



ATC3

Umbrella Tool Changer

Operator's Manual

Rev. 05-October-2007

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Operating Instructions for Geneva mechanism tool changers. (05-Oct-2007)

Overview

This document contains instructions intended for operators who use enhanced RTK3/ATC3 based tool changers. RTK3 refers to specific PLC electronics hardware inside the electrical cabinet and the ATC3 refers to the particular revision of software logic that controls the tool changer and other input/output points. The ATC3 programs were developed and used after the release of v1.52 software. The operating instructions assume that the tool changer machine has been properly set up and initialized by a qualified technician.

ATC Machine Related Software Parameters

- Machine Parameter 0. This parameter specifies the PLC bit number to which the physical E-stop is connected. It should be set to 11.
- Machine Parameter 6. This parameter signifies if an Automatic Tool changer system is installed. It should be set to 1 for proper operation.
- Machine Parameter 160. This parameter determines the type of ATC system that is being used. It should be set to 1 (nonrandom) for “Umbrella” type tool changers.
- Machine Parameter 161. This parameter specifies the maximum number of carousel bin locations. The value in this parameter is sent to the PLC subsystem on power up. Therefore, if this parameter is changed, the system must be rebooted and the tool library initialized.
- Machine Parameter 162. This parameter affects how Intercon programs post M&G codes for a tool change operation. When set to a non-zero value, Intercon will post out an M-code at the start of a tool change and an M5 command after the Txx M6 command. This parameter should be set to 17 so that Intercon will post an M17 code at the start of a tool change. The M17 command turns off spindle and coolant and starts the spindle orientation process.
- Machine Parameter 164. This parameter controls specific features of the ATC system. It should be set to 1.0 to enable the ATC Reset feature, which will appear as the <F6> ATC Reset function key in the tool library menu.
- Machine Parameter 175. This parameter specifies the time in minutes for the spindle chiller or cooling fan to remain on after the spindle is turned off.
- Machine Parameter 177. This parameter allows most fault conditions to be disabled. When set to 1.0, lube faults, spindle drive faults, axis drive faults, and other stop conditions are prevented from happening. If set to 0.0, pressing or releasing the Emergency Stop does not result in a displayed message. The parameter should be set to 0.0 to enable faults and stop conditions to occur.
- Machine Parameter 178. This is a bitmapped parameter that can switch the state of some of the inputs. The value of these bits determines what the default state of the input will be. The bits that are related to the ATC system are:

AIR_SIGNAL	P178 Bit 2 (4) (Setting this bit will make AIR_SIGNAL normally open)
TOOL_COUNTER	P178 Bit 3 (8) (Setting this bit will make TOOL_COUNTER default state closed).
INV_ZERO_SPEED	P178 Bit 5 (32) (Setting this bit will make INV_ZERO_SPEED normally open).
CHILLER_FAULT	P178 Bit 10 (1024) (Setting this bit will make CHILLER_FAULT normally open).

These settings are configured during control system integration and should not be changed.

- In the Work Coordinate System Configuration menu, Return #2 (G30) Z value is set to the position of the Z-axis at the tool carousel height. If the Z-axis motor is removed or replaced, or the Z-axis machine home position is changed (such as if the limit switch of the machine were moved or replaced), this value may need to be adjusted. The Return #1 (G28) value is normally set to the same value as the G30 Z return point so that an M25 command does not move to the home position and then back down to the G30 point when doing a tool change, which saves time on tool changes.

Other ATC Specifics

- The M19 command is used to orient the spindle. The spindle inverter controls the orient position and all settings related to it. For details on setting up the spindle inverter refer to TB 112.
- The air pressure gauge normally has two adjustments that affect a set point and range for normal operation. These settings should not be changed to compensate for lack of air capacity.
- The solenoids that control the carousel in, carousel out, air blow, and drawbar can usually be manually engaged by pressing a small button located on the solenoid.

Most systems rely on a 3-phase motor to control the carousel rotation. If the machine is moved and the power phases are reconnected differently, the carousel rotation may be backwards.

Startup

When the CNC software is powered up, **the following steps must be completed before any tool change is attempted:**

- 1.) Machine Home must be set.
- 2.) Tool number displayed in the CNC software status window must be correct – “T---“ signifies no tool is present in the spindle.
- 3.) Press <ALT> + <K> on the control to confirm correct ATC Bin, “ATC BIN xx” will be displayed, where xx is the current carousel position.

