Requirements: CNC12 v5.0+

The Centroid Acorn and AcornSix and Hickory Wizard supports a variety of common Automatic Tool Changer types.

Rack Mount, Carousel and a number of Turrets

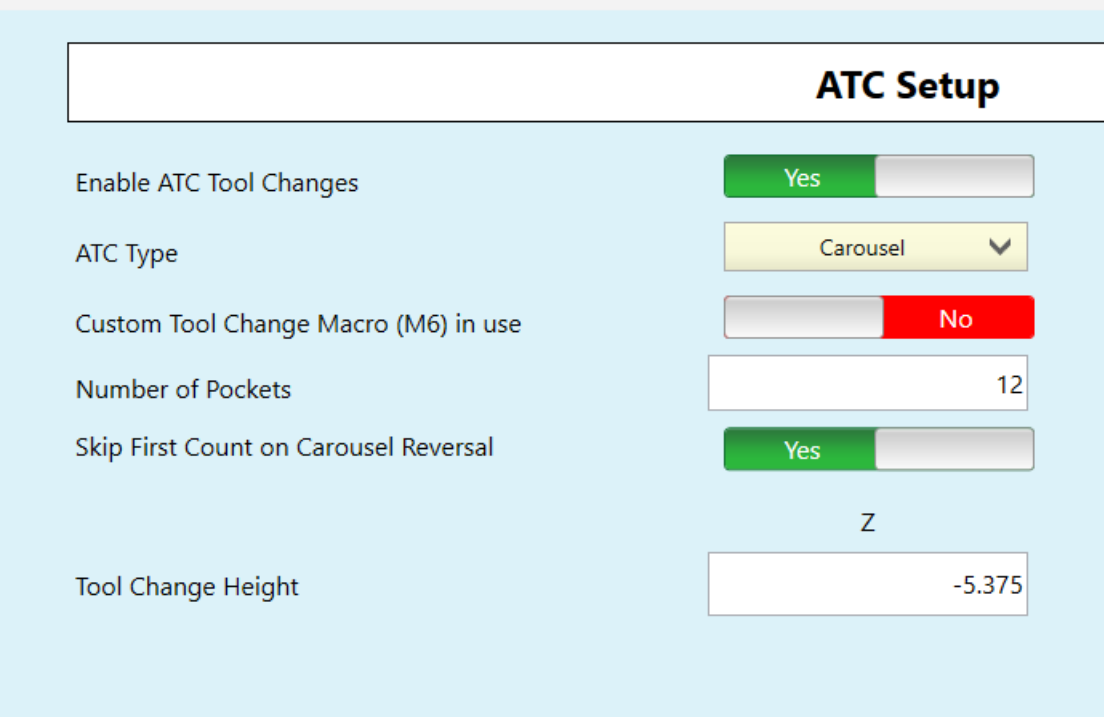
There are many variations of automatic tool changers (ATC's). The Wizard supports many common configurations out of the box but it is not uncommon to modify the Wizard generated PLC program and/or the M6 Tool Change macro to tailor those ATC command controls to a specific ATC type and configuration. That being said below is a review of the standard ATC types and configurations that the Wizard ATC menu supports without any customization.

Rack Mount: Single Rack mount, Fork or Hole with or without Automatic Tool Touch off and moveable Z zero touch off plate.

Carousel.

- A slide In/Out Geneva mechanism Carousel is the default configuration commonly found on Machining Centers and Bridgemills and Routers

