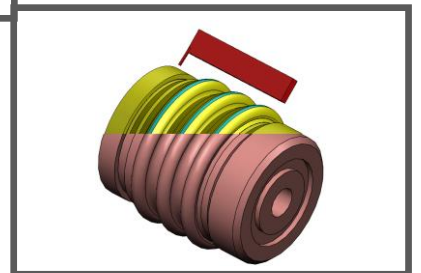
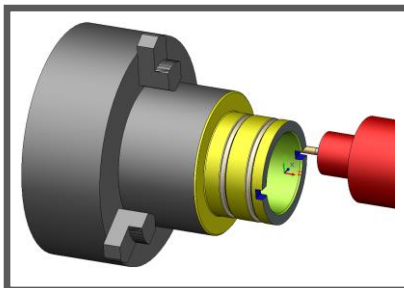
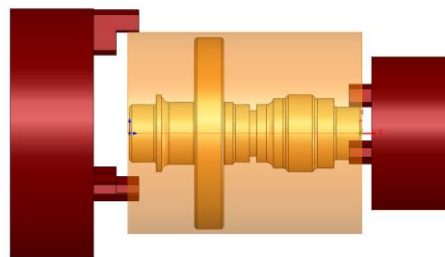
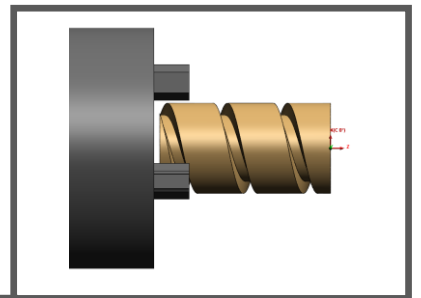
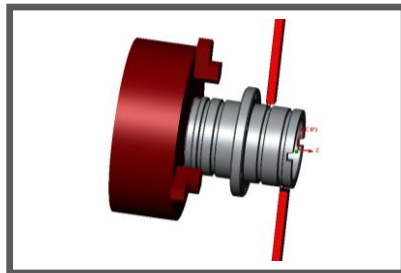


Sub Spindle Operations & CAMWorks Sync Manager Tutorial



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1. SUB SPINDLE OPERATIONS & SYNC MANAGER

This chapter provides an opportunity to learn how to use the Multi-Function module of CAMWorks, which comprises of the Sub Spindle functionality and the CAMWorks Sync Manager.

In this chapter, the tutorial is intended to show you how to use CAMWorks and may not correspond to actual machining practices.

The part of the tutorial is installed when you install CAMWorks and are in the \Examples\Tutorial_Parts\Mill-Turn folder on your computer. This folder is inside the CAMWorks data folder (Location: \CAMWorksData\CAMWorks202Xx64\Examples\Tutorial_Parts\Mill-Turn).

Before you begin with the tutorial given in this chapter, ensure that you are thorough with the concepts explained in Turn Tutorial Manual. You can access this tutorial by selecting Start on the Windows task bar and then selecting **CAMWorks202Xx64>>Manuals>>Turn Tutorial**.

IMPORTANT! CAMWorks uses a set of knowledge-based rules to assign machining operations to features. The Technology Database contains the data for the machining process plans and can be customized for your facility's machining methodology. When you do these exercises, your results may not be the same as described in the steps and illustrated in the figures. This is because the machining sequences and operations data in your Technology Database may be different from the database used to produce the documentation.



Sub Spindle Operations and Sync Manager Tutorial

This tutorial demonstrates the use of Sub Spindle operations and the CAMWorks Sync Manager.



The Sub Spindle operations can be used in Turn and Mill-Turn machines having Sub spindles. These operations help you to reposition the stock in the Main spindle by pushing or pulling, to transfer the part from Main spindle to Sub spindle. These Sub Spindle operations are a set of steps that together carry out the task of transferring the part from Main to Sub spindle and vice versa, relocating the part in the spindle or even supporting the part while some cutting operations are carried out on the part.



The Sync Manager helps in optimizing the toolpaths on multi-function machines. These machines can be either Turn or Mill-Turn machines having a twin-spindle setup or twin turrets along with one or two spindles. The turn toolpaths that require similar speed and feeds can be synchronized by using the Sync Manager.



If your CAMWorks license does not support Multi Function module, then all commands related to Sub spindle operations and Sync Manager will be disabled.

Topics covered in this tutorial:

In this tutorial, the stock shape, features, operations and toolpaths required to machine the Mill-Turn part model (which will be machined on a Mill-Turn machine with twin spindle setup) have already been generated.

The following aspects will be cover in detail:

- Defining a Sub Spindle operation and saving it
- Location of the saved Sub Spindle operation files
- Using the CAMWorks Sync Manager to synchronize toolpaths

Step 1: Opening the Part

1. Open part file **Sync_Manager_Demo.SLDPRT** in the following folder.

Drive:\CAMWorksData\CAMWorks202x\Examples\Tutorial_Parts\Mill-Turn.

2. Examine the part. Observe that the features, operations and toolpaths already have been generated.



3. Click on the *Operation tree*. Observe that to completely machine the part, you need to machine the part from both the directions. Operations are machined from both the Main and Sub spindles.

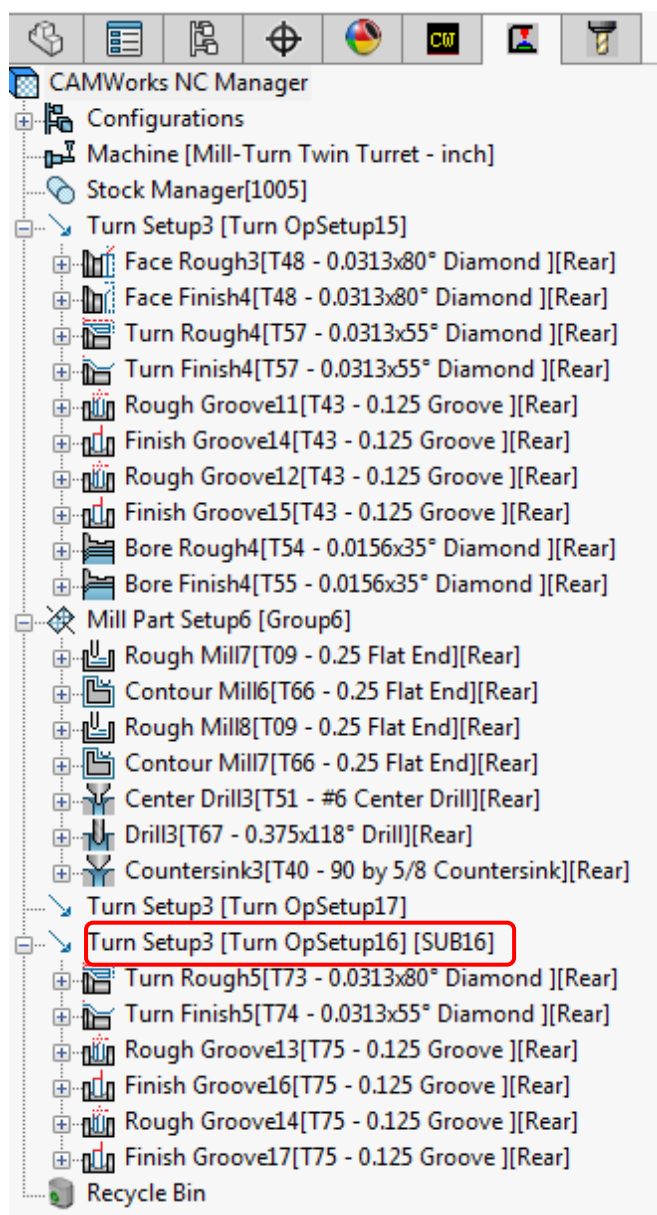


Sync_Manager_Demo.SLDPRT




CAMWorks Sync Manager Tutorial

Hence, you will need to transfer the part to the Sub spindle after the completion of drilling on the hinge area by the *Mill Part Setup6* (from Main Spindle).



Generated Toolpaths

Step 2: Adding a User-Defined Sub Spindle Operation

1.  Highlight *Turn Setup3 [TurnOpSetup16]* in the Operation tree and click on the *New Sub Spindle Operation* button on the CAMWorks Command Manager.


OR


Right click *Turn Setup3 [TurnOpSetup16]* in the Operation tree and select *New Sub Spindle Operation* command from the context menu.

The *New Sub Spindle Operations* dialog box is displayed.

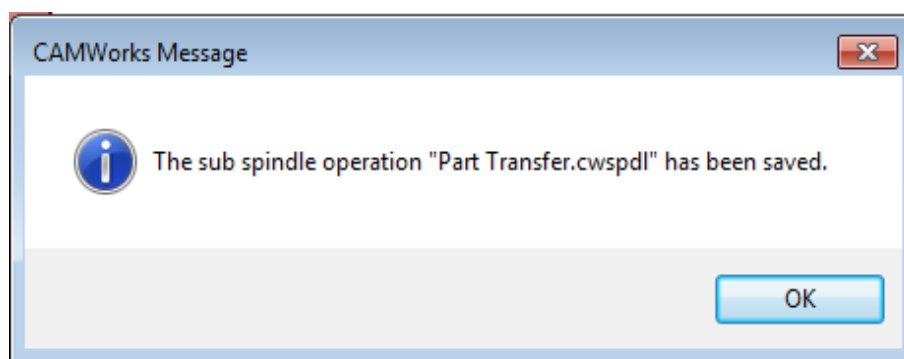
2. In the *Available Templates* list, select *[NEW]*.





