TRAK® LPM

Service, Safety, Installation, Maintenance and Parts List

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4TH Axis Option-8" SWI – 27066-6 Rev B
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1.0 Safety

The safe operation of the LPM depends on its proper use and the precautions taken by each operator.

- Read and study this manual and the LPM Programming, Operating, and Care Manual. Be certain every operator understands the operation and safety requirements of this machine *before* its use.
- Never run the machine with enclosure doors open
- Always wear safety glasses and safety shoes.
- Always stop the spindle and check to ensure the CNC control is in the stop mode before changing or adjusting the tool or workpiece.
- Never wear gloves, rings, watches, long sleeves, neckties, jewelry, or other loose items when operating or around the machine.
- Use adequate point of operation safeguarding. It is the responsibility of the employer to provide and ensure point of operation safeguarding per OSHA 1910.212 - Machining centers.

1.1 Safety Publications

Refer to and study the following publications for assistance in enhancing the safe use of this machine.

Safety Requirements for Machining Centers and Automatic, Numerically Controlled Milling, Drilling and Boring Machines (ANSI B11.23-2002) (R2007). Available from The American National Standards Institute, 1819 L Street N.W., Washington D.C. 20036

Concepts And Techniques Of Machine Safeguarding (OSHA Publication Number 3067). Available from The Publication Office - O.S.H.A., U.S. Department of Labor, 200 Constitution Avenue, NW, Washington, DC 0210.

1.2 Danger, Warning, Caution, and Note Labels & Notices As Used In This Manual

DANGER - Immediate hazards that **will** result in severe personal injury or death. Danger labels on the machine are red in color.

WARNING - Hazards or unsafe practices that *could* result in severe personal injury and/or damage to the equipment. Warning labels on the machine are orange in color.

CAUTION - Hazards or unsafe practices, which *could* result in minor personal injury or equipment/product damage. Caution labels on the machine are yellow in color.

NOTE - Call attention to specific issues requiring special attention or understanding.

Safety & Information Labels Used On The
LPM Milling Machine
It is forbidden by OSHA regulations and by law to deface, destroy or remove any of these labels

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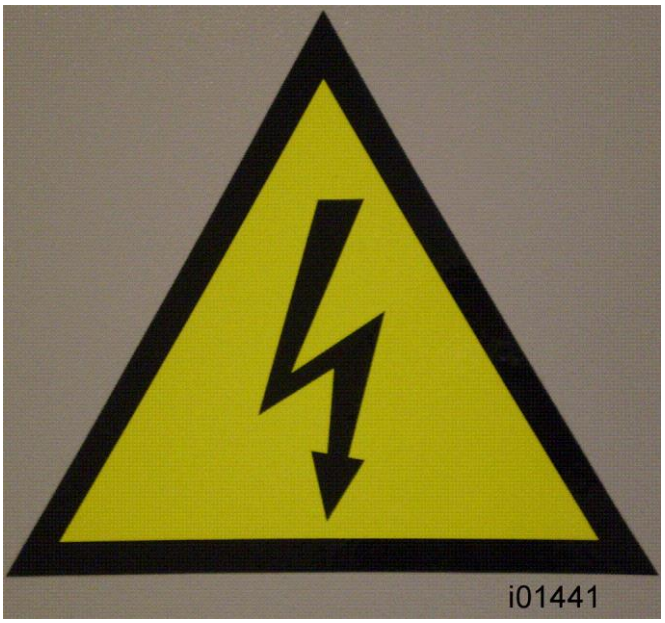
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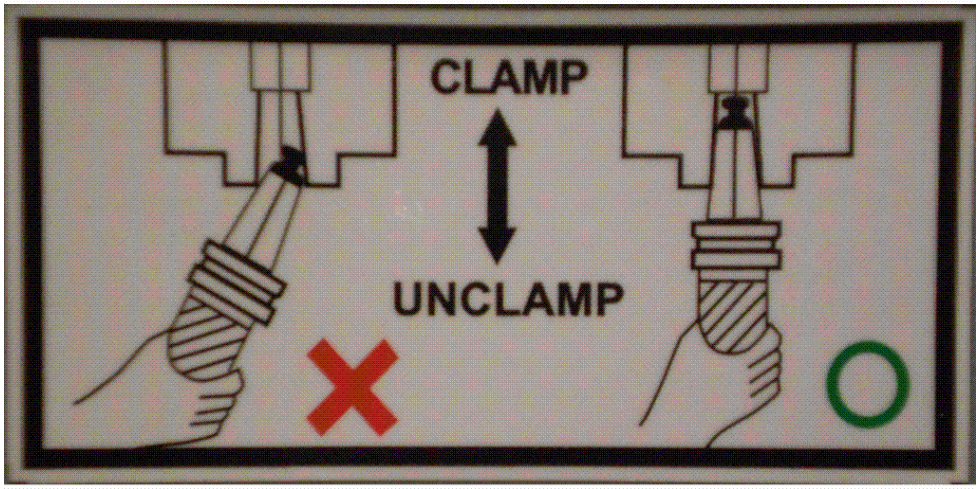

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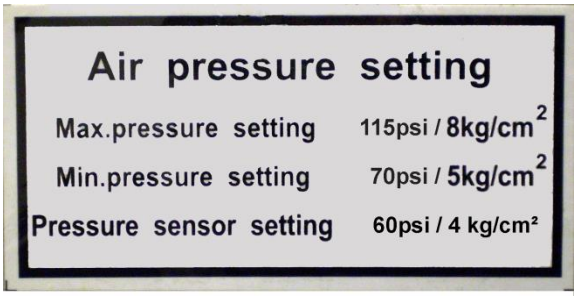

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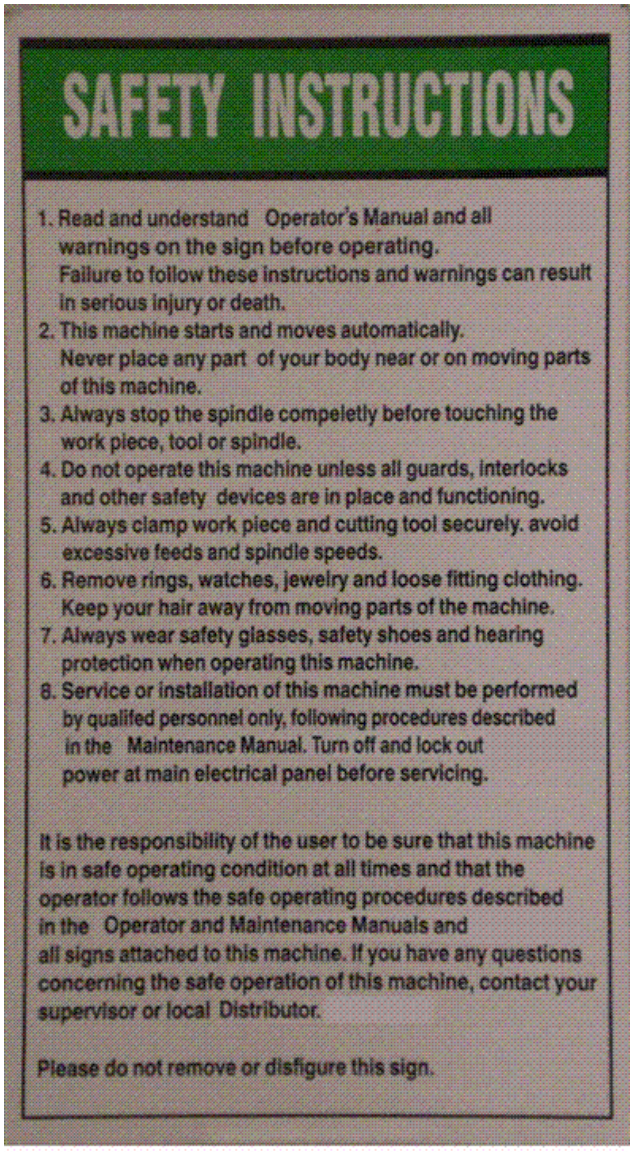

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WARNING
• IMPROPER OPERATION OR IMPROPER MAINTENANCE OF THIS MACHINE MAY CAUSE SERIOUS BODILY INJURY.
• DO NOT OPERATE THIS MACHINE UNTIL YOU HAVE RECEIVED OPERATING AND SAFETY INSTRUCTIONS FROM YOUR EMPLOYER.
• FOLLOW ALL SAFETY PRACTICES PRESCRIBED BY YOUR EMPLOYER AND OUTLINED IN THE PROGRAMMING, OPERATING AND CARE MANUAL.
• ALWAYS AVOID UNSAFE OPERATING CONDITIONS SUCH AS EXCESSIVE FEEDS AND SPEEDS.
• ALWAYS BE SURE ALL SAFETY DEVICES ARE IN GOOD OPERATING CONDITION (SEE MANUAL).
• ALWAYS BE CERTAIN THAT SERVICE IS PERFORMED ONLY BY QUALIFIED PERSONNEL.
• IT IS THE RESPONSIBILITY OF THE EMPLOYER TO PROVIDE AND ENSURE POINT OF SAFEGUARDING PER ANSI B11.6-1984 (R1994) & ANSI B11.8-1983 (R1994).
• THE MANUFACTURER IS NOT LIABLE (RESPONSIBLE) FOR ANY DAMAGE OR INJURY OF ANY KIND TO PERSONS OR PROPERTY CAUSED BY OR RESULTING FROM THE IMPROPER OR UNAUTHORIZED USE, OPERATION, MAINTENANCE, ALTERATION, MODIFICATION, CHANGE IN CONFIGURATION OF THIS MACHINE OR ANY OF ITS COMPONENTS, PARTS, OR THE USE OF THIS UNIT WITH ANY THIRD PARTY ACCESSORIES OR PARTS.
DO NOT REMOVE THIS SIGN FROM MACHINE.

i22774

1.3 Safety Precautions

1. Do not operate this machine before the **LPM Installation, Maintenance, Service and Parts List Manual**, **Operating & Care Manual** have been studied and understood.

2. Do not run this machine without knowing the function of every control key, button, knob, or handle. Ask your supervisor or a qualified instructor for help when needed.

3. Protect your eyes. Wear approved safety glasses (with side shields) at all times.

4. Don't get caught in moving parts. Before operating this machine remove all jewelry including watches and rings, neckties, and any loose-fitting clothing.

5. Keep your hair away from moving parts. Wear adequate safety headgear.

6. Protect your feet. Wear safety shoes with oil-resistant, anti-skid soles, and steel toes.

7. Take off gloves before you start the machine. Gloves are easily caught in moving parts.

8. Remove all tools from the machine before you start. Loose items can become dangerous flying projectiles.

9. Never operate a milling machine after consuming alcoholic beverages, or taking strong medication, or while using non-prescription drugs.

10. Protect your hands. Stop the machine spindle and ensure that the CNC control is in the stop mode:
    - Before changing tools
    - Before changing parts
    - Before you clear away the chips, oil or coolant. Always use a chip scraper or brush.
    - Do not used compressed air to clean the machine.
    - Before you make an adjustment to the part, fixture, coolant nozzle or take measurements.
    - Do not attempt to disable any safety interlock. Never reach around a safeguard.

11. Protect your eyes and the machine as well.

12. Disconnect power to the machine before you change belts, pulley, and gears.

13. Keep work areas well lighted. Ask for additional light if needed.

14. Do not lean on the machine while it is running.

15. Prevent slippage. Keep the work area dry and clean. Remove the chips, oil, coolant and obstacles of any kind around the machine.
16. Avoid getting pinched in places where the table, saddle or spindle head create "pinch points" while in motion.

17. Securely clamp and properly locate the workpiece in the vise, on the table, or in a fixture. Use stop blocks to prevent objects from flying loose. Use proper holding clamping attachments and position them clear of the tool path.

18. Use correct cutting parameters (speed, feed, depth, and width of cut) in order to prevent tool breakage due to premature wear.

19. Use proper cutting tools for the job. Pay attention to the rotation of the spindle: As viewed from above, left hand tool for counterclockwise rotation of spindle, and right hand tool for clockwise rotation of spindle.

20. To prevent damage to the work piece or the cutting tool, never start the machine (including the rotation of the spindle) if the tool is in contact with the part.

21. Check the direction (+ or -) of movement of the table when using the jog feature, clockwise rotation of the EHW moves the axis in the positive direction, counterclockwise in the negative direction.

22. Don't use dull or damaged cutting tools. They break easily and become airborne. Inspect the sharpness of the edges, and the integrity of cutting tools and their holders. Use proper length for the tool.

23. Inspect the retention knobs for damage or excessive wear before each use.

24. Large overhang on cutting tools when not required result in accidents and damaged parts.

25. Prevent fires. When machining certain materials (magnesium, etc.) the chips and dust are highly flammable. Obtain special instruction from your supervisor before machining these materials.

26. Prevent fires. Keep flammable materials and fluids away from the machine and hot, flying chips.

Warning

Retention knobs come in a wide variety of designs, however they often look similar and appear to be interchangeable, but they are not. Use only the knob that the LPM is designed to use. The use of the incorrect knob, or the incorrect usage of a knob, may result in injury or property damage. To ensure the correct knob is chosen, please refer to section 2.4.4, Machine Major Subassemblies section of this manual

2.0 System Description

Read and understand this entire installation section before beginning the installation procedure.

2.1 Machine Specifications

Please see the drawing on the next page for a layout of the LPM machine.

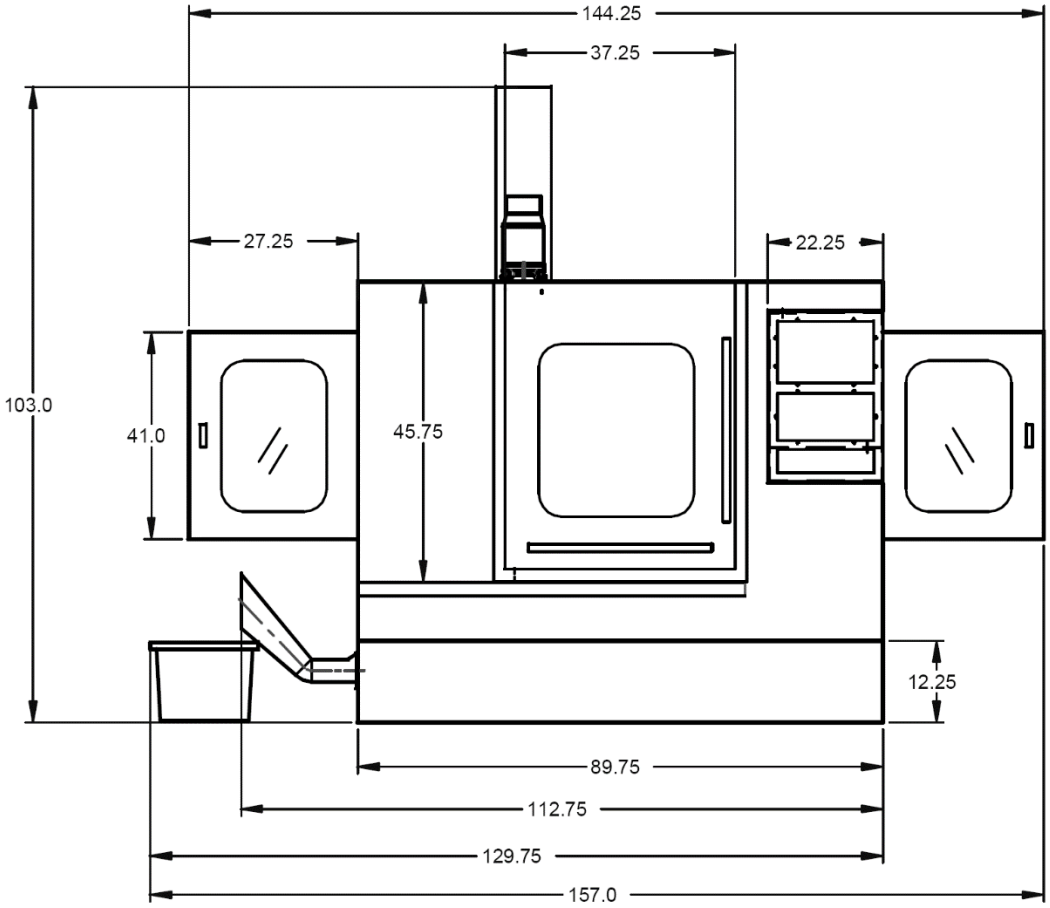
Overall Machine Dimensions

Width of LPM without chip cart and auger chute	89.75″
Depth of LPM	88″
Height of LPM with head all the way up	103″
Width of LPM with chip cart and side doors open	157″
Minimum height to fit LPM through doorway (Z cable carrier collapsed)	85″

Minimum doorway width or height the LPM can fit through is 88″ x 85″ (assumes Z cable carrier collapsed and Z axis motor removed). The 85″ dimension can be reduced to 82″ if further items are removed or adjusted.

Machine Specifications

Table Dimensions	
Table size	35.38″ X 19.63″
Number of tee slots and pitch	5 @ 100 mm
Tee slot width	0.710″ or 18 mm
Table maximum load	1000 lbs.
Ball Lock ® hold down force	2250 lbs @ 35 in/lbs of torque
Travel	
X-axis	31″
Y-axis	18.5″
Z-axis	21″
Maximum distance from spindle nose table surface	24″
Minimum distance from spindle nose table surface	3.375″
Maximum swing clearance from spindle center to column	19.25″
Maximum Rapid speed X & Y-axis, inches per minute	800
Maximum Rapid speed Z-axis, inches per minute	700
Spindle	
Tool holder type	CAT40
Spindle nose diameter	~3″ or 75 mm
Maximum RPM	8000
Automatic Tool Changer	
Tool Capacity	16
Maximum tool weight including holder	15 lbs
Maximum tool diameter	3.14″
Carousel speed	.8 sec from station to station
Tool selection system	Bi-directional/ shortest path
Retention knob	See section 2.4.4
Air Requirements	
Pressure CFM or SCFM	90 psi 2.5 or 18 at 90 psi
Quality	Air dried/ water separator upstream of the LPM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37.25
27.25
22.25
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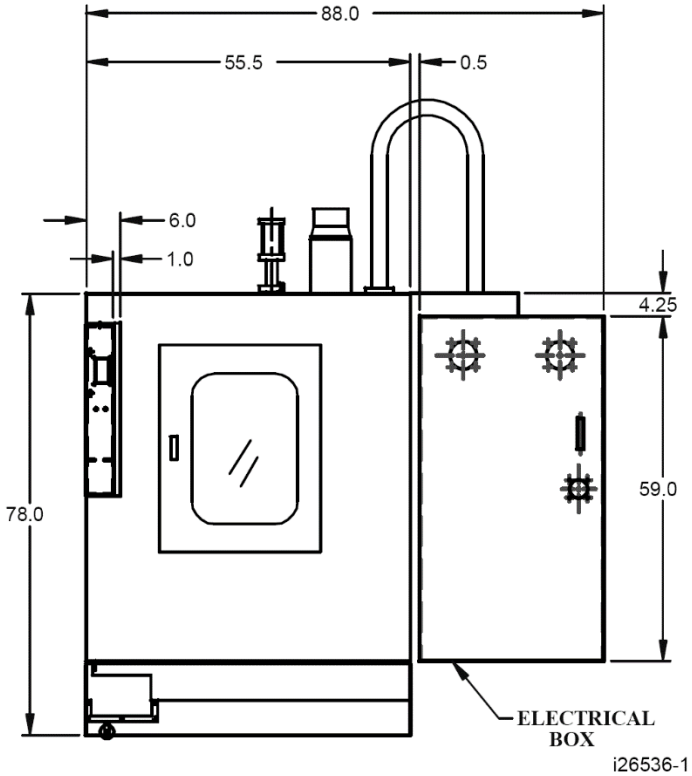
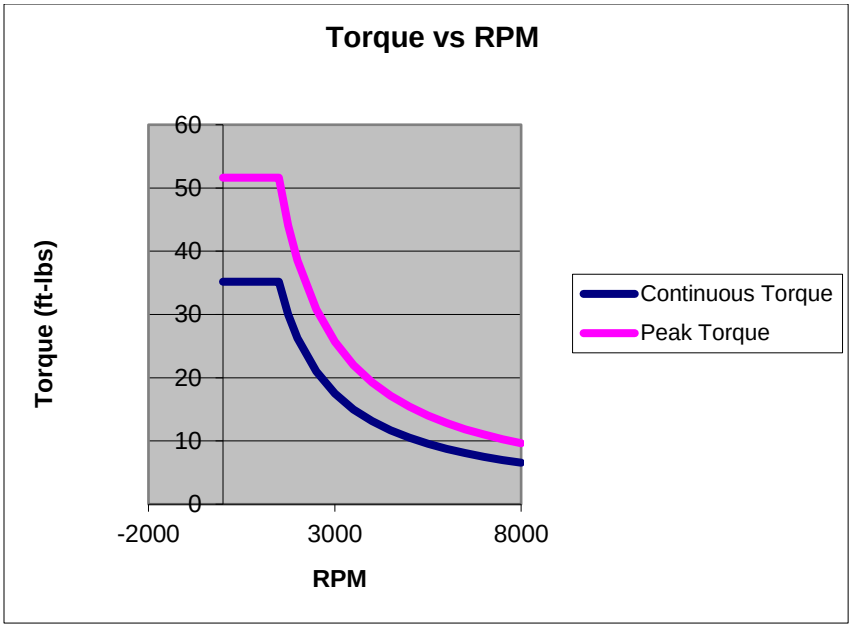
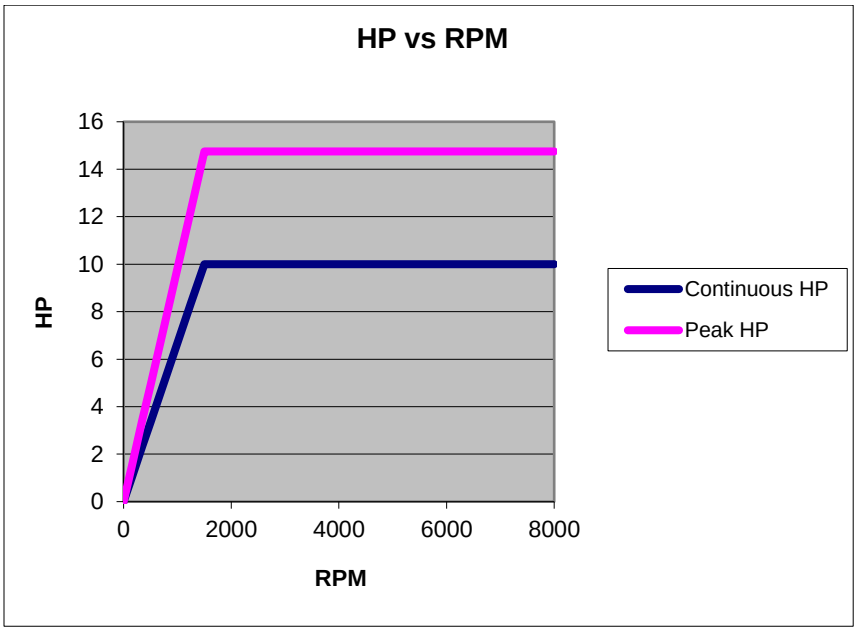
41.0
45.75
12.25
89.75
112.75
129.75
157.0


88.0
55.5
0.5
6.0
1.0
4.25
78.0
59.0
ELECTRICAL
BOX
i26536-1

2.2 Maximum Spindle Torque and Horsepower

The following graphs illustrate the continuous and peak torque vs RPM and horsepower vs RPM for the LPM machine at the spindle. Peak torque and horsepower values can only be attained for a short period of time before the spindle drive will fault out to protect the motor.





Note - Maximum work capacities are dependent on a lot of variables that cannot be controlled by the machine manufacturer. Each one of the following will have an impact on the above numbers: speeds, feeds, cutter, cutter sharpness, material, setup, coolant and machine adjustments.

2.3 ProtoTRAK PMX Control Hardware

2.3.1 Pendant Assembly

The pendant assembly on the LPM is the sheet metal control box that sits in the upper right hand corner of the machine. The pendant assembly contains the program panel, run panel, 4 USB ports and a servo on button and cable. The pendant assembly can rotate and sit at a 45 or 80 degree angle or sit flush with the machine. See drawing 26584 at the rear of the manual.

2.3.1.1 Program Panel

The program panel is the upper panel found on the LPM pendant assembly. The program panel is where the user enters all the associated information when creating, setting up and running a program.

The program panel consists of the program overlay and a 12.1" LCD. At the rear of the assembly the VGA cable connects to the back of the assembly and routes back to the electrical box. The VGA cable carries video signals from the computer module to LCD controller board. There are also 3 local cables that route between the LCD and associated boards. They are the LCD inverter power, LCD user interface and LCD power cables.

2.3.1.2 Run Panel

The run panel is the lower panel found on the LPM pendant assembly. The run panel is where the user is able to turn the spindle on, move the machine around with the electronic handwheels, control the spindle and feed overrides and where various outputs can be turned on or off. Things like the coolant pump, auger, etc.

The run panel consists of the run overlay, electronic handwheel and E-stop switch. At the rear of the assembly there are 6 cables that connect to the back of the assembly and route back to the electrical box. They are the COM port cable, handwheel cable, USB cable, E-stop cable, overlay power cable and ground wire.

The COM cable communicates between computer module and overlay interface board.

2.3.2 Electrical Cabinet

The electrical cabinet is found at the rear of the LPM on the right side. The electrical cabinet contains the main control hardware for the machine. The main components are as follows: computer module, AC spindle drive, servo drives, input/output modules, relays and contactors. See drawing 26571 at the rear of the manual.

2.3.3 Computer Module

The computer module is the heart and soul of the machine. All of the inputs and outputs are fed through this module. The computer module controls the program panel, run panel, AC spindle drive, servo drives, motor signals and feedback and input/output modules. Inside of the computer module is a motherboard, motion control board and an applications board along with a power supply.

The computer module also contains 4 more USB ports and a network port. We ship the machine with 3 USB ports having something plugged into them. The 3 USB ports contain the following: machine option key, a D drive for part storage and an overlay interface USB cable. The network port is available to the user if they want to network the control to an offline computer or network.

2.3.4 Servo Motors
The LPM can run up to 4 axis motors. The 4th motor would be used to control a 4th axis indexer. The motors used on the X and Y axis are rated for 5.7 N-m of torque. The Z axis motor is rated at 11 N-m and also contains a mechanical brake that holds the head in position when the power is turned off to the machine.

2.3.5 Servo Drives
The LPM can also contain up to 4 servo drives. The 4th servo drive would be used to control a 4th axis indexer. The servo drives receive signals from the computer module which in turn send signals to the servo motors. The X and Y axis servo drives are identical and the Z axis and 4th axis servo drives are programmed differently for their unique application so this means that only the X and Y axis are interchangeable.

2.4 Machine Major Subassemblies
2.4.1 Spindle
The spindle is contained within a cartridge and CAT 40 tool holders must be used. The spindle bearings are permanently lubricated and require no additional attention by the user. The spindle is also air cooled, and has an air purge system that is automatically activated during the tool change sequence, it blows air down the spindle to prevent chips from being trapped between the holder and spindle taper.

Warning!
The spindle unit is not field serviceable. If the bearings go bad the entire spindle cartridge will be replaced.

2.4.2 Spindle Motor & Drive
The spindle motor is 10 HP and drives the spindle via a timing belt. The ratio between the spindle and spindle motor is 1 to 1. The RPM range for this machine is 150 to 8000 RPM.

2.4.3 Automatic Draw Bar Assembly
The automatic drawbar is an assembly consisting of an air cylinder and an actuator that unclamps the tool. Tooling is changed by means of the Automatic Tool Changer (ATC), or can be done manually by pressing and holding the "Unclamp" button. Tools are clamped when the button is released. A clamping force of approximately 1500 lbs is generated to clamp the toolholder to the spindle. The Automatic Draw Bar Assembly uses full system air and requires no adjustment. The air cylinder that does the clamping and unclamping is lubricated with a small cup. Make sure to check the oil level in this cup on a regular basis.

2.4.4 Retention Knobs

The LPM uses CAT40 retention knobs as shown in Figure 2.4.4a. Tightening to the proper torque value is important for all retention knobs. Please see the retention knob manufacturer for the proper torque. You can order these retention knobs from Southwestern Industries under part number 26800-2.

