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REFERENCE  
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**AEROTECH**

**TOOL CHANGER III**

**INSTRUCTION MANUAL**

**AUGUST, 1984**  
**REV. 1**



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## CHAPTER 1: GENERAL INFORMATION

The Aerotech Tool Changer III holds a maximum of 25 tools and has a typical tool change time of six seconds. Commands are accepted by the tool changer through the front panel keyboard or from the remote interface in auto operation. Remote mode commands are entered in a BCD coded format with a data strobe pulse, which signals the tool changer that a command is present.

Error codes are displayed for invalid operations or operations which could result in damage to the system. The tool changer also contains several other useful features, such as the reset key, battery powered RAM, and the axis inhibit.

The reset key allows the operator to stop operation of the tool changer at any time.

The battery powered RAM retains the location of the tools during short power outages and shutdowns.

The axis inhibit is an output that is used to indicate to the CNC that the drives should not be moved, because the tool changer may not be in its safe position.

**NOTE:** It is very important that only approved tool holders (listed below) will be used with the ATC2540 Tool Changer. An unauthorized tool holder can hinder the operation of the tool changer, cause excessive draw bar wear, and WILL VOID THE WARRANTY. The tool holder may have to be modified per the attached Spec. Control Drawing #952-1029 (Rev. B).

### APPROVED TOOL HOLDER(S)

G.E. Carboloy #NMTB40-CC

## CHAPTER 2: INSTALLATION INSTRUCTIONS

### SECTION 2-1 ELECTRICAL POWER REQUIREMENTS

Tool Changer III requires 5 amps of 115 VAC unregulated power and .5 amps of 115 VAC regulated AC. The regulated source should regulate between 105 and 125 VAC. If a regulated AC source is not available, the unregulated AC power may be used in place of the regulated AC source. However, severe line fluctuations may cause tool changer malfunctions. Power is connected to TB1 which is located on the Control Module assembly.

A power ground connection point is available next to the AC power input terminal board.

#### AC POWER CONNECTION DESCRIPTION

<u>CONNECTION</u>	<u>DESCRIPTION</u>
TB1-1	115 VAC HI UNREGULATED
TB1-2	115 VAC LO UNREGULATED
TB1-3	115 VAC HI REGULATED
TB1-4	115 VAC LO REGULATED
CHASSIS	POWER GROUND

### SECTION 2-2 REMOTE INPUT/OUTPUT INTERFACE

The Tool Changer III interface card (690C1247) is used to interface the tool changer to the CNC. This board enables the tool changer to operate at voltage levels not directly compatible to the tool changer. The interface consists of a 7 line BCD command bus, data strobe line, continue line, drive inhibit line, Z axis monitor and return lines.

This card requires that all voltages be between 5 and 30 volts. Direct connection to the tool changer is possible by placing the P1/P5 connector into the J5 connector.

NOTE: The P1/P5 connector must be in the J1 connector for the opto-coupled interface or when the logic voltage levels of 0 volts and +5 volts cannot be met. Operation of the tool changer with the P1/P5 connector placed in the J5 connector with improper logic levels may result in damage to the tool changer.

The tool changer BCD coded command requires the setting of 14 jumpers (P2/P3) for opto-coupler operation. Either the solid or dotted jumpers are used. The jumpers can be determined by selecting the path which will make the anode (pin 1) of the opto-couplers more positive than the cathode (pin 2). If the operating voltage is greater than 12 volts, the resistor pack (M5) should be replaced with one that will limit the current to approximately 10 mA. The data strobe is used to signal the tool changer that a valid command is present. The data strobe jumpers are set up to be the same as the BCD command jumpers.

The CNTC output is used to notify the CNC that the tool change has been completed. The axis disable output provides a disable signal when the tool changer is in a position which may result in damage if an axis should move. Both the CNTN and the axis disable are opto-isolated transistor outputs. The P4 jumpers are selected so the collector (Pin 5) of the opto-couplers is connected to the most positive voltage compared to the emitter (Pin 4). Pull up or pull down resistors may also be required depending on the load. The CNTN section also contains jumpers and pulse width selection components. Jumper 1 to 2 and cut jumper 1 to 3 provide a continue pulse for all 41 to 65 commands.

To select the polarity of the CNTN output, select either jumper 4 to 5 or 4 to 6. The time between the data strobe and the outputting of a continue pulse can be extended or shortened by changing C1 or R20. The continue output pulse width can be altered by changing C2 or R21. Resistors R20 and R21 should not be made smaller than 10K.

The Z axis input is connected to the Z axis contact closure. This contact should provide a closure only when the Z axis is in the tool change position. Jumper 7 to 8 is used to select opto-coupling and jumper 7 to 9 is used to select direct coupling.

### INTERFACE BOARD CONNECTION DESCRIPTION

IB1 PIN #	FUNCTION
1	BCD code 1 line
2	BCD code 2 line
3	BCD code 4 line
4	BCD code 8 line
5	BCD code 10 line
6	BCD code 20 line
7	BCD code 40 line
8	Data strobe
9	COM/ +V
10	CNTN (tool change complete)
11	Z axis TC position switch
12	Common
13	Axis disable
14	+V/ COM

### SECTION 2-3 POWER DRAW BAR AND SPINDLE CONTROL INTERFACE

There are four sets of control outputs for control of the spindle and power draw bar:

SPINDLE ON/OFF  
 IMPACT WRENCH ON/OFF  
 IMPACT WRENCH UP/DOWN  
 IMPACT WRENCH CW/CCW

The Spindle on/off outputs (TB1-5 and TB1-6) on the AC power control board provide a contact closure to enable the spindle to be turned on. The spindle contact is rated at 115 VAC, .5 amps and should be connected in series with any other spindle control.

