

Operations Manual for Machines Equipped with a Rotary Axis

Supplement to the WinCNC Operations Manual

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Laguna Tools

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OVERVIEW

The terms rotational axis, rotary axis, 4th axis, and A-axis are synonymous. All these terms refer to a rotary axis that has been integrated with a CNC machine. The rotary axis is similar to a lathe or rotary table such that it rotates the work piece on its axis. But the 4th axis allows for more functionality beyond continuous machining. It can perform indexing, as well as wrapping. The figure on the right is a CNC machine equipped with a 4th axis.

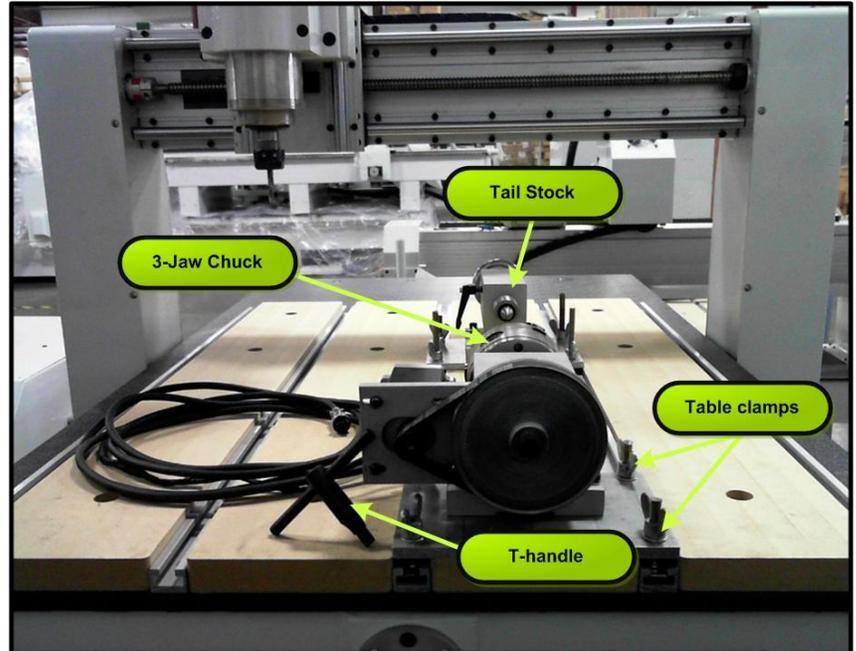


Figure 1. Rotary axis overview.

SAFETY WARNING

It is imperative that the T-handle chuck key is never left in the turner. Injury to the user and damage to the machine can occur.



Figure 2. WARNING.

PRELIMINARY CHECKS

If the chuck and tail stock are not permanently fixed onto the CNC machine, it is important to verify that the 4th axis is aligned to the machine.

VERIFY THE A-AXIS IS PARALLEL WITH THE Y-AXIS

Whether the rotary axis is placed along the X-axis or Y-axis it is important to verify that the center line of the rotary axis is parallel with the respective axis. In the figure below the rotary axis has been aligned to the Y-axis. There are multiple techniques to verify whether or not the two axes are parallel.

One suggestion is to mount a dial indicator onto the spindle or Z plate. Run the dial indicator along the work piece. Adjust the tail stock and chuck to correct for any deviation.

Of course, this is only one possibility, you are encouraged to develop your own techniques that suits your work flow.