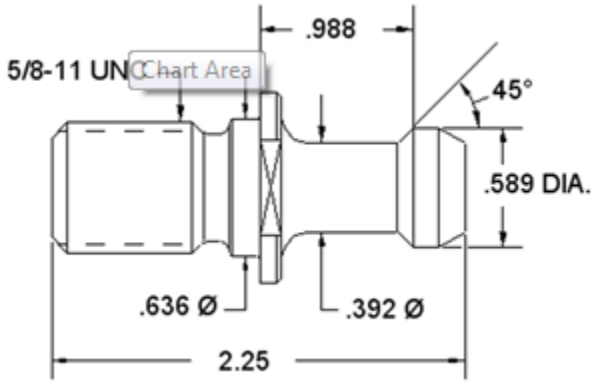


Figure 2.4.4a

Warning!
Retention knobs come in a wide variety of designs, however they often look similar and appear to be interchangeable, but they are not. Use only the knob that the LPM is designed to use. The use of the incorrect knob, or the incorrect use of a knob, may result in injury and/or damage to the mechanism.

2.4.5 Tool Changer

The tool changer is an armless carousel type automatic tool changer that has a capacity of 16 tools. The carousel is mechanically indexed by means of a Geneva mechanism. The position of the carousel is controlled by a signal from Home Position Sensor. As an additional safety feature, the ATC also has Tool Detect Sensor at the "ready position". This means if a tool is sitting in this position and the control tries to put the tool in the spindle into this spot, an error will be generated by the control.

2.4.6 Drive Train, Axes

Each axis (X, Y and Z) rides on precision linear guideways, with four preloaded recirculating ball carriages. Each axis is moved via an 8 mm pitch ballscrew. The axis motors direct drive the ballscrew.

2.4.7 Worktable

The LPM table utilizes Ball Lock® technology as well as conventional T-bolt construction. Each Ball Lock mechanism has a hold-down force of 2250 lbs when 35 in/lbs of torque is applied to the screw. The software on the LPM is based on these ball locks as we ask the user which ball lock location they wish to run the part on. The 3 locations are called ball lock A, B and C. The distance between ball locks A, B and C are approximately 7.829".

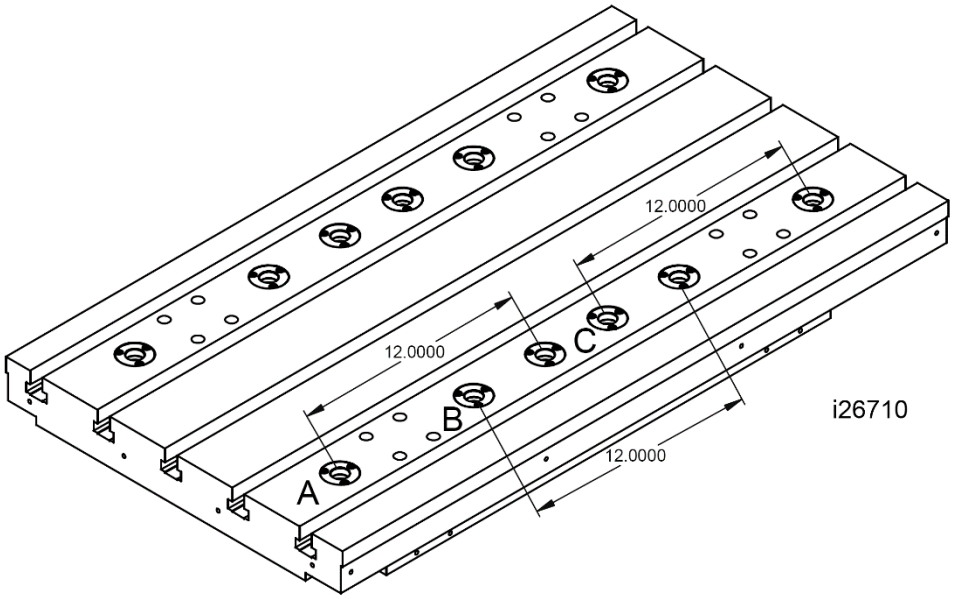


Figure 2.4.7a

2.4.8 Limit/Home Switches

Each axis has a limit switch, which serves two purposes, to protect the LPM in the event of an over-travel situation in either the positive or negative direction, and secondly for the purpose of homing the machine. The following table describes where the cams are that trigger the limit switches.

Table - Limit Switch Cam Locations

Axis End	Location of Cam Bracket	Cam Location
X-axis Negative End	Left hand side of the table (front)	Upper channel
X-axis Positive End	Right hand side of the table (front)	Lower channel
Y-axis Negative End	On the base casting, beneath the saddle (back)	Upper channel
Y-axis Positive End	On the base casting, beneath the saddle (front)	Lower channel
Z-axis Negative End	On the column casting (upper)	Right hand channel
Z-axis Positive End	On the column casting (lower)	Left hand channel
ATC Home Position Sensor	ATC shroud	Target bolt on the carousel
ATC Sliding Body, home	Bracket-Sliding Body Support, left	Sliding Body
ATC Sliding Body, Advanced	Bracket-Sliding Body Support, right	Sliding Body

Warning

It is not recommended that the position of the limit switches be changed. They are preset at the factory and should require no additional adjustments. Should any major adjustments be done, service code 500, 505 and/or 501 and 502 may need to be performed.

2.4.9 Lubrication System

The automatic lubricating system is a centralized system. It is located at the rear of the machine. While the system is automatic, it is recommended that after long idle periods, the machine be manually lubricated by pressing, holding (about five seconds) until the system is charged, then releasing the square green button located on the lubricator, repeat two to three times. The lubricating system delivers 2 shots of oil when the machine is turned on at the disconnect switch, and 1 shot every 30 minutes of axis motion. Each shot provides 2.7 ml of oil. The lubrication reservoir should be maintained on a daily basis, filling only with high quality lubricating oil. All pneumatic components are lubricated by means of an inline oiler. See section 3.11

2.4.10 Coolant and Coolant Wash System

The coolant and coolant wash system uses two pumps, one for providing coolant to the work, and the other for washing the chips into the auger. Wash areas can be controlled by the flexible coolant lines found at the base of the enclosure, both left and right-hand sides. Coolant wash can also be done with the use of the hose and nozzle found on the front exterior of the enclosure. The coolant pump must be turned on for this hose to work. We recommend you close the coolant pump hoses at the spindle to provide the most pressure to the hose.

The coolant tank holds approximately 55 gallons of coolant.

See drawing 26943 at the rear of the manual for the coolant system.

2.4.11 Pneumatic System

The machine requires a supply of compressed air between 85-100 psi with a recommended air supply of ½" I.D. Air pressure to pneumatic components, the ATC slide mechanism, air blast and air purge (internal spindle) can be controlled individually by means of the adjusting valves located at the back of the LPM. See drawing 26930 for an overview of the pneumatic system.

CAUTION!
Always Observe Low Air Pressure and Low Oil Level Warnings

2.4.12 Enclosure Doors

The front door has an electro-mechanical safety interlock that must be engaged when running a CNC program. If the door is opened during a machining operation, the program will be shut down.

The enclosure is also equipped with left and a right latched and lockable access doors.

CAUTION!
Do not Attempt to Disable or Override the Safety Interlock.

2.4.13 Status Lights

The machine has a status light attached to the top giving the user status of what is going on. The lights perform as follows:

a. The green light is illuminated when the machine is running a program.
b. The yellow light is illuminated when operator input is required, like when a part change needs to be done.
c. The red light is illuminated when an alarm has occurred.

2.4.14 Chip Removal System

The LPM uses an auger chip removal system. When the forward direction is chosen on the run panel, the auger will displace chips into the chip cart. It can be run momentarily in the reverse direction in order to free a jam.

WARNING!
Use Extreme Care When Working with the Auger, serious injury could occur.

2.4.15 Work Lamps

The LPM comes equipped with two fluorescent work lamps, which come on automatically when the power is turned on.

2.4.16 Transformer Option

The TRAK LPM comes with an optional step down transformer, which takes 440 volts down to 220 volts. The transformer comes with multiple taps to allow for up to 3 different input voltages. The 3 taps are rated for 400, 440 and 480 volts. See figure 2.4.16a. The machine ships out from the factory with the wires attached to the 440-volt taps. Please adjust these 3 wires depending on the input voltage to the machine.

There is also a 200 volt and 220 volt tap on the secondary side of the transformer. In most cases the wires will be on the 220-volt tap. As a general rule, we would like the output voltage from the transformer to be between 220 and 230 volts. On a rare occasion where the customers shop is around 500 volts, it may be necessary to move the wires from the 220 to 200 volt tap. You should also place the primary side wires on the 480 taps.

In the case of 415 volts, it is better to place the wires on the 400-volt taps as the output voltage will be closer to 230 volts.

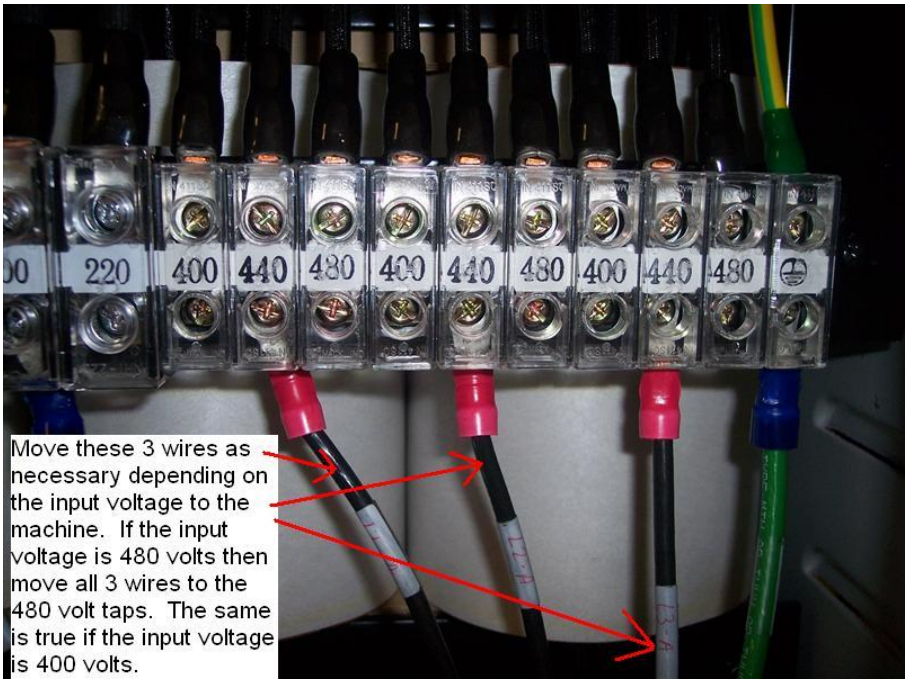


Figure 2.4.16a

Please see drawing 26939 at the rear of the manual for more information.

3.0 Installation

3.1 Lifting and Placing the LPM

The LPM must be lifted and/or moved with a forklift with a minimum capacity of 15,000 lbs from the rear of the machine or from either side. Make certain that the blades of the forklift are completely through the casting cutouts beneath the machine before lifting. The LPM may also be lifted via eye bolts placed at the top of the column and in the front of the Y axis on the bed.

Figure 3.1a

Figure 3.1b

Figure 3.1c

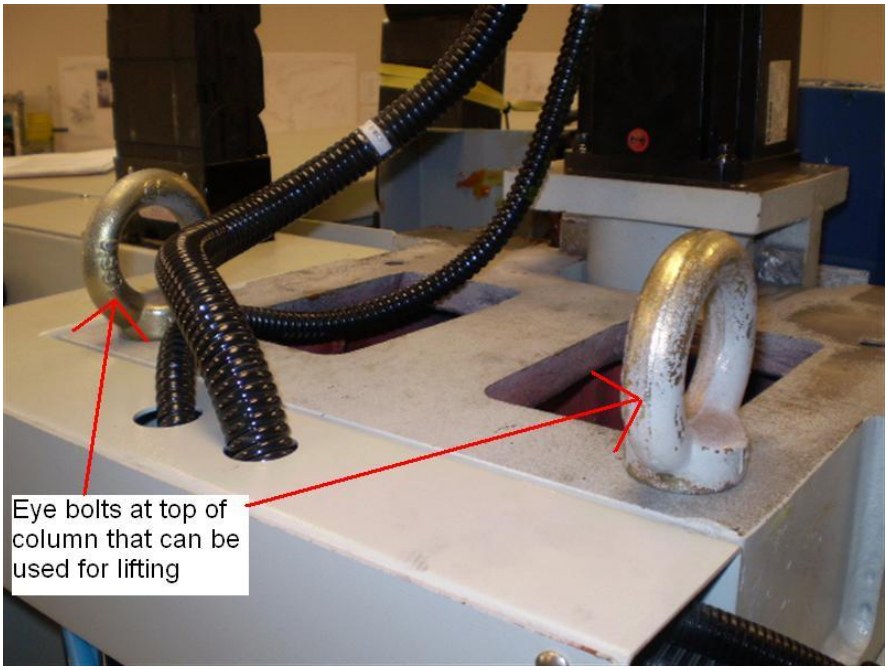


Figure 3.1d

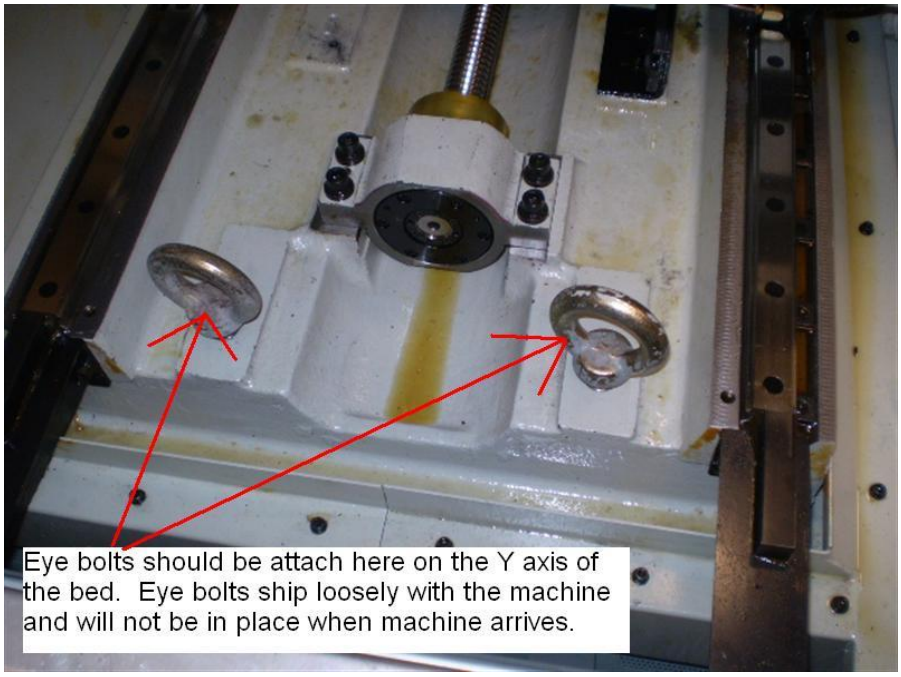


Figure 3.1e

Important

Before lowering the machine make certain that the six leveling screws have been lowered all the way down then backed-up two complete turns. Failure to do this may mean the machine will be sitting too low to allow the coolant tray to fit underneath it.

It is highly recommended that the footprint of the LPM leveling screws be placed on only one concrete pad and not across two.

3.2 Leveling Screw Locations

Figure 3.2a illustrates the 6 locations for the leveling screws on the LPM.

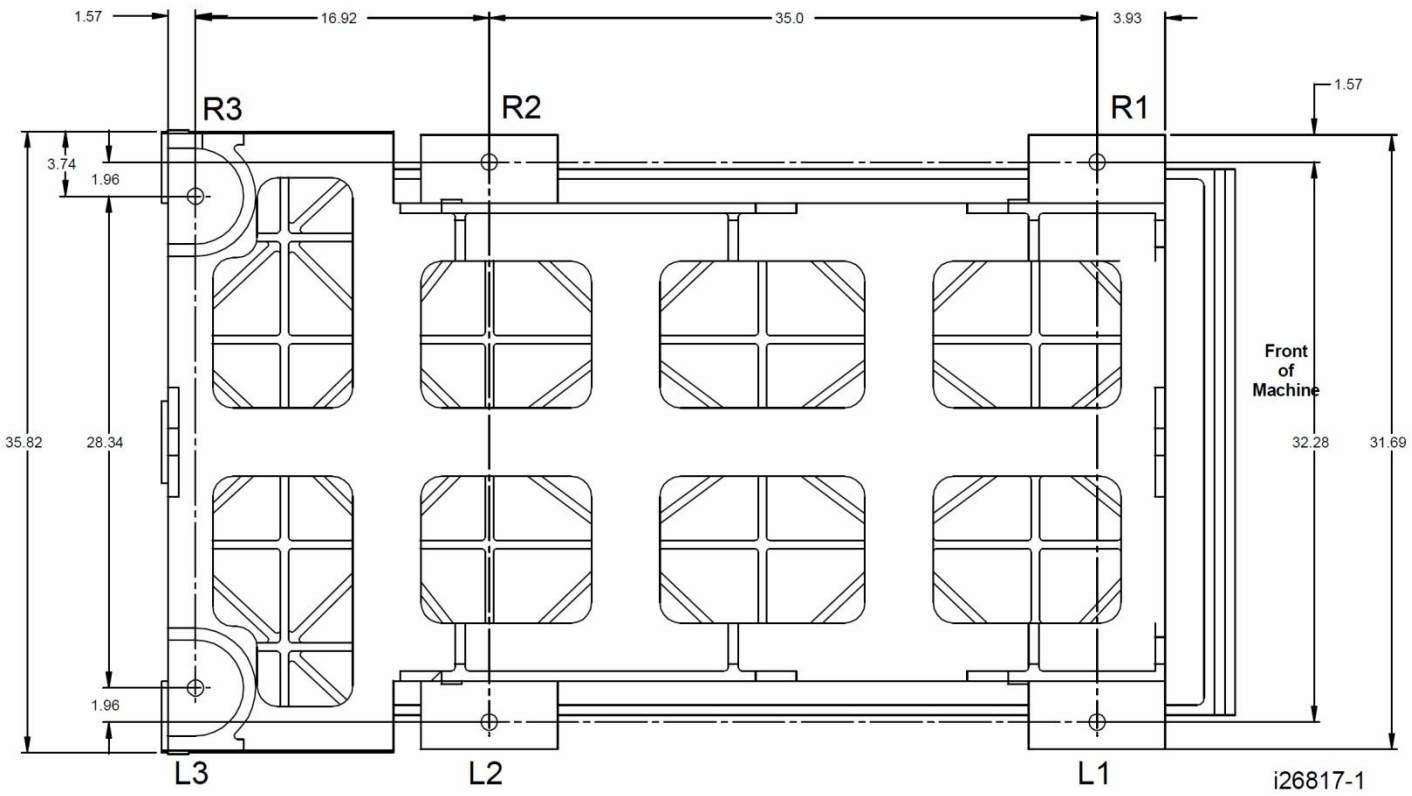


Figure 3.2a

3.3 Uncrating the LPM

1. Remove the loose articles from the pallet and check them against the loose Inventory Checklist (Section 3.4).
2. The tool measurement cart kit and the tooling pre-setter will require some assembly. Instructions to assemble will be found in the kit.
3. Remove the 5 M6x15 SHCS that secure the saddle and table support brackets, and remove the brackets (See figure 3.3a)
4. Remove the 4 M12x40 SHCS that secure the column support bracket from the table and the head, but **DO NOT ATTEMPT TO REMOVE THE SUPPORT AT THIS TIME**. (See figure 3.3b)
5. Remove the ATC cover, left. Remove the M8x60 SHCS that secures the ATC during shipping (See figure 3.3c).

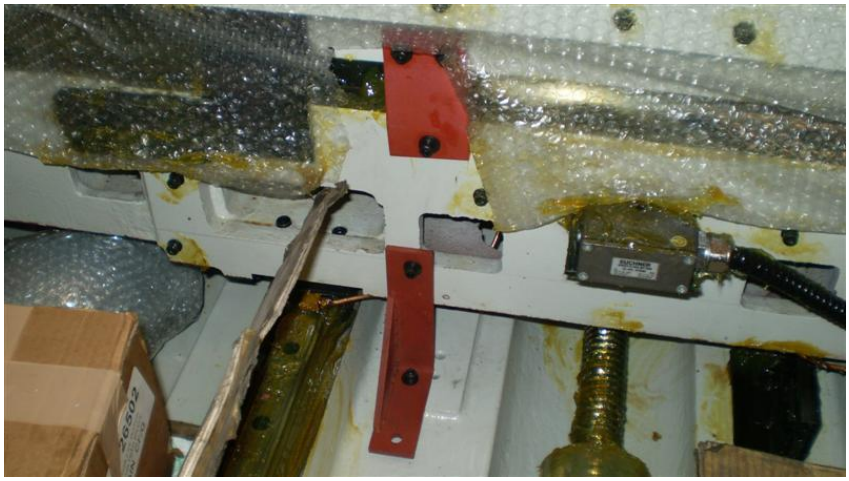


Figure 3.3a

Figure 3.3b

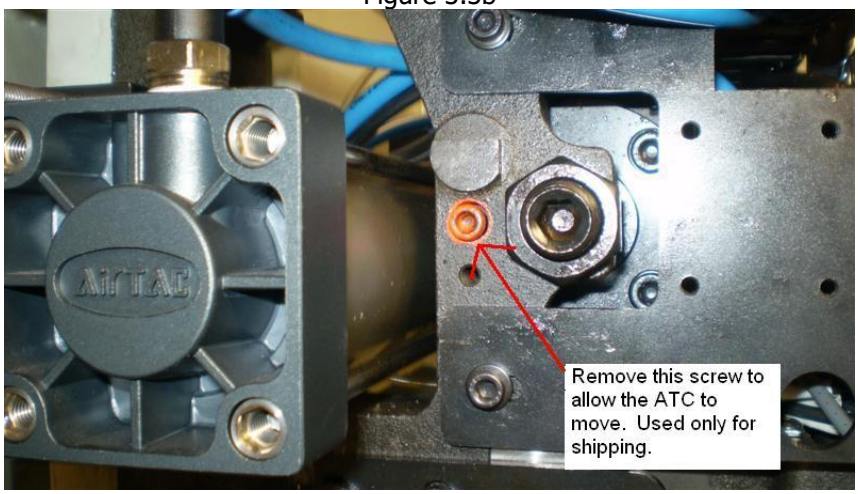


Figure 3.3c

Releasing the Head Support Bracket

1. Disconnect the motor and encoder cables to the motor.
2. Remove the four M8X30 SHCS that secure the Z-axis motor to the bracket. Carefully rotate the motor in the clockwise direction three complete turns and re-secure the motor.
3. Fasten the motor back down in place.

Note:
When the Z-axis motor is attached and power is off, the motor has a mechanical brake that holds the column in place.

Figure 3.3d

4. The column should now be raised up off of the support by approximately one inch, **IF IT IS NOT, DO NOT PROCEED UNTIL IT IS DETERMINED WHY THE Z-AXIS BRAKE IS NOT FUNCTIONING PROPERLY**.

5. Remove the column support bracket (See fig 3.3b). Customer is to retain the column support as a tool for a variety of services in the future.

Lifting and/or Raising the LPM

The spindle bracket support must be used whenever the machine is being moved or the Z axis motor is being replaced as it will support the weight of the head.

1. Place and secure the spindle support bracket on the table at the second slot from the back. See figure 3.3b
2. Jog the Z-axis downward and stop it just before the head rests on the bracket.
3. Align the spindle support bracket with the 2 tapped holes under the spindle head and then install the two M12 SHCS and tighten until snug. Continue to jog the head downward until it rests on the support bracket, tighten down the M12 SHCS.

3.4 Shortages: Inventory Checklist

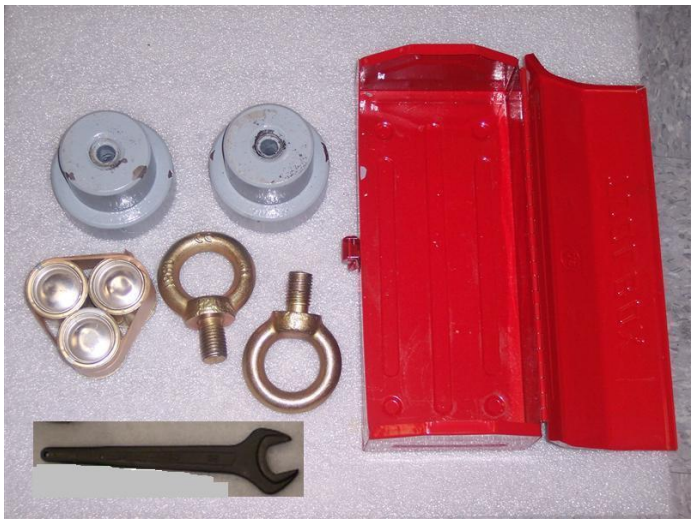
The following items will come with the LPM. Please note the optional items that have been ordered are present.

ATTENTION!
Immediately report, in writing, any damages observed at this time that can be attributed to the transportation or improper handling/moving of the machine.

Loose Accessories Checklist

Box #1
(1) Self-coiling air hose – p/n 26961
(1) Air nozzle – p/n 26960
(1) Coolant nozzle and fitting – p/n 26958
(1) 10' 120 PSI rated hose – p/n 26959
(1) Air and coolant nozzle bracket – p/n 27044

Box #2
(1) Toolbox containing the following – P/N - 27646
- (2) Leveling pads – P/N 26922
- (1) Set of touch-up paint (1 can RAL 7035, 1 can RAL 7040 & 1 can of hardener) – P/N 27644
- (1) 36mm open end wrench – P/N 27643
- (2) Eye bolts - P/N 27645



Loose standard parts on pallet (note – a number of these items will be found in the coolant tank)
(1) Chip container – p/n 27041
(1) Auger chute – p/n 26946
(1) Oil/coolant overflow tank - 27045
(2) door handles – p/n 26881
(2) Y side covers – p/n 26818-2
(1) X axis front way cover – p/n 26818-4
(1) Measurement Scale box
(3) Boxes that hold the measurement cart

Brackets fastened to machine and need removal
(1) Column support bracket
(1) Bed shipping bracket
(1) X-axis shipping bracket

Hardware Kit Box – p/n 26533
1. CD containing LPM Programming and Service Manuals (not shown in picture) – 27104
2. LPM Programming and Operating Manual – 26728
3. Label – SWI Logo for Measurement Cart – 26970
4. Instruction for Measurement Cart – where to place SWI logo – 26816-DOC
5. Ball lock Clamping Shanks - 26712 – Qty. 4

NOTE - Please place Offline and/or DXF software kits in hardware box if ordered.

Potential Optional Items

1. Small Fixture Plate
2. Medium Fixture Plate
3. Large Fixture Plate
4. Vise Fixture Plate Kit – includes aluminum fixture plate, fence and vise stop assembly
5. Vise Stop Assembly
6. Ball Lock Guide Assembly
7. Fixture Cart – comes in 3 boxes
8. Retention Knobs – a kit of 16 knobs
9. Primary Liner Kit – comes with 8 liners
10. Secondary Liner Kit – comes with 8 liners
11. Ball Lock Clamping Kit – comes with 4 clamping shanks
12. 6" Kurt Vise

Final packaging of all standard loose parts and optional items – subject to change depending on optional items ordered

3.5 Installation Checklist

Installer – Use this checklist to assure a complete setup on the LPM.

☐	1. Shut off power to the machine.
☐	2. Visually inspect the 220 volt wiring (or 440 volt if transformer option is installed) going into the electrical panel. Visually verify the wiring is correct per our wiring diagram and the voltage is between 208 and 240 volts. Make sure a strain relief is being used where the wiring enters the cabinet. Have the customer repair any wiring discrepancies. See figure 3.6.1a. Double check how the machine has been grounded and notify user if it is not done per our recommendations.
☐	3. If 440 volt transformer option is installed, measure incoming voltage and adjust transformer taps as necessary. See section 2.4.16.
☐	4. Clean the machine if needed and remove any remaining protective grease.
☐	5. Unlock table, saddle, head and tool changer by removing support brackets **WARNING! Refer to section 3.3 before proceeding.** Install 2 door handles on front door. Re-install the door lock L shaped bracket that will be found mounted in reverse on the door bracket.
☐	6. Re-attach the Z cable carrier if it has been disconnected for shipping purposes.
☐	7. Re-attach the Z motor power and encoder cable if it was disconnected during shipment. Make sure to thread the cables on all the way.
☐	8. Turn on the power to the machine. Verify the lube pump cycles 2 times when machine is turned on.
☐	9. Adjust air pressure on the main air regulator to 90 psi. Adjust air regulator for the spindle cartridge to 7 psi.
☐	10. Check the level of the machine. The machine should be level to within 0.0005"/12 inches front to back and 0.0005" inches side to side. Adjust level with rear screws as necessary for spindle tram.
☐	11. Temporarily fasten the left side X axis way cover and front Y axis way cover prior to homing. This is to ensure we don't damage these covers by accident. We say temporarily because you should remove it again to check lubrication as step 13 states.
☐	12. Press SET HOME to home machine. Did the X axis home properly? Did the Y axis home properly? Did the Z axis home properly? Did the ATC home properly? Station # 1 should be at the tool change position.
☐	13. Jog the X, Y and Z axis back and forth until the linear guide surfaces are well lubricated. Oil should be visible on all the linear guide surfaces and ball screws. Once lubrication is verified, attached all way covers.
☐	14. Go to DRO mode and move each axis in a positive direction. Select the X axis, does the table move to the left when turning EHW CW? Select the Y axis, does the saddle move toward the operator when turning the EHW CW? Select the Z axis, does the head move up when turning the EHW CW? Check that 1 click of the EHW in FAST mode is 0.100"
☐	15. Final test each axis by jogging at FAST speed into the soft limits. Verify the machine does not hit the hard limit switch or hard stop on the machine. Re-adjust limit switch cam if it does. Service Code 500 may need to be performed if major adjustments have been made to the X and Y axis limit switch system. If the Z axis is adjusted, then service codes 501 and 502 may need to be performed. Service code 505 must also be run to reset the soft limits on all axes. See section 5.12
☐	16. Check to make sure that the E-Stop button is functioning correctly. Turn spindle on and power feed an axis. Press the E-stop button during this operation and verify the spindle and axis stops. You will need to press the RESET button once this is done.

