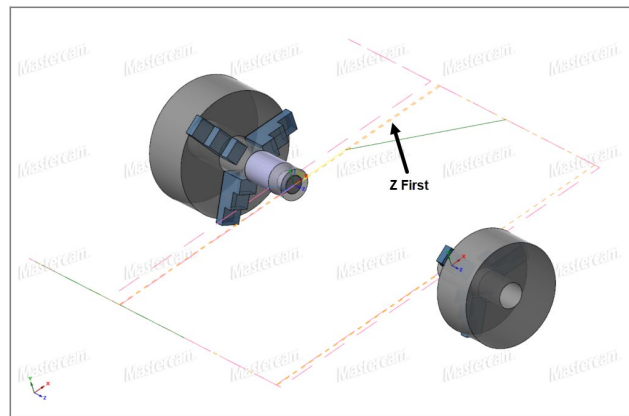
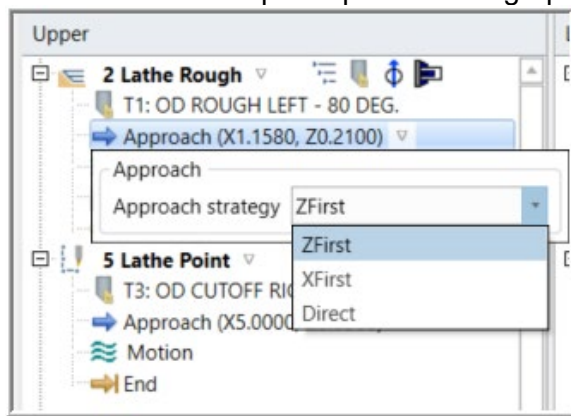


- If you **click on that tool** additional information is displayed in the **Properties window**. You may need to open the **Properties window > View Menu / Properties**.

