

Tormach® PCNC 770 ATC

AUTOMATIC TOOL CHANGER

Operator Manual



IMPORTANT: Read all safety precautions and instructions thoroughly before attempting Automatic Tool Changer (ATC) installation, operation, or maintenance.

Questions or comments?
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PCNC 770 ATC Operator Manual
UM10114_PCNC770_ATC_1014A
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Preface

1.1 Manual Overview

This manual is intended for users of the Tormach Tooling System Automatic Tool Changer - an accessory to the Tormach PCNC 770 mill. Readers are assumed to be familiar with the operation and documentation for their particular milling machine. For questions of a general nature (e.g. applying tool height offset compensation) please refer to the PCNC 770 machine manual.

The TTS ATC can be used with all existing part programs without modification, regardless of existing tool number assignments. For programs that use 10 tools or fewer the ATC may be used for all tool changes. For part programs requiring more than 10 tools, or for programs requiring special tooling not appropriate for an ATC, such as a reversing tapping head, it can be used in conjunction with manual changes. Any tool number between 1 and 253 may be assigned to a position in the tool tray – you are not confined to using tool numbers 1-10. This is convenient if you have a tool library already set up with tool numbers and heights measured in your tool offset table. The tool changer remembers tools assigned to the tray, and prompts for manual spindle insertion and removal of non-assigned tools at appropriate times. Tools may be assigned to different tray numbers so that, for instance, one can dedicate groups of tray assignments to specific jobs that are run frequently.

All tools are called from G code with standard M6 commands, or from buttons on the ATC control screen.

1.2 Safety



Any machine tool is potentially dangerous, especially automated tools under computer control. Because Tormach does not know the details of your workshop or other local conditions, no responsibility can be taken for damage or injury caused by the use of the mill and ATC. It is the owner's and operators responsibility to understand the mill/ATC system integration and operation and to comply with any legislation and codes of practice applicable to country or state. If there is any doubt, seek guidance from a professionally qualified expert rather than risk injury.

The safety of any application using the ATC is ultimately the responsibility of those performing the setup and operation. Please do not take this responsibility lightly - use common sense and review all instructions on the

operation and maintenance of the ATC

Operator Safety

- When using electric tools, machines or equipment, basic safety precautions should always be followed to reduce the risk of fire, electric shock, and personal injury.
- Read and understand this manual. Do not operate the ATC without knowing the function of every control key, button, and alignment and referencing procedure. Refer to this manual or contact Tormach if any function is not understood.
- Keep hands clear of the ATC at all times during tool changes or when commanding any ATC motion from the ATC control screen of the mill's control software.
- Avoid contact with moving parts. Before operating the mill and ATC, remove all jewelry including watches and rings, neckties and any loose-fitting clothing. Tie back hair.
- Keep hair away from moving parts.
- Do not reach for the part, tool or fixture while running a part program.
- Keep work area clean. Cluttered areas invite injuries.
- Wear ANSI approved eye protection at all times.
- Keep work area well lit.
- Keep the computer area clear of clutter.
- Never use longer or larger tools than necessary.
- Do not use the ATC or power tools in damp, wet or poorly lit locations.
- Do not use tools in the presence of flammable gases or liquids.
- Use only identical replacement parts when servicing.
- Take off gloves before you operate the ATC. Gloves are easily caught in moving parts or cutting tools.
- Never operate with unbalanced tooling.
- Never operate the ATC after consuming alcoholic beverages or taking strong medication.
- Protect your hands. Stop the machine and ensure that the computer control is stopped before you:
 - * Change tools;
 - * Change parts or adjust the work piece;
 - * Make an adjustment;
- Keep work area well lit. Ask for additional light if needed.
- Always use proper feeds and speeds, as well as depth and width of cut, to prevent tool breakage.
- Use proper cutting tools for the job.
- Do not use dull or damaged cutting tools. They break easily and become dangerous projectiles.
- Be certain every operator understands the operation and safety requirements of the mill and ATC before

operating. It is the responsibility of the owner of the ATC to provide and ensure point of operation safeguarding per OSHA standards.

Electrical Safety



The Tormach Tooling System ATC operates on 70 VDC, fused at 8 amps. It is powered from the DC Bus Board (PN 32005) inside the control cabinet of the mill. Never operate the machine tool with the cabinet door open.

Never make or check these connections with the mill powered on.

Power to the ATC and other devices inside the control cabinet may retain dangerous voltages after external power has been removed. Do not modify these connections in any way. If unsure about the connections, call Tormach or a qualified repair technician.

1.3 System Requirements

To use the Tormach Tooling System ATC, your machine must meet the following requirements:

- You must provide a compressed air source capable of delivering clean, dry air at 95 PSI and 2 CFM.
- The Tormach Power Draw Bar (PN 31706) must be installed

Required Tools

- Metric Allen wrench set
- Screwdrivers
- Box wrenches and large crescent wrench
- Hot glue gun
- 12" long wooden dowel or round stock

Preparation

1.4 Unpacking and Checking Shipment

Upon receipt, carefully unpack the ATC and inspect to ensure damage did not occur in transit and also to account for all parts. If any damage is apparent, or parts missing, please contact Tormach immediately.

With an assistant, lift the ATC onto a sturdy surface or workbench to prepare it for use.

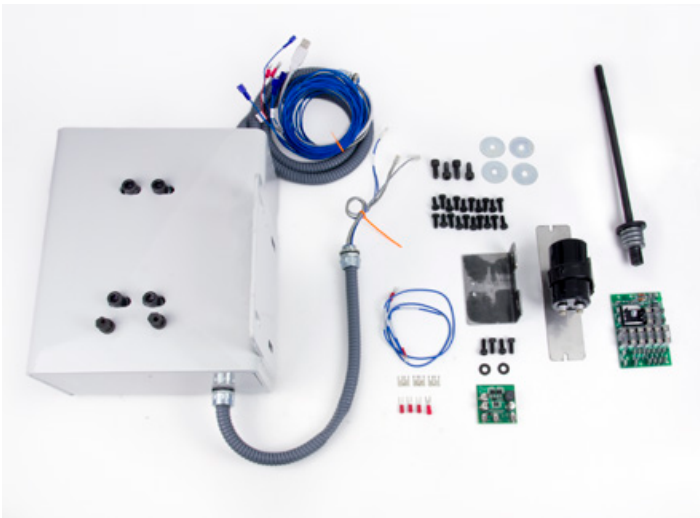


1	1 ATC assembly
2	4 ¼" air lines, one w/ check valve and push fitting
3	1 ATC square tube mount
4	4 flange nuts and washers
5	4 M8 socket head cap screws
6	20 nylon M6x16 hex bolts
7	1 USB cable
8	1 ATC communication RJ-11 cable (512-515)
9	1 VFD interconnect wiring kit (532-535)
10	1 Main power cable (503,504) terminated with 4 pin Molex and spades
11	1 PDB power cable (501,502) terminated with PDB connector and spades
12	1 coolant hose mounting plate with fasteners
13	Power Draw Bar power supply board
14	1 R8 TTS expanded collet
15	Instruction Manual
16	Software installation CD
17	2 5X20 glass fuses

The following items may or may not be included based on the age of your machine and power draw bar installation:

1. DC Bus Board
2. Capacitor with wiring harness and mounting bracket
3. Brake relay jumper wire

Check these items. Notify Tormach of any damage incurred during transit or missing parts so any claims can be made within the shipping carrier's deadline.



1.5 Before You Begin

The Tormach Tooling System ATC is designed for machines with the power drawbar (PN 32436) installed. All machines will need to have the power drawbar installed before installing the ATC. See the power draw bar manual (included with the power draw bar package and on the ATC software CD) for power draw bar installation instructions.

1.6 Mounting the ATC

Mounting and aligning the ATC to the mill is a job that is best done with two people. The ATC carousel assembly, which weighs approximately 50 pounds, is cumbersome to lift and position accurately especially when working over the mill's chip tray. Installation goes smoothly when one person holds the ATC in position while an assistant tightens the fasteners that connect it to the square tube mount.

Initial Hardware Installation



WARNING! Shut the computer down, then power down the mill using the rotary shutoff switch on the right hand side of the control cabinet.

You may find installation easiest if you first pull the mill away from the wall.

If fitted, remove the coolant hose and mount from the spindle head.



If fitted, remove the left hand machine arm from the mill

column.



4. Fasten the ATC mount into the mill column using the four M8 socket head cap screws.



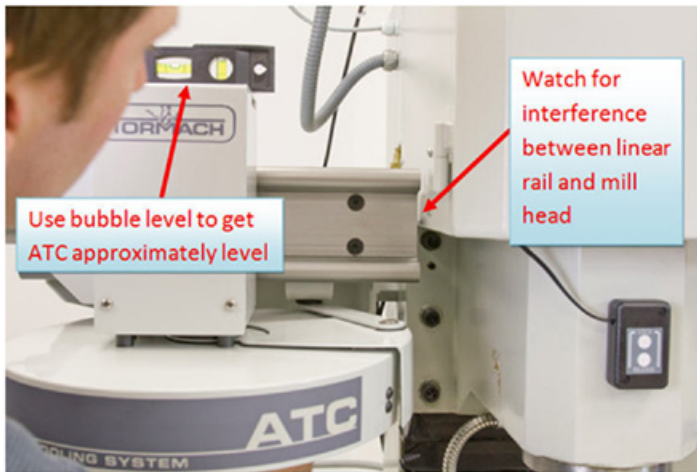
5. With the assistance of another person, fasten the ATC to the mount using the four M10 socket head caps screws and flange nuts.



7. Reroute the coolant hose by mounting the coolant hose clamp to the included coolant plate. Attach the plate to the underside of the spindle head using the two threaded holes on the underside of the spindle head casting.



6. Due to stack up of part tolerances, flexibility, and backlash in the linear bearings, the changer might settle slightly, or sag from horizontal on its mounting system. This is normal. Compensate for minor sag by tilting the mount slightly so the tool tray appears level using a bubble level.



Note: Be sure to adjust the mount so that the mill spindle cover sheet metal clears the ATC linear rail. The mount will be fine tuned later in the procedure. Do not tighten the flange nuts down at this point, as you will likely be sliding the ATC a bit before final tightening. Lightly snug the fasteners for now.

Electrical Installation

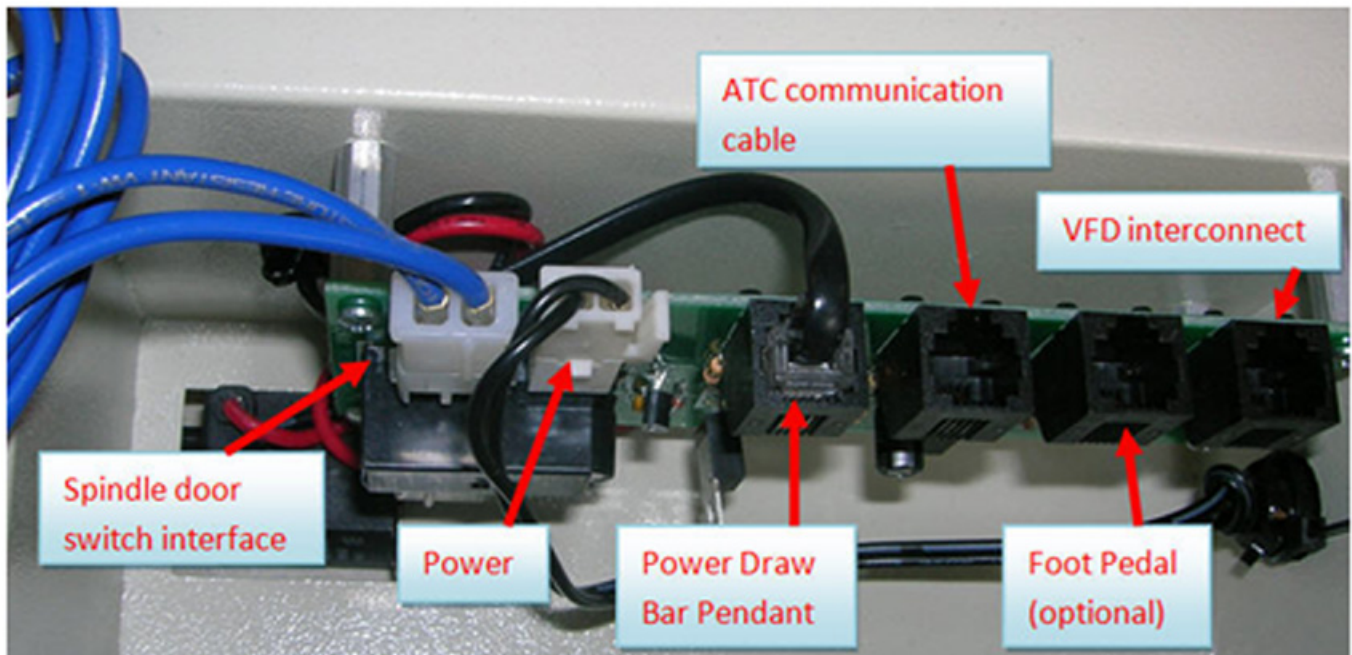
Note: In 770 mills, the ATC control unit is located in the back of the mount.

1. Lay the ATC control module plate with solenoid side down on the chip tray or the Y axis bearing box temporarily.

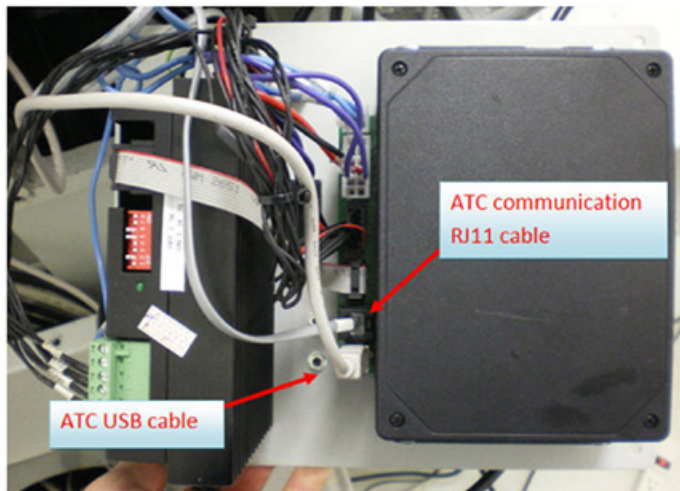


2. Locate the flex conduit on the top of the ATC mount and screw it to the opening in the power draw bar electrical housing. All wires have been pre-wired through the conduit; if necessary, carefully pull the wires into the electrical housing if additional length is needed. Connect the black VFD interconnect RJ11 cable (with the spade terminal ends) to the DB1 connector on the power draw bar control board, and the ATC communication RJ11 cable to the DB3 connector as shown below.
3. Remove the old “wall wart” power connector and replace it with wires 501, 502. These wires will be routed to the new DC Bus Board, and you will be able to throw out the wall wart power supply.

Note: If you purchased a Power Draw Bar and ATC at the same time, you will not have a wall wart power supply.