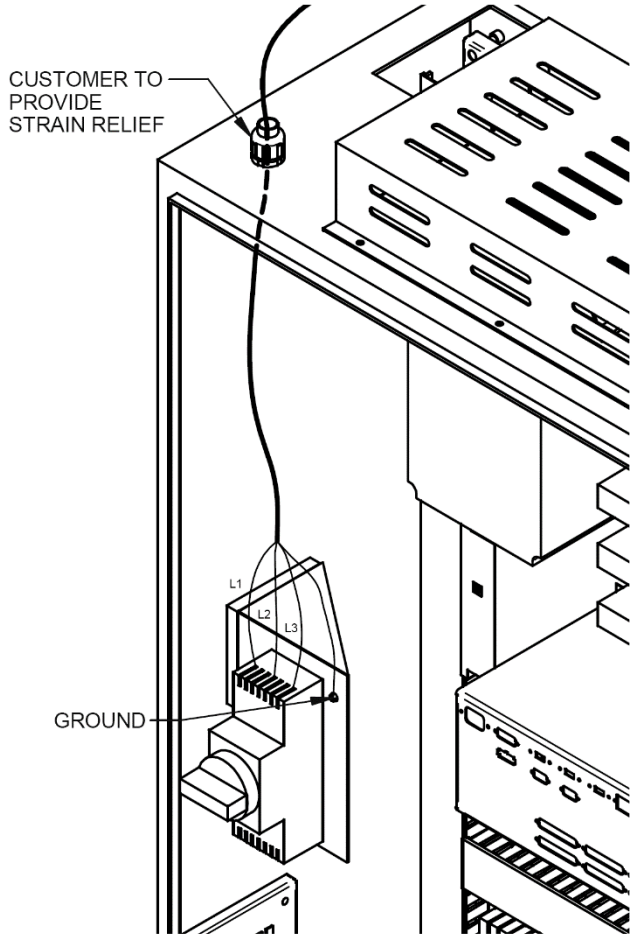
	Make sure the Z axis does not move when the E-stop is pressed. The brake on the Z axis motor will hold the head.
☐	17. Wire up the auger, coolant pump and coolant wash pumps per section 3.6.3.
☐	18. Turn the auger (chip conveyor) on in the forward and reverse directions and make sure it turns in the correct direction. You need to hold the REVERSE key down for the auger to turn. FWD should cause the auger motor to turn CCW when viewing from the rear of the motor.
☐	19. Turn the coolant wash pump on and make sure it rotates in the correct direction (Counterclockwise). Note: Coolant coming out of the wash down nozzles is not an indication that the pump is turning in the proper direction. Observe the direction of the motor fan.
☐	20. Turn the coolant pump on by pressing the coolant ON button and make sure it rotates in the correct direction (Counterclockwise). Note: Coolant coming out of the nozzles is not an indication that the pump is turning in the proper direction. Observe the direction of the motor fan.
☐	21. Turn the AIR blast on by pressing the Air ON button. Open and close the valves and make sure there are no leaks.
☐	22. Is the spindle motor fan running? Is it turning in the correct direction? Air should be blowing up and away from the motor.
☐	23. Close the door and make sure the control recognizes the door as being closed. When the door is open a DOOR OPEN message should be on the screen when in DRO mode. It goes away when the door is closed. Press the DOOR LOCK button and make sure the door locks when pressed.
☐	24. Press the manual tool change button on the head (GREEN button) and make sure air is coming down through the spindle. This can be adjusted, see pneumatic system drawing 26930. Put a tool in the spindle and verify the tool clamps once the green button is released.
☐	25. Press the jog button on the run panel to jog the ATC carousel. Each press of the forward and reverse button should move the ATC 1 station. Jog the ATC completely around all 16 stations. The door must be closed. Also make sure the ATC is rotating in the correct direction. When the FWD button on the ATC is pressed the ATC should rotate from station 1 to station 2, etc.
☐	26. Physically load and tool in and out of the carousel to make sure the orientation angle and tool change height are correct. This can be done by assigning a tool to the carousel and then using the ADD TOOL feature in TOOL LOADING. Use CALL TOOL to bring it back to the spindle.
☐	27. Turn off air to the machine (in-line switch) and verify the control recognizes low air pressure. There should be a warning message on the screen.
☐	28. Run spindle in DRO in forward and reverse at low speeds.
☐	29. Run the 10 minute warm up program.
☐	30. Spindle head test Run spindle at 1000 RPM for 5 minutes Run spindle at 8000 RPM for 5 minutes Run spindle at 500 RPM increments for a few seconds per increment. Please note any of the following: Head noise, excessive heat on spindle, vibration, spindle fan noise.
☐	30a. Make sure the "Tool Detect Sensor" is working and seeing a tool in the location.
☐	31. Double check the tool change height with service code 501. Once verified, check to make sure that the tools load and unload properly into the tool carousel, the tool should not deflect as the tool is being loaded automatically into the spindle.

☐	32. Double check the motor index angle for each axis using service code 505. Index angles must be checked in the positive direction, towards the homing switch. If this needs to be modified, then steps 33 and 34 may need to be done as well as setting the tool change height with service code 501.
☐	33. Double check the position of each ball lock location. Modify service 500 as necessary.
☐	34. Double check the base tool height and adjust service code 502 as necessary.
☐	35. Assemble the tool measurement cart and tool measurement gage. Make sure to align the tool measurement gage per the instructions included with the kit. Make sure to attach the SWI logo that comes in the hardware kit to the cart.
☐	36. Assemble the optional fixture cart if ordered. Make sure to attach the SWI logo to the cart.
☐	37. Wipe down machine.

3.6 Electrical Connections

3.6.1 Main Power to the Machine Connections

The 3 phase 220 voltage (208 – 240 V acceptable) is connected to L1, L2 and L3 at the power switch inside the electrical box. Connect the ground wire as shown in the figure 3.6.1a. See section 3.6.2 for further grounding information.



i26571

Figure 3.6.1a

3.6.2 Machine Grounding

It is strongly recommended that the machine be earth grounded in shops with an inadequate building grounding system. A dedicated copper rod 8 feet or so in length should be driven into the ground near the LPM. This may also require the ground rod to be bonded to the buildings ground as well, consult with your electrician on this matter. A ground wire should then be run from the filter ground to the copper rod. Please see figure 3.6.2a for where to connect the ground wire on the filter. The ground wire should come up through the bottom of the electrical cabinet in the same location as the coolant pump cables. The wire should be 6 gage in size. See figure 3.6.2a. Figure 3.6.2b shows an OK method for grounding.

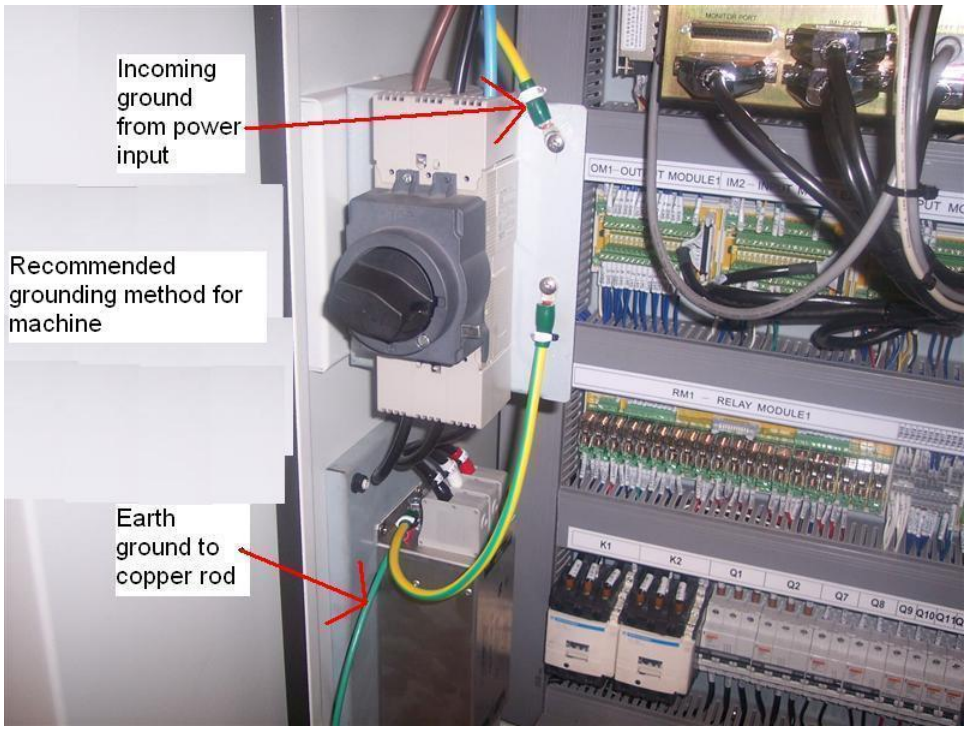


Figure 3.6.2a

Figure 3.6.2b

3.6.3 Coolant, Washdown and Auger Motor Connections

The coolant, washdown and auger motor cables are routed through the soft seal opening at the bottom right-hand side of the electrical box as shown in the figure.

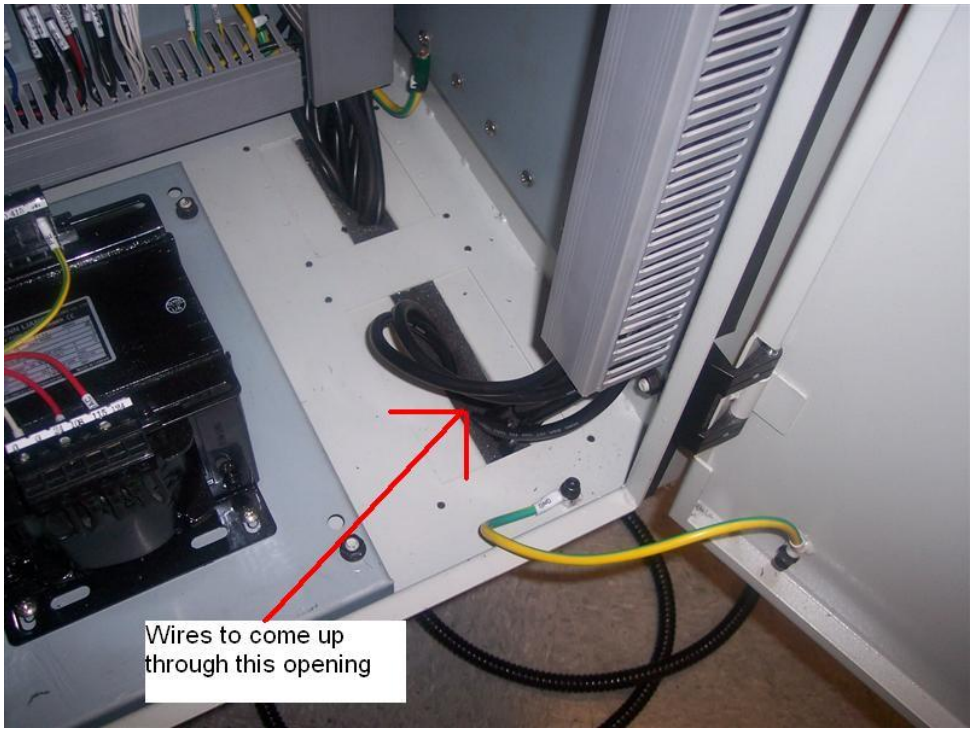


Figure 3.6.3a

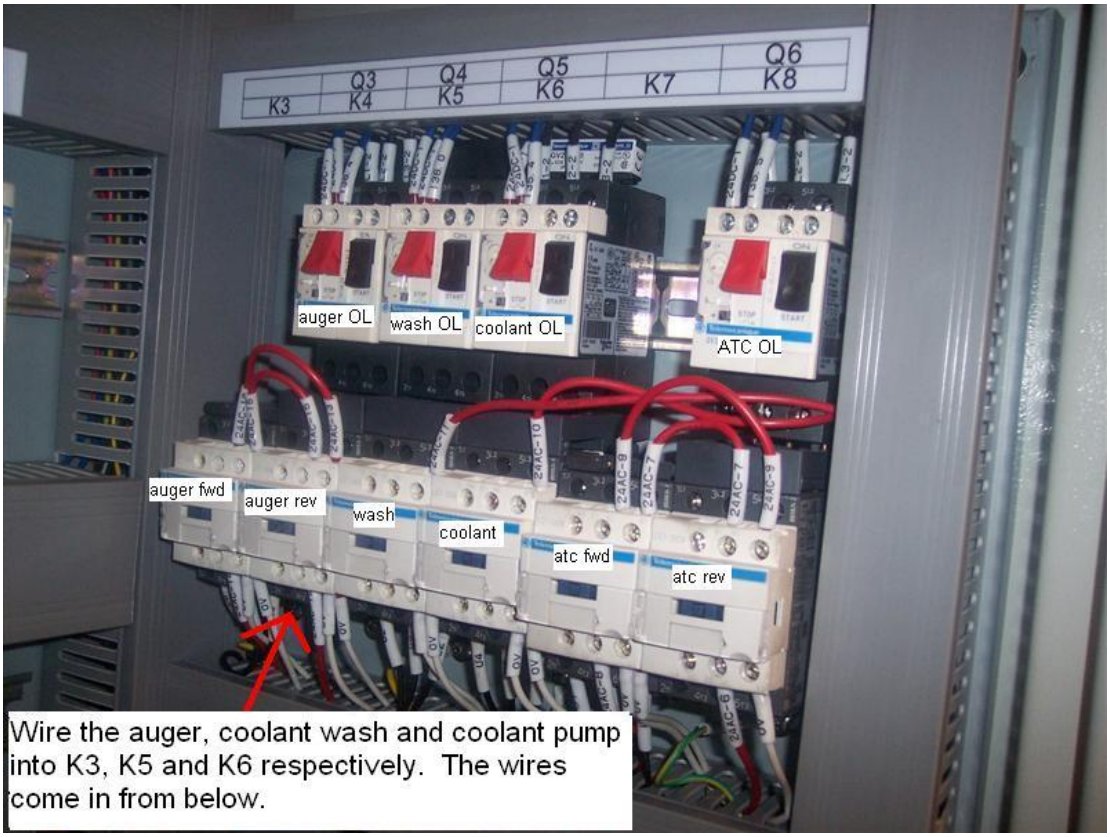


Figure 3.6.3b

The auger motor wires are identified as U6, V6, W6 and GND. They are to be connected to contactor K3 at terminal points T1, T2, T3 and GS28 respectively. See sheet 2 detail I on drawing 26734 for the grounding locations.

The coolant wash pump wires are identified as U2, V2, W2 and GND. They are to be connected to contactor K5 at terminal points T1, T2, T3 and GS29 respectively.

The coolant pump wires are identified as U4, V4, W4 and GND. They are to be connected to contactor K6 at terminal points T1, T2, T3 and GS30 respectively.

To verify the main power to the machine is correct, the auger should be rotating in the counter-clockwise direction when viewed from rear of motor. If it is not correct, turn off the main power and switch any two of the line-in wires. Also make sure the coolant pump and coolant wash pumps are rotating the correct direction. There are labels on the pumps indicating which direction is correct.

3.7 Air Connections

3.7.1 Air Connection

Connect the air supply to the quick disconnect coupling to the left of the pressure regulator and beneath the in-line air switch. The air supply line should have a minimum of ½" inside diameter. It is recommended that a water separator or air dryer be installed upstream of the LPM air supply. See the pneumatic drawing 26930 for where the air is connected to the machine and all other pneumatic information.

3.7.2 Air Regulators and Solenoids

The LPM consists of 2 air regulators, 3 air flow valves and 4 solenoids that need no adjustment. They are all set at the factory but should be checked upon installation.

The main air regulator for the machine should be set at 90 psi and the secondary one that supplies air to the spindle cartridge should be set at 7 psi. These regulators are adjusted by pulling the cap upward and rotating the cap clockwise to increase the air pressure and CCW to decrease the air pressure.

The 3 air flow valves should be set at the factory but can be checked as follows. For the valve that controls the flow of air through the spindle during a tool change, close this valve and open it 6 turns and then lock it in place. For the other 2 valves that control the speed by which the ATC moves in and out, they should be opened all the way and locked in place.

The in-line air switch shown in figure 3.7.2a turns the system air on and off, put the collar in the lowered position (off) before connecting the air supply. Push upward to turn on the air.

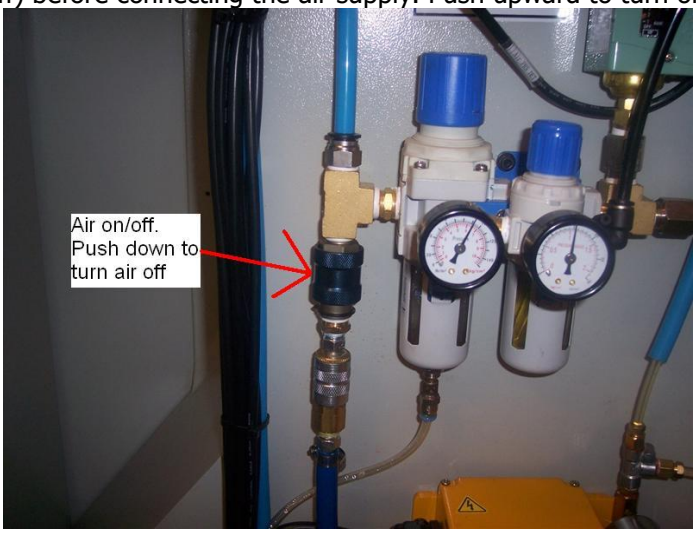


Figure 3.7.2a

3.8 Placing the Coolant System

1. Locate coolant tank beneath the machine.
2. Remove loose ends of coolant hoses from the underside of the LPM enclosure and route them to the pumps.
3. Attach and secure these hoses with hose clamps per the diagram below. Each coolant hose will be marked 1 through 5 on the hose and 1 through 5 on the attachment point. For reference, hose labeled 1 is the coolant wash left (as viewed from rear of machine), hose 2 is coolant wash right, hose 3 is coolant to spindle tool nozzles, hose 4 is return line from overflow tank and hose 5 is to the coolant gun.

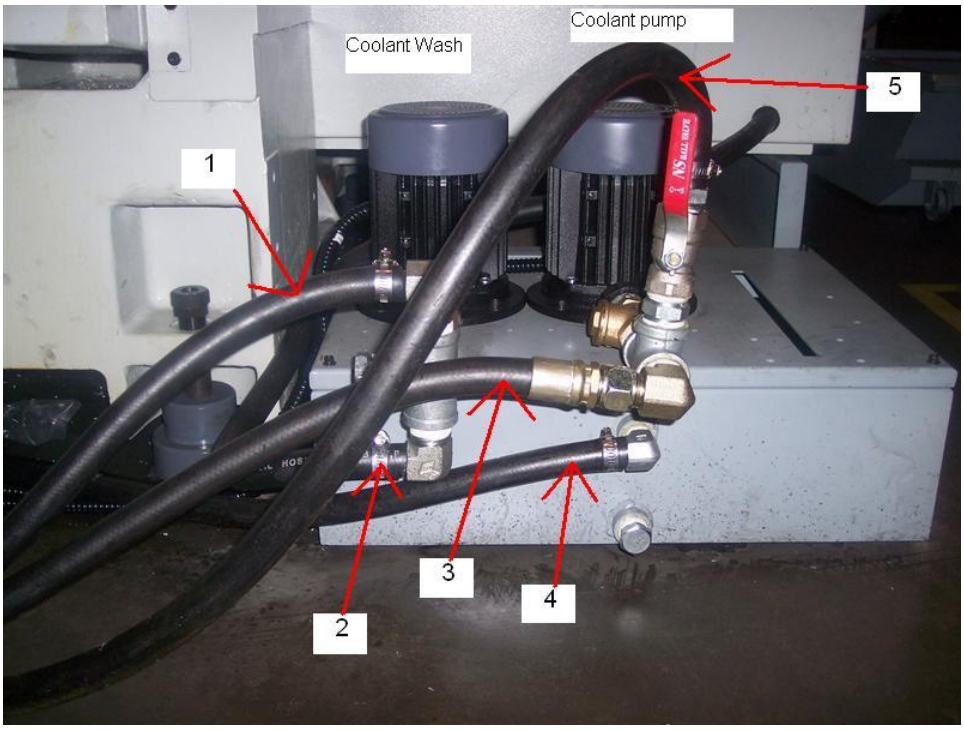


Figure 3.8a

3.9 Cleaning the LPM

1. Remove all the cardboard and protective plastic sheeting from the machine.
2. With a soft plastic scraper, remove all the protective grease from the machine. DO NOT USE ANY SHARP OBJECTS ON THE LINEAR GUIDEWAYS OR THE BALL SCREW. USE ONLY LINT FREE CLOTH IN THESE AREAS. It may be necessary to move the table, saddle and head left and right, up and down when cleaning.
3. Clean the way covers as they come shipped with a rust prevention spray on them. WD-40 works well to remove this agent.
4. When cleaning the windows, use a suitable cleaner that DOES NOT contain ammonia or solvents that could damage that polycarbonate windows.

Warning!
Do not use water based cleaning agents for cleaning the machine.

3.10 Leveling Procedure

Leveling the LPM in the field consists of leveling the machine and then adjusting the level, if necessary, to make sure the tram of the spindle is perpendicular to the table.

Leveling the LPM

1. Set the machine on its 4 leveling pads L1, L2, R1, & R2 on a solid, level floor prepared in accordance with the state and local rules for machine tool installation.
2. Clean the table thoroughly and place 1 or 2 precision Spirit levels or electronic levels in the center of the table in the positions illustrated in figure 3.10b.

Caution!

If using 2 levels, make sure each level is measuring correctly. To check, place the level in one direction and note reading and then flip 180º and see if the reading is the same. If not, have the level recalibrated.

3. Leveling is achieved by using leveling screws R1, R2, L1 and L2. See figure 3.2a in section 3.2. Adjusting screws R3 and L3 should be left loose with the leveling pads and have no pressure at this time. A 36 mm wrench is required to adjust the leveling bolts.
4. With the precision levels placed on the worktable as shown in 3.10b, level the LPM to within 0.0005"/10 in.
5. If the machine must be anchored to the floor, follow the general instruction for installing machine tools when anchoring.
6. If the machine must be installed on vibration mounts/pads (rubber, commercially available leveling and vibration mounts, etc.) follow the instructions delivered with the mounts/pads, ordering them to satisfy the load of the machine and the maximum weight of the workpiece (~10,000 lb.).
7. When machine is correctly leveled, lock the adjusting screws in place with their hex nuts. See figure 3.10a

Figure 3.10a

Adjusting Level for Tram

1. Mount the .0001" test indicator to the spindle nose and sweep the table with a 12" span (6" radius).
2. If the tram measurement is not .0008 TIR, adjust the R3 and L3 leveling bolts to adjust the tram within specification. This will tend to help adjust any error you have in the Y axis for the tram. By adjusting these bolts, you can in affect slightly affect the column and bring in the tram.
3. Once complete, lock all leveling screws in place with the lock nuts. See figure 3.10a

Figure 3.10b

3.11 Lubrication

3.11.1 Way Lubrication

The auto lube system provides centralized automatic lubrication for the linear guides and ballscrews. The lube pumps 1-liter reservoir is serviced with Mobil Vactra Oil No. 1 or equivalent (ISO32). The pump is factory set to distributor 2.7 ml of oil for every cycle of the lube pump. The lube pump cycles automatically 2 times upon initial startup of the control and then 1 cycle for every 30 minutes of axis movement time. Each cycle of the lube pump lasts for 5 seconds or so, once the lube pump is turned off, oil is then discharged from the spring loaded oil manifolds to the linear guides and ballscrews.

Discharge Pressure - Approximately 200 psi
To adjust the amount of Discharge Pressure displayed on the lube pump gauge, turn the adjustment screw clockwise to increase the pressure. 1 turn of this screw will raise the pressure about 100 psi.

At the beginning of each day, check the oil level in the Auto Lube system. If low, fill with an ISO32 oil (ex Mobil Vactra Oil No. 1) or equivalent. If the lube pump runs dry a flashing message will appear on the screen that says LOW OIL. The control will allow the machine to complete its current cycle and 2 additional ones before stopping the machine and not allowing it to run until the lube oil gets replenished.

CAUTION!
Failure to manually activate the pump at the beginning of each day if the control was left on and the machine has been idle for a long period of time may cause severe damage to the TRAK LPM linear guides and ballscrews.

To manually activate the lube pump, press the button on the pump and hold for 5 seconds until the lube pressure builds up and then release. Repeat this process 2 or 3 times.

See lubrication system drawing 27050 for an overview of the system.

3.11.2 Other LPM Lubrication Points

1. Tool Change Air Cylinder Oil Cup supplies oil to the "Air Over Oil" cylinder and should not require replenishment. However, if it does fill the oil cup on the front of this cylinder with an ISO32 oil or equivalent.

2. Oiler
   Once every 2 weeks:
   Fill the oiler that supplies lubrication to the solenoid valves and other various components within the pneumatic system with an ISO32 oil or equivalent. It holds approximately 5 ounces. See drawing 26930.

3. Grease fitting on ATC
   Yearly:
   Apply a good grade of general-purpose grease like Shell Darina AX or equivalent through the grease fitting on the top of the ATC. This provides lubrication to the sliding rails as the ATC moves in and out from the spindle. Make sure to supply enough grease to distribute grease through the grease line that connects between the top and bottom rail.

3.12 Cutting a Euclid Block

The test part may be machined at the completion of the installation.

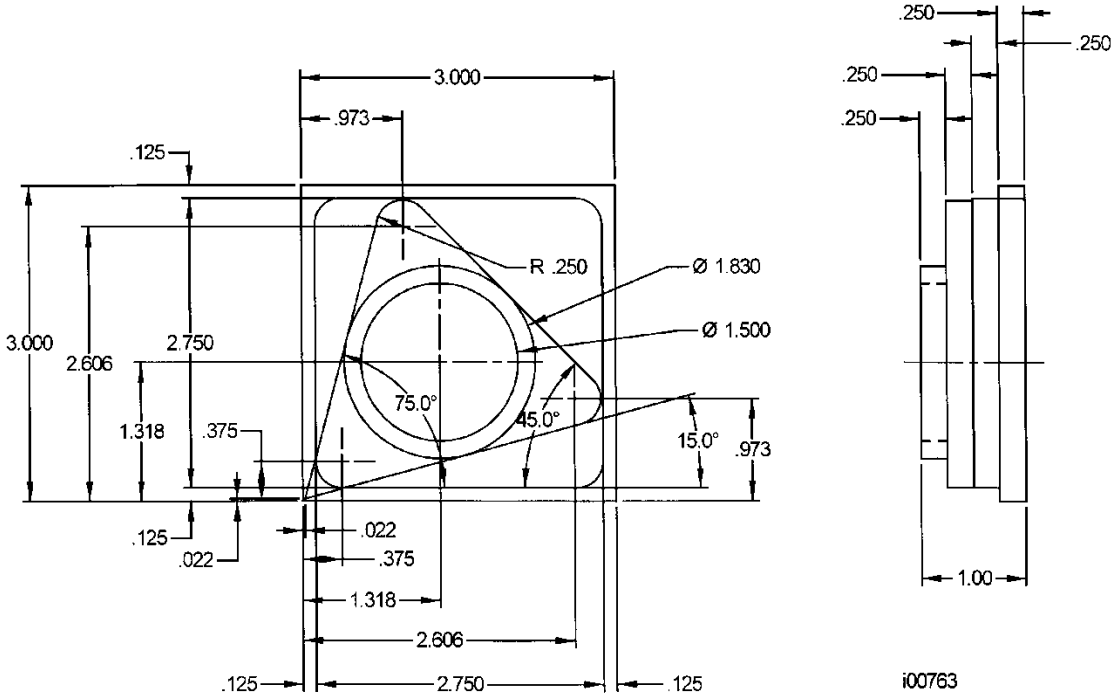
Material Specification: Aluminum, 6061-T6 or T4
Blank Size: (minimum dimensions) 3 x 3 x 1"
Tool: .750 end mill, 2 flute, high speed steel, ***sharp***
Coolant: Flood coolant

1. Mount vise and indicate the back jaw parallel to the table within .0005". Use fixture vise plate if customer ordered this option.
2. Clamp material in vice with a minimum of 0.800" above the vise jaws.
3. Load in the Euclid block program from the ProtoTRAK PMX C drive, it is part number euclid.PT7. It is found under the PT4 folder followed by the SWI TEST PROGRAMS folder.
4. Go to the checklist found in machine setup mode. The checklist will take you through all the steps necessary to run the part. Start with step 6
5. Set your ball lock location to be B.
6. Use an edge finder to set your offsets for X, Y and Z. Absolute zero is the front left corner of the block as viewed from in front of the machine. The values you are entering are the distances in X and Y from ball lock B and the distance from the top of the part to the top of the table for the Z.
7. Go to the tool management screen and assign the tool to carousel location 1. You can also chose to load the tool manually and so you can assign the tool to location 17.
8. Enter the Z offset location by measuring your tool against the base tool on the tool measurement cart.
9. Go to tool loading and load this tool into the carousel by pressing ADD tool.
10. Set the coolant to AUTO if you are going to use flood coolant.
11. Begin to run the program by pressing RUN, START and GO. The part will be machined in the following sequence:
12. After the program run, the program will locate to the following position.