The Impact Wrench On/Off outputs (TB1-3 and TB1-4) on the AC power control card is a 115 VAC, .5 amp contact closure which is closed when inserting or removing a tool. The Impact Wrench Direction outputs (TB1-1 and TB1-2) on the AC power control card consist of a 115 VAC, .5 amp contact closure that is closed when inserting tools into the spindle. The Impact Wrench Down outputs (TB1-7 and TB1-8) on the AC power control card also consist of a 115 VAC, .5 amp contact closure that provides a closure to move the impact wrench to the down position.

NOTE: TB1-1 and TB1-3 are connected together on the AC power control card. To isolate these outputs, cut the trace between pads A and B.

#### **SECTION 2-4 Z AXIS TOOL CHANGE POSITION SWITCH**

A contact closure when the Z axis is in the tool change position is required by the tool changer. This closure should only occur when the spindle is in the tool change position to insure that the tool will be inserted and removed from the spindle properly. The Z axis tool change position switch is connected to the Tool Changer III interface board (TB1-11 and TB1-12). The contact closure should be rated at a minimum of 10 volts and a current of 10 mA.

#### **SECTION 2-5 DRIVE DISABLE**

The Drive Disable output (TB1-13) on the interface is used to inhibit axis movement during times when the tool changer is not in a safe position and axis movement MAY RESULT IN DAMAGE TO THE SYSTEM. This output (indicated by an LED on the left of the display) will be pulled to common when activated.

## **SECTION 2-6    MANUAL TOOL IN/TOOL OUT INTERFACE**

The Manual Tool In/Tool Out Interface consists of 2 contact driven inputs located on the AC power control card. The Tool In input (TB2-5) causes the impact wrench to operate in the tool-in mode as long as this input is connected to common. The Tool Out input (TB2-6) will place the impact wrench in the tool-out mode of operation, as long as this input is connected to common. Common connections are provided at TB2-3 and TB2-4.



## CHAPTER 3: OPERATION

### SECTION 3-1 COMMAND AND ERROR CODE LISTING

#### MANUAL MODE COMMANDS

1-25	Insert that tool
26	Carrousel to home
27	Return tool from spindle to carrousel
28	Reset carrousel memory (operator must replace all tools into original position after executing this command)
29	Retract claws (open claws)
30	Extend claws (close claws)
31	Return tools to initial carrousel position
32	Not used
33	Not used
34	Tool out of spindle
35	Tool into spindle
36	Release tool from carrousel
37	Lock tool into carrousel
38	Not used
39	Spindle on
40	Spindle off
41-65	Move carrousel to tool (Tool number + 40)
66	Arm down
67	Arm up
68	Not used
69	Rotate arm CW

70 Rotate arm CCW  
71-99 Not used

#### **AUTO MODE COMMANDS**

1-25 Insert that tool  
26 Carrousel to home  
27 Return tool from spindle to carrousel  
28-40 Not used  
41-65 Carrousel to selected tool (Tool number + 40)  
66-99 Not used

#### **TEST MODE COMMANDS**

1 Display BCD Tool command  
2 Display tool number in carrousel claw  
3 Display tool number in spindle claw  
4 Display tool number in spindle  
5 Display tool number in carrousel ready position  
6 Display carrousel Home status (display 88 when Home)  
7 Display Z axis status (display 88 when in position)  
8 Not used  
9 Display air supply status (display 88 when air is on and up to pressure)  
10 SL tests (carrousel tests)  
11 Check RAM (98 pass, 99 fail)  
12 Check ROM (98 pass, 99 fail)

- 13 Display tool number for entered carousel position
- 14 Display carousel position for entered tool number
- 15 Keep changing tools (do not run continually - for service personnel use only)
- 16 Monitor tool tightening number
- 17 Monitor tool-release delay number
- 18 Monitor spindle-off delay number
- 19 Display marker status (88 when present)
- 20 Display INFSN status (88 when present)
- 21-99 Not used

#### **ERROR MESSAGES**

- 80 Invalid directive (tool changer cannot perform command, invalid command)
- 81 Tool in spindle (remove tool, using manual command #28)
- 82-83 Not used
- 84 Arm not in rotation position
- 85 Tool changer's tools must be reconfigured (manual command #28)
- 86 Arm position unknown (arm must be moved either full CW or CCW)
- 87 Requires home command #26
- 88 Indicates signal present (test mode)
- 89 Air supply problem (air pressure less than 45 PSI)

- 90 Possible tool in claws (must be cleared by retract claws command #29)
- 91 At-zone-position switch not closed (device not in position for command to be executed)
- 92-97 Not used
- 98 Check OK (Pass)
- 99 Check Bad (Fail)

### **SECTION 3-2 INITIAL START-UP**

Before applying power, remove any tools that may be present in the claws. When power is first applied, the tool changer should display 98 with the MAN and AUTO LEDs on. The 98 indicates that the program and memory are OK. At that time, if there is a tool in the spindle, it must be removed by command #34. Tools in claws may be cleared by using command #29.

The tool changer may now be initialized (command #26). If error command #85 appears, the tools are unknown to the tool changer and the reconfiguration command (#28) must be entered.

Tools that are to be placed into the tool changer must be put into the correct location. The location for each tool will be made available by entering the tool number with a 40 offset and pressing enter (for instance, tool #1 will be entered as #51). By using this procedure, the tools may be identified even though the tools are not in their original positions. If the tool changer is to be loaded with all new tools, it is recommended that the reconfiguration command #28 be given first. The 31 command will cause the tool changer to physically put all the tools back in numerical order.

**NOTE:** To insure that the correct tools are selected, it is important to strictly adhere to the following statements.

1. Tools should not be inserted into the tool changer without regard for the present status of the effected location. For example, placing a tool in a location considered empty by the tool changer may result in jamming or damage to the tool changer.
2. Any time a 28 command is used, tools will be issued a tool number, the same as their carrousel position.