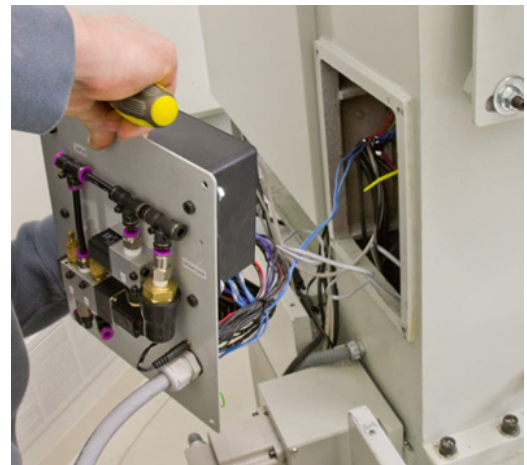
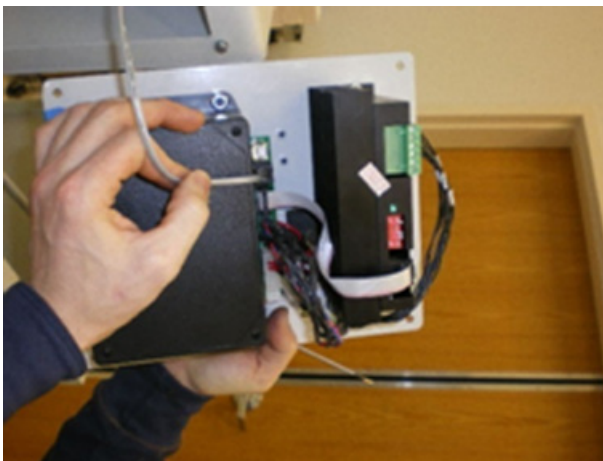


4. Re-secure the draw bar electrical housing to the Z axis motor connection box cover plate.
5. Connect the ATC communication RJ11 cable (from the DB3 connector on the power draw bar circuit board) and the USB cable to the ATC control board.



7. Drop any slack wires from the ATC control module into the Z column, and secure the ATC control module to the back of the mill using the saved M5 screws and into existing column holes. Be sure that extra wire slack does not contact the Y axis ballscrew.

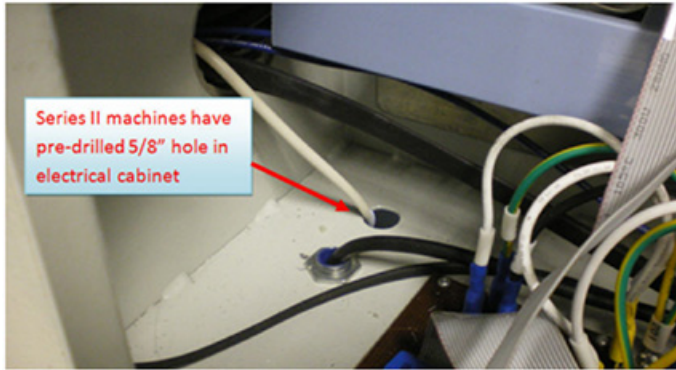
6. Locate the bottom of the flex conduit. Connect the RJ11 cable to the RJ11 connector for the ATC control board and connect the 506, 507 wires to the plus/minus connector for the Stepper Driver as shown.



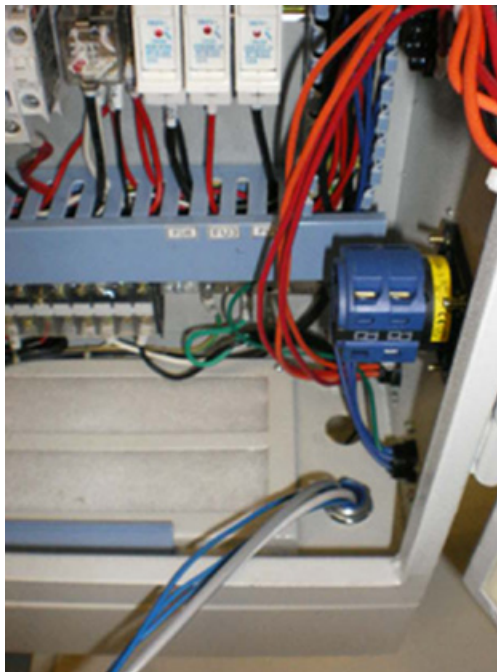
8. Route the USB cable through the bottom hole of the electric cabinet into any PC USB port.



CAUTION! Do not connect the usb cable to the computer until after the software installation is complete.



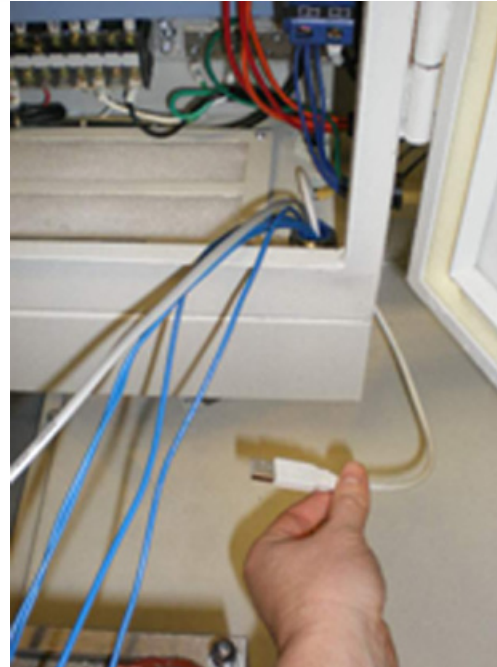
9. Run the blue ATC control board power leads (503, 504) and the power draw bar circuit board power leads (501, 502) through the wire channels from the hole to the bus board at the top of the cabinet.
10. Route the bottom of the flex conduit to the bottom right-hand corner of the electrical cabinet. Screw the conduit into one of the knockouts; if necessary, carefully pull the wires into the electrical cabinet if additional length is needed.



11. Locate the USB cable and feed the wire down through the second, open, knockout.



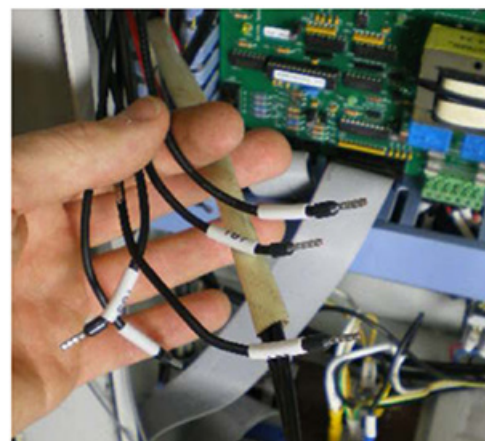
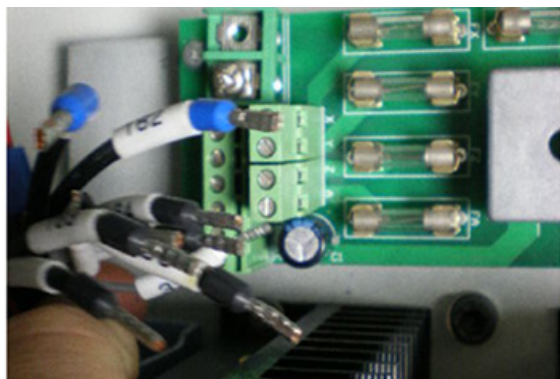
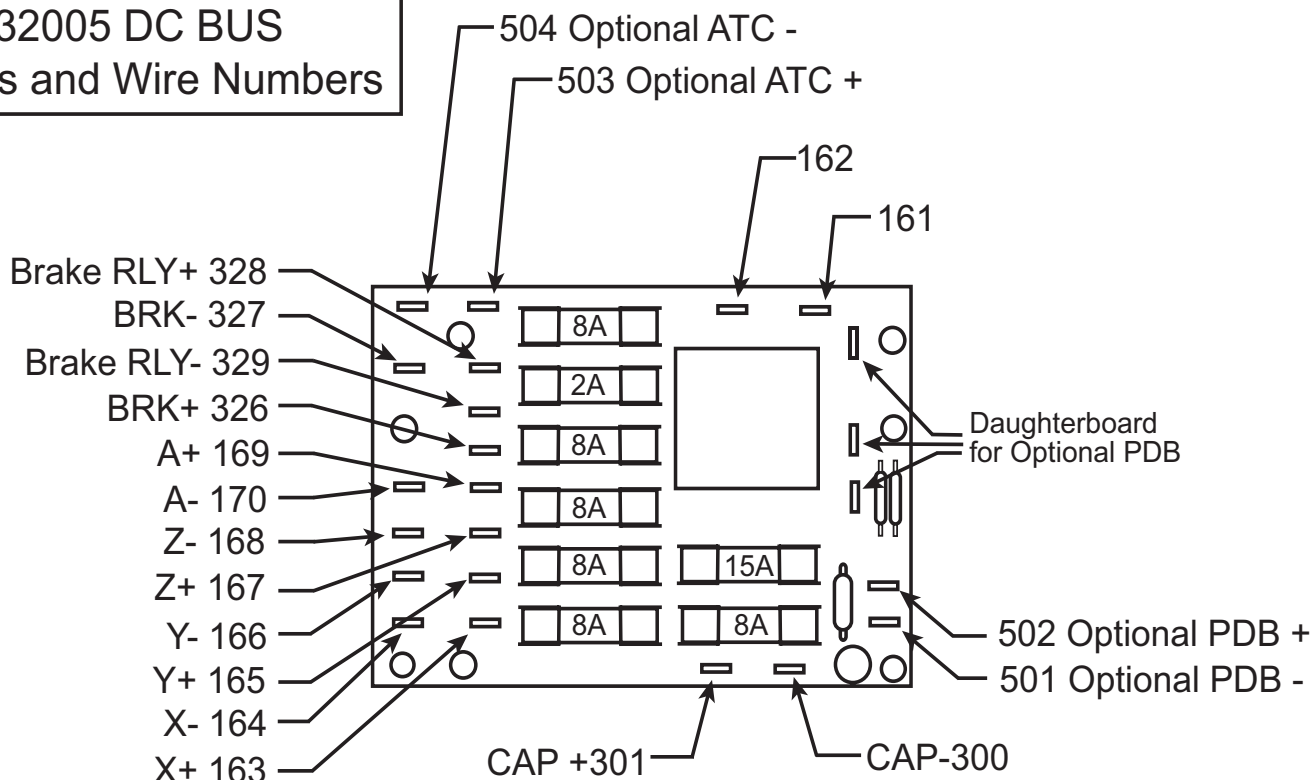
CAUTION! Do not connect the usb cable to the computer until after the software installation is complete.



Note: Series 3 770 machines come with the correct DC Bus Board for use with the ATC. Series 3 owners can skip steps 12-19.

12. **PCNC 770 MACHINES SERIAL NUMBERS 7199 AND LOWER:** Remove the old power distribution board. Loosen screw terminals, remove wires, and remove the four screws that hold the distribution board in place being sure to catch the stand offs and the screws.

32005 DC BUS Labels and Wire Numbers



13. Pull wires out of the blue wire tray for easier access to make the following steps easier. Snip the wire crimp ends off of the wires and crimp the included female spade connectors onto the ends of the each of these wires.

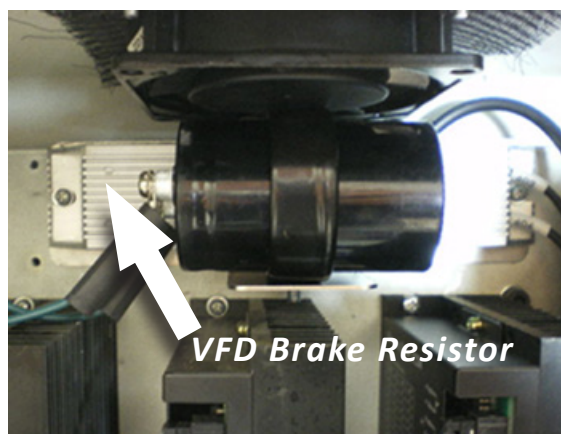
14. Make sure to retain the wire labels.

15. Attach the included BRAKE RELAY jumper wire (328/329) to the , BRKRLY- and BRKRLY+ connectors on the DC Bus Board.

16. Mount the new DC bus board in the cabinet, and run the wires back up to the board. Make sure to check that the ATC and PDB 5X20mm power supply fuses have been installed in the DC Bus Board (this applies to all model machines). When removing the old DC bus board, catch the standoffs and save the screws. Replace with the new board on the same standoffs. It is extremely helpful to tack glue the standoffs in place before mounting the board. An easy way to do this is to put a dab of hot glue on the fasteners before inserting them through the board holes and standoffs.



17. Installation of the new DC bus board requires a capacitor. Fit the included capacitor and bracket behind the VFD brake resistor.



18. Reconnect the wires to the DC bus board. (Refer to the DC bus board layout diagram on the previous page.)
 19. Double-check the polarity of the capacitor, stepper driver, and ATC connections before powering up the machine. Reversing polarity will destroy the stepper drivers and ATC control board. The finished installation should look like this:



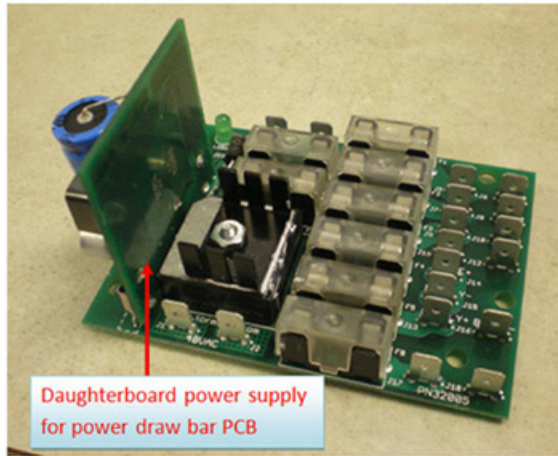
WARNNG! 770 mills serial numbers 70199 and lower have stepper drivers that will accept AC or DC. In the AC configuration (old power distribution board) the polarity is not important. With this new DC Bus Board the polarity is critical. Verify the connections between the DC Bus Board and the drivers – if necessary remove and reconnect the wires at the stepper driver power terminals. Positive on the DC Bus must connect to positive on the driver, negative on the DC bus must connect to GND on the driver. It is crucial that polarity is verified before powering up the mill.

When in doubt, unplug the green terminal blocks from the stepper drivers before powering up the mill. You can then use a voltmeter (with the mill powered up) to check polarity on the wires going to the drivers. The top terminal on the green stepper driver connector should be ground, the next terminal down should be V+. On some pre-Series 3 770 mills these wire numbers did not match the current wiring schematic – you will damage all three drivers if the mill is powered up with these connection reversed.

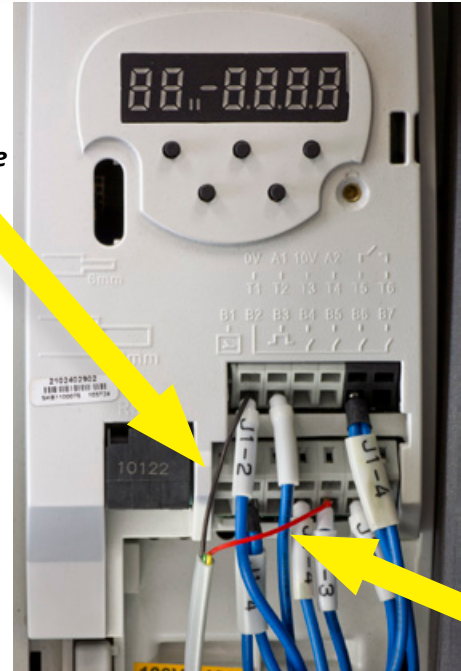
Note: Make sure to check that the ATC and PDB 5X20mm power supply fuses have been installed in the DC Bus Board (this applies to all model machines).