X = 1.318
Y = 1.318

Event(s) #	Description	Depth of Cut
2	circle pocket – cuts middle circle	-.250
3	circle frame – cuts outer 1.830 diameter circle	-.250
4	circle frame – cuts material from corners remaining on Euclid block	-0.250
5	roughs material in upper right-hand corner	-. 500
6-13	cuts triangle on Euclid block	-.500
14	rectangular frame – cuts outer 2.750" rectangle	-.750
15	position to 1.318 on X and Y	+10.000

13. Mount a dial indicator in the quill and check the circles.
14. Check the runout of the sides of the square frame.
15. Inspect the machined surfaces for smoothness.



3.13 Indexer Installation

The following section describes how to install a 3rd party indexer to the LPM machine. All machines will come with a cable that runs from our electrical box to the indexer. It may be necessary to use a different connector that matches the indexer you have chosen. It is also up to the customer to provide the necessary power (typically 110 volts) to run the indexer.

The following cable in figure 3.13a is used to send signals back and forth between the indexer control box and the ProtoTRAK control. The output to the indexer from the ProtoTRAK is done via a contact closure on the green and black wires. The ProtoTRAK sends a 0.3 second pulse to the indexer as required per the program written in the ProtoTRAK control. The input back to the ProtoTRAK is carried through the red and white wires. The indexer will need to provide a contact closure, which tells the ProtoTRAK that it is done indexing and the program can begin again.

The red and white wires go into the IM2 module at A16 and common respectively.
The green and black wires go into K7 relay on RM2 on the NO and common terminal respectively.

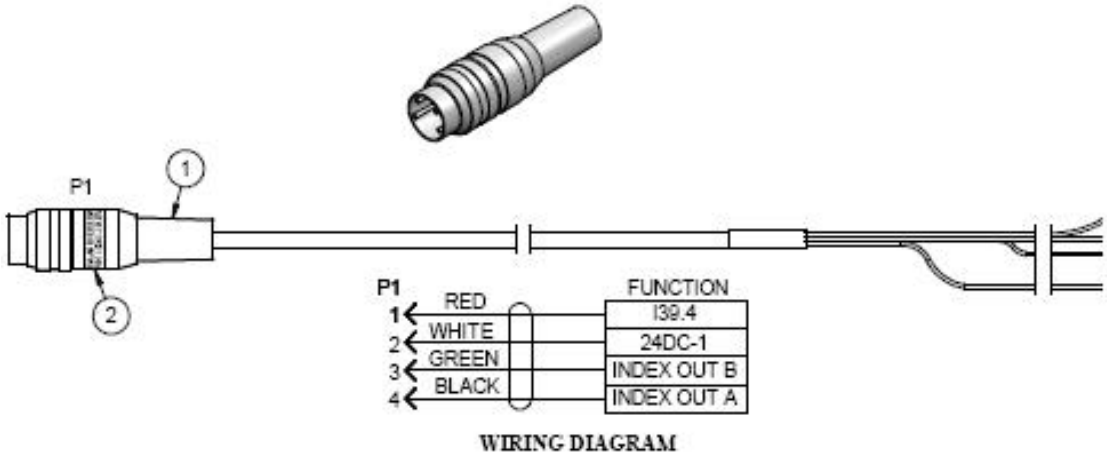


Figure 3.13a

The following pictures depict how you might wire up and mount your indexer.

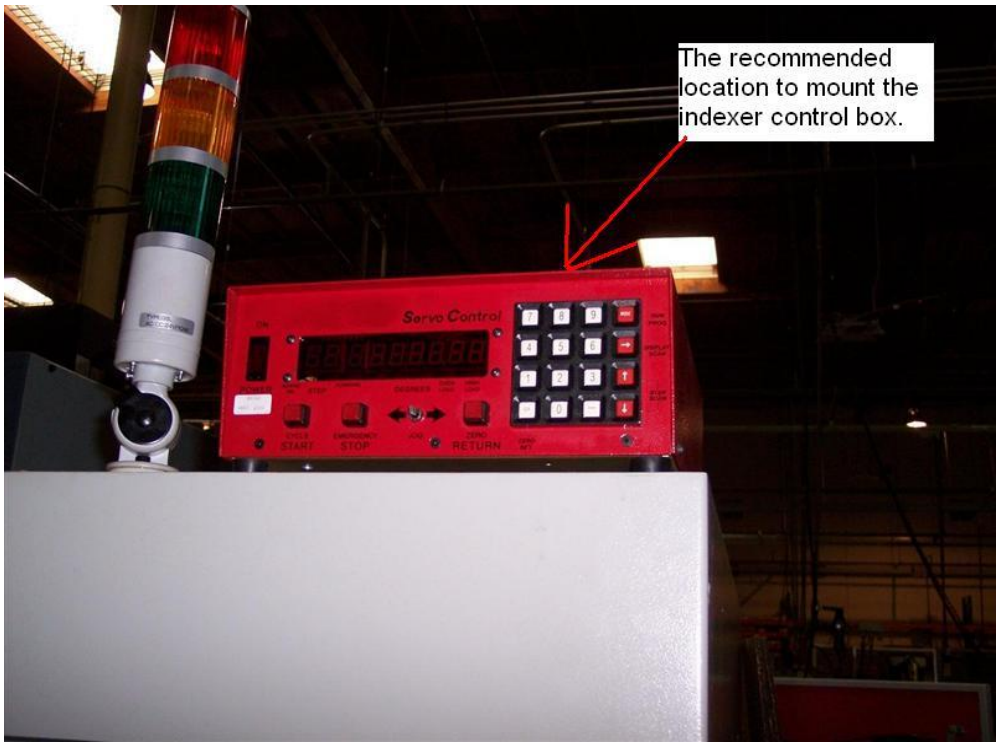


Figure 3.13b

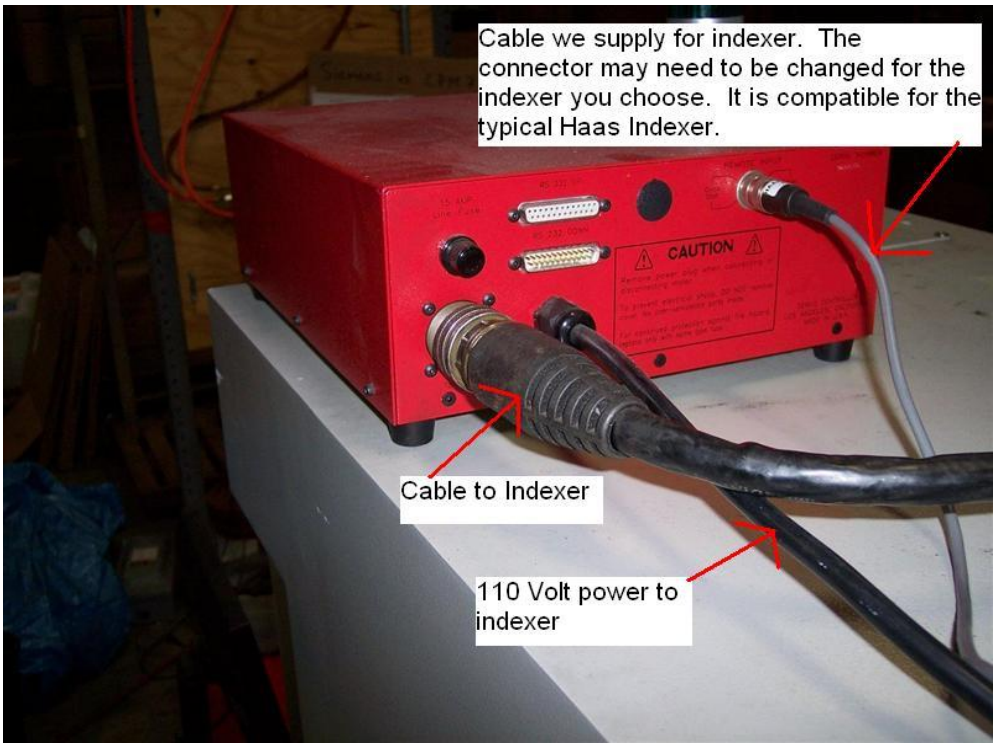


Figure 3.13c

Figure 3.13d

Figure 3.13e

Figure 3.13f

Figure 3.13g

4.0 Troubleshooting by Symptom

Use this section to begin the process of resolving a service problem. Each symptom type is described in a few words and then more fully described in an explanatory paragraph. Following this is a chart that directs in the most logical steps.

4.1 Machining Problems

4.1.1 Poor Finish

The part finish is marred with scallops or is very rough.

Do the following Service Codes and document values:

- **Code 33 -** Software Identification. This is needed if you call SWI Customer Service
- **Code 128 -** Enter backlash compensation
- **Code 134** – Friction Feed Forward
- **Code 508** – S Curve On - Accel and Decel

Possible Cause	Check This
Too much backlash entered for code 128.	Verify nothing is mechanically loose and the backlash values are not higher than what physically is in the system.
Friction feed forward set too high or low	Check the value of code 134. Default values are 1000 for X and Y. Typical values are a few hundred above or below this value.
Machine Tool & Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). Check the condition and type of cutter being used, type of material, RPM and Feedrate, etc. See Machine Tool & Setup Section 5.1
Inadequate or no Lubrication to Ballscrews and Linear Guide surfaces	Make sure all the Linear Guide surfaces are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines. See Lubrication Section 3.11
X & Y-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 5.2
Linear Guide surfaces are scarred, exhibit noise or vibration, or are excessively worn	Visually check the condition of all the Linear Guide surfaces. For machines that may have excessively worn Linear Guide surfaces, a trained SWI Technician may need to inspect this area to determine if they need to be replaced. Check lubrication to affected areas.
Too aggressive acceleration and deceleration of axis motors	Turn on service code 508 (S curves on) to lessen acceleration. This will improved the Z surface finish on a part.

4.1.2 Circles Out of Round

Circles are not round within 0.001" TIR over a 1.830" dia. This is best measured by placing a dial indicator in the spindle and sweeping around circle on the euclid block part.

Do the following Service Codes and document values:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service
- **Code 128** Enter backlash compensation
- **Code 134** – Friction Feed Forward

Possible Cause	Check This
Backlash values set too high or low	Check code 128. Typically values for backlash should be less than 0.0005". Reset values as necessary.
Friction feed forward set too high or low	Check the value of code 134. Default values are 1000 for X and Y. Typical values are a few hundred above or below this value.
Machine Tool and Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). See Machine Tool & Setup - Section 5.1
Machine not level	Verify that the machine is level to specification.
Head is not trammed	Verify that the Head is trammed to specification.
Torque values on X and Y-axis are too high.	Make sure torque is lower than 20 in-lbs. Normal values for a machine that is aligned and adjusted properly should be between 10 and 15 in-lbs. Make sure torque is consistent across axis travel.
X & Y-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 5.2

4.1.3 Parts Have Incorrect Dimensions

Parts are being machined with dimensions that are different than those programmed. Typical accuracy expectations should be:

- **Circles:** 0.001" TIR over a 1.830" DIA (assumes cutting euclid block)
- **Positional Accuracy:** 0.0002"
- **Repeatability:** 0.0002"

Do the following Service Code:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service
- **Code 123** Calibration
- **Code 128** Enter backlash compensation

4.1.3.1 Every Part Has the Same Error

Possible Cause	Check This
Machine Tool & Setup problem	See Machine Tool & Setup Section 5.1
Programming Error	In the program, look for common errors in programming such as transposing numbers, tool diameters, and pressing INC SET when ABS SET is meant. This is especially suspected if the dimensional errors are larger than a few thousandths. See the Controls Programming, Operations and Care manual.

Possible Cause	Check This
Configuration file that contains calibration file that has been erased or corrupted.	Make sure there are values for calibration under service code 123. Default values would read all zero's which means the machine needs to be calibrated. A back up copy of the configuration file will be found on the control and a backup copy will be available at SWI. We will need the machines serial number when you call in.
Backlash problem	Unusual high backlash values are causing slight variations in your part dimensions. Values for backlash should be less than 0.0005".

4.1.3.2 The Dimensional Errors Are Random or Accumulate in Size Over the Part Program Run

Possible Cause	Check This
Machine Tool & Setup problem	See Machine Tool & Setup Section 5.1
X and Y-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 5.2

4.2 Motion Related Problems

4.2.1 Run Away Axis

The axis makes an unwanted move at rapid speed in one direction and faults out. This is usually caused by an encoder signal being interrupted or following error building up on that axis. Following error is when the control sends a signal to the motor and the motor does not respond as it should. Once the error builds up to a certain point this will lead to a following error fault.

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service
- **Code 100** Axis open loop test. Used to check the maximum feed rate of an axis and if the encoders are counting and are they counting in the correct direction.

Possible Cause	Check This
Poor cable connection	Check the cable connections at the motor, computer module and servo amp
Bad Servo Amp	Check the status of LED lights on servo amp when problem occurs. See servo amp diagnostics section 5.6
Bad Motor Encoder	See Motor diagnostics section 5.5
Computer module	See computer module diagnostics section 5.3

4.2.2 Slow Down Axis

The axis slows down and moves at a feedrate that is lower than rapid or than the programmed feedrate.

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service
- **Code 100** Axis open loop test. Used to check the maximum feed rate of an axis and if the encoders are counting and are they counting in the correct direction.
- **Code 503** Sets the maximum rapid feedrates of the machine.

Possible Cause	Check This
The user has set the feedrate override to something less than 100% and hence the machine is moving slower	Check feedrate override.
Service code 503 set to a low value and now the machine is running that rapid speed	Check the setting of service code 503. See service code diagnostics section 5.12.
The control is automatically slowing down the feedrate because the control is not capable of running at the programmed feedrates and minimizing the following error.	Use lower feedrates when programming or change the tool path so the change in direction is not as abrupt.
Inadequate or no Lubrication to Ballscrews and Linear guides	Make sure all the ballscrews and linear guides are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines. See Lubrication Section 3.11
Binding in the Drive Train	Check the torque reading of the Drive Train. Step by step, carefully inspect the Drive Train for any binding. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 5.2

4.2.3 Axis Will Not Jog with Electronic Handwheel

The system powers up but will not respond to the jog command using the electronic handwheel.

Do the following Service Codes and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service
- **Code 132** Each revolution of the EHW should display 100 counts on the screen
- **Code 100** Axis open loop test. Used to check the maximum feed rate of an axis and if the encoders are counting and are they counting in the correct direction.

Possible Cause	Check This
Software may be in an indeterminate state	Press the MODE button and reenter the same screen and see if EHW works.
E-Stop is pressed in	Check E-Stop. Make sure the servo ON button has been pressed to energize the servo system.
The servo amp for a given axis may be disabled	Check the LED lights on each servo amp. If the red and green lights are both on one of the servo amps, press the E-stop to reset the servo amp. See servo amp diagnostics.
EHW has failed	Verify the wiring of the EHW and replace as necessary. If only 1 axis will not jog, then it is not the EHW.
Poor cable or wiring connections	See Electrical Connection Section 3.6 or 5.7
Servo Drive failure	Especially, if only one axis will not jog; See Servo Driver Section 5.6

Possible Cause	Check This
Motor failure	See Motor Section 5.5
Computer module failed	See Computer module diagnostics Section 5.3

4.2.4 Axis Motor Motion is not Smooth

While under motor power, the motion is not smooth. The motion appears to be "rough" or jerky".

Do the following Service Codes and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service
- **Code 100** Axis open loop test. Used to check the maximum feed rate of an axis and if the encoders are counting and are they counting in the correct direction.
- **Code 128** Enter backlash compensation

Possible Cause	Check This
Excessive backlash value entered	Go to service code 128 and note value of backlash for axis in question. Values should be less than 0.0005"
Binding in the Drive Train	Check for excessive backlash in the drive train. Check the torque reading of the Drive Train. Step by step, carefully inspect the Drive Train for any binding. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 5.2

4.2.5 Vibration at Rest

While axis is holding position there is vibration or noise coming from the X, Y or Z-axis.

Do the following Service Codes and procedures:

- **Code 127** Measure's the backlash in the system.
- **Code 128** Enter backlash compensation

Possible Cause	Check This
Too much backlash entered in Code 128	Recheck the machines backlash.
Inadequate or no Lubrication to Ballscrews and linear guides	Make sure all the ballscrews and linear guides are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines. See Lubrication section 3.11
Binding or looseness in the Drive Train	Check for excessive backlash on an axis. Check the torque reading of the Drive Train. Step by step, carefully inspect the Drive Train for any binding or looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 5.2

4.2.6 Searching Axis

The DRO screen is flickering back and forth when the servos are engaged. Several ten thousandths of motion are observed and the frequency is one cycle every couple of seconds.

Do the following Service Code and procedures:

- **Code 127** Measure's the backlash in the system.
- **Code 128** Backlash compensation

Possible Cause	Check This
Most often caused by excess backlash compensation	Check physical backlash in system and re-enter in code 128.
Looseness or excessive friction in the drive train	The drive train of the axis that is searching, especially the tightness of the drive assembly. See Mechanical Drive Train (X, Y) - Section 5.2

4.3 Control Related Problems

4.3.1 Display Blanks

The display is a 12.1 LCD that connects to the computer module via the VGA port. The LCD is driven by 12VDC coming from the computer module through the Overlay Interface PCB.

The display is completely blank with no text or video on the screen.

Please also read section 4.3.6, as this is a similar symptom.

Possible Cause	Check This
Screen saver has been activated	Press any key to turn back on. All LED keys on pendant will blink when the screen saver is on. Press any key to deactivate. Hitting this key will not activate any feature on the control.
Power failure to the Computer Module.	Verify that 115VAC is supplied to the computer module and that the fuse is okay.
LCD Power is OFF.	Verify that the LCD power LED is on and green. Press the LCD power button on the LCD User Board inside the Pendant. See drawing 26584.
If you turned on power to the machine and the VGA cable was not plugged in on the computer side of pendant side or the overlay power cable was not plugged in the screen may go black. The machine will boot up to the WELCOME screen prior to doing this.	Replace compact flash on computer module as a file on it may be corrupt.
Connection problem with the Overlay Power cable.	Verify that the Overlay Power cable is connected properly from the computer module to the Overlay Interface Board inside the Pendant. See drawing 26584.
Connection problem with the LCD 12VDC Power cable.	Verify that the LCD 12VDC Power cable is connected properly between the Overlay Interface Board and the LCD Controller board inside the Pendant.
Connection problem with the LCD	Verify that the LCD Inverter Cable is connected

Possible Cause	Check This
Inverter Cable.	properly between the LCD Controller Board and the LCD Inverter Board.
Connection problem with the VGA cable connection.	Verify that the VGA cable is connected properly between the Computer Module and the LCD Controller Board.
Connection problem with LCD Digital cable.	Verify that the LCD Digital cable is connected properly between the LCD Controller Board and the LCD.
LCD Power failure.	Verify that the LCD power LED on the LCD User Board is on and green. Verify that the 12VCD green LED (D9) on the Overlay Interface Board is on.
The system has shut down	Turn the power switch off; check the computer/pendant fuses and cable connections.
Computer Module failure.	See Computer Module diagnostics, Section 5.3
LCD Controller Board failure.	See LCD Controller Board diagnostics, Section 5.4
Overlay Interface Board failure.	See Interface Board diagnostics, Section 5.4

4.3.2 Distorted Video on Display

The display has strange characters, horizontal bars or other unfamiliar images, or the display continually rolls.

Possible Cause	Check This
Connection problem with the LCD Digital Cable.	Verify that the LCD Digital cable is connected properly between the LCD Controller Board and the LCD.
Connection problem with the VGA cable connection.	Verify that the VGA cable is connected properly between the Computer Module and the LCD Controller Board.
LCD Controller Board failure	See Interface Board diagnostics, Section 5.4
Computer Module failure	See Computer Module diagnostics, Section 5.3

4.3.3 Overlay Key Not Responding

The screen display is normal, but the system will not respond to an Overlay key press. Utilizing an external keyboard or mouse the system will respond.

Do the following Service Codes and procedures:

- **Code 81** (**Programming Panel Key)**
- **Code 82 (Run Panel Key Test)**

To check if the Programming/Run Panel keys are working properly, press each key. If the key is working, the corresponding key on the screen will light up. The pendant will also beep.

Possible Cause	Check This
Connection problem with the Overlay Power cable.	Verify that the Overlay Power cable is connected properly from the computer module to the Overlay Interface Board.
Connection problem with COM port cable.	Verify that the COM port cable is connected properly from the computer module to the Overlay Interface Board.
Connection problem with the Programming Panel cable.	Verify that the Programming panel cable is connected properly from the Programming panel to the Overlay Interface board.
Connection problem with the Run Panel cable.	Verify that the Run panel cable is connected properly from the Run panel to the Overlay Interface board.

Possible Cause	Check This
Computer Module failure	See Computer Module diagnostics, Section 5.3
Overlay Interface Board failure.	See Interface Board diagnostics, Section 5.4
Programming Panel Failure	See Programming Panel diagnostics, section 5.4
Run Panel Failure	See Run Panel diagnostics, section 5.4

4.3.4 Axis Faulting

The program run or jogging operations are interrupted with an Axis Fault Message on the display. For a servo amp fault, you must run service code 507 to reset the amps.

Do the following Service Codes and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 100** Axis open loop test. Used to check the maximum feed rate of an axis and if the encoders are counting and are they counting in the correct direction.
- **Code 507** – reset servo amp

Possible Cause	Check This
Servo Drive circuit breaker tripped.	Verify Q1 is in the ON position. See schematic 26775-SCH at the rear of the manual.
Connection problem with Motor Encoder cable.	Verify that the Motor Encoder cable is connected properly from the motor to the Servo Drive
Connection problem with Motor Power cable.	Verify that the Motor Power cable is connected properly from the motor to the Servo Drive
Connection problem with Axis Control Cable	Verify that the Axis Control cable is connected properly from the Computer Module to the Servo Drive
Excessive friction in the slide ways	See Machine Tool & Setup Section 5.1
Binding or looseness in the Drive Train	See Mechanical Drive Train (X, Y) Section 5.2
Servo Drive failure	See Servo Driver diagnostics, Section 5.6
Motor failure	See Motor diagnostics, Section 5.5
Computer Module failure	See Computer diagnostics, Section 5.3
Servo amp module fan failure	If one of the fans fails it could lead to a fault one or more of the servo amps.

4.3.5 Problems Reading or saving to the USB Drive

The USB ports are USB 2.0 version. Only USB Drives formatted with FAT16 or higher should be used and USB Keyboards and Mouse, no other type of USB devices should be used, as they may not be supported.

Possible Cause	Check This
USB device is full	Check USB device for memory with service code 327
Connection problem with USB cable.	Verify that the USB cable is connected properly from the Computer Module to the Overlay Interface Board
Overlay Interface Board failure.	See Overlay Interface Board Diagnostics, section 5.4
Computer Module failure	See Computer diagnostics, Section 5.3
USB Drive failure	See USB drive might not be compatible with system or has failed. Verify that the USB Drive supplied with the system is functional.

4.3.6 System Will Not Turn On or Boot-Up

Nothing happens when the switch is turned on or the system does not boot-up.

Possible Cause	Check This
Circuit breaker is tripped.	Verify that Q8 and Q10 are in the ON position. See schematic 26775-SCH at the rear of the manual.
Connection problem with the 115VAC cable.	Verify that the 115VAC cable is connected properly to the computer module.
Computer Module fuse is blown.	Remove fuses and check continuity.
Compact Flash is not inserted correctly or has failed	The display will indicate "Disk Boot Failure" if the Compact Flash is not inserted correctly.
Computer Module failure.	See Computer diagnostics, Section 5.3

4.3.7 System Reboots by Itself

During operation, the screen suddenly blanks and then shows that the system has begun the boot-up sequence.

Possible Cause	Check This
Connection problem with the 115VAC cable.	Verify that the 115VAC cable is connected properly to the computer module.
Computer Module failed	See Computer diagnostics, Section 5.3

4.3.8 System Shuts Off

During operation, the system shuts off and will not turn back on.

Possible Cause	Check This
Fuse blown in pendant	Remove fuse and check continuity
Circuit Breaker is tripped	Verify that Q8 and Q10 are in the ON position.
Connection problem with the 115VAC cable.	Verify that the 115VAC cable is connected properly to the computer module.
Computer Module failure	See Computer diagnostics, Section 5.3

4.3.9 Will Not Hold Configurations

The system has 5 main configurations that will contribute the system's overall accuracy and performance that can be adjusted from a Service Code.

- Calibration (Service Code 123) – This configuration saves the calibration factors for each axis.
- Backlash (Service Code 128) – This will allow the system to compensate for the backlash between the motor motion and the actual table.
- Squareness (Service Code 135) –This will allow the system to compensate for the machine being out of square between the X and Y axis.
- Friction Feed-forward (Service Code 134) – This will allow the machine to compensate for the machines initial friction. In particular it adjusts for reversal spikes as seen on a ballbar plot. See section 5.12.
- Spindle Calibration (service code 510) – this configuration saves the calibration factors for the spindle.

The system will not hold configurations. Turn the system off and on and see if the values are held. The defaults for service code 128 and 123 would be zero if they are not being held.

Possible Cause	Check This
Configuration file corrupt	Load a backed up configuration by going to code 141
Compact Flash is full or has failed	Replace Compact Flash

4.3.10 Auxiliary Functions Not Working

There are 3 main Auxiliary Functions available on the system. These 3 Auxiliary functions are to be programmed as part of an event in a program.

- Coolant Pump, this function may be activated or deactivated. The Coolant Pump function needs to be in Auto mode in order to be controlled by the program.
- The Air Blast may be activated or deactivated. The Air function needs to be in Auto mode in order to be controlled by the program.
- Mill Indexer, this function will cause the RM2-K7 relay to activate and thus provide a contact closure to the Mill Indexer. This function may also be placed in a wait state that will cause the program to stop until the input, at I39.2 has been triggered.

The Auxiliary Functions will not turn on or off at the programmed times.

Possible Cause	Check This
Air Blast or Coolant Pump not in Auto mode	Verify that the Air Blast and Coolant Pump is set to auto by holding down its corresponding button for a couple of seconds.
Mill Indexer connection problem.	Verify that the wiring is correct utilizing the Wiring Diagram.
Mill Indexer Power failure.	Verify that voltage is being supplied to the Mill indexer.
RM2-K7 relay failure.	Identify that the light above RM2-K7 relay does turn on when the program activates the Mill Indexer option.

4.3.11 E-Stop Error

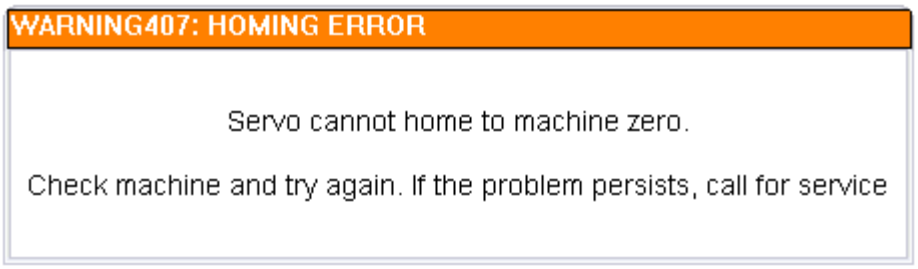
The E-stop will remove power to the Spindle AC Drive, Servo Drives, Tool Changer, Coolant motors, Auger and Z-axis brake via their corresponding relays and K10 relay.

