

# CNC Milling

## WORKING WITH THE ATC

Name	Class/Period	Date

### 1. Overview

This tutorial teaches you how to use your machine's automatic tool changer (ATC), both in CNCMotion and with the machine itself.

### 2. Performance Objectives

After completing these hardware tasks, you will be able to:

- Configure the ATC.
- Define ATC station locations.
- Initialize ATC station locations.
- Switch tools using the ATC.
- Run a program with multiple tools where tool switching is performed automatically by the ATC.

### 3. Required Materials

You need these materials to complete the hardware tasks:

- CNC milling center with installed mechanical vice and ATC
- Connected computer with CNCMotion
- 1/8 inch or 3 mm end mill (in a tool holder)
- 3/8 inch or 10 mm end mill (in a tool holder)
- Two empty tool holders
- Hex Allen wrench set
- Machinable workpiece
- Safety goggles

### 4. Safety and Inventory Checks

Before beginning the hardware task, review this checklist.

- Ensure that your lab station passes the safety guidelines.
- Complete the inventory and safety checklists for your lab station.
- If there is a tool in the spindle and you need to construct a vice, remove the tool before constructing the vise.
- You have read through the entirety of this lab activity to familiarize yourself with the requirements.

## 5. Working with the ATC in CNCMotion

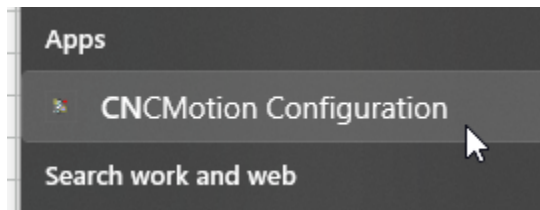
Perform this section's tasks in CNCMotion before using the ATC on a physical machine.

### 5.1. Installing the ATC

Your machine's default configuration does not have an ATC. Perform the steps below to install the ATC into the virtual machine.

If your virtual machine has an ATC, skip to Section 5.2 Preparing the ATC on page 7.

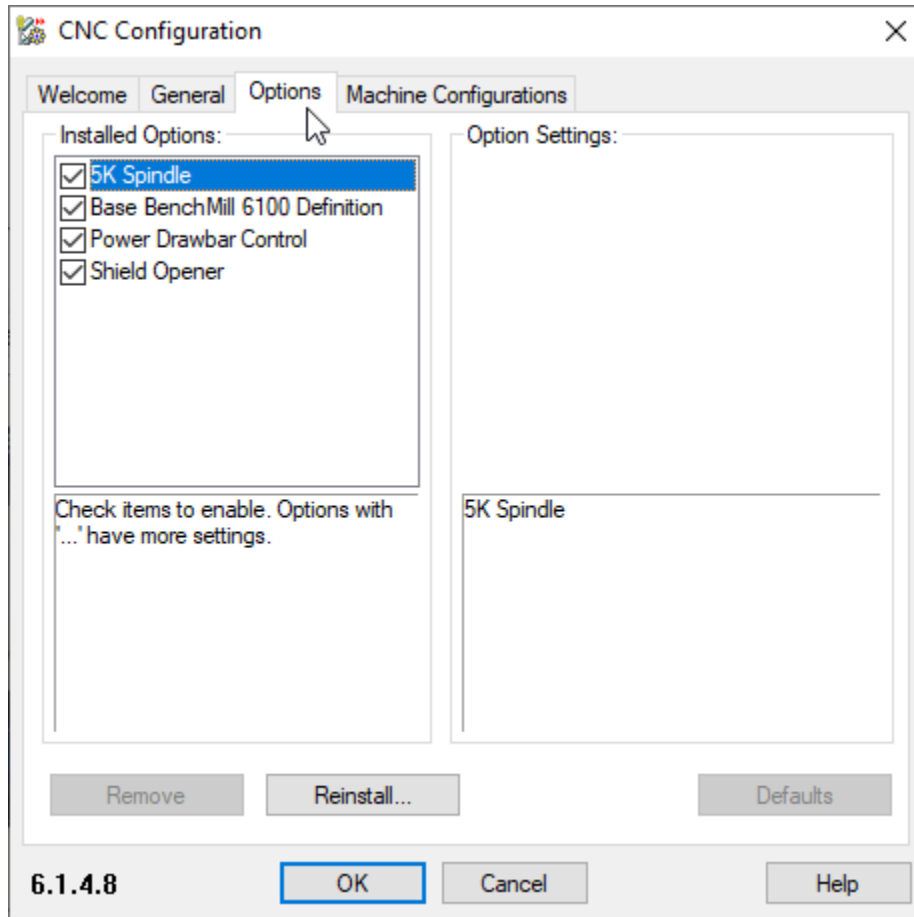
1. Close CNCMotion if it is running.
2. In your computer's Start or Program menu, open the **CNCMotion Configuration** app.



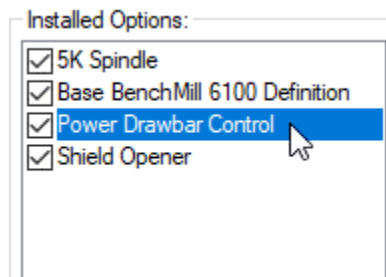
The CNC Configuration window for your machine is displayed. The BenchMill 6100's is shown here.



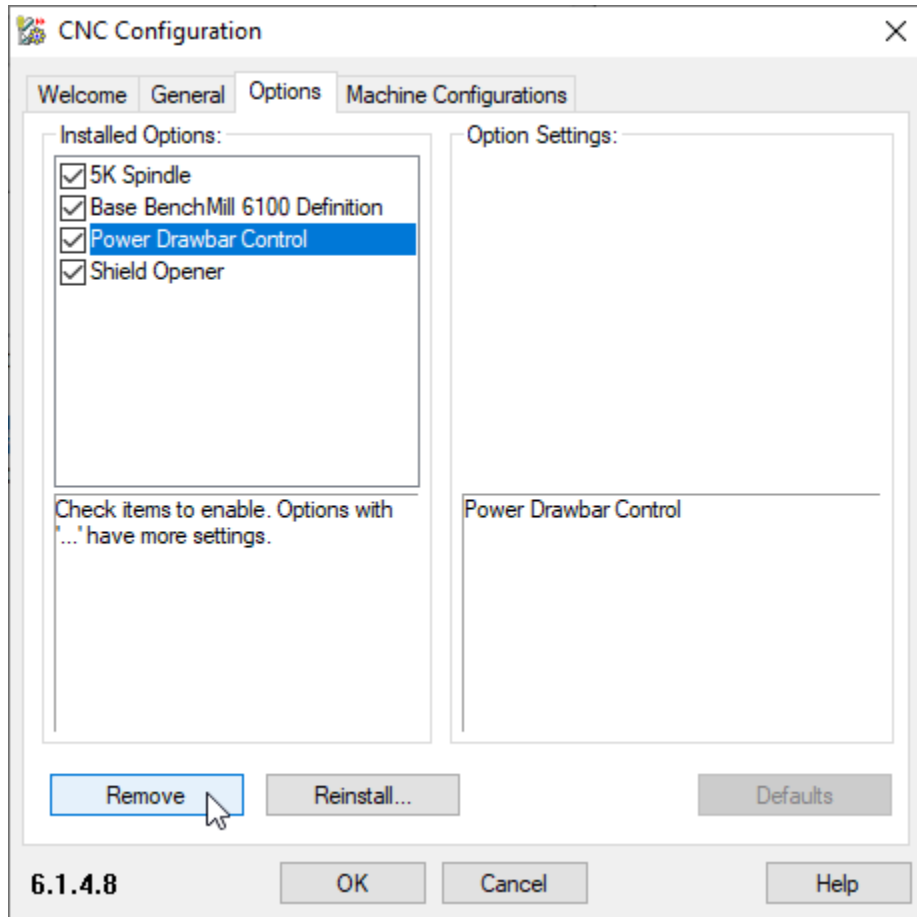
3. Select the **Options** tab.



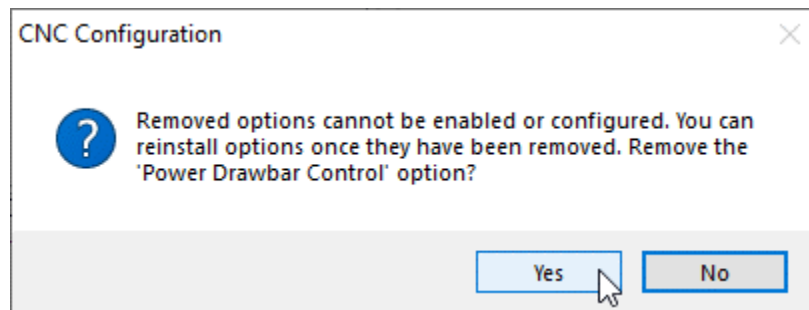
4. Before adding an ATC, the power drawbar must be deactivated. Select **Power Drawbar Control**.



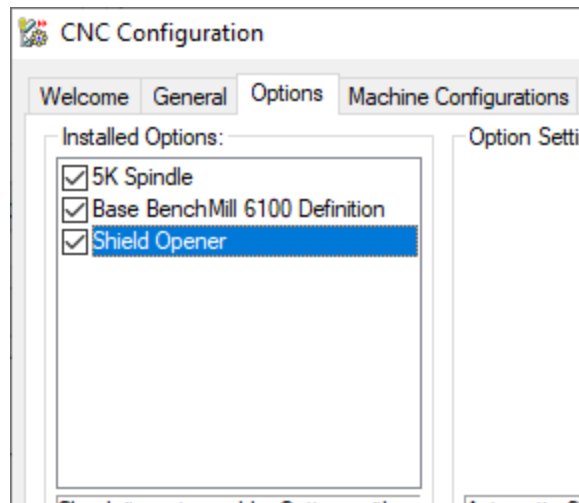
5. Click **Remove**.