### **SECTION 3-3 MANUAL MODE**

In manual operations, all commands are entered through the keyboard. To enter the manual mode, press the MAN key (the MAN LED will be turned on). Pressing the RESET key will also place the tool changer in the manual mode. However, this method will require reinitialization of the tool changer. To enter a command through the keyboard, enter the command code number and then press ENTER. The ENTER key will cause the command to be executed. To clear or change a number in the display, the ERASE key may be pressed or a new number may be keyed over the old number.

During a tool move operation, the tool changer will only respond to the RESET key. For more detailed information on the RESET key, refer to section 3-6. If an invalid command or operation is attempted, an error code will be displayed. For more information concerning these codes, refer to sections 3-1 and 4-1.

The following is a description of the manual mode commands:

#### **MANUAL MODE COMMANDS**

1-25 The tool with the command number 1 to 25 is inserted into the spindle. If a tool is already in the spindle, it is returned to the carrousel position formerly used by the tool presently being placed into the spindle.

- 26 The tool changer is initialized by moving the carrousel to its Home position and putting the arm in the up position. All tools must be removed from the claws and spindle before initialization.
- 27 The tool in the spindle is returned to the carrousel.
- 28 Carrousel memory is reset. Tools in the carrousel are numbered the same as their carrousel position.
- CAUTION: Use of this command will result in reassignment of the tool numbers if the tool numbers do not agree with their locations.
- 29 Retract (open) claws. Clears tool-in-claws number.
- 30 Expand (close) claws. Stores unknown tool-in-claws number, which must be cleared by open-claw command #29.
- 31 Return all tools to initial carrousel position. All tools will physically be put back into their original order.
- 32-33 Not used.
- 34 Tool is released from spindle. Tool must be supported manually. Power Draw Bar is activated for apporximately 2 seconds. This operation will clear the number of any tool held by the spindle.
- 35 Tool is tightened into spindle. Power Draw Bar is activated for approximately 2 seconds. An unknown tool number is stored for tool in spindle, which must be cleared by the release-tool-from-spindle command #34.
- 36 Release tool from carrousel. Tool must be manually supported to prevent tool from falling.
- 37 Lock tool into carrousel.

- 38 Not used.
- 39 Turn spindle ON.
- 40 Turn spindle OFF.
- 41-65 Get tool in ready position (tool number + 40).
- 66 Move arm to rotate position.
- 67 Move arm to spindle position.
- 68 Not used.
- 69 Rotate arm CW (claws are retracted).
- 70 Rotate arm CCW (claws are retracted).
- 71-99 Not used.

### **SECTION 3-4 AUTO MODE**

Auto mode (remote) will probably be the most used mode. Auto mode is selected by pressing the AUTO key when in the manual mode. The auto mode commands are executed the same as their corresponding manual mode commands. For example, the auto mode command #26 is the same as the Manual mode command #26.

In the auto mode, the tool changer will only respond to the pressing of two keys: the RESET key and the MAN key. The RESET key (section 3-6) will respond at all times. The MAN key will respond only when the tool changer is not executing a command.

Commands in the auto mode are entered into the tool changer in the following manner. First the BCD coded command is placed on the command lines. The tool changer must then be notified that a command is present by placing a negative pulse on the data strobe line for a minimum of 10 milliseconds. During this time, the command must not change. Upon completion of this command, the tool changer will output a continue pulse (commands 41 to 65 do not provide a software continue).

The continue pulse will be a negative going pulse with a minimum pulse width of five milliseconds. Auto commands (1-27) should also inhibit all axis movement until the continue pulse is received from the tool changer.

### **SECTION 3-5 TEST MODE**

Test mode is a seldom needed, but very useful mode for the testing and check-out of the tool changer. The test mode commands provide the capability to read tool numbers and remote T commands, monitor signals, and test the tool changer. Following is a list and description of the test mode commands:

#### **TEST MODE COMMANDS**

- 1 Display BCD input command
- 2 Display tool number in carrousel claw
- 3 Display tool number in spindle claw
- 4 Display tool number in spindle
- 5 Display carrousel position
- 6 Show Home status; display 88 when home
- 7 Show Z axis status; display 88 when Z axis is in the tool change position.
- 8 Not used
- 9 Show air supply status; display 88 when air pressure main valve is on and pressure is 45 PSI or greater.
- 10 SL test commands (Carrousel Indexer Test Commands).



<u>KEY</u>	<u>FUNCTION</u>
1	Step carrousel one step CW
2	Step carrousel one step CCW
3	+ and - two step cycle
4	Slew carrousel CW
5	Slew carrousel CCW
6	Home and index check; 98 pass, 99 fail
#	Reset carrousel
RESET	Reset entire tool changer and go to the manual mode
TEST	Exit SL test and go into test mode
11	RAM check with contents unchanged (98 pass, 99 fail).
12	Verify PROMS (98 pass, 99 fail)
13	Display tool number for entered carrousel position (after command #13 is entered, the display will blank and will accept the carrousel position in the form of a 2 digit code followed by ENTER).
14	Display carrousel position for entered tool number. (Use the same procedure as command #13).
15	Continuously change tools. (For service personnel use only.)
16	Monitor tool tighten time number (multiply by 16 milliseconds).
17	Monitor tool release delay number (multiply by 16 milliseconds).
18	Monitor spindle off delay (multiply by 32 milliseconds).

- 19      Display carrousel marker status.    (Display 88 when present.)
  
- 20      Display INPSN status.    INPSN indicates that the carrousel is in position. (Display 88 when INPSN is present.)

### **SECTION 3-6    RESET**

The RESET key is used to enable the operator to stop the operation of the tool changer should a problem occur. Once RESET is depressed, the tool changer must be reinitialized.

Pressing RESET causes the air to be turned off and all devices to be stopped. At this time, all of the air activated devices will be deactivated and can be repositioned manually. WHEN ENTERING THE FIRST COMMAND FOLLOWING A RESET, TO INSURE SAFETY, STAY CLEAR OF ALL MOVING PARTS. This is because the tool changer will be positioning all air operated devices. The first command should be one which will put the arm and/or claws into a safe position. Following commands should be ones which will clear and release tools from the spindle and claws.

