



# i2R CNC 4<sup>th</sup> Axis Kit Manual



BG Precision  
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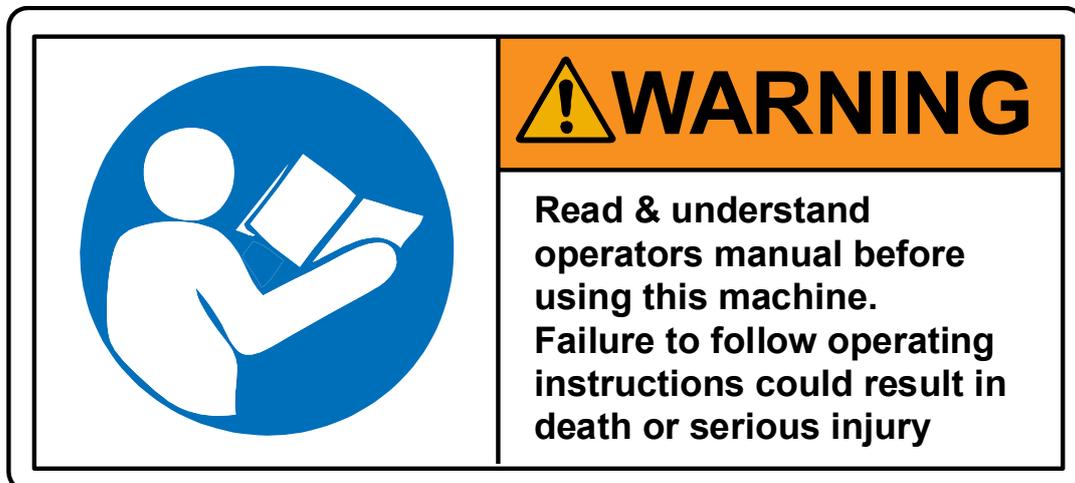
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**Before using/powering on the machine, the device should be carefully checked to make sure all connections are secure, and the device is technically sound as highlighted in this user manual.**



As a Rotary Index, this accessory rotates or indexes material in small increments for CNC machining applications. Depending on the toolpath design, continuous rotation is also possible.

The best way of thinking about it is, when you make a design on Vectric it's all on a flat plane. As an example, when you engrave a name in a flat piece of wood the machine will move on the x, y and z axes as it engraves the name. Now imagine, writing the name on a piece of paper and then wrap that paper around the outside of a cylinder. That's how your CAD design gets transposed to the Rotary (4<sup>th</sup>) Axis on the CNC machine. (In this manual, Rotary Axis, 4<sup>th</sup> Axis and A-axis, all refer to the same axis and used interchangeably.)

For rotary work on your CNC machine, Vectric will “wrap” either the X, or Y axis around the A-axis which is the rotary axis. You need to choose the wrap around X, or Y depending on how you set up the kit on your CNC table. If you set up along the Y axis as seen in the image above, then you should use the following post processor for 4<sup>th</sup> axis work.

### ***Mach2\_3\_Wrap\_X2A\_ATC\_mm***

You will need to change the post processor when changing between 4<sup>th</sup> axis and normal work, so take note of your current post processor also.

**The following video-links may assist you to gain a basic understanding of Rotary axis machining:**

Create Rounding Toolpath: This Vectric ‘gadget’ toolpath quickly sets up a toolpath to machine a cylinder out of a square cross-sectioned blank in a few simple steps. [Ctrl+Click to follow Link](#).

Modelling a spindle for rotary machining: Vectric video tutorial that runs you through setting up a spindle machining toolpath from a cylinder. [Ctrl+Click to follow Link](#).