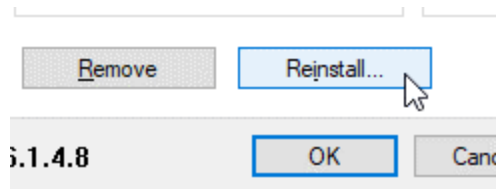
6. In the confirmation window, select **Yes**.



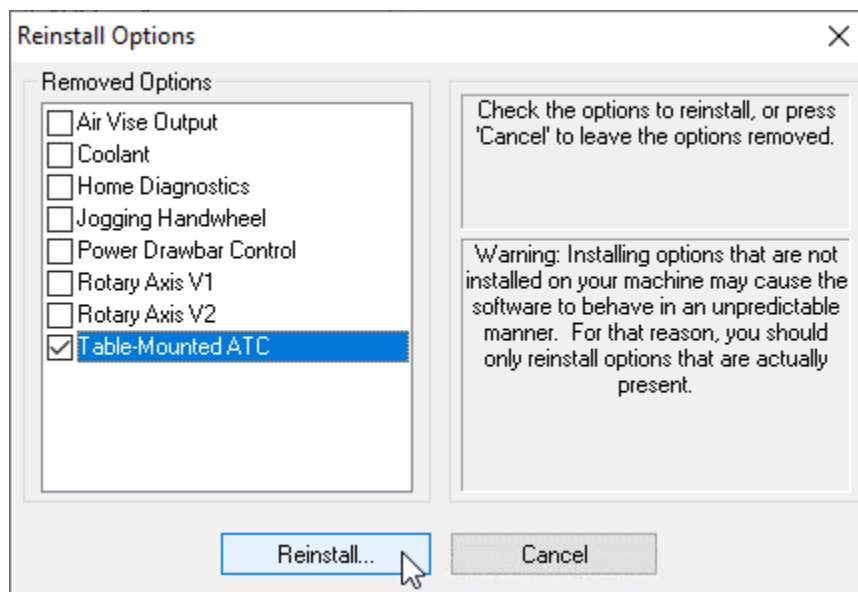
The power drawbar is removed from the Installed Options.



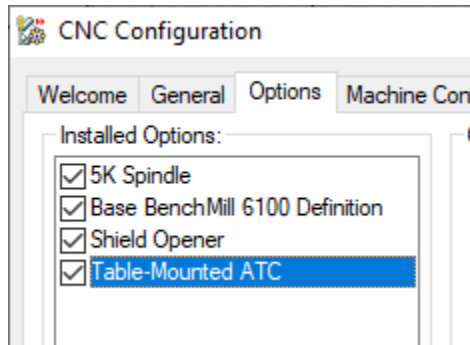
7. Click **Reinstall**.



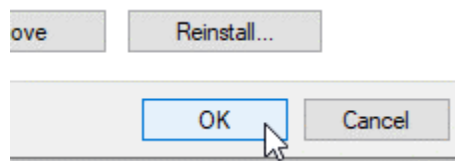
8. The Reinstall Options window is displayed. Select the **Table-Mounted ATC** and then click **Reinstall**.



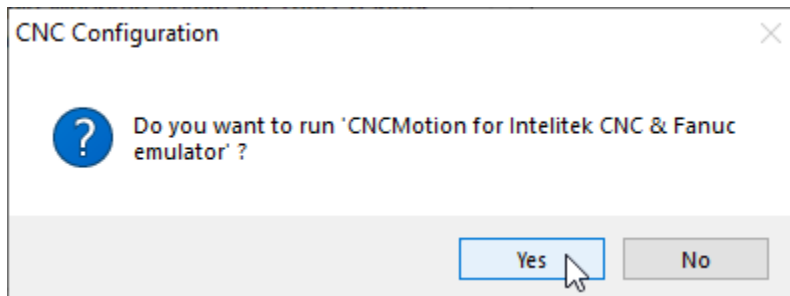
The ATC is added to the Installed Options.



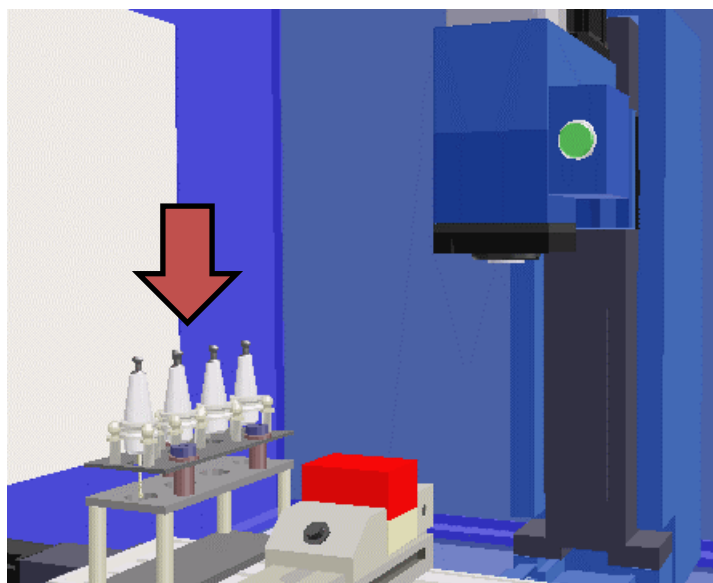
9. Click **OK**.



10. A popup window is displayed. Click **Yes** to run CNCMotion.



11. CNCMotion opens. The ATC is inside the machine envelope.

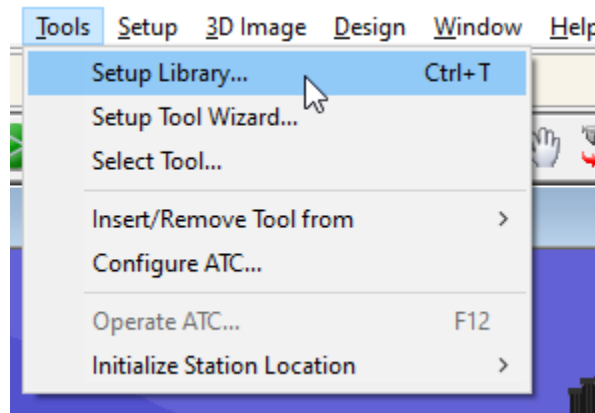


## 5.2. Preparing the ATC

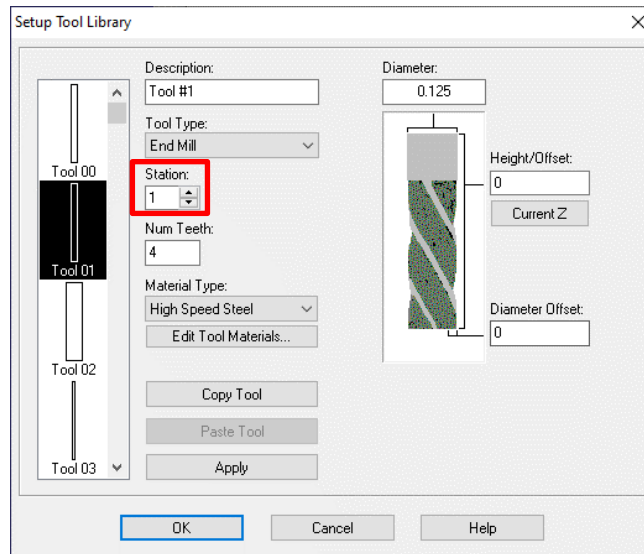
In this task, you will add tools to the first two stations of the ATC and initialize the locations of all four of the stations.

Perform these steps:

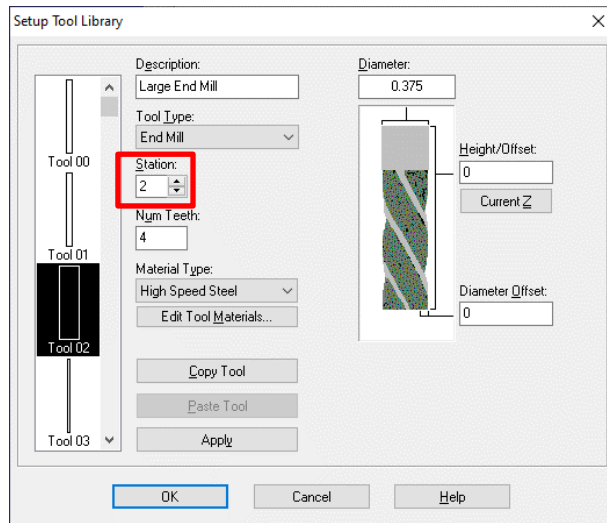
1. Close the safety shield / door.
2. From the menu, select **Tools > Setup Library**.



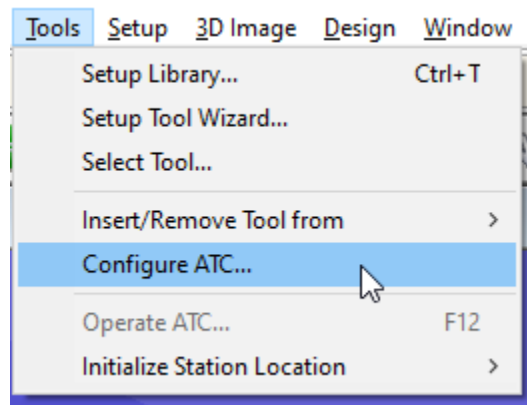
3. Configure the following tools:
  - Tool 1 – A 0.125' / 3 mm endmill. Set the Station to 1.