### **SECTION 3-7    ADJUSTMENTS**

The tool changer contains three controls which allow the operator to adjust the tool changer for the machine and tools being used. The three controls are:

- 1.    Spindle off delay
- 2.    Tool release delay
- 3.    Tool tighten delay

The spindle off delay is a 0 to 2 second delay between the turn off of the spindle and the extending of the claws. The tool release delay is a 0 to .5 second delay between the loosening of the tool and the starting of the arm down. The tool tighten delay adds

up to .5 seconds of additional tightening time to the tool being placed into the spindle.

To adjust the spindle off delay, start with the spindle off delay set maximum and turn the spindle on (there must not be any tool in the spindle). In the manual mode, have the tool changer position one of the tools to the Ready position (41 - 65). When this tool is in the ready position, enter the tool-to-spindle command for the tool in the ready position (1-25). If the spindle has stopped before the claws have begun to extend, the adjustment is OK.

The optimization point is reached when the claws extend just after the spindle has stopped rotating. Do not adjust the spindle-off delay so that the claws extend before the spindle has stopped as this will result in damage to the tool changer.

The tool tighten delay is used to provide additional tightening of the tool when inserting a tool into the spindle. This delay should be adjusted for the minimum amount of time needed to secure a tool into the spindle. Excessive tightening time will increase wear on the Draw Bar assembly. Too little tightening time will result in the tool in the spindle being loose and/or dropping.

The tool release delay is used to help synchronize the arm-down motion and the tool-out motion so that there will be a minimum amount of stress on the arm. This adjustment should not be done without consulting the factory. This adjustment, and the two previously mentioned, interact both mechanically and electrically. Therefore, it may be necessary to change all three if one is changed.

## CHAPTER 4: TROUBLESHOOTING AND MAINTENANCE

### SECTION 4-1 ERROR MESSAGES

The error messages are displayed to inform the operator that a problem exists and what the possible cause may be. The tool changer must perform all tool moving operations. Tools placed or removed by the operator without the use of the tool changer will not be acknowledged by the tool changer and may result in damage to the system. Tools removed from the spindle or claws can be cleared by giving the appropriate retract-claws or release-tool-from-spindle command. Following is a brief description of the error codes also shown in section 3-1.

#### ERROR CODES

- 80 Command cannot be performed because it is not a valid command or command may result in damage to system.
- 81 Possible tool in spindle which must be removed by using the manual mode tool-out command #34.
- 82 Not used.
- 83 Not used.
- 84 Arm not in rotate position.
- 85 Tool memory is not complete. Use manual mode command #28 to reset memory.
- 86 Arm position unknown. Arm must be moved full CW or CCW.
- 87 Tool changer must be initialized using manual or auto mode command #26.
- 88 Signal-present indication.
- 89 Air supply pressure dropped to less than 45 PSI. This error results in a reset.
- 90 Possible tool in claws which must be removed by manual mode command #29.

## ERROR CODES

- 91 Device not in position for command to be executed. Example: Z axis contact not closed.
- 92-97 Not used.
- 98 Indicates check passed
- 99 Indicates check failed

## SECTION 4-2 TROUBLESHOOTING

Tool changer problems should be corrected immediately to prevent the possibility of damage occurring to the system. Most causes can be found visually or through the aid of the error codes. Following is a list of problems and their possible causes.

<u>PROBLEM</u>	<u>POSSIBLE CAUSES</u>
Tool changer dead	<ul style="list-style-type: none"><li>- Check AC power</li><li>- Check fuses</li><li>- Check connections</li></ul>
Tool changer power OK, but will not execute command	<ul style="list-style-type: none"><li>- Command not entered correctly</li><li>- Command error (check error codes)</li><li>- Air supply problem</li><li>- Tool changer waiting for contact closure (Example: Z axis contact not closed)</li><li>- Fuse blown on power amp</li></ul>
Carrousel runs when power is applied	<ul style="list-style-type: none"><li>- Check fuses in power supply</li><li>- Check connectors and cables</li></ul>
Carrousel does not go home	<ul style="list-style-type: none"><li>- Check home switch</li><li>- Check fuse in power amp</li></ul>

- |   |   |
|---|---|
| Sluggish operation of air devices                     | <ul style="list-style-type: none"> <li>- Verify air pressure of 85 PSI</li> <li>- Devices may operate sluggish after being idle for extended lengths of time. Run for a short time</li> </ul>           |
| Carrousel will not move                               | <ul style="list-style-type: none"> <li>- Object preventing carrousel movement</li> <li>- Fuse blown in power amp</li> </ul>   |
| Tool not inserted or released from carrousel properly | <ul style="list-style-type: none"> <li>- Reinitialize tool changer</li> <li>- Check tools for damage</li> <li>- Chain is loose or needs adjustment</li> </ul>   |
| Tool not inserted or released from spindle properly   | <ul style="list-style-type: none"> <li>- Spindle not in tool change position</li> <li>- Arm upper position switch is not adjusted correctly</li> <li>- Impact wrench is not working properly</li> </ul> |

### **SECTION 4-3 MAINTENANCE**

Periodic cleaning and inspection of the tool changer is required to insure reliable operation. Cleaning should be done daily if possible to prevent the accumulation of chips, fluids, and other materials. Inspections should be performed at least once per week. Damaged or loose parts should be repaired at once.

#### **A. AIR SUPPLY AND LUBRICATION REQUIREMENTS**

The air supply must maintain a pressure range of 90 to 140 PSI at the tool changer, and must be capable of delivering at least 1 CFM at the required pressure. The tool changer's air regulator is located on the rear side of the tool changer and is adjusted for 85 PSI. Lubricant for the air supply is placed in the lubricant container, which is located on the rear side of

the tool changer on the regulated side of the pressure regulator. Use Atlantic Richfield Duro S-315 (Duro AW 68) or equivalent non-detergent lubricant only for the air supply. For arm up/down control, Dow Corning 200 50 CS fluid is used. The arm fluid is placed in a bowl located on the arm assembly and is visible through a window on the arm cover. Consult the factory before adding or changing the fluid, as this should not require attention. During operation, a daily lubrication is required for the claws and power draw bar. Lubrication is accomplished by spreading a moly type grease on the claws (the portion that holds the tool) and on the threads of the tool holder of the first tool to be placed in the spindle.