3.  Click OK to insert the operation.



This action will display an empty Sub Spindle operation. You can add the desired steps for the operation in the displayed *Sub Spindle Parameters* dialog box.
4. In the *Name* field, assign the name '*Part Transfer*'.
5. In the *Description* field, enter the text '*Part Transfer from Main Spindle to Sub Spindle*'.
6.  Click on the Save button to save the newly created Sub Spindle operation to the local system.

The CAMWorks message dialog box is displayed.

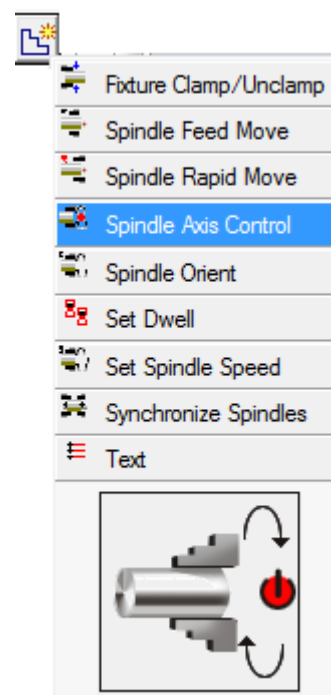


CAMWorks message

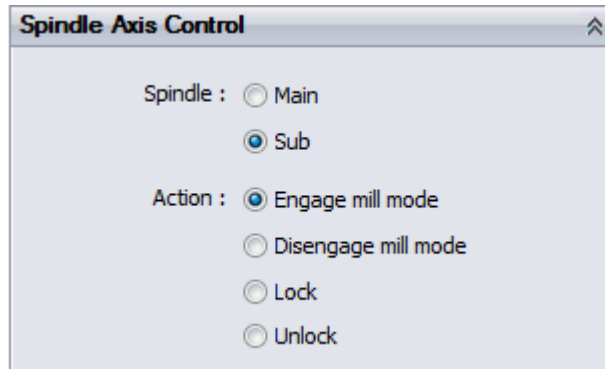
7. Click OK to close the message dialog box.
8.  In the *Steps* group box, click on the *New Steps* button.
9. From the dropdown list of steps, select the  *Spindle Axis Control* step. This will be the first step of the Sub Spindle operation.
10. This action activates the step-specific group box below the *Steps* group box. In this case, the *Spindle Axis Control* group box will display. In this group box:
 - Select *Main* as the Spindle.
 - Select *Disengage mill mode* as the action.

This action sets the Main Spindle to Disengaged mill mode condition.
11.  Click on the *New Steps* button and once again select the  *Spindle Axis Control* step. This will be the second step in the Sub Spindle operation.
12. In the *Spindle Axis Control* group box:
 - Select *Sub* as the Spindle.
 - Select *Engage mill mode* as the action.

This action sets the Sub Spindle to Engage mill mode condition.



Select Spindle Axis Control from list of steps



Spindle Axis Control group box

13. The next step will be to orient both the Main and Sub spindles.

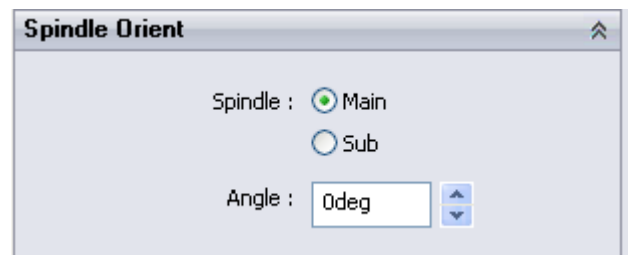
14.  Click on the *New Steps* button and select  *Spindle Orient*. This action will add a new step *Spindle Orient* to the list. The *Spindle Orient* group box is activated.

15. In the *Spindle Orient* group box:



- Select *Main* as the Spindle.
- Leave the Angle set to **0deg**.

16. Once again, insert a *Spindle Orient* step.

- This time select *Sub* as the Spindle type.
- Leave the Angle set to **0deg**.

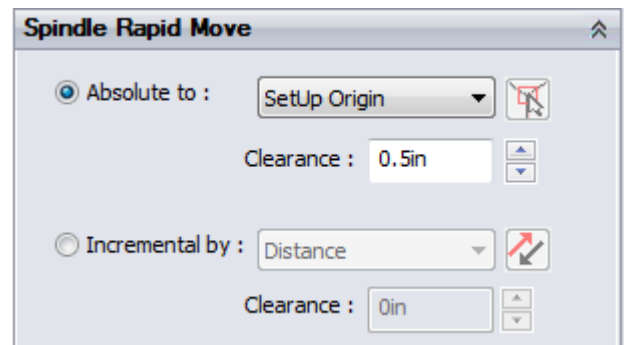


Spindle Orient group box



17.  Click on the *New Steps* button and select  *Spindle Rapid Move* step from the list of steps. This step will insert a rapid move for the Sub spindle.

18. In the activated *Spindle Rapid Move* group box:

- Check the *Absolute To* option.
- Leave the point type set to *SetUp Origin*.
- Add a clearance of **0.5in**. This will ensure that the Sub Spindle stops **0.5in** away from the setup origin.

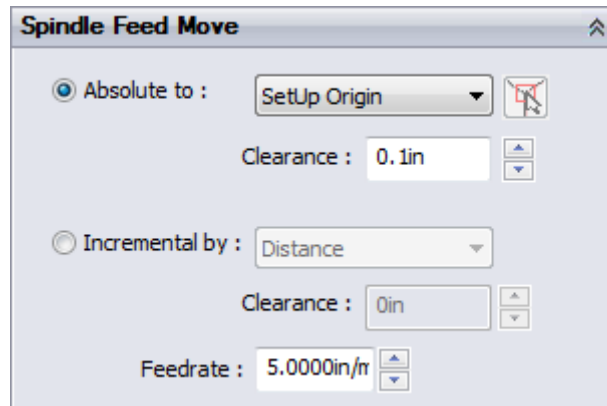


Spindle Rapid Move group box

19.  Click on the *New Steps* button and select  *Spindle Feed Move* step from the list of steps.

20. In the activated *Spindle Feed Move* group box:

- Check the *Absolute To* option.
- Leave the point type set to *SetUp Origin*.
- Add a clearance of **0.1in**. This will ensure that the chuck face stays **0.1in** away from the part setup origin which is at the front face of the part.





The **Spindle Feed Move** dialog box contains the following settings:

- Absolute to :** ☒ **SetUp Origin** (with a selection icon)
- Clearance :** 0.1in
- Incremental by :** ☐ **Distance**
- Clearance :** 0in
- Feedrate :** 5.0000in/min

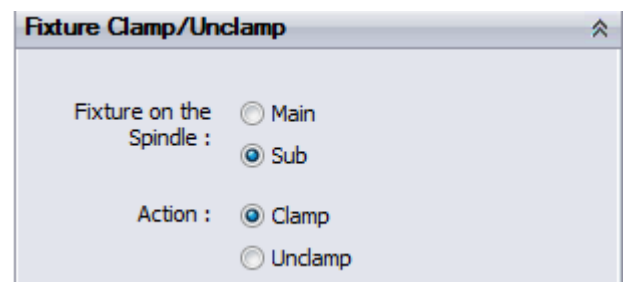
Spindle Feed Move group box

21. The next step will be to clamp the part in the

Sub Spindle chuck.  Click on the **New Steps** button and select  **Fixture Clamp/Unclamp** step from the list of steps.

22. In the **Fixture Clamp/Unclamp** group box:



- Select **Sub** as the Fixture on the Spindle type.
- Set the Action to **Clamp**.





The **Fixture Clamp/Unclamp** dialog box contains the following settings:

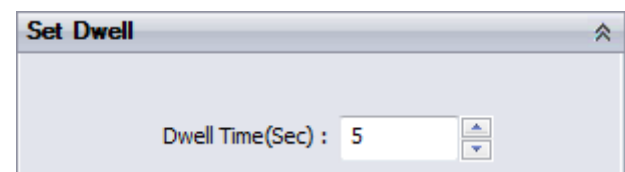
- Fixture on the Spindle :** ☐ **Main**, ☒ **Sub**
- Action :** ☒ **Clamp**, ☐ **Unclamp**

Fixture Clamp/Unclamp group box

23.  Click on the **New Steps** button and select  **Set Dwell** step from the list of steps.

24. In the **Set Dwell** group box, set the **Dwell Time** to **5seconds**.

25. The next step will be to unclamp the part from the Main Spindle chuck.  Click on the **New Steps** button and select  **Fixture Clamp/Unclamp** step from the list of steps.





The **Set Dwell** dialog box contains the following setting:

- Dwell Time(Sec) :** 5



Set Dwell group box

26. In the **Fixture Clamp/Unclamp** group box:

- Select **Main** as the Fixture on the Spindle type.
- Set the Action to **Unclamp**.

27.  Click on the **New Steps** button and select  **Set Dwell** step from the list of steps.

28. In the **Set Dwell** group box, set the **Dwell Time** to **5seconds**.

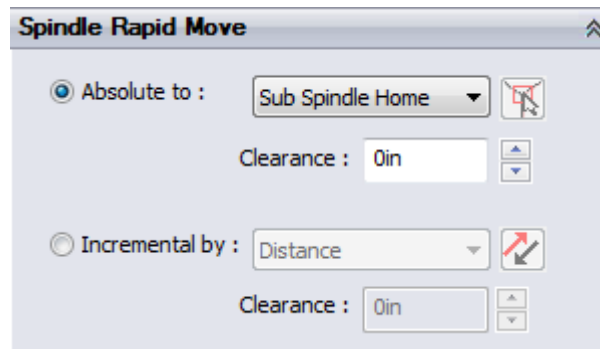
29. To move the Sub Spindle to its home position, you need to insert a step to move the Sub spindle in Rapid.  Click on the **New Steps** button and select  **Spindle Rapid Move** step from the list of steps.