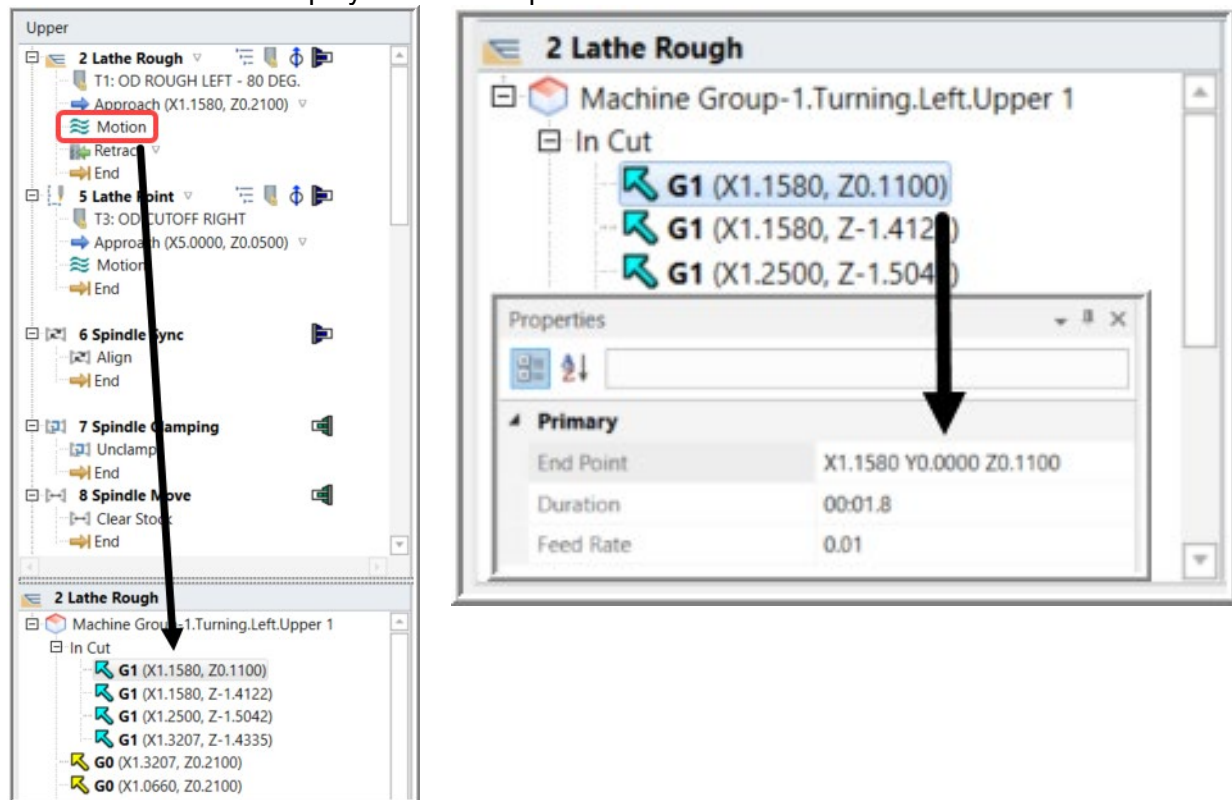


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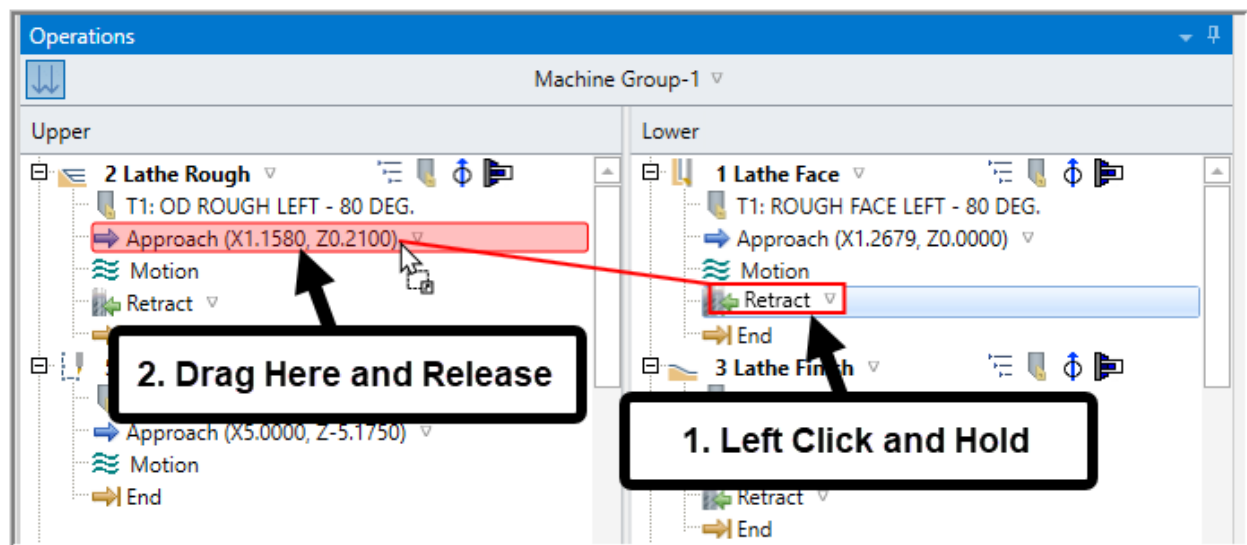
6. Click the **pulldown** menu of the **Approach** in the same op and you are given options as to how the approach is made, **Z first**, **X First** or **Direct**. If you change the approach type you will see the tool path update in the graphics window. Leave this set at **Z first** for now.



7. If you **click on the Motion** object an overview of the code will display below the stream. The In Cut movements can be expanded as well for further review. **Click on the G1** movement and more info is displayed in the Properties Menu.

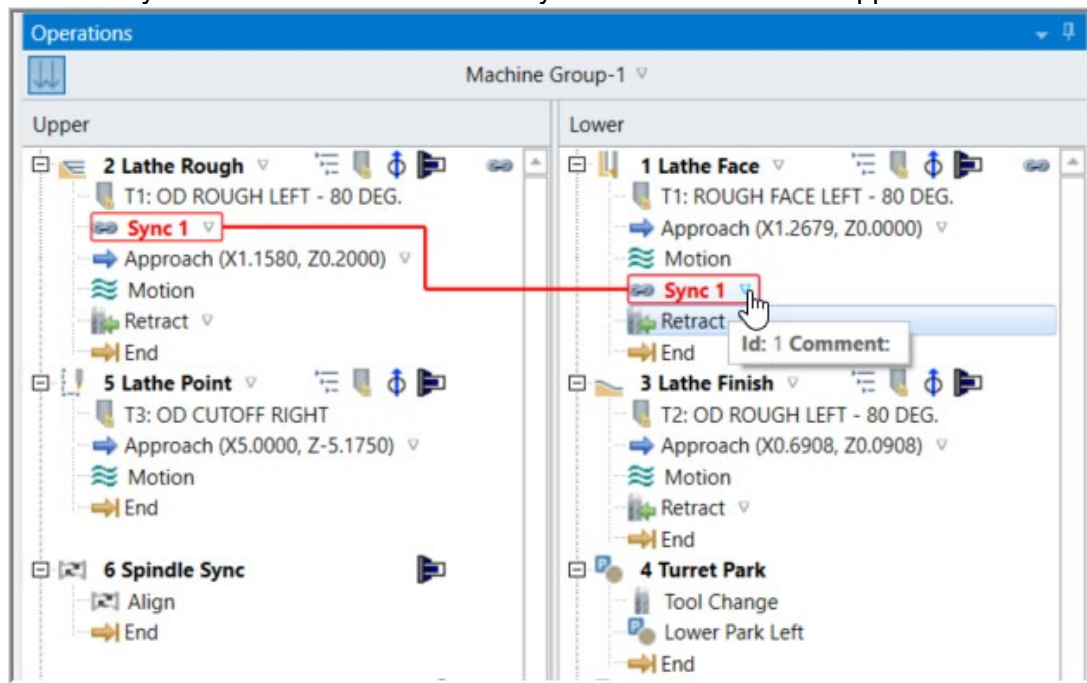


8. **Syncing Operations.** Syncing is done by clicking and holding on an object and dragging to the object you wish to sync with. Our first sync will occur between the **retract of Lower Stream Lathe Face** and the **Approach of the Lathe Rough in the Upper Stream**. Click and hold on the Lathe Face Retract and drag to the Approach of the Lathe Rough and release.