## B. LUBRICATION LIST

For use with air tools, air motors, air valves, air cylinders and other air-operated devices, these suggested lubrication oils are the best for most applications. Viscosity 100-200 S.U.S. at 100 F.

### SUGGESTED LUBRICATION OILS

<u>MANUFACTURER</u>	<u>LUBRICANT</u>
Amalie Refining Company	AMA-Oil 200
Amoco Oil Company	American Industrial Oil No. 15 Indoll Industrial Oil No. 15 Amomist Oil No. 18
Ashland Oil Incorporated	Ultramax AW-15 ETC (R & O) No. 15
Atlantic Richfield Company (Arco) - recommended	Duro Oil S-150 Duro Oil S-150LP
Champlin Petroleum Company	Champlin Inhibited Turbine and Hydraulic Oil Light
Chevron Oil Company	Chevron EP Machine Oil 9 Chevron OC Turbine Oil 9

**MANUFACTURER****LUBRICANT**

Cities Service Oil Company	Citgo Pacemaker 10 Citgo Pacemaker 15 Citgo Pacemaker XD-15 Citgo Sentry 10 Citgo Sentry 15 Citgo Extra Duty Circulating Oil 42
Continental Oil Company	Spindle 11 Pale Paraffin 11 Dectol 15 R & O
Exxon Company U.S.A.	Teresstic 43 Teresstic 44 Nuto H44 Nuto 43 Esstic 42
Getty Oil Company	Veedol Alweave 4 Veedol Aturbrio 50
Gulf Oil Corporation	Gulf Harmony 41 Gulf Harmony 44 Gulf Harmony 47 Gulf Harmony 43 AW Gulf Harmony 48 AW Gulf Security 43 AW Gulf Stainless Machine 44
Kendall Refining Company	Kenoil R & O 047 EP Kenoil R & O 043 EP Kenoil 945
Marathon Oil Company	Maraf fluid 45 Endurance Oil 600
Mobil Oil Corporation	Mobil Velocite Oil 10 Mobil Velocite Oil 12 Mobil DTE Oil Light Mobil DTE 24
Phillips Petroleum Company	Magnus Oil Grade 150
Quaker State Oil Refining Corporation	Quaker State Quadrolube SAE 75



<u>MANUFACTURER</u>	<u>LUBRICANT</u>
Shell Oil Company	Shell Tellus Oil 21 Shell Tellus Oil 23 Shell Turbo Oil 25 Shell Tellus Oil 25
Standard Oil Company of British Columbia Ltd.	Chevron EP Machine Oil 9 Chevron EP Spindle Oil 9
Standard Oil Company of California	Chevron EP Machine Oil 9 Chevron EP Spindle Oil 9
Standard Oil Company of Kentucky	Chevron EP Machine Oil 9 Chevron EP Spindle Oil 9
Standard Oil Company of Ohio (Sohio)	Industron 44 Factovis 43 Turbin Oil Light
Sun Oil Company	Sunvis 706 Sunvis 916
Texaco Incorporated	Rando Oil HD AZ Rando Oil A Rando Oil HD A Regal Oil R & O
Union Oil Company	Union Turbine Oil 150 Union Turbine Oil XD 150 Union UNAX RX 150
Valvoline Oil Company	Anti-Wear Oil No. 15