30. In the **Spindle Rapid Move** group box:

- Check the **Absolute To** option.
- Set the point type set to **Sub Spindle Home**



- Leave the Clearance set to **0inch**.

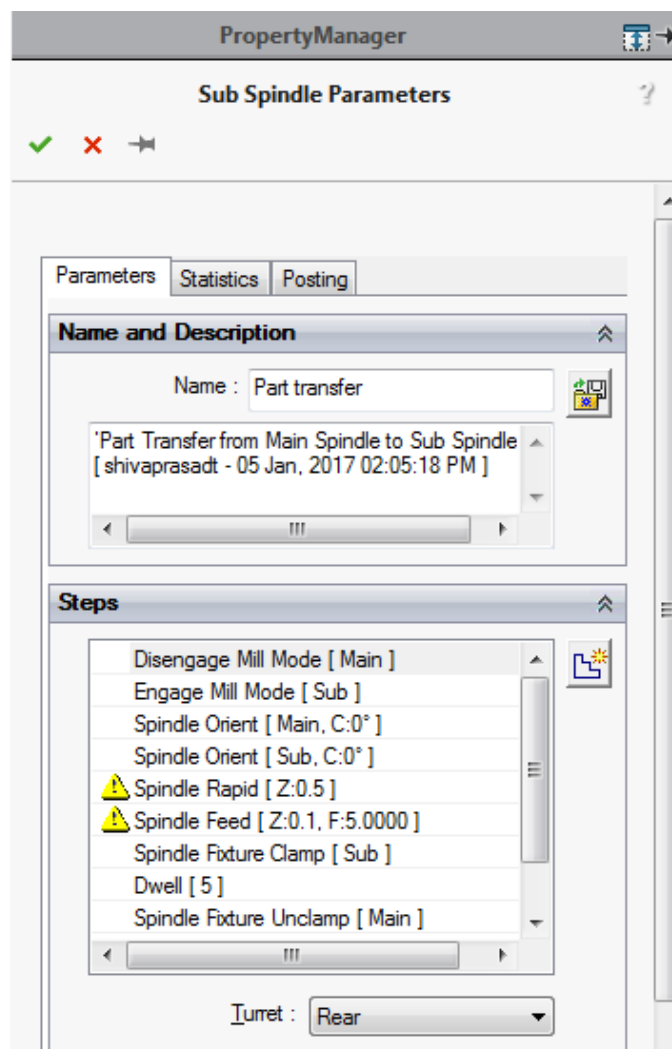


Spindle Rapid Move group box

31. This action will make the Sub Spindle to move to its home position.
32. In the *Steps* group box, scroll through the different added steps by highlighting them. Observe how the chuck display changes in the graphics area.

33.  In the *Name and Description* group box, click *Save*.

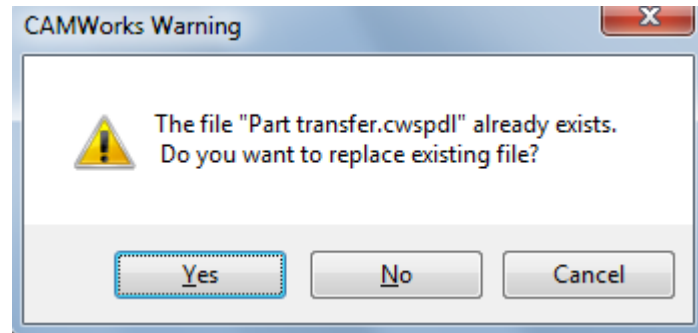
This action will save the existing set of steps.



Sub Spindle Parameters dialog box




34. You will get a message asking you whether you wish to replace the existing Sub Spindle operation file. Select Yes to replace it.



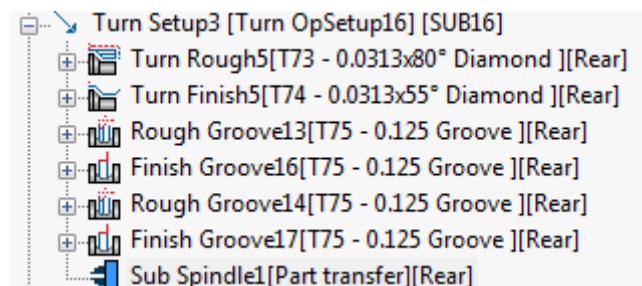
CAMWorks Warning message

35. The CAMWorks message is displayed indicating that the operation has been successfully saved.
36. Click OK to close this message.

Observe that after you Save the operation, the time of saving the operation is displayed in the *Description* field automatically.

37.  Click OK to close the *Sub spindle Parameters* dialog box.

Observe the *Sub Spindle Setup* in the Operation tree. The newly inserted Sub Spindle operation *Sub Spindle3 [Part Transfer][Rear]* is listed.

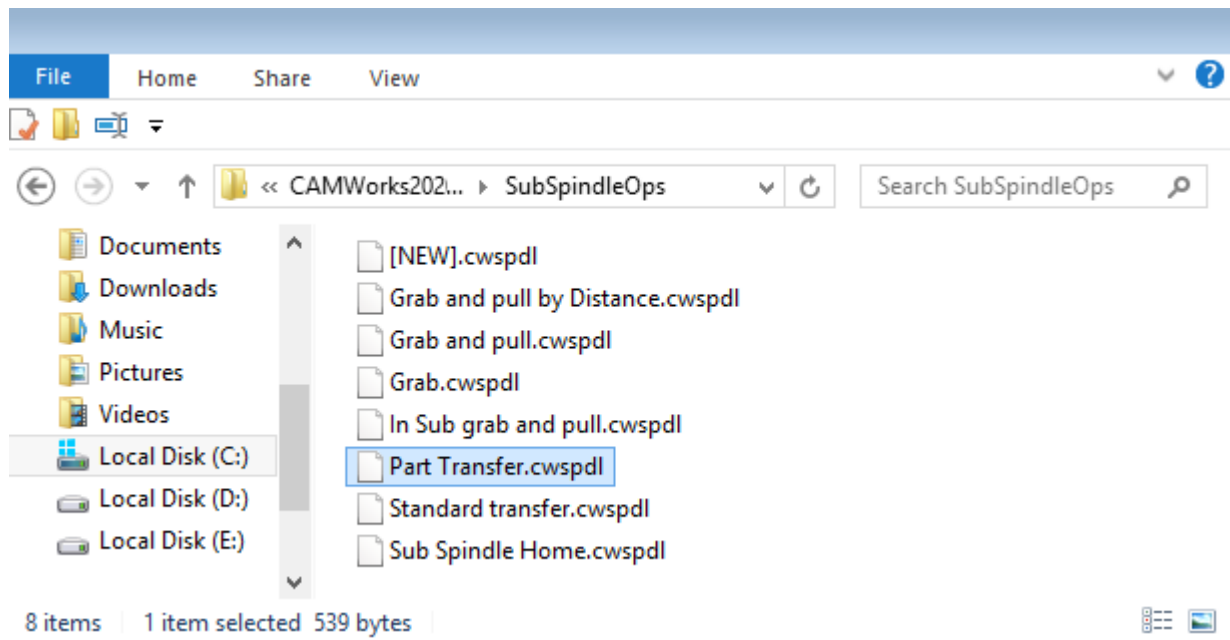


Sub Spindle Operation listed in Setup

Location of the saved Sub Spindle Operation files

The saved Sub spindle operation file can be used on other parts for transferring the parts from Main to Sub spindle. All saved files are stored at following location on the local system on which CAMWorks is installed.

Drive:\CAMWorksData\CAMWorks202Xx64\SubSpindleOps [on 64-bit machines]



Typical Default Location of the Saved Sub Spindle Files


Step 3: Using CAMWorks Sync Manager to Synchronize Operations

In this section, you will synchronize the toolpaths by assigning them different turrets. You can also add wait codes so that the toolpaths begin cutting at the same time.