# 1 UNBOXING AND ASSEMBLY:

## 1. Unbox all items

The components are:

- |  |      |
|--|------|
| 1. Headstock   | x 1  |
| 2. Mounting plates   | x 2  |
| 3. Taper 1" - 8TPI   | x 1  |
| 4. Drawbar   | x 1  |
| 5. Chuck – 4 jaw   | x 1  |
| 6. T-bar – Square  | x 1  |
| 7. T-bar – 4Allen  | x 1  |
| 8. Woodscrew   | x 1  |
| 9. Tailstock   | x 1  |
| 10. Live Centre  | x 1  |
| 11. Spin Handle  | x 1  |
| 12. Set Screw with Kip Lever                                       | x 1  |
| 13. Connecting cable   | x 1  |
| 14. Hardware: Separate and identify the mounting screws, as below: |      |
| Cap screws (Allen heads)   |      |
| M6 x 16mm  | x 4  |
| M6 x 20mm  | x 4+ |
| M6 x 25mm  | x 2  |
| 6mm washers  | x 2  |
| M6 Square nuts   | x 6  |



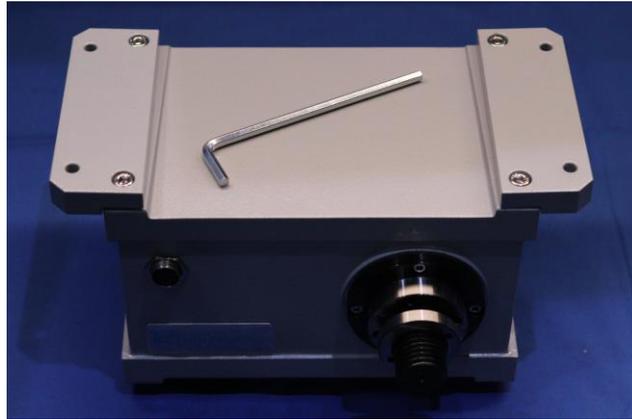
## 2. Locate the following:

- |                      |        |
|----------------------|--------|
| a. Head-Stock Body   |        |
| b. Mounting Plates   |        |
| c. M6 x 16mm screws  | (4 of) |
| d. M6 x 20mm screws  | (4 of) |
| e. M6 – Square Nuts  | (4 of) |
| f. 1"- 8TPI Taper    |        |
| g. Drawbar           |        |
| h. Chuck – 4 jaw     |        |
| i. T-bar – Square    |        |
| j. T-bar – 4mm Allen |        |



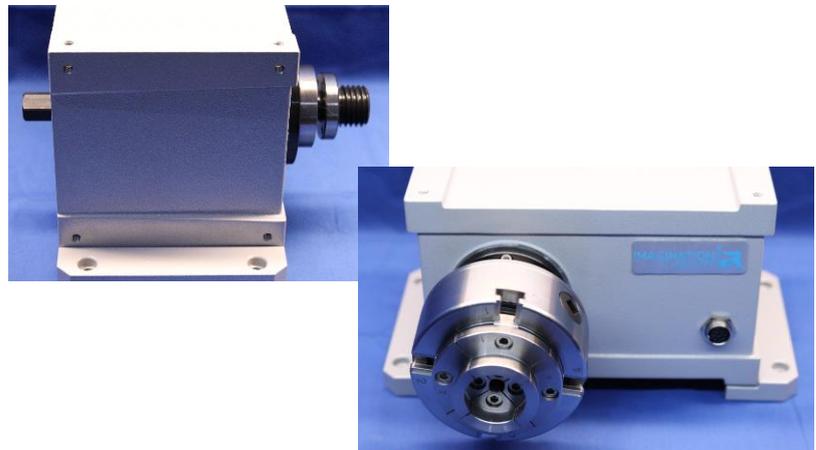
3. Attach the mounting plates using the M6 x 16mm cap screws. (5mm Allen key will be required – not supplied)