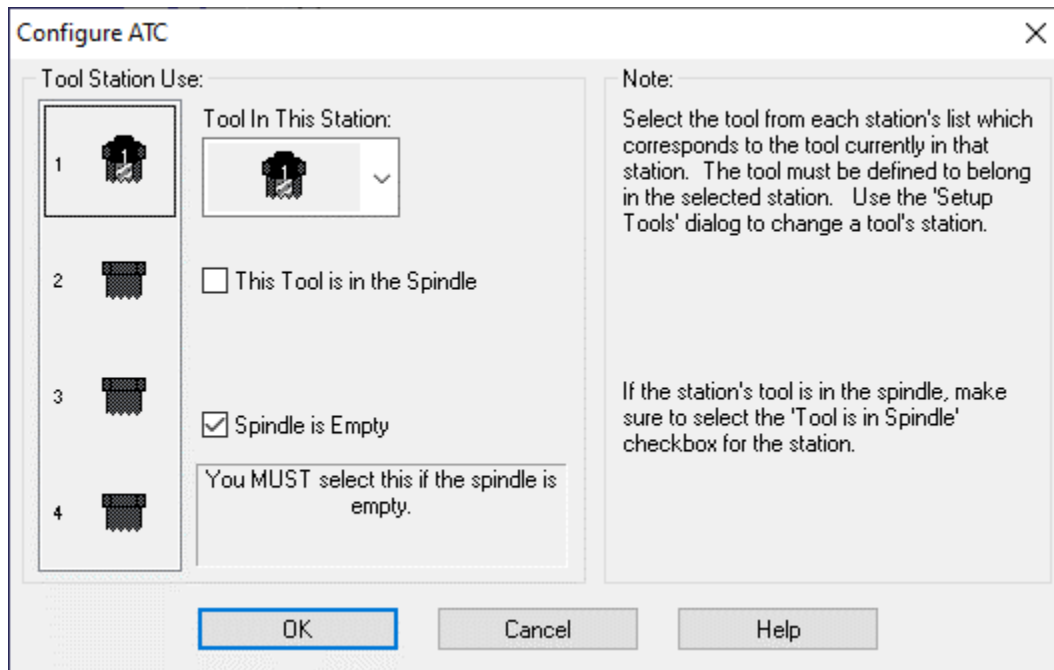
- Tool 2 – A 0.375' / 10 mm endmill. Set the Station to 2.



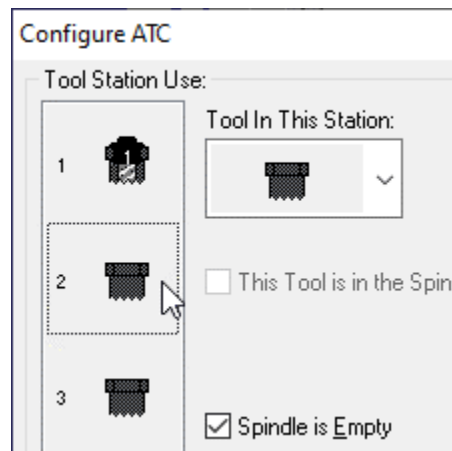
4. Navigate to **Tools > Configure ATC**.



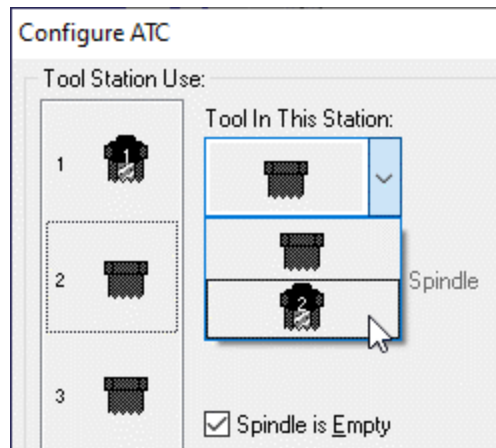
The Configure ATC window is displayed. Tool 1 is in Station 1 and the spindle is empty.



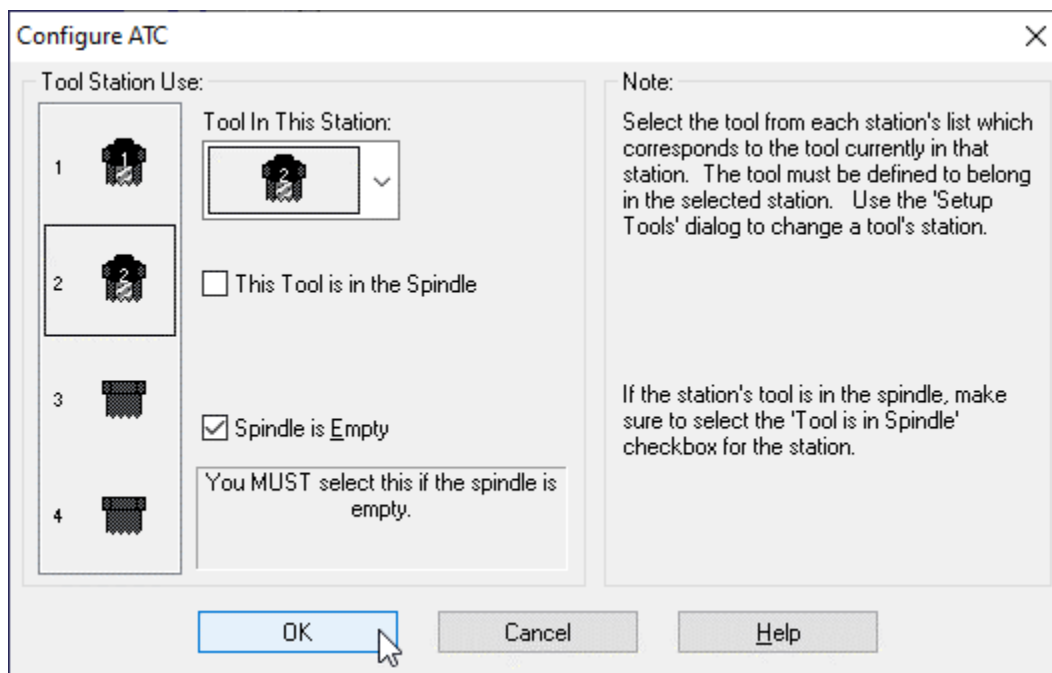
5. Select Station 2.



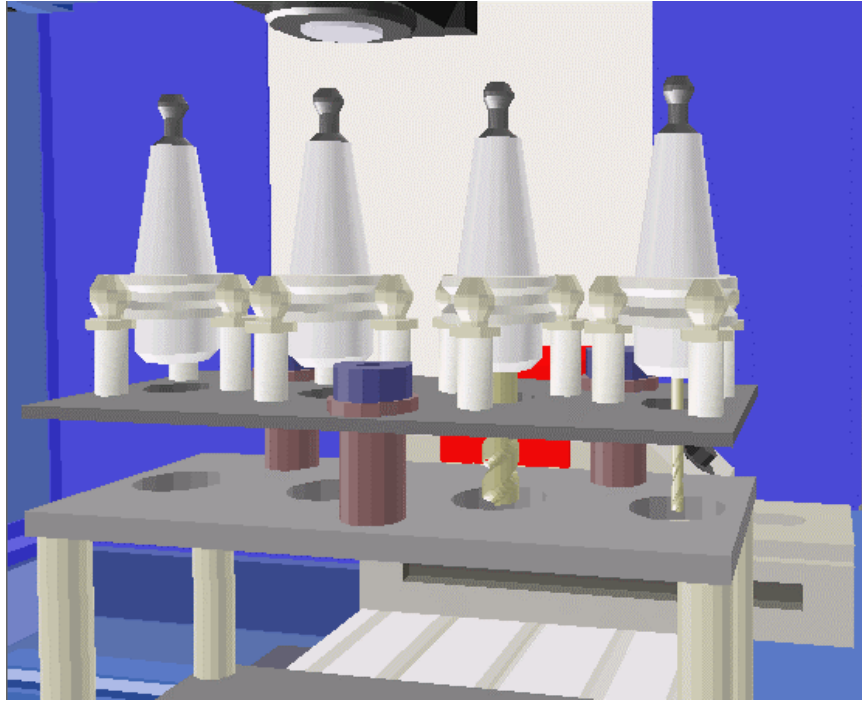
- From the Tool In This Station dropdown menu, select Tool 2.



- Click **OK** to confirm the changes and close the window.

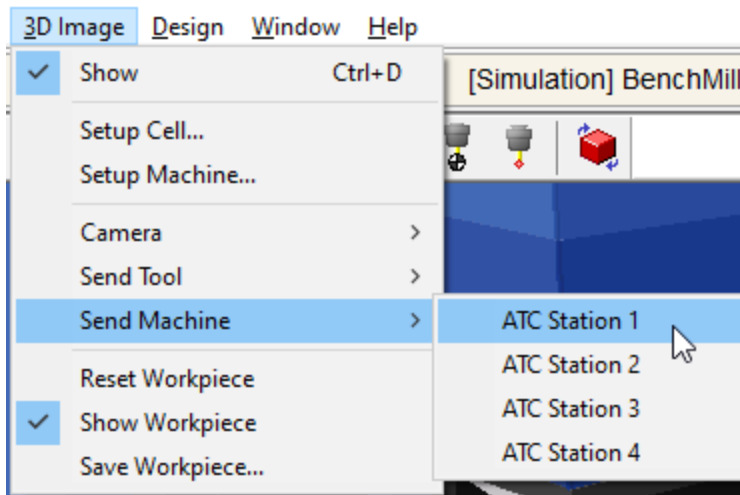


8. In the 3D graphic window, ensure that the two tools have been equipped onto the ATC and that the spindle is empty.



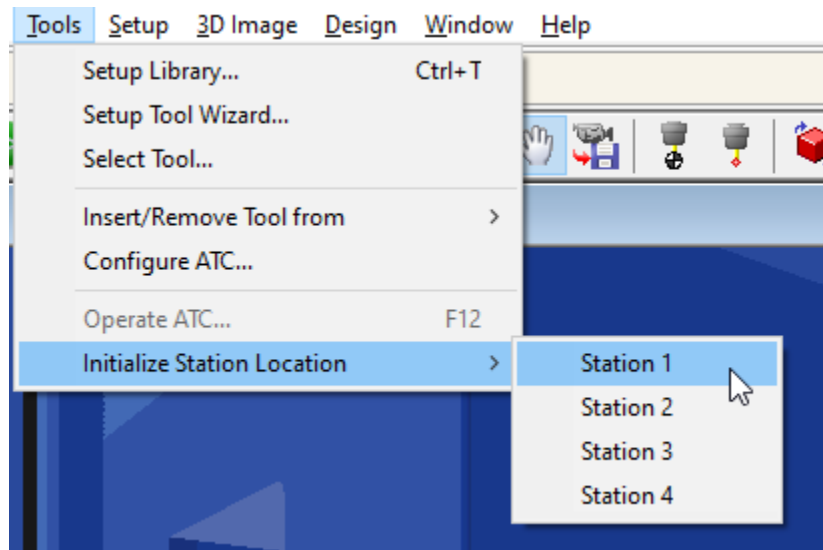
In the next steps, you will send the spindle to the ATC tool station locations and initialize those locations so they are usable during machine operation.