If any of the above operations are not completed after powering up the machine, **a crash could happen.**

If the tool number or ATC Bin numbers do not match, refer to the section *Handling Errors*.

General Operation

- Once the machine has homed successfully and the operator has made the initial checks, the system is ready for general operation. When using the tool changer system, the tool change (or tool indexing) process should not be stopped unless necessary. If a tool change process must be stopped, the procedures in the *Handling Errors* section should be followed to ensure that the tool changer is initialized.
- There is a push-button switch mounted on the head that can be used to activate the drawbar unclamp and air blow provided that the spindle is not running and the control is not running a program.
- The jog panel has two keys that can be used to index the tool carousel if a program is not running or in MDI mode.
- The tool changer will skip a tool change if the requested tool is already in the spindle.

Loading Tools

To load tools, use the <F7> ATC function found in the <F1> Setup menu from the main screen of the CNC software or in the Tool Offset Library. Alternatively, a *TnnM6* can be executed at the MDI prompt, where *nn* is the tool number to load. When the tool change sequence is complete, insert the tool into the spindle. Note that *the drawbar unclamp switch mounted on the head will not function in MDI mode*. Repeat this process until all the tools are loaded. Initial setup of the tool library is such that tool #1 belongs in carousel bin #1, tool #2 belongs in carousel position #2, and so on, up to the maximum number of bins. The tool library interface is described more fully below.

The Tool Library Interface

Enter tool in spindle: 1

Press ESC to abort the reset function. Press ENTER to proceed to the “Enter putback location of tool in spindle” prompt as shown below. The default value is always blank. Enter the carousel bin location where the tool in the spindle should be assigned.

Enter putback location of tool in spindle:

Press ESC to abort the reset function. Press ENTER to proceed to the final warning prompt as shown below. The carousel bin that must be empty is the same as that entered in the “Enter putback location...” prompt above. The reason that this carousel bin location needs to be empty is because the tool in the spindle will be placed back into it on the next tool change.

**WARNING: Carousel bin 1 must be empty.
Reset cannot be undone.
Are you sure (Y/N)?**

Press 'Y' to continue with the reset feature or any other key to abort. If there is an error preventing the reset procedure from executing, an error message is displayed. After a successful ATC reset, the message window will show the message “9046 --- ATC INITIALIZED ---”.

Initializing the Tool Library – Using <F6> Init

The <F6> Init function is used for initial setup. To access this function from the main menu, choose <F1> Setup followed by <F3> Config. When the <F6> Init function key is pressed, a warning prompt will be displayed as below:

******* WARNING *****
All bin numbers will be initialized.
Are you sure? (Y/N)**

Note: If there is a fault condition that would prevent initialization procedures from being executed properly, a different message will be displayed and the fault must be cleared before proceeding. After choosing to continue with the 'Y' key, there is no way to reverse this decision. The ATC system will be reset. If 'Y' is chosen to continue, the following prompt is displayed:

**The PLC system must be initialized.
Use the tool index keys to rotate the carousel to bin #1
and then press '1' to continue with PLC initialization.**

These instructions should be followed. The tool index keys are located on the operator jog panel. After the '1' key is pressed, the software will reset the PLC subsystem so that the current tool carousel position is #1 and that

tool #1 will be placed back into carousel position #1 on the next tool change. Further, the initialization assumes tool #1 is in the spindle and that carousel bin #1 is empty.

If attempting to index the carousel results in a noise fault then press Emergency Stop to clear the fault and then press one of the tool index keys. This will rotate the carousel until the TOOL_COUNTER is in the correct state and then indexing can continue.

After the Init command is executed, the following message is displayed.

******* WARNING *******
Tool #1 should be placed into the spindle.
Carousel bin #1 MUST be empty.
Press '2' to exit and complete these tasks.

After pressing '2', finish the initialization by performing, if necessary, the removal of any tool in carousel bin #1 and placing tool #1 into the spindle.

To remove a tool that may be in carousel bin #1 after initializing.

- (1) If there is a tool in the spindle, remove it.
- (2) Jog the Z-axis to the upper home position.
- (3) Execute an M80 command in MDI mode or manually activate the tool-carousel-IN solenoid.
- (4) Press <ESC> to exit MDI mode and manually remove the tool.
- (5) Execute an M81 command in MDI or manually activate the tool-carousel-OUT solenoid.

