CNC Milling

ACTIVITY 10 HARDWARE TASKS

Name	Class/Period	Date

1. Overview

In this lab activity you will run your house NC program on the stock using two different end mills.

2. Performance Objectives

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

- Define tool offsets.
- Machine a part using multiple tools.
- Change a tool during a programmed tool change event (M06).

3. Required Materials

You need these materials to complete the hardware tasks:

- CNC milling center with installed mechanical vice
- 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)
- 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.

5. Hardware Tasks

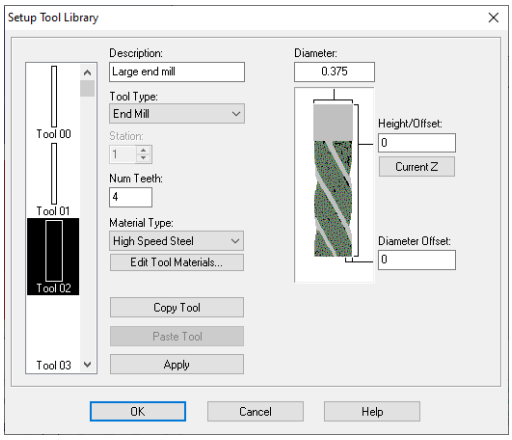
5.1. Preparing the Milling Station

> ***Note:*** *If required, review the previous activities and hardware tasks for any procedures that are not described in full.*

Follow the steps below to prepare the milling center.

1. Transfer the house NC program that you prepared in the online activity to the computer connected to the milling center.
2. Ensure that the Emergency Stop button is released.
3. Turn on the power switch.
4. Run CNCMotion (If required, use the launch button in the activity), and ensure that it is connected to the mill (**Setup > On-Line**).
5. Close the safety shield.
6. Home the machine.
7. Open the safety shield.
8. Secure a workpiece to the vise.
9. Secure Tool 01, the thinner end-mill, in the tool holder and insert the tool holder into the spindle.
10. Open the Setup Tool Library **(Tools > Setup Library)** and confirm that Tool 01 is defined as the end mill that you installed.
11. In the Setup Tool Library, define Tool 02 as the large end mill.

Imperial



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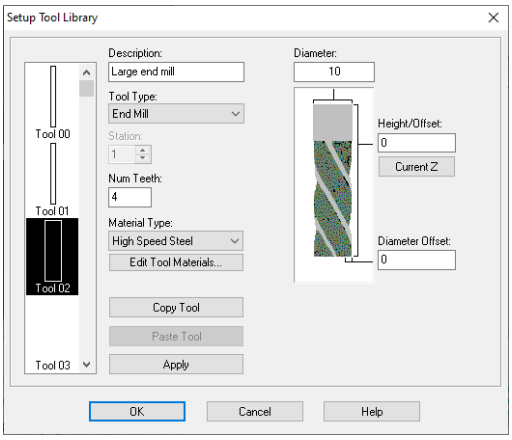
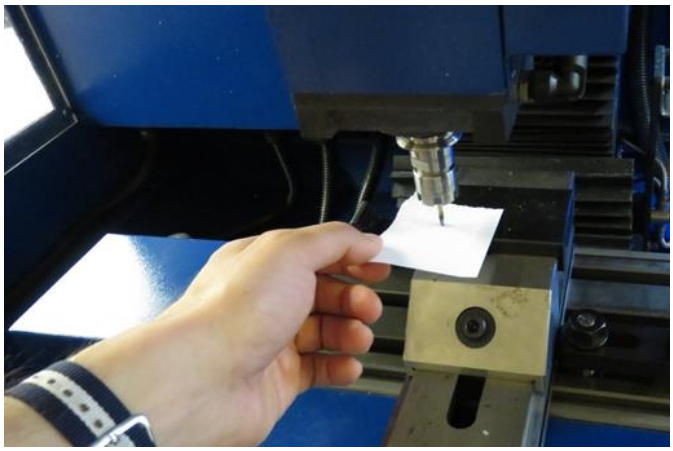
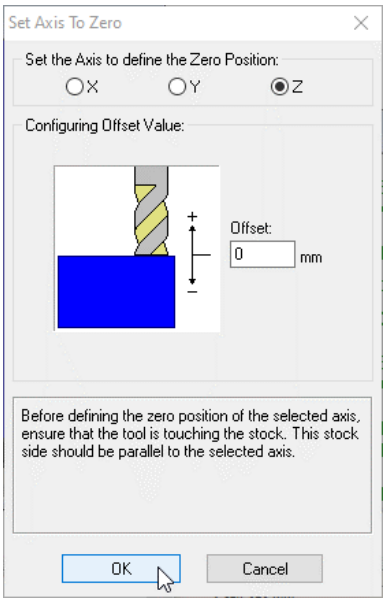