9. Home the machine.
10. From the menu, select **3D Image > Send Machine > ATC Station 1**.

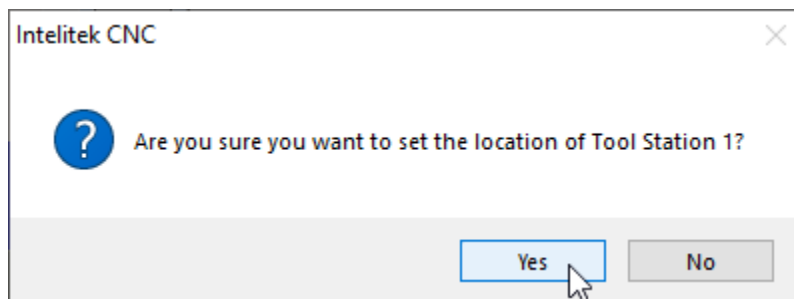


The machine moves to Station 1. Note that when using the actual machine in Section 6, you will need to jog the machine to the tool holder in the station.

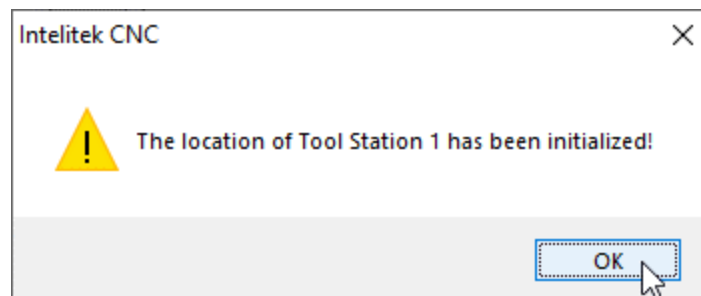
11. Select **Tools > Initialize Station Location > Station 1**.



12. A confirmation window is displayed. Select **Yes**.



13. The station is initialized. Click **OK** to close the window.

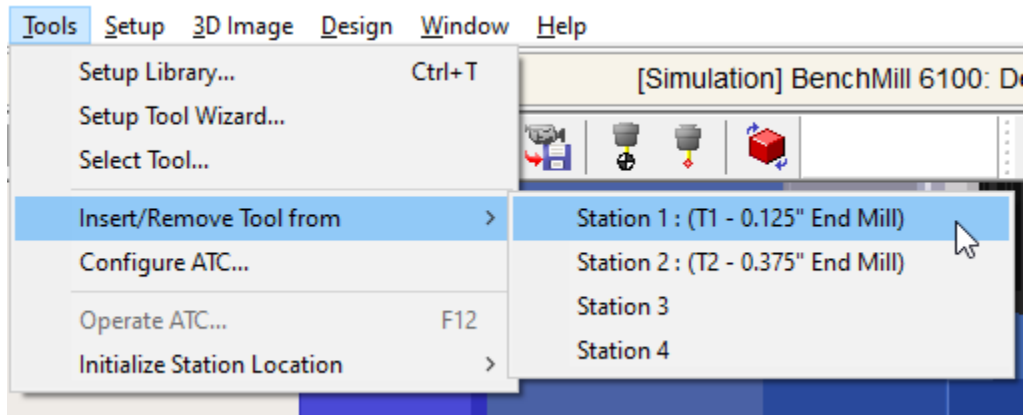


14. Repeat steps 10 to 13 for Stations 2, 3, and 4.

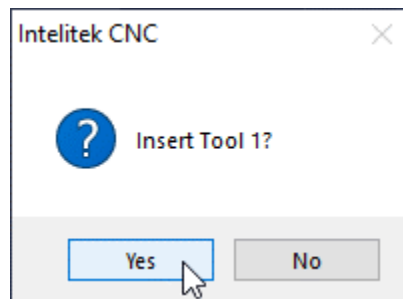
### 5.3. Switching Tools

In this task, you will use the ATC to switch between the two tools. Perform these steps:

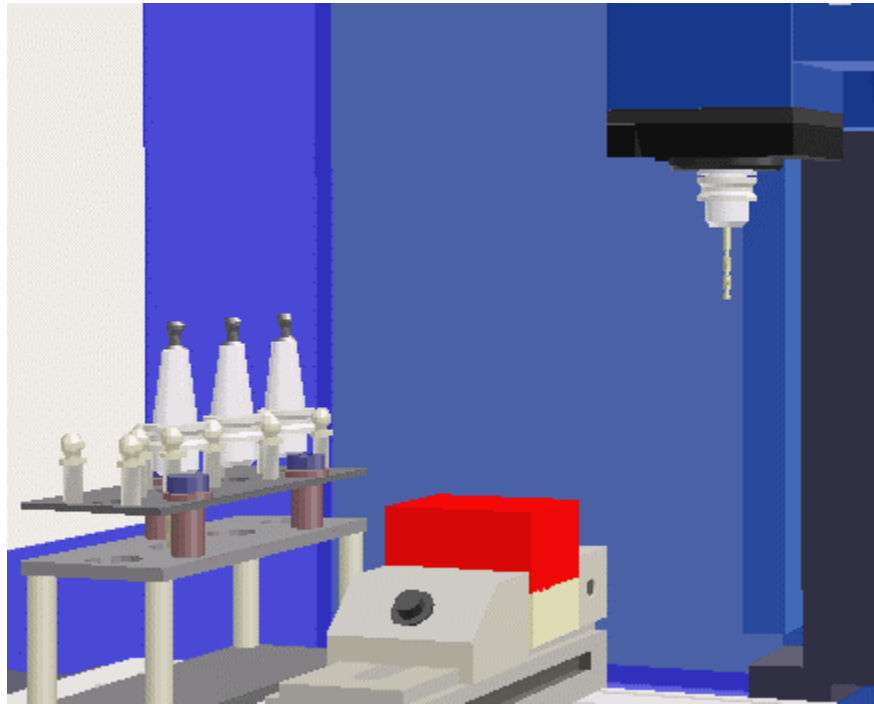
1. Tool 1 will be equipped first. Select **Tools > Insert/Remove Tool from > Station 1**.



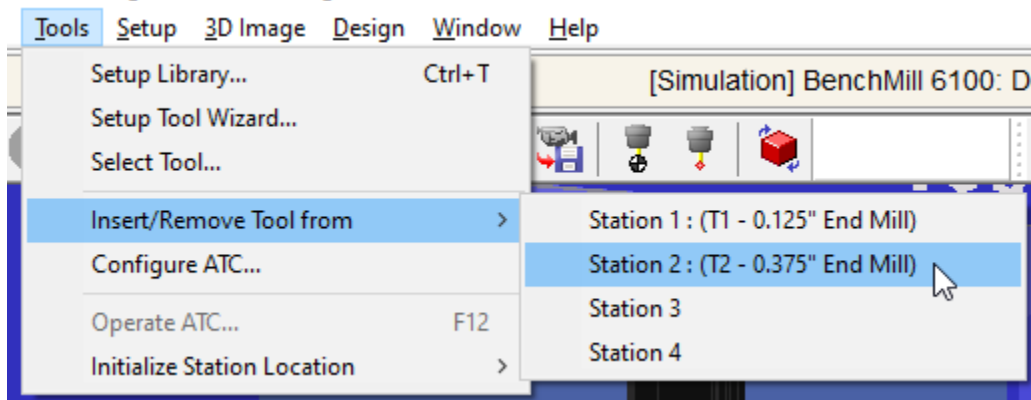
2. In the confirmation popup, select **Yes**.



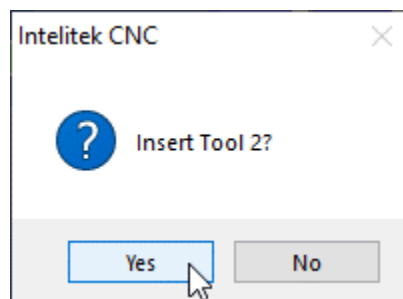
The machine moves to Station 1 and mounts Tool 1. It then returns to the initial spindle position (which was the home position).