An E-stop error message is displayed on the screen and is unable to reset even when the E-stop is in the out position and the Servo On button has been pressed and the return key has been pressed.

Possible Cause	Check This
Machine is sitting on one of the hard limit switches	If this is the case, go to service code 505 and move machine off of switch.
Connection problem with the E-stop cable.	Verify that the E-stop cable is connected properly from the E-stop button to the Electrical cabinet
N.C. Signal not active	Verify that the N.C. LED relay (RM2-K6) is on.
N.C. Relay failure	See Relay Module diagnostics, section 5.8.
Servo On Button failure	See Servo On Button diagnostics, section 5.4.

4.3.12 Homing Error – Axis, Tool Changer

The homing function is a very critical function that locates and identifies the absolute machine zero position, where all other positions and offset are derived from. This function is to be performed every time the system has been turned on or reset. The homing function will cause the tool changer to move to tool position one, it will also cause each axis to move in the most positive direction that it can.



If a homing error occurs these are some of the possible causes. Note, normally a second error will be displayed once the return button is pressed. The second error will identify why the homing error occurred.

Possible Cause	Check This
Servo Drive circuit breaker tripped.	Verify that Q1 is not on the tripped position. See schematic 26775-SCH at the rear of the manual.
Door is open.	If the Door is open the tool changer will not turn, a "Door Error" should be displayed.
Wiring problem with tool changer.	Verify that the tool changer wiring is correct. See drawing 26734
Tool changer in or out failure. Note the tool changer should be in the out position when homing.	See Tool changer errors section 5.9.
Tool changer will not rotate. Note the tool changer should home to where tool position 1 is facing toward the spindle.	See Tool Changer error section 5.9.
Limit Switch failure.	The system will move the axis to the positive limit switch when homing. If the switch is not seen by the system that axis will hit the hard stop and produce a servo fault error. This is noticeable because the axis will move only toward the end stop, it will not back up away from the stop. See Limit/Switch Replacement, Section 6.21.
Servo Drive failure	See Servo Driver diagnostics, Section 5.6.
Motor failure	See Motor diagnostics, Section 5.5.
Computer Module failure	See Computer diagnostics, Section 5.3.

4.4 Tool Changer or Loading and Unloading Tools from Spindle Problems

4.4.1 Automatic Tool Changer (ATC) will not move

4.4.1.1 ATC will not rotate

The tool carousel will not index from one tool station to the next when commanded. Press the forward and reverse buttons on the run panel to index the ATC carousel. Service code F can be used to check all ATC inputs and outputs. It is a good place to start to see what the control thinks is the status of the various ATC sensors.

Do the following Service Codes and procedures:

- **Code F – Check Inputs & Outputs**

Possible Cause	Check This
Door is open	The door must be closed for the ATC motor to work.
ATC indexing motor has overloaded. When this happens a error messages should appear on the screen.	Has the overload relay Q6 tripped? Refer to the drawing 26571 for its location. Locate the cause of the overload. Reset the overload in the electrical cabinet by pressing the black button and then clear the error on the screen and see if the motor works. The machine will not continue to run when this overload trips. Additional items to check • Check the overload setting. It should be set to 1.3 amps. • Check excessive debris in the ATC indexing mechanism. • Check the indexing pin for damage. • Check the Geneva mechanism for damage to the locking pockets. • Check the Geneva mechanism for damage to the locking segment.
The K7 or K8 contactor has failed. The FWD direction is controlled by K7 and REV by K8.	Check the K17 (FWD or CW) and K18 (REV or CCW) output from RM1 to see if the light is on. If the light is not on, then the signal upstream is the problem and toward the computer module. If the light is on, then the relay K17 or K18 on RM1 or the K7 or K8 contactor may be the problem. If it is the relay, then the individual relay should be replaced. See input/output diagnostics, section 5.8.
OM1 Module Failure	Check if lights Q42.0 or Q42.1 are on or not on OM1. If the lights are on then the computer is OK. If the lights are not on check wiring between compute and module. If the light is on OM1 but not on RM1, then check wiring between OM1 And RM1. See input/output diagnostics, section 5.8.
Geneva indexing pin is lost.	Through the cutout in the ATC shroud (left side) check to see if the indexing pin is present. See drawing 26811.
ATC indexing motor has failed.	Verify that the motor is receiving power yet fails to rotate. Check the motor for continuity between phases and for any shorts to ground. See motor diagnostics, Section 5.5.
Computer module failure	If the wiring between the computer and OM1 is OK but the ATC still does not move, then the computer module is bad.

4.4.1.2 ATC will not advance towards or away from the spindle

When a tool change is commanded, the ATC will not advance toward or away from the spindle.

Possible Cause	Check This
Is the sliding door open	Make sure the door is closed completely and the key is engaging the safety interlock switch.
Compressed air not being supplied to the machine.	Is air connected to the machine? Make certain the in-line air switch is in the open position (upward) Has the air pressure been turned down at the pressure regulator? It should be set at 90 PSI
Low air pressure. A low air pressure warning should appear on the screen when the air pressure falls below 60 psi.	Make sure the machine is receiving a minimum of 100 PSI and the regulator is adjusted to 90 PSI.
Shipping bolt has not been removed.	Remove ATC cover and remove the SHCS that secures the ATC sliding assembly. Make certain the air is switch off while screw is being removed. See figure 3.3c in section 3.
The Tool Detect Sensor is detecting a tool. If this is the case, a warning message should appear on the screen.	Is there a tool in the carousel at the location you are trying to return a tool to? Is there debris on the Tool Detect Sensor that is causing a faulty reading? Is the Tool Detect Sensor set properly? See section 6.16
Something is obstructing the movement of the ATC sliding assembly.	Switch off the air. Remove the ATC cover, upper, and visually inspect for any foreign objects that may be preventing the movement of the ATC.
There is an air leak in one of the air lines feeding the ATC in/out pneumatic cylinder.	With the air switched on, inspect the air lines and fittings for a leak.
The tool changer in and out switches labeled LS7 and LS8 on IM1 on drawing 26775-SCH are in an abnormal state. Before the ATC will move, the control should recognize one of the switches mentioned.	Run service code F to check the state of these switches or Check if LED A4 (ATC out) on IM1 is on or if LED A3 (ATC in) is on. One of these lights should always be on when the ATC is stationary. If neither is on then check the adjustment of the switches.
ATC in/out pneumatic cylinder is faulty	Check for air escaping from the ATC in/out pneumatic cylinder.
The K1 or K2 relay on RM2 has failed	Check the K1 (ATC out) and K2 (ATC in) output from RM1 to see if the light is on. If the light is not on, then the signal upstream is the problem and toward the computer module. If the light is on, then the relay K1 or K2 on RM1 or the solenoid valve may be the problem. If it is the relay, then the individual relay should be replaced. See input/output diagnostics, section 5.8.
OM1 Module Failure	Check if lights Q42.1 or Q42.2 are on or not on OM1. If the lights are on then the computer is OK. If the lights are not on then check wiring between computer and module. If the light is on OM1 but not on RM1, then check wiring between OM1 and RM1. See input/output diagnostics, section 5.8
The solenoid labeled A on drawing 26930 has failed or is not receiving an electrical signal.	On the solenoid check and see if the green LED is illuminated when a command is given. If the light is on then the signal is reaching the solenoid and everything upstream is good. If it still does not work then the solenoid value is most likely bad.

4.4.2 ATC is out of sync with the control

This means the control thinks a different tool is in the spindle than what physically is. It can also mean the control does not recognize the position of the carousel. In other words, the ATC carousel is not at the same tool position that the control says, i.e. the control says the current carousel location is #5 but the ATC is physically at station 2. The following explains what is display in the tool information table on the control.

ATC Pos 2	Loc 9	Tool # 1	Dia 0.5000	Drill

Box # 1 – this reads the location of the ATC tool change position. This is the location directly across from the spindle.
Box # 2 – this is the location the tool in the spindle will be place back into the carousel
Box # 3 – this is the tool # of the tool in the spindle as defined in your program
Box # 4 – this is the diameter of the tool in the spindle
Box # 5 – this is the description of the tool in the spindle

Possible Cause	Check This
Metallic debris is on the ATC home sensor causing a false reading of home.	Check the ATC home sensor for metal chips that are stuck to the sensor. Re-home the machine. Whenever this situation arises, you must re-home the machine.
The ATC counter sensor is not counting correctly. See drawing 26784 for an illustration of this sensor and drawing 26811.	Make sure the counter sensor is centered in the middle of item 15 on drawing 26811. If the sensor is not centered then the sensor may misread and lead to an out of sync condition. Check LED A2 on IM1 to see if the sensor is counting each time the ATC is indexed.
The tool detect sensor failed to detect that a tool was present. Failure of this sensor to read correctly can lead to crashes on the machine. The tool detect sensor adds a layer of protection against crashes when the control does get out of sync with the control.	Check the LED on the tool detect sensor, it should be red when a tool is present and green when a tool is not. Has the tool detect sensor been damaged? Has the tool detect sensor cable been damaged?

4.4.3 ATC will not home

The home position is when tool location #1 is in the "ready to load" position, and tool location #9 is viewable through the shroud cutout, left hand side. Each time the machine is turned on in the morning the machine must be homed.
See section 4.3.12 for additional information

Possible Cause	Check This
The ATC home sensor is not recognizing the home position stud. If this happens the ATC will rotate 1 complete revolution and then error out stating that it cannot home.	Is the home detect stud properly adjusted? There should be approximately a .100" air gap between the sensor and the stud. Place a steel object beneath the home sensor and check if the LED on the top of the sensor changes from orange to green. If the LED is working then check the LED light A5 on IM1.
Motor overload is tripped	Is there a warning message on the screen? Reset overload in the electrical cabinet.
Motor has failed	See section 5.5.3

4.4.4 Spindle will not orientate properly

Each time a tool change is performed, the spindle must orientate the spindle so the dogs line up with the ATC fingers that hold the tool. Spindle will rotate slowly during this time.

Do the following Service Codes and procedures:

- **Code 510 – Spindle Setup**

Possible Cause	Check This
The belt has slipped and now the orientation angle is off	This is only likely after a heavy crash on the machine. If this happens you will need to perform service code 510 - spindle orientation to resolve the issue.
The spindle encoder is not being read properly.	There is an index mark on the spindle encoder that we are reading to orientate the spindle. Check this by running service code 510. Make sure parameter 10-19 in the AC drive matches the value set in service code 510
Poor cable connection at spindle encoder, AC drive or computer module.	Check the cable connection at the spindle motor and AC drive. Also check the cable that runs from the AC drive to the computer module
Spindle drive failure	Replace drive
Computer module failure	Replace computer module. See section 5.3 or 6.4.

4.4.5 Tool will not clamp or unclamp in the spindle

The automatic draw bar uses pull fingers that close down and pull up simultaneously on the retention knob to lock the tool holder into the spindle taper. These fingers act in the opposite fashion to release the tool holder. Tools can be clamped and unclamped manually by pressing the green button on the head. See section 4.5.14 for troubleshooting on this button.

Possible Cause	Check This
The control thinks the door is closed when pressing the green button on the head.	The door must be open for the green button to work
No or low air pressure	There is no air being supplied to the machine. Is the in-line air switch off? Is the pressure regulator set at 90 PSI Is there a leak in the pneumatic system?
Are the tool holder(s) or the spindle taper bore dirty?	Examine the spindle taper bore and the tool holder for embedded chips and "tackiness" from excessive coolant residue. Sometimes tools that are worn or have defects on the taper will stick in the spindle.
The automatic draw bar adjusting screw is not set properly.	Check the air gap between the air gap between the air cylinder adjusting screw and the automatic draw bar, the gap should be 5mm (.200") **with the system pressurized.** Look for wear to the air cylinder adjusting screw caused by the impact with the draw bar. Are the SHCS that secure the clamping ring tight?
The retention knob you are using is not correct for this machine	See section 2 for an illustration of the correct retention knob.
Loose tool holder retention knob	Check that the retention knob is tightened to the torque value of between 70 and 85 ft lbs
Bellville washers are damaged, worn or fatigued.	With a CAT40 tension gage, check the pull strength of the draw bar, it should be approximately 1500 lbs.
The pull fingers inside the spindle have become loose	Check the fingers are tightened to the torque value of 20 ft lbs. The spindle would have to be removed to check this.

Possible Cause	Check This
The pull fingers inside the spindle have been damaged	Remove the pull fingers and visually inspect for damage and replace as necessary

4.4.6 Air is not blowing through the spindle during a tool change

Air should blow through the spindle when a tool holder is being removed, whether automatically or manually. The amount of air that flows down the spindle is controlled by a flow control valve at the rear of the machine. See drawing 26930. Press the green button on the head when the door is open to check this.

Possible Cause	Check This
No or low air pressure	There is no air being supplied to the machine. Is the in-line air switch off? Is the pressure regulator set at 90 PSI Is there a leak in the pneumatic system?
The flow control valve is not adjusted properly	Check that the flow control valve is adjusted outward from the closed position, five complete turns. See item 5 on drawing 26930.
There is a blockage	Check that there are no kinked lines. Remove the air tubing from the quick disconnect fitting at the lower base plate of the air cylinder, air should flow through the air cylinder adjusting screw when compressed air is applied the fitting. Check for blockages at either the air cylinder adjusting screw or the draw bar.
The bolt that engages the spindle drawbar has been damaged. See item 10 on drawing 26854.	A hole exists in this bolt that allows air to flow down inside of the spindle. If this hole was damaged due to some sort of crash, then this bolt will need to be replaced.
The K2 relay on RM1 has failed	Check the K2 output from RM1 to see if the light is on when the green button is pressed. If the light is not on, then the signal upstream is the problem and toward the computer module. If the light is on, then the relay K2 on RM1 or the solenoid valve may be the problem. If it is the relay, then the individual relay should be replaced. See input/output diagnostics, section 5.8.
OM1 Module Failure	Check if light Q40.1 is on or not on OM1. If the light is on then the computer is OK. If light is not on then check wiring between computer and this module. If the light is on OM1 but not on RM1, then check wiring between OM1 and RM1. See input/output diagnostics, section 5.8.
The solenoid labeled D on drawing 26930 has failed or is not receiving an electrical signal.	On the solenoid check and see if the green LED is illuminated when a command is given. If the light is on then the signal is reaching the solenoid and everything upstream is good. If it still does not work then the solenoid value is most likely bad.

4.5 Control Input or Output Problems

4.5.1 Limit Switch Error

Limit switches are installed to prevent serious damage to the machine. There are two types of limit switch errors that you may encounter, a soft limit or hard limit switch. The following chart will help you troubleshoot for both. A flashing message will appear when a soft limit is activated. To clear this condition, use the EHW to move off of the limit. For a hard limit switch, the control will create a detailed error message and refer you to service code 505 to get the machine off of this limit switch.

Do the following Service Code:

- **Code 505 – Over travel Limits**

Possible Cause	Check This
X-axis soft limit active	This flashing message will appear once you have reached the end of travel for that axis. Using the EHW move off the limit.
X-axis hard limit error message	This message will appear if you travel past the soft limit and trigger a limit switch. Use service code 505 to jog off the limit.
Limit switch failure	Verify that limit switch is working properly. Check for loose connection to terminal block or input modules, IM1 and IM2. Refer to drawing 26775-SCH. If an axis limit is tripped and no message appears. Check the LED status for that limit switch in question. Use the following as reference: X axis plus/home limit IM1 I33.0 Negative limit IM2 I37.4 Y axis plus/home limit IM1 I33.1 Negative limit IM2 I37.5 Z axis plus/home limit IM1 I33.2 Negative limit IM2 I37.6 Refer to 26734 system diagram.
IM1 and IM2 not receiving power	Check that LED A1 on IM1 and IM2 is on or not. If the LEDs are on, the IM1 and IM2 modules are fine. If not check the I/O cable connection between the computer module and the IM1 or IM2 module. If cable appears OK then computer module has failed.
Computer Module failed	See computer module diagnostics, section 5.3

4.5.2 Axis stuck past the limit switch

This condition is rare. As rare as it may be this will occur if the axis moves past the its soft limits and is resting on a hard limit switch.

Possible Cause	Check This
Axis made an unexpected move past soft limit	Go to code 505 to move off hard limit and past soft limit. If condition continues see symptom 4.2.1 or 4.3.4

4.5.3 Air blast feature not working

The feature is used to remove chips and/or debris off of the tool in the spindle. It can be turned on or off like a switch when the ON button is pressed under the air blast section of the RUN panel. This is also a programmable auxiliary function that can be set to turn on and off within your program using the AUTO feature. This feature can be used with the door closed only.

Possible Cause	Check This
No air	Check that incoming airline is connected or that air regulator is set correctly. Check that the air in line switch is in the open position. Refer to drawing 26930 - pneumatic assembly.
Air blast valves closed	Check each valve and open if necessary.
Solenoid not working	Verify that the solenoid allows air to flow through by pressing the manual override value for the solenoid. Refer to pneumatic system diagnostics section
The K6 relay on RM1 has failed	Check the K6 output from RM1 to see if the light is on when the air on button is pressed. If the light is not on, then the signal upstream is the problem and toward the computer module. If the light is on, then the relay K6 on RM1 or the solenoid valve may be the problem. If it is the relay, then the individual relay should be replaced. See input/output diagnostics, section 5.8.
OM1 Module Failure	Check if light Q40.5 is on or not on OM1. If the light is on then the computer is OK. If light is not on then check wiring between computer and this module. If the light is on OM1 but not on RM1, then check wiring between OM1 and RM1. See input/output diagnostics, section 5.8
The solenoid labeled B on drawing 26930 has failed or is not receiving an electrical signal.	On the solenoid check and see if the green LED is illuminated when a command is given. If the light is on then the signal is reaching the solenoid and everything upstream is good. If it still does not work then the solenoid valve is most likely bad.
Computer module failed	See computer module diagnostics, section 5.3

4.5.4 Control reports low air pressure

The Control has the ability to display a number of different messages depending on the status of the machine. A low air message would be displayed as 'AIR PRESSURE LOW'. The following chart describes possible causes to this condition.

Possible Cause	Check This
Air in line switch to machine not open	Make sure that the air in line switch is open to allow in air. Refer to drawing 26930.
Air line pinched	Check that air hose is not pinched or bent.
Air pressure not set	Check air regulator for the correct psi setting. Verify that it is set to 90psi.
Air pressure sensor not working	Check the air pressure sensor is set to 4kg/cm². Check the status LED on IM2-A5 is on. If on, the air pressure is fine and the sensor is working. If not, make sure wires I36.6 and 24DC-1 is properly secure to IM2-A5 and A5-com terminals.
IM2 module failed	Verify that IM2 A1 LED is on. If it is on the IM2 module is fine. If not check the cable connection between the computer module and the IM2 module. If the cable connection looks good then the problem may be the computer module.
Computer module failed	See computer module diagnostics, section 5.3

4.5.5 Status lights are not functioning correctly

The status lights are used to identify the state of the program in RUN mode. The Green status light indicates that the program is running. The Yellow status light indicates that the program is waiting for input from the operator or is in a dwell state. The Red status light will indicate a fault condition or problem in both DRO and in RUN mode.

Do the following Service Code:

- **Code F – Input/Output Service Code**

Possible Cause	Check This
Status lights failed	Check the wiring connection to RM1-K3, K4, and K5 on the module. Ensure that the wire is connected to the normally open (NO) terminal of the relay. RED light RM1-K3-NO YELLOW light RM1-K4-NO GREEN light RM1-K5-NO Using service code F turn on the status lights. If one or all lights do not turn on. Check for 24VDC across the NO terminal and ground on the relay (K3 K4 K5). If power is present check the bulb for the light(s) not turning on and replace as necessary. If no power check the connection to RM1
K3, K4, K5 relay on RM1 failed	Verify that relay is energizing. Verify that the status LED above each relay on RM1 turns on or not. Use service code F to turn on/off the status light. Toggle the status light on (red, yellow, or green). If the LED turns on, the RM1 module is fine. If not check the connection between the OM1 and RM1 modules.
OM1 Module Failure	Check if lights Q40.2, Q40.3 or Q40.4 are on or not on OM1. If the lights are on then the computer is OK. If light is not on then check wiring between computer and this module. If the light is on OM1 but not on RM1, then check wiring between OM1 and RM1. See input/output diagnostics, section 5.8.
Computer module failed	See computer module diagnostic, Section 5.3

4.5.6 Door lock is stuck, will not lock or door open message is constantly flashing

The door lock is used to ensure the safety of the operator. A flashing message appears on the screen when the door is open. It has an AUTO feature that when activated it will lock the door during a program. It will then turn the door lock on and off automatically at the beginning and end of programs. If you do not use this feature the door will only lock during all tool changes automatically.

Possible Cause	Check This
Switch is in the unlock position	Check that the switch is set to the lock position. If it is not this will not allow the switch to lock when the door is closed and the key is pressed. Note: From the factory the switch should be set to the lock position.
No power to switch	Check for 24VDC. Refer to drawing 26734 system diagram.
Not wired correctly	Verify that the switch was wired correctly. There are 4 wires. The blue wire goes to switch pin E1, the white wire goes to E2, the black wire goes to 21 and the red wire goes to 22.

Possible Cause	Check This
The K7 relay on RM1 has failed and the door will not lock or unlock.	Check the K7 output from RM1 to see if the light is on when the door lock should be locked. If the light is not on, then the signal upstream is the problem and toward the computer module. If the light is on, then the relay K7 on RM1 may be the problem. If it is the relay, then the individual relay should be replaced. If K7 on RM1 has failed & no VDC out the door lock will not release. See input/output diagnostics, section 5.8.
IM1 module failed (I34.6) and door open message always appears on the screen.	Verify that A1 LED on IM1 is on. If it is on, the IM1 module is fine. If not check the connection between the computer module and IM1. With the door CLOSED verify the IM1-A13 LED is on. If it is on, the connection to IM1-A13 is good. If not check the connection between IM1 and door relay K9. Check for 24VDC at K9 A1 to ground. If power is present K9 is good. If not then check the connection between K9 and the door switch. If the connections between these points are good then IM1 is bad.
OM1 module failed (Q40.6) and door will not lock when it should	Verify that A1 LED of OM1 is on. If it is OM1 is fine. If not check the connection between the computer module and OM1. With the door switch OPEN verify that the OM1-A5 LED is on. If not check the connection between the OM1 and RM1 module.
Computer module failed	See computer module diagnostic, section 5.3

4.5.7 Lube pump not working

The lube pump plays a key role in assuring the performance and durability of the LPM. Lack of lubrication can lead to problems with your machine motion due to increased friction on the sliding ways. This lube pump is set to lubricate the sliding ways and ball screws upon initial power up of the control and every 30 minutes of axial movement. See section 3.11 for more information.

Possible Cause	Check This
Flashing "Lube Low" message	Verify adequate amount of lube oil is in reservoir tank. Add to level indicated on label on pump. The machine can only run for 2 program cycles before we will not allow it to run any longer.
Q11 overload failed	Verify that Q11 overload is not tripped. If so reset Q11. If not, check the output end of the overload for power 110VAC. If power is present the overload is fine. If no power is present at the output check the input end of Q11. If no input power is present check the connection between Q11 and Q10 overloads.
RM1-K9 failed	Check the wire connection to and from RM1-K9 relay. Verify that the LED above the relay turns ON when the lube pump button in service code F is turned ON. If the LED turns ON but there is no 115VAC measured at the "NO" terminal of the RM1-K9 relay, then the relay has failed.
OM1 failed	Verify that OM1 LED A1 is on. If it is on OM1 is fine. If not check the cable connection between the computer module and the OM1 module.
Computer module failed	See computer module diagnostic, section 5.3
Fuse on Lube pump blown.	Check 5 Amp Fuse on Lube pump. Fuse: 5x20mm 5 Amp, Fast Blow. Possible replacement: Mfg: Little Fuse P/N 218005.HXP

4.5.8 Work lights do not come on

There are two work lights inside the LPM. These lights come on as soon as main power is applied. If not check the following:

Possible Cause	Check This
Light bulb burnt out	Verify that the florescent bulb is good. Remove the screw that hold the light cover on and twist bulb to remove. Make sure main power is off.
No 24VAC	Verify 24VAC output at transformer. Using a voltmeter set to AC voltage check across the OV and 24V terminals. If power is present the transformer is fine.
No power to work lights	Check Q9 circuit breaker is not tripped. If it is reset circuit breaker. Check the output end of the breaker for the 24VAC. If power is present Q9 is fine.
RM1-K10 failed	Check the wiring connection is good and to the correct terminal on K-10 relay, normally closed.
OM1 module failed	Verify that A1 LED on OM1 module is on or not. If LED A1 is on the OM1 module is fine. If not check the cable connection between the computer module and the OM1 module. Check LED OM1-B6 (Q41.1) is on or not. If on the work lights will be off. Use PMAC stat under the I/O tab check the lights section and verify that the work light have not been turned off. If so using a keyboard toggle the button labeled Work. Should change from green to red. If work lights remain off computer module has failed.
Computer module failed	See computer module diagnostics, section 5.3

4.5.9 Coolant pump is not working

The coolant pump is not working when you press the ON or AUTO button on the run panel overlay. The ON button acts just like an on and off switch. The coolant will work with the door open and spindle off. For the AUTO feature, you must program the pump to come on and turn off in your program. See the LPM Programming and Operating Manual if you are unclear about this feature.

The coolant pump must be running for the coolant gun nozzle to work.

Possible Cause	Check This
Coolant pump is rotating backwards	Turn the pump on and off and note the direction of the fan on top of the pump. The pump has arrows on top of it to depict the direction it should go. This should only be a problem at the initial installation of the machine and once it is correct it will always be correct.
The control must be in a mode that allows the pump to run	Make sure control is in DRO or RUN modes. The AUTO feature only works in RUN mode.
The coolant pump overload Q5 has tripped	When the overload trips it will cause an error message to be displayed on the screen. Reset the overload in the electrical cabinet by pressing the black button and then clear the error on the screen and see if the pump works.
The K6 contactor has failed	Check the K11 output from RM1 to see if the light is on. If the light is not on, then the signal upstream is the problem and toward the computer module. If the light is on, then the relay K11 on RM1 or the K6 contactor may be the problem. If it is the relay, then the individual relay should be replaced. See input/output diagnostics, section 5.8.

Possible Cause	Check This
OM1 Module Failure	Check if the light Q41.2 light is on or not on OM1. If light is on then the computer is OK. If light is not on then check wiring between computer and module. If the light is on OM1 but not on RM1, then check wiring between OM1 and RM1. See input/output diagnostics, section 5.8.
Q5 overload has failed	Check if voltage is present coming out of the overload. Make sure the overload is not tripped.
Coolant pump has failed	Check the pump for continuity between phases and for any shorts to ground. See motor diagnostics, section 5.5
Computer module has failed	See computer module diagnostics, section 5.3

4.5.10 Coolant wash pump is not working

The coolant wash pump is used to wash chips from the LPM chip pan down into the auger or chip collection pan. This feature can be turned on at any time by pressing the coolant wash button on the run panel. The coolant wash can be run in any mode and door can be open during this operation except when running a program in run mode.

Possible Cause	Check This
Coolant pump is rotating backwards	Turn the pump on and off and note the direction of the fan on top of the pump. The pump has arrows on top of it to depict the direction it should go. This should only be a problem at the initial installation of the machine and once it is correct it will always be correct.
The coolant wash pump overload Q4 has tripped	When the overload trips it will cause a flashing error message on the screen. Reset the overload in the electrical cabinet by pressing the black button and then clear the error on the screen and see if the pump works. The machine will continue to run when this overload trips.
The K5 contactor has failed	Check the K12 output from RM1 to see if the light is on. If the light is not on, then the signal upstream is the problem and toward the computer module. If the light is on, then the relay K12 on RM1 or the K5 contactor may be the problem. If it is the relay, then the individual relay should be replaced. See input/output diagnostics, section 5.8.
OM1 Module Failure	Check if the light Q41.3 light is on or not on OM1. If light is on then the computer is OK. If light is not on then check wiring between computer and module. If the light is on OM1 but not on RM1, then check wiring between OM1 and RM1. See input/output diagnostics, section 5.8
Q4 overload has failed	Check if voltage is present coming out of the overload. Make sure the overload is not tripped.
Coolant wash pump has failed	Check the pump for continuity between phases and for any shorts to ground. See motor diagnostics, section 5.5
Computer module has failed	See computer module diagnostics, section 5.3

4.5.11 Chip auger is not working

The chip auger is used to evacuate chips from the LPM to the chip cart found on the left side of the machine. Chips are evacuated when you press the FWD button on the run panel. Reverse is only used to reverse the motor if it gets stuck. You must hold down this button while the motor rotates backwards.