12. Select Tool 01 **(Tools > Select Tool)** for use in the spindle.

13. Touch off the top of the stock using a piece of paper as you normally would before setting the Z-axis to 0.

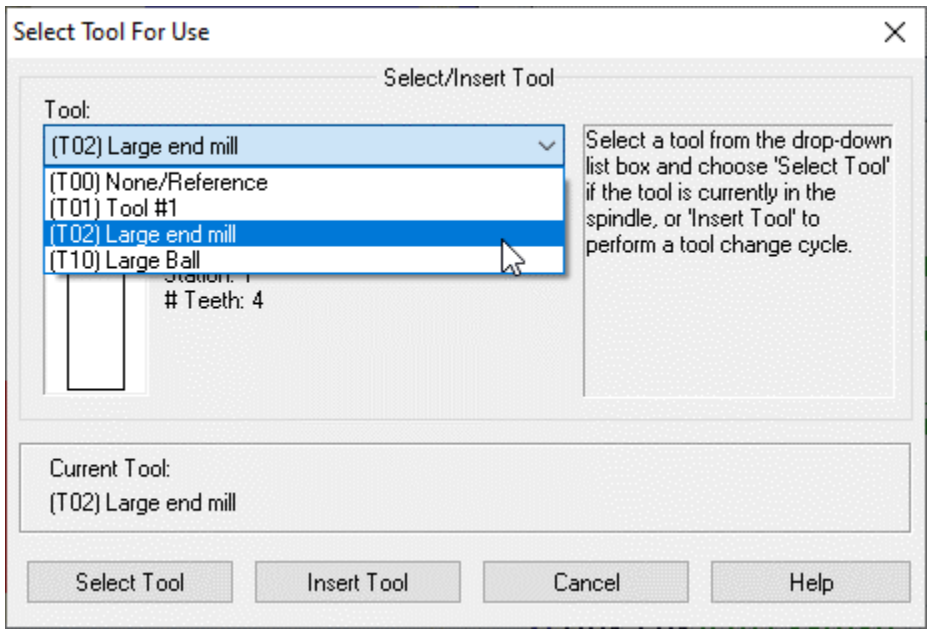


14. Set the Z-axis position to 0 (**Setup > Set Axis to Zero**).



5.2. Defining the Tool Offset

1. Using the jog control panel, move the spindle upwards to a point where you can easily switch the tool.
2. Remove Tool 01.
3. Insert Tool 02, the thicker end mill, into the spindle and select it (**Tools > Select Tool**).

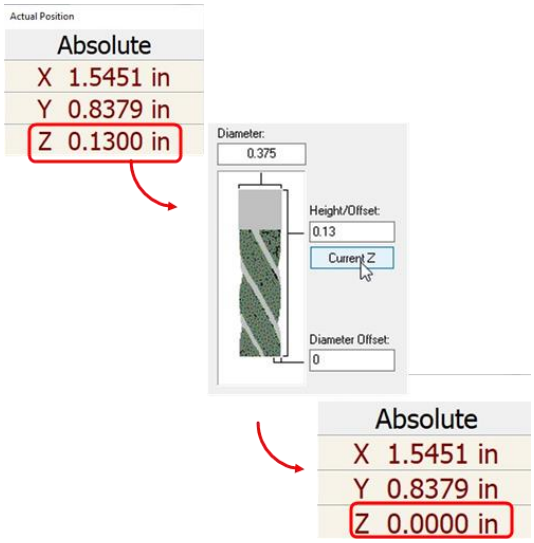
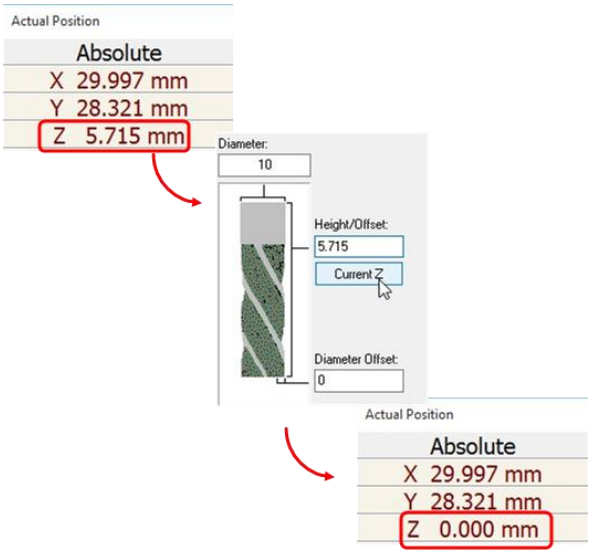