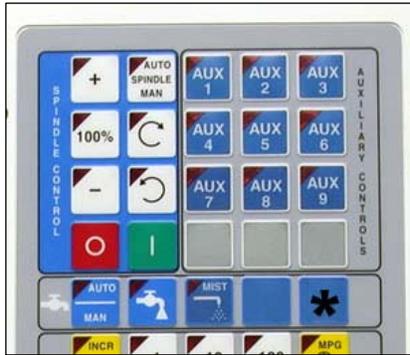
At this point, it may be necessary to remove and insert tools so that T1 is in the spindle, T2 is in bin #2, T3 is in bin #3, and so on. The main point is that after the initialization, T1 should be in the spindle and carousel bin #1 MUST be empty. If some of the other tools are not in the correct bins then the tool library can be changed to match where the tools are presently located in the carousel, if desired.

Handling Errors

As noted above, there are many errors that can be detected and displayed by the tool changing system. What to do for a given fault depends upon the particular fault and when the fault occurs. Faults are normally caused by one or more inputs in the system not being in the right state at the right time. The state of most of the plc I/O can be determined by pressing <ALT+I> to enter the live PLC display. The PLC display will give an indication of what state the system is in. After a fault is generated, viewing the PLC display is helpful in determining the cause of the problem.

- The procedure below is a generic procedure that will attempt to recover from most conditions. Ensure that the carousel is out, or away from the spindle, before attempting these procedures.
 - (1) Engage and release E-stop. This will clear any fault and will reset other internal registers.
 - (2) Perform the <F2> ATC Reset procedure in the Tool Library menu as outlined earlier.
- The following message is displayed when attempting to run a job (or entering MDI mode) if the system detects a possibility of the tool changing system being in error. This message will continue to be displayed until it is cleared by pressing the 'Y' key.

******* WARNING: Possible ATC Fault *******
The PLC system reports carousel bin 8.
The tool in the spindle is T1.
The tool library should be checked.
To clear the fault and continue press Y.



The above message is reported because a tool change (M6) did not completely finish. This condition can happen due to loss of power, pressing the <ESC> key, or pressing the Emergency Stop while executing an M6. It is also possible that there is file system corruption. When this message is displayed, verify that the information is correct. Be sure to also check the tool library to ensure that the Bin assignments agree with the tools in the carousel. If discrepancies are found, follow the steps above.

M-codes for troubleshooting and maintenance

The tool changer system has several special M-functions. The special

M-functions are:

- M5 Turn off spindle and cancel orientation (M19)
- M15* Tool Unclamp and Air Blow On (spindle must be oriented or at zero speed)
- M16* Tool Clamp and Air Blow Off
- M17 Turn off spindle and coolant and start spindle orient process.
- M18 ATC Reset. Used by the ATC Reset feature in CNC software to set the carousel position and putback bin. **Do not use an M18 in MDI mode**, can only be used in an M-code.
- M19 Spindle Orient
- M21 Move Z axis to home position
- M22 Move Z axis to carousel height
- M31/M32 Chip Auger FWD/REV (optional)
- M33 Chip Auger Off (optional)
- M50/M51 Rotate Carousel FWD/REV. These commands can be used within a running program to rotate the tool carousel and are typically used when there are large tools in the tool carousel that would interfere with a part or fixture.
- M80* Carousel in (extend into the spindle)
- M81* Carousel out (retract away from the spindle)
- M6 A complete tool change sequence.

It is highly cautioned that these M-codes are not casually used. They are mainly available to simplify the ATC integration and to aid in troubleshooting a faulty system by qualified technicians. It is possible to cause damage to the ATC system by blindly executing these M functions.

*These commands require that the AUX12 jog panel key is pressed. The AUX12 key must be held down continually until the carousel and clamp switches are in the default state or a stop condition will result. The AUX12 key is the unlabeled blue key located in the rightmost column of the coolant section (right of the mist key and below the tool index + key) as shown with an * in the picture to the left.

ATC Messages

The following messages are displayed in the CNC7 message window during the tool changing process (M6) or during execution of one of the basic customized M functions:

"WAITING FOR SPINDLE ORIENT..."

This message is displayed as part of an M19 command. It indicates that a signal has been communicated to the spindle drive requesting an orient operation and that an orient complete signal from the spindle drive is being waited for.

"WAITING FOR UNCLAMP..."