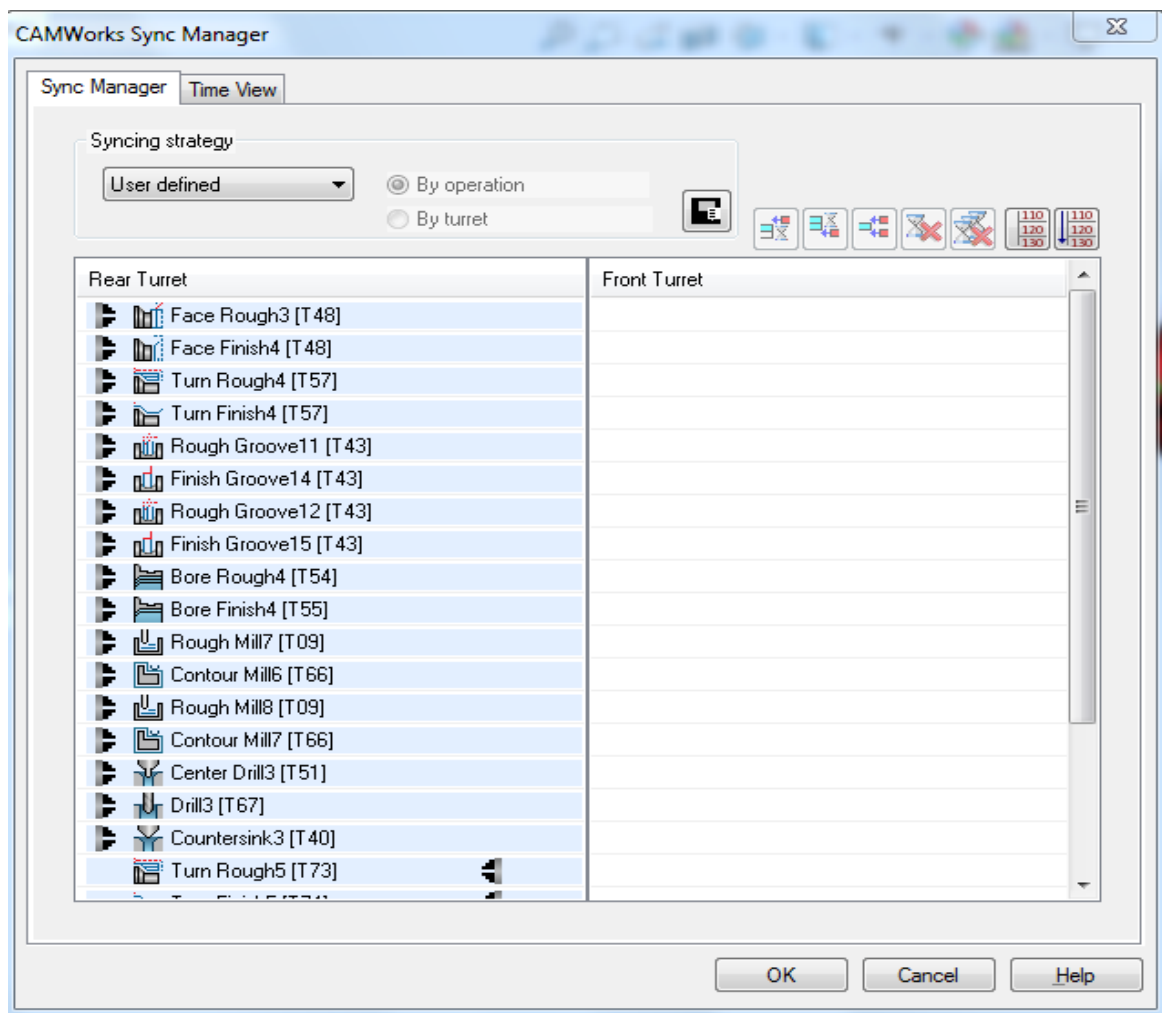
The CAMWorks Sync Manager allows you to re order the operations and synchronize compatible operations so that they can be carried out at the same time. This will help in reduction of machining time. The User Interface of CAMWorks Sync Manager has been designed such that user can drag and drop the operations from the list of one turret into the list of another turret.



1. Click on the *CAMWorks Sync Manager* button on the CAMWorks Command Manager.
2. The *CAMWorks Sync Manager* dialog box is displayed.
3. In the CAMWorks Sync Manager dialog box, the first tab is the *Sync Manager* tab. In this tab:
 - The Sync Manager list display the operations based upon the turret being used in the respective toolpath.
For example, all the operations using tools from rear turret will be listed in the left column and all the operations using the front turret will be listed in right column.
 -  The chuck icon next to the Operation node indicates the spindle on which the part is being machined in that particular operation.



- You can insert wait codes to synchronize operations which can then be carried out at the same time.
- The Syncing strategies can be set as either *User defined* or *Sequential*.



Sync Manager tab on CAMWorks Sync Manager dialog box

In this tutorial, you will set the Syncing strategy as User defined and insert the wait code at required locations.

Synchronizing Operations machine from Main Spindle

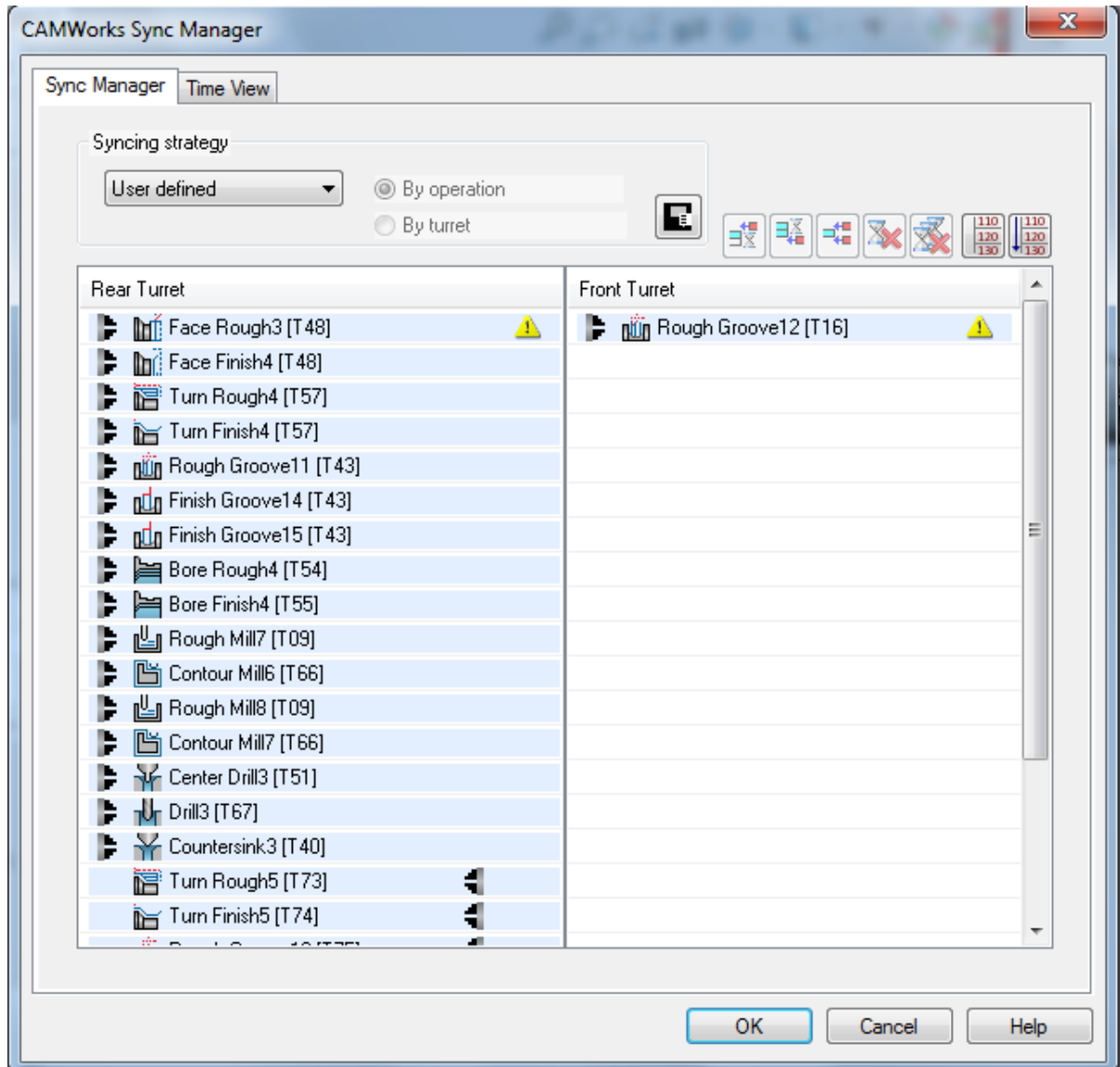
1. Highlight the operations *Rough Groove11*, *Finish Groove14*, *Rough Groove12* and *Finish Groove15* that are displayed in sequential order in the *Rear Turret* column of CAMWorks Sync Manager dialog box and view their toolpaths in the graphics area.
 - Both the Rough groove operations can use the same speed and feed.
 - Likewise, both the Finish groove operations can use similar speed and feed.
2. At this moment, all the operations are being cut by tools from *Rear Turret*. We can move one set of rough groove and one set of finish groove operations to *Front Turret*.



Synchronizing the *Rough Groove11* and *Rough Groove12* operations:

To synchronize the *Rough Groove11* and *Rough Groove12* operations, following are the steps:

- i. Drag and drop *Rough Groove 12* from the Rear Turret column in the Front Turret column. The operation gets listed in the Front Turret column.
- ii. Now highlight this operation in the Front Turret column and observe that its tool Orientation and the position of the toolpath have been changed in the graphics area.





***Rough Groove12* operation dropped to Front Turret column**



Inserting Wait Codes for synchronizing Rough Groove operations:

You need to insert wait codes so that *Rough Groove11* and *Rough Groove12* will start cutting at the same time. It will also ensure that no other operation will be machined until the longer of these two operations is completed. To do so, following are the steps:

- i. Press the *Control* key and highlight *Rough Groove11* in the Rear Turret list and *Rough Groove12* in the Front Turret list.
- ii.  Click on the *Insert Wait Code before the selected operation* button.
- iii. Once again, press the *Control* key and highlight *Rough Groove11* and *Rough Groove12* operations in the respective column.
- iv.  Click on the *Insert Wait Code after the selected operation* button.

This action will insert wait codes before and after both these operations.