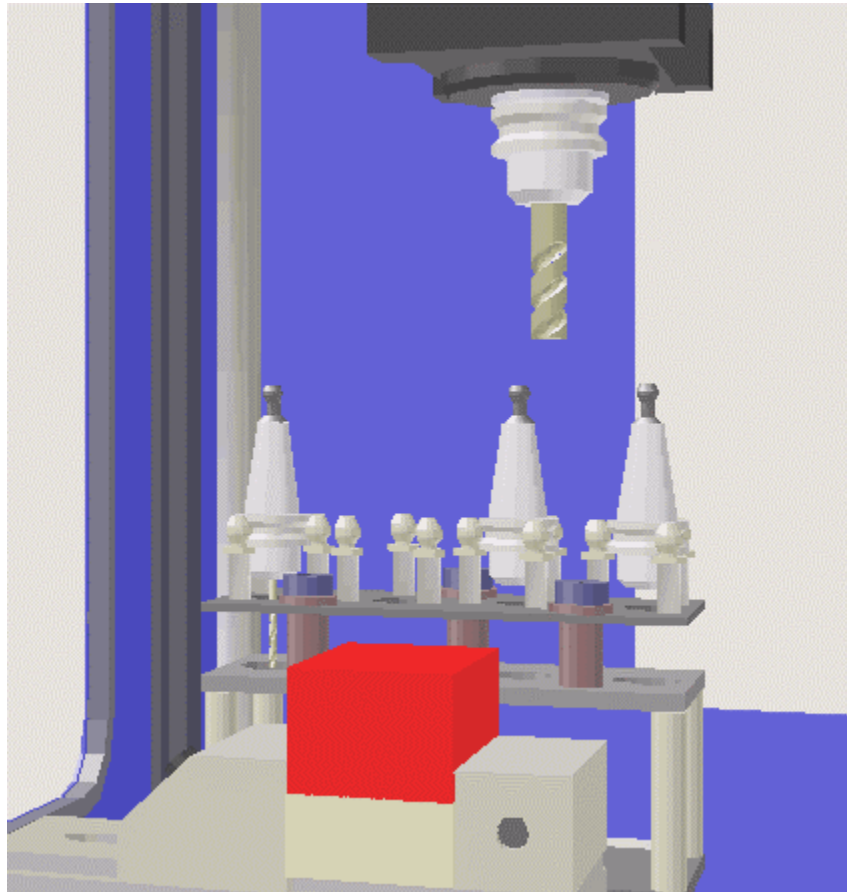
- 3. You will now equip the machine with Tool 2. Select **Tools > Insert/Remove Tool from > Station 2.**



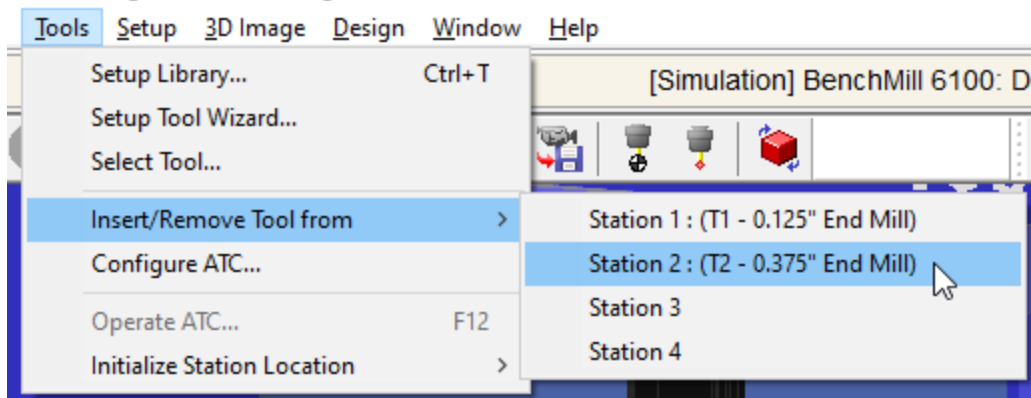
- 4. In the confirmation popup, select **Yes.**



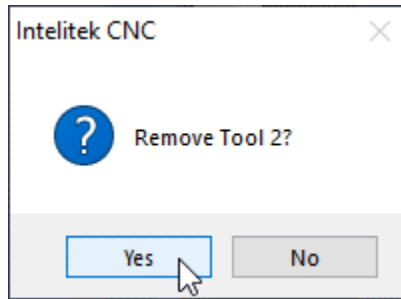
The machine moves to Station 1 to return Tool 1. It then moves to Station 2 and mounts Tool 2. It then returns to the home position.



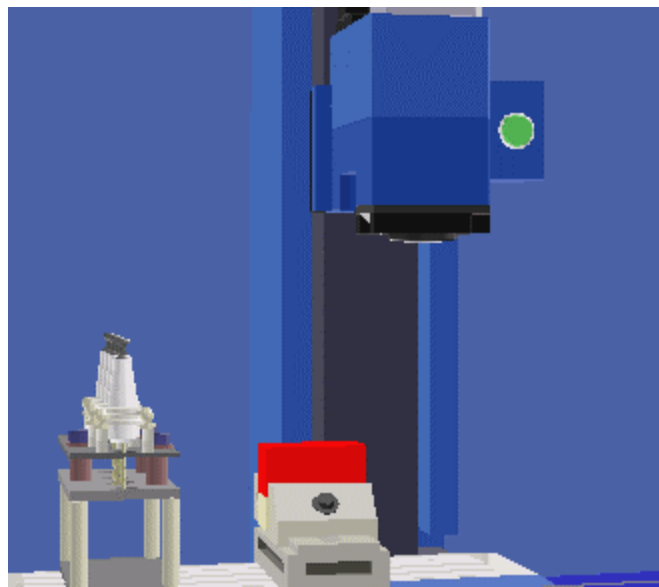
- 5. Return Tool 2 to the ATC. Select **Tools > Insert/Remove Tool from > Station 2.**



6. In the confirmation popup, select **Yes**.



The tool is returned to Station 2, and the machine returns to the Home position without any tools in the spindle.



① **Note:** Another way to insert/remove tools is to use the tool change feature in the CNCMotion Toolbar.



#### 5.4. Running a Program with the ATC

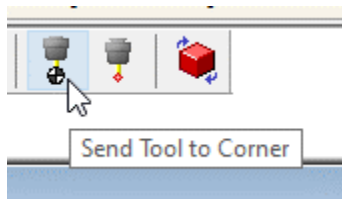
In this task, you will prepare and run the House program that you created in Activity 10. Because the ATC is active and the station locations have been initialized, tool switching is performed automatically during an M06 command.

Perform these steps:

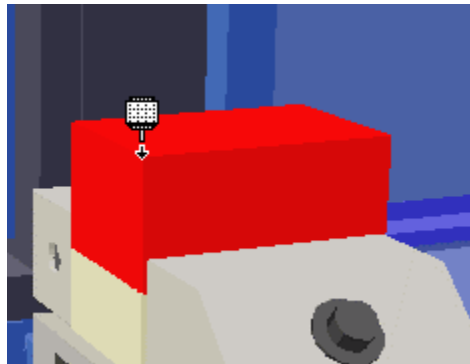
1. Load the House program.



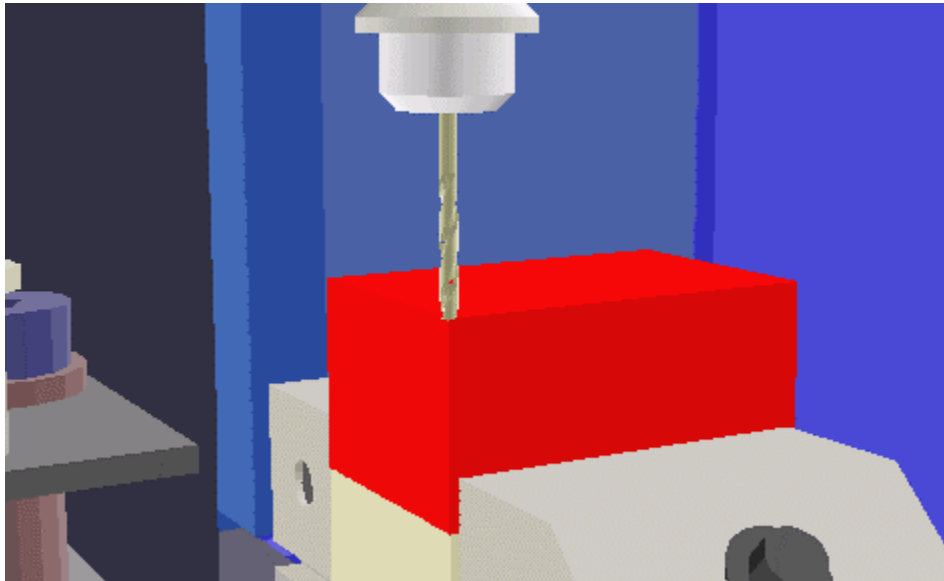
2. Equip the spindle with Tool 1. Select **Tools > Insert/Remove Tool from > Station 1**. In the confirmation popup, select **Yes**.
3. From the toolbar, click the Send Tool to Corner icon.



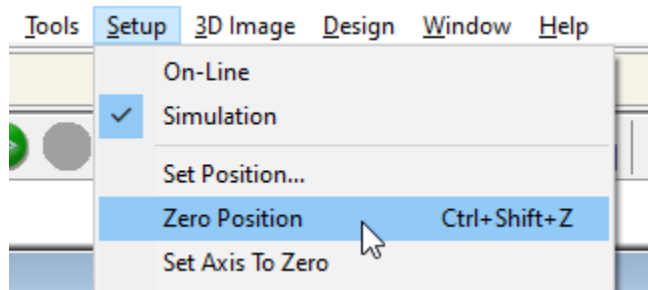
4. Click the near corner of the machine.