4. Insert the 1”- 8TPI taper through the front of the Head-Stock



5. Insert the Drawbar through the rear of the Headstock and tighten.

6. Attach the 4-Jaw chuck onto the threads and rotate by hand until tight.



7. At the machine, remove the left-most two spoil board strips.

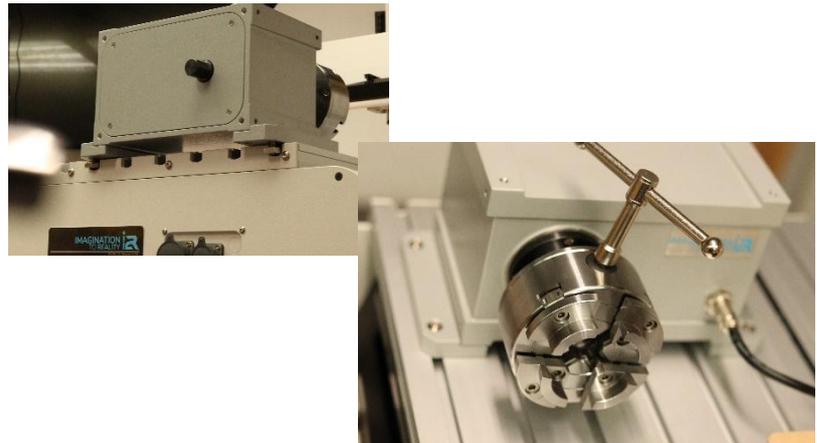
To remove, loosen all the cap screws and slide the strip off the table.

*Note: Although it is possible to locate the 4<sup>th</sup> Axis in other positions on the table, the setup detailed in this manual makes optimal use of the available table space with the kit installed.*



8. Assemble the M6 x 20mm cap screws and square nuts onto the mounting plates of the Headstock.

- a. Slide the Headstock into the space behind the back edge of the spoil boards (see picture).
- b. Leave the cap screws loose for the time being.



9. Install the 4th Axis control wire to the Headstock.

- a. One end of this wire will plug into the front of the Headstock.
- b. On i2R-A: the opposite end will plug into the rear plate of the machine-bed, (next to other existing connections).

On i2R-B: the opposite end will plug into the rear of the Control-box.

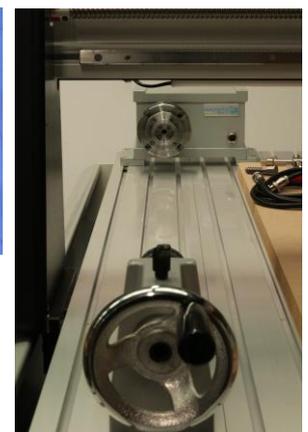
- c. Tighten the threaded check-nut on both connectors.



10. Complete the component assembly on the Tailstock as follows:

- Spin handle
- Set screw (Kip Lever)
- Live Centre
- M6 x 25mm + washer + Sq Nut (x2)

Install towards the front of the machine-table in the pair of t-slot that are either side of the chuck-centre.



## 2 SQUARING AND JOB SETUP:

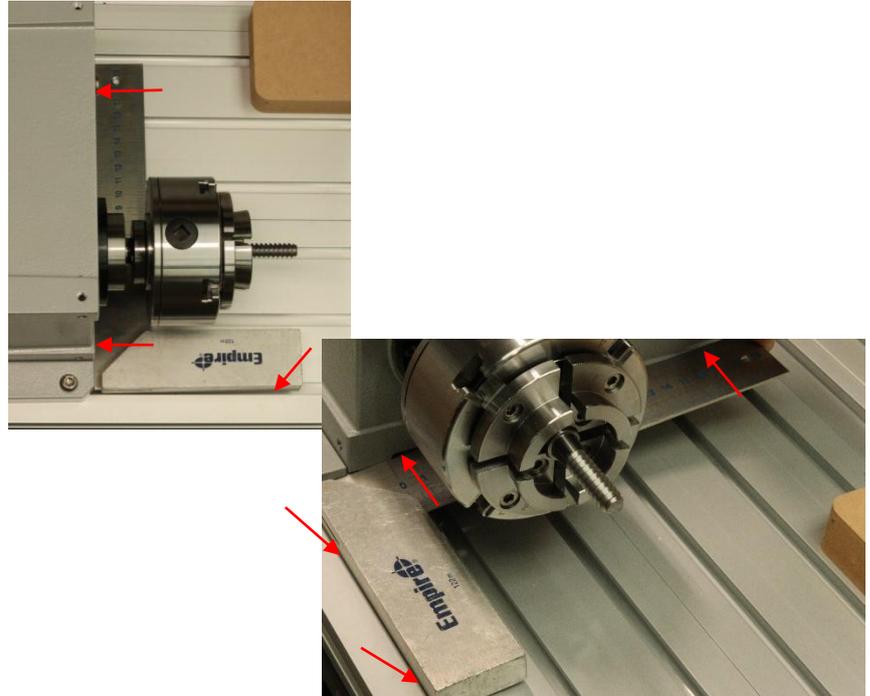
Now that all the components are lightly mounted to the table, it is time to square them to the machine and setup for the job. The machine should be turned on and homed using UCCNC at this stage as you will require to move all axes during the rest of the setup.