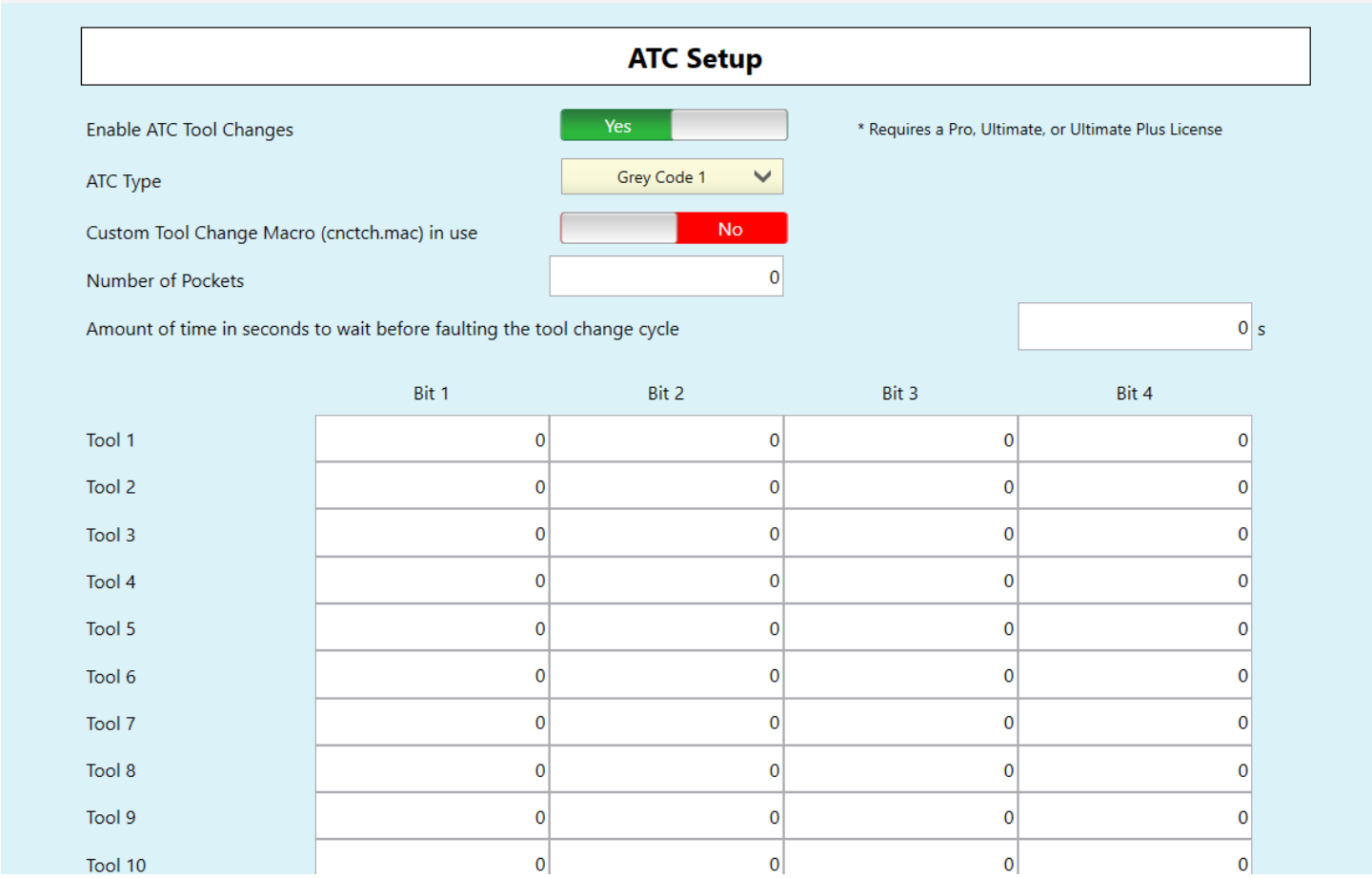
- A fixed Carousel, commonly found on Routers where the axis moved in/out rather than the carousel being on a slide.



Lathe Turrets:

There is a wide variety of Lathe Turrets on the market, The Acorn Wizard supports these types

- Gray Code (a unique multi-bit pattern to indicate each position of the turret. It could be Gray Code; BCD, plain binary; or it could be any other pattern).
- Counter based
- Axis motor based
- Timer based



ATC Setup

Enable ATC Tool Changes: Yes

* Requires a Pro, Ultimate, or Ultimate Plus License

ATC Type: Grey Code 1

Custom Tool Change Macro (cnctch.mac) in use: No

Number of Pockets: 0

Amount of time in seconds to wait before faulting the tool change cycle: 0 s

	Bit 1	Bit 2	Bit 3	Bit 4
Tool 1	0	0	0	0
Tool 2	0	0	0	0
Tool 3	0	0	0	0
Tool 4	0	0	0	0
Tool 5	0	0	0	0
Tool 6	0	0	0	0
Tool 7	0	0	0	0
Tool 8	0	0	0	0
Tool 9	0	0	0	0
Tool 10	0	0	0	0

Axis Based Lathe Turret Instructions:

1. Wizard Axis Configuration Screen: Set an axis to the letter “A”, ensure turns/rev is set so that between each tool is 1 inch or 1 mm. So tool 1 = DRO Position 1, Tool 2 = DRO Position 2, etc.