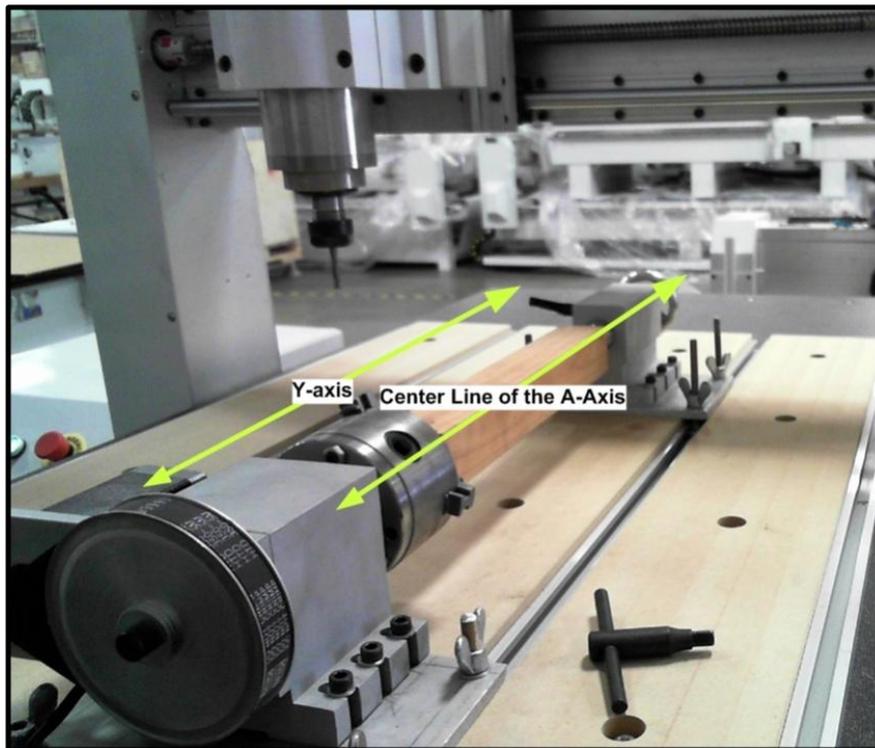


Figure 3. 4th axis alignment.

CONTROLLER OVERVIEW

Machines equipped with a 4th axis have an additional set of controls and functionality.

MANUAL JOG CONTROLS

Manually rotating the A-axis can be done by first selecting a continuous or incremental setting. Then either the A-axis manual jog buttons on the control screen can be pressed or the keyboard hotkeys.

The hotkeys to manually rotate the A-axis are the "Home" and "End" keys.

