V2 Edge Finding Tutorial

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Revision History:

First Release: Updated for Pocket NC V2 October 2017. Based on previous tutorial for Pocket NC V1. (JD)

Introduction

The purpose of this tutorial is to familiarize readers with the process of edge finding on the Pocket NC mill. This process is necessary in order to make the machine origin and the model or part origin coincident with one another. These origins must be at the same point in space in order for the toolpaths written in CAM software to produce the desired geometry on the finished parts.

Tools Needed

- Pocket NC mill
- Pocket NC vise
- Stock material
- Pocket NC Edge Finder Tool Holder
- ⅜ inch diameter shank Edge Finder
- Calipers or Micrometer
- 5 mm Allen wrench
- Computer running Autodesk Fusion 360 CAD/CAM

Notes:

This document is for reference only! Readers and operators take on all liability in the use of this document.

Unless otherwise noted, all measurements are in inches.

This document assumes the user knows basic functions of the machine. These functions include setting up the Pocket NC vise, transferring files to and from the machine, loading/running programs, setting up tooling and measuring tool length offsets.

All files talked about in this document can be found within the zip folder containing this document.

Pocket NC does not take responsibility for any damage or injury caused by the use of this or any other shared program.

Note that each machine has a slightly different center of rotation and as a result the Fusion part must have its center of rotation changed before using the program. The documentation shipped with each machine includes the offset. If the machine was shipped prior to 2017 see the “B axis offset Tutorial” for how to check the offset on your machine. This offset must be properly set in the model prior to starting the edge finding process.

Section 1: Getting Started

Section 1.1: Definition of Terms

Origin:

The point in space at which all the axes of a coordinate system are zero.

Machine Origin:

The point in space about which the “A” and “B” rotary table on the Pocket NC mill rotate and where the X, Y, and Z axes are defined to be zero (X0, Y0, Z0). This point is the “physical origin” of the part being machined.

Part Origin:

The point in 3D space that establishes the coordinate system defining the model geometry, orientation, and location. This is also the origin for the toolpaths. This point is also the physical point on the stock that correlates with the origin used to define the model and in particular the toolpaths. This point is the “digital origin” of the part being machined.

Work Offset:

The physical distance between the machine origin and the part origin. For the Pocket NC mill, the work offset should be zero. The machine origin and part origin must be at the same point in space (coincident points).

Tool Length Offset:

Distance from the Z home position to the machine origin. For more information see the “Tool Length Offset” tutorial.

B Axis Offset:

The vertical distance from the face of the B table to the machine origin. This distance is unique to every machine. For more informations see the B Axis Offset tutorial.

Edge Finder:

Tool used to accurately locate the edges of a part.

Toolpath:

The computer generated path the tool follows in order to cut the part out of the stock. The toolpath is generated in Fusion 360 CAM and then converted to G code using a post processor.

Touch off:

Method of locating a face on the stock by touching it with a tool held in the Pocket NC spindle. The spindle is not rotating during the touch off.

Edge Finding:

The process of locating the stock in space by touching off of one or more face(s).

Stock:

The piece of material out of which the part is being machined.

Section 1.2: What is Edge Finding?

Edge finding is the process of locating the the stock being machined in physical space in relation to the machine origin point.

Section 1.3: Why is Edge Finding Necessary?

In order for parts to be machined correctly the machine origin and part origin must be coincident. The machine origin on the Pocket NC mill is fixed. The toolpaths in Fusion CAM must be written in relation to the origin of the Pocket NC. The stock must then be located in the vise so that the digital origin of the model used to make the toolpaths and the physical origin of the machine are coincident.

The coincidence of the origins is critical if the rotary axes are used. If the origins are misaligned by an arbitrary amount, for example 0.010 inches in the X direction, when the B table is rotated 180º the misalignment will now be -0.010 inches in the X direction. The magnitude of the total misalignment is the sum of magnitudes of the misalignment in each direction. Here 0.010 inches + 0.010 inches for a total effective misalignment of 0.020 inches between the physical and digital origins. This will cause the part to be machined in a lopsided fashion and could result in crashes and/or broken tooling.