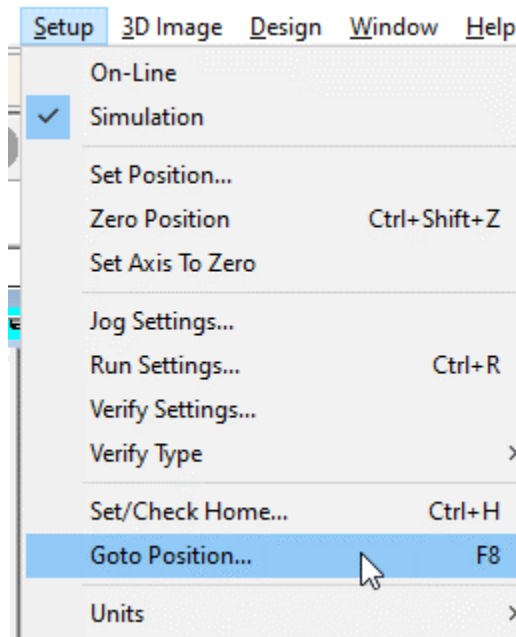
The machine moves the tool tip to the corner.



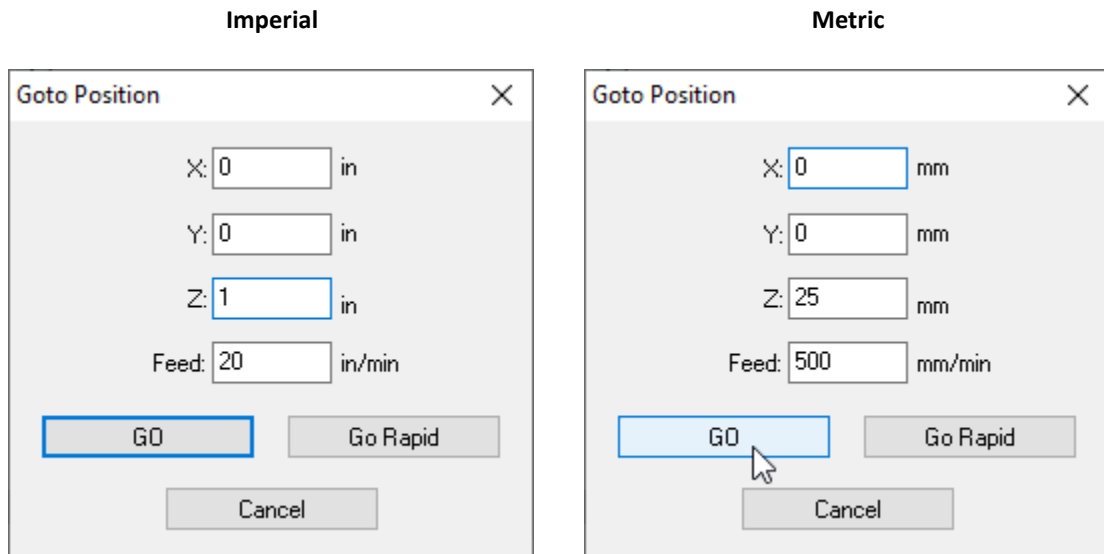
5. Select **Setup > Zero Position** to set this position as the origin (0,0,0).



6. You will now set the position for a dry run. Select **Setup > Goto Position**.



7. Enter the following coordinates in the dialog box:

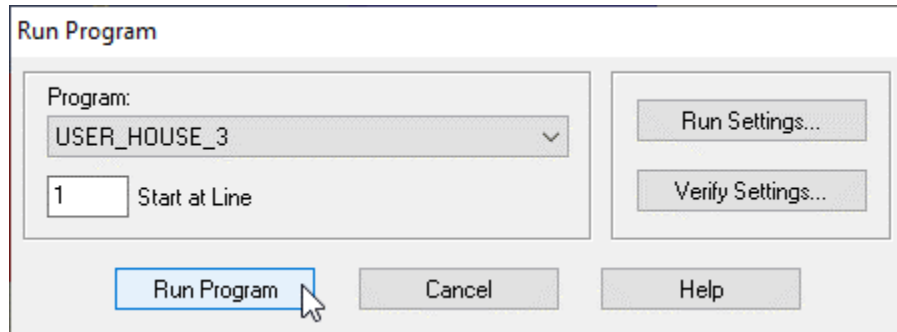


8. Select **Setup > Zero Position** to set this position as the origin.

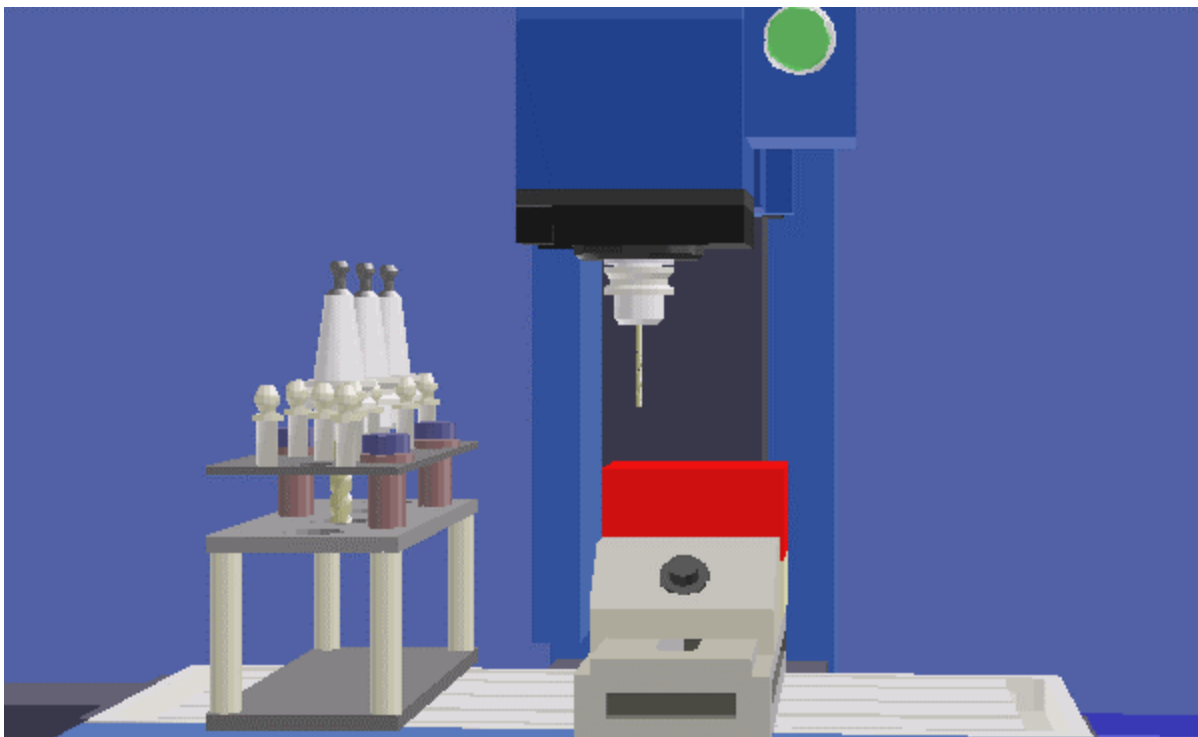
9. Click the Run button.



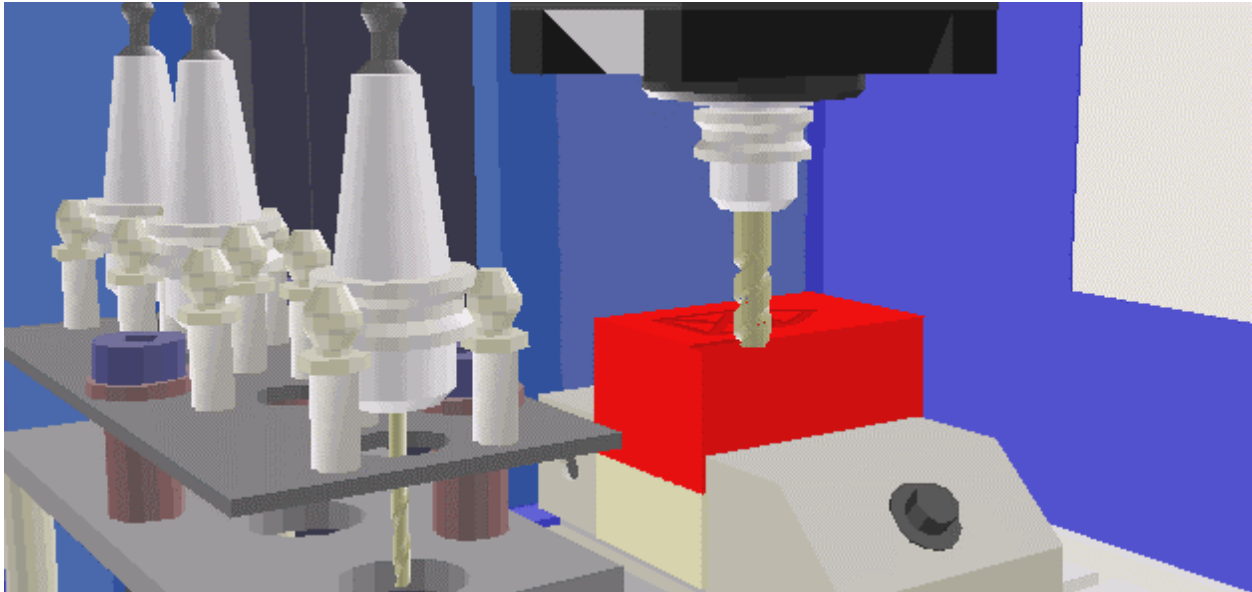
10. The Run Program window opens. Click **Run Program**.



11. Ensure that the program runs with the tooltip 1 inch / 25 mm above the workpiece. Note how the tools are changed automatically during the program run.



12. Once the program competes, send the tooltip to the origin (which is now 1 inch / 25 mm above the near corner of the workpiece).
13. Set the position as 0,0,1 (for Imperial) or 0,0,25 (for metric). This returns the origin to the corner of the workpiece.
14. Run the program to completion. Ensure that it executes as expected.