2. Wizard ATC Setup Screen: Set ATC Type to “Axis Driven Turret” and input the number of Tools on your turret. Write Settings when all settings are done in wizard.

3. Macros:
   A) M18 must be called on every startup to initialize the turret. This macro will prompt operator to input the tool Number the turret currently is sitting at, it will set the turret to that position.
      a) **Note:** It is recommended to modify your homing macro to include M18.
   B) The tool change macro (cnctch.mac) may need modified to meet your specific setup.
   C) M21 macro will Index the turret by 1 tool.

Note: DRO may not reflect 100% the current tool position, it reflects the actual position of the motor. If the user finds it distracting, you can hide the A axis DRO by adding 512 to the Axis Properties Parameter (Parameter 94 for 4th Axis).

Counter Based Lathe Turret:

1. Wizard Input Definitions, the following inputs are required,
   A) ToolTurretSyncBit – Input to home the axis.
   B) ToolTurretCounter – Input that counts the tools as the turret rotates.

2. Wizard Output Definitions, the following outputs are required unless otherwise specified,
   A) RotateToolTurret – Output signal to rotate the turret.
   B) ToolTurretEnable – **OPTIONAL** Output signal that enables the turret

3. Wizard ATC Setup Screen: Set ATC Type to “Counter Turret” and input the number of tools on your turret. Write settings when all settings are done in wizard.
   A) “Amount of time to wait before actually seeing the tool counter input” is a delay when the turret starts turning that the ToolTurretCounter input is ignored. This is useful for counting mechanisms that may perform an extra count on the current tool.
      a) **Note:** If a value of 0, the default value of 2.5s will be used.
   B) “Amount of time in seconds to go past the tool counter input before the turret reverses into the locked position” is the delay after the requested tool is reached that “RotateToolTurret” is remained enabled for.
      a) **Note:** If a value of 0, the default value of 0.75s will be used.

4. Macros:
   A) M18 must be called on every startup to initialize the turret. This macro will begin to rotate the turret and will stop when the “ToolTurretSyncBit” is seen, the turret is then set to Tool 1 and initialized.
      a) **Note:** It is recommended to modify your homing macro to include M18.

Time Based Lathe Turret:

1. Wizard Input Definitions, the following inputs are required,
   A) ToolTurretSyncBit – Input to home the axis.

2. Wizard Output Definitions, the following outputs are required unless otherwise specified,
   A) RotateToolTurret – Output signal to rotate the turret.
   B) ToolTurretEnable – **OPTIONAL** Output signal that enables the turret

3. Wizard ATC Setup Screen: Set ATC Type to “Time Turret” and input the number of tools on your turret. Write settings when all settings are done in wizard.
   A) “Amount of time in milliseconds the turret takes between each tool position” is the time the turret uses to determine when the next tool is reached.
      a) **Note:** This parameter has no default value, recommend using best guess and adjust time as needed.

4. Macros:
   A) M18 must be called on every startup to initialize the turret. This macro will begin to rotate the turret and will stop when the “ToolTurretSyncBit” is seen, the turret is then set to Tool 1 and initialized.
      a) **Note:** It is recommended to modify your homing macro to include M18.

Gray Code 1 Output Turret:

1. Wizard Input Definitions, the following inputs are required unless otherwise specified,
   A) ToolTurretPosBit1 – Encoder Bit 1
   B) ToolTurretPosBit2 – Encoder Bit 2
   C) ToolTurretPosBit3 – Encoder Bit 3
   D) ToolTurretPosBit4 – **OPTIONAL** Encoder Bit 4

2. Wizard Output Definitions, the following outputs are required unless otherwise specified,
   A) RotateToolTurret – Output signal to rotate the turret.
   B) ToolTurretEnable – **OPTIONAL** Output signal that enables the turret.