20. Install the power drawbar daughterboard power supply (PN 31980) by sliding it onto the spade connectors on the new DC bus board (PN 32005). This

board supplies the 12V needed by the power draw bar, and will allow you to throw away the wall wart power supply that came with the power draw bar.



Black Wire to T1



21. Route the RJ11 VFD interconnect cable along the bottom wire tray to the VFD. Remove the VFD cover by unscrewing the Phillips fastener on the face of the cover plate.
22. Clip the spade connectors off of the black and red wires of the RJ-11 VFD interconnect cable, strip the insulation back ¼", and insert the wires into positions T1 and B5. To make these connections, insert a small flat head screw driver in the hole just above the wire terminal to open the terminal.

23. Tidy up the wires and replace the cable tray covers.



1.7 Air Line Connection and Requirements

It is recommended to use a filter/dryer/lubricator on the air line used to supply the ATC. Air supply requirements depend on frequency of tool changes. For successful operation, your compressor will need to be able to maintain 95 PSI to the ATC. Typically consumption for *frequent* tool changes is less than 4 CFM at 95 PSI.

Please note that not all regulators are created equal. Inexpensive regulators tend to constrict air flow, which makes for longer make-up times as the power draw bar fires. While this is not a problem for the power draw bar when operated by hand (the user just waits the extra second or two for the cylinder to fully pressurize), it can cause problems when using the ATC, which only pauses 500 ms between the draw bar firing and the z axis moving. Better regulators do not restrict the flow while regulating pressure.

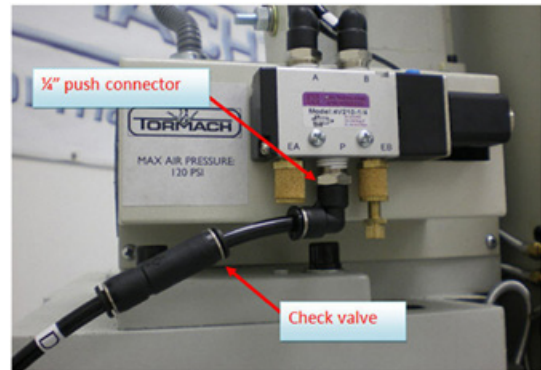
Connecting the Air Lines

1. Manually pull the tool tray to the retracted position by pulling on the motor enclosure or it will retract suddenly when you pressurize the air lines.

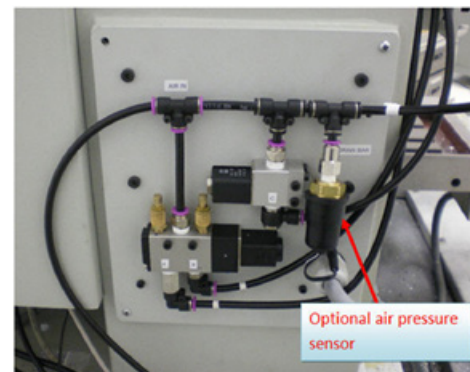


2. Route the air lines. The lines are labeled at each end - connect them to the solenoids/fittings with the same labels.
3. Connect the air line from your compressor to the left side input connector labeled "AIR-IN". You can remove the push fitting and use a quick connect against the first tee if desired, but we've found it easier to run tubing to a quick connect fitting in an easier-to-reach location.
4. Thread the 1/4 NPT push fitting into the air input port of the power draw bar. Connect the power draw bar air line labeled "D" (with the attached check valve) between the "DRAW BAR" push fitting on the right

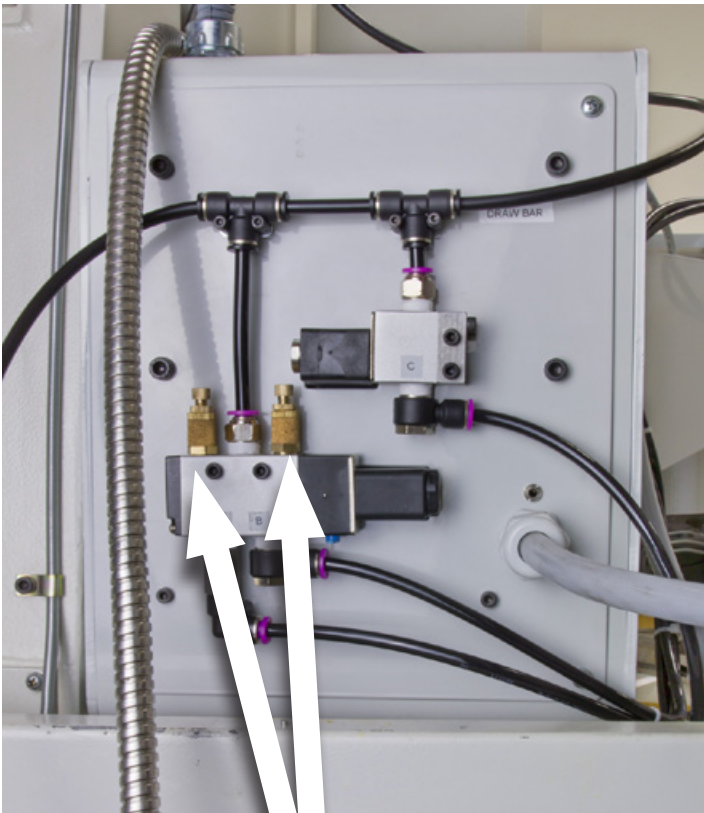
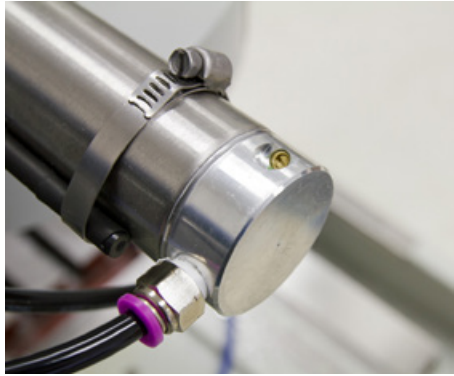
side of the ATC solenoid panel and the draw bar input push fitting on the draw bar solenoid. The check valve allows air to pass in one direction only – if you install it backwards the power drawbar will not operate.



5. If you have purchased the optional pressure sensor (PN 32329), splice it into air line D and insert the electrical connector into the jack on the column cover plate as shown in this photo:



The tray solenoids have adjustment screws that allow you to adjust tray in and tray out speeds. The solenoids have been pre-adjusted before shipping. Air cushion pin valves at either end of the air cylinder can be adjusted to control damping at extreme ends of cylinder travel. These are also pre-adjusted. Tool change time should not be adjusted to less than 8 seconds. Conversely, moving too slowly will trigger an error condition.



Tray Solenoids

You may now reapply power to the mill and power on your computer. Make sure that the USB cable to the ATC controller is unplugged for the next steps.

The ATC software installation will delete the contents of the PCNC3 folder on your C drive before installing the new software. If you have saved personal files in the PCNC3 folder, copy these files to a folder on your desktop before you install the new software.

To begin the ATC software installation, make sure that Mach 3 is shut down, and insert the CD into the computer's CD drive. **A menu will display choices for 770 milling machines. Choose the appropriate software for your machine.** The software installation should preserve your tool table, fixture offsets, and Mach license file. It will, however, delete any changes you have made (probe polarity, jog increments, NewFangled Wizard license file). If you previously customized your version of Mach 3 using PCNCConfig you will need to repeat these customizations after installing the new software.

Note: The ATC software is only compatible with the standard Tormach screens. Flash screens are no longer supported by Mach or Tormach and we have made no effort to develop flash screens for the ATC.

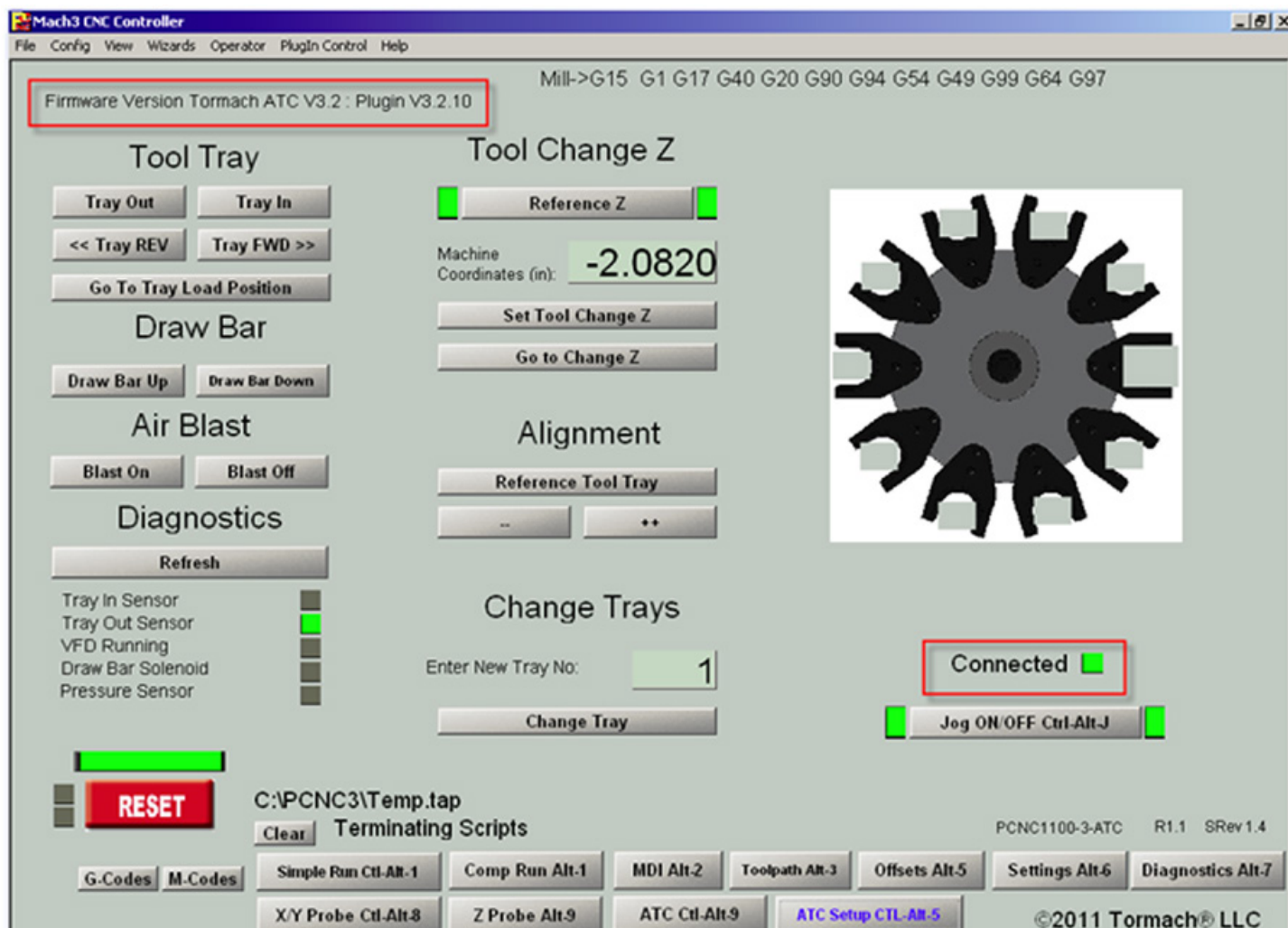
System Validation

Connect the USB cable from the ATC controller to the mill's control computer. Start the control software using the PCNC1100-ATC icon on the desktop. When the system comes up, it should find the ATC automatically on the USB ports and configure itself. You should see a confirmation message on the main Mach screen message line that displays the software version:

"ATC Startup – initialized"

Answer YES to screen prompts requesting it's "okay to reset and reference z". When using the ATC, these prompts always occur at start up. In general, you should always reference Z immediately. The tool changer will prompt during execution if you skip it now.

Click on the ATC Setup button on the lower portion of the screen. Note that the upper left corner displays the firmware and plugin versions. The green CONNECTED light should be glowing to indicate USB communication is established. This verifies the software installation and the USB connection.



If there is a tool in the spindle, remove it and set the current digital read out (DRO) to zero before continuing with these instructions.

With the Z axis in the homed (highest) position, perform the following tests to verify the operation of the tool changer:

1. Apply a thin film of way oil to the linear rails of the ATC slide assembly. Some chatter is expected until the oil has lubricated the linear bearings.
2. On the ATC Setup screen, click "Tray In", "Tray Out" buttons to verify that the tray air lines are correct and that the magnetic air cylinder sensors are properly working. Message "ATC button executed" after each button press verifies operation completion.
3. With the tray in the "in" position, click the "Refresh" button under "Diagnostics" on the ATC Setup screen. Verify that the Tray In Sensor LED is illuminated when the tray is in.
4. Repeat Step 3 for Tray Out position. You will need to click the "Refresh" button to read the sensors.
 - If either the Tray In or Tray Out sensor fails to respond as expected, refer to the "Sensor Issue" section in *Maintenance and Troubleshooting*.
5. With the tray out jog the Z axis down a couple of inches.

Make sure when doing this that the spindle cover sheet metal will not hit the ATC linear rail. If there is interference, adjust the X position of the ATC by loosening the fasteners that attach the ATC to the square tube mount.

Click the "Go to Tray Load Position". This should move the Z axis up and bring the tray in.

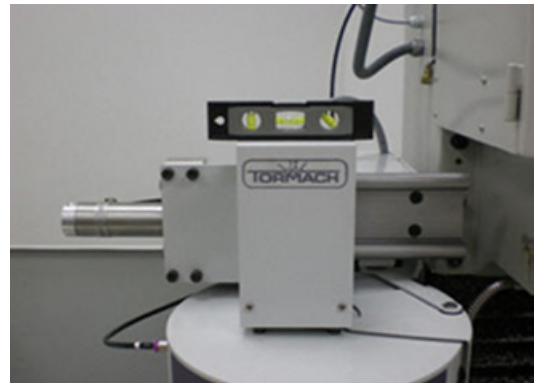
6. Click the "Reference Tool Tray" button on the ATC Setup screen - it should find and center on its home switch. It will turn until it finds one end of the sensor, then reverse and find the other end of the sensor, and then center between these two spots.
7. Test the draw bar pendant **with the spindle off**.
8. On the ATC Setup screen, click the Draw Bar Up, Draw Bar Down buttons. The draw bar should operate accordingly.
9. Click Draw Bar Down button on the ATC setup screen. It should fire and latch. Now hit the top (Lock) button on the pendant. It should unlatch.
10. Click Blast on, Blast off on the ATC Setup screen. You should hear the air start and stop at the nozzles in the tool tray.