### 1. Start with the Headstock

- a. Use a square to align the body of the Headstock with the t-track found on the table. (*Avoid referencing off the mountplates*).

*Note: Although steps 1 to 8 may not render the rotary-axis perfectly parallel with the Y-axis travel of the CNC spindle, it should be very close to being correct. You may need to make a minor adjustment later in the process.*

- b. Once positioned, tighten the cap screws, locking the unit in place. Watch out for the unit 'creeping' out of position as the screws are tightened.



2. Use the included T-handle wrench to close the jaws of the Chuck all the way.

3. Now slide the Live Centre of the Tailstock into the Chuck. This will allow you to centre the Tailstock and align it to the centreline of the Chuck.

*Tip: Clamping a long straightedge to the tailstock as shown, may make it easier to check parallelism.*

4. Now re-adjust the long edge of straightedge parallel to the t-slot. **IMP:** Ensure the live centre cone is pushed firmly into the centre of the chuck while the next step is carried out.

5. Clamp both ends of the straightedge to the table with just enough clamping force to keep it in place.

6. Release the first clamp (from step 3). Use the straight edge to act as a fence, to guide the Tailstock, maintaining the alignment as you position it. Ensure there is enough distance between the chuck jaws and the tip of the live-centre to place the material length.

7. Once in place, tighten both cap screws on the Tailstock and lock the unit in place.

8. Unclamp and remove the straightedge



9. Draw centre marks on the material being used. \*Centreline templates are available at wood working specialty stores\*

- a. Open the Jaws of the Chuck
- b. Insert the material into the Chuck and close the jaws loosely on to the material.



10. Align the centreline with the Live Centre's tip.

- a. Spin the wheel to extend the Live Centre onto the material, allowing it to penetrate enough to provide a secure pivot.
- b. Tighten the set screw kip-lever.

11. Tighten the Chuck.

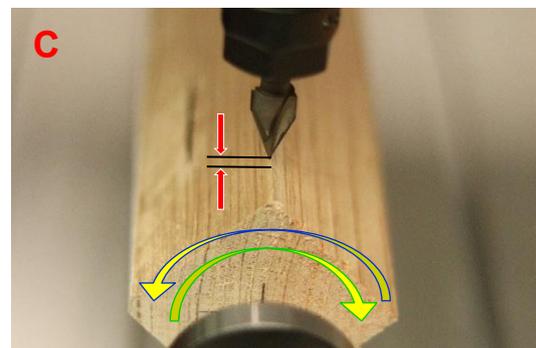
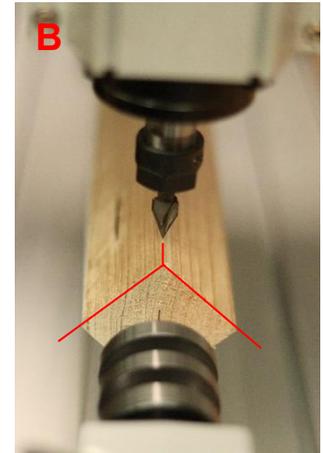
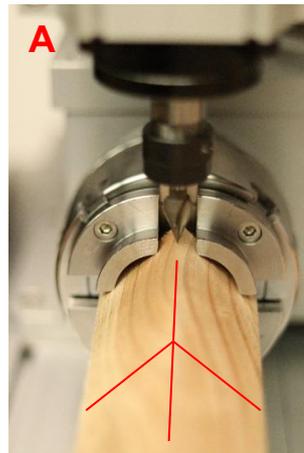
- a. Use either the Ins (Insert) or Del (Delete) button to rotate the A-axis to carry out the above checks. *Do not rotate the chuck by hand!*