3. Wizard ATC Setup Screen: Set ATC Type to “Grey Code 1” and input the number of tools on your turret. Write settings when all settings are done in wizard.
   A) “Amount of time in seconds to wait before faulting the tool change cycle” is the time the turret is continue to try to find tool before faulting out.
      a) **Note:** If value of 0, the default value of 10s will be used.
   B) Setup the “Bit Grid” for each tool. Each tool should have a unique set of Bits that correspond to that tool.
      a) **Note:** A 0 means the bit will be OFF for that tool, a 1 means the bit will be ON for that tool.

Note: This style of Turret has no associated macros, nor does it require any initialization

Gray Code 2 Output Turret:

4. Wizard Input Definitions, the following inputs are required unless otherwise specified,
   A) ToolTurretPosBit1 – Encoder Bit 1
   B) ToolTurretPosBit2 – Encoder Bit 2
   C) ToolTurretPosBit3 – Encoder Bit 3
   D) ToolTurretPosBit4 – **OPTIONAL** Encoder Bit 4

5. Wizard Output Definitions, the following outputs are required unless otherwise specified,
   A) RotateToolTurret – Output signal to rotate the turret.
   B) ReverseToolTurret – Output signal to reverse the turret.
   C) ToolTurretEnable – **OPTIONAL** Output signal that enables the turret.

6. Wizard ATC Setup Screen: Set ATC Type to “Grey Code 1” and input the number of tools on your turret. Write settings when all settings are done in wizard.
   A) “Amount of time in seconds to wait before faulting the tool change cycle” is the time the turret is continue to try to find tool before faulting out.
      a) **Note:** If value of 0, the default value of 10s will be used.

B) Setup the “Bit Grid” for each tool. Each tool should have a unique set of Bits that correspond to that tool.
   a) **Note:** A 0 means the bit will be OFF for that tool, a 1 means the bit will be ON for that tool.

Note: This style of Turret has no associated macros, nor does it require any initialization

Acorn/AcornSix/Hickory ATC setup procedure.

Step 1: Configure ATC Wizard menu settings.
Step 2: Initialize ATC in CNC12 for the first time before attempting to use the ATC.

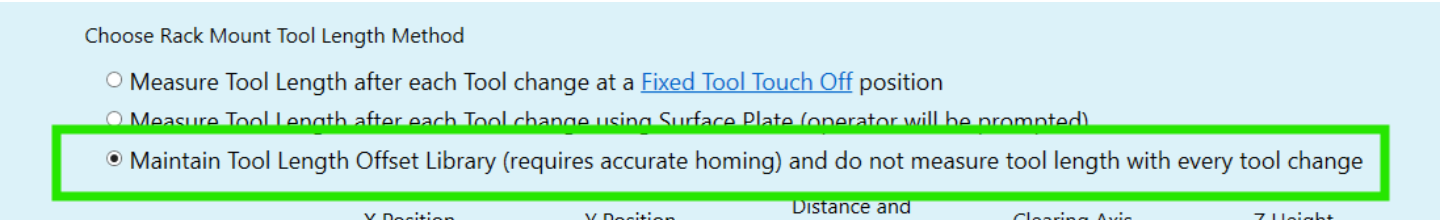
Step 1.) Wizard ATC configuration

- Do not attempt ATC configuration without first configuring and testing the entire CNC control system! Commissioning the ATC is the last function to be added to a CNC machine and only after everything else has been set and verified otherwise machine tool damage may occur. Critical details to get right are but not limited to: Homing, Overall turns ratio, steps per rev, estop circuitry,

- Install the system Pro or Ultimate License as ATC functionality is a part of the Pro or Ultimate License. Utility Menu F8 “Import License”

- Configure the Wizard ATC menu, press Write Settings to CNC control and follow the directions on the screen.

The best Tool Height Management method for use with ATC is with a Fixed Tool Touch Off and the CNC control will maintain a height offset library.



Step 2.) Initialize the ATC:

In CNC12 Mill and Lathe Initialize the ATC: F1 Setup →F3 Config →F6 ATC Init.