11. With a tool in the spindle and the tray in the out position, start the spindle at low speed in manual mode. Click the "Refresh" button on the ATC Setup screen, and verify that the VFD Running LED is illuminated.
12. Optional pressure sensor verification: If you have installed the pressure sensor accessory (PN 32329) you may verify that the Pressure Sensor LED on the ATC Setup screen is illuminated under low pressure conditions and dark under normal pressure conditions. You will have to click the "Refresh" button to see the LED change corresponding to a change in state.

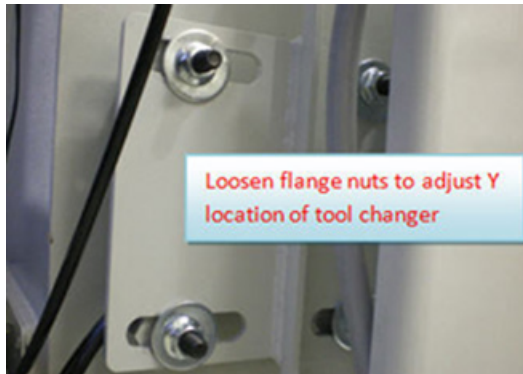
1.8 Align Tool Tray and Slots

Accurate alignment of the tool tray and slots, and the draw bar throw, are the most important factors in assuring reliable and repeatable tool changer operation. Take your time, and take care to do this accurately. A video of the alignment procedure can be watched on our website: http://www.tormach.com/upgrades_tts_atc.html

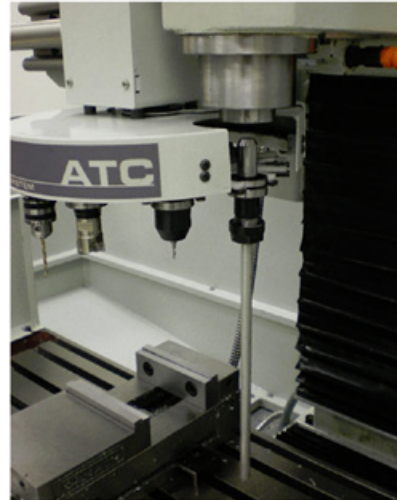
1. It is helpful to get the ATC assembly approximately level using a bubble level before beginning the alignment procedure.



2. Make sure the spindle is initially empty. There should be no tool holder in the spindle at this point.
3. Click the "Go To Tray Load Position" button on the ATC Setup screen. The Z axis will jog up and the tray will actuate in, opening the tool access door, and the draw bar will actuate.
4. Verify that the spindle is roughly in the center of the carousel door opening. If necessary, move the ATC forward or backward by loosening the four flange nuts that hold the square tube mount to the column.



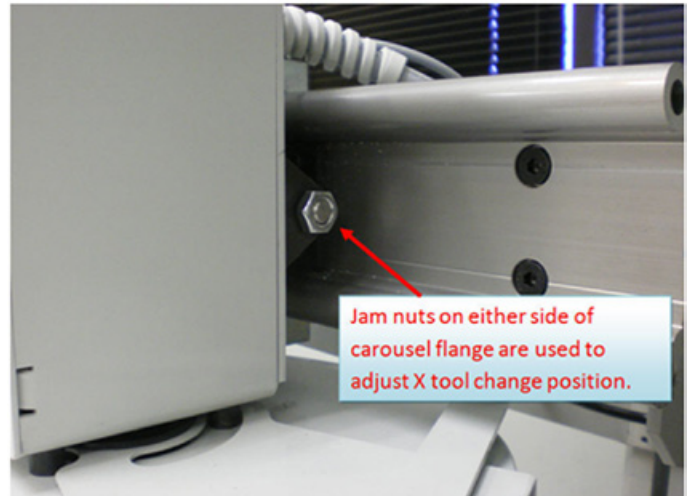
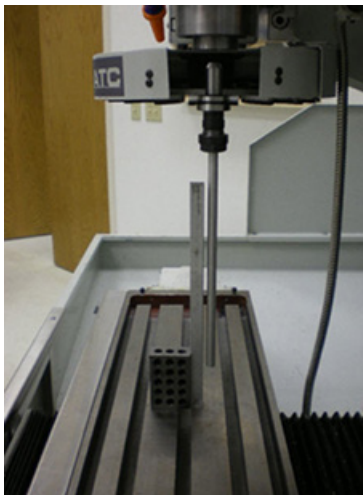
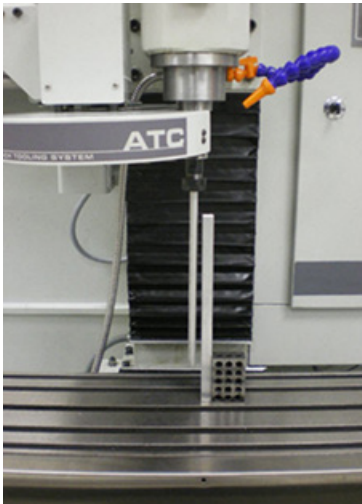
5. Insert a long (12-14") dowel or piece of round stock into a TTS tool holder. Insert the tool holder into the fork of the exposed tray slot. Using other vertical lines (edge of mil column, T slots in table) sight along the dowel and check whether the dowel and the spindle axis are parallel in both X and Y planes.



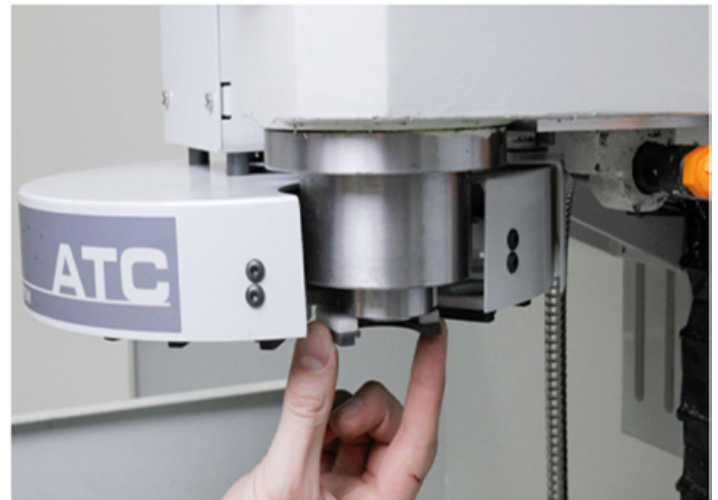
6. If the dowel and the spindle axis are not parallel, adjust the tilt of the ATC in both X and Y directions until they are.
 - Tilt in the Y direction is facilitated by loosening the flange nuts that hold the square tube mount to the column, then gently tapping the ATC trapezoid mount with a mallet.
 - Tilt in the X direction can be adjusted by loosening the socket head cap screws that mount the ATC to the square tube, then turning the eccentric adjustment screws. This is best done with the ATC in the "Tray In" position, as the center of gravity of the unit in the "Tray In" position will allow you to use both adjustment screws to tilt the ATC.



- Verify that the tool holder shank is parallel to the spindle axis in both X and Y by using an angle block or 1-2-3 block with a straightedge:



- To adjust the alignment of the tool holder to the collet in the Y direction, use the "--" or "+" buttons on the ATC Setup screen Alignment section. It is best to wiggle the fork with your thumb and index finger to feel the extremes of the carousel backlash against the spindle with your fingers to see that it is roughly centered left and right of fork while making this adjustment.



7. Once you are satisfied that the axis of the dowel is parallel to the spindle axis in both X and Y, jog the spindle down to the top of the Tormach tool holder shank. Do not go all the way down to the shoulder yet. Verify by eye that it is roughly centered on the collet center opening.
- To adjust the alignment of the tool holder to the collet in the X direction, loosen the jam nut at the end of the tray cylinder rod and move it to a roughly centered position. Press "Tray In" to verify the adjustment. You will likely have to repeat this procedure several times to get the location correct.

8. Remove the tool from the tray, then jog the Z axis back down until the spindle is just above the tool fork. Visually check that the tray is level and on a parallel plane to the underside of the spindle. You should see the same distance between the tool fork and the spindle face around the perimeter of the spindle.
9. Now, pull your hand away, and click "Reference tool tray". It will return to the newly centered position. Once the first slot is oriented, all other slots will stop in the same relative position. The ATC will remember this offset indefinitely, until it is reset by the same procedure. This is now the reference location for the ATC.

We're now ready to verify the alignment. First, verify that the power drawbar is adjusted correctly. The drawbar should be adjusted so that a tool holder will fall out of the spindle when the drawbar is actuated. Draw bar adjustment is discussed in the power draw bar installation manual, included for reference on the ATC software installation CD.

Test the ATC Alignment

1. Click "Go To Tray Load Position" on the ATC Setup screen.
2. Push the TTS tool holder with dowel into the open slot in the tool tray.
3. Slowly jog Z down until the TTS shoulder touches the spindle nose. It should slide smoothly on the TTS shank. If it doesn't, the tray is miss-aligned (not centered or perpendicular to the spindle), or the collet hasn't opened far enough to spring out for smooth entry.

If the tray is not properly aligned there will be noticeable movement at the end of the dowel as the spindle slides down over the tool shank. This must be corrected by adjusting either the tilt or the XY location of the forks to ensure trouble-free operation.

4. Once you get aligned for a smooth descent, jog Z to the shoulder. When the spindle is resting on the tool shoulder, click the "Set Tool Change Z" button on the ATC Setup screen.
5. You've now set the tool change location of the Z axis for all tool changes. This position is remembered as a machine coordinate, is saved at shutdown, and is independent of all work or tool offsets established during machining. As long as Z is referenced, the tool change will occur at the same place.

6. After setting the tool change location, jog the Z axis back up off of the tool shank and remove the tool from the fork.

Now check the individual fork alignment. During shipping or assembly, the forks in the tool tray can shift a bit off center. The tool holding forks need to all line up the same way under the spindle. Jog the spindle up slightly, then on the ATC Control screen click the Tray FWD button to index the carousel to the next tool fork. Jog Z down to so the spindle is touching the top of the fork spring. Push the spring left or right until it is roughly centered using the thumb and index finger technique employed in step 7 in the previous section (*Align tool Tray and Slots*). If the alignment is off, you might have to jog up and loosen the nylon bolts a tad first. Jog up and tighten the nylon bolts at center until snug but not overly tight. Repeat to align all the slots.



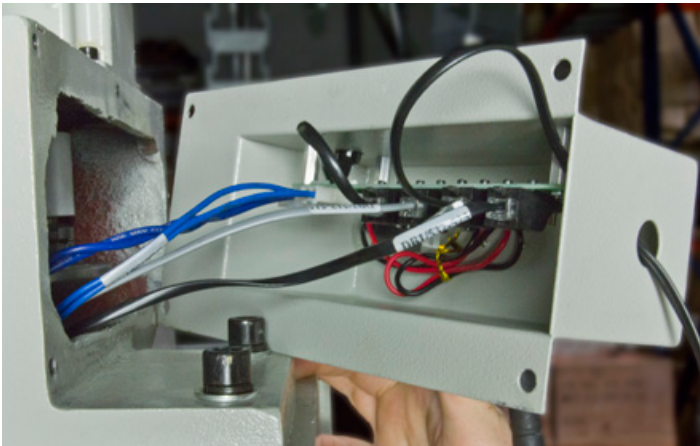
You should only have to do this once. At this point all the forks will align identically to the spindle and work as SLOT 1 did. You may verify this by hitting the "Go To Tray Load Position" button and advancing through each of the tool positions. With the draw bar actuated, insert a tool holder in the slot, jog down to Tool Change Z by hitting the "Go to Change Z" button on the ATC screen. When finished, click "Go To Tray Load Position" to move the spindle away from the tool, then manually remove the tool from the fork. Your system, once aligned and verified, is ready for use.

1.9 Foot Pedal Kit

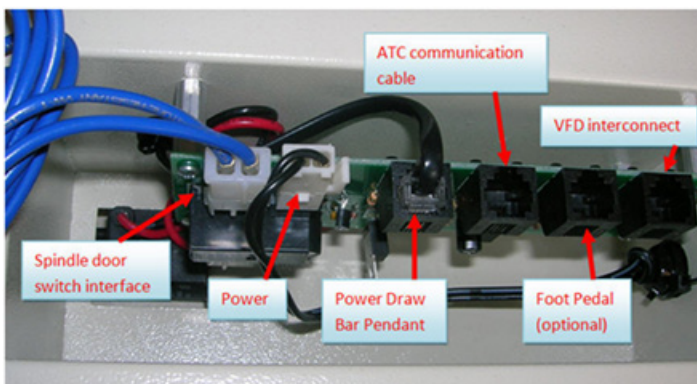
The Foot Pedal Kit (PN 31728) provides easy foot-activation of Power Draw Bar for hands-free operation.

To install:

1. Remove the power draw bar electrical housing.



2. Plug the foot pedal cable into the Foot Pedal connector port on the power draw bar control board (as shown in the figure below).



3. Place the foot pedal in a position that allows for easy access during mill operation.



1.10 Filter Regulator Lubricator (FRL)

The Filter Regulator Lubricator (PN 32457) is recommended for proper conditioning of supply air for both the Power Draw Bar and the ATC.

Note: See Chapter 4: Air Lines for recommended air supply requirements.

To install:

1. Drill two holes into the back of the splash guard (or wherever is convenient for mills without a splash guard).
2. Secure the FRL to the mounting bracket with your own equipment.
3. Wrap the fittings on the two NPT reducers with Teflon tape and secure the fittings into the FRL valve housings.
4. Splice the air supply line and insert a quick connect bushing (PN 32212) to each end of the open line.
5. Connect the bushings to the NPT reducers.



6. Open the FRL fill port with a hex key.
7. Fill the port with standard air tool oil (using a small funnel if necessary).



Note: Before first use, air must be flushed from the FRL system.

Note: Proper function may be confirmed visually through the sight glass on the top of the FRL.



A droplet of lubricant will form on the bottom of the stem located inside of the sight glass.

1. Open the lube adjustment knob 1/2 turn (towards the +).
2. Flush all air bubbles from the system.
3. When air bubbles no longer appear in the sight window and a droplet of lubricant forms on the bottom of the stem, close the lube adjustment knob 1/4 turn (so that it is open approximately 1/4 turn from the closed position).

1.11 Pressure Sensor

Pressure Sensor (PN 32329) prevents the carousel from actuating during low air supply pressure condition.

1. Splice air line D and insert the Pressure Sensor as shown.



2. Plug the male end of the electrical connector into the jack on the column cover plate.



Note: See Chapter 4: Air Lines for additional information.

Operation

1.12 General Theory of Operation

The Tormach Tooling System ATC will hold up to ten tools in a single tray. Additional “logical” trays are permitted in the software, so that, for instance, you could dedicate a tray number to a specific job that you run frequently. Also, the ATC allows mixing manual and automatic tool changes within the same part program. If your program requires 11 or more tools, the ATC will change tools automatically for all tools in its tray, and pause for a manual change for tools that are not assigned to the tray. Any tool number between 1 and 253 may be assigned to a position in the tool tray – you are not confined to using tool numbers 1-10. This is convenient if you have a tool library already set up with tool numbers and heights measured in your tool offset table. There is no need to remember which slot a particular tool has been assigned to – simply call the tool number in G code with an M6 command and the ATC will retrieve the appropriate tool.