12. It is advised that you check the Y-axis alignment of the material by using a V-bit in the spindle. The following checks are recommended. (*Square stock has been used in this manual for ease of explanation*)

a. Y-axis alignment: Rotate the material such that a corner is at the top. Align the tip of a V-bit near the chuck end of the material (*photo-A*). Now move the spindle along the Y-axis, bring it close to the tailstock (*photo-B*). The tip should follow the corner of the stock. If it does not; loosen the cap screws on the tailstock and adjust to correct the alignment.

b. While the bit is positioned over the material at the tailstock end, use the 'INS' or 'DEL' to rotate the A-axis while watching the gap between the bit and the material (*photo-C*).  
*Note: If the material is 'wobbling', that is, it is not running 'true' to the axis-line of the rotary-axis; double-check the cross-hair marking is done correctly, and, the centre of the live centre is actually placed in the cross-hair centre.*



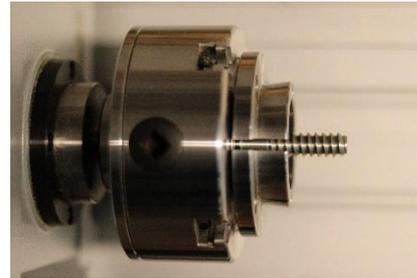
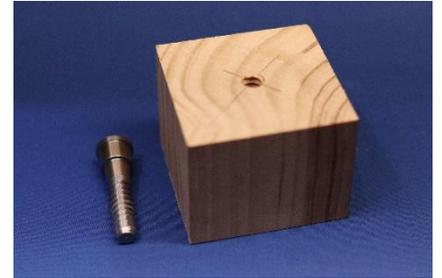
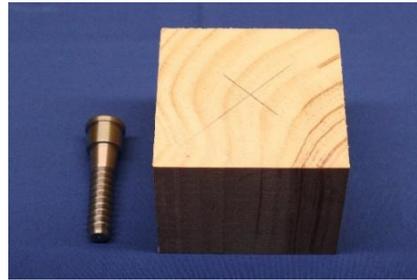
This completes the Rotary Axis setup in preparation for machining. Depending on the range of work you wish to perform on your CNC, you may prefer to leave the headstock fixed in place and remove/refit the tailstock. The configuration and positioning detailed here should allow refitting the spoilboards if the complete width of the table becomes necessary for a specific job. Always thoroughly check the extents of the job set up to prevent crashing into any of the rotary axis components.

**IMPORTANT:** It is imperative that you read and understand the UCCNC configuration set up explained in the final section. Take note that the selection of post processors is critical when switching between 3-axes machining and rotary axis machining.

## WOODSCREW

The woodscrew supplied in the kit allows material to be held in the chuck without the live centre being used. Commonly used for bowl turning but can be used whenever the material to be machined is very short. A blank may be also temporarily glued onto the stock piece of material threaded on the woodscrew.

Mark centrelines on one end of the material. Drill an 8mm hole, 35-38mm deep centred on the crosshairs. Ensure the hole is 'square' to the surface. Open the chuck enough to insert the woodscrew past the shoulder. Tighten the chuck and check that the screw is chucked-up 'true' to centre. Screw-on the stock material until it tightens-up against the chuck jaws. Take it off and glue the blank to it and clamp-up until set.