## 6. Hardware Tasks

### 6.1. Preparing the ATC

- ① **Note:** *The 4-Station ATC must already be installed in your machine (preferably by an Intelitek technician) before beginning any hardware tasks. Assembly instructions can be found [here](#).*
- ① **Note:** *If required, review previous activities and hardware tasks for any procedures that are not described in full.*

Follow the steps below to prepare the ATC.

1. If the CNCMotion or CNCBase software at the machine workstation is not where you performed the offline tasks, and the ATC is not already configured, perform the steps in Section 5.1 Installing the ATC.
2. Ensure that the Emergency Stop button is released.
3. Turn on the power switch.
4. Ensure that the control software is connected to the mill (**Setup > On-Line**).
5. Close the safety shield.
6. Home the machine.
7. Open the safety shield.
8. If there is a tool holder in the spindle, remove it.
9. Secure Tool 01, the thinner end-mill, in a tool holder and insert the tool holder into Station 1 (the frontmost station) of the ATC. The ridges of the tool holder should fit securely in the knobs of the station as shown on the next page.



10. Open the Setup Tool Library (**Tools > Setup Library**) and confirm that Tool 01 is defined as the end mill that you installed. In the Station field, enter **1**.
11. Secure Tool 02, the thicker end-mill, in a tool holder and insert the tool holder into Station 2 of the ATC.
12. In the Setup Tool Library, define Tool 02 as the large end mill. In the Station field, enter **2**.
13. Insert empty tool holders (or tool holders with other tools) into Stations 3 and 4.
14. Close the safety shield.
15. Navigate to **Tools > Configure ATC**. Configure the two tools as you did in Section 5.2 Preparing the ATC.
16. Jog the spindle over Station 1 on the ATC.
17. Slowly lower the spindle over the tool holder for Station 1. The tool holder should be centered in the spindle. Watch the gap between the spindle and the tool holder. Adjust the cross-slide's X and Y positioning accordingly.

18. When the spindle is half-way down the tool holder, press and hold the green button to open the drawbar. With the drawbar button being pushed to hold the drawbar open, continue to lower the spindle over the tool holder. Continue to make X and Y axis adjustments, keeping the spindle centered on the tool holder. When the springs start to collapse, stop movement of the Z-axis. Release the drawbar button to clamp the tool.



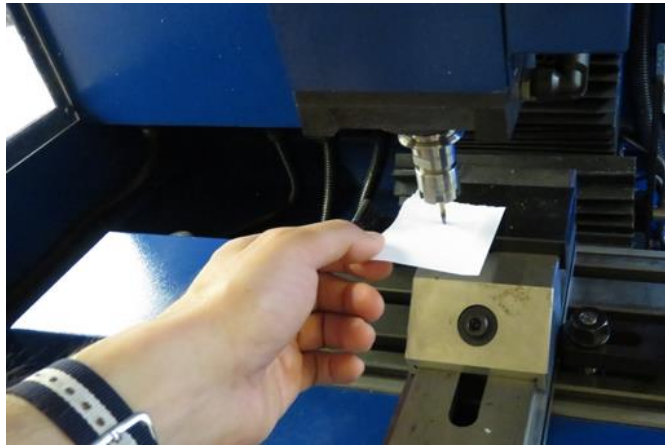
Click or scan this QR code to watch a video of the above step.

19. In the software, select **Tools > Initialize Station Location > Station 1**. In the confirmation window, click **Yes**.
  20. Hold the green drawbar button and move the spindle upwards, away from the tool holder in Station 1.
  21. Repeat steps 16 to 20 for the other three stations.
  22. Close the safety shield.
- ⚠ Warning:** *You will now test the ATC. Be ready to press the Emergency Stop button in case you need to prevent crashes.*
23. Select **Tools > Insert/Remove Tool from > Station 1**. In the confirmation popup, select **Yes**.  
The machine moves to Station 1 and mounts Tool 1.
  24. Select **Tools > Insert/Remove Tool from > Station 2**. In the confirmation popup, select **Yes**.
  25. The machine moves to Station 1 to return Tool 1. It then moves to Station 2 and mounts Tool 2.
  26. Select **Tools > Insert/Remove Tool from > Station 1**. In the confirmation popup, select **Yes**. The machine returns Tool 2 and inserts Tool 1.

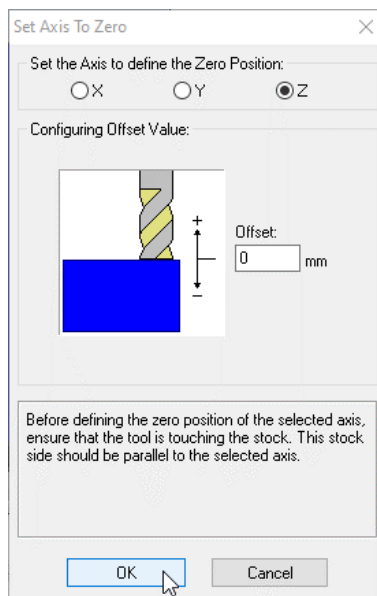
## 6.2. Preparing the Machine and Workpiece

In this task you will prepare the other elements of the machine setup. Perform the following:

1. Secure a workpiece to the vise.
2. Touch off the top of the stock using a piece of paper as you normally would before setting the Z-axis to 0.



3. Set the Z-axis position to 0 (**Setup > Set Axis to Zero**).



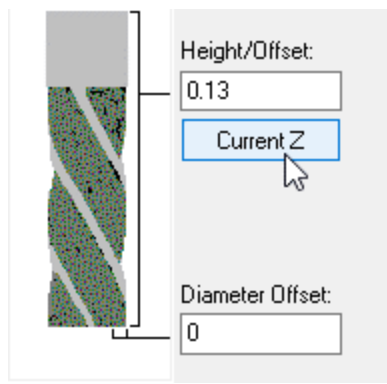
### 6.3. Defining the Tool Offset

Perform these steps to define the tool offset for Tool 2.

1. Using the ATC, equip the spindle with Tool 2 (**Tools > Insert/Remove Tool from > Station 2**).
2. Touch off the top of the stock using a piece of paper as you normally would before setting the Z-axis to 0. **Do NOT zero the axis yet.**

At this point, the absolute Z-axis position will not be 0, because the tools will have different heights.

3. Navigate to the Setup Tool Library (**Tools > Setup Library**), where Tool 02 is selected.
4. Click **Current Z**.



5. Click **OK**.
6. Ensure that in the Actual Position window, the absolute Z-axis position is now **0**.

Imperial Example	Metric Example																																
<p>Actual Position</p> <table border="1"> <tr><th colspan="2">Absolute</th></tr> <tr><td>X</td><td>1.5451 in</td></tr> <tr><td>Y</td><td>0.8379 in</td></tr> <tr><td>Z</td><td>0.1300 in</td></tr> </table> <p>Diameter: 0.375</p> <p>Height/Offset: 0.13</p> <p>Current Z</p> <p>Diameter Offset: 0</p> <p>Actual Position</p> <table border="1"> <tr><th colspan="2">Absolute</th></tr> <tr><td>X</td><td>1.5451 in</td></tr> <tr><td>Y</td><td>0.8379 in</td></tr> <tr><td>Z</td><td>0.0000 in</td></tr> </table>	Absolute		X	1.5451 in	Y	0.8379 in	Z	0.1300 in	Absolute		X	1.5451 in	Y	0.8379 in	Z	0.0000 in	<p>Actual Position</p> <table border="1"> <tr><th colspan="2">Absolute</th></tr> <tr><td>X</td><td>29.997 mm</td></tr> <tr><td>Y</td><td>28.321 mm</td></tr> <tr><td>Z</td><td>5.715 mm</td></tr> </table> <p>Diameter: 10</p> <p>Height/Offset: 5.715</p> <p>Current Z</p> <p>Diameter Offset: 0</p> <p>Actual Position</p> <table border="1"> <tr><th colspan="2">Absolute</th></tr> <tr><td>X</td><td>29.997 mm</td></tr> <tr><td>Y</td><td>28.321 mm</td></tr> <tr><td>Z</td><td>0.000 mm</td></tr> </table>	Absolute		X	29.997 mm	Y	28.321 mm	Z	5.715 mm	Absolute		X	29.997 mm	Y	28.321 mm	Z	0.000 mm
Absolute																																	
X	1.5451 in																																
Y	0.8379 in																																
Z	0.1300 in																																
Absolute																																	
X	1.5451 in																																
Y	0.8379 in																																
Z	0.0000 in																																
Absolute																																	
X	29.997 mm																																
Y	28.321 mm																																
Z	5.715 mm																																
Absolute																																	
X	29.997 mm																																
Y	28.321 mm																																
Z	0.000 mm																																

7. Using the ATC, equip the spindle with tool 1.

8. In the Machine Info window, ensure that Tool 01, the thinner end mill, is active.
9. Touch off the front and left faces of the workpiece, and zero those axes to complete definition of the workpiece origin.
10. Verify the workplace origin by sending the tool tip to a location directly above the origin. Keep your hand on the Emergency Stop button to prevent any potential accidents.