4. Check the Machine Info window to ensure that this tool is selected.
5. Touch off the top of the stock using a piece of paper as you normally would before setting the Z-axis to 0. **Do NOT zero the axis yet.**

   At this point, the absolute Z-axis position will not be 0, because the tools will have different heights.
6. Navigate to the Setup Tool Library (**Tools > Setup Library**), where Tool 02 is selected.
7. Click **Current Z.**

8. Click **OK**.

9. Ensure that in the Actual Position window, the absolute Z-axis position is now **0**.

Imperial Example	Metric Example
	

10. Using the jog control panel, move the spindle upwards to a point where you can easily switch the tool.
11. Insert Tool 01 into the spindle and select it (**Tools > Select Tool**).
12. In the Machine Info window, ensure that Tool 01, the thinner end mill, is selected.
13. Touch off the front and left faces of the workpiece, and zero those axes to complete definition of the workpiece origin.
14. Close the safety shield.
15. 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.

5.3. 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.
2. Double-click the Verify window to bring up the verify settings. Set the stock settings to those shown here:

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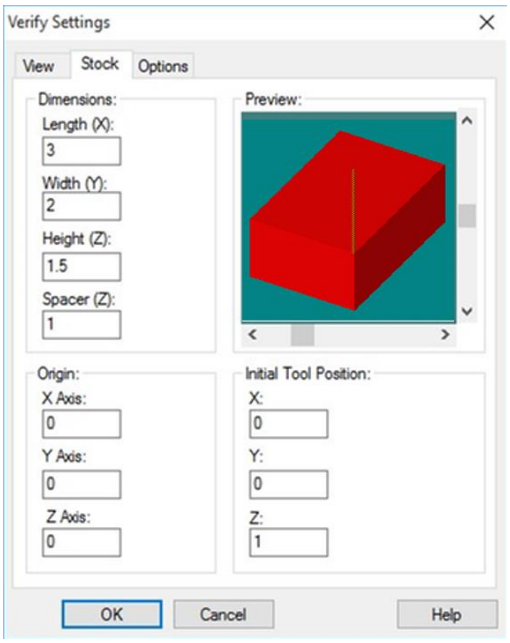

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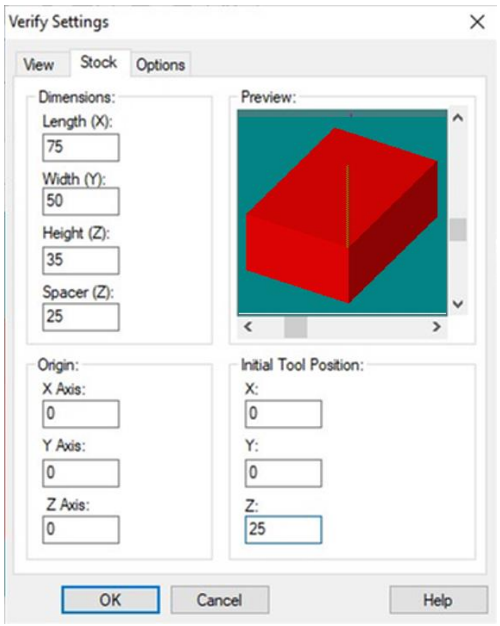

3. Verify the NC program. Confirm that the graphic verification draws the house and then clears the top face.

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.