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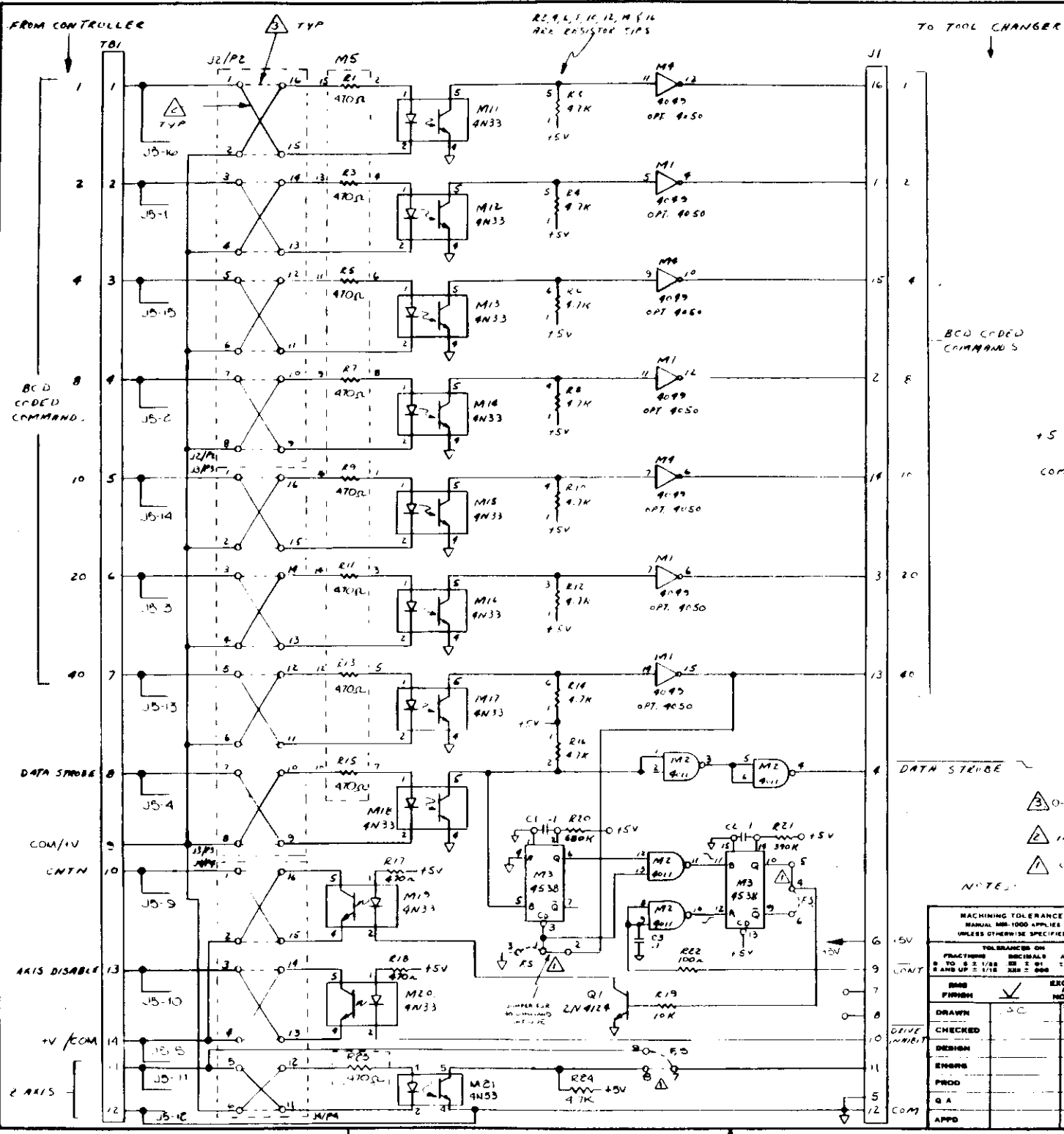
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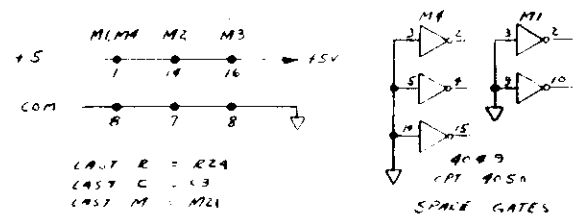
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REVISIONS				
REV	DATE	DESCRIPTION	DATE	APPROVAL
A		CHANGED VALUE OF R1, R5, R5, R7, R9, R11, R13, M5. ADDED R25, R24, M21. JUMPER 7, B, D. (COLLECTING FOR J4/P4)	2/7/84	JMC

BCD CODED COMMANDS




- ③ 0-0 INDICATES F.S. JUMPER ON HEADER
- ② INDICATES STANDARD JUMPER ON HEADER
- ① NOT TRACE WHEN F.S. JUMPER ARE USED

NOTE:

MACHINING TOLERANCE MANUAL MM-1000 APPLIES UNLESS OTHERWISE SPECIFIED		
FRAC TIONS	DECIMALS	ANGLES
± TO 0.1/100	± TO 0.01	± 0°-90°
± AND UP ± 1/100	± 0.001	± 0°-90°