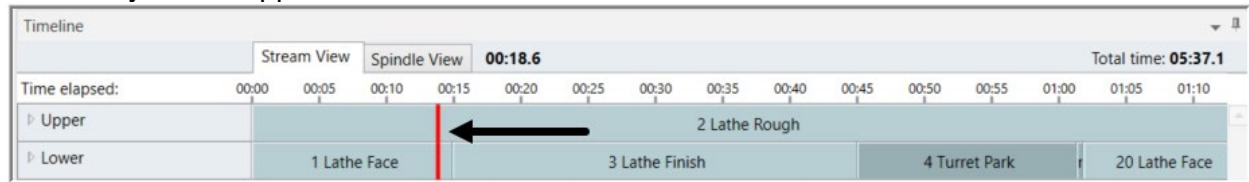


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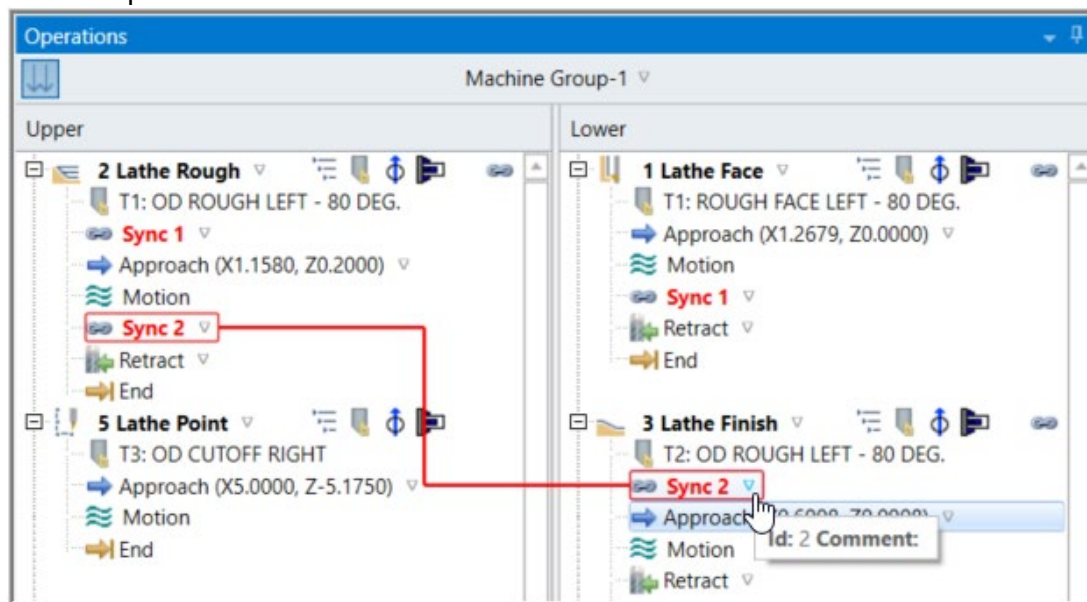
9. Hover your cursor over either of the syncs and a red link will appear.



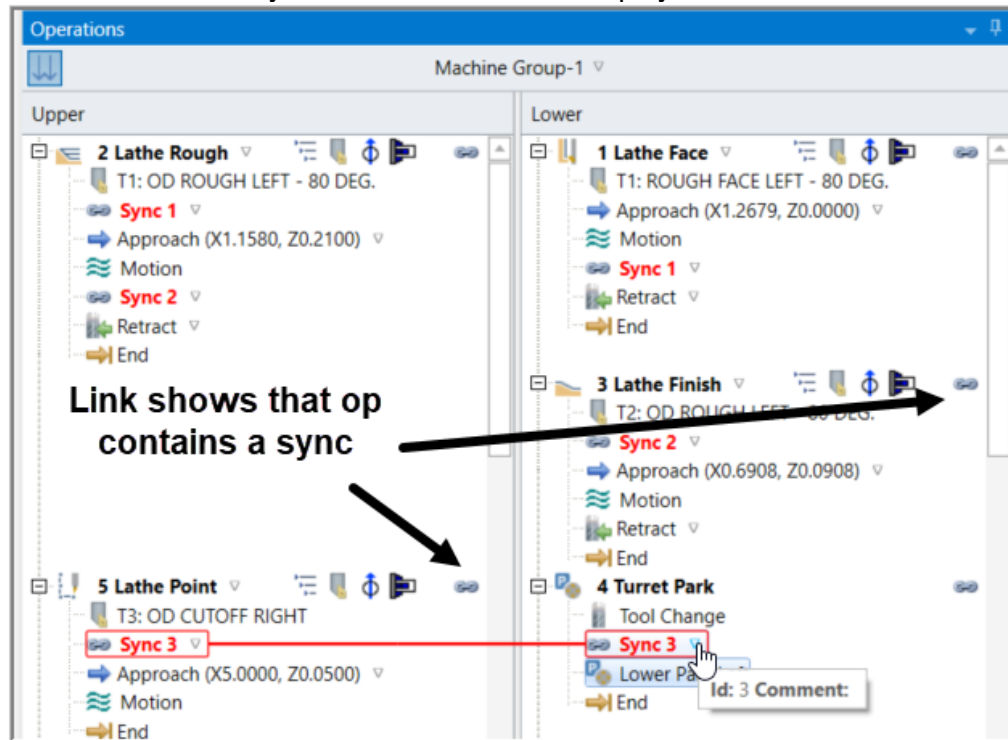
10. The sync also appears in the **Timeline**.



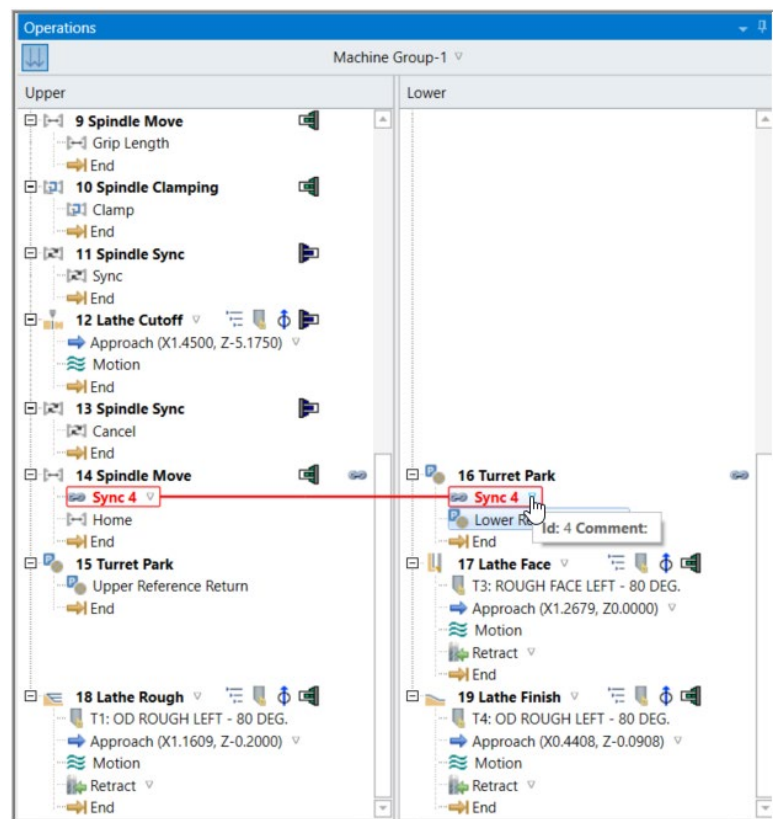
11. The next sync needs to occur once the roughing is done. Sync between the **Lathe Rough Retract** in the Upper Stream and the **Lathe Finish Approach** in the Lower Stream. **Note:** Sync numbers can be changed from the drop-down arrow if needed. Sync numbers cannot be duplicated.