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

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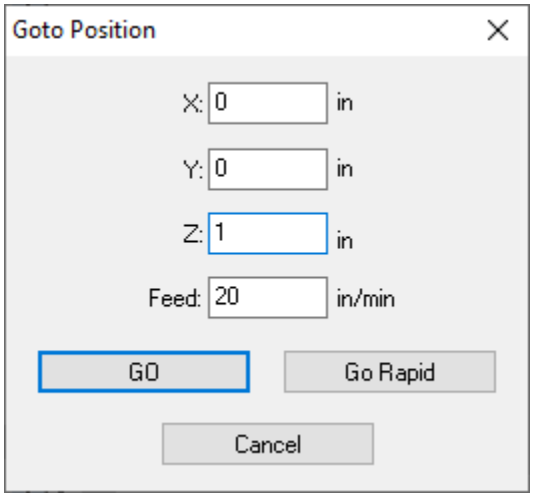

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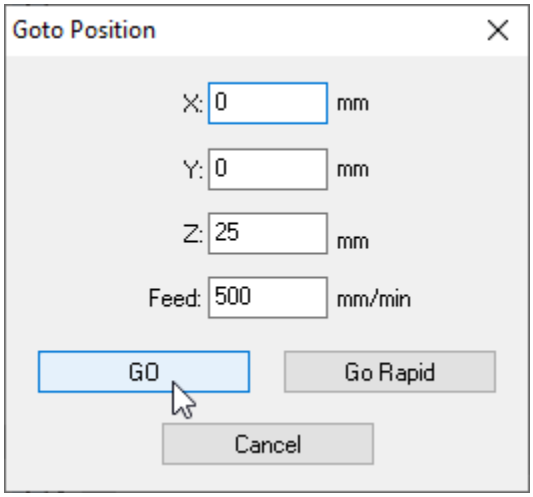


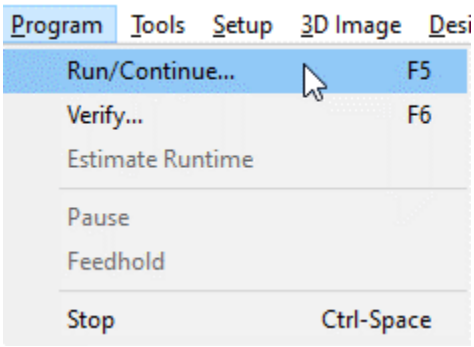
5. With one hand on the Emergency Stop button to prevent potential accidents, click **GO** to send the tool to the defined position above the point-of-origin.

6. 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.

5.4. Performing the Dry Run

Follow the steps to perform the dry run:

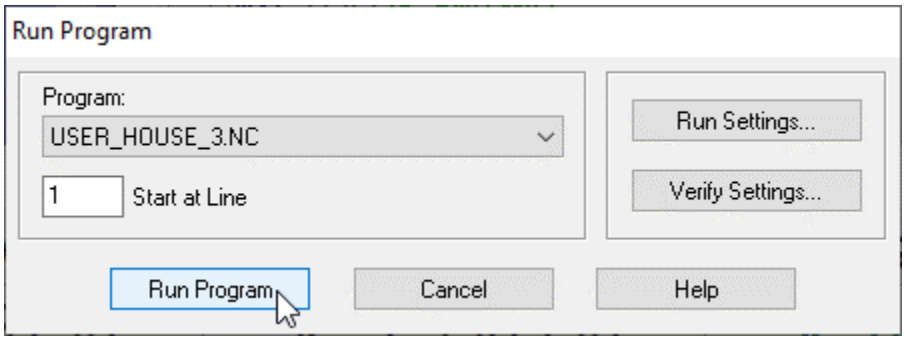
1. Select **Program > Run/Continue** or click the green Run icon on the toolbar.



The Run Program dialog box is displayed.

Note: *In the next step you will run the program for the first time. 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 tool change position.

3. Open the shield and remove Tool 01 from the spindle. Mount Tool 02, the thicker end mill.
4. Once the tool is mounted properly in the spindle, close the safety shield and click the Run icon to continue the program run.
5. Confirm that the program executes correctly *above the workpiece* without striking the hardware.
   - If you are satisfied with the program execution, continue to the next step.
   - If there are any problems, make the necessary corrections and rerun the dry run until the program executes correctly.
6. Open the shield and remove Tool 02 from the spindle. Mount Tool 01.
7. Once the tool is mounted properly in the spindle, close the safety shield.