In CNC12 Router F5 Tool/ATC → F8 Tool Library → F6 ATC Init

ATC Initialize will ask you to put Tool 1 into the spindle. Ensure the carousel is also at position for Tool 1 when performing ATC Init.

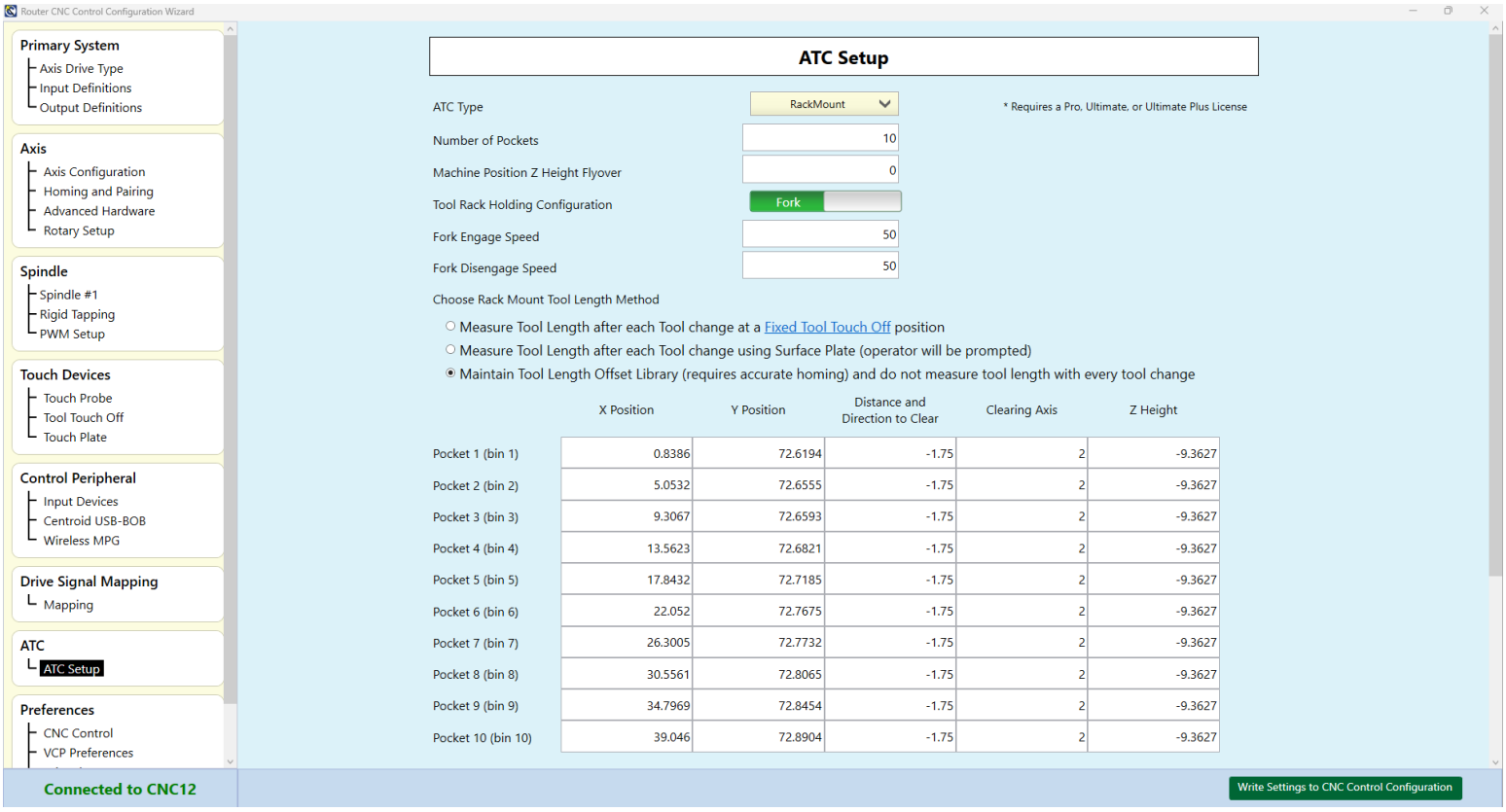
Note: This process is required to be repeated if the carousel or machine losses position, in that case power cycle rehome and reinitialize the ATC.