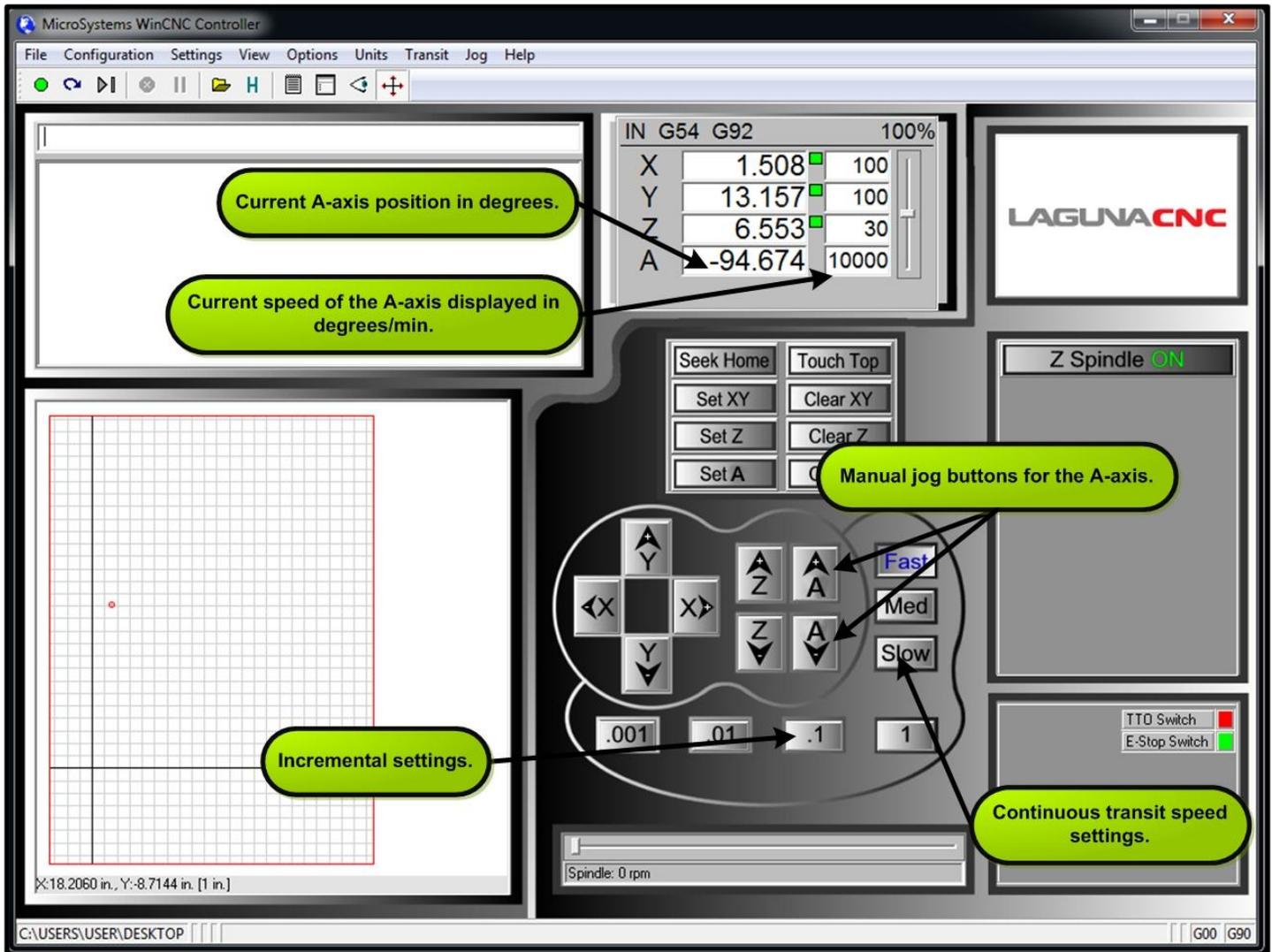


Figure 4. Controller interface overview, highlighting additional 4th axis controls.

A-AXIS WORK COORDINATES

It will be necessary to specify a work zero for the A-axis when aligning a new stock. To declare a new A0 position press the "SetA" button. As shown in the command history window below a "G92A" command is executed.

The screenshot shows the MicroSystems WinCNC Controller interface. The command history window displays the command `G92A`. The coordinate display shows the following values:

Axis	Value	Unit
X	1.508	100
Y	13.157	100
Z	6.553	30
A	0.000	9000

The A-axis value (0.000) is highlighted with a green box, indicating that a local zero has been declared and is active. The control panel includes buttons for `Seek Home`, `Set XY`, `Set Z`, `Set A`, `Clear Z`, and `Clear A`. The graphical display shows the current position: X: -4.1642 in., Y: 0.9566 in. [1 in.]. The status bar at the bottom shows `G00 G90`.

Callouts provide the following information:

- The button "Set A" sets local a local zero for the A-axis.
- The button "Clear A" removes the local zero. It will not be stored automatically.
- A green box next to the A-axis indicates a local zero has been declared and is active.

Figure 5. How to create and remove work coordinates for the A-axis.

This section captures the workflow for milling with the 4th axis. This tutorial will walk you through how to create a new wrapped project using the CAM software Aspire. And how to toolpath that project as well as preparing the CNC machine for 4th axis machining.

Keep in mind that this is not the only methodology for a project. It depends on how the project is defined in the CAD software. For example, some variances will be the starting location and the position of the Z0 plane.

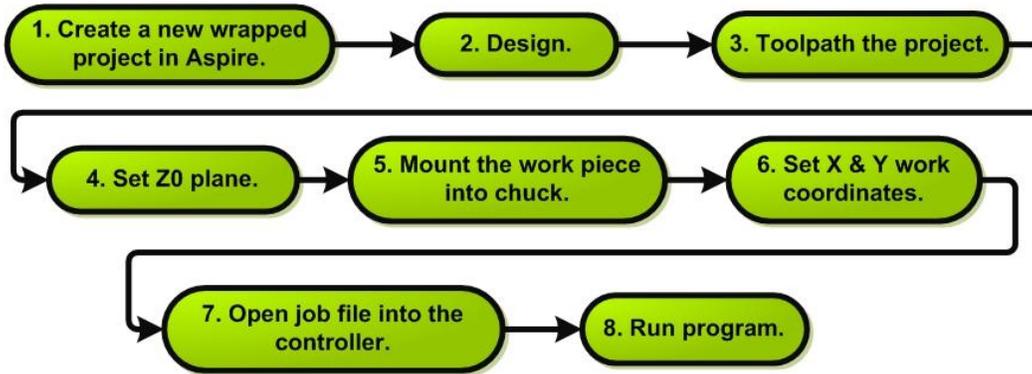


Figure 6. Workflow for 4th axis machining.

STEP 1. CREATING A NEW WRAPPED PROJECT IN ASPIRE

- Open Aspire.
- Follow the path Gadgets → Wrapping → Wrapped Job Setup.
- Enter in the dimensions of the cylinder blank.
- For consistency and accuracy, the center of cylinder should be selected as the Z0 plane.