Section 2: Edge Finding Process

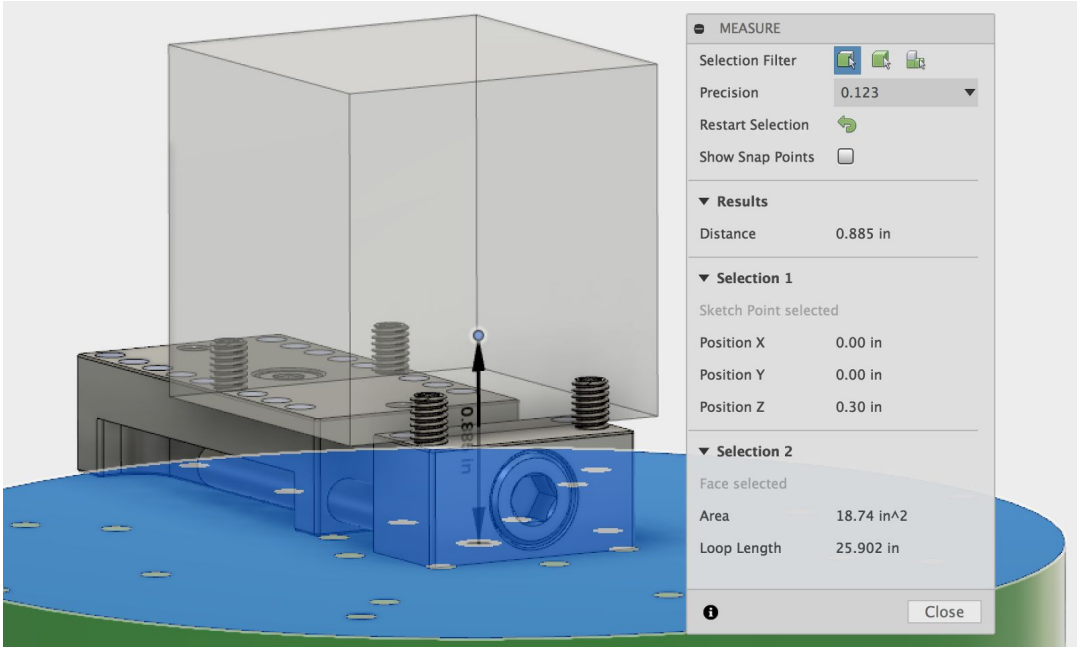
Section 2.1: Check B Axis Offset

Before proceeding with edge finding, verify that the B axis offset in your CAD model is correct for the machine you are using. The default B axis offset in CAD files supplied by Pocket NC is 0.885 inches. However, this value is unique to

every machine. The B offset for your machine is included with the documentation supplied with the machine.

If this documentation is no longer available, contact Pocket NC here, and we will find it for you. Or, if you prefer, you may measure it yourself using the instructions in this tutorial.

The best way to check the B offset in the CAD model is to measure the distance between the B table and the origin. In the image below, the B table offset is 0.885 inches.



Section 2.2: Setup and Home Machine

Turn on your Pocket NC mill, and home all axes on the machine before proceeding with edge finding.

Section 2.3: Measure Tool and Stock

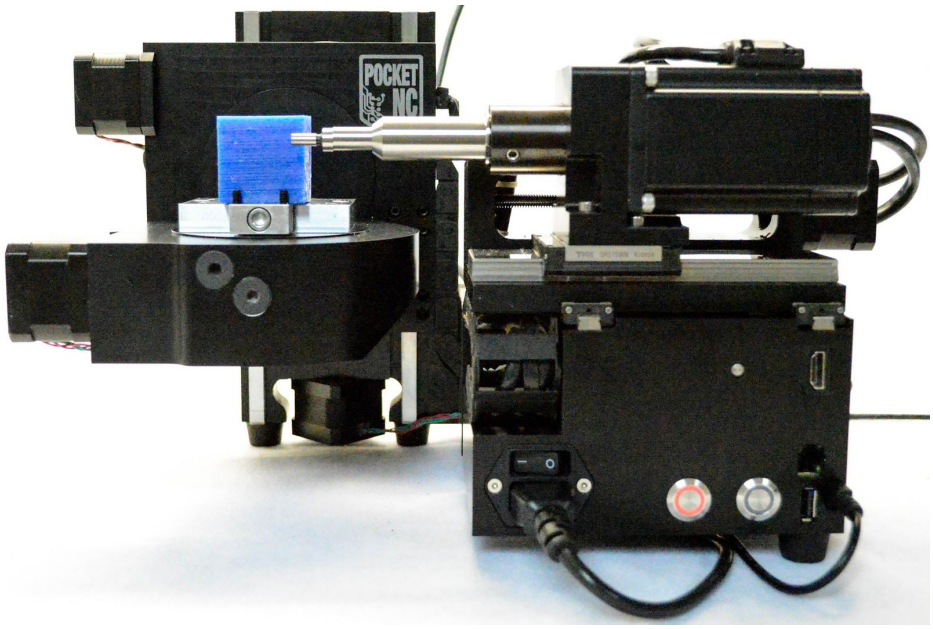
Measure the diameter of the edge finder tip using calipers or a micrometer. If you are using the edge finder supplied by Pocket NC the tip diameter is 0.200 inches. Record this measurement for future use.

Measure your stock and adjust the stock in the model to match the size of the physical stock. In this tutorial the stock size is 1.512 inches x 1.4885 inches x 1.4665 inches (X, Y, and Z respectively).