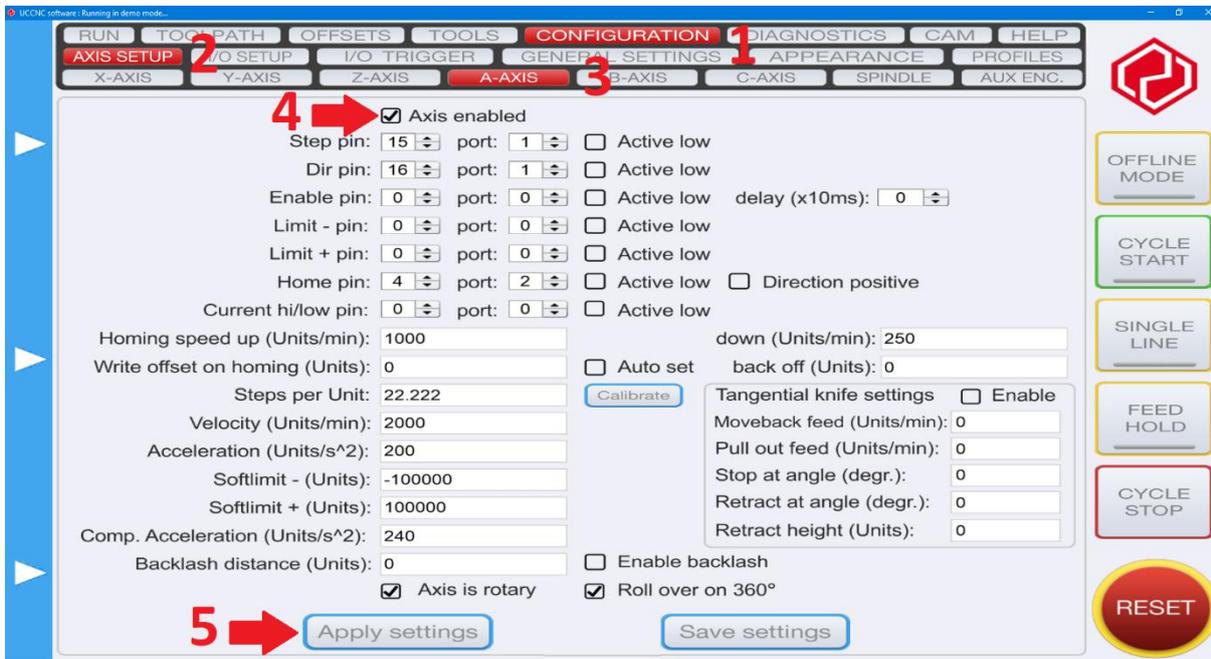
### 3 UCCNC CONFIGURATION

The UCCNC machine profile provided with your machine is set-up for 4<sup>th</sup> Axis machining, but the 4<sup>th</sup> Axis (A-Axis) needs to be enabled on UCCNC when the 4<sup>th</sup> Axis is connected. When you are finished using the A-Axis you must disable the A-Axis. Alternatively if you do not “save settings”, on next start-up of UCCNC software the A-Axis will be disabled

To Enable:

Launch UCCNC machine profile as normal

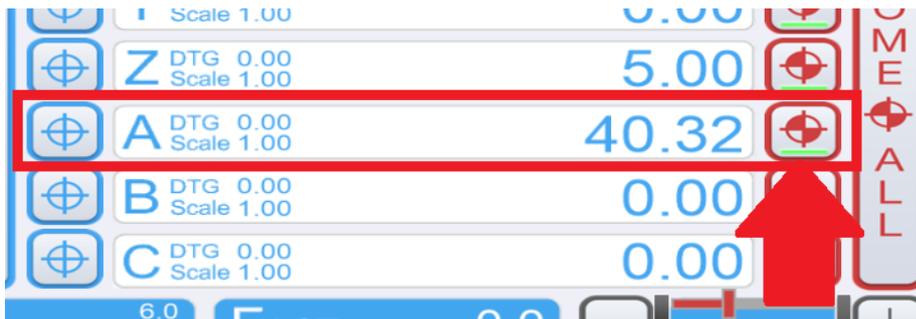
- 1) Navigate to the configuration tab
- 2) Axis Setup
- 3) A-Axis
- 4) Tick the “Axis enabled”
- 5) Apply settings



As always you must home your CNC before use.

Your A-Axis is not part of the “Home All” Sequence

You can home the A-Axis by clicking the Home button (Red Crosshair) beside the A-Axis