12. Next you will set up a sync between the **End of Turret Park** on the **Lower Stream** and the **Approach of Lathe Point** on the **Upper Stream**. This sync will ensure the lower turret is parked under the left spindle before the POCO routine runs. You will notice op 5 of the Upper Stream is now dropped to be in-line with op 4 of the lower. Also notice that any op that contains a sync will have a link icon displayed with it.

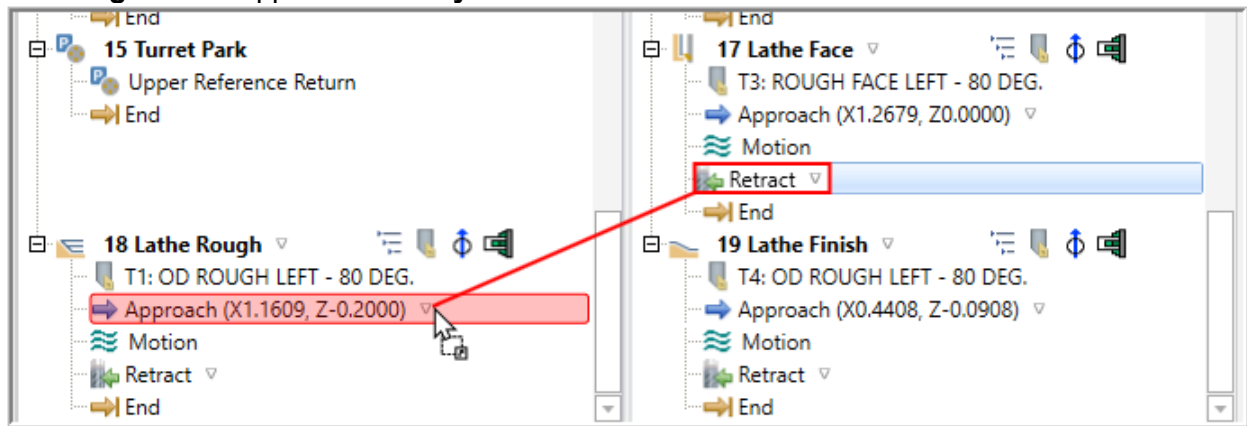


13. After the POCO routine is completed, we need to sync the sub spindles **End** movement (**14 Spindle Move**) with the **Lower Reference Return** of the Turret Park (**16 Turret Park**). **Click and hold** on the **Lower Reference Return** of the 16 Turret Park and drag it down. When you get to the lower extent of the window the **menu will start to scroll**. Drop the sync on the **End** movement of 14 Spindle Move. Sync 4 is created.

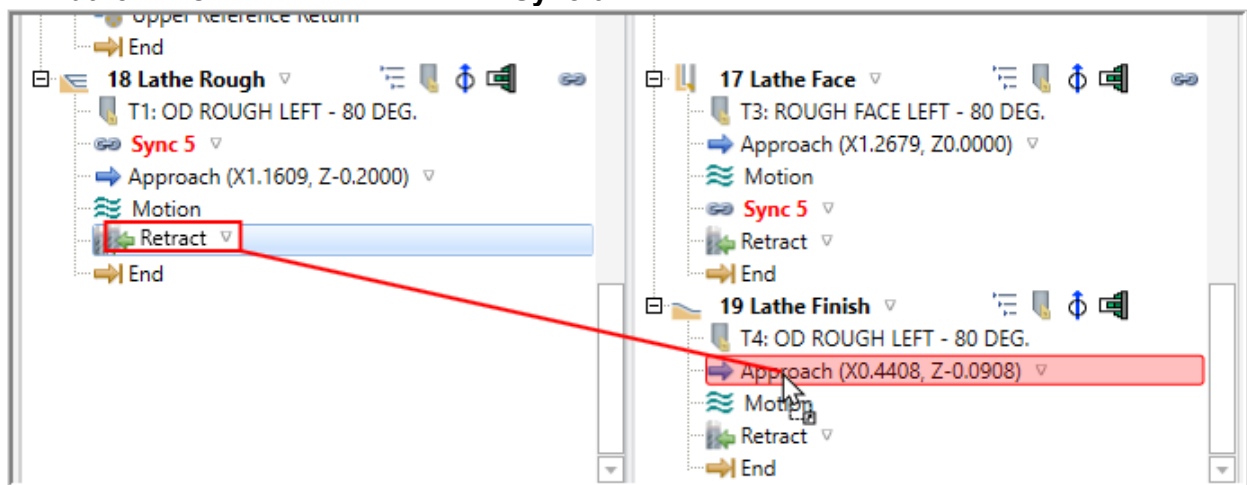



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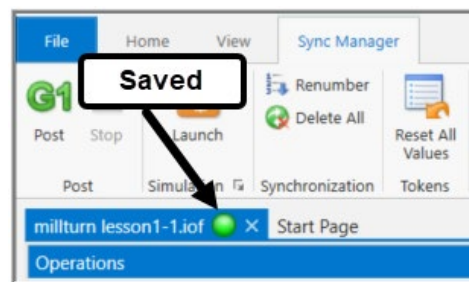
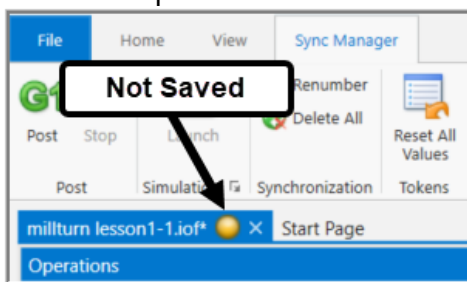
14. All that is left now is to sync the sub spindle ops the same way we did the main spindle.
Sync the **Retract of the Lathe Face** in the Lower Stream with the **Approach of the Lathe Rough** of the Upper Stream. **Sync 5** is created.