Section 2.4: Measure Tool Length Offset

Measure the tool length offset of the tools you will be using for machining the part. All the tool offsets needed for every operation on the part should be measured before mounting the stock. It is sometimes possible to measure a tool offset with stock mounted on the table, but it may be much more difficult. For more information see the “Tool Length Offset” tutorial located on the Pocket NC V2 resources page.

When you are finished measuring tool length offsets, load the edge finding tool holder into the spindle and install the edge finding tool. You do not need to measure the tool length offset of the edge finder.



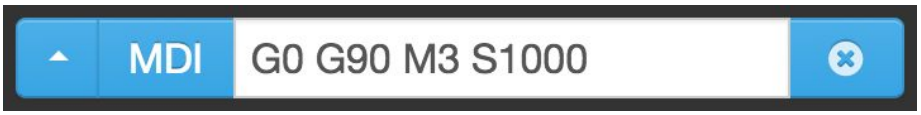
Section 2.5: Mount Stock

Mount the stock in the Pocket NC. See the “Workholding” tutorial for more information on how to use the Pocket NC vise. Locate the stock close to the position in which it is located in the CAD/CAM model. Tighten the vise to secure the stock. Pay particular attention to making sure that the stock is seated securely in the Y direction so that the stock will not be able to pivot/rock when it is machined.

Section 2.6: Measure X Offset

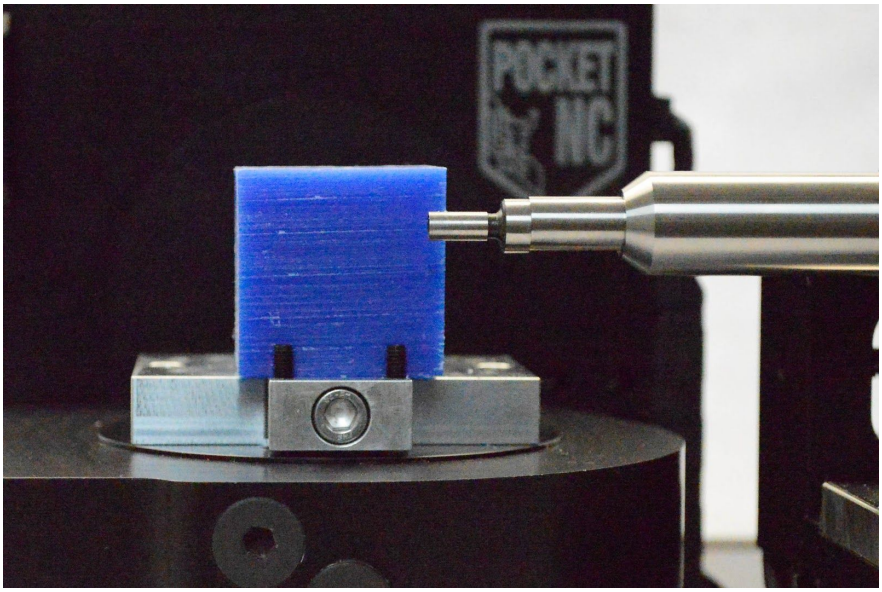
First, measure the X offset. Use the manual controls to move the spindle alongside the stock on the outside (opposite from the A table side) of the stock. The edge finding tool should be parallel to the X face of the stock.

Bump the wobbler on the edge finder slightly so that it is not concentric with the shank. Turn on the spindle using the MIDI command G0 G90 M5 S1000.