Synchronizing the *Finish Groove14* and *Finish Groove15* operations:

To synchronize the *Finish Groove14* and *Finish Groove15* operations, following are the steps:

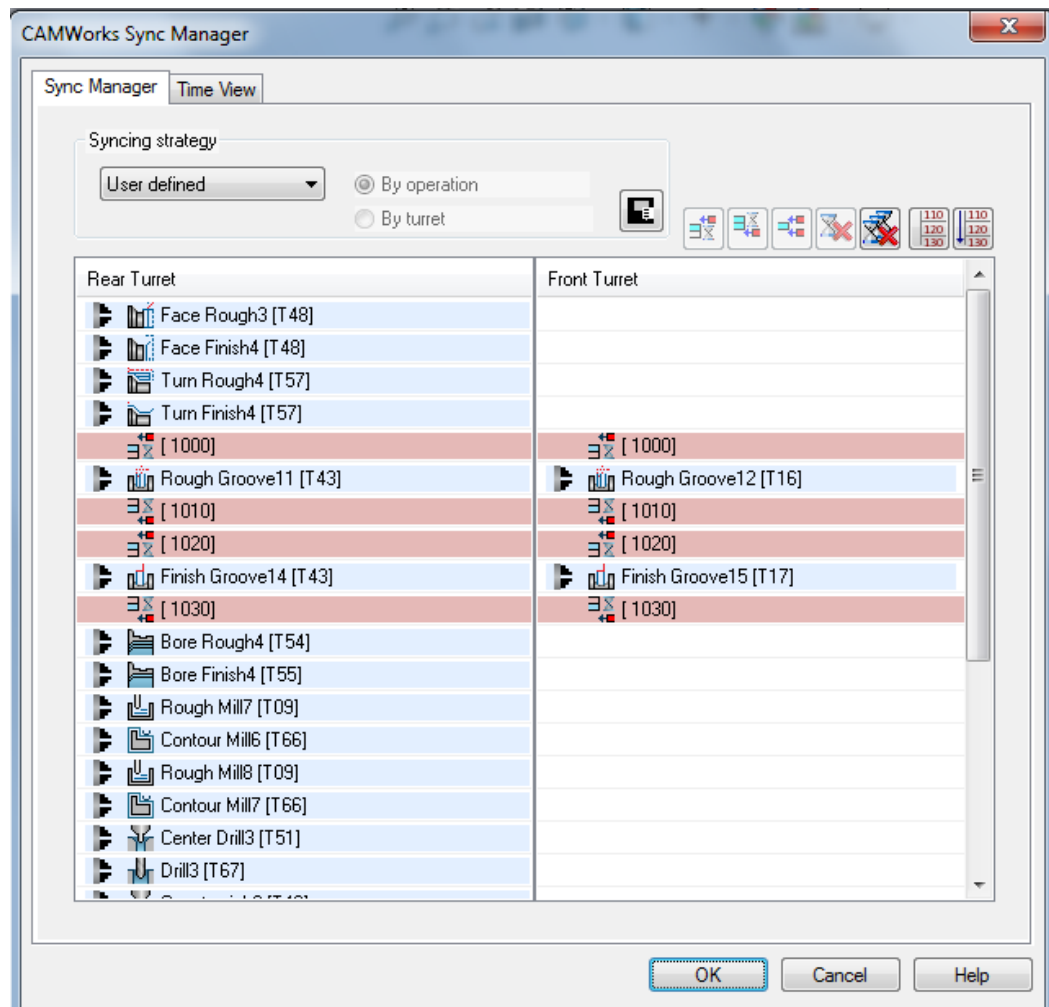
- i. Drag and drop *Finish Groove 15* from the Rear Turret column in the Front Turret column. The operation gets listed in the Front Turret column.
- ii. Now highlight this operation in the Front Turret column and observe that its Tool Orientation and the position of the toolpath has been changed in the graphics area.

Inserting Wait Codes for synchronizing Finish Groove operations:

You need to insert wait codes so that *Finish Groove14* and *Finish Groove15* will start cutting at the same time. To do so, following are the steps:

- i. Press the *Control* key and highlight *Finish Groove14* in the Rear Turret list and *Finish Groove15* in the Front Turret list.
- ii.  Click on the *Insert Wait Code before the selected operation* button.
- iii. Once again, press the *Control* key and highlight *Finish Groove14* and *Finish Groove15* operations.
- iv.  Click on the *Insert Wait Code after the selected operation* button.

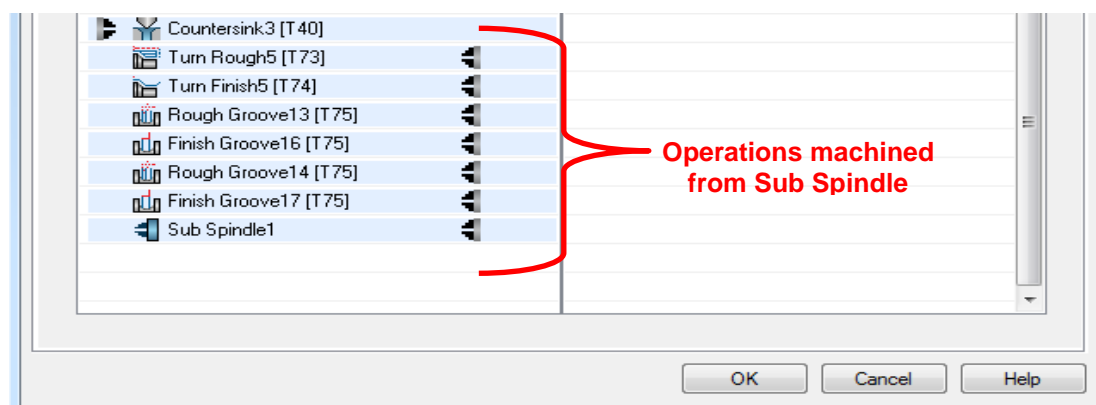
This action will insert wait codes before and after both these operations.



Synchronized Rough Groove and Finish Groove operations

Synchronizing Operations machined from the Sub Spindle

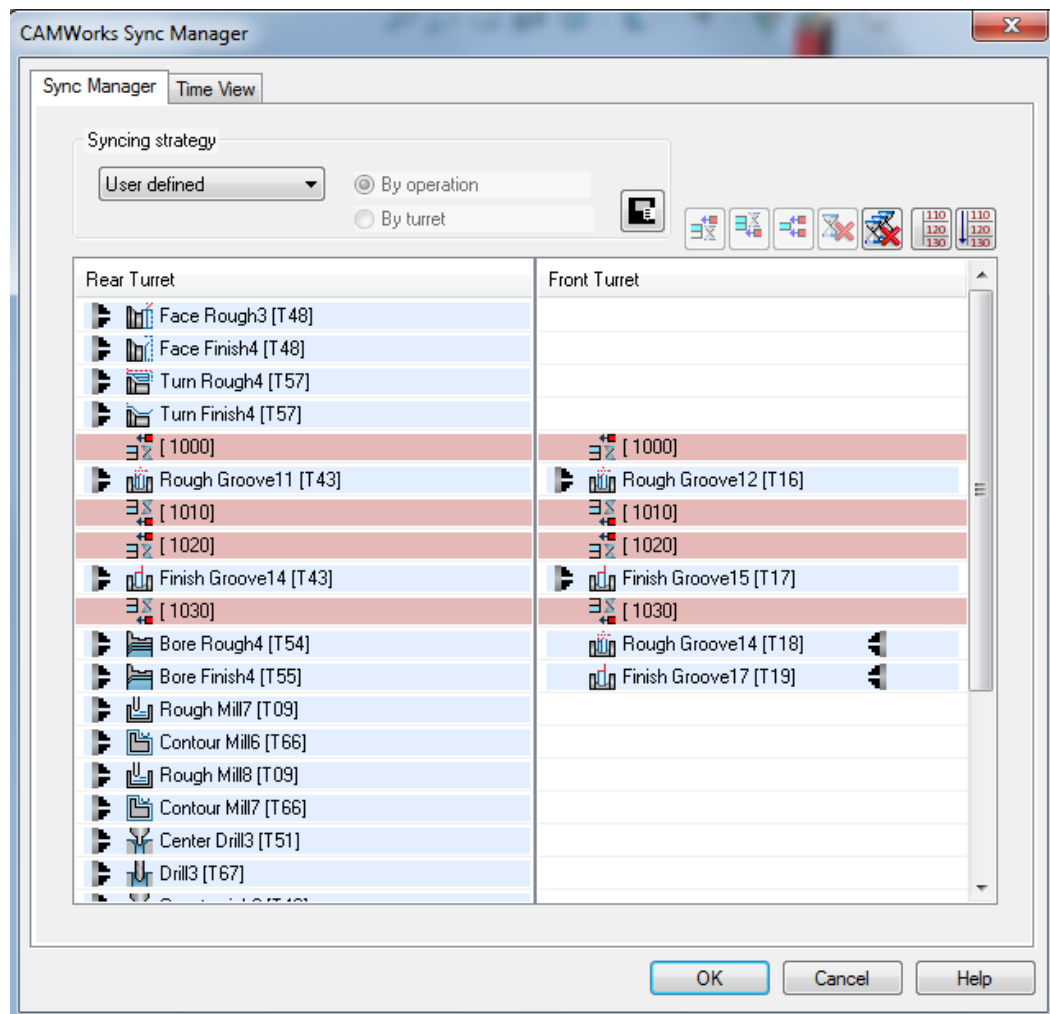
1. Scroll down and observe that there some operations being carried out on the sub spindle. Here also we can synchronize the groove operations, as they can be executed using similar feed and speeds.