Possible Cause	Check This
Chip auger motor is rotating backwards	When you press the FWD button, the motor and screw should be turning CCW when viewed from behind the motor. This should only be a problem at the initial installation of the machine and once it is correct it will always be correct.
Auger is slipping	The set screws that secure the auger to the motor shaft have come loose.
The auger motor overload Q3 has tripped	When the overload trips it will cause a flashing error message on the screen. Reset the overload in the electrical cabinet by pressing the black button and then clear the error on the screen and see if the motor works. The machine will continue to run when this overload trips.
The K3 or K4 contactor has failed. The FWD direction is controlled by K4 and REV by K3.	Check the K14 (REV) and K15 (FWD) output from RM1 to see if the light is on. If the light is not on, then the signal upstream is the problem and toward the computer module. If the light is on, then the relay K14 or K15 on RM1 or the K3 or K4 contactor may be the problem. If it is the relay, then the individual relay should be replaced. See input/output diagnostics, section 5.8.
OM1 Module Failure	Check if the lights Q41.5 or Q41.6 is on or not on OM1. If light is on computer is OK. If light is not on then check wiring between computer and module. If the light is on OM1 but not on RM1, then check wiring between OM1 and RM1. See input/output diagnostics, section 5.8.
Q3 overload has failed	Check if voltage is present coming out of the overload. Make sure the overload is not tripped.
Auger motor has failed	Check the pump for continuity between phases and for any shorts to ground. See motor diagnostics, section 5.5
Computer module has failed	See computer module diagnostics, section 5.3

4.5.12 Z Axis Motor Brake is not working

The LPM has no counterweight to support the head when the servos are off. The Z motor has a brake that comes on whenever the power to the servomotor is turned off. If this brake fails and does not engage, the head will move downward at a few hundred inches per minute. If the brake does not turn off, the motor will most likely fault since it is trying to move the head and has additional load due to brake being on.

4.5.12.1 Z Axis Motor Brake is always on

Possible Cause	Check This
Wiring has come loose to K16 relay on RM1 module	Check all wiring and make sure it is seated properly.
K16 relay has failed on RM1	Check if light is on or off on K16. If light is on it indicates command from computer is telling the brake to release. See input/output diagnostics, section 5.8.

OM1 module has failed.	Check if the light Q41.7 is on or not on OM1. If light is on computer is OK. If light is not on then check wiring between computer and module. If the light is on OM1 but not on RM1, then check wiring between OM1 and RM1. See input/output diagnostics, section 5.8.
Computer module failure	Identify the status of the Z axis brake light on the computer module. When the brake is off, the light should be green. If it is red then the computer is sending a signal to turn brake on. See computer module diagnostics, section 5.3.
Motor brake has failed	Replace axis motor. See motor diagnostics, section 5.5.

4.5.12.2 Z Axis Motor Brake Will Not Turn on

Possible Cause	Check This
Motor brake has failed and won't engage	Remove power from motor. If brake is still off then replace axis motor. See motor diagnostics, section 5.5
RM1-K16 relay is faulty.	The LED light on RM1-K16 will go off when the brake comes on. With a volt meter verify that the 24VDC goes to 0 volts on the NO contact of RM1-K16 (24DC-22) as soon as the red LED turns off on the RM1-K16 relay If the relay is delayed from going from 24VDC to once the computer module gives it the signal, then the head will come down. The LED light on the computer module is red when the brake should be on. Pressing the E-stop will always turn the brake on since it kills power to the brake. If you suspect the relay, then switch it with one of the spare relays on the RM1 module.
Computer module failure	Check the LED light on the computer module, if light is green then the computer must be replaced. See computer module diagnostics
Servo Driver failure	See servo driver diagnostics, section 5.6

4.5.13 Servo on button is not working

The LPM has a servo on button, which is found on the right side of the pendant. This button must be pressed each time the LPM is powered up or after the E-stop button is pressed. The servo on button allows power to flow to the axis and spindle motors. The button should be illuminated in green when energized.

Possible Cause	Check This
Machine is sitting on hard limit switches	Make sure the machine is not sitting at a limit switch which will disconnect power. If it is, then go to service code 505 to get off of limit switch. The LED light K5 on RM2 will be off when the condition exists.
E-stop wiring problem	Check wiring to E stop and switch itself.
NC ready function has failed	If servo on light is off, check wiring between computer module, OM1 and RM2 K6. Check the light K6 on RM2. If this light is not on then check Q43.1 light on OM1.
OT override function has failed	If servo on light is off, check wiring between computer module, OM1 and RM2 K5. Check the light K5 on RM2. If this light is not on then check Q43.0 light on OM1.
Reset button failure	Check the wiring to the reset button

Possible Cause	Check This
K11 relay is not energized	Check the LED light on the K11 relay. If the light is not on then a problem exists with this relay or the wiring to the relay. See input/output diagnostics, section 5.8.

4.5.14 Manual tool loading button is not working (green button on head)

The LPM has green button on the front of the head, which allows the user to manually load a tool into the spindle. Pressing this button activates an air cylinder, which pushes down on a drawbar in the spindle. This in turn opens up the fingers that grip the retention knob on your tool. When this button is released, the air cylinder moves up and the fingers grab the knob and hold the tool in the spindle.

Warning – Be careful when loading tools. The tool is held in the spindle with as much as 1500 lbs of force.

Possible Cause	Check This
No air or low air is supplied to the machine	The screen should have a flashing air pressure low message if this is true.
Switch has failed	Check the LED B9 on IM1 to see if the light comes on when the button is pressed. If it does not, then remove switch from front of head and check wiring and continuity. Replace as necessary.
The K1 relay on RM1 is not working. This could mean the RM1 module is bad or the computer module.	Checking the status of the LED light for K1 on RM1 when the button is being pushed. The LED light should be green when pushed and off when not pushed. If the light is on when expected then the problem is downstream and could mean the air solenoid is not working properly. If the light is not on then the problem could be the RM1 module or computer module.
Air solenoid that supplies air to the tool change air cylinder is not working	Check the Y1 solenoid in question. Check pneumatic diagnostics, section 5.10.
Computer module failure	If no LED on OM1, Q40.0 then computer module may be the problem See computer module diagnostics, section 5.3

4.6 Measurement Problems

4.6.1 X, Y and Z-Axis Measurements Do Not Repeat

With a dial indicator mounted to the bottom of the spindle, touch off a fixed surface either in the X or Y-axis direction and then set the DRO equal to 0. Crank away several inches and then touch off again at the same place. If the reading has not returned to 0 on the DRO, zero the display and repeat the procedure. This will test for uni directional repeatability. If the measurement does not repeat, you have a repeatability problem that must be resolved.

Test for accumulative error by moving the axis a number of times to see if the error gradually grows by a small amount. If the error abruptly changes by a large amount it may be caused by a bad motor encoder.

Expected repeatability numbers should be 0.0002" or less.

Bi directional repeatability tests moving up to the same point from different directions. If the machine does not repeat bi directionally, then you may need to adjust your backlash compensation for the given axis using service code 128. See section 7.2.

In order to identify whether the problem is mechanical or electrical/software, make a mark on the motor and verify the motor shaft or coupling returns to the correct position. If it does, but your indicator does not, then the problem is mechanical in nature.

Possible Cause	Check This
Machine Tool & Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). Make sure there is sufficient contact between the tool holder and the spindle. See Machine Tool & Setup Section 5.1
Thermal expansion of the ballscrew	This should not be apparent since we pre-tension the ballscrews. If the machine is run very hard at high feedrates then this may come into play.
X and Y-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 5.2. The coupling is the first place you should look. Make sure the coupling is not slipping on the motor or ballscrew end.
Encoder Disk or Reader Head on motor are loose	Swap the motor in question with a known good motor. For example, swap the X-axis motor with the Y-axis motor. If the symptom stays with the motor in question, then replace the motor. If not, then the motor is not at fault and something else is causing the problem.
Spindle and/or Quill are loose	Use a Dial Indicator and check for side-to-side movement between the Spindle and the Head. Next, check for side-to-side movement between the Quill and the Head. There should be no more than 0.0003" of side-to-side movement.

4.6.2 X, Y, and Z-Axis Measurements are not Accurate

Measurements repeat, but with a dial indicator mounted to the bottom the spindle, traversing the length of a gage block or some other measurement standard, the measurement is not accurate. Check for accuracy in 1 direction initially so as to not bring backlash compensation into play. If you reverse direction and have not set the backlash correctly, this could be the cause of your error.

Note: If your part has incorrect dimensions, see Parts Have Incorrect Dimensions, Section 4.1.3.

Note: First check for repeatability of the DRO: With a dial indicator mounted to the bottom of the spindle, touch off a fixed surface either in the X, Y, or Z-axis direction and set the DRO equal to 0. Crank away several inches and touch off again at the same place. If the reading has not returned to 0 on the DRO, zero the display and repeat the procedure. If the measurement does not repeat, you have a repeatability problem that must be resolved before the accuracy problem can be resolved. See Measurements Do Not Repeat, Section 4.6.1.

Possible Cause	Do This
Part has been programmed wrong	Check the programming of your part to make sure no errors were made.
The tool diameter or tool length has not been entered correctly	Make sure you have measured the OD of the cutter and entered it correctly. Also check the tool length entered for your tool.
Machine Tool & Setup problem	This is the first place to start because if you setup is not sufficient it will affect the accuracy of your part. Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). Make sure there is sufficient contact between the tool holder and the spindle. See Machine Tool & Setup Section 5.1
Ballscrew Coupling is loose	Make sure the coupling is not slipping on the motor or ballscrew end.
Thermal expansion of the ballscrew	This should not be apparent since we pre-tension the ballscrews. If the machine is run very hard at high feedrates then this may come into play.
Calibration values are not set	Go to service code 123 for the axis in question and verify values are displayed in the table. If the table consists of all zeros then the calibration has been lost or has not been done. See service code section for more information
The Calibration is incorrect	Recalibrate the machine. See Calibration & Backlash Constants, sections 7.1 & 7.2
Incorrect backlash values	If the machine does not repeat bi-directionally check the backlash on the axis in question. See Section 7.2.

4.6.3 The DRO is not counting

The DRO for one axis is not counting when an axis is moved. Often times if this is the case the axis will fault. See Faulting Axis Section 4.3.4

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 100** Axis open loop test. Used to check the maximum feed rate of an axis and if the encoders are counting and are they counting in the correct direction.

Possible Cause	Check This
The E-stop is pressed	Undo the E-stop and press the Servo on button
Servo amp failure	See Servo amp Section 5.6
Motor Encoder not counting	See Motor diagnostics, section 5.5
Computer module failure	See Computer module diagnostics, section 5.3

4.6.4 Electronic Handwheel Moves Machine in Wrong Direction

The Electronic Handwheel moves the machine in the wrong direction on all 3 axis. When you move the EHW in a CW fashion on the machine, each axis will move in a positive direction.

Possible Cause	Check This
The EHW has been just replaced and wired wrong	Make sure the A and A' wires and B and B' wires are fastened to the proper terminals on the EHW.

4.7 Machine Tool Problems

4.7.1 X, Y or Z-Axis Noisy

While jogging or cutting on a particular axis, the axis makes unusual noises. See below for axis noise.

Possible Cause	Check This
The way covers are not properly aligned	Move the axis that the noise is coming from until the way cover is collapsed completely, slacken the SHCS that secure the way cover to the spindle bracket, allow the cover to center itself and then retighten. Examine way cover for damage.
Inadequate or no Lubrication to the Ballscrew and linear guides	Make sure the ballscrew and linear guides are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines. See Lubrication Section 3.11 and drawing 27050.
Machine Tool and Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). See Machine Tool & Setup Section 5.1
A crash has damaged the angular contact bearings.	Remove the bearings and check for damage, any damage felt by rotating the bearings in your hand may be very subtle.
Mechanical Drive Train	Misalign ballscrew, or top and lower bearing failure.
Z-axis motor failure	Replace Z-axis motor See Motor Diagnostics Section 5.5

4.7.2 Spindle Stalls or Turns-Off During Machining

During machining, the spindle turns off and loses power. The LPM has a spindle load meter that measures the cutting load on the spindle. The bar on the screen measures from 0 to 150% of what the spindle is capable of. The spindle is able to maintain the spindle load up to 100% on a continuous basis. The spindle motor is capable of running over 100% for a period of a minute or 2. Once the system runs above 100% for more than a few minutes a spindle drive fault is likely. The spindle drive will shut the system down to prevent any long-term damage to the motor.

Possible Cause	Check This
Machine Tool and Setup problem	Check the type of material being cut, type and size of cutting tool, RPM, and Feed rate. Also check the condition of the cutter to verify that the cutter is not dull. See Machine Tool & Setup Section 5.1
Drive Belt in the head is slipping	Check the alignment, condition, and tension of the Drive Belt.
Cut more than the machine is capable	Check width and depth of cut
Spindle Drive Thermal Overload Relay has tripped	IOUT - Current Out (located on the Spindle Drive) cannot exceed 40 amps for more than a few minutes. When the spindle drive faults, a drive fault message will appear on the screen.
Spindle Drive parameters are not correct	May need to re-download the Spindle Drive parameters. Contact Customer Service for assistance.
Spindle run command not reaching AC Drive	See diagnostic section 5.6.2 for how to check this signal.

4.7.3 Spindle Motor Hums or Will Not Run

The spindle motor makes a constant humming noise during operation or will not turn on.

Note: machines can only be wired for 220 volts. 440 volts will ruin electrical components in the machine. These components will not be covered under warranty.

Possible Cause	Check This
Wrong voltage	Check the voltage to the machine before and after the Spindle Drive with a Voltmeter. Also, check the voltage to the Spindle Drive (L1, L2, and L3).
Poor wiring connections	Check all the wiring connections to the Spindle Drive and Spindle Motor. See section 6.13 for a wiring diagram for the spindle motor.
Spindle Drive may be in "Local Mode" and can not be run from the Pendant	On the Spindle Drive, push the "PU". If the PU letters under the display are red, then the drive is in local mode. Press the PU button once again to turn this feature off.
Spindle Motor is faulty	Check the resistance of the spindle motor windings on the spindle motor between L1 (U) and L2 (V), L2 (V) and L3 (W), then L1 (U) and L3 (W) using a digital ohmmeter. If the ohmmeter reads more than one (1) ohm difference or "OL" (infinite) between any pair, replace the motor. The next check is for resistance to ground using a digital ohmmeter. Check L1 (U) to ground, L2 (V) to ground, and L3 (W) to ground. The meter reading in the display window should be "OL" (infinite) with reference to ground. Any other reading indicates a problem, and the motor should be replaced.
Spindle Drive contains incorrect parameters and is not programmed correctly	Contact customer service.
Spindle enable signal not reaching AC Drive	See diagnostic section 5.6.2 for how to check this signal.

4.7.4 Spindle Runs Backwards

The spindle motor runs in the opposite direction. The direction should be set at the factory and so this should not be the case in the field. Since the spindle motor is run with an AC drive, switching the power wires coming into the machine will have no affect on direction.

Possible Cause	Check This
3-Phase wires backwards	Switch any 2 of the 3 wires either coming out of the AC Drive (T1, T2 & T3) or going into the Spindle Motor (U, V & W). Caution: Be sure to shut off all power to the machine before attempting to switch any wires.

4.7.5 Head Noise

Head noise pertains to any unusual noises coming from the head under load and no load situations. Most often head noise will only be noticeable under load situations. It is important to try to distinguish between problems with components in the head versus problems caused by the setup or tooling being used on a particular job. Use the table below to try to pinpoint the possible cause.

Possible Cause	Check This
Machine setup or tooling problem	If the noise is most evident under load (cutting situations) then it is important to look at setup and tooling being used. Ask the following questions. Is the cutter dull? Is the tool loose in the holder? Am I taking a bigger cut then is possible on the machine? Is the part moving in the vice? Am I using realistic speeds and feeds? Any one of these can have a significant impact.
Belt is loose	The spindle is run via a timing belt that runs from the motor to the spindle pulley. Make sure the belt is tensioned properly. There is a tensioning screw that is used to set the belt tension. Make sure not to over tighten the belt.
Spindle bearings are worn out	This is categorized by a high pitch sound and is most evident at high RPMs. It should also cause chatter under load. Replace the spindle cartridge if this is the case. See spindle replacement in Section 6.14.

5.0 Diagnostics

This section explains the diagnostic procedures used to isolate service problems.

5.1 The Machine Tool & Set-Up

5.1.1 The Milling Machine Checklist

The following is a quick reference for the types of problems that may arise if problems are noticed in these areas.

Problems With:	Can Contribute To:	Most Suspect When (and why):
Spindle bearings See Spindle cartridge replacement	Noisy head Parts incorrect Circles out of round	Older machines, machines that are pushed hard. Run spindle at high RPM's for long periods of time.
Lubrication system	Premature wear of ball screws and linear guides Poor part finish	New installations (may not be hooked up or line sheared)
Linear guides worn	Poor finish Out of round circles Faulting	Inadequate lubrication It should take many years for this to become a problem.
Machine not level Weight not distributed evenly on all six screws See Leveling procedures	Parts incorrect Machine geometry off, i.e. tram.	New installation or heavy crash.
Head out of tram	Leaves uneven surfaces on bottom of pockets.	Machine not level
Water in your air lines	Faulty solenoid valves Rust Problems with the pneumatics on the tool change and tool change air cylinder	User does not drain air regular/water separator on a regular basis Users shop has a poorly designed air system with no air dryers to prevent water from entering lines
Performing periodic maintenance such as checking oil cup on air tool cylinder and greasing fittings on ATC	Lack of lubrication to cylinder and premature failure Wear of sliding surfaces on ATC and premature failure	User does not perform recommended periodic maintenance on machine tool.

5.1.2 A Special Word About Linear Guides

The linear guides on your LPM are vital to the performance of the machine.

They should require very little maintenance over the life of the guides. It is recommended that these guides be inspected for any signs of excessive wear. Lubrication is the key to the longevity of the guides so it is important to verify oil is reaching the guides. It is also a good idea to make sure no cutting fluids or chips are reaching the guide surfaces. Periodic cleaning or inspection of the guides is recommended.

It is good machining practice to avoid the use of shop air to clean the chips off a machine. This risks blowing chips into the linear way surfaces and compromising the performance of the machine.

5.1.3 Lubrication

Lubrication is one of the single, most important maintenance issues and plays a key role in assuring the performance and durability of the machine. At the beginning of each day manually supply oil to the way surfaces. The ProtoTRAK will automatically lubricate the machine when it is turned on. If the machine has been left on overnight, then it is recommended to go to the rear of the machine and press the manual lubrication button. You will need to press the button and hold for a few seconds and repeat this process a few times.

Lack of lubrication can lead to a variety of problems with your machine motion due to increased friction in the sliding ways. This increased friction may lead to part inaccuracies and decreased life expectancies of your ball screws and linear guides.

5.1.4 Machining Set-Up

The machining set-up can greatly influence the performance of your mill. Be aware of the following:

Problems With	Can Contribute To:
Feed and Speeds (spindle rpm) See below	Poor finish Machine chatter Excessive speeds and feeds can break cutting tools or wear tools prematurely.
Poor Tooling Using the wrong cutter for an application Entering the wrong size diameter.	Poor finish Tool chatter Parts incorrect size
Cutting too deep	Part dimensions incorrect Driving and cutting forces cause deflections, since no material is totally rigid Machine chatter
No coolant	Poor finish, decrease the life of the cutter

5.1.4.1 Spindle Speeds

Spindle speeds are influenced by a number of variables:

- Material
- Rigidity of the Machine Setup
- Coolant
- Cutter type, material and diameter
- Cutting Depth

As a general rule:

- Lower spindle speeds are used to machine hard or tough material or where heavy cuts are taken.
- Higher spindle speeds are used to machine softer materials in order to achieve better surface finishes. Higher speeds also apply when using small diameter cutters for light cuts on frail work pieces and delicate setups.

Note: Cutter diameter greatly affects spindle speeds. The larger the diameter, the lower the spindle speed.

5.1.4.2 Feedrates

Factors that affect feedrates:

- Depth and width of cut
- Design or type of cutter
- Sharpness of the cutter
- Workpiece material
- Type of finish or accuracy required
- Climb or conventional milling

If a fine finish is required, reduce the feed rather than increase the spindle speed. Cutters are dulled by higher spindle speeds rather than high feedrates.

5.2 The Mechanical Drive Train

The following sections talk about a key number of mechanical items that should be reviewed when a mechanical problem exists on the LPM machine.

5.2.1 Ballscrew Alignment

Ballscrew alignment plays a critical role in making sure the machine performs at its highest level. It is very important to have consistent rolling torque values across the length of the X and Y-axis ballscrews. (Note – the Z axis has a mechanical brake so it is not possible to measure the torque) When values vary by more than a few inch-lbs across the length of the ballscrew, then this points to the ballscrew not being properly aligned.

Note!
It should be noted that the bearing housings and yokes are all pinned in place, so machines that leave the factory should be aligned and this should not change over time.

To measure the rolling torque on the X and Y-axis you need to move the axis to the location you wish to check and then press the E-stop. This turns the axis motors off and allows you to manually turn the ballscrew with a torque wrench. The torque wrench is placed on the end opposite of the motor in the hex drive. We recommend each axis be checked in 3 places. Check the rolling torque in the center of travel and at both ends of travel within an inch or 2 of the limit switches.

Note: Ball screws are inspected throughout their entire travel for backlash and consistent torque. A ball screw should be good for millions of inches of travel if installed properly. Do not be too quick to replace a ball screw if there is insufficient indication that it is bad; this will just be a costly delay to resolving the real problem.

5.2.2 Pre-Tensioning of Ballscrews

The purpose behind pre-tensioning of a ballscrew is to minimize the effects of thermal expansion caused by heat that is generated during normal operation of the machine. If pre-tensioning was not performed, this could lead to part inaccuracies as the machine warms up.

How does pre-tensioning actually work? Simply put, the ballscrew is mechanically "stretched" by the value of anticipated growth caused by heat generated during typical operating conditions. In the case of the LPM, the amount of anticipated growth under typical operating conditions is .003" for the X axis and 0.0023" for the Y and Z axes. It should be noted that when a ballscrew is stretched, it does create a higher rolling torque on the ballscrew when measured with a torque meter. The rolling torque will come down once the ballscrew reaches its normal operating temperature. This is due to the ballscrew growing and hence the forces built up with stretching the ballscrew are no longer there causing the torque to come down.

Without pre-tensioning, thermal expansion can compromise the machines ability to hold position as it heats up and cools down during the course of operation. The ambient temperature within a shop has little to no bearing on this phenomenon since the entire machine will heat up and cool down.

To determine whether or not a ballscrew is pre-tensioned, the LPM must have not run for at least eight hours. A .0001" plunger type indicator is placed at the support end of the ballscrew. With the indicator set at zero, the bearing locknut is released and the total indicated reading is the amount of pre-tension that existed on the ballscrew. Full pre-tension value is .003" or 0.0023", however the indicator reading may be slightly higher due to the "pull through" effect that occurs during the pre-tensioning process. Pull through is the amount that the bearings settle at the motor end. Pre-tensioning begins when the indicator reading at the support end, exceeds the indicator at the motor end. See sections 6.8 through 6.10 for a detailed procedure on ballscrew pre-tensioning.

5.2.3 Angular Contact Bearings

The LPM uses angular contact bearings at each end of the ballscrew due to the pre-tensioning of the ballscrew described above. They are mounted in a face-to-face arrangement at each end of the ballscrew. This arrangement is more forgiving of misalignment than a back-to-back arrangement while still providing very good axial and radial support. The angle of contact of the bearings that are used on the LPM is 60°. See drawings 26772, 26817 and 26756 for an illustration of how the bearings look when mounted in a face-to-face arrangement.

The bearings at the motor end are the "fixed" set. As a "fixed" set, the inner races are clamped together against the shoulder of the ballscrew and the outer races are pushed together by the bearing cap. The bearings at the support end allow for pre-tensioning, due to a .050" gap that separates the inner races of the bearings from the shoulder of the ballscrew. This allows the ballscrew to grow as it warms up.

The bearing housings are fitted to align with one another at the factory, they are then secured with tapered locating pins to ensure that the housing will return to its exact location after it has been removed for service.

5.2.4 Preloading the Angular Contact Bearings

Bearing preload, simply put, takes out all of the unnecessary clearances between the balls and the races in which they travel. Preloaded angular contact bearings reduce axial movement and radial run-out, which translates into greater control over positional accuracy.

The preload on the angular contact bearings is controlled by a strict tightening procedure that provides a pre-determined amount of pressure to the outer races of the bearings. Inadequate pressure on the bearing cap will allow for axial and radial movement hence, a loss of accuracy. This loss of accuracy would surface as bad finish on the work (chatter), steps on transition moves or excessive backlash in the system.

Excessive pressure on the outer races will deform the bearings, which will generate more heat, which leads to more than anticipated expansion of the ballscrew. Once the pre-tension has been exceeded, the positional control of the machine will be reduced. Additionally, excessive preload on the angular contact bearings will over burden the servo motor as well as the servo driver. In terms of machining, poor finishes should be expected on transitional moves due to the excessive load. Lastly, excessive preload would greatly reduce the life expectancy of the bearings.

5.2.5 Protecting the Axis from a Crash

There are three safeguards in place on the LPM to protect each axis from a crash at either end of travel. First is the soft limit, which the control recognizes as the end of travel. However, should the machine fail to recognize the soft limit, a hard limit (switch) would next be activated, the limit switch once activated, acts like an E-Stop, killing power to the servo motors. Lastly, in the unlikely event that the velocity is sufficient enough to get past those two safeguards, a thick polyurethane hard stop will absorb most of the energy of the impact.

The soft limits are established relative to the limit switch setting. Service Code F is used to check whether a limit switch is functioning properly or not. Clearly the limit switch setting plays a vital role in protecting the LPM. The limit switches are precisely set at the factory and should not be tampered with in the field. If changes are made to the limit switches and other service codes are not performed, the machine may potentially crash and damage will occur.

5.2.6 Axis Servomotors

The X an Y axes servomotors are rated at 5.7 N-m. The motors utilize an adapter ring that centers the motor pilot diameter with the motor mounting bracket, which in turn aligns the motor shaft with the ballscrew. It is essential that this ring be used; failure to do so would result in uncertain alignment between the motor and the ballscrew. Misalignments of any rotating forces, generally causes vibration. Vibration can adversely affect the finish on the work being machined. It can also take its toll on the life of the coupling.

The Z-axis motor is rated at 11.5 N-m. The Z-axis motor is unique in several ways. It has a larger motor shaft allowing for greater clamping power by the coupling. The biggest difference between this motor and the one used on the X and Y-axis is that it is equipped with an electro mechanical brake. Because there is no counterbalance, the brake is required to hold the head in place when ever the Z-axis servomotor is disabled, which happens when the E-stop is pressed or power is turned off to the machine.

5.2.7 Ballscrew Coupling

The coupling is designed to compensate for very minor misalignments between the ballscrew and the servomotor. In addition, it also dampens the impact between the servomotor and the ballscrew when a change of direction occurs.

The coupling is a simple enough device, however certain precautions must be observed. The coupling is to be treated as an assembly that is attached to the motor. The coupling assembly consists of three components, the driving side (attached to the motor shaft) the spider, and driven side. Do not separate the driven side, secure it to the ballscrew, and then attempt to force them together when installing them onto the machine. Attempting to do so will result in unnecessary axial load on the servomotor. Always follow the procedure described in section 6.1 of this manual.

The couplings on the X and Y-axes are the same, however the Z-axis coupling is unique. The motor side of the coupling has a larger inside diameter to accommodate the larger Z-axis motor shaft diameter.

In all cases, the couplings are the keyless type. Being so, it is imperative that care be taken when installing to avoid the potential of slippage. A witness mark is placed on both the ballscrew and the coupling so it can be quickly determined in the field, whether slippage has occurred. It is obviously very important to make sure the coupling is tight between the motor and coupling as well.

5.2.8 Linear Guides

The linear guideways play a very important role in the drive system of the machine and with proper care and lubrication, they should last many years. They require no additional service nor are there any provisions for adjustment. Great care must be taken to protect the linear guideways. Never operate the LPM with the way covers removed (except when service requires it). NEVER ALLOW ANY OBJECT TO FALL ONTO THE LINEAR GUIDEWAYS!

5.2.9 Lubrication

The automatic lubricating system is dedicated exclusively to the ballscrew and the linear guideways for this machine. The amount of oil and how often oil is applied is controlled in the PMX control. See section 3.11 for more information. Also see drawing 27050.