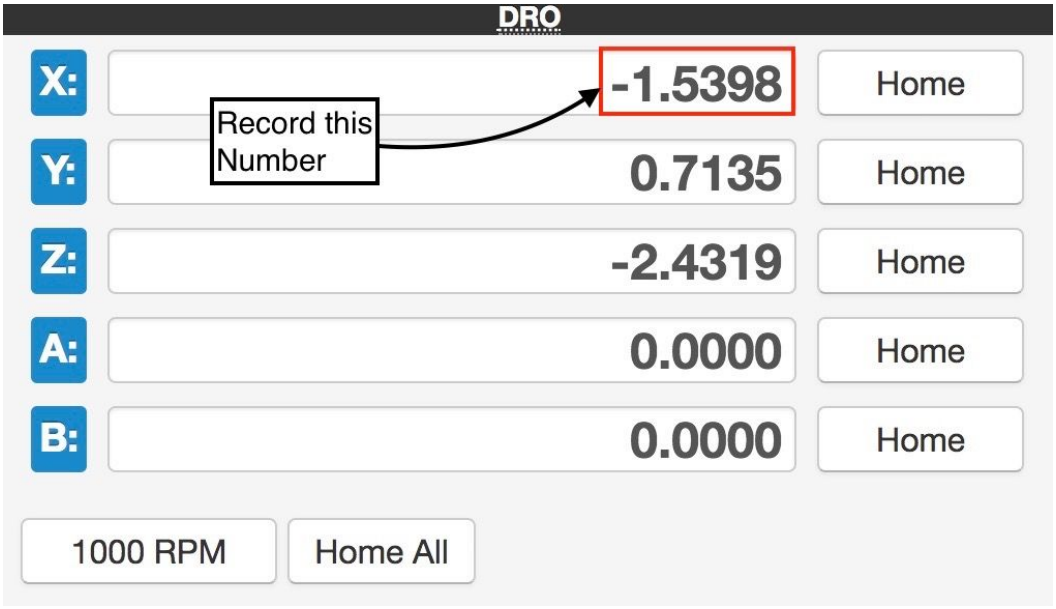


Do not exceed the maximum speed for which the edge finder is rated. For the Pocket NC the maximum operating speed is 2000 rpm. Exceeding this speed is dangerous for the operator and is likely to cause damage to the tool.
Bumping the wobbler, with a finger or other object, while the spindle is turning is not recommended. Fingers, clothing or tools may become snagged on the spindle and there is a potential for physical injury and/or damage to the Pocket NC. Only adjust the wobbler position when the spindle is off.

Move the tool toward the face. Decrease the step size to 0.001 inches or less as you get close to the part. As the wobbler starts to touch the face it will start to spin more concentrically with the shank of the edge finder. Keep moving the edge finder toward the part until the wobbler spins concentrically with the shaft of the edge finder. Continue to move the edge finder closer to the part until you see the wobbler suddenly “jump” to a new position that is no longer concentric with the shank of the edge finder.



Look at the Digital Readout (DRO) and record the X position.



Type “G0 G90 M5” into the MDI window to stop the spindle.

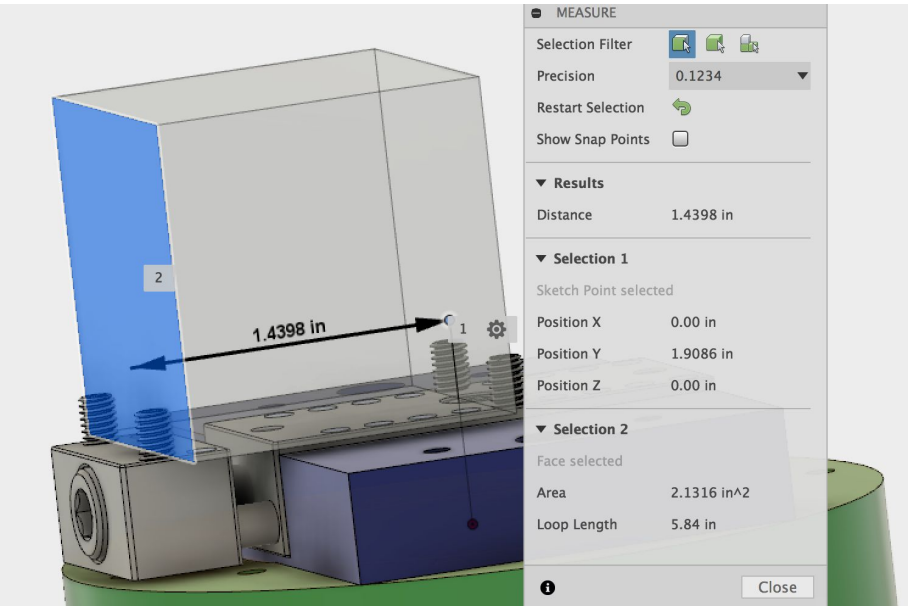
The offset is the X distance displayed in DRO minus half of the edge finder tip diameter. The calculation for the X offset is: (absolute value of measured X distance) - (½ edge finder tip diameter) = X offset.

In this case the X offset is 1.5398 - 0.200/2 = 1.4398 inches.

Compare this measured X offset with the distance between the origin and the X face in Fusion. If they do not match, move the part in Fusion until the measured X offset and the model X offset match. Do not adjust the size of the stock in CAD. Instead use the move commands to adjust its location.

The original X offset in the CAD model is shown below. The original offset is 1.4206 inches. Note the measurement precision is 4 decimal places.

The adjusted X offset in the CAD model is shown below. The distance from the X face to the machine origin in digital space now matches the physical distance.