Sub Spindle operations



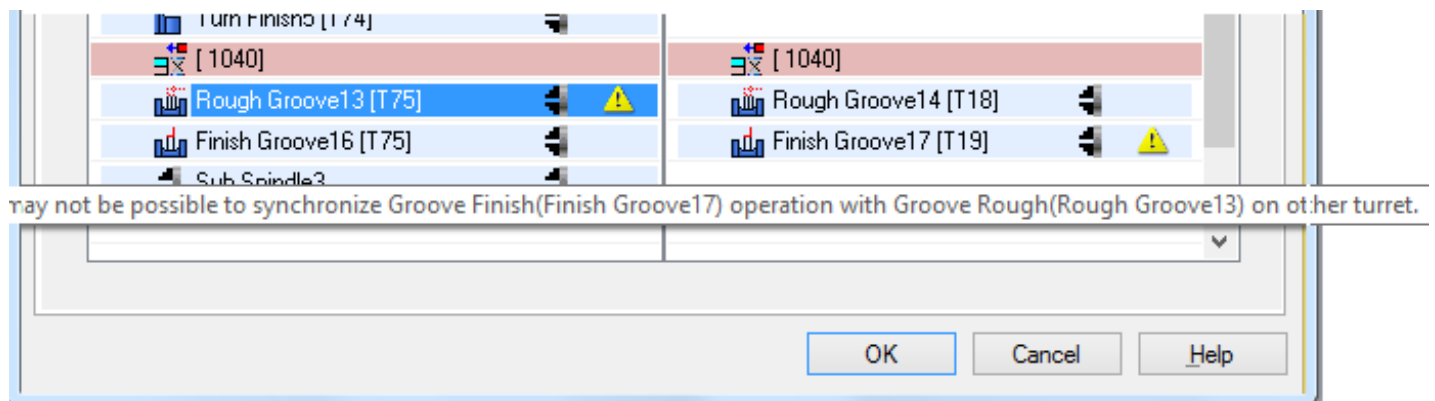
2. Drag and drop *Rough Groove 14* from the Rear Turret column in the Front Turret column. Similarly select *Finish Groove 17* and drag and drop it in the Front Turret column. The operations get listed in the Front Turret column.




Rough Groove and Finish Groove operations transferred to Front Turret

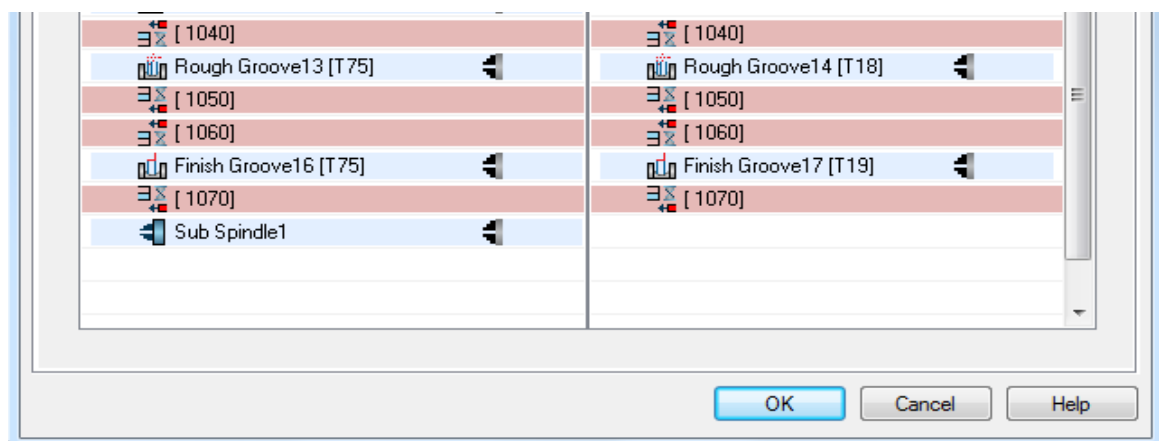
3. Press the *Control* key and highlight *Rough Groove13* in the Rear Turret list and *Rough Groove14* in the Front Turret list.
4.  Click on the *Insert Wait Code before the selected operation* button.
5. Observe that a warning symbol  may appear next to the *Rough Groove 13* and *Finish Groove 17* operations.

When you mouseover the warning symbol, the error message is displayed as a mouse tip. In this case, the warning message indicates that the Rough Groove 13 and Finish Groove 17 operations cannot be synchronized.



Warning symbols next Rough Groove and Finish Groove operations

6. Press the *Control* key and once again highlight *Rough Groove13* and *Rough Groove14* operations.
7.  Click on the *Insert Wait Code after the selected operation* button. Observe that as soon as this new wait code is inserted, the warning symbols displayed earlier disappear. This is because the newly inserted wait code synchronizes operations.
8. To synchronize *Finish Groove 16* and *Finish Groove 17* operations, insert wait codes before and after the operations using the same process as explained earlier.
9. Now we have all the wait codes inserted in the required locations.



Synchronized Rough Groove & Finish Groove operations

Step 4: Viewing Estimated Machining Time using CAMWorks Sync Manager

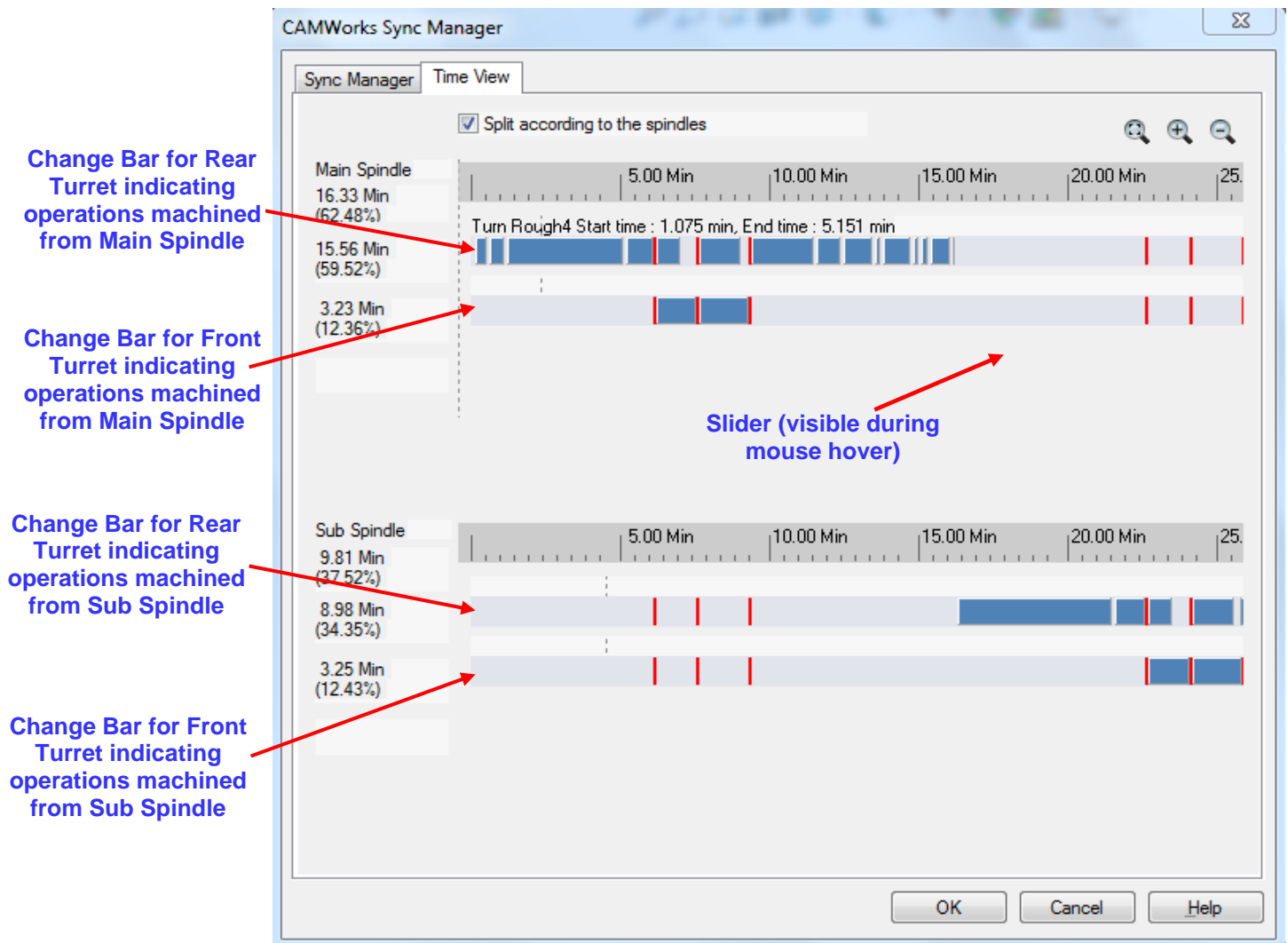
1. Click on the *Time View* tab of the *CAMWorks Sync Manager* dialog box.
2. The *Time View* tab of the *CAMWorks Sync Manager* graphically displays the estimated machining time in the form of a Time Line. This Time Line consists of a *Time bar* with time-phased information (Separated by markers on the ruler). The display also consists of *Change bars* which represent the turrets. The estimated machining time of the operations present in the Operation tree is displayed with respect to the rear and front turrets.



- Since the modifications made in the Sync Manager tab do not come into effect until the **OK** button is pressed, the Time View tab displays graphical information prior to synchronizing operations. Click **OK** to apply the changes. The toolpaths will be regenerated automatically.



- Click on the *CAMWorks Sync Manager* button on the CAMWorks Command Manager to open the CAMWorks Sync Manager dialog box again.
- Click on the *Time View* tab.