DATE FINISH	✓	EXCEPT AS NOTED
DRAWN	J.C.	7/10/83
CHECKED		
DESIGN		
ENGINE		
PROD		
QA		
APPD		



**AEROTECH, INC.**  
101 Zeno Drive  
Pittsburgh, Pa. 15230 412 843 7470

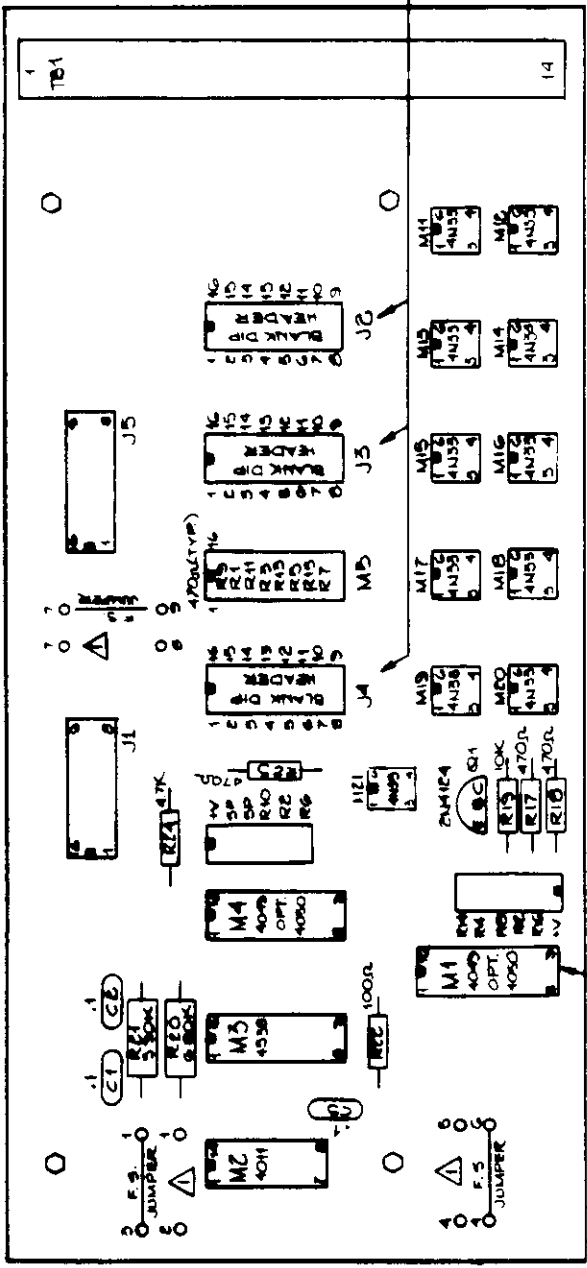
## TOOL CHANGER III INTERFACE

### SCHEMATIC

CORE IDENT. NO.	REV
	<b>C</b>
<b>690C1247</b>	
SCALE	WT
	SHEET 1 OF 8

690C1247

REV	DATE	BY	APPROVAL
A	4/1/84	JAC	JAC
MOVED T81 ADDED SOCKET NOTE FOR M11-M20 HEADERS A.F.C. M.C.L.E.P. JUMPER			



NOTES:  
 1. CUT TRACE WHEN F.S. JUMPERS ARE USED  
 2. SEE SCHEMATIC

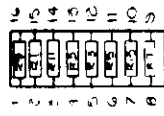
MACHINING TOLERANCE UNLESS OTHERWISE SPECIFIED	FRAC TIONS 1/16 1/8 1/4 3/8 1/2 5/8 3/4 7/8 1 1 1/4 1 1/2 1 3/4 2 2 1/4 2 1/2 3 3 1/4 3 1/2 4 4 1/4 4 1/2 5 5 1/4 5 1/2 6 6 1/4 6 1/2 7 7 1/4 7 1/2 8 8 1/4 8 1/2 9 9 1/4 9 1/2 10 10 1/4 10 1/2 11 11 1/4 11 1/2 12 12 1/4 12 1/2 13 13 1/4 13 1/2 14 14 1/4 14 1/2 15 15 1/4 15 1/2 16 16 1/4 16 1/2
DRAWN	JAC
CHECKED	
DESIGN	
ENGRS	
PROD	
D.A.	
APP	



**TOOL CHANGER INTERFACE ASSEMBLY**

690C1247

CODE IDENT. NO.	C
REV.	2 1



DETAIL 'A'

USE CARVER FL 30 (MS)  
 VIEW FROM FRONT  
 PL ENVELOPE WITH HEADER ASSES

REVISIONS			
BY	DATE	DESCRIPTION	APPROVAL
B	02	REDRAWN	LYNAM
C	03	3.766 ± .010 MIC 3.062 ± .052	LYNAM

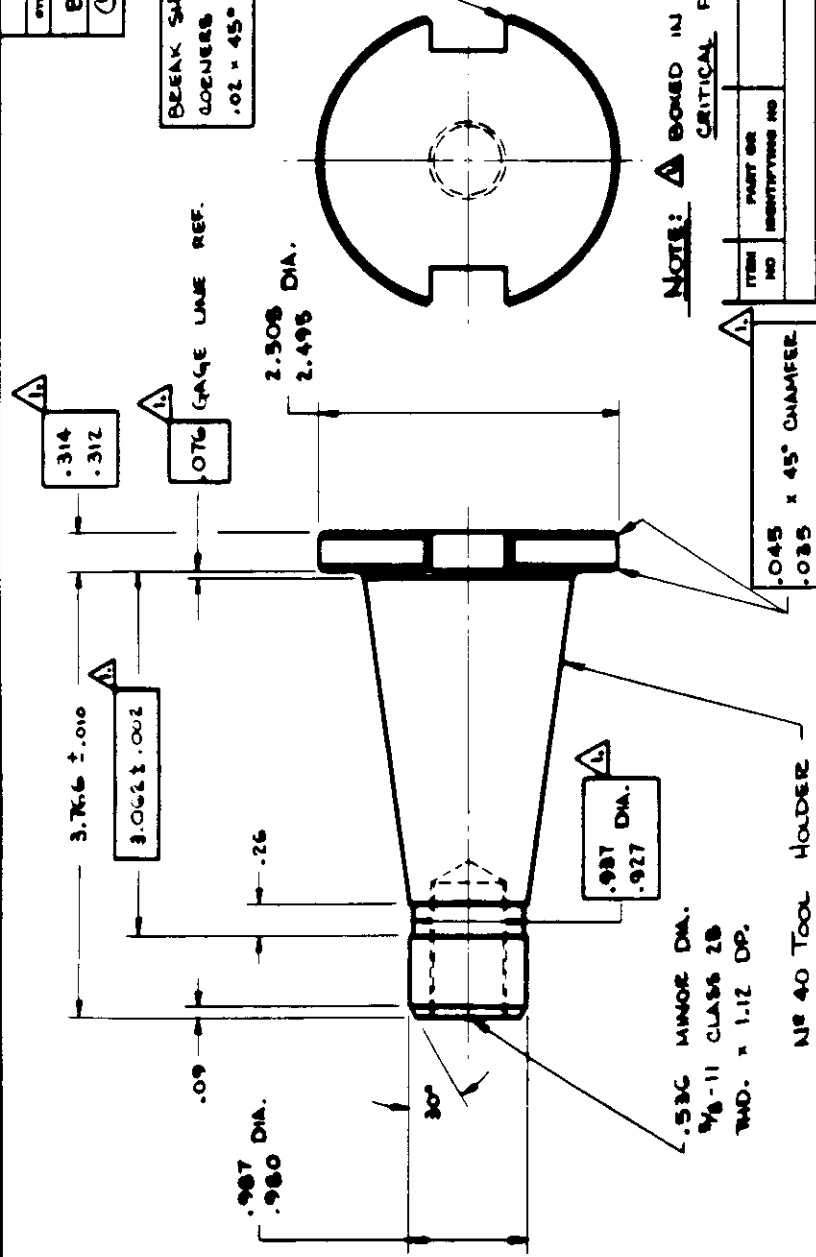
1) BREAK SHARP  
CORNERS  
.02 ± 45° TYP.

2) .076 GAGE LINE REF.

2.508 DIA.  
2.495

APPROVED TOOL HOLDER (S):

1) G. E. CARBOLOY \* NMTB40-00



NOTE: **Δ** DIMENSIONS IN **XXX** DIMENSIONS ARE EXTREMELY CRITICAL FOR PROPER TOOL CHANGER OPERATION.

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	SPEC	MATERIAL OR NOTE	CITY REQD
LIST OF MATERIAL					

**AEROTECH, INC.**  
Pittsburgh, Pa 15228 412 963 7676

101 20th Street  
Pittsburgh, Pa 15228 412 963 7676

NO 40 TOOL HOLDER SHANK  
DIMENSIONS  
(SPEC. CONTROL DIMS.)