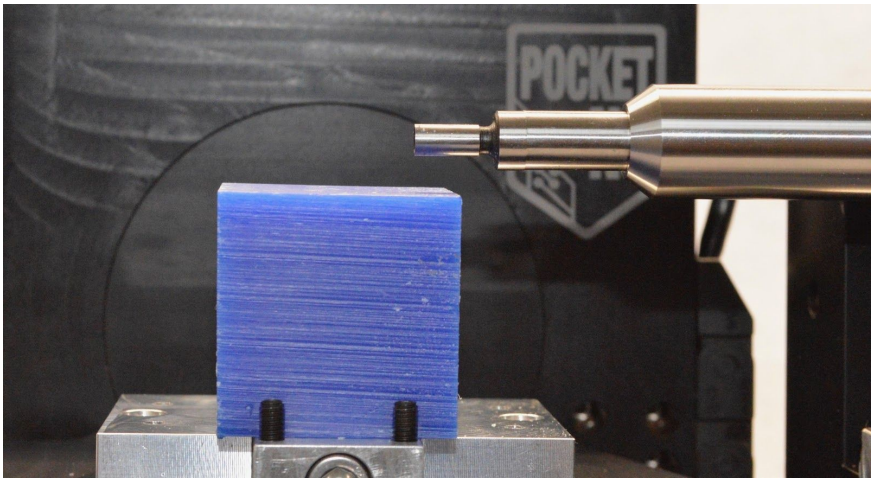


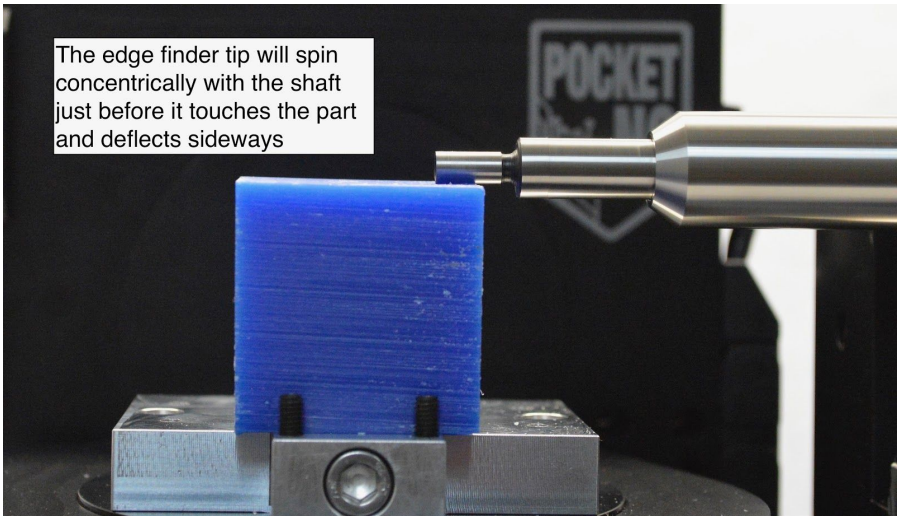
Section 2.7: Measure Y Offset

Next, measure the Y offset. Use the manual controls to move the spindle so that the edge finder is above the stock. The tool should be parallel to the Y face of the stock.

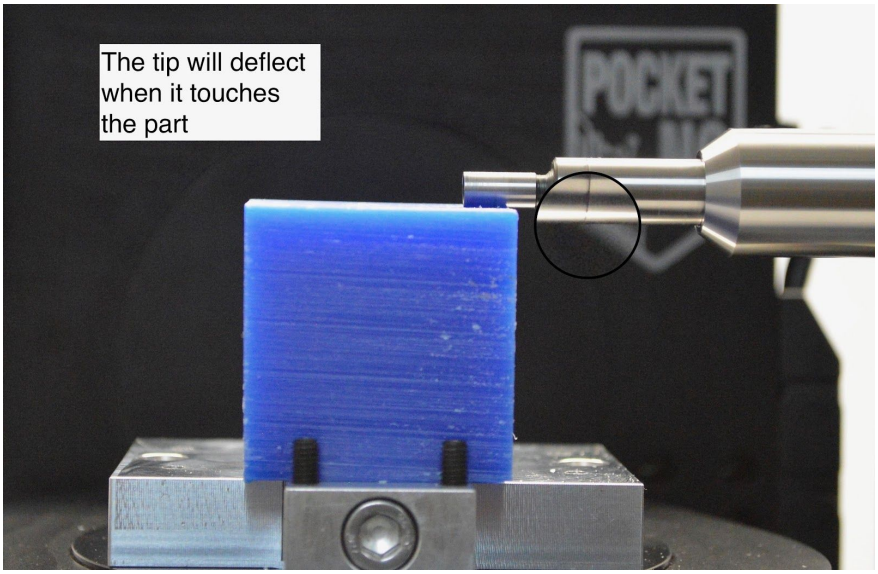
Bump the wobbler on the edge finder slightly so that it is not concentric with the shank. Turn on the spindle using the MIDI command G0 G90 M5 S1000. Do not exceed the maximum speed for which the edge finder is rated.

Move the tool toward the face. Decrease the step size to 0.001 inches or less as you get close to the part. As the wobbler starts to touch the face it will start to spin more concentrically with the shank of the edge finder.