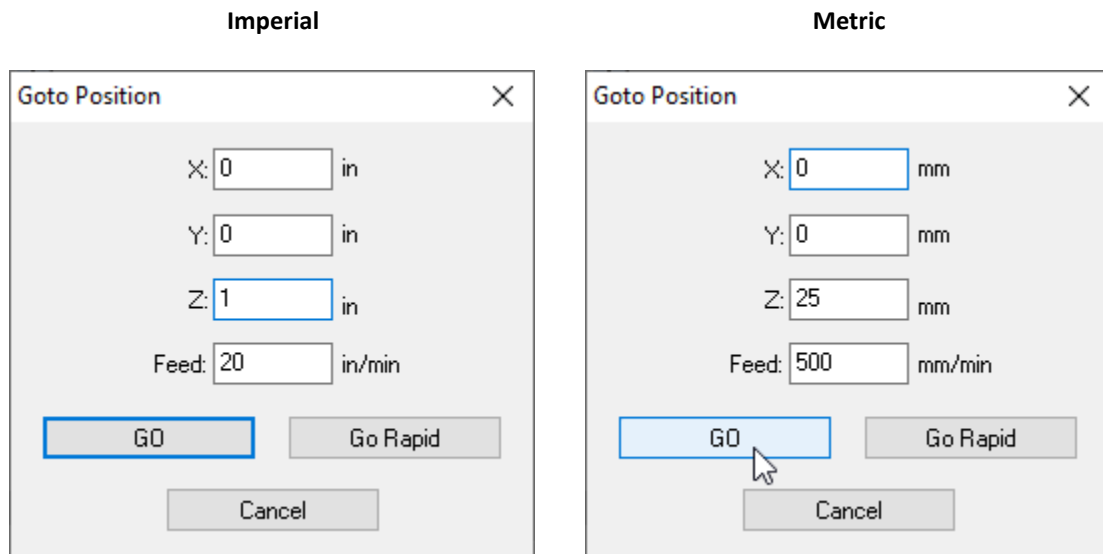
#### 6.4. Preparing for the Dry Run

Follow the steps below to prepare the machine for the dry run.

1. Open (**File > Open**) the House NC program that you completed in activity 10.

You will now set the workpiece origin as 1 inch / 25 mm above the top-front-left corner of the stock so that when the program is run for the dry run, the tool will operate above the workpiece.

2. Navigate to **Setup > Goto Position** and enter the following coordinates in the dialog box:

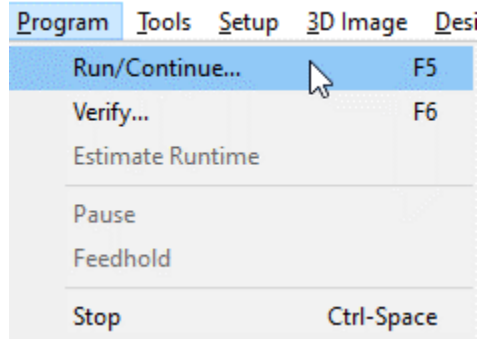


3. With one hand on the Emergency Stop button to prevent potential accidents, click **GO** to send the tool to the defined position above the point-of-origin.
4. Select **Setup > Set Position** to display the Set Position dialog box. Enter the coordinates **(0, 0, 0)** and then click **OK** to reset the point-of-origin to the current position.

## 6.5. Performing the Dry Run

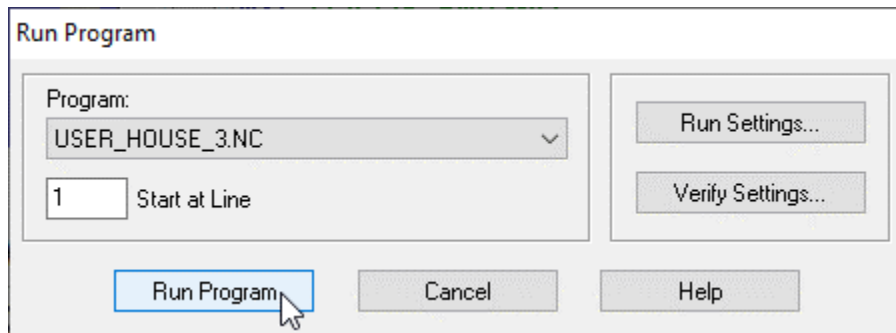
Follow the steps to perform the dry run:

1. Select **Program > Run/Continue** or click the green Run icon on the toolbar.



The Run Program dialog box is displayed.

- Note:** *In the next step you will run the program. Watch the tool motion in relation to the vise and the workpiece.*
2. With one hand on the Emergency Stop button, click **Run Program**. Look for signs of a possible tool crash with the hardware or stock and be prepared to prevent any crashes by pressing the Emergency Stop button.



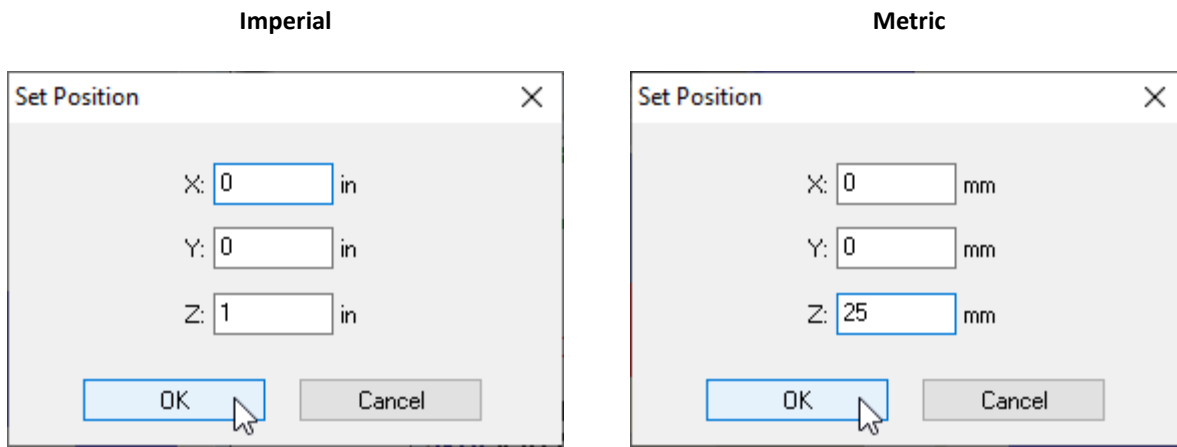
When the program reaches the second tool change command, the cross-slide stops moving, and the spindle stops rotating. The spindle moves automatically to the ATC and returns Tool 1. It then installs Tool 2.

3. Confirm that the program executes correctly *above the workpiece* without striking the hardware and that the tool changes occur automatically without error.
  - If you are satisfied with the program execution, continue to the next section.
  - If there are any problems, make the necessary corrections and rerun the dry run until the program executes correctly.

## 6.6. Resetting the Origin

You will now reset the workpiece origin to the top-front-left corner of the stock in preparation for actual machining.

1. Navigate to **Setup > Go to Position** and enter the coordinates **(0, 0, 0)**.
2. With your hand on the Emergency Stop button to prevent potential accidents, click **GO** to send the tool to the position currently defined as the point-of-origin. As required for the dry run, this position is 1 inch / 25 mm above the origin.
3. Navigate to **Setup > Set Position**. Enter the coordinates shown below and then click **OK**.



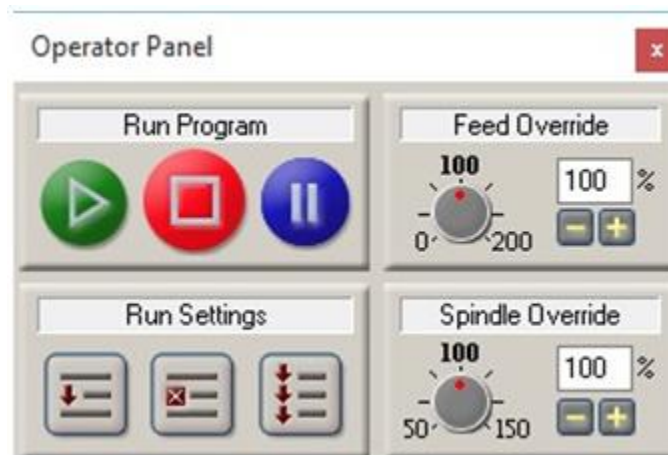
This resets the position to its true coordinates and restores the original workpiece origin.


## 6.7. Machining the Part

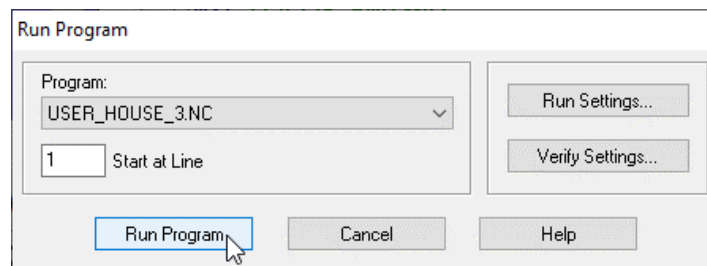
You will now observe the machining center cutting the part. Remember that when working with a machining center, safety is of the highest importance. You are expected to be ready to instantly stop the machine should any problems arise.

Perform this procedure to machine the part:

1. Put on your safety goggles.
2. In the Operator Panel, set both the **Spindle Override** and **Feed Override** to **100%**. This ensures that the spindle speed and feed rate will be exactly as defined in the NC program.



3. Select **Program > Run/Continue** or click the Run icon  on the toolbar. The Run Program dialog box is displayed.
4. Click **Run Program**.



Note that even though the program starts with Tool 2 mounted in the spindle, the first M06 command instructs the machine to use the ATC to return Tool 2 and insert Tool 1.

5. Confirm that the program executes correctly with tool changes being performed automatically.
  - If you are satisfied with the program execution, continue.
  - If there are any problems, make any necessary corrections and rerun the program until it executes correctly.

### 7. Authentic Skills Assessment

Have your instructor verify that your work meets the requirements in the Performance Objectives and sign below. Keep this hardware task sheet for future reference.

Instructor Signature	Date

### 8. Inventory and Shutdown

Unless instructed otherwise by your instructor, complete each of the steps below.

1. Home the mill.
2. Open the safety shield.
3. Use the ATC to return tool 2 back to station 2.
4. Store the step clamp and hex wrenches away.
5. Use a dry brush to clear any chips from the vise and cross-slide.
6. Switch off the machine power.
7. Exit the iCNC control software.