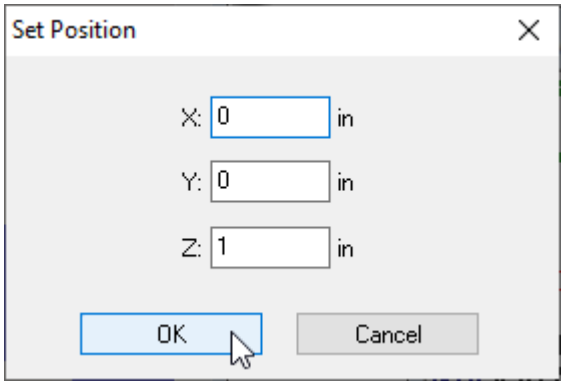
5.5. Resetting the Origin

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**.

Imperial



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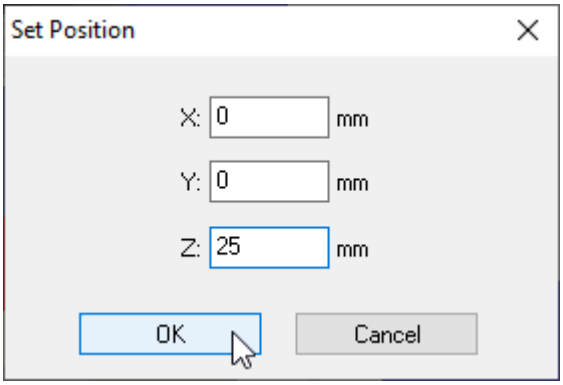


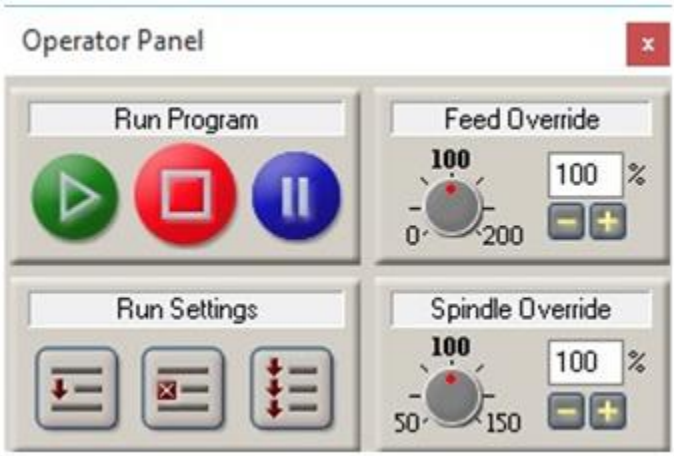
This resets the position to its true coordinates and restores the original workpiece origin.

5.6. Machining the Part

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

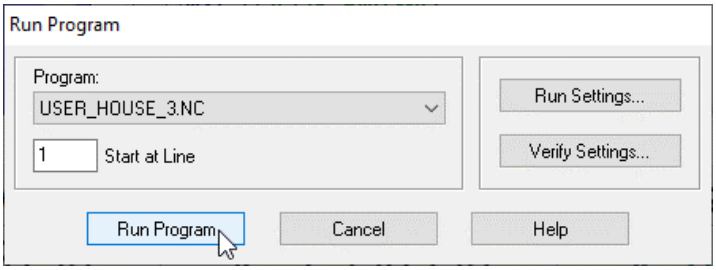
Perform this procedure to machine the part:

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**.



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 tool change position.

5. Open the shield and remove Tool 01 from the spindle. Mount Tool 02, the thicker end mill.
6. Once the tool is mounted properly in the spindle, close the safety shield and click the Run icon to continue the program run.
7. Confirm that the program executes correctly:
   - If you are satisfied with the program execution, continue on.
   - If there are any problems, make any necessary corrections and rerun the program until it executes correctly.

6. 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

7. 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. Remove the workpiece from the vise and store it away.
4. Remove Tool 02 from the spindle and carefully store both tools away.
5. Store the step clamp and hex wrenches away.
6. Use a dry brush to clear any chips from the vise and cross-slide.
7. Switch off the milling center.
8. Exit CNCMotion.