5.2.10 Way Covers

Way covers are telescoping in design, so alignment is important to avoid binding, way covers must be attached in the near fully collapsed state. This is the best way to align the covers to the axis. Do not move axes around with covers detached but still in the enclosure.

5.3 Computer Module Diagnostics

The computer module is the main component that controls the entire system. The computer module requires 115VAC input. The computer module fuse is located just below the power input connection. The fuse is a 3-amp slow blow fuse that can be checked with a digital multi meter. If the digital meter reads zero across the fuse, then the fuse is okay. If the digital Ohmmeter reads infinite Ohms across the fuse then the fuse is blown and must be replaced.

The computer module consists of 5 main internal components.

1. The Motherboard, that runs the main software and the operating system and interfaces to the Motion Board.
2. The Motion Board, that actually controls each axis and every digital I/O function, it also interfaces between the Motherboard and the APPS Board.
3. The APPS Board, contains the circuitry that provides the interface for the motion board to control each axis and all the Digital I/O functions.
4. The Compact Flash IDE Board, that provides the interface between the Motherboard and the compact flash.
5. The Power Supply, that provides 5, 12 and –12 volts for all the boards inside the computer module.

See figure 5.3 below.

The computer module contains 4 pairs of red and green LEDS.

1. DC Power, when the red LED is ON it signifies that the 5 volts, 12 volts, -12 volts or clock signal is not working properly. When the green LED is ON it signifies that the 5 volts, 12 volts, -12 volts and clock signal are working properly.
2. Watch Dog Timer, when the red LED is ON it signifies that the Motion Board is not working properly. When the green LED is ON it signifies that the Motion board is still operating.
3. Z-axis Brake, when the red LED is ON it signifies that the Z-axis motor brake is activated and 0V, thus 0 volts DC is being applied to the brake. When the green LED is ON it signifies that the Z-axis motor brake is deactivated, thus 24 volts DC is being applied to the brake.
4. E-stop, when the red LED is ON it signifies that the E-stop is activated and thus power to the AC Drive and Servo Drive is disabled. When the green LED is on it signifies that the E-stop is deactivated and thus power is supplied to the AC Drive and Servo Drives.

The green and red LED should never be ON or OFF at the same time unless there is no power to the computer module or the computer module does not work.

The computer module has 4 DB 25 pin motor ports that are labeled X-axis, Y-axis, Z-axis and 4th axis. These motor ports contain the following signals. The pin assignments for these functions may be found on the wiring diagram 26734.

1. DAC Signal is an analog ±10 Volt signal that is used to control the motor speed and current.
2. ADCIN Signal is an analog 10 Volt signal that is used to measure the current feedback from the servo drive.
3. AENA signal is a 5 Volt digital signal that is used to enable the servo driver.
4. RESET signal is a 5 Volt digital signal that is used to reset the servo driver after a fault condition has occurred.
5. FALT signal is a 5 Volt digital signal that is used to identify when the servo driver has faulted.
6. CHA, CHB, CHC are 5 volt signals that are used for the motor encoder input. The CHC signal is the index pulse of the motor that is activated once per revolution.

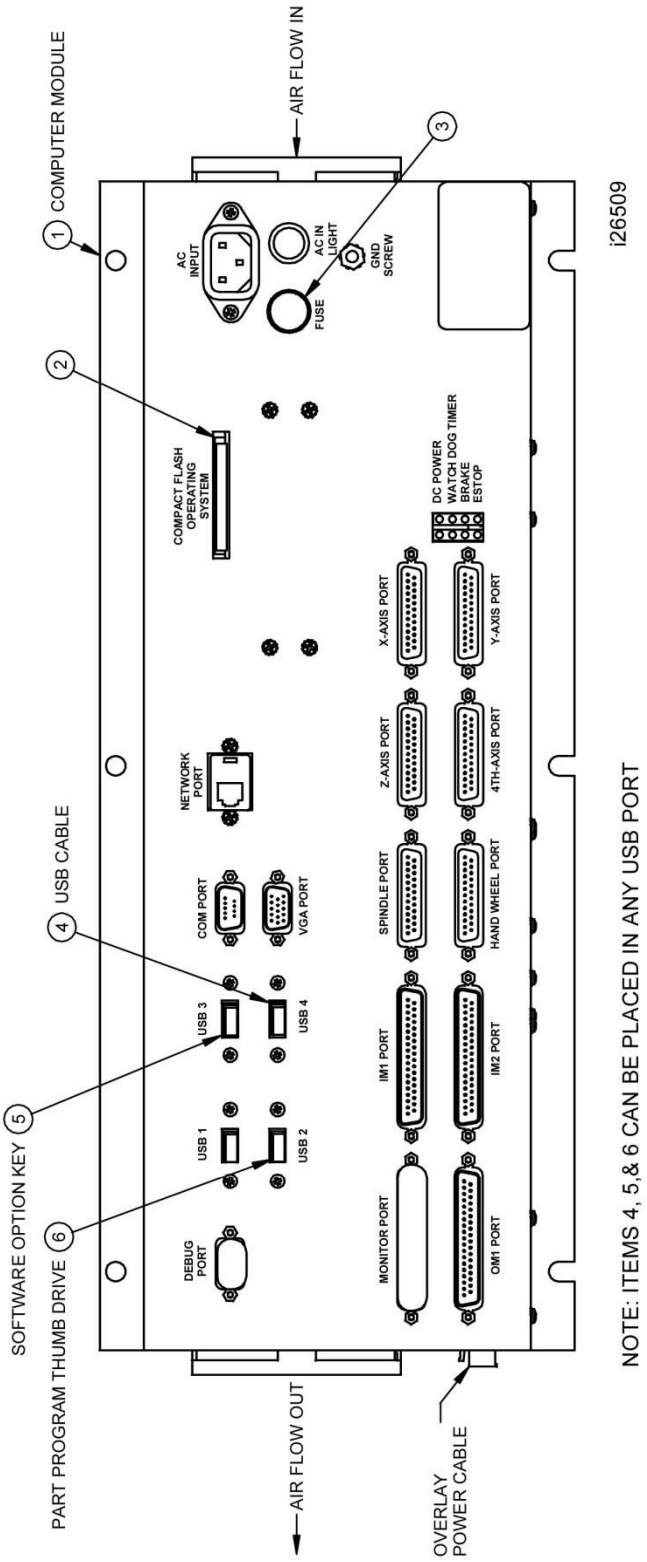

1 COMPUTER MODULE
AIR FLOW IN
3
AC INPUT
AC IN LIGHT
GND SCREW
FUSE
2
COMPACT FLASH OPERATING SYSTEM
DC POWER
WATCH DOG TIMER
BRAKE
ESTOP
X-AXIS PORT
Y-AXIS PORT
NETWORK PORT
Z-AXIS PORT
4TH-AXIS PORT
4 USB CABLE
COM PORT
VGA PORT
SPINDLE PORT
HAND WHEEL PORT
USB 3
USB 4
IM1 PORT
IM2 PORT
5
USB 1
USB 2
SOFTWARE OPTION KEY
6
DEBUG PORT
MONITOR PORT
OM1 PORT
PART PROGRAM THUMB DRIVE
AIR FLOW OUT
OVERLAY POWER CABLE
i26509
NOTE: ITEMS 4, 5,& 6 CAN BE PLACED IN ANY USB PORT

Figure 5.3

The Spindle Port contains the following signals.

1. DAC signal is an analog 10 Volt signal that is used to control the speed of the spindle motor.
2. ADCIN signal is a 10 Volt signal that is used to measure the current of the spindle motor that is in turn identified by the spindle load meter.
3. SPD_FWD signal is 24 DC Volt digital signal from the AC Drive that is used to command the spindle to spin in the forward direction.
4. SPD_REV signal is 24 DC Volt digital signal from the AC Drive that is used to command the spindle to spin in the reverse direction.
5. SPD_ORT signal is 24 DC Volt digital signal from the AC Drive that is used to command the spindle to go to the orientation angle for a tool change.
6. SPD_RESET signal is 24 DC Volt digital signal from the AC Drive that is used to command the spindle to reset the AC Drive when a fault has occurred.
7. E-SPD COM signal is the common signal from the AC Drive that is used to trigger the Forward, Reverse, Orientate and Reset command signals.
8. CHA, CHB, CHC are 5 volt DC digital signals that are used for the motor encoder input. The CHC signal is the index pulse of the motor that is activated once per revolution.

The computer module contains one Handwheel port that is used to move each axes, it is also used for spindle override, axis override and for TRAKing. The signals that are used on the Handwheel port are CHA and CHB signals for the encoder input. They are 5 Volt digital signals.

The IM1 and IM2 ports contain (32) 24 Volt digital inputs each. These digital inputs require 22 to 26 Volts to be applied in order for them to be seen by the computer module software. See drawing 26775-SCH for which inputs we use.

The OM1 port contains (32) 24 Volt digital outputs. These digital outputs are used to control the RM1 and RM2 relay modules. See drawing 26775-SCH for which outputs we use.

The Overlay Power Port is used to provide power to the pendant and for some critical overlay key feedback from the Run Panel inside the pendant. The following are the signals that are carried inside the Overlay Power port.

1. 5V is the 5 Volt DC power signal used to power up the Overlay Interface Board.
2. 12V is the 12 Volt DC power signal used to power up the LCD controller board.
3. KEY-COM is a 24 Volt DC power signal used for triggering the critical overlay keys.
4. FWD-KEY is a 24 Volt DC digital signal that is used to command the spindle motor to rotate in the forward direction.
5. REV-KEY is a 24 Volt DC digital signal that is used to command the spindle motor to rotate in the reverse direction.
6. OFF-KEY is a 24 Volt DC digital signal that is used to command the spindle motor to stop spinning.
7. GO-KEY is a 24 Volt DC digital signal that is used to command the machine to start an automatic process like a Homing or run a program.
8. STOP-KEY is a 24 Volt DC digital signal that is used to command the machine to stop the axis while in an automatic process.

There are 4 USB port on the computer module. The USB ports are standard USB 2.0 version. USB port 4 is used for the USB Hub located on the Overlay Interface board. USB port 3 is designated to be used for the Option Key. USB port 2 is designated to be used for the Parts Program Drive. USB port 1 is a spare for standard USB drives or Keyboards and mouse, all other USB devices may not be supported and thus should not be installed, unless otherwise stated.

The network port is a 10/100Mps port and is compatible with a 100Base-T protocol. The Debug port is used for factory testing and debugging only. The VGA port is used to interface with the LCD controller board located in the pendant. It provides the video signals to the LCD at a resolution of 800x600.

The COM port is a serial port used to communicate to the Overlay Interface board. If the Run Panel nor the Programming panel keys are operating correctly this port or cable may be at fault.

The compact flash is a 1GB compact flash. The compact flash stores the main operating system and software used to control the machine. The configurations for the machine are also stored on the compact flash. If a computer module is ever replaced then the compact flash will need to stay with the new computer module so that the configuration also stays with the machine. A special service code may be used in order to check the compact flash, see section 5.12 for service codes.

Warning!
Never remove or replace the compact flash with the computer turned on. It may damaged the compact flash and most likely will need to be replaced.

In general, the computer module is best diagnosed by eliminating all other possible alternatives. The following table lists some symptoms and diagnostics that may be used in order to assure that the problem is due to the computer module, and thus should be replaced. Refer to figure 5.3.

Symptoms	Diagnostics
As a general rule all symptoms should be checked for the following items.	• Verify that the 5VDC is ±0.25 volts DC. • Verify that the 12VDC is ±1 volts DC. • Verify that the -12VDC is ±1 volts DC. • Verify that the 24VDC is ±2 volts DC. • Verify that the 115VAC is ±12 volts AC. • Verify that loading defaults has no affect on the symptom. • Utilize service code F to test the I/O of each port.
X-axis Faulting	• Connect X-axis port to Y-axis servo drive, to assure that the problem follows the computer module X-axis port. • Utilize service code 131 to test the encoder portion of the axis.
Y-axis Faulting	• Connect Y-axis port to X-axis servo drive, to assure that the problem follows the computer module Y-axis port. • Utilize service code 131 to test the encoder portion of the axis.
Z-axis Faulting	• **Z-axis should not be swapped with any other axis.** • Utilize service code 131 to test the encoder portion of the axis.
4th axis Faulting	• Utilize service code 131 to test the encoder portion of the axis.
Spindle Faulting	• Utilize service code F to test the digital I/O from the computer module to the AC Drive. • Utilize service code 510 to test the encoder portion of the axis.
Handwheel will not work	• Utilize service code 132 to test the encoder portion of the handwheel.
Digital Input Errors	• Make sure that the LEDs to the corresponding digital input that is in question turn OFF and ON in the corresponding Input module (IM1 or IM2). • Utilize service code F to test all the inputs to the computer module.
Digital Output Errors	• Make sure that the LED on OM1 corresponding to the output function in question turns OFF and ON utilizing service code F.

Symptoms	Diagnostics
E-stop error cannot be cleared.	• Verify that E-stop input (I39.1) is on, this indicates that the E-stop signal is okay and is being sent to the computer module. • Verify that the 24VDC is between 22-26 volts DC. • Service code F should be performed and verified that the E-stop signal is not being seen by the computer module.
Critical Keys (FWD, OFF, REV, GO, STOP) are not responding.	• Verify that the 24VDC is between 22-26 volts DC. • Service code F should be performed to identify what critical keys are working.
Blank Video or Distorted Video	• Verify that the 12VDC on the Overlay Power connector is between 11-13 volts DC. • A standard desktop monitor with a VGA port may be connected to verify if any signal is being send out from the computer module.
Overlay Keys not responding	• Note that when an overlay key is not responding to a command but a beep is produced by the pendant this is an indication that the COM port on the computer module is functioning correctly. • Verify that the Overlay software is running by using an external USB keyboard and pressing "Cntrl-Alt-Delete" this will bring up a window that will show the Overlay Key software running. If the Overlay Key software is not running this may be a Compact Flash problem.
USB Device is not recognized by the system.	• Plug in the device to another port to see if the device is identify by a different port, if it is not then the device may not be supported as not all devices are compatible with this system. • Verify that the USB does not have any obstructions in the port.
System Software does not respond to any commands (Locks-up)	• When the system does not respond to an Overlay command, verify if the operating system is still operational by utilizing a USB keyboard. • Identify if the problem is resolved by restarting the system.
System Will not boot up error	• Verify that the compact flash is properly inserted. • Try disconnecting all cables one at a time until only the 115VAC Power Input, VGA, and Overlay Power cable are connected to the computer module, if it still errors out then the computer module will need replacing.
DC Power red LED is ON all the time.	• Verify that the computer module is at fault by removing all the cables connected to the computer module, except for the 115VAC input power cable, and seeing that the DC power LED is still on.
Watch Dog Timer red LED is ON all the time.	• Verify that the computer module is at fault by removing all the cables connected to the computer module, except for the 115VAC input power cable, and seeing that the DC power LED is still on.

5.4 Pendant

The pendant consists of 2 separate Panels: the Program Panel and the Run Panel. In addition to this, it contains 4 USB ports and a Servo On button that must be energized to allow the system to run. Please see drawing 26584 for a drawing of the pendant assembly.

In general, the pendant is best diagnosed by eliminating all other possible alternatives. The following table lists some problems and what these problems can lead to. Make sure to first unplug any accessories such as external keyboard/mouse USB thumb drives etc. to eliminate any interference.

5.4.1 Program Panel

Fig. 5.4.1a

The Program Panel consists of the following components. See drawing 26584 when an item number is referenced.

1. LCD Controller board –It controls the video output to the LCD screen, which comes from the computer module.
2. LCD User interface board - allows you set the resolution, set the video input signal and adjust the screen image for brightness, contrast, etc. It also switches on/off the controller board and LCD screen. It has 1 LED light that shows the state of the controller. The light will be in 1 of the following 3 states.
    a. Green: Normal state – should always be on when everything is running correctly.
    b. Off: Off – if the control is on but there is no light on the board, then there is no power to the board. Check power cable below.
    c. Amber: DPMS mode – the video signal is not recognized or the control is in a sleep mode. If the LCD is in sleep mode, then pressing any key should turn the screen back on and the amber light should go to green.
3. LCD Inverter board - is a DC to AC inverter designed to power the backlight within the LCD screen. It converts 12 VDC to 300 VAC. Do not touch this board as it contains high voltage.

4. LCD Power Cable - provides power to the program panel assembly from the overlay interface board found on the run panel. Item 9.
5. LCD User Interface Cable – used to communicate between the LCD controller board and LCD user interface board. The signals carried through this cables are power, brightness, contrast, etc. Item 11
6. LCD Interface Cable - used to communicate between the LCD controller board and the LCD screen. The signals carried through this cables are the horizontal view, vertical view and power. Item 12
7. VGA Cable – this cable carries the video signal from the computer module to the LCD controller board. Item 1.
8. LCD Inverter Power Cable - carries power from the LCD controller board to the LCD inverter board. Item 10.
9. Ground Wires – there are 2 ground wires used to ground these panels and pendant. Items 8 and 13.

Possible Problems	Can lead to:
Poor cable connections	Loss of backlight, video signal, overlay function, and/or LCD power. Check all cable connections. Refer to drawing 26734 and 26584 at the rear of the manual.
Pendant locks up	The system will not respond to key presses or operate. Shut down the system and wait 10 seconds before rebooting the system. If the problem continues the computer module may have failed. See section 5.3 computer module diagnostics.
Overlay Key failure	Keys on panel do not work. Check by using service code 81. The screen will display a picture of the overlay. See Fig. 5.4.1a. Each key pressed on the overlay will light up on the screen and the pendant will beep which means it is working. If not check the connection between the Program panel overlay and the overlay interface board. Refer to Fig. 5.4.2c below.
Disk boot failure message	If the compact flash fails or is not recognized, the system would not boot up or operate. Shut down power reseat the compact flash and power up. If problem continues refer to section 5.3 computer module diagnostics.
Servo On Button failure	Constant E-stop message. Make sure the E-Stop button is released (out position). If it is not released the Servo On button will not reset the servo power when pressed. Check the wiring connection to the button. If the wiring is good the Servo On button LED will be lit and E-Stop message will clear after pressing MODE key on the panel. If not verify button is working using a volt/ohm meter. With power off, set meter to ohms. Remove the wires on the normally open (NO) terminals of the button. With one lead on each of the NO terminals press the button. Refer to drawing 26734 System diagram for Servo On button terminal layout. If the meter reads zero or close to it the button is fine. If not the button needs to be replaced.
LCD backlight burns out	You will not have the ability to see the video signal. Make sure the user interface board is not turned off. The indicator LED will be amber the screen is in sleep mode, green when on. Press the on/off button to turn on or reset the backlight. If the user interface board LED is on but the backlights remain off. Check all cable connections to LCD controller board and inverter board. See Fig. 5.4.1b below. If the connection is good the inverter board needs to be replaced. Make sure the power is turned off before doing so. Refer to section 6.20 for Programming/ Run panel replacement procedures.

Possible Problems	Can lead to:
Dip switches on LCD controller board are not set correctly. See figure 5.4.1b below.	The LCD will not work correctly if this is the issue. Dip switched position for Rev - of 26580-1: 1) ON (Up) 2)OFF (Down) 3)ON (Up) 4)ON (Up) 5)OFF (Down). Dip switched position for Rev A & B of 26580-1: 1) ON (Up) 2)OFF (Down) 3)ON (Up) 4)OFF (Down) 5)OFF (Down).

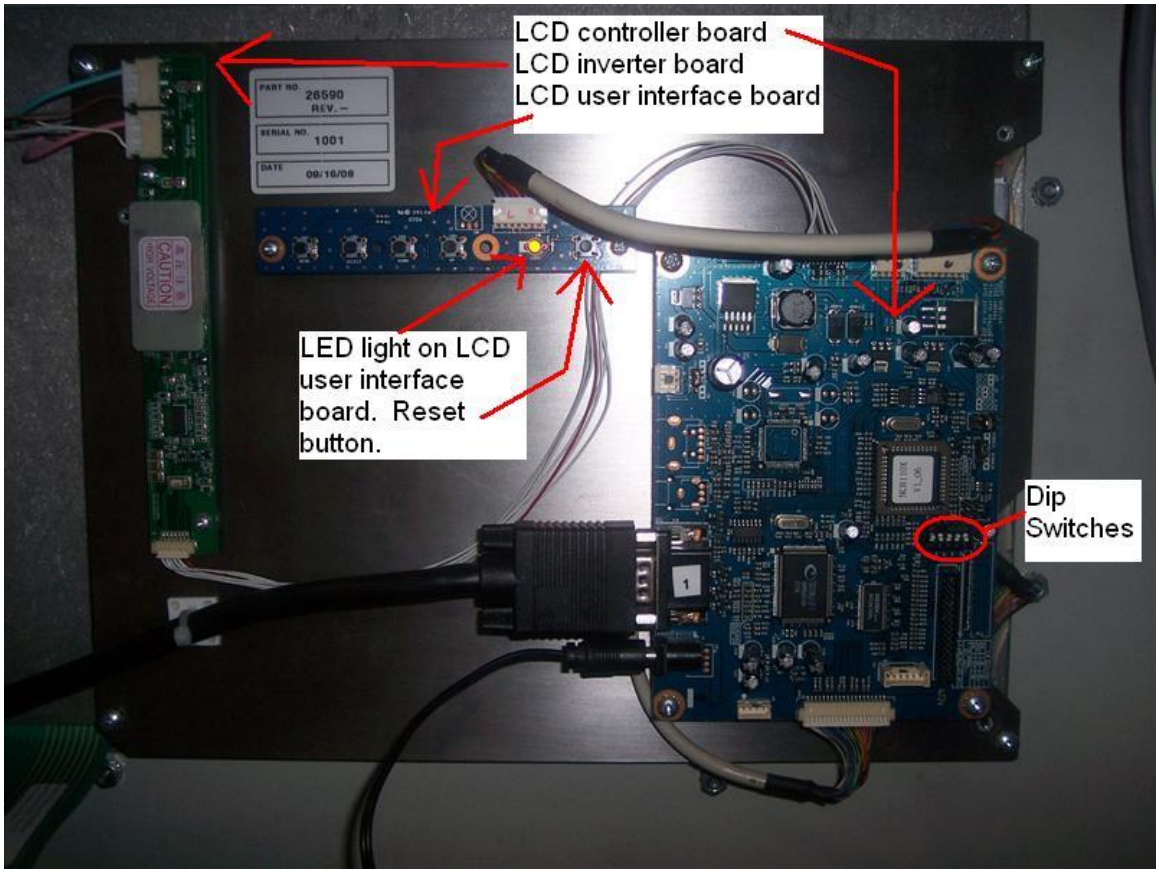


Fig.5.4.1b

5.4.2 Run Panel

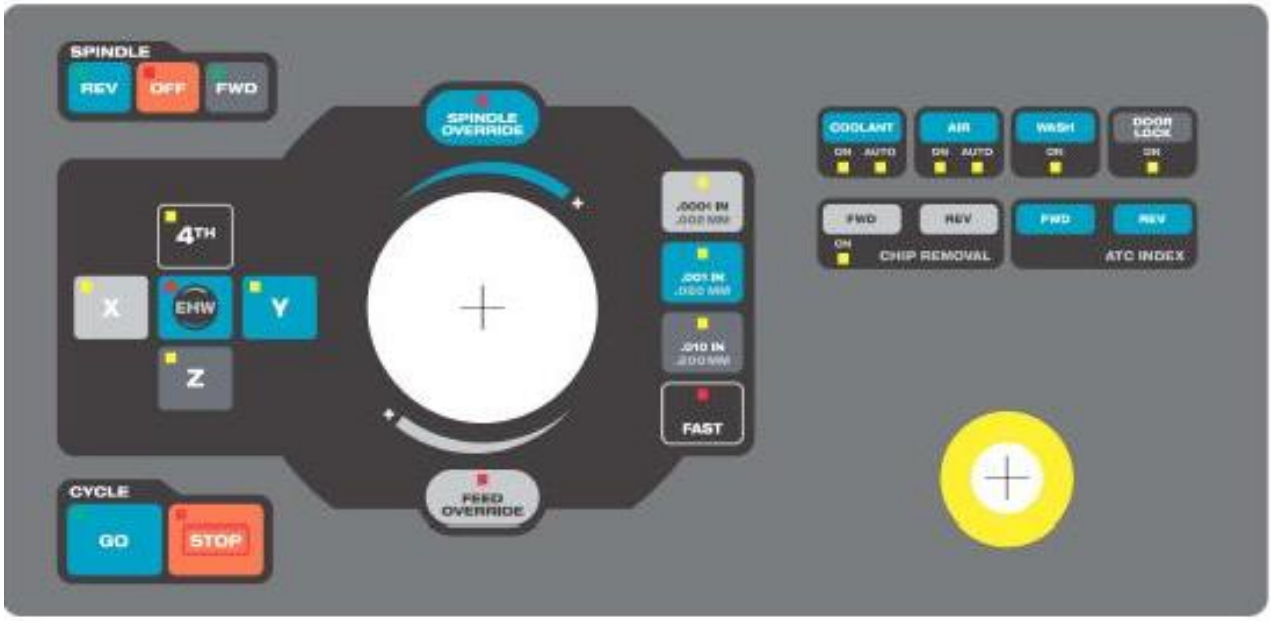


Fig. 5.4.2a

The Run panel consists of the following components.

1. Overlay Interface Board - this board is responsible for sending and receiving signals to and from the pendant and computer module. This board is responsible for transmitting the USB signals and overlay buttons. The beeper is also found on this board.

2. USB Cables – there are 2 USB cables that run from the overlay interface board to the USB ports on the side of the pendant sheet metal. Each cable contains 2 connectors.

3. E-stop Cable - sends the signal for the E stop. If the E stop is not pressed, then the signal is able to travel back to the computer module. The signal is 24 VDC.

4. EHW Cable - carries the encoder signals, which allows the axis to move in either direction. The 6 wires carry the following signals: power, ground, A, A not, B and B not. If one channel is not there it will not run right in one direction.

5. LCD Power Cable – this is the same cable that is mentioned above. It provides power to the LCD controller board, which is 12 VDC.

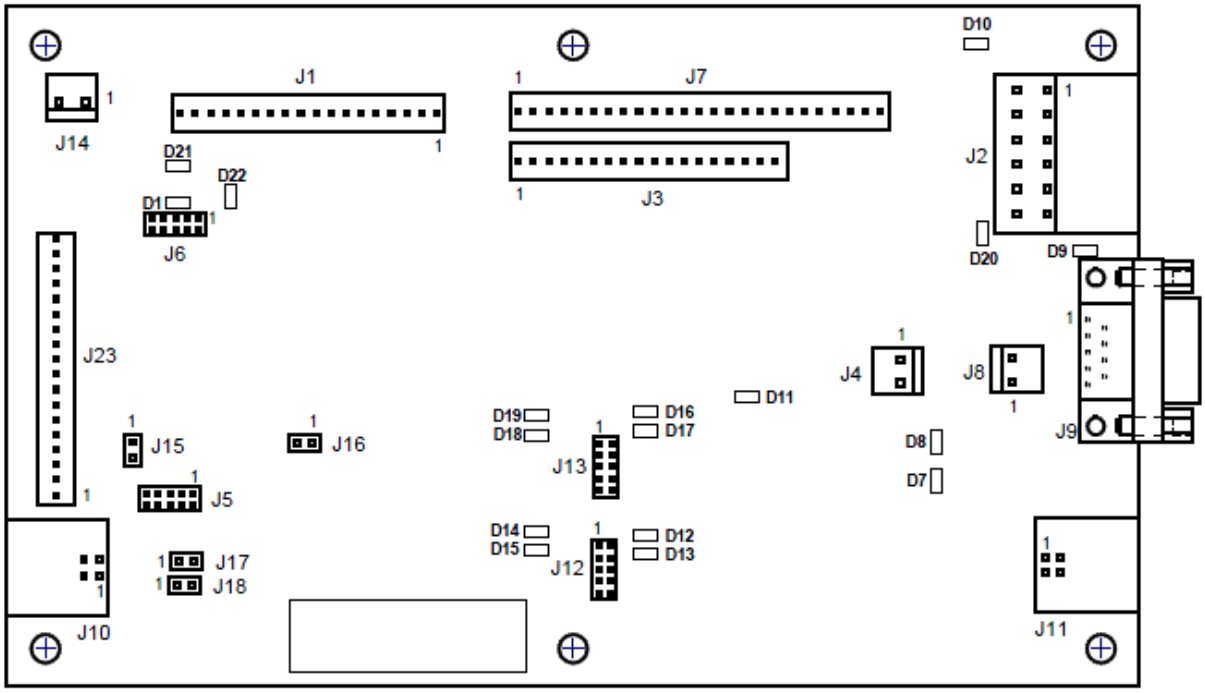
6. USB Cable – this cable carries the USB signals to and from the computer module to the overlay interface board.