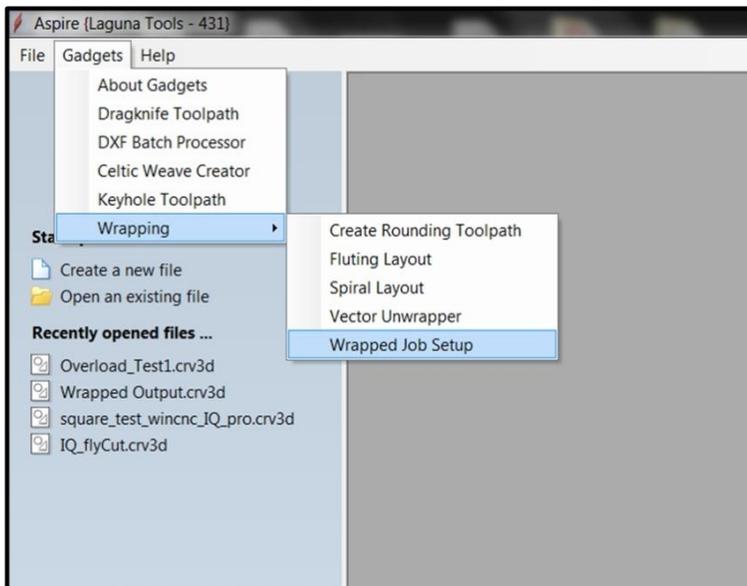


Figure 7. Path to create a wrapped project in Aspire.

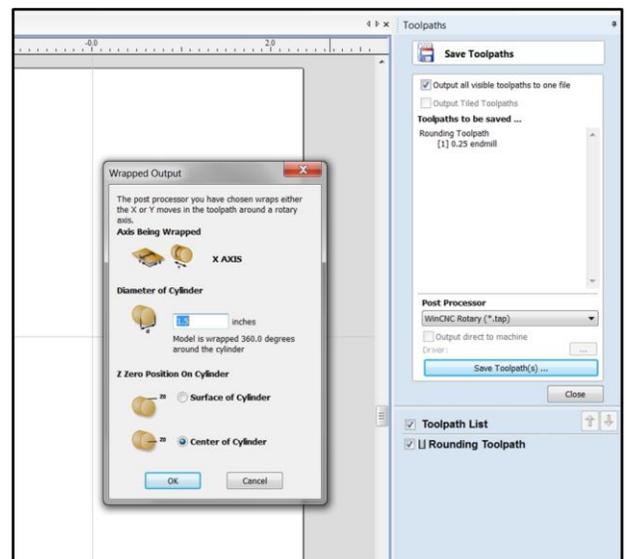


Figure 8. Window to set job dimensions.

- There are a few reasons to use the Center of the Cylinder, and they are listed below.
 - When rounding a blank, the surface is actually the surface of finished cylinder not the surface of the blank.
 - There could be irregularities in the work piece
 - The work piece could be mounted with a small amount of error.

STEP 2. DESIGN

Vectric, who is the developer of Aspire, provides tutorials and documentation on their website. It is an excellent resource if you are new to Aspire.

STEP 3. TOOLPATH THE PROJECT

- If you are creating a cylinder blank follow the toolpath
 - Gadgets --> Wrapping --> Create Rounding Toolpath
- If you are toolpathing your design, then you create a toolpath the same way as a 2D-Drawing.
- Once the toolpath is created, select which toolpath(s) to output.
- Select the WinCNC Rotary Post Processor. Then click Save Toolspath(s).
- Transfer the output file to the machine's PC.