CAMWorks Sync Manager: Time View tab


- When you mouseover the particular *Change bar*, a summary of the estimated machining time of the operations from the given turret is displayed on the left hand side of the change.
- The different vertical grid lines on the Change bars indicate wait codes, idle time and machining times.
 - Red:** Indicates wait codes
 - Blue:** Indicates an operation being machined by the particular turret
 - Grey:** Indicates idle time of the turret.



CAMWorks Sync Manager Tutorial



8. Observe that *Rough Groove 12*, *Finish Groove 15*, *Rough Groove 14* and *Finish Groove 17* operations are being machined by Front Turret while all other operations are being machined by the Rear turret.
9. When you mouse synchronized operations, the details of these operations will be displayed both the Front and Rear turret Change bars.
10. The *Time View* tab is a read-only entity. Click *OK* to close the CAMWorks Sync Manager dialog box after viewing the estimated machining time.


Step 5: Step Through Toolpath

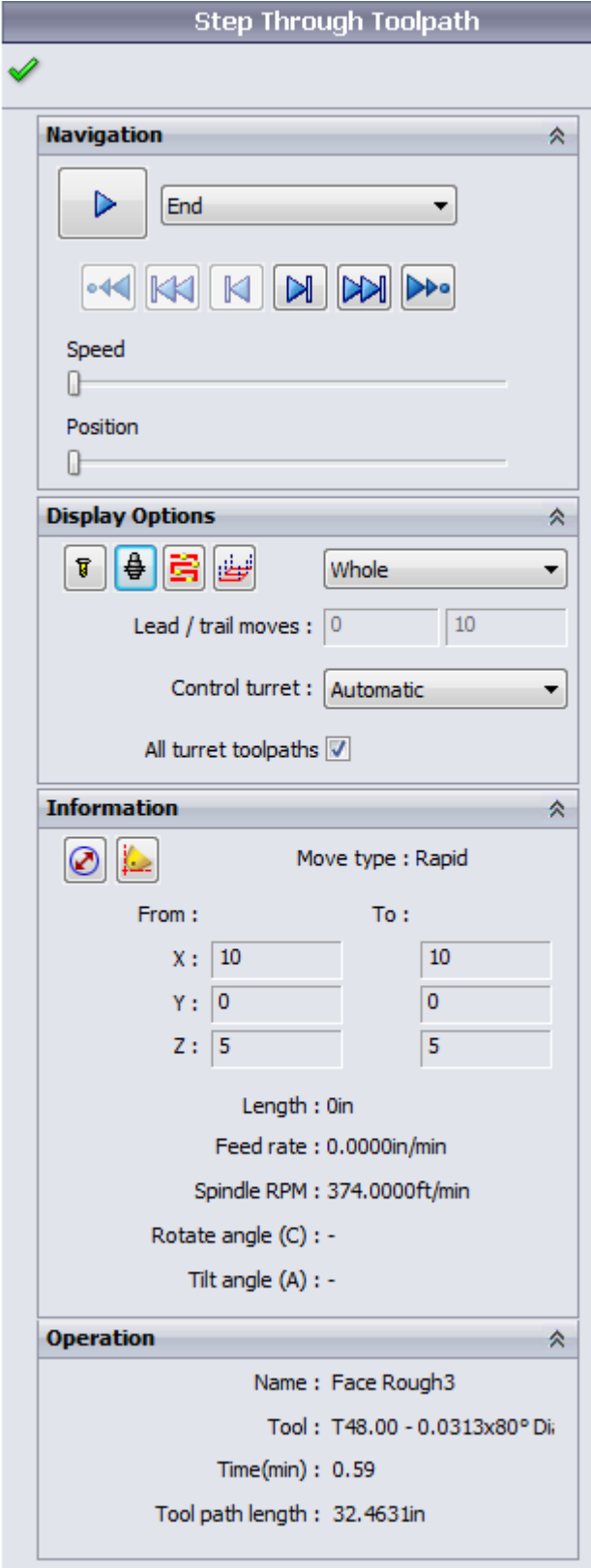
1.  Click on the *Step Through Toolpath* button on the CAMWorks Command Manager or Workflow Toolbar.

The *Step Through Toolpath* dialog box is displayed.

2. In the *Navigation* group box, use the slider to set the speed to the lowest.
3. In the *Display Options* group box, set the following display options:

-  Set the Tool display to *Tool Shaded with Edges*.
-  Set the Tool Holder display to *Tool Holder Shaded with Edges*.
- Set the Control Turret option to *Automatic*.
- Ensure that the *All turret toolpaths* option is checked.

4.  Click on the *Play* button and observe that the synchronized toolpaths are executed at the same time.
5. Click *OK* to exit the *Step Through Toolpath* mode after viewing the toolpaths.



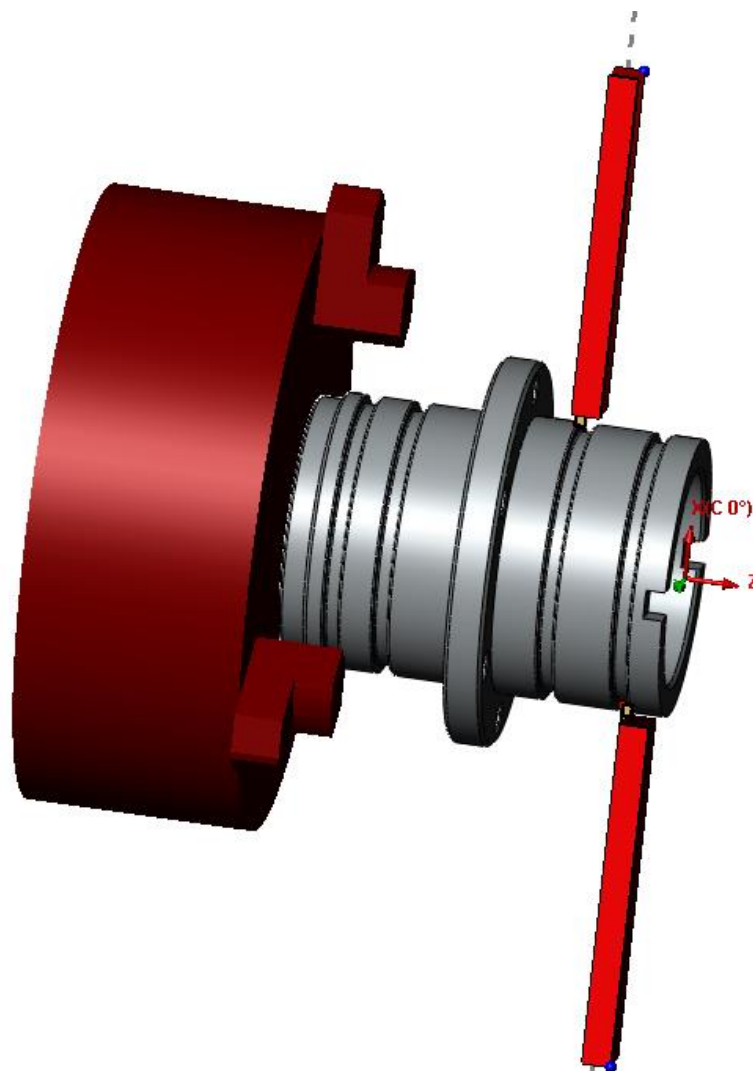
The screenshot shows the 'Step Through Toolpath' dialog box with the following sections:

- Navigation:** Includes a play button, a dropdown menu set to 'End', and several navigation icons (back, forward, etc.). Below are sliders for 'Speed' and 'Position'.
- Display Options:** Contains icons for tool and tool holder display, a dropdown set to 'Whole', a 'Lead / trail moves' field with values 0 and 10, a 'Control turret' dropdown set to 'Automatic', and a checked 'All turret toolpaths' checkbox.
- Information:** Shows 'Move type : Rapid' and a table for coordinates:

	From :	To :
X :	10	10
Y :	0	0
Z :	5	5

 Below the table are fields for 'Length : 0in', 'Feed rate : 0.0000in/min', 'Spindle RPM : 374.0000ft/min', 'Rotate angle (C) : -', and 'Tilt angle (A) : -'.
- Operation:** Displays 'Name : Face Rough3', 'Tool : T48.00 - 0.0313x80° Di', 'Time(min) : 0.59', and 'Tool path length : 32.4631in'.

Step Through Toolpath dialog box



During Step Through Toolpath, observe that synchronized toolpaths are executed simultaneously

Step 6: Post Process Toolpaths

Post processing is the final step in generating the NC program file. This step translates generalized toolpath and operation information into NC code for a specific machine tool controller. CAMWorks creates NC code for each toolpath in the order the toolpath operation appears in the Operation tree. When you post process a part, CAMWorks creates two files: the NC program and the Setup Sheet. These are text files that you can read, edit and print using a word processor or text editor.