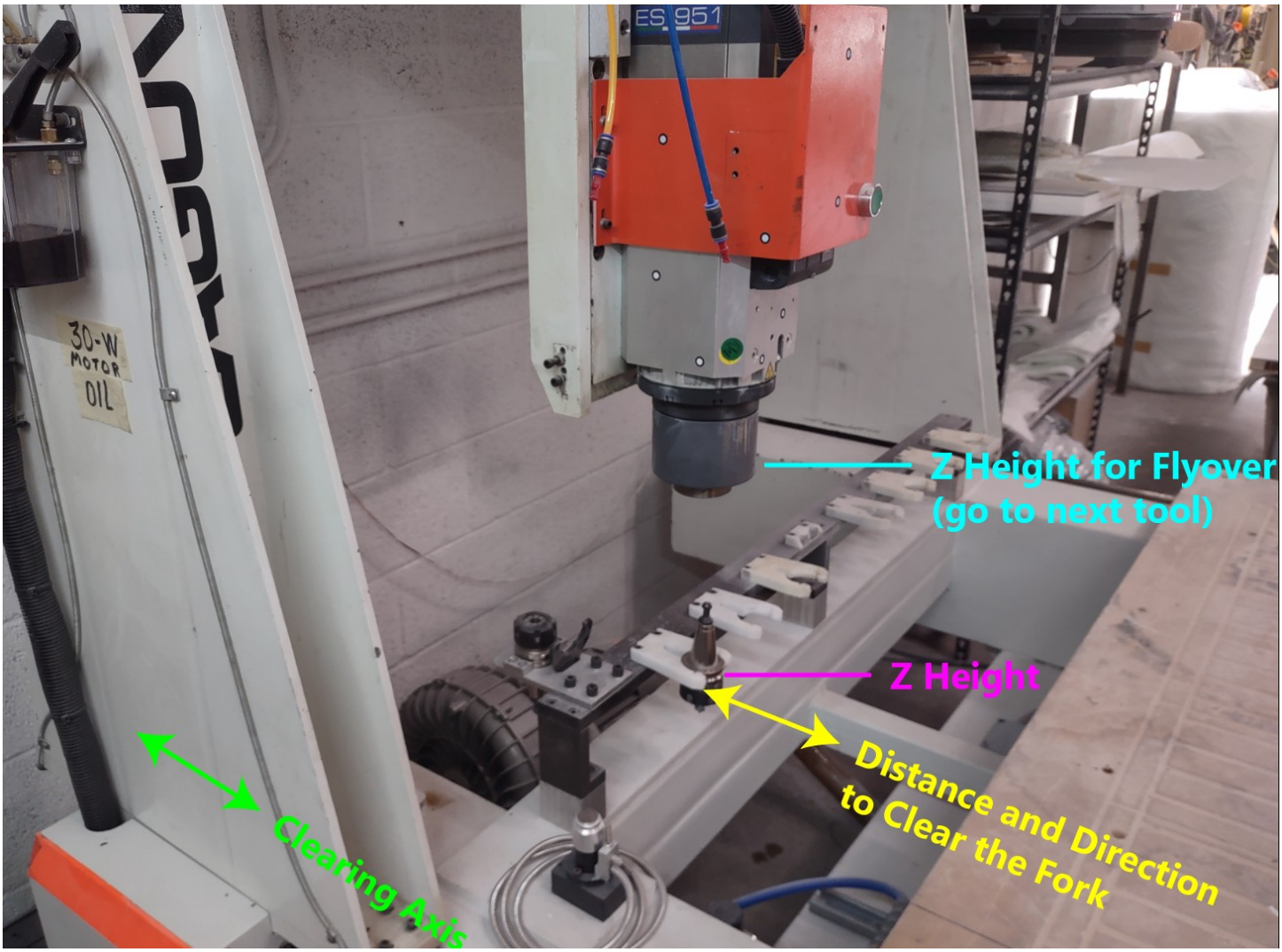
Rack Mount ATC

There are two basic types of Rack Mount Tool Changers:

1.) Rack Mounts that drop the tool in a “pot” (a hole) that may or may not need orientation of the tool to fit in the pot.