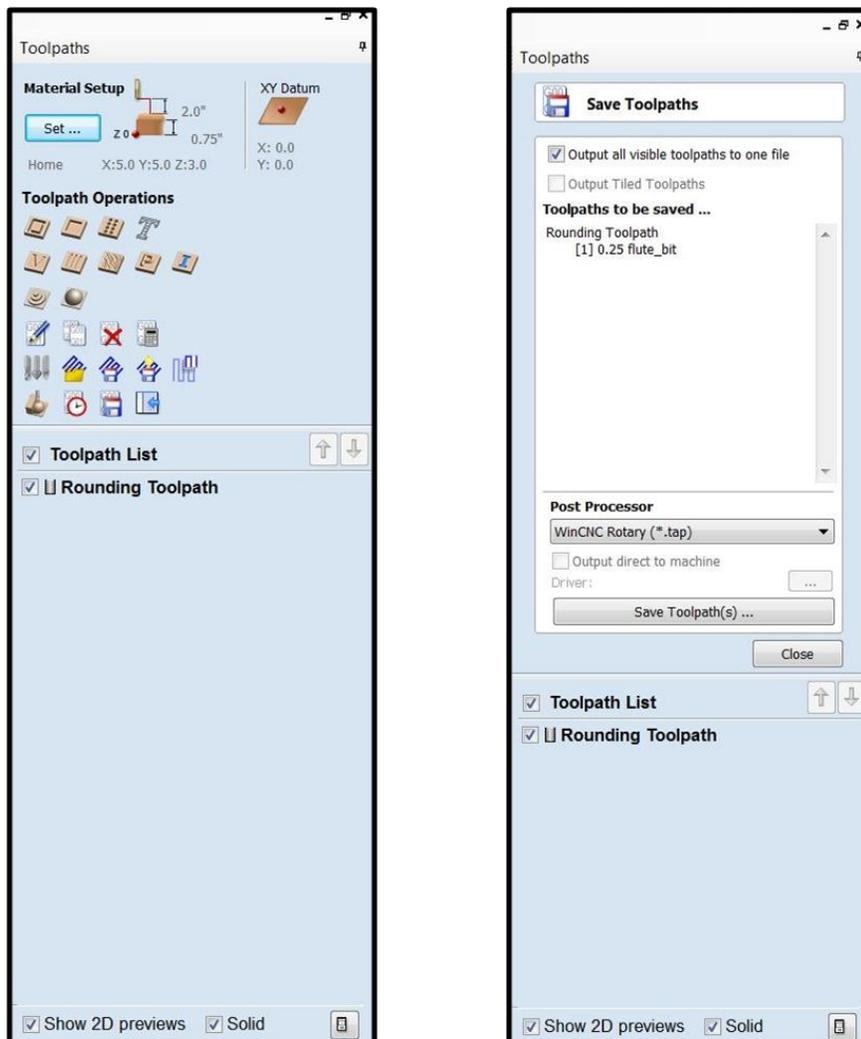


Figure 7. Snapshot of Aspire's toolpath tab.

STEP 4. SETTING THE Z0 PLANE WITH THE CENTER LINE OF THE A-AXIS

- Carefully align the bottom of the router bit with the point of the tail stock as shown in figure 10.
- Press the "SetZ" button. This will establish the Z0 coordinate plane as the center line of the cylinder as was declared in Aspire.

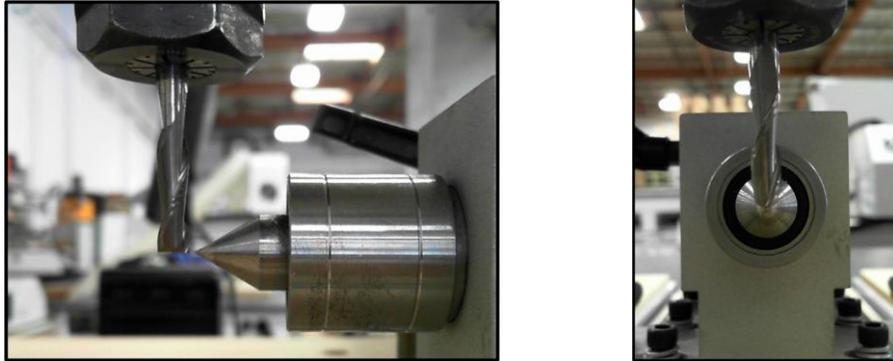


Figure 8. Locating the Z0 plane.

STEP 5. MOUNT THE WORK PIECE INTO THE CHUCK

The goal is to align the center line of the work piece with the centerline of the A-axis. It may take some ingenuity if the work piece is irregular.

STEP 6. SETTING THE X & Y WORK COORDINATES

Work coordinates need to be established prior to executing code. This applies to each axis.

- Mark the center of the material.
- Navigate the router bit and center it over the mark.
- Store this X and Y position by pressing the "SetXY" button.

STEPS 7 AND 8. LOAD AND RUN PROGRAM

- Load program into the controller using the path
File --> Open
- Run program.

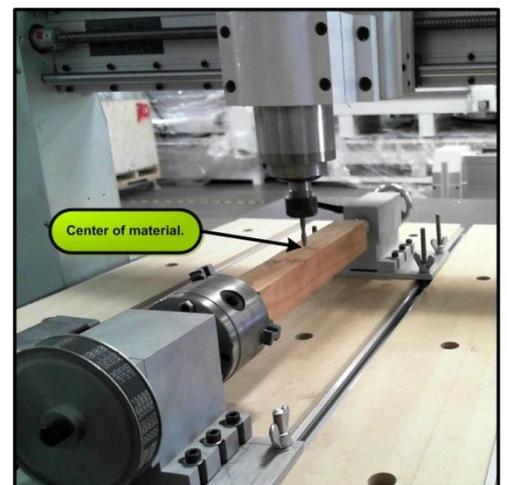


Figure 9. Aligning the spindle to the center of the material.