This message is displayed as part of an M15 command. It indicates that a signal has been communicated to unclamp the drawbar and turn on the air blow through-the-spindle and that the program is waiting for the drawbar unclamp sensor to be recognized.

"WAITING FOR CLAMP..."

This message is displayed as part of an M16 command. It indicates that a signal has been communicated to clamp the drawbar and turn off the air blow through the spindle and that the program is waiting for the drawbar clamp sensor to be recognized.

"WAITING FOR CAROUSEL OUT..."

This message is displayed as part of an M81 command. It indicates that a signal has been communicated to retract the tool carousel away from the spindle and that the program is waiting for the carousel out sensor to be recognized.

"WAITING FOR CAROUSEL IN..."

This message is displayed as part of an M80 command. It indicates that a signal has been communicated to extend the tool carousel toward the spindle and that the program is waiting for the carousel in sensor to be recognized.

"Waiting for plc END REQ"

This message is displayed as part of an M6 command. It indicates that the M6 macro is waiting for the plc system to signal the end of the tool change.

"Waiting for plc HU REQ"

This message is displayed as part of an M6 command. It indicates that the M6 macro is waiting for the plc system to signal the start of moving the Z axis to the home position, which occurs after the carousel has been moved in and the tool has been unclamped.

"Waiting for plc HD REQ"

This message is displayed as part of an M6 command. It indicates that the M6 macro is waiting for the plc system to signal the start of moving the Z axis downward to the carousel position, which occurs after the carousel has been rotated to the tool that will be picked up.

"Waiting for plc MZ REQ"

This message is displayed as part of an M6 command. It indicates that the M6 macro is waiting for the plc system to signal the start of moving the Z axis up or down to the carousel position, which is the very first movement of the Z axis at the start of a tool change.

"9001 ATC NOT READY: HU_ACK"

This message is displayed at the start of a tool change (M6) if the HU_ACK signal is in the wrong state. It is not likely this message will be displayed unless the custom M6 file has been modified.

"9002 ATC NOT READY: HD_ACK"

This message is displayed at the start of a tool change (M6) if the HD_ACK signal is in the wrong state. It is not likely this message will be displayed unless the custom M6 file has been modified.

"9003 ATC NOT READY: CAROUSEL_OUT INP"

This message is displayed at the start of a tool change (M6) if the CAROUSEL_OUT input is in the wrong state. The CAROUSEL_OUT input must be electrically closed at the start of a tool change.

"9004 ATC NOT READY: CAROUSEL_IN INP"

This message is displayed at the start of a tool change (M6) if the CAROUSEL_IN input is in the wrong state. The CAROUSEL_IN input must be electrically open at the start of a tool change.

"9005 ATC NOT READY: TOOL_CLAMPED INP"

This message is displayed at the start of a tool change (M6) if the TOOL_CLAMPED input is in the wrong state. The TOOL_CLAMPED input must be electrically closed at the start of a tool change.

"9006 ATC NOT READY: TOOL_UNCLAMPED INP"

This message is displayed at the start of a tool change (M6) if the TOOL_UNCLAMPED input is in the wrong state. The TOOL_UNCLAMPED input must be electrically open at the start of a tool change.

"9007 ATC NOT READY: TOOL_COUNTER INP"

This message is displayed at the start of a tool change (M6) if the TOOL_COUNTER input is in the wrong state. The TOOL_COUNTER input must be electrically open at the start of a tool change unless CNC machine parameter 178 is configured to change the default state.

"9008 ATC NOT READY: ORIENT_COMP INP"

This message is displayed at the start of a tool change (M6) if the ORIENT_COMP input is in the wrong state. The ORIENT_COMP input must be electrically open at the start of a tool change unless CNC machine parameter 178 is configured to change the default state.

"9009 ATC BIN OUT OF RANGE"

This message is displayed at the start of a tool change (M6) if the plc system receives a command to change to a tool number that is less than one or greater than the maximum number of bins specified in CNC machine parameter 161. The value in CNC machine parameter 161 is sent to the plc system when the software is initially started after a powerup. This message is likely to be displayed if P161 has changed or not been set or it may be caused by corrupt data in the tool library file.

"9010 ATC ORIENT TIMEOUT"

This message is displayed if the plc cannot continue past the state of orienting the spindle. The greatest probability is that the ORIENT_COMPLETE input is not closed- but it could be caused by one or more other inputs being in the wrong state.