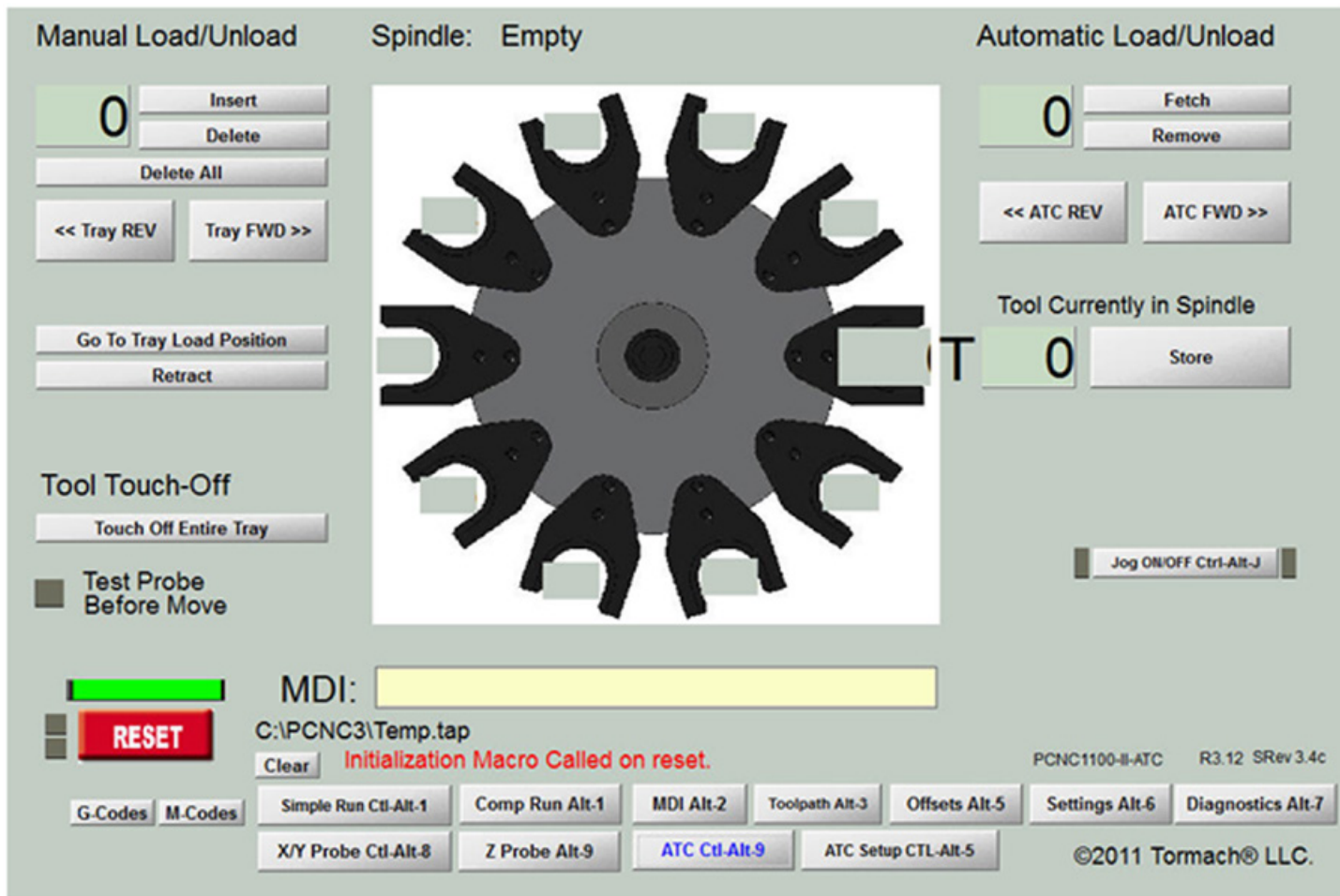


Note: Always shut down the control software (mach3) before turning off the control computer. Failure to shut mach down properly will result in the atc not remembering tool locations.

1.13 Loading/Unloading Tools

There are two ways to load and unload the tool tray in preparation for machining using the ATC. In automatic tool loading, the ATC will load the tool that is currently in the spindle and store it in the nearest open tray slot. In manual tool loading, the tray will slide in and the tray door will open, allowing the operator to manually place tools into the tray. The following sections detail these two modes of operation.

1.14 Automatic Tray Load/Unload



The left hand side of the ATC control screen contains the buttons and DROs used to store and retrieve tools.

To load a tool into the tray:

1. Load the desired tool into the spindle.
2. Enter the tool number in the tool DRO (next to the “Store” button). Do not forget to press “Enter” after typing in this number.

Note: This DRO is identical to the tool DROs on the other screens.

3. Click the “Store” button. The ATC will assign the tool to the nearest open slot and store the tool in that slot in the tray. The tool number will now be displayed on the tray image in the center of the screen. The spindle is now ready for the next tool to be stored.

To retrieve a tool from the tray there are two options. You can type Txx M6 at the MDI line (where xx is the desired tool number) or enter the tool number in the DRO next to the “Fetch” button and click “Fetch”. This will retrieve that tool from the tray and leave it in the spindle. It also leaves it assigned to the tray.

To remove a tool from the **tray**, type in the tool number in the DRO next to the “Remove” button (remember to press enter after typing in the tool number), then click “Remove”. After the ATC fetches the tool you will be prompted to remove the tool from the spindle.

To remove a tool from the **spindle**, and delete its assignment from the tray, click “Remove”. You will be prompted to remove the spindle tool. PLEASE NOTE THAT SIMPLY TYPING A NEW TOOL NUMBER INTO THE TOOL DRO DOES NOT REMOVE THE TRAY ASSIGNMENT. You must use the “Remove” button to delete the tool’s tray assignment.

“ATC FWD” and “ATC REV” will return the spindle tool to the tray, then fetch the next/previous tool in the tray.

1.15 Manual Tray Load/Unload

If you want to load or unload multiple tools you may find it faster to open the tool changer door and load or unload them manually. The Manual Load/Unload buttons and DRO on the right hand side of the ATC Control screen will allow you to bring the tray to a loading position (door open), manually insert or delete, and assign or un-assign tool numbers to tray positions.

To load tools manually:

1. Click “Go To Tray Load Position” to move the spindle head up and bring the ATC in to the door open position.
2. Insert a tool into an open fork
3. Type the tool number into the DRO next to the “Insert” button. Remember to press enter after typing in the number.
4. Click “Insert” to assign the tool to the exposed tray slot.
5. Click “Tray FWD” or “Tray REV” to advance to the next location if you want to load another tool.

To unload tools manually:

1. Click “Go To Tray Load Position” to move the spindle head up and bring the ATC in to the door open position.
2. If the exposed tool is the one you want to remove, simply click “Delete” to un-assign the tool from the tray.
3. If the tool you want to remove is not the exposed tool, type the tool number into the DRO next to the “Insert” button. Remember to press enter after typing in the number.
4. Click “Delete” to un-assign the tool. The tray will move to the tool to be removed.
5. Click “Tray FWD” or “Tray REV” to advance to the next location if you want to unload the next or previous tool.
6. When you are finished loading or unloading tools, call any tool (using the “Fetch” button or with an M6 command at the MDI line) or click “Retract” to return the tray to machining position.

Shortcut: If you click “Delete” or “Insert” and the ATC is not in tray load position, it will move to tray load position automatically.

1.16 Tool Touch-off Routine

If you have the optional TTS Tool Setter (PN 31875) the ATC control software can be used to automatically measure the tool height offset for every tool in the tray. To use this feature, plug the Tool Setter into the accessory port and test communication by actuating the Tool Setter by hand and ensuring that the green Tool Setter LED on the ATC Control screen lights up. Center the Tool Setter directly under the spindle and click the “Touch Off Entire Tray” button on the ATC Control screen. The ATC will cycle through every tool in the tray and enter the measured tool length in the tool table. A few things to note about tool touch-off:

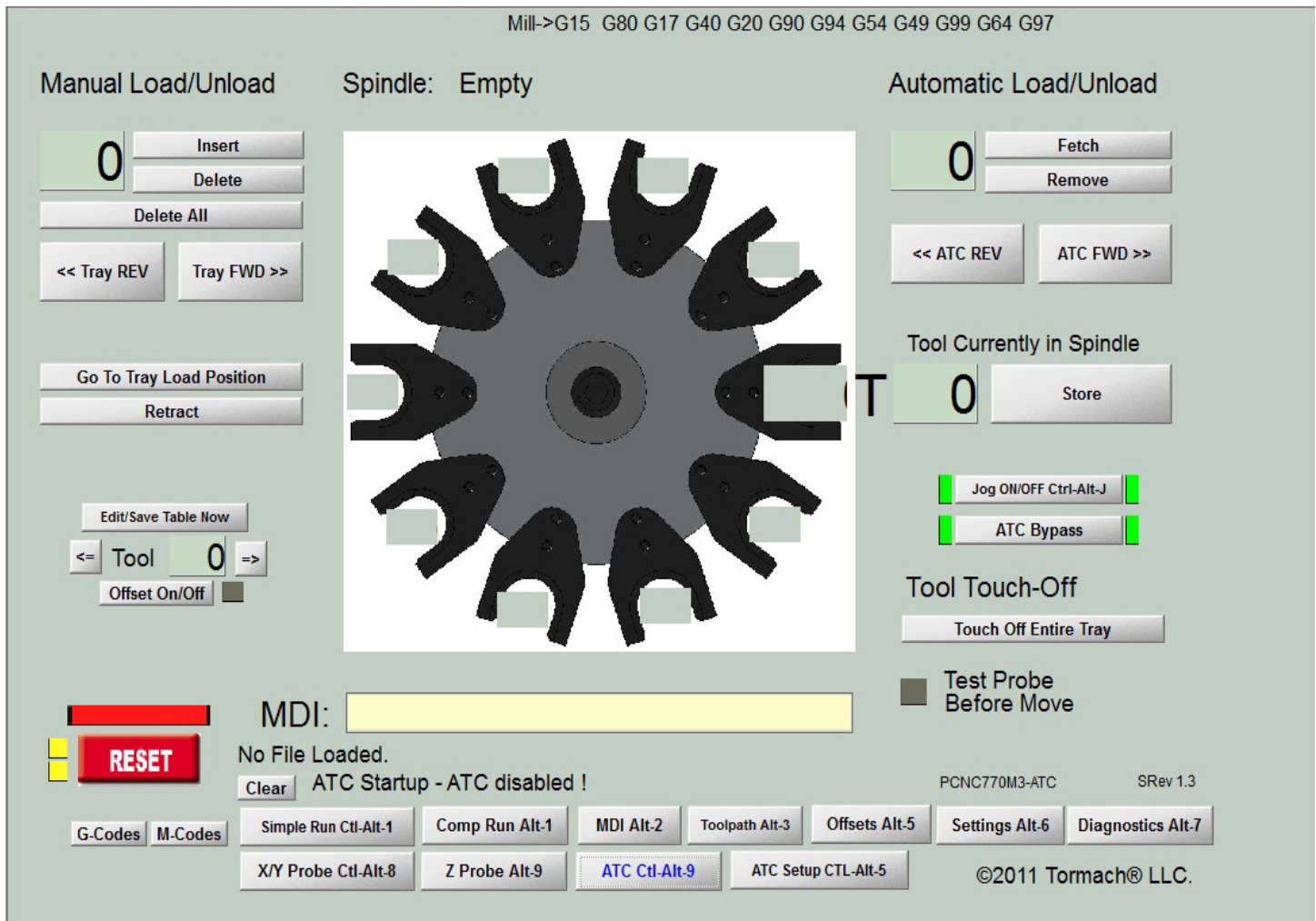
1. Tools with large diameters (greater than the diameter of the Tool Setter pad) will not be accurately measured unless the cutting edge of the tool makes contact with the Tool Setter. For instance, care must be taken when using the “Touch Off Entire Tray” routine with a fly cutter or shell mill in the tray.
2. Unless you set up the sensor height of your Tool Setter before touching off the tools, the tool lengths entered

in your tool table will be relative, not true tool lengths. You must set up the Tool Setter sensor height to mix ATC tools that have been measured using the Tool Setter with tools that have been measured on a granite block and height gauge. Setting the sensor height is described in detail in the PCNC 1100 operator’s manual, section 8.2.

1.17 ATC Bypass

To activate the ATC Bypass, click the ATC Bypass Button on the ATC Control screen.

When the ATC Bypass is activated, this will prevent the ATC from executing any tool changes. Instead you will be prompted by the software to manually complete any tool changes that are called within a program.



1.18 Support

Tormach provides free technical support through multiple channels. The methods are listed below, in order of preference:

1. This manual (for ATC related issues) or the PCNC manual is always the first place to check!
2. Related documents at <http://www.tormach.com/documents.html>
3. Our website at www.tormach.com
4. Send an email to: info@tormach.com
5. Telephone Tormach at: 608-849-8381
6. Fax Tormach at: 209-885-4534

1.19 Maintenance

The Tormach Tooling System Automatic Tool Changer requires little maintenance. Periodically inspect the following:

1. Ensure that your air is clean and dry. A filter/regulator unit should be sufficient for supplying dry air, as long as you periodically drain your compressor.
2. The linear guides should be periodically wiped clean and given a light coat of way oil.
3. The Delrin bearing on the carousel door should be periodically oiled with way oil.
4. If chips accumulate inside the carousel, it is advised to blow chips clear of the carousel and tray to prevent them from obstructing tool changes. (Always wear eye protection.)

Additionally, after installing the ATC you may find that you are using your power draw bar more frequently. Power draw bar maintenance items to consider are:

1. Periodically tighten the set screw on the spindle flange.
2. Periodically ensure that mounting hardware is snug and fasteners are tight.
3. Belleville washers are wear items that have a service life of ~30,000 tool changes. If you experience collet slip or notice deterioration of the bellevilles, replace them according to the procedure outlined in the Power Draw Bar installation manual.

1.20 Troubleshooting

Mechanical Issues

Binding

If your ATC has not been properly aligned you may experience binding as the collet descends over the tool holder shank. The ATC carousel must be in a plane perpendicular to the spindle axis. The best way to check this is to place a long dowel in a drill chuck or set screw tool holder, then position that toolholder in an open tray slot. As you jog the spindle down over the toolholder shank, watch the end of the dowel. If the ATC is properly aligned, the end of the dowel won't move as the collet slides over the shank. Aligning the ATC is time consuming to do properly, but once set the alignment should not change.

Collet Slip

Collet slip can result from a variety of causes. The best way to prevent collet slip is to make sure that your tool holders and the bore of the TTS R8 collet are clean and dry. Wiping them down with alcohol or acetone is a good way to remove way oil or cutting fluid that may cause collet slip.