15. Then sync the **Retract of the Lathe Rough** in the Upper Stream with the **Approach of the Lathe Finish** in the Lower Stream. **Sync 6** is created.



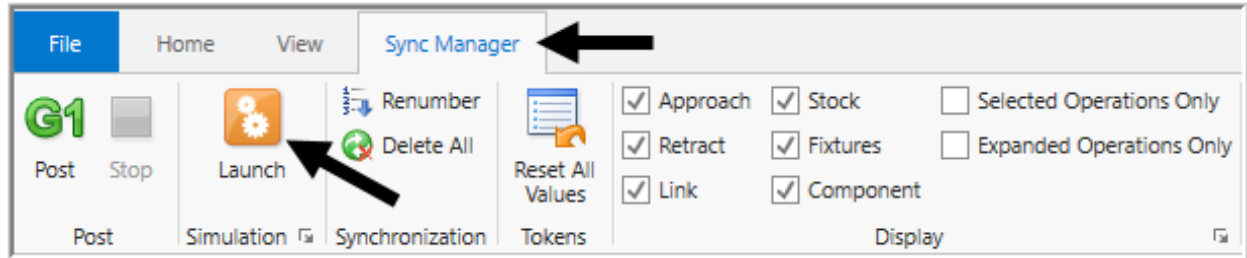
16. **Save** your file.  This will also be written back to the Mastercam file. There is a colored light in the upper left tab of the Code Expert. This light indicates if your current settings are backed up to the Mastercam file.



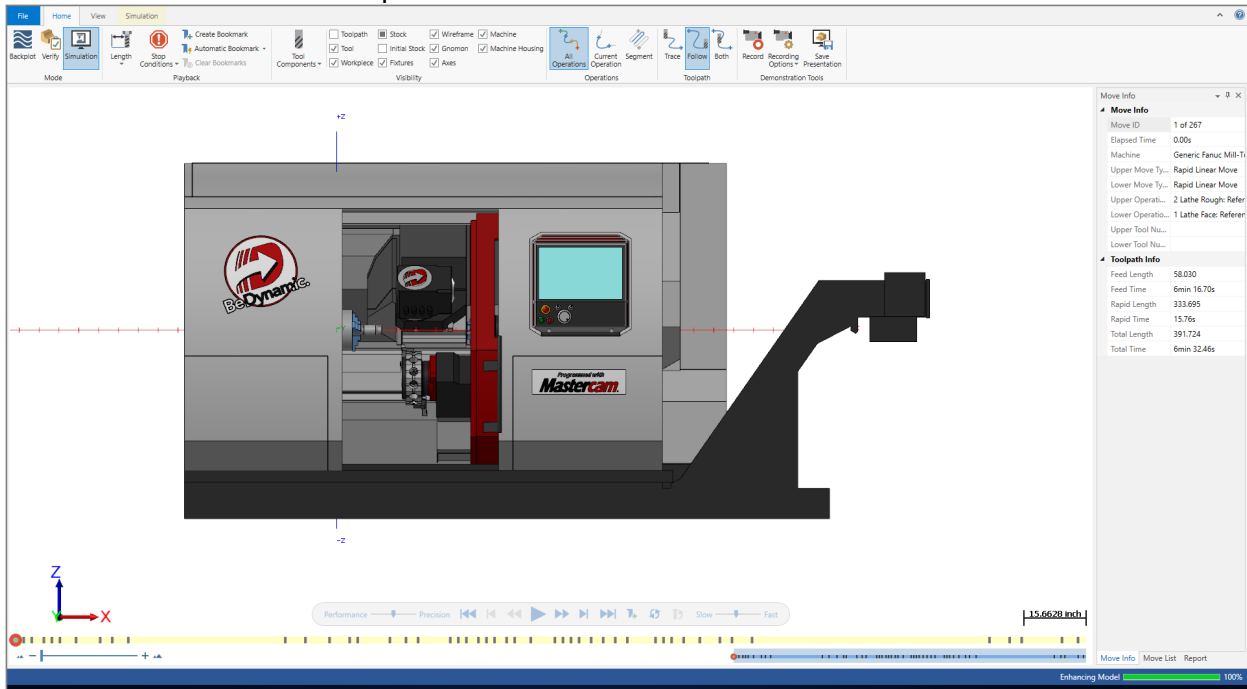
TASK 7: MACHINE SIMULATION:

➔ In this task you will run a complete machine simulation to check for potential problems.

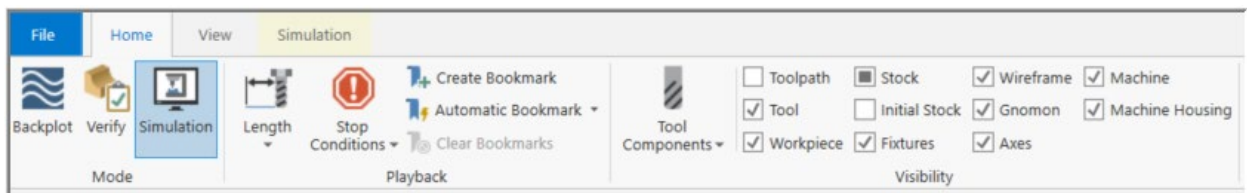
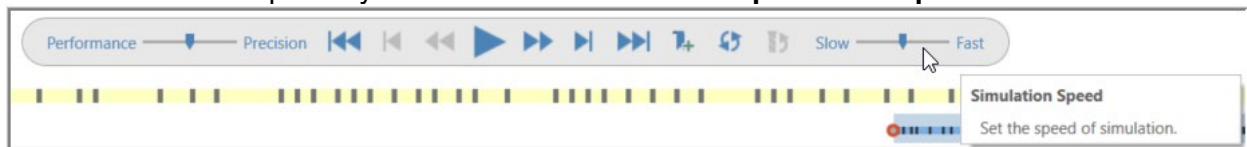
1. In Code Expert, from the **Sync Manager** tab click on the **Launch Icon** to launch machine simulation.