"9011 ATC CAROUSEL_IN NOISE"

This message is displayed if the plc system detects that the change from the carousel out position to the carousel in position happened too quickly.

"9012 ATC CAROUSEL_IN ORIENT LOST"

This message is displayed if the ORIENT_COMPLETE input indicates that the spindle is no longer oriented while the carousel is moving in.

"9013 ATC CAROUSEL_IN TIMEOUT"

This message is displayed if the plc cannot continue past the state of moving the carousel inward. The greatest probability is that the CAROUSEL_IN input is not closed- but it could be caused by one or more other inputs being in the wrong state.

"9014 ATC CAROUSEL_IN DB TIMEOUT"

This message is displayed if the CAROUSEL_IN sensor closes, but then after a short de-bounce time of 0.5 seconds, the CAROUSEL_IN input is open or some other input is in the wrong state.

"9015 ATC UNCLAMP TIMEOUT"

This message is displayed if the plc cannot continue past the state of unclamping the tool. The greatest probability is that the TOOL_UNCLAMPED input is not closed- but it could be caused by one or more other inputs being in the wrong state.

"9016 ATC HEAD UP TOOL NOT UNCLAMPED"

This message is displayed if the Z axis is moving toward the home position and the TOOL_UNCLAMPED input is open.

"9017 ATC HEAD UP TOOL CLAMPED"

This message is displayed if the Z axis is moving toward the home position and the TOOL_CLAMPED input is closed.

"9018 ATC HEAD UP TIMEOUT"

This message is displayed if the plc cannot continue past the state of moving the Z axis to the home position, which occurs if the input signals are not in the right state.

"9019 ATC TOOL COUNTER NOISE"

This message is displayed if the plc determines that the TOOL_COUNTER input has changed state too quickly.

"9020 ATC TOOL COUNTER TIMEOUT"

This message is displayed if the plc determines that the TOOL_COUNTER has not changed after a certain amount of time. It could be a problem with the carousel motor or TOOL_COUNTER sensor or wiring.

"9021 ATC TOOL COUNTER NOISE"

This message is displayed if the plc determines that the TOOL_COUNTER input has changed state too quickly. The difference between this error and 9019 is whether the noise occurred on the leading edge or trailing edge of the TOOL_COUNTER signal.

"9022 ATC TOOL COUNTER TIMEOUT"

This message is displayed if the plc determines that the TOOL_COUNTER has not changed after a certain amount of time. It could be a problem with the carousel motor or TOOL_COUNTER sensor or wiring. The difference between this error and 9020 is whether the timeout occurred is whether the TOOL_COUNTER input was on or off.

"9023 ATC HEAD DOWN TIMEOUT"

This message is displayed if the plc cannot continue past the state of moving the Z axis down to the carousel position, which occurs if the input signals are not in the right state.

"9024 ATC HEAD DOWN TOOL NOT UNCLAMPED"

This message is displayed if the Z axis is moving down to the carousel position and the TOOL_UNCLAMPED input is open.

"9025 ATC HEAD DOWN TOOL CLAMPED"

This message is displayed if the Z axis is moving down to the home position and the TOOL_CLAMPED input is closed.

"9026 ATC CLAMP TIMEOUT"

This message is displayed if the plc cannot continue past the state of clamping the tool. The greatest probability is that the TOOL_CLAMPED input is not closed- but it could be caused by one or more other inputs being in the wrong state.

"9027 ATC CAR OUT NOISE"

This message is displayed if the plc system detects that the change from the carousel in position to the carousel out position happened too quickly.

"9028 ATC CAR OUT TIMEOUT"

This message is displayed if the plc cannot continue past the state of moving the carousel outward. The greatest probability is that the CAROUSEL_OUT input is not closed- but it could be caused by one or more other inputs being in the wrong state.

"9029 ATC CAR OUT DEBOUNCE TIMEOUT"

This message is displayed if the CAROUSEL_OUT sensor closes, but then after a short de-bounce time of 0.5 seconds, the CAROUSEL_OUT input is open or some other input is in the wrong state.

"9030 ATC END TIMEOUT"

This message is displayed if the plc cannot continue past the end handshaking state.

"9031 ATC CAR IN DB ORIENT LOST"

This message is displayed if the ORIENT_COMPLETE input indicates that the spindle is no longer oriented while the carousel is moving in and waiting for the de-bounce time to expire. It could be caused by improper setting of the orient position or mechanical interaction between the carousel tool fingers knocking the spindle out of its orient position.