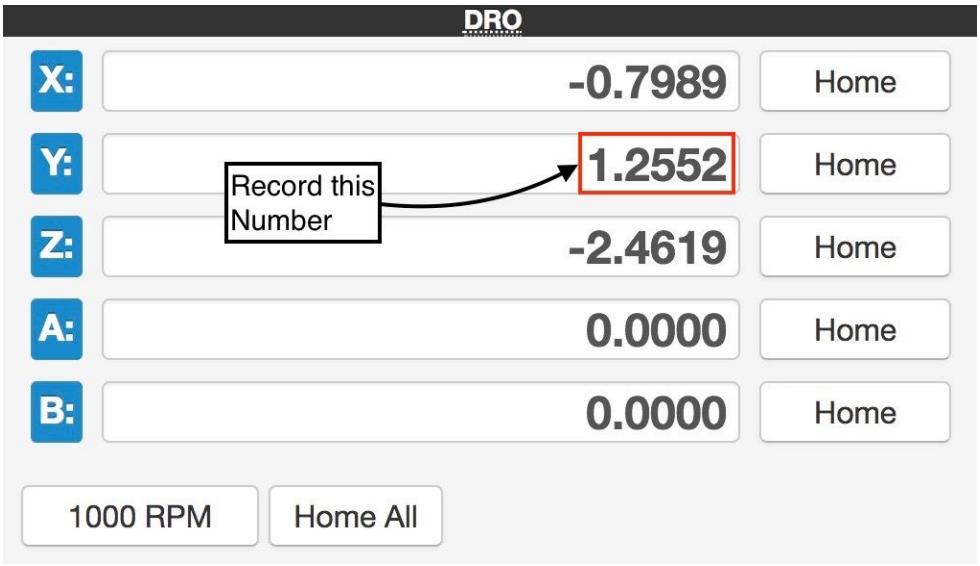




Keep moving the edge finder toward the part until the wobbler spins concentrically with the shaft of the edge finder. Continue to move the edge finder closer to the part until you see the wobbler suddenly “jump” to a new position that is no longer concentric with the shank of the edge finder.



Look at the Digital Readout (DRO) and record the Y position.



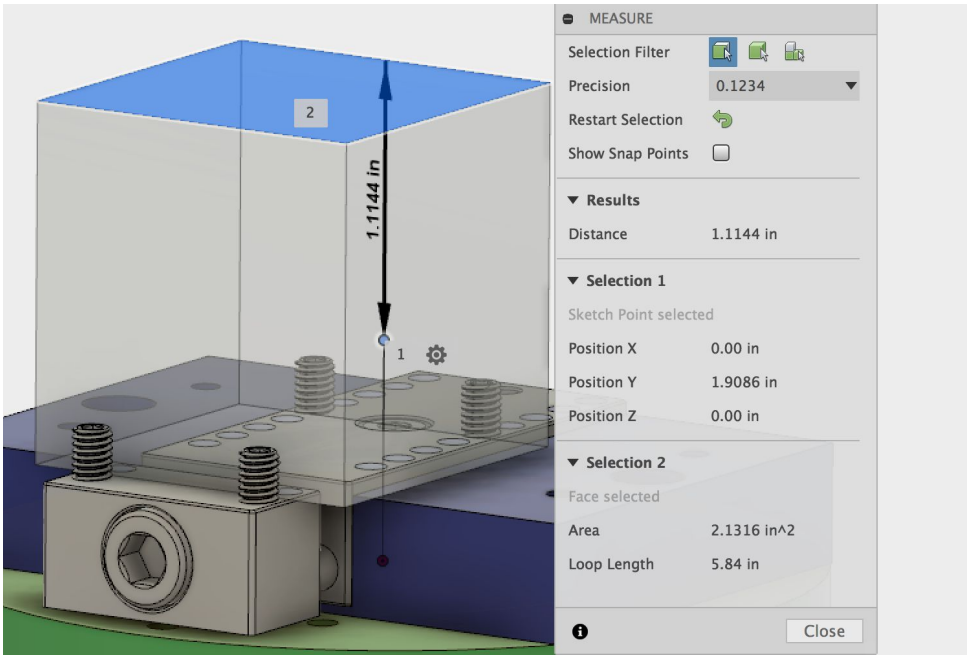
Type “G0 G90 M5” into the MDI window to stop the spindle.

The offset is the Y distance displayed in the DRO, minus half of the tool diameter. The calculation for the Y offset is: (Y distance) - (½ Edge Finder Tip Diameter) = Y offset.