2. Machine Simulation will open.



3. Turn the **speed of the simulation** down to approximately $\frac{1}{4}$ so you can see some of the faster moves. For clarity you can also **toggle the machine housing to transparent or invisible**. Check mark is full visibility, grey box is transparent, and white box is invisible. Transparency can also be set from **File / Options / Graphics** menu.

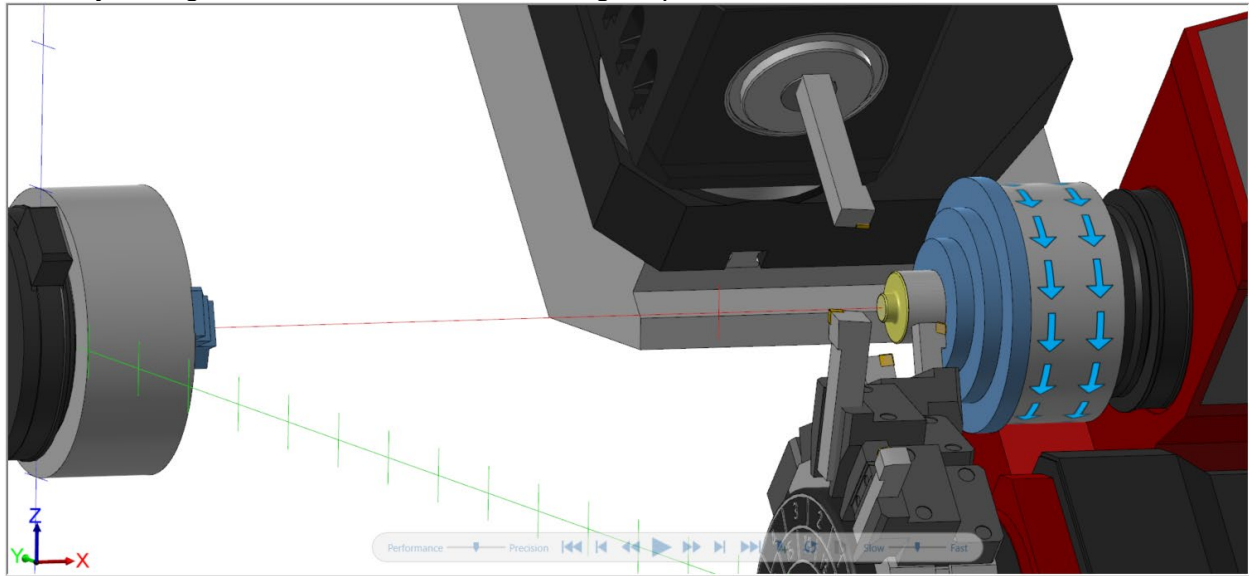


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- Click the **Play** button to start the simulation.



- Play through the entire simulation checking for potential issues.



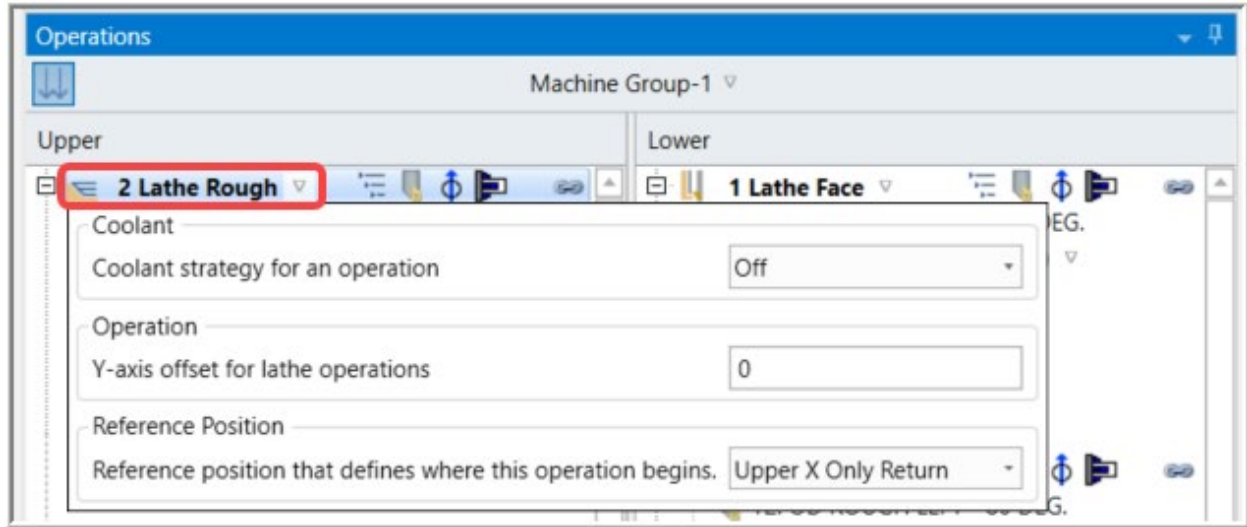
- When you are finished click the **Close** button in the upper right corner and return to Code Expert to post the NC code.