"9032 M19 ORIENT LOST"

This message is displayed if the M19 command to orient the spindle has completed but then afterwards the ORIENT_COMPLETE input indicates that the spindle is no longer oriented.

"9033 INTERNAL PLC FAULT"

This message is displayed when there is an internal fault with the plc system. It is not likely to ever occur, but could be caused by a corrupt pc.plc file or using the wrong version of the plc executor software.

"9034 LOW AIR FAULT"

This message is displayed during a tool change process (M6) if the AIR_SIGNAL input has been open for for than 0.5 seconds.

"9035 CAROUSEL IN/OUT BOTH ON"

This message is displayed whenever the plc system detects that the CAROUSEL_IN and CAROUSEL_OUT inputs are both closed.

"9036 TOOL CLAMP/UNCLAMP BOTH ON"

This message is displayed whenever the plc system detects that the TOOL_CLAMPED and TOOL_UNCLAMPED inputs are both closed.

"9037 ATC M6 PROCESS CANCELLED"

This message is displayed if the M6 process was cancelled by the CYCLE CANCEL button on the operator panel or the <ESC> key was pressed on the keyboard. There will be a warning displayed the next time a job is started.

"9038 M19 STOPPED"

This message is displayed whenever an M19 (spindle orient) command has been executed and then stopped via the CYCLE CANCEL key on the operator panel or the <ESC> key was pressed on the keyboard before the ORIENT_COMPLETE signal was detected indicating the spindle was oriented.

"9039 M80 STOPPED"

This message is displayed whenever an M80 (carousel in) command has been executed and then stopped via the CYCLE CANCEL key on the operator panel or the <ESC> key was pressed on the keyboard before the CAROUSEL_IN signal was closed.

"9040 M81 STOPPED"

This message is displayed whenever an M81 (carousel out) command has been executed and then stopped via the CYCLE CANCEL key on the operator panel or the <ESC> key was pressed on the keyboard before the CAROUSEL_OUT signal was closed.

"9041 M15 STOPPED"

This message is displayed whenever an M15 (tool unclamp and air blow on) command has been executed and then stopped via the CYCLE CANCEL key on the operator panel or the <ESC> key was pressed on the keyboard before the TOOL_UNCLAMPED signal was closed.

"9042 M16 STOPPED"

This message is displayed whenever an M16 (tool clamp and air blow off) command has been executed and then stopped via the CYCLE CANCEL key on the operator panel or the <ESC> key was pressed on the keyboard before the TOOL_CLAMPED signal was closed.

"9043 M15 FAULT NO ORIENT/ZERO SPEED"

This message is displayed whenever an M15 (tool unclamp and air blow on) command has been executed without the ORIENT_COMPLETE input indicating that the spindle is oriented or without the INV_ZERO_SPEED input indicating that the spindle is stopped.

"9045 TOOL COUNTER FAULT CLEARED"

This is an asynchronous message that is displayed after having had a "9019 ATC TOOL COUNTER NOISE" or "9021 ATC TOOL COUNTER NOISE" fault and then using the Tool Index keys to index the carousel. If the TOOL_COUNTER input is stuck in the wrong state, such as would happen if the E-stop or power loss happened while the carousel was rotating, then it is impossible to do a tool change or to index the carousel without getting a noise fault. After a noise fault has been generated and the Emergency Stop has been depressed to clear it, the tool index keys can be used to rotate the carousel and attempt to clear the fault. When the fault has been cleared then this message is displayed.

"9046 --- ATC INITIALIZED ---"

This is an asynchronous message that is displayed after executing an M18 command, which is called as part of the atc reset or init functions.

"9047 ATC MOVE Z AXIS TIMEOUT"

This message is displayed if the plc cannot continue past the state of moving the Z axis up/down to the carousel position, which occurs if the input signals are not in the right state.

"9048 ATC NOT READY: MZ_ACK"

This message is displayed at the start of a tool change (M6) if the MZ_ACK signal is in the wrong state. It is not likely this message will be displayed unless the custom M6 file has been modified. The MZ_ACK signal is a software signal that acknowledges the Z axis has been moved to the carousel position.

"9099 FAULT CLEARED"

This message is displayed whenever the emergency stop is pressed after one of the above 90xx messages is displayed. The emergency stop must be engaged to clear any of the above 90xx faults after they occur or the control will not run a job or allow MDI mode to be entered.