The procedure for adjusting the preload on the bellevilles is outlined in the power drawbar installation guide (Technical Document 31706, included on your ATC software installation CD). Because the belleville washer preload also affects the operation of the ATC, certain parts of this procedure are worth repeating here:

1. When adjusting the preload, make sure that you have a regulator on your air line set to at or below the cut in pressure on your air compressor. For instance, if your regulator switches on at 90 PSI, and your regulator is set to 95 PSI, the actual air pressure at the draw bar could be anywhere between 90 and 95 PSI depending on the tank pressure. This is bad – if you set the belleville preload when you have 95 PSI to work with, the drawbar will not properly release when your air pressure decreases to 90 PSI and you are at risk for crashing the ATC.
2. The higher the working air pressure, the more preload you can get on the bellevilles. If your compressor can be adjusted to maintain 100 PSI, you can run with higher preload than you would at 90 PSI. We recommend a minimum of 95 PSI, but if you have collet slip problems you may need to increase the

supply pressure to get the preload up. **Do not exceed 120 PSI, the working limit for the power draw bar cylinder.**

3. Not all air regulators are created equal. We have found that inexpensive regulators tend to constrict air flow, which makes for longer make-up times as the power draw bar fires. While this is not a problem for the power draw bar when operated by hand (the user just waits the extra second or two for the cylinder to fully pressurize), it can cause problems when using the ATC, which only pauses 500 ms between the draw bar firing and the z axis moving. Better regulators do not restrict the flow while regulating pressure.
4. Collet slip is more likely to occur if your speeds, feeds, or fixturing result in machining operations with a lot of high frequency chatter (end mill “squeal”). We have seen even light cuts result in collet slip if the end mill is squealing or chattering excessively. Usually, such noise and vibration should be avoided for other reasons (poor surface finish, reduced tool life) and tweaking the spindle RPM or increasing the feedrate will tune the chatter out.

ATC Tray Chatter

If the 3 linear bearings that support the carousel are not properly aligned with the linear guides, you may experience chatter on tool changes. Sometimes this chatter can be eliminated with a light application of way oil to the linear guides. If the chatter persists, loosen the 4 M5 Allen head screws that hold the linear bearings on to the carousel assembly. Allow the bearings to self align, then retighten.

Z Height Not Repeatable

If tool change Z height is set incorrectly the tool will not be properly seated against the spindle nose. This problem manifests itself in poor repeatability of tool length compensation. This is a condition that can be hard to diagnose, because a small gap between the tool holder shoulder and spindle nose can be difficult to see. If you suspect that the tools are not seating properly, backlight the toolholder with a flashlight – any gap will become apparent. During tool changes, the spindle should come down and make contact with the shoulder of the tool. If the spindle travels down too far or not enough, there will be a visible gap between the tool holder and the spindle nose. Adjustment of tool change Z height is discussed in section 2.2.6 of this manual.

It is also possible the R8 collet is protruding too far from the spindle nose, this can be the case if the drawbar isn't tightened down sufficiently or if the gap between the air cylinder bolt head and the top of the draw bar bolt is not large enough. Adjusting the spring washer tension is covered in the Initial Setup section near the end of the PDB installation document. If the gap between the air cylinder bolt and the draw bar is too little, this will over-travel the R8 collet allowing it to hit in the bottom of the pocket of the TTS holders. Remove washers as required to allow full release of the TTS yet still not push the collet as to be contacting the TTS holder.

Sensors

The ATC uses the following sensors:

1. TRAY IN
2. TRAY OUT
3. TRAY REFERENCE
4. (optional) pressure switch

The TRAY IN/OUT sensors are normally open reed switches. TRAY OUT is visible under the band clamp at the end the pneumatic actuator. TRAY IN is hidden in a recess in the linear rail behind the pneumatic cylinder and is not visible unless the cylinder has been removed. The piston of this pneumatic actuator is magnetic - the reed switches are actuated when the piston inside the cylinder comes within 0.100" of the sensor.

When Mach 3 is started the ATC goes through initialization, the TRAY IN and TRAY OUT sensors are evaluated. If the ATC software encounters a condition where both sensors return HI or both return LO, an error message is generated. Other checks in the software use the tray sensors to try to prevent crashes – for instance if the TRAY IN sensor is active the ATC will stop you from jogging past the tool change position (a soft limit is triggered.)

Software versions 1.1 and higher have diagnostic LEDs on the ATC Setup screen. These can be used to verify the sensors. They are not automatically refreshed by Mach – if the system changes state you must click the Refresh button to see the LEDs change.

If a sensor is not working as expected, the following possible causes should be investigated:

Sensor is Defective

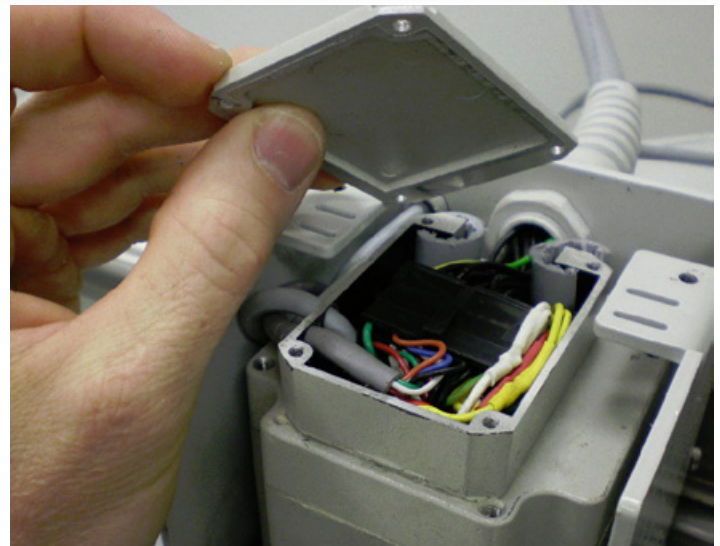
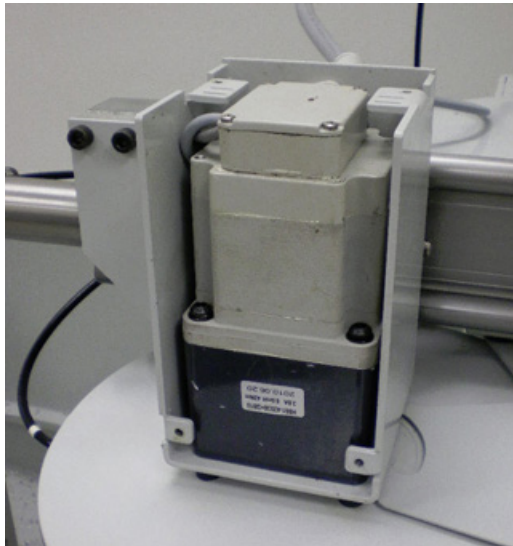
Any magnet can be used to verify whether or not the sensor is working. If you bring a strong magnet near the TRAY IN or TRAY OUT sensors they should return TRUE. If the sensor is working, you can skip to the “Sensor is out of adjustment” section.

If the sensor is not working, you will need to determine whether the sensor itself is defective or if there is a short in the wiring.

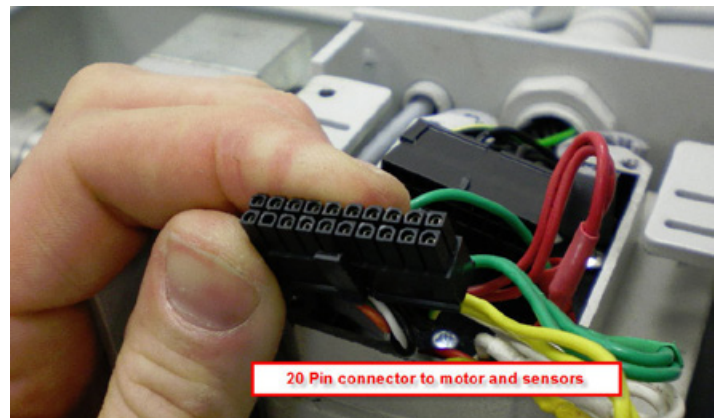
NOTE: The TRAY OUT sensor is held in place by a band clamp – if this clamp is over tightened it will prevent the sensor from working. You might try loosening the band clamp as a first step in diagnosing a bad TRAY OUT sensor.

To distinguish between a wiring problem and a sensor problem, you will need to Ohm out the sensor with a multimeter:

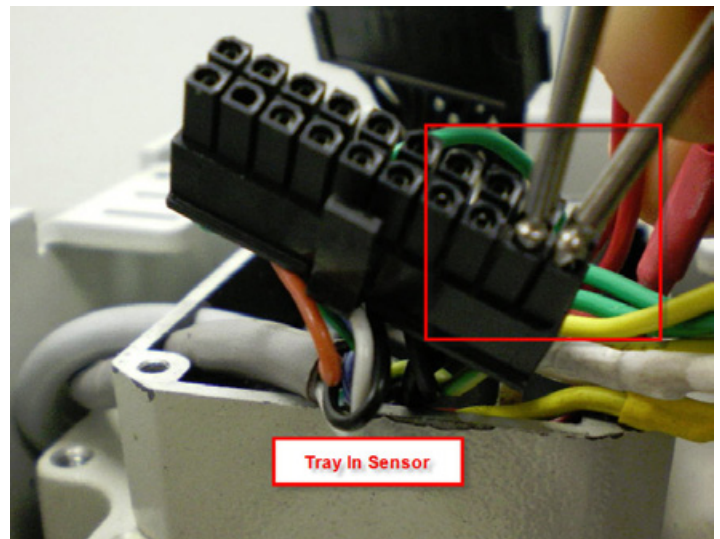
1. Remove the motor cover, then remove the top of the stepper motor’s electrical junction box:



2. Disconnect the 20 pin Molex connector. The female side goes to the motor and sensors:

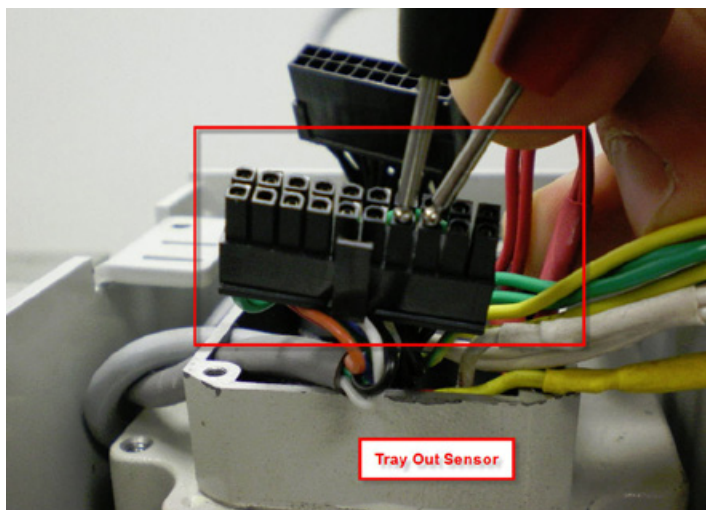


3. Touch your probe leads to the pins corresponding to the sensor of interest:



TRAY REFERENCE

The TRAY REFERENCE sensor is a normally open reed switch housed in a black plastic enclosure on the underside of the carousel umbrella. It is used to provide a carousel home reference position. It reads a small neodymium magnet embedded in the hub.



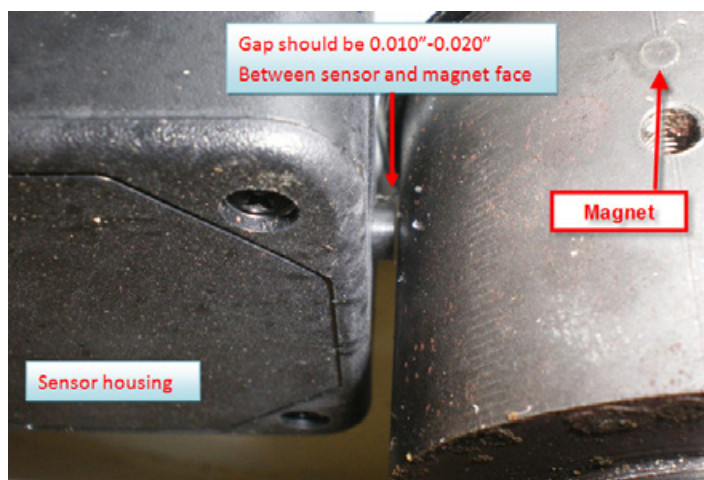
4. When a magnet is near the sensor, the sensor should read close to 0 Ohms, otherwise it should read open circuit.

If the sensor reads appropriately at the 20 pin connector, then the overwhelming likelihood is that the 20 pin junction (male side – to the control board) has a faulty crimp. To be sure you can repeat the above multimeter tests at the control board (see schematic for appropriate pins.)

If the sensor does not read appropriately you should remove the sensor assembly (which requires removal of the pneumatic actuator). As a final check you can ohm out the sensors when they are off of the machine. The sensor assembly is PN 32138.

Sensor is Out of Adjustment

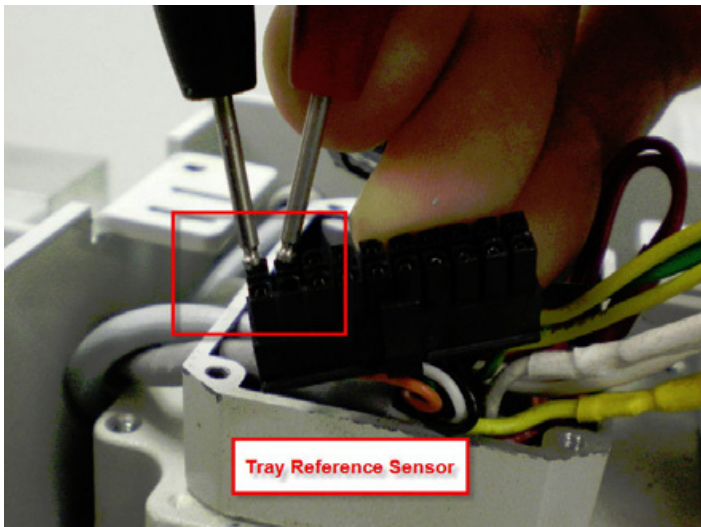
If the tray sensors work when you wave a magnet over them, but don't read the tray position accurately, they are out of adjustment. The magnetic piston must come within about 0.100" of the sensor to activate the sensor. Sprinkling iron filings on the outside of the cylinder is a good way to verify the position of the magnetic piston. You should verify that the sensor is positioned such that the magnetic piston is directly over the sensor when in the tray out or tray in positions. Also, check that the air cushion adjustment (small brass set screw) hasn't been over-adjusted to a hard stop, which will prevent the piston from traveling all the way to either position.



The first tool change after the control software is started, or any time after the mill is e-stopped and then re-powered, the tray will reference itself. It spins quickly in one direction until the sensor reads the magnet, moves past the magnet, then it reverses direction and moves slowly until it reads the magnet again. If the sensor is not working properly the tray will spin for 10 seconds or so, then time out and give an error message.

The sensor should be positioned as shown in the above photo – a small gap should be present between the magnet embedded in the hub and the sensor itself.

This sensor can be Ohmed out in the same way as the TRAY IN and TRAY OUT sensors:



Hub Disassembly

1. Remove the tool tray by removing the flange nut that attaches the tray to the hub.
2. Use an Allen wrench to unscrew the stud that the flange nut was screwed on to
3. Behind the stud is a small (M4?) socket head cap screw. Remove this
4. Loosen the two set screws and remove the hub from the shaft.