2.) Rack Mounts that use Forks (aka Fingers) to hold the tool in place that may or may not need orientation of the tool/spindle to fit the tool in the Forks





◉ Maintain Tool Length Offset Library (requires accurate homing) and do not measure tool length with every tool change

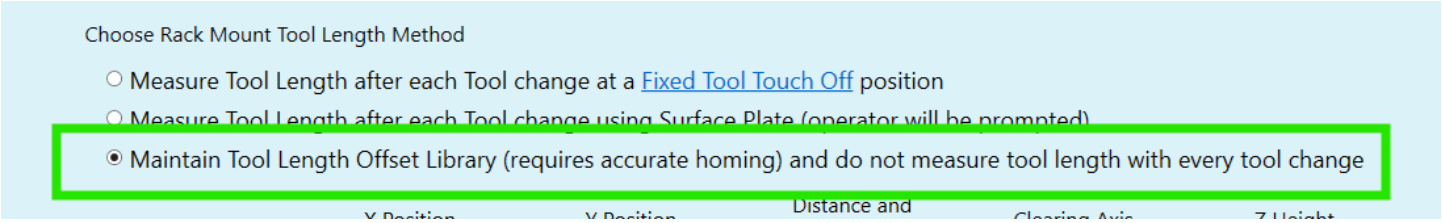
	X Position	Y Position	Distance and Direction to Clear	Clearing Axis	Z Height
Pocket 1 (bin 1)	0.8386	72.6194	-1.75	2	-9.3627
Pocket 2 (bin 2)	5.0532	72.6555	-1.75	2	-9.3627
Pocket 3 (bin 3)	9.3067	72.6593	-1.75	2	-9.3627
Pocket 4 (bin 4)	13.5623	72.6821	-1.75	2	-9.3627
Pocket 5 (bin 5)	17.8432	72.7185	-1.75	2	-9.3627
Pocket 6 (bin 6)	22.052	72.7675	-1.75	2	-9.3627
Pocket 7 (bin 7)	26.3005	72.7732	-1.75	2	-9.3627
Pocket 8 (bin 8)	30.5561	72.8065	-1.75	2	-9.3627

All positions and heights are in MACHINE COORDINATES.

There are three common Router Rack Mount Tool Length management strategies.

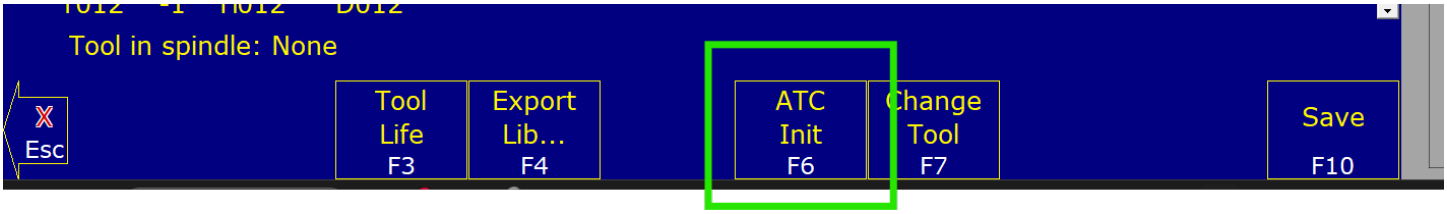
First and Recommended Method: Maintain a Tool Library with Tool Height Offsets

This is the best Tool Height Management method for use with ATC is with a Fixed Tool Touch Off and the CNC control will maintain a height offset library.



Pros: Does not require a tool touch off after each tool change. Saves time, after each tool change the machine goes right to work and does not touch the tool off of a TT device or surface plate. Allows easy individual tool cutting depth to be tweaked via the tool library which is remembered by the CNC control from day to day. Operator only has to set tool lengths once, never have to set them again until tool bit is replaced, or the tool is worn down. Then only have to remeasure just that one tool, no need to reset the entire tool library.

Note: F6 ATC Initialize button appears in the Tool Library when using this method. No need to use M18 when using this method.