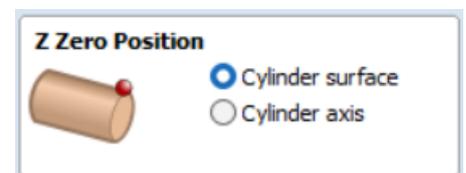
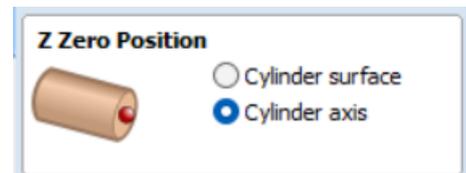
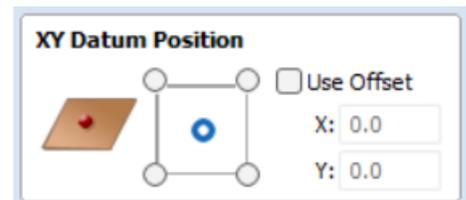
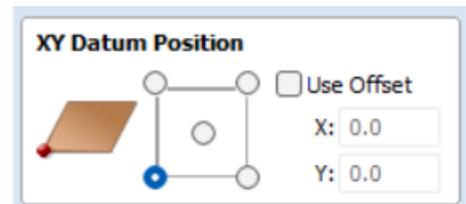


NOTE: It is highly recommended that you watch the Rotary Axis video tutorials from Vectric listed at the start of this manual, to obtain a clear understanding of job-setup before proceeding further.

It is assumed here that you have set up the 4<sup>th</sup> axis kit as per instruction above, that is, the Rotary axis lies along the Y-axis. It is also assumed that you are familiar with 3-axes machining before starting on Rotary machining.

In the context of Rotary machining, the following points are worth noting regarding each of the axes:

- X-Axis: In 4<sup>th</sup> axis machining, the spindle does not move across the X-axis. The rotation of the A axis achieves the travel required in the 'unwrapped' X axis, hence irrespective of the XY datum set in Vectric, the X-0 should always be on the rotary-axis' centreline along the Y-axis.
- Y-axis: origin 0 (zero) needs to match the set up in Vectric (see the snapshots on the right). In the first case, the Y-0 on the machine should be set close to the tailstock. The second example, it should be set to the centre of the material length along the Y-axis.
- Z-axis: For most applications, using the centre of the cylinder axis will provide repeatable, accurate results. This is because, after the initial roughing pass, for subsequent tool-changes the cylinder surface used for probe touch-off may no longer be available to reference off, whereas the centre of the axis will not change. Hence it becomes important that the height of the tip of the live-centre from the surface where the touch probe is placed, is measured accurately and noted for future reference. (see photo)



Two things important to note are:

- The t-slot table may not be 'dead flat' across the entire surface. Therefore it is reasonably important to touch-probe at the same XY machine-coordinates after each tool-change to obtain accurate results.
- The rotary axis-centre's height should be ascertained at first use. Make a note of this value using a marker on the tailstock body to act as a reminder every time the axis is used. See below on how to obtain this value.

Note: It is recommended a V-bit (60 or 90 deg) be chucked-up in the spindle for the following steps.

### Setting the Z Origin

- a. Move along the X axis so the bit is directly above the aluminium tabletop.
- b. Use the Touch-Off device to set the Z-0 to the metal surface of the tabletop. For details on how to use this device, refer to the machine  operation manual.
- c. Once the Z origin is set to the tabletop, raise the Z to 75.00. Carefully move the tool tip close to the tip of the live-centre. Move Z-axis up/down to position the tips of the V-bit and the live-centre to be at the exact same height (use the step-jog function in UCCNC if required). Note the Z value (it may be worth pencilling this number on the tail-stock as a reminder for subsequent setups
- d. Now use the  button for the Z axis to manually set the Z Origin at this height.

### Setting the X Origin

- a. The tool tip is most likely already on the centreline of the rotary axis at the end of the previous step. If not, position it correctly to line up with the axis of rotation.
- b. Now use the  button for the X axis to manually set the X Origin. Unless the rotary kit is moved on the t-slot table, this should not change and is worth noting for future reference.

### Setting the Y Origin

- c. The Y origin needs to match the job setup in Vectric. Always ensure there is adequate clearance to prevent the tool, spindle-chuck or spindle from coming in contact with the rotary chuck and/or live-centre and tailstock. Be especially careful when moving between 'home' position and job-setup on the rotary axis.

Once the Origin is completely setup and the controller changes have been made, the 4th axis files should be able to run. As with 3-axes machining, always double check the extents of the machining toolpath will not make contact with anything unintended (headstock, chuck, live-centre tailstock etc).