Software

The ATC requires the latest Tormach release of Mach3 Machine control software to run. You can verify your version of Mach3 by clicking Help>About Mach3/PCNC3 controller in the control software and comparing the Mach3 version to the current version listed on our website. The latest version of the mill's control software can be found on the website at <http://www.tormach.com/documents.html>. Additionally, you will need to install

the ATC specific software from the CD that was included with the ATC. This software installs drivers specific to the operation of the ATC, and must be installed prior to running the ATC.

ATC Recovery

As you learn to use the tool changer you may experience a tool crash. Thankfully, it is very difficult to damage the Tormach ATC. The software is intelligent and can predict potential crashes, warning the operator with a pop-up window before executing the commanded change. If you are unfortunate enough to experience a crash:

1. Use the "Drawbar Down" button on the ATC Setup screen or the "Release" and "Lock" buttons on the pendant to release the tool.
2. Use the Reference Z button to move the Z axis clear of the ATC.
3. Use the "Tray Out" button on the ATC Setup screen to retract the tray.
4. Always re-reference the tool tray after a crash.
5. Make sure that the tools that are physically in the tray match the tools shown on the ATC control screen.
6. If there is a mismatch between the software and the actual tools that are present in the tray, click the "Go To Tray Load Position" button and then use the "Insert" and "Delete" buttons to correct the error.

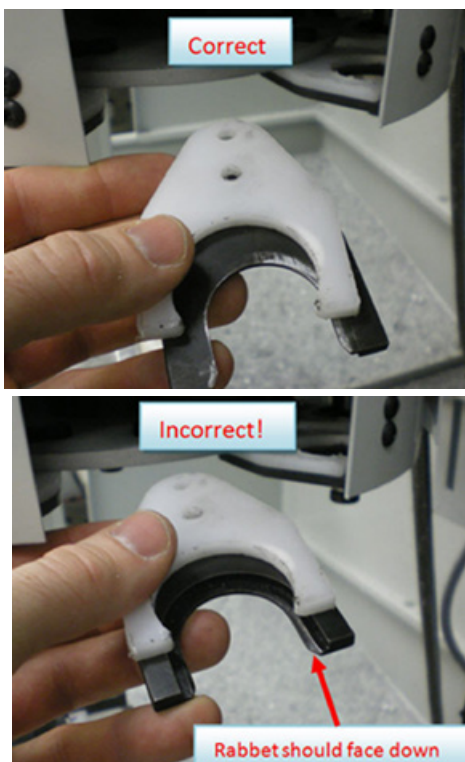
Broken Fork Fasteners

The hex bolts that hold the tool forks to the tray are nylon shear bolts that have been engineered to fail under greater-than-normal loads. These bolts will snap in the event of a tool crash, preventing damage to the ATC.

NEVER REPLACE THESE BOLTS WITH METAL FASTENERS!

Doing so will put your ATC at risk to more serious damage in the event of a tool crash. If you experience a crash that breaks these shear bolts, replace them with the extra bolts provided with the ATC and realign the tool fork using the

procedure described in section 2.3.3. Note that the fork has a U-shaped rabbet on one side. This rabbet must face down as shown in the following photos:



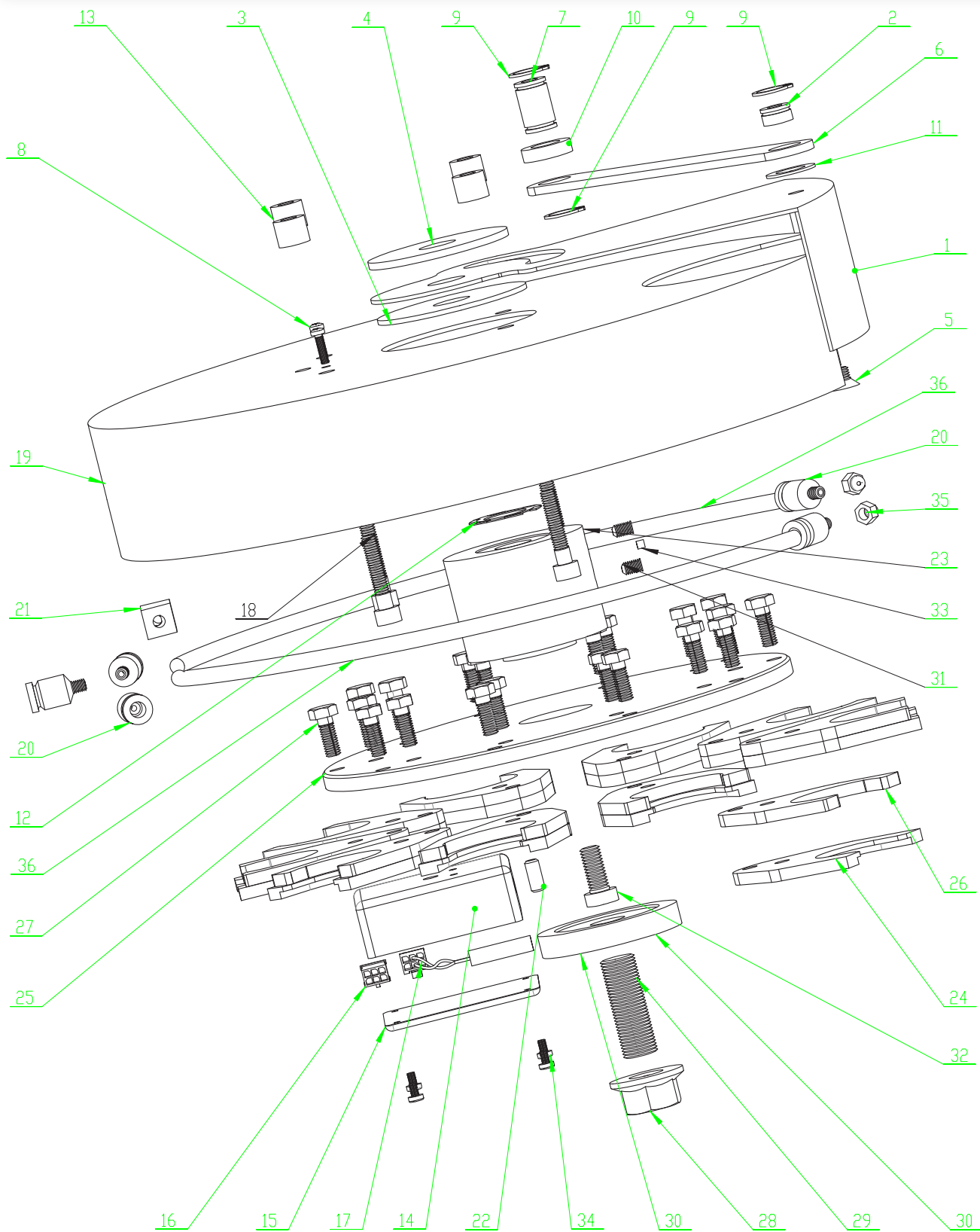
The control software records the positions of the tools in the carousel and spindle in a configuration file when you shut the software down. If you fail to shut the software down before turning off the computer, or if you have a power failure during operation, the software may restart with incorrect tool positions shown on the ATC screen. This is an easy condition to recover from. Perform the following steps to correct this problem:

1. If there is a tool in the spindle, remove it before proceeding with an ATC recovery.
2. Click the “Tray Load Position” button on the ATC screen.
3. Using the “Tray FWD” or “Tray REV” buttons, index through the tray. Use the “Insert” and “Delete” buttons on the Manual Load/Unload section of the ATC control screen until the tools that are physically in the tray match up with the tools shown on the ATC control screen.

Notes

[illegible]

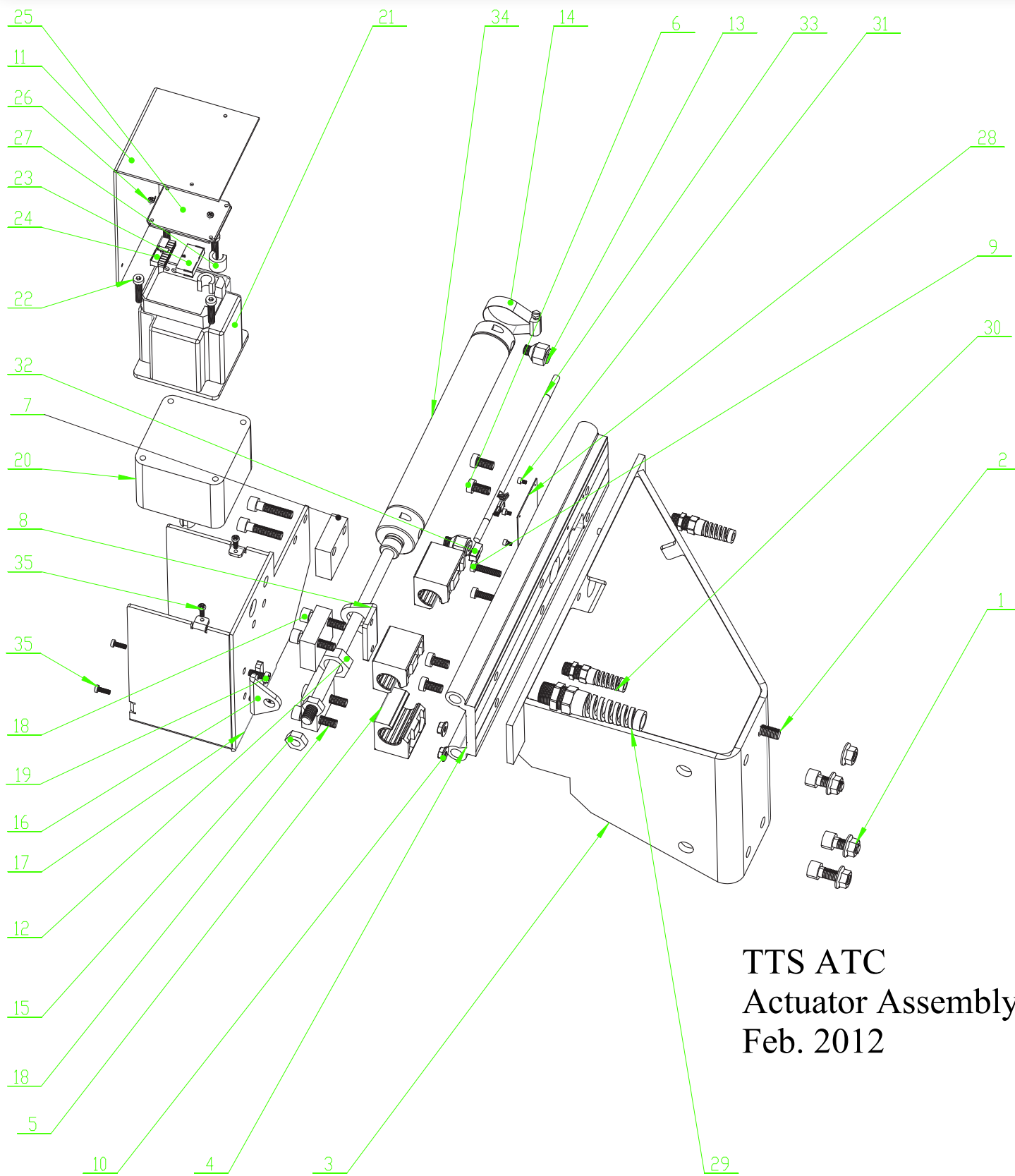
Exploded View & Parts List



TTS ATC
TOOL CAROUSEL
FEB 2012

1.21 ATC Carousel

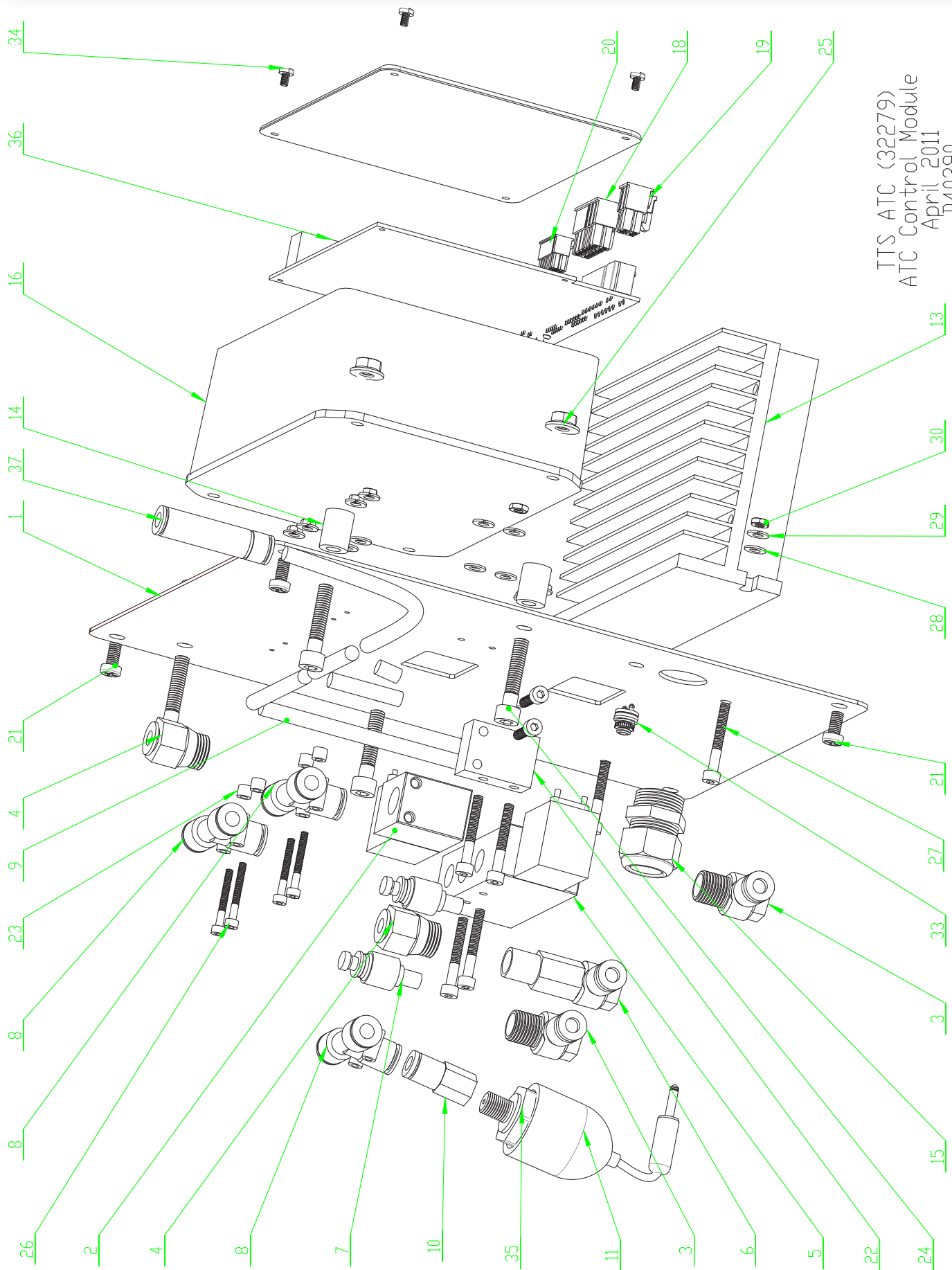
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	32149	Tool Tray Door	1
2	32133	Tray Arm Pin - Front	1
3	32150	Tray Door Thrust Bearing - Lower	1
4	32148	Door Thrust Bearing - Upper	1
5	32195	M6 x 5 Flat Head Screw	1
6	32131	Tray Door Arm	1
7	32132	Tray Arm Pin - Rear	1
8	32192	M3 x 12 SHCS	2
9	32136	12mm C-Clip	3
10	32135	Tray Lever Washer - Rear	1
11	32134	Lever Washer - Front	1
12	32151	Spring Washer	1
13	32153	Cowling Standoff	4
14	32160	Tool Tray Sensor Housing	1
15	32162	Tray Sensor Housing - Top	1
16	32166	6 Pin Molex Header	1
17	32164	Tray Sensor Assembly	1
18	21205	M6 x 30 SHCS	4
19	32155	Tool Tray Cowling	1
20	32169	10-32 x 1/4 Push Connector	5
21	32141	Blast Union Block	1
22	32180	1/4 Roll Pin	1
23	32152	Tool Tray Hub	1
24	32159	Tool Claw	10
25	32156	Tool Tray Plate	1
26	32158	Tool Claw Spring	10
27	32173	M6 X 16 Nylon Hex Bolt	20
28	32174	M14 Flange Nut	1
29	32176	M14 x 30 Stud	1
30	32157	Tray Stiffener Washer	1
31	32179	M5 x 12 Set Screw	2
32	32177	M8 x 10 Hub Retention Bolt	1
33	32178	Magnet	1
34	32236	Lid Screw	4
35	32243	Blast nozzle	2
36	32232	PUR 1/4 Air Line	2