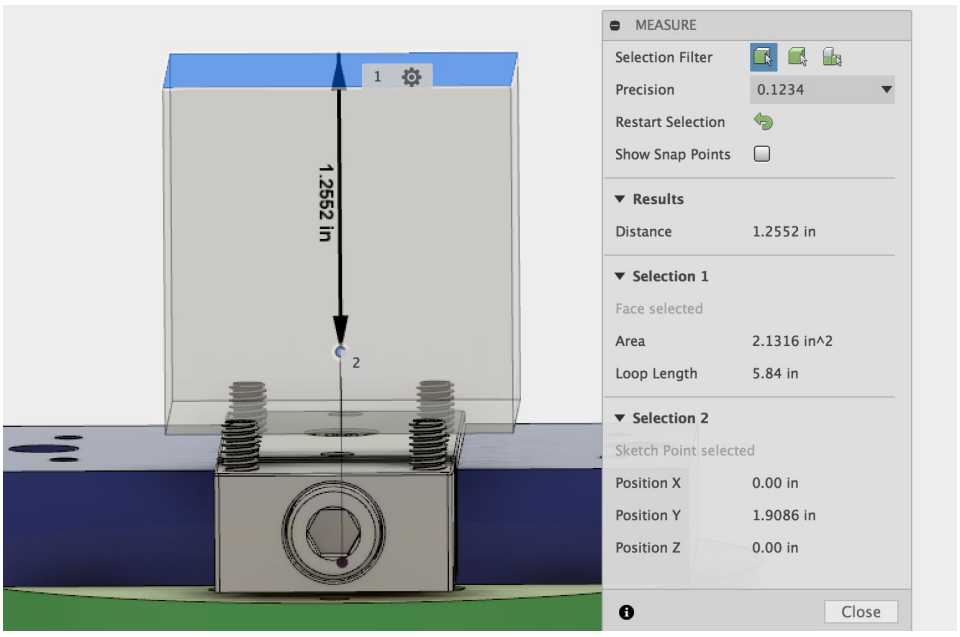
In this case the Y offset = 1.2552 - 0.200/2 = 1.1552 inches.

Compare this measured Y offset with the distance between the origin and the Y face in Fusion. If they do not match, move the part in Fusion until the measured Y offset and the model Y offset match. Do not adjust the size of the stock in CAD. Instead use the move commands to adjust its location.

The original Y offset in the CAD model is shown below. The original offset is 1.103 inches. Note the the measurement precision is 4 decimal places. Only three decimal places are displayed because the distance is exactly 1.103 inches.



The adjusted Y offset in the CAD model is shown below. The distance from the Y face to the machine origin in digital space now matches the physical distance.

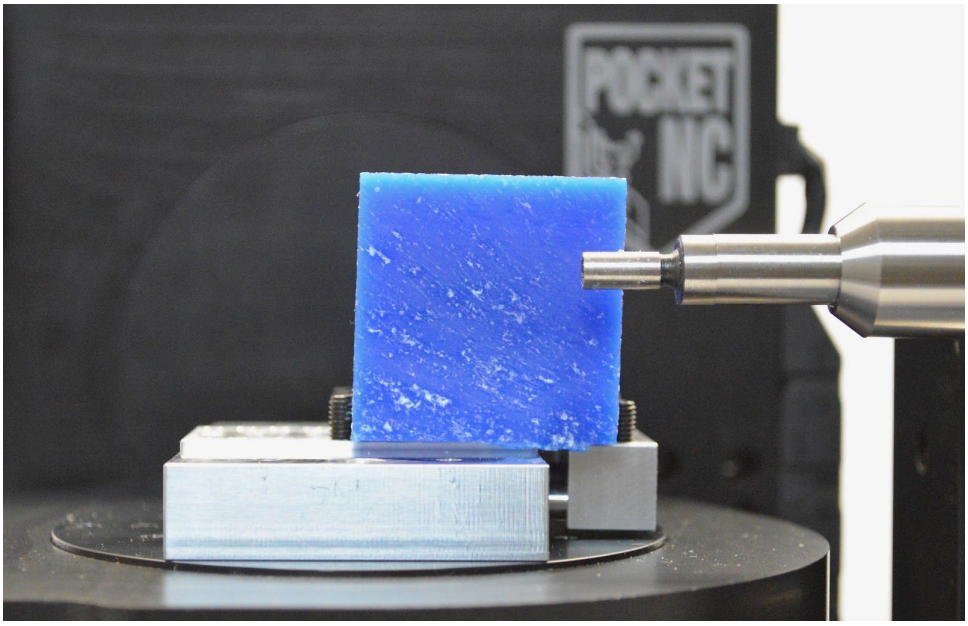


If the measured distance from the machine origin to the Y surface and the model value are significantly different before adjustment, and you have measured your stock and verified that the model dimensions match the physical dimensions, it means your machine origin in your model may be in the wrong location. Double check before proceeding.

Section 2.8: Measure Z Offset

Finally, measure the Z offset using the same method used to find the X and Y offsets. First, use the manual controls to rotate the B table -90º (90º clockwise).