952-1029

CODE IDENT. NO. B

SCALE 1:1

DATE 7/27

APPV

**OPTIONAL INFORMATION**  
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STEEL  CASTING  TUBING  ALUM  STRUCT  CRSS  SEE LAB OR P/L  SEE NOTE

BLACK ANODIZE  CLEAR ANODIZE  BLACK ANODIZE  ALODINE  SEE NOTE

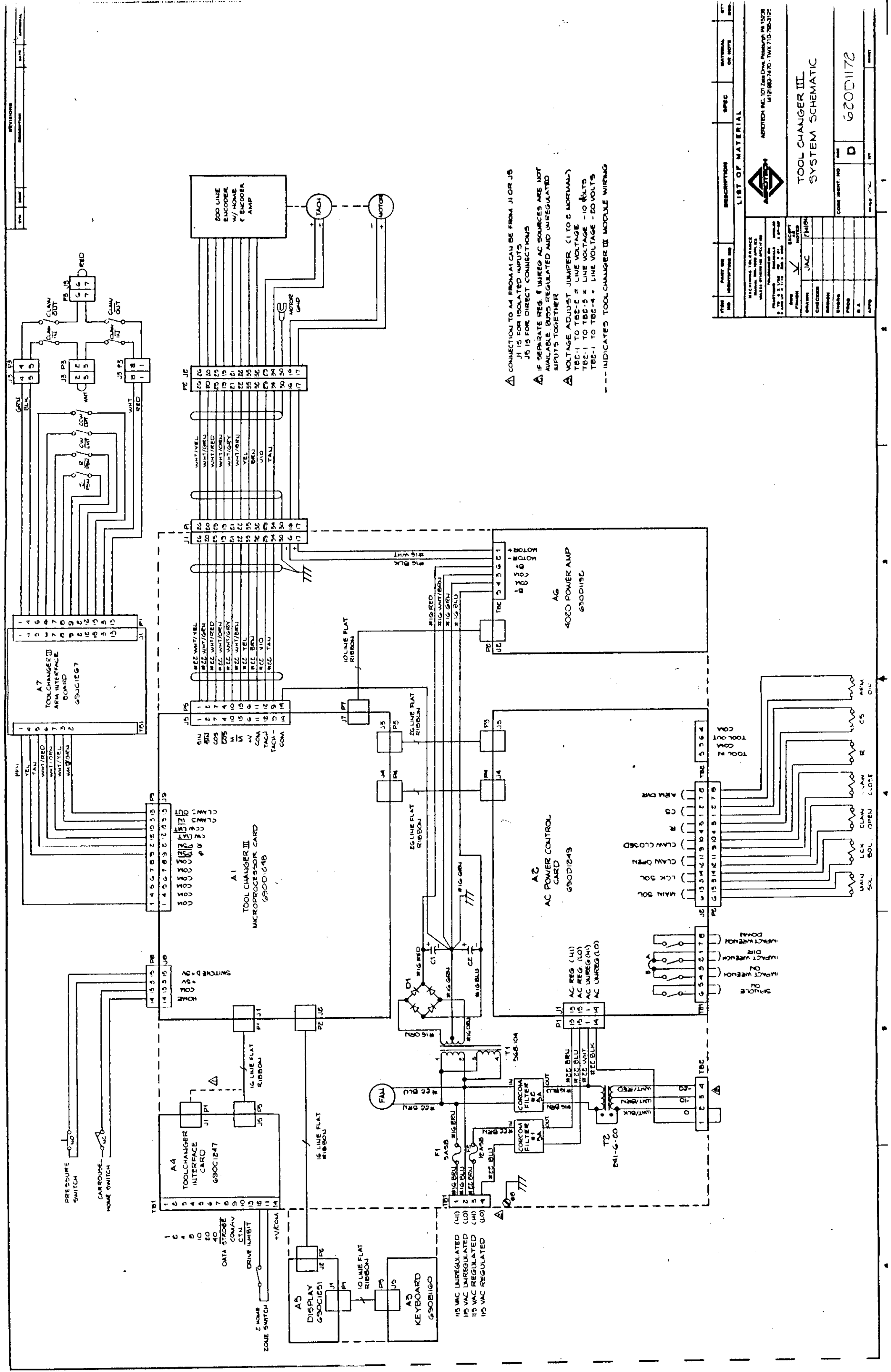
DO NOT PAINT SURFACES MARKED PER AEROTECH SPEC OR PER

701-1000

APPLICATION

QTY REQD





Δ CONNECTION TO A1 FROM A1 CAN BE FROM J1 OR J5  
 J1 IS FOR ISOLATED INPUTS  
 J5 IS FOR DIRECT CONNECTIONS  
 Δ IF SEPARATE REG & UNREG AC SOURCES ARE NOT AVAILABLE BUSES REGULATED AND UNREGULATED INPUTS TOGETHER  
 Δ VOLTAGE ADJUST JUMPER (1 TO C NORMAL)  
 TBC-1 TO TBC-2 = LINE VOLTAGE -10 VOLTS  
 TBC-1 TO TBC-3 = LINE VOLTAGE -10 VOLTS  
 TBC-1 TO TBC-4 = LINE VOLTAGE -20 VOLTS  
 --- INDICATES TOOL CHANGER III MODULE WIRING

REV	DATE	DESCRIPTION	BY	CHKD
1				

ITEM NO.	QUANTITY REQ.	DESCRIPTION	SPEC.	MATERIAL OR NOTE	QTY.
LIST OF MATERIAL					
TOOL CHANGER III SYSTEM SCHEMATIC AEROTECH INC. 101 Zee Drive, Pittsburgh, PA 15228 412/883-7470 - TWX 710-788-3122					
TOOL CHANGER III SYSTEM SCHEMATIC					
FORM NO.	REV.	DATE	BY	CHKD	QTY.
620D1172	D				