In this tutorial, you will post process all the operations and generate the NC program:

1.  Click the *Post Process* button on the CAMWorks Command Manager/ Workflow Toolbar

OR

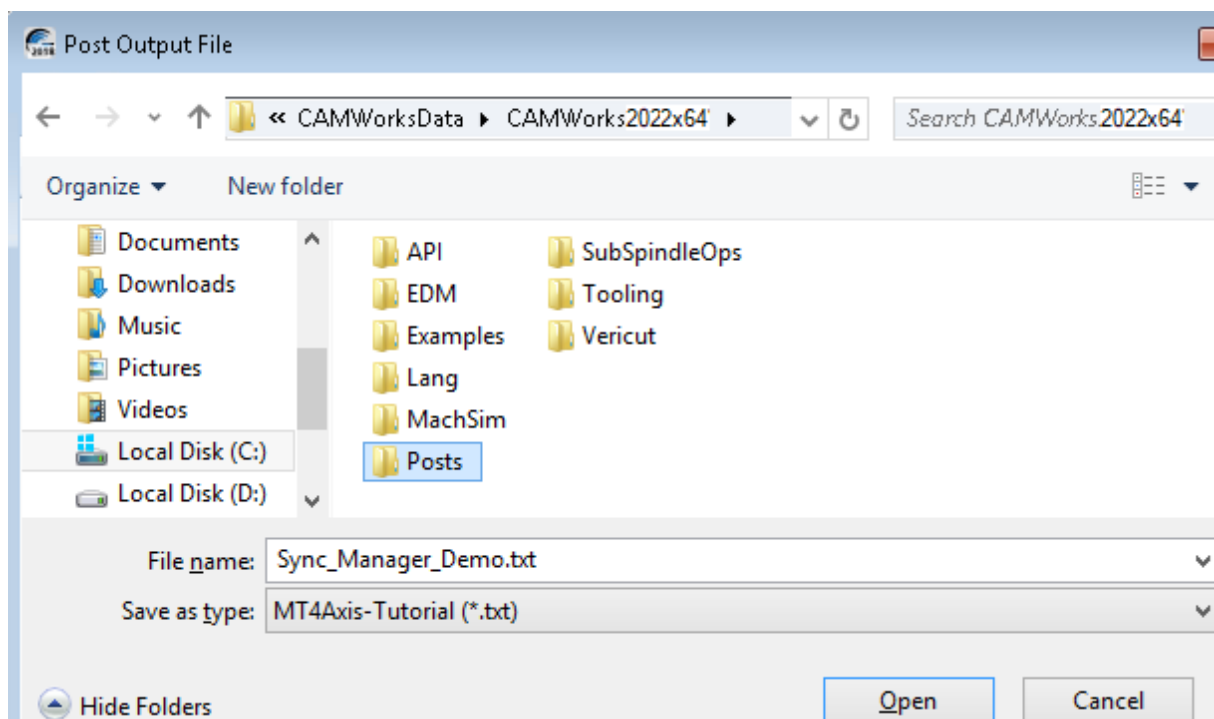
Right click the *CAMWorks NC Manager* in the Operation tree and select *Post Process* on the context menu.

The *Post Output File* dialog box is displayed so that you can save the NC program file.



CAMWorks Sync Manager Tutorial


- Typically, the NC program and Setup Sheet files are stored in the folder that contained the last part that was opened. If you want these files in another location, you can change the folder location.





Post Output File dialog box



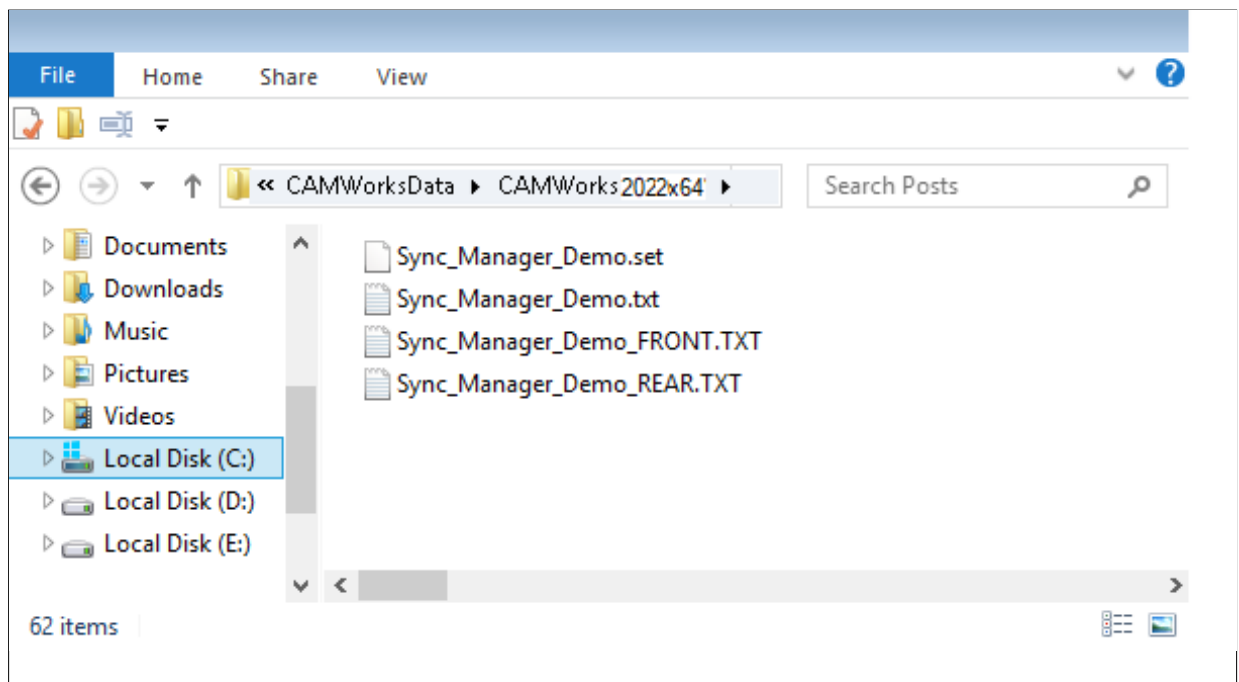
If **Post Process** button is grayed out on the **CAMWorks** menu, **Command Manager** or the **CAMWorks Workflow** toolbar, make sure that you have selected a post processor and generated the toolpaths.

- In the *File name* textbox, type the suitable file name, and then click *Save* button.
- The *Post Process* dialog box is displayed. Click the *Step* button  on the control bar at the top.

CAMWorks starts to generate the NC program and the first line of NC code displays in the NC code view box. The post processing mode is set to post process one line of code at a time (Step mode).
- Click the *Step* button. The next line of NC code is displayed.
- Click the *Run* button . Post processing continues until it is completed.
- When the post processing is finished, view the code using the vertical scroll bar.
- Click *OK*  to close the dialog box.
- Four files will be created when posting process is completed:
 - The .set file contains the information regarding the tools.



- The files having suffix of **_REAR** and **_FRONT** are the NC codes for the respective turrets.



Files generated after Post Processing the Toolpaths

10. Edit the files of “Demo1 - Sync Manager-tutorial_FRONT.TXT” and “Demo1 - Sync Manager-tutorial_REAR.TXT” using the text editor.
11. Observe the line of **N53** in the file of **Sync_Manager_Demo_REAR.TXT**. The wait code of M1000 is output in this line.
12. Similarly, now observe the line of **N1** in the file of **Sync_Manager_Demo_FRONT.TXT**.
13. The **M1000** is the wait code inserted by you in the CAMWorks Sync Manager. In the CAMWorks Operation tree, we have Face Rough, Face Finish, Turn Rough and Turn Finish operations in the sequential order. After Turn Finish, we have the *Rough Groove11* operation. In the posted output for Rear turret, the M1000 code is output before this operation and in the output for the front turret, the same code is output before the *Rough Groove12* operation. This wait code makes the front turret to wait at the home position until the rear turret executes the toolpaths preceding the *Rough Groove11* operation.
14. We can also observe the other wait codes in the posted output files at the end of Rough Groove11 and Rough Groove12 operations. These wait codes will have the same numbers. Likewise, the wait codes at the beginning of other synchronized operations will be same.



```

Sync_Manager_Demo_REAR - Notepad
File Edit Format View Help
N43 G01 Z10.
N44 ( Turn Finish4 )
N45 G00 Z.1894
N46 X3.9414
N47 G01 X3.6 Z.0187
N48 Z-.2
N49 X4.8633
N50 X4.9817 Z-.2.2592
N51 G00 X20.
N52 Z10. M09
N53 M1000
N54 M01
N55 (NASL-103B NG-3L )
N56 T4343
N57 B90.
N58 M303
N59 G99 G18 M46
N60 G96 S245 M03
N61 M08
N62 ( Rough Groove11 )
N63 G54 G00 Z-1.435
N64 X4.
N65 G01 X3.8 Z-1.535 F.0015
N66 G00 X3.6
N67 G01 X3.395
N68 G00 X3.8
N69 Z-1.59
N70 X3.6
N71 G01 X3.395
N72 X3.8
N73 G00 X20.
N74 Z10.
N75 M1010
N76 M1020
N77 ( Finish Groove14 )

```

NC Code for Rear Turret

```

Sync_Manager_Demo_FRONT - Notepad
File Edit Format View Help
O0002
N1 M1000
N2 M01
N3 (NASL-103B NG-3L )
N4 T1616
N5 B270.
N6 M303
N7 G99 G18 M46
N8 G96 S245 M03
N9 ( Rough Groove12 )
N10 G54 G00 Z-.46
N11 X-4.
N12 G01 X-3.8 Z-.56 F.0015
N13 G00 X-3.6
N14 G01 X-3.395
N15 G00 X-3.8
N16 Z-.615
N17 X-3.6
N18 G01 X-3.395
N19 X-3.8
N20 G00 X-20.
N21 Z10. M09
N22 M1010
N23 M1020
N24 M01
N25 (NASL-103B NG-3L )
N26 T1717
N27 B270.
N28 M303
N29 G99 G18 M46
N30 G96 S245 M03
N31 M08
N32 ( Finish Groove15 )
N33 G54 G00 Z-.5575

```

NC Code for Front Turret



If there is a need of inserting multiple sub spindle operations, we can insert them as per the requirement in the machining process. In addition, the synchronizing of the toolpaths can be changed at any point of time based on the machining process. Once the modifications are done, the toolpaths need to be post processed again.