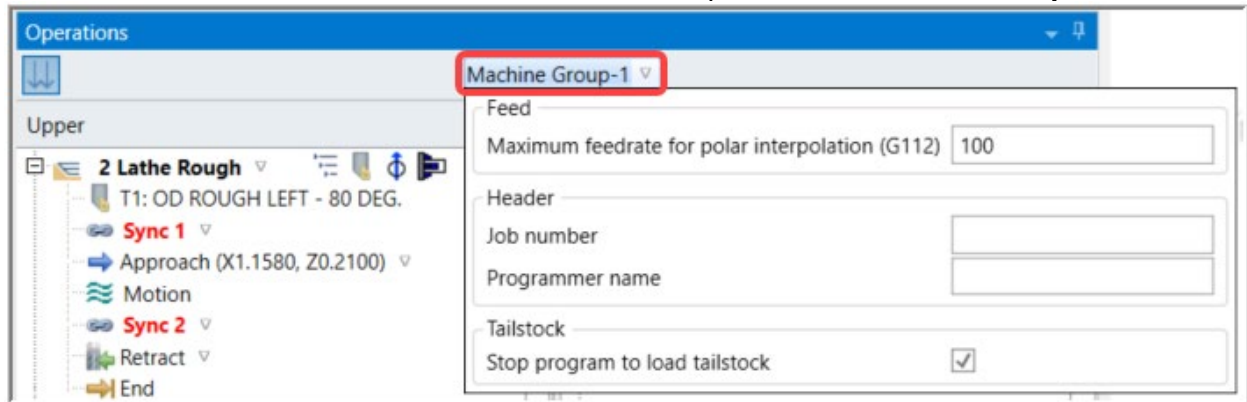
TASK 8:
POSTING THE CODE:


➔ In this task you use code expert to post the NC program.

1. Before we post the code, we have a few extra settings to consider. Each operation has an independent **Coolant Strategy** selection as well as Y-axis offsets and Reference Positions if desired to set. Access from the drop-down arrow for each operation.



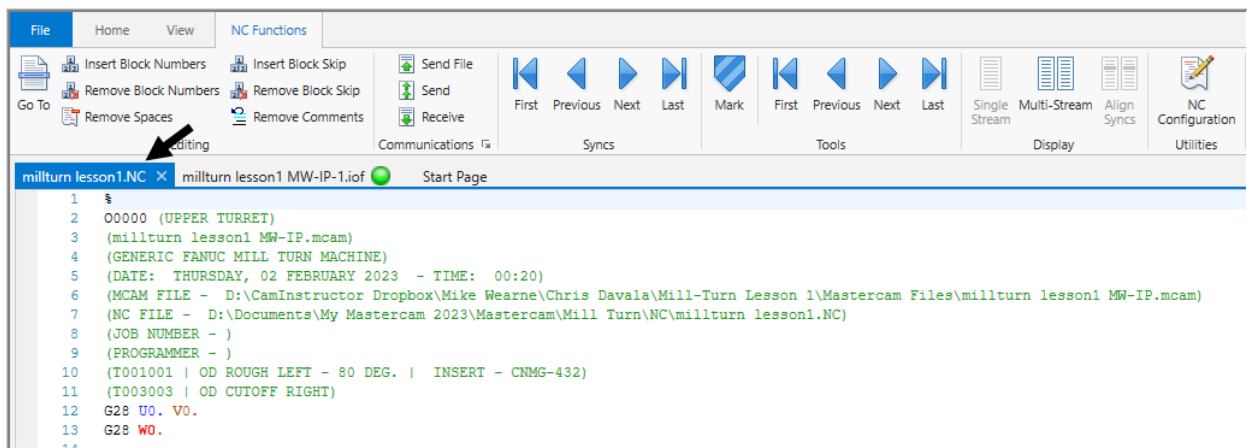
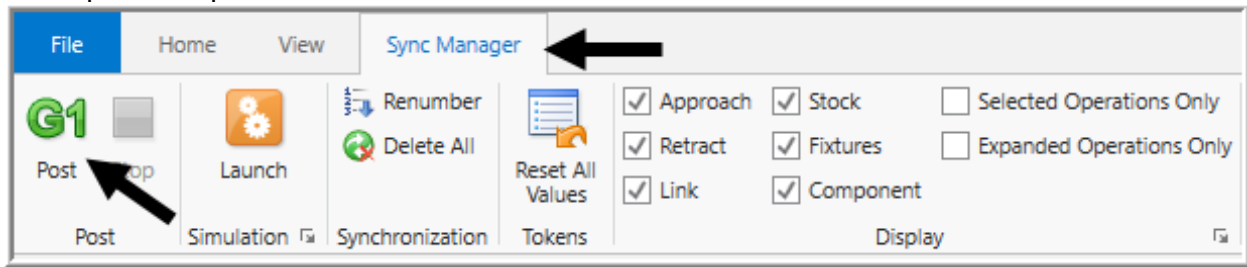
2. You can also enter more information under the drop-down for **Machine Group-1**.



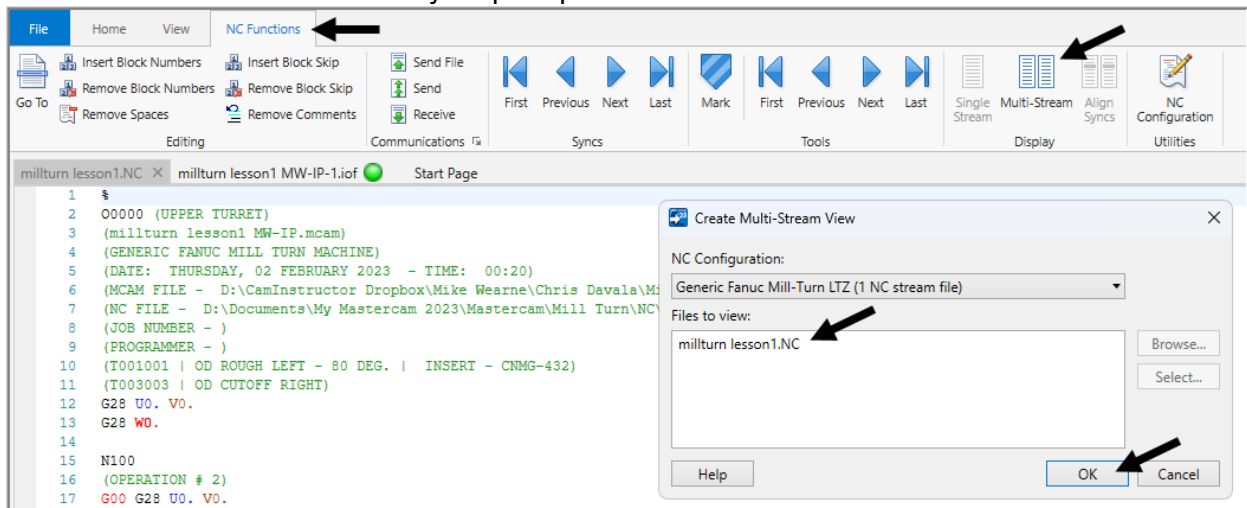
3. **Save** your file. 