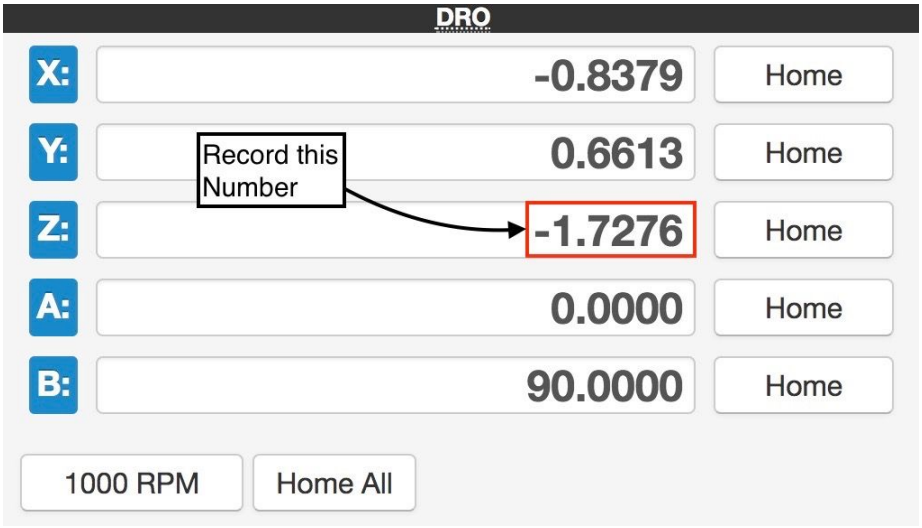
Use the same procedure detailed above for the X offset to find the Z offset. Use the manual controls to move the spindle alongside the stock on the outside (opposite from the A table side) of the stock. The edge finder should be parallel to the Z face of the stock that has been rotated over to the “X position.”



Bump the wobbler on the edge finder slightly so that it is not concentric with the shank. Turn on the spindle using the MIDI command G0 G90 M5 S1000. Do not exceed the maximum speed for which the edge finder is rated.

Move the tool toward the face. Decrease the step size to 0.001 inches or less as you get close to the part. As the wobbler starts to touch the face it will start to spin more concentrically with the shank of the edge finder. Keep moving the edge finder toward the part until the wobbler spins concentrically with the shaft of the edge finder. Continue to move the edge finder closer to the part until you see the wobbler suddenly “jump” to a new position that is no longer concentric with the shank of the edge finder.

Look at the Digital Readout (DRO) and record the Z position.



Type “G0 G90 M5” into the MDI window to stop the spindle.

The offset is the X distance displayed in the DRO, minus half of the edge finder tip diameter. The calculation for the Z offset is: (absolute value of measured X distance) - ½ edge finder tip diameter = Z offset.

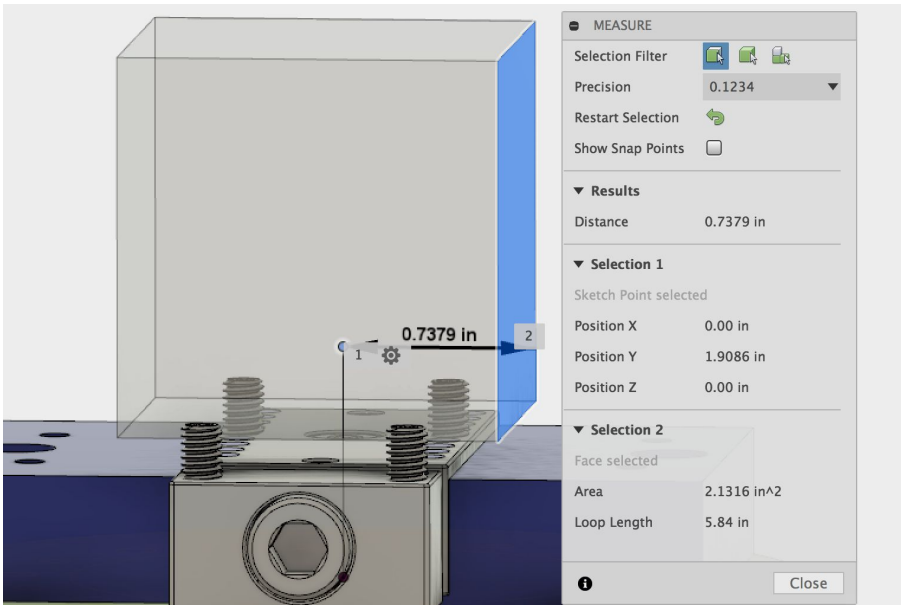
In this case the Z offset is 0.8379 - 0.200/2 = 0.7379”

Rotate the B table back to its home position by moving +90º (90º counter-clockwise) when you are finished measuring the Z offset.

Compare the measured Z offset to the CAD model and if necessary, move the model to reconcile the values.

The measured value from the CAD model is shown below. In the model the stock is centered. The distance from the Z face to the machine origin (digital origin) is 0.7513 inches. Note that the precision on the measurement is set to 4 decimal places.

The adjusted Z offset in the CAD model is shown below. The distance from the Z face to the machine origin in digital space now matches the physical distance of 0.7417 inches.



Section 2.9: Wrapping Up

Once the digital origin and the physical origin are coincident, generate and postprocess the toolpaths. Save the toolpaths to a USB and proceed with machining the part. Do not move the stock after it has been located through the edge finding process. If the stock is moved, the edge finding process will have to be repeated.