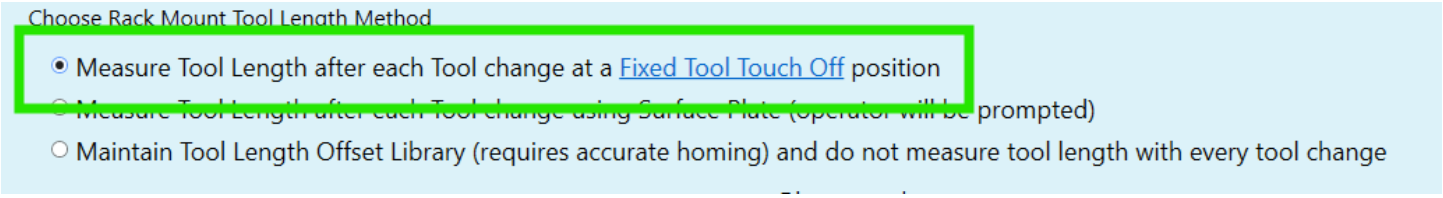


Cons: Requires CNC operator to learn how to maintain a tool library. Dedicated tool holder are required/recommended for each tool ($). Requires CNC operator to learn the difference between WCS Z 0, Z reference position and Z home position. It is recommended that all Routers use Z reference at the Z home position. The CNC12 Router installer defaults to using Z home as Z tool height measurement reference position. See this document for more information.
https://www.centroidcnc.com/centroid_diy/downloads/centroid_tool_height_measurement.pdf

Z ref = Z home has a number of advantages.

1.) It eliminates the reference tool.
2.) Tool Height offset values are easy to understand, they simply are the distance it takes to move from Z home to the top of the Tool Touch Off device for each tool.

Measure Tool Length with TT after each Tool Change Method: After each tool change, the machine will automatically touch the new tool in the spindle off of a TT (Tool Touch Off) device and reset the current WCS Z 0.000 (part zero position) with that tool before proceeding to run that tool. Requires the TT be setup properly XY position and Height.

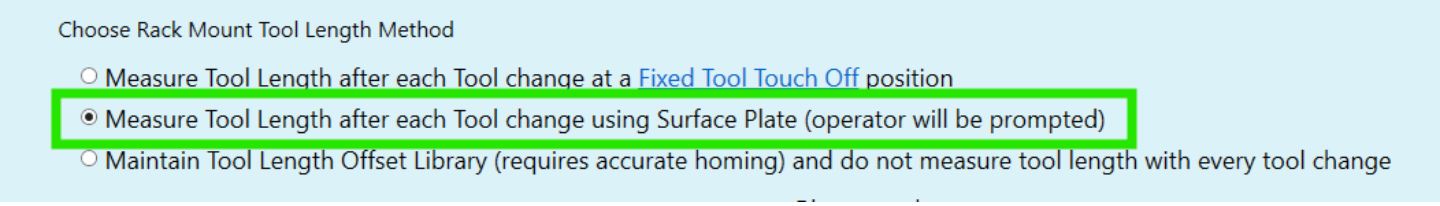


Pros: Works with collet style tool holders where the tool bit is being changed a lot and therefore is not always in the same position in the tool holder. Works with machines that don't have a lot of tool holders and/or the operator is using multiple bits in same tool holder.

Cons: - Machine performs a touch off cycle after each tool change which adds time to the job
- Requires operator to manually Initialize the ATC with MDI and the M18 code.

Third Method: Touch Off Surface Plate after every tool change.

Measure Tool Length with Surface Plate after each Tool Change Method:



After each tool change, the machine will ask the operator to touch the new tool in the spindle off of a Surface Plate device which will reset the current WCS Z 0.000 (part zero position) with that tool before proceeding to run that tool.

Pros: This method is the certainly the easiest method and least prone to having newbie related issues for the newbie CNC operator. Works with collet style tool holders where the tool bit is being changed a lot and therefore is not always in the same position in the tool holder. Works with machines that don't have a lot of tool holders and/or the operator is using multiple bits in same tool holder. Pretty much a fail safe method since the machine is resetting part Z zero position with each tool being used. User doesn't have to learn anything about tool height offsets and Z reference position as they are not used in this method.

Cons: - Machine performs a touch off cycle after each tool change which adds time to the job
- Requires operator to manually Initialize the ATC with MDI and the M18 code.