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4. **Post** the code by pressing the **G1** button located under the **Sync Manager** tab. Code Expert will open a new tab with the NC code.



5. By default, the code is displayed in single stream. Under the **NC Functions** tab, to switch to **Multi-Stream** mode. You may be prompted to select a file name for multi-stream view.



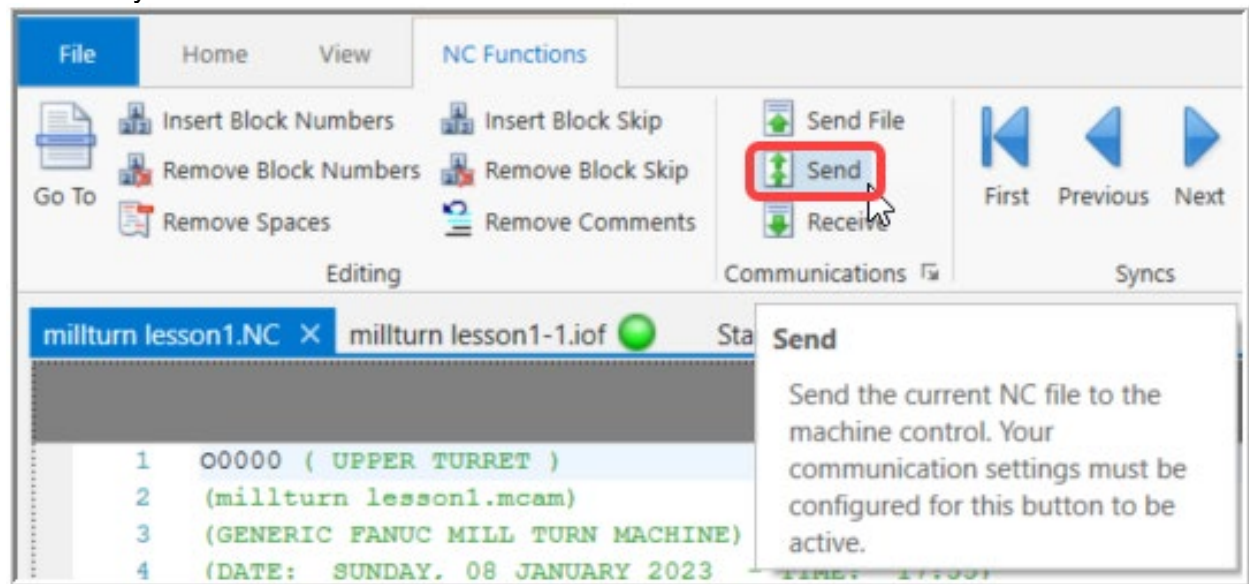
- You will see all the sync points you created. Hovering over one sync point will highlight it in both streams if they are both visible on-screen.

```

millturn lesson1.NC
1 O0000 (UPPER TURRET)
2 (millturn lesson1 MW-IP.mcam)
3 (GENERIC FANUC MILL TURN MACHINE)
4 (DATE: THURSDAY, 02 FEBRUARY 2023 - TIME: 00:20)
5 (MCAM FILE - D:\CamInstructor Dropbox\Mike Wearne\Chris Davala
6 (NC FILE - D:\Documents\My Mastercam 2023\Mastercam\Mill Turn
7 (JOB NUMBER - )
8 (PROGRAMMER - )
9 (T001001 | OD ROUGH LEFT - 80 DEG. | INSERT - CNMG-432)
10 (T003003 | OD CUTOFF RIGHT)
11 G28 U0. V0.
12 G28 W0.
13
14 N100
15 (OPERATION # 2)
16 G00 G28 U0. V0.
17 (T001001 | OD ROUGH LEFT - 80 DEG. | INSERT - CNMG-432)
18 M34
19 G54
20 T001 T003 M6 D001
21 P1
22 G18
23 G97 S330 M04 R11
24 G00 Z.21
25 X2.316
26 G92 S5000
27 G96 S200 R11

millturn lesson1.NC
1 O0001 (LOWER TURRET)
2 (T001001 | ROUGH FACE LEFT - 80 DEG.)
3 (T002002 | OD ROUGH LEFT - 80 DEG. | INSERT - CNMG-432)
4 (T003003 | ROUGH FACE LEFT - 80 DEG.)
5 (T004004 | OD ROUGH LEFT - 80 DEG. | INSERT - CNMG-432)
6 G28 U0.
7 G28 W0.
8
9 N130
10 (OPERATION # 1)
11 G00 G28 U0. V0.
12 (T001001 | ROUGH FACE LEFT - 80 DEG. | INSERT - NONE)
13 M34
14 G54
15 T001001
16 G18
17 G97 S301 M04 R11
18 G00 Z0.
19 X2.5357
20 G92 S5000
21 G96 S200 R11
22 G95 G01 X-.2268 F.01
23 G00 Z.1
24 P1
25 G00 G28 U0. V0.
26 M05 R11
27 M01
    
```

- Your code is now ready to run. If you have communications set up, hit send to send the NC file to your machine.



- This concludes Mill-Turn Lesson 1.