**TTS ATC
Actuator Assembly
Feb. 2012**

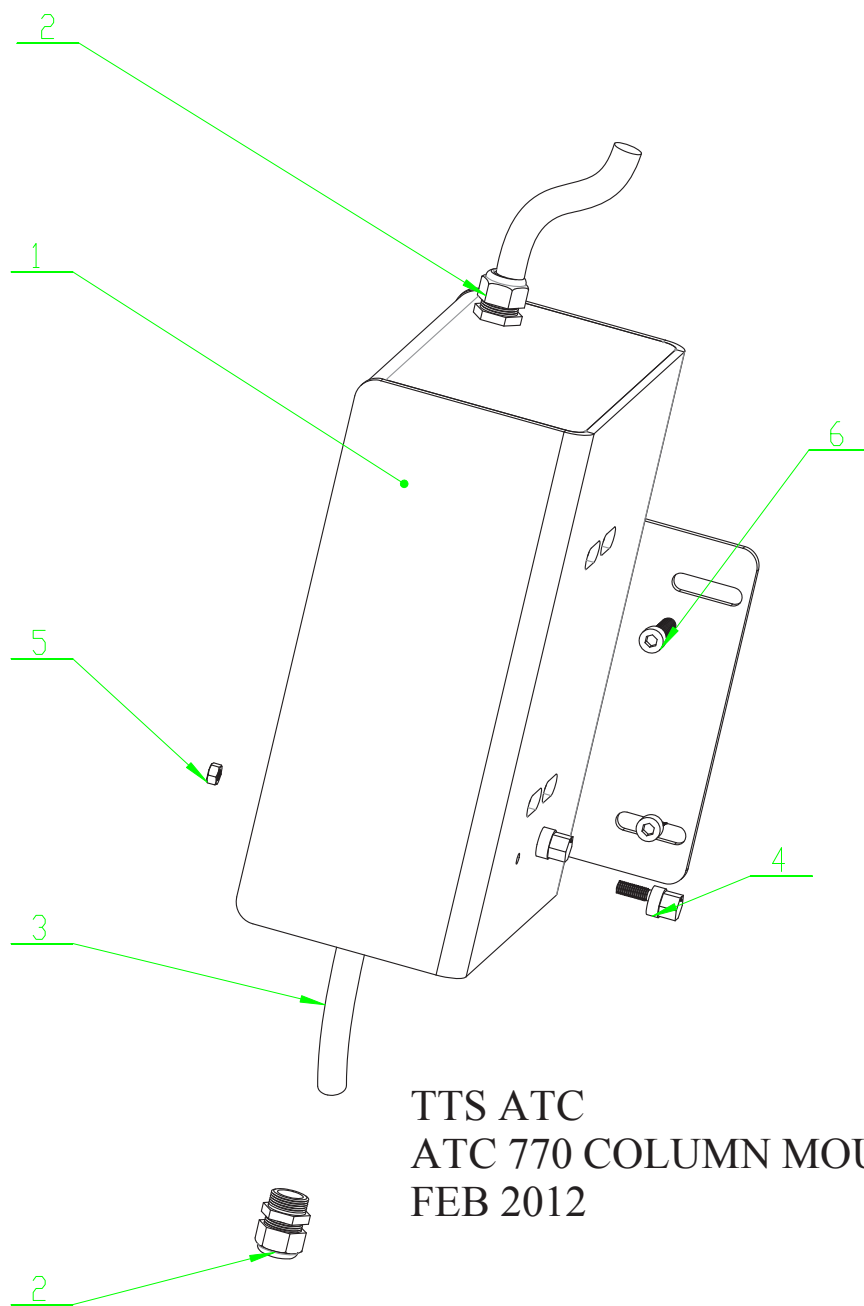
1.22 TTS ATC Actuator

ITEM NO.	PART NUMBER	DESCRIPTION
1	32187	M10 Flange Nut
2	32186	M10 x 25 SHCS
3	32122	Interface Mount
4	32123	Rail
5	32124	Linear Bearing
6	32183	M8 x 16 Low Head SHCS
7	32125	Bearing Spacer Block
8	32126	Front Cylinder Bracket
9	32188	M6 x 25 SHCS
10	32190	M6 Flange Nut
11	32145	Motor Chassis Cover
12	32130	Cylinder 3/4 x 16 Jam Nut
13	32142	1/8 NPT x 1/4 Push Connector
14	32137	Band Clamp
15	32172	7/16 Jam Nut
16	32127	Cylinder Rod Bracket
17	32143	Motor Chassis
18	32182	M8 x 35 SHCS
19	32189	M6 x 16 SHCS
20	32147	Gear Head
21	32146	NEMA 34 Motor
22	32191	M6 x 24 SHCS
23	32200	Molex 20 Pin Heade
24	32199	20 Pin Molex Plug
25	32249	Connection Box Lid
26	32250	M3 x 5 Pan Head
27	42249	Cable Chafe Guard
28	32129	Rail Cover Plate
29	32140	Flex Cable Retainer 1/2 NPT
30	32139	Flex Cable Retainer - 1/4 NPT
31	32193	M3 x 5 SHCS
32	32203	4 Pin Molex Header
33	32138	Cylinder Sensor Module
34	32128	Air Cylinder
35	32201	M4 x 25 PH Screw



1.23 ATC Control Module Assembly

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	32206	Column Access Plate	1
2	32210	2 Port Solenoid	1
3	32207	1/4 NPT x 1/4 Elbow	2
4	32212	1/4 NPT x 1/4 Straight	2
5	32209	5 Port Solenoid	1
6	32213	1/4 NPT x 1/4 Extended Elbow	1
7	32211	Speed Muffler	2
8	32215	1/4 Run Tee	3
9	32232	1/4 PUR Air Line	1
10	32238	1/8 NPT X 1/4 Straight Female	1
11	32238	Pressure switch boot	1
12	32237	Pressure Plug	1
13	32793	Stepper Driver	1
14	32230	Control Box Standoff	1
15	32228	1/2 NPT Cable Clamp	1
16	32227	Control Box	1
17	32231	Control Box Lid	1
18	32239	Molex Micro Mini 10 pin	1
19	32238	4 pin molex jr	1
20	32240	Molex Micro 12 Pin	1
21	32208	M5 x 10 Pan Head	4
22	32214	2 Port Solenoid Mount Block	1
23	32223	Run Tee Standoff	1
24	21205	M6 x 30 SHCS	4
25	32190	M6 Flange Nut	4
26	32218	M3 x 25 SHCS	4
27	32217	M4 x 30 SHCS	6
28	32221	M4 Washer	10
29	32222	M4 Lock Washer	10
30	32219	M4 Hex Nut	6
31	32220	M3 Hex Nut	4
32	32225	M4 x 16 SHCS	2
33	32235	3.5mm jack	1
34	32236	Lid Screw	4
35	32241	Pressure Switch	1
36	32270	ATC Control PCB	1
37	32226	Check Valve In Line	1

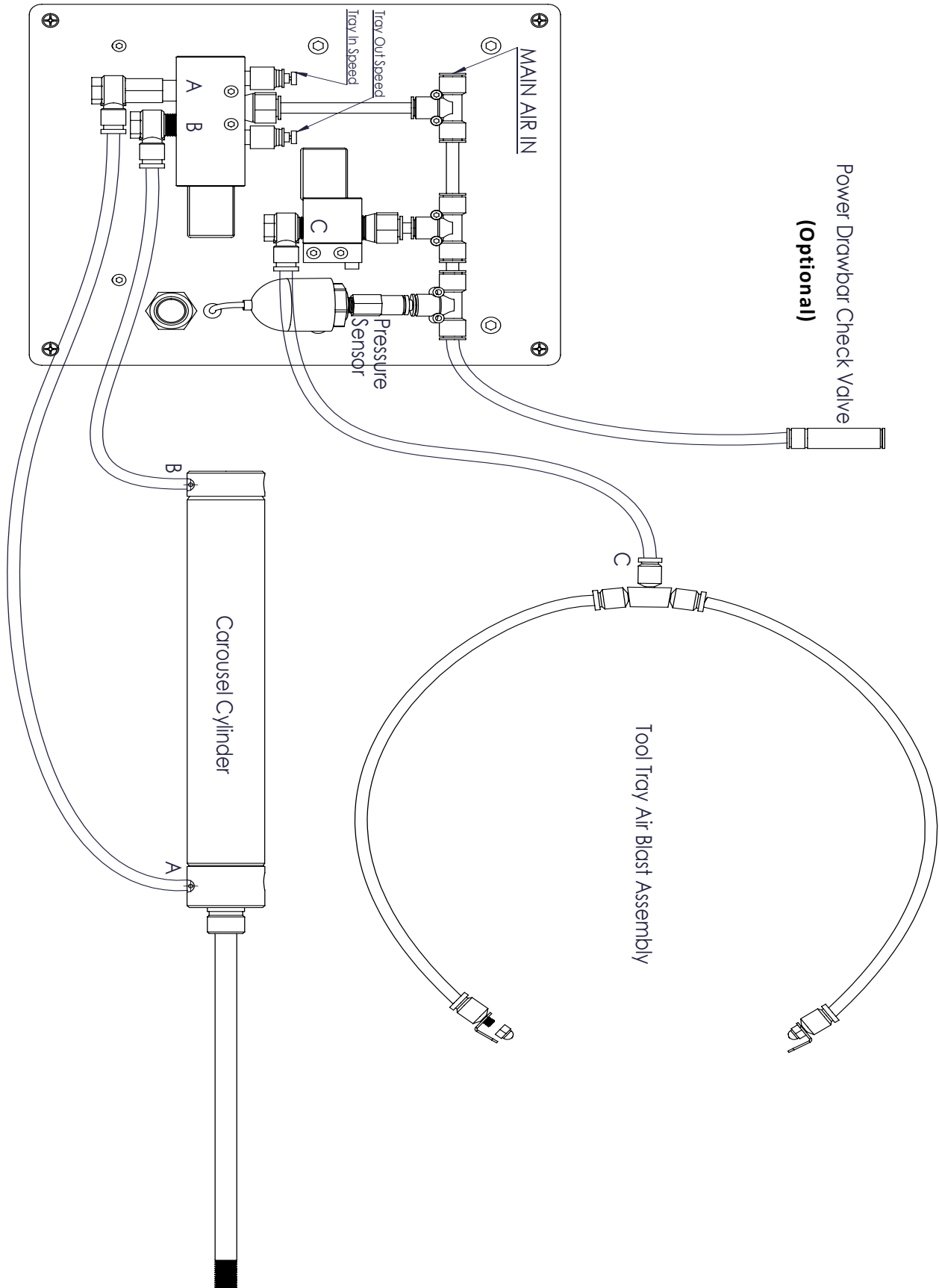


TTS ATC
ATC 770 COLUMN MOUNT
FEB 2012

1.24 ATC 770 Column Mount

ITEM NO.	PART NUMBER	DESCRIPTION
1	32196	770 Column Mount
2	32228	1/2 NPT Cable Clamp
3	32194	Conduit
4	32244	Cam Tilt Adjuster
5	42246	M6 Nylock Nut
6	32182	M8 x 35 SHCS

1.25 TTS ATC Pneumatic Schematic



1.26 ATC Electrical

ATC J1 - Power (Molex Mini Jr 4)

ATC J1	P1	+70V in
ATC J1	P2	+70V in
ATC J1	P3	Gnd
ATC J1	P4	Gnd

ATC J2 - Solenoids/Estop (Molex Mini Jr 12)

ATC J2	P1	Solenoid 5 +12V
ATC J2	P2	Solenoid 4 +12V
ATC J2	P3	Solenoid 3 +12V
ATC J2	P4	Air Blast Solenoid +12V
ATC J2	P5	Tool Tray Solenoid +12V
ATC J2	P6	Estop (not used)
ATC J2	P7	Solenoid 5 - Gnd
ATC J2	P8	Solenoid 4 - Gnd
ATC J2	P9	Solenoid 3 - Gnd
ATC J2	P10	Air Blast Solenoid - Gnd
ATC J2	P11	Tool Tray Solenoid - Gnd
ATC J2	P12	Estop (not used)

ATC J3 - Switches and Sensors (Molex Micro 12)

ATC J3	P1	unused
ATC J3	P2	unused
ATC J3	P3	Cylinder In Switch/ +5V
ATC J3	P4	Tool Tray Homing Switch /+5V
ATC J3	P5	Cylinder Out Switch /+5V
ATC J3	P6	Extra Switch / +5V
ATC J3	P7	unused
ATC J3	P8	unused
ATC J3	P9	Cylinder In Switch/ Gnd
ATC J3	P10	Tool Tray Homing Switch / Gnd
ATC J3	P11	Cylinder Out Switch /Gnd
ATC J3	P12	Extra Switch/Gnd

ATC J4 - Tormach Stepper Ribbon (IDC 10)

ATC J4	P1	unused
ATC J4	P2	unused
ATC J4	P3	+5V common
ATC J4	P4	Step
ATC J4	P5	Direction
ATC J4	P6	unused
ATC J4	P7	unused
ATC J4	P8	unused
ATC J4	P9	unused
ATC J4	P10	unused

ATC J5 - ATC (RJ-11)

ATC J5	P1	Draw Bar Board Input Signal (VFD, Solenoid Status via PWM)
ATC J5	P2	Draw Bar Output - UP
ATC J5	P3	Draw Bar Output - DN
ATC J5	P4	Draw Bar/Gnd

Stepper Driver Dip

Sw 1	On
Sw 2	Off
Sw 3	On
Sw 4	On
Sw 5	On
Sw 6	Off
Sw 7	On
Sw 8	On