7. Com Port Cable – this cable is used to establish communication between the pendant and computer module. It carries the overlay key signals for both the programming and run panels as well as the signal for the beeper.
8. Overlay Power Cable – this cable provides power necessary to run both panels. The voltages are 12 VDC, 5 VDC and 24 VDC. This cable also carries the following critical keys: FWD, OFF, REV, GO and STOP.

9. LED Lights – The overlay interface board has a number of LED lights that can be used for troubleshooting. The following LED's are the most important.

    a. D9 – this LED signifies that 12VDC is reaching the board. If this light is not on, the LCD will not work.
    b. D10 - this LED signifies that 5VDC is reaching the board. If this light is not on, the overlay keys will not work.
    c. D11 – this LED signifies that 3.3 VDC is reaching the board. If this light is not on, the USB ports will not work.
    d. D12, D14, D16, D18 – these 4 LED lights correspond to the 4 USB connectors. When something is plugged into each port, these lights should be on.
    e. D13, D15, D17, D19 – these 4 LED lights correspond to errors with the USB signals.
    f. D22 – each key press on either overlay will cause this light to flash

    See figure and table 5.4.2b below.



LED	FUNCTION
D1	TEST MODE
D7	TXD
D8	RXD
D9	12VDC INPUT
D10	VCC
D11	3.3 VDC
D12	USB PORT 1, ENABLED & TRANSMITTING.
D13	USB PORT 1, ERROR.
D14	USB PORT 2, ENABLED & TRANSMITTING.
D15	USB PORT 2, ERROR.
D16	USB PORT 3, ENABLED & TRANSMITTING.
D17	USB PORT 3, ERROR.
D18	USB PORT 4, ENABLED & TRANSMITTING.
D19	USB PORT 4, ERROR.
D20	KEY COM
D21	WATCH DOG
D22	KEY PRESS

i26562-3

Figure 5.4.2b

Possible Problems	Can lead to:
Poor cable connections	Lose of power to panel, overlay key functions, EHW functions, and USB failure. This can also lead to problems with the Program panel. Check all cable connections. Refer to drawing 26734 and 26584 at the rear of the manual.
Faulty E-stop switch	It can be stuck open or closed. If it is stuck closed the E-Stop switch will need to be replaced because the user will have no way to clear the E-Stop error message. If it is stuck open it will allow the machine to still operate but it will be unsafe for the user. The E-Stop switch will still need to be replaced. Refer to section 6.20 for programming/run panel replacement procedures. The replacement part number for E stop switch is 23997.

USB port failure	Will fail to recognize any external device. Check that the USB cables are properly connected to the overlay interface board. Check the status LEDs for the port(s) being used on the overlay interface board inside the pendant. Each port has two status LEDs. Port1: D12, D13 Port2: D14, D15 Port3: D16, D17 Port: D18, D19. The even numbered LED signifies the port is enabled and transmitting. The odd numbered LED signifies the port has encountered an error. If neither of the two LEDs' is on when a device is connected verify that the power LED (D9) is on. If not check the overlay power cable between the overlay interface board and computer module.
Overlay failure (keys on pendant)	Keys on panel do not work. Check by using service code 82 to verify keys beep. Keys on panel do not work. The screen will display a picture of the overlay. See Fig. 5.4.2a. Each key pressed on the overlay will light up on the screen and the pendant will beep which means it is working. If not check the connection between the RUN panel overlay and the overlay interface board. Refer to Fig. 5.4.2c below.
Electronic Handwheel does not work	Unable to jog an axis. Make certain that the EHW key on the overlay has been pressed to active the EHW. Also make certain you have selected an axis to jog. Check service code 132 to verify EHW is counting. One complete revolution of the EHW will display 100 counts on the screen. If not check EHW cable connection at the rear of panel to the computer module.

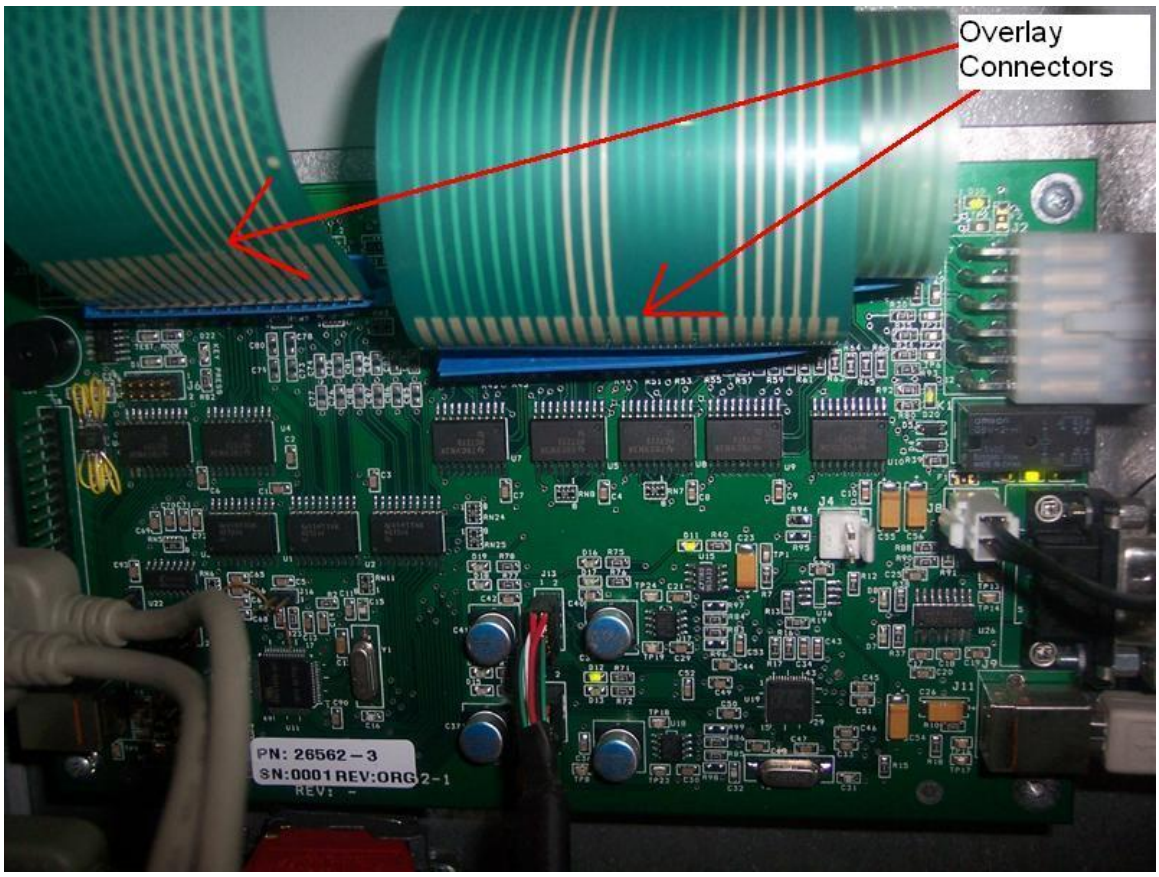


Fig. 5.4.2c

5.4.3 Cable Connections

Check that all cables coming into the Pendant from the electrical cabinet box are properly connected as well as the connection within the Pendant assembly. Check cable assembly to ensure no pins are pushed in, wire terminals are loose or cable connection is broken. See drawing 26584 for a drawing of the pendant assembly and all cable connections. Drawing 26734 also shows all the connections within the pendant and computer module.

5.4.4 Servo On Button

The Servo On button, which is located on the right side of the Pendant assembly, is a vital part of the electrical power circuit. If this circuit is not working correctly, the machine will not run because the following items will not have power: the spindle motor, the ATC, the pumps, the auger, and the X, Y, Z, & 4th Axis.

In addition to the servo on button, the following items must also work for the circuit to work correctly.

1. E-stop button – must be in its out state so power can flow to the servo on button.

2. The computer module must output the NC ready signals. Check RM2 K6 LED light.

3. The machine must not be on a hard limit switch.

4. The E-Stop relay (K10) and the OFF Delay relay (K11) need to also be energized to allow power to the AC drive and servo drive power supply.

5. K11 is the off delay relay and it turns off 1 second after the e-stop has been pressed so the servo drives can decelerate the motors.

Fig. 5.4.4a

5.5 Motor Diagnostics

WARNING!
The motors described in this section use 300 DC volts or 220 AC volts to operate, utilize care when working with these components. There is possibility of death by electrocution!

5.5.1 Axis Motors

The motor is a brushless DC motor that has a 3 phase power input. The X, Y and Z axis motor encoder has a 2048 window encoder which produces 8192 encoder counts per revolution. The motor encoder also contains one index pulse per revolution, along with a Hall-effect sensor. The Hall-effect sensor contains 3 pairs of 5volt digital signals that are synchronized with the 3 phase power input magnets in the motor rotor, that are used to control the motor speed and direction.

The Servo Drive sends out a 300 volt digital signal on each phase, that varies both in direction and width depending on the speed and rotation.

Rarely do both the X and Y motor/servo systems fail at the same time and in the same way. If the symptom involves both axes, the source of the problem is something that both motors have in common, like the Servo Power Supply or computer module.

The motors on the X-axis and Y-axis are identical, while the Z-axis is a bigger size motor and contains a brake. When troubleshooting only X-axis and Y-axis may be interchangeable. The Z-axis is not interchangeable with any other axis.

WARNING!
Whenever a motor is replaced or just removed it needs to be realigned so that the index pulse on the motor is 180 degrees from the limit switch, service code 505 should be used to perform this alignment. Note that the ball lock locations under service code 500 must also be redone.
If the Z-axis motor is removed then the ATC tool change height must also be realign and the base tool height must also be redone, codes 501 and 502.

The following table lists some symptoms and diagnostics that may be used in order to insure that the problem is due to a motor problem, and thus should be replaced.

Symptoms	Diagnostics
X-axis or Y-axis faulting because axis does not move	• Verify that power wiring is correctly connected to the Servo Drive. • Utilize code 100 and verify that when a plus command is given that the motor moves in a plus direction or in a CCW when viewed from the back of the motor. • Swap the X-axis motor and the Y-axis motor. If the problem is the motor it self, then the system will now detect that the other axis is faulting.
Z-axis faulting because the axis does not move	• Verify that power wiring is correctly connected to the Servo Drive. • Utilize service code F, verify that the brake is disengaging by hearing an audible "Click" from the Z-axis motor when the Z-axis motor is enabled. • Utilize code 100 and verify that when a plus command is given that the motor moves in a plus direction or in a CW when viewed from the back of the motor.

Symptoms	Diagnostics
X-axis or Y-axis faulting because axis does not count.	• Utilize code 131 to identify that the motor is counting in a plus direction when the motor is moved in the CCW direction when viewed from the back of the motor. • Utilizing code 131 identify that the motor resets every time the encoder index counts reaches 8192 counts, that is one revolution of the motor shaft. • Swap the X-axis motor and the Y-axis motor. If the problem is the motor it self, then the system will now detect that the other axis is faulting.
Z-axis faulting because axis does not count.	• Note the motor may need to be disconnected from the ball-screw in order to perform some of the diagnostics. • Utilize code 131 to identify that the motor is counting in a plus direction when the motor is moved in the CW direction when viewed from the back of the motor. • Utilizing code 131 identify that the motor resets every time the encoder index counts reaches 8192 counts, that is one revolution of the motor shaft.
X-axis or Y-axis faulting because axis moves in opposite direction than commanded.	• Verify that power wiring is correctly connected to the Servo Drive. • Utilize code 100 and verify that when a plus command is given that the motor moves in a plus direction or in a CCW when viewed from the back of the motor. • Swap the X-axis motor and the Y-axis motor. If the problem is the motor it self, then the system will now detect that the other axis is faulting.
Z-axis faulting because the axis moves in the opposite direction than commanded.	• Verify that power wiring is correctly connected to the Servo Drive. • Utilize code 100 and verify that when a plus command is given that the motor moves in a plus direction or in a CW when viewed from the back of the motor.

5.5.2 Spindle Motor

The spindle motor is a 10HP induction motor rated for a max rpm of 8000 rpm. The spindle motor contains a 1024 window encoder that produces 4096 counts per revolution and is attached to the back of the motor. The spindle motor has a 1:1 gear ratio to the actual spindle head. The spindle motor also contains a 220 single phase fan that is connected to circuit breaker Q7.

WARNING!
Whenever the spindle motor or spindle belt is replaced or just removed it need to have the spindle orientation angle adjusted again, code 510

Symptoms	Diagnostics
Spindle goes to the wrong orientation angle when doing a tool change.	• Verify that the spindle count on parameter 10-19 is set to the same value as the spindle orientation counter under service code 510. • Check for spindle belt slip, identify if belt is somewhat loose. • Redo the spindle orientation setup.
Spindle faults out immediately when trying to run the spindle.	• Verify that the spindle encoder is working properly. • Verify that the parameters have the correct values. • Verify that the spindle is able to turn freely. • Verify that the spindle power wiring is correct and properly fastened.

Symptoms	Diagnostics
Spindle faults out when decelerating from high speed.	• Verify that the deceleration parameter on the AC Drive 01-13 is set correctly. • Verify that the spindle braking resistors are connected properly to the AC drive. • Verify that the braking resistance is equal to 15 ohms at the AC drive.
Spindle will not turn when a forward or reverse command is given.	• Verify that the AC Drive has power. • Verify that the Forward command is given to the AC Drive, by measuring 0 volts DC across the FWD terminal and the DCM terminal on the AC drive when the FWD command is given and 24 VDC when it is not. • Verify that an RPM command greater than 100 rpm is entered on the spindle speed command. • Verify that the voltage across terminal AVI and ACM is greater than 0 VDC. • Verify that the all the parameters on the AC drive is set correctly.
Spindle temperature exceeds maximum temperature	• Check temperature of motor & verify fan is running.

5.5.3 Coolant, Wash, Auger and ATC Motor

The Coolant, Coolant Wash, Auger and ATC motors are all 3phase 220 VAC motors that simply run at one constant RPM. The Coolant and Coolant Wash motor pumps only run in one direction. The Auger and ATC motor are able to run in CW and CCW direction. All these motors are turned off and on with a contact relay located on the inside of the electrical cabinet.

When the coolant motor is commanded to turn on, the computer module will turn ON Q41.2 (A7 LED) on OM1, thus turning ON RM1-K11. The relay then turns on relay contactor K6, that provides the 220 VAC to the coolant pump motor.

When the coolant wash motor is commanded to turn on, the computer module will turn ON Q41.3 (B7 LED) on OM1, thus turning ON RM1-K12. The relay then turns on relay contactor K5, that will provide the 220 VAC to the wash coolant pump motor.

When the Auger motor is commanded to turn on, the computer module will turn ON Q41.6 (A9 LED) for forward and Q41.5 (B8 LED) for reverse on OM1, thus turning ON RM1-K15 for FWD and RM1-K14 for REV. The relay then turns on relay contactor K3 for FWD and K4 for REV, that provides the 220 VAC to the auger motor.

When the Tool Changer motor is commanded to turn on, the computer module will turn ON Q42.0 (A10 LED) for FWD and Q42.1 (B10 LED) for REV on OM1, thus turning ON RM1-K17 for FWD and RM1-K18 for REV. The relay then turns on relay contactor K7 for FWD and K8 for REV, that provides the 220 VAC to the Tool Changer motor.

Symptoms	Diagnostics
Coolant or Coolant Wash motor is on but it is not pumping correctly.	• Verify that the motor is turning in the correct direction when it is on. This can be checked by verifying that the direction of the fan blades, on the back of the coolant or coolant wash motor, correspond to the arrow label on top of the coolant or coolant wash. • Verify that the wiring for the coolant and coolant wash is wired correctly

Symptoms	Diagnostics
Tool Changer is turning in the wrong direction than commanded.	• Verify that the wiring for the power input is correct. If the Tool Changer, Auger, Coolant and Coolant wash are all turning in the opposite direction then the power input is most likely incorrect. The simplest way of correcting this is to swap 2 of the 3 phases that you wired into the contactors.
Coolant, Wash Coolant, ATC motor or Auger motor is causing the overload relay to trip immediately after is turned on.	• Verify that the current setting on the overload is set correctly. The coolant and the wash coolant overload should be 2amps. The Auger should be set to 1.5 and the Tool Changer should be set to 1.3 amps. • Check the wiring of the motor to the electrical cabinet. • Check if any of the windings is shorted to ground by measuring the resistance from each phase to ground when the motor is disconnected from the electrical cabinet.

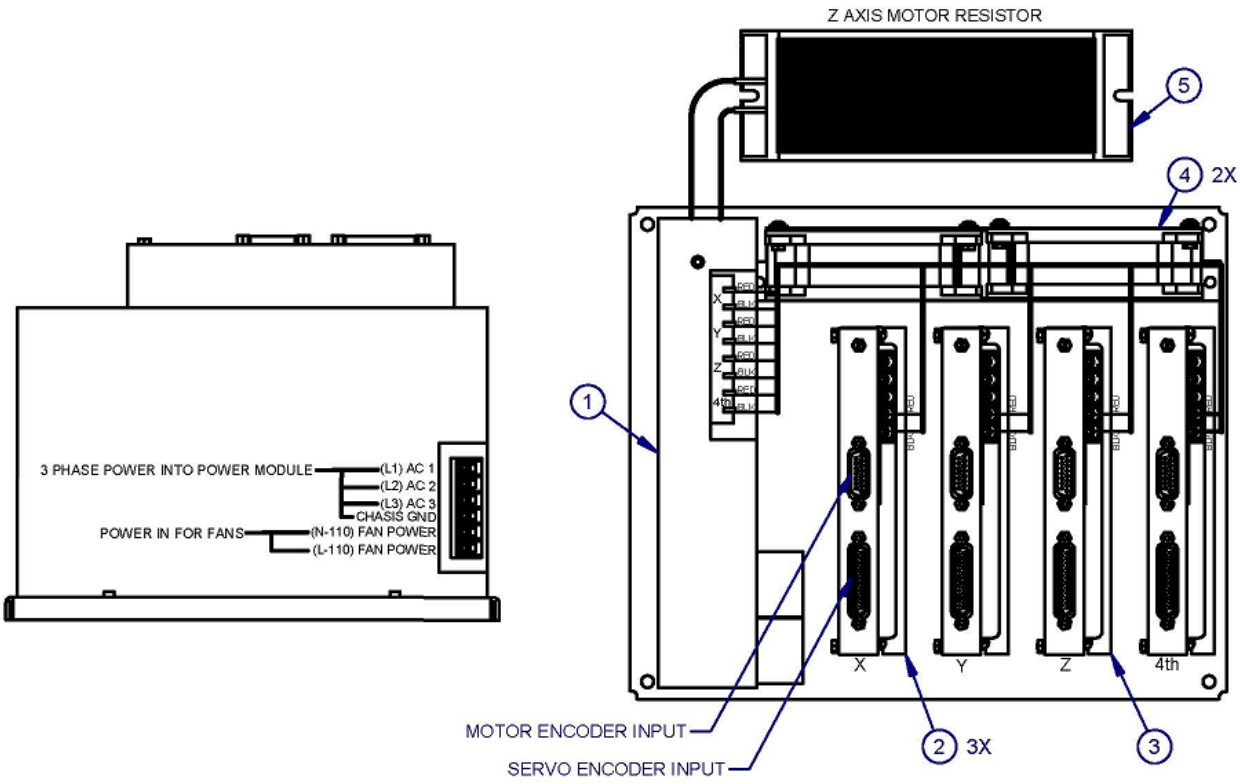
5.6 Axis and Spindle Drives

Danger!
The axis motor, servo drive, spindle motor and AC Drive uses 300 DC volts and 220 AC volts to operate, utilize care when working with these components. There is possibility of death by electrocution!

Warning!
The spindle inverter and servo amplifiers are able to store energy after power is removed. Please allow 20 seconds for the power to dissipate from these devices before servicing.

5.6.1 Axis Servo Drives

The servo drive produces a 3-phase 300-volt power to each motor. Each servo drive gets 300 DC volts from the Servo Drive Power Supply. The X, Y and Z axis motor encoder produce 8192 encoder count per revolution and are routed through the servo drive to the computer module along with the a single index pulse per revolution.



Item	P/N	Title	Qty
1	26528	POWER MODULE-SERVO DRIVE	1
2	26599 or 26599-2	SERVO DRIVER ASSY-5.7 Nm MOTOR	3
3	26599-3	SERVO DRIVE ASSY-11.5 Nm MOTOR	1
4	26965	FAN-SERVO	2
5	22890-500-30	RESISTOR-BRAKING-500W-30ohm	1

i26576

Figure 5.6A

Each servo drive has the following connections.

1. 300 volts DC input, used for powering the motor and supplied by the servo power supply.
2. Motor power output, used to supply the motor with varying 3-phase 300-volt power.
3. Motor encoder and Hall sensor input used as feed back to the drive from the motor. The encoder signals are used to identify the location and speed of the motor. The Hall sensor inputs are used to identify the magnet positions of the motor that are used to control the motor.
4. Servo encoder output and control signals come in and out to the servo drive through a DB 25 pin connector from the computer module. The encoder output signals are used by the computer module to control the servo drive and thus control the motor.

Rarely do both the X and Y servo drives fail at the same time and in the same way. If the symptom involves both axes, the source of the problem is something that both drives have in common, like the Servo Power Supply or computer module. The X-axis and Y-axis may be interchanged in order to troubleshoot however the Z-axis servo drive should not be interchanged with any other axis.

The drives on the X-axis and Y-axis are identical, while the Z-axis is configured for a bigger size motor. When troubleshooting only X-axis and Y-axis may be interchangeable. The Z-axis is not interchangeable with any other axis.

When a servo amp faults, a message will be displayed on the ProtoTRAK screen. It will notify the user to run service code 507, which resets the servo amps.

In mid 2013, the servo amp design changed on the LPM machine. The old style amps 26599 and 26599-1 were replaced by new amps with part numbers of 26599-2 and 26599-3. The -2 is used on the X and Y axis and the -3 is used on the Z axis.

Servo Amps 26599 and 26599-1

There are 4 states that the red and green LED on the servo drives may be in.

1. No LED is ON, this indicates that there is no 5 VDC power to the servo drive or the drive has completely failed.
2. The red LED is ON and the green LED is OFF, this indicates the servo drive is in a fault condition. This fault is normally caused by an E-stop condition.
3. The red and green LEDs are ON, this indicates that the servo drive is disabled.
4. The green LED is on and the red LED is OFF, this indicates that the drive is in operation mode and working properly.

Servo Amps 26599-2 and 26599-3

The status of the servo amp on this model is now shown via a 7 segment LED display as shown on the picture below. During normal operation, 1 segment of the 7 LED segment will be lit up. If the machine is moving, the LED segment moves from segment to segment. At rapid speeds, the segment will show the 6 outer segments lit up, which makes it look like a "0". During a fault condition, anyone of the fault codes shown in table 5.6 may be present. The side closest to the DB25 connector is the bottom portion of the seven segment LED, thus a "Ш" would be an "E" for encoder error.

Shows 1 segment turned on during normal operation and machine is stationary

Amplifier Status Codes

Condition for each of the display values by a 7-segment LED display.

Display	Name	Description
1	EEPROM Fault*	Parameter EEPROM checksum fault
2	Reserved	Reserved
3	Reserved	Reserved
4	Reserved	Reserved
8	Reset	External reset
b	Bus Over Voltage	DC bus exceeded 450VDC nominal (for 320VDC input) DC bus exceeded 250VDC nominal (for 160VDC input)
C	Clamp (Disabled)	Output stage disabled
E	Encoder Fault	Encoder fault detected
F	Foldback	Foldback condition active
H	Heatsink Over Temperature	Heatsink thermal switch tripped (65°C typical)
h	Motor Over Temperature	Motor thermal switch / thermister tripped
L	LS/ECB	Motor RMS over current
0	Normal Operation	Amp enabled (no Hall only)
S	HS/ECB	Output short circuit detected
U	Bus Under Voltage	DC bus below 150VDC nominal (for 320VDC input) DC bus below 80VDC nominal (for 160VDC input)
=	Hall Fault	Invalid hall state (000 or 111)
≡	Commutation Fault	Hall angle does not match encoder counter angle No Halls: Phase finding routine failed
8.	Reset	Drive processor is in reset Logic power indicator
Single outer segment	Amp Enabled, Hall	Amp enabled Segment indicates one of six hall states

Table 5.6

LED Segment Display Value Notes

1. If the servo amp fans fail or are not running at the right speed, a Display Fault "F" may be present on the LED segment.
2. When the E-stop is pressed, the LED segment will read "C" while the energy in the amp is dissipated and then read "U" once the energy falls below a certain value. After 10 seconds or so, all energy should be dissipated and the amp will continue to read "U".
3. When we command a reset via service code 507, the LED on the servo amp will show a value of "8" for a few seconds and then return to its normal state of showing a single outer segment lit.
4. If the braking resistor fails during operation, chances are a fault code "b" (bus over voltage) will show up.
5. A fault code C means the servo amps are in a disabled state. In the past, we would see the red and green LED lights being on at once.

There is one 30-ohm resistor located on top of the electrical cabinet used for the heavy duty motor axis braking, along with 2 other 30-ohm resistors that are used for the spindle motor braking. The Servo Power Supply contains a circuit named the regen Circuit that dissipates the extra energy created by a motor when it is decelerating. The Z-axis is the only axis on this system that causes the regen circuit to activate during a deceleration in the negative direction. The LED located on the Servo Power Supply will turn on whenever the regen circuit is activated. The 30-ohm resistor located closes to the electrical cabinet door is the one used by the servo power supply. The resistance can be checked with a digital ohm meter, by measuring the ohms across the 2 terminals on the servo power supply, when power is off, as seen on the figure 5.6B.

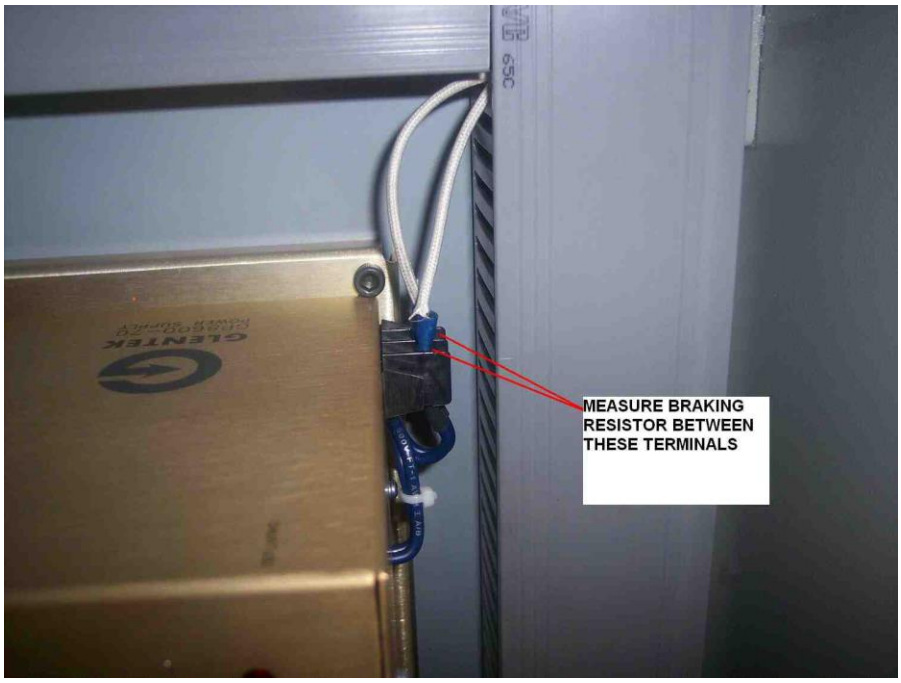


Figure 5.6B

The servo drives require a ±10 volt analog signal from the computer module in order for the servo drives to move the axis motor. The voltage will vary from -10 to +10 volts on the Analog+ terminal and the opposite voltage on the Analog- terminal with reference to ground, depending on the speed and load of the motor.

The servo power supply is used for 3 main purposes. The 1st and most important is to convert the 220VAC input to 300 DC volts that is fed to each axis servo drive through the red and black wires on terminal 1(-) and 2(+) of each servo drive. The 2nd reason is to prevent an over voltage situation when decelerating the axis motors by using a regen circuit and dumping the extra energy through a braking resistor located on top of the electrical cabinet. The 3rd main purpose of the servo power supply is to supply cooling air through the use of the two 220 VAC fans.

The following table lists some symptoms and diagnostics that may be used in order to insure that the problem is due to a servo drive problem, and thus should be replaced. This table refers to servo amps 26599 and 26599-1 only.

Symptoms	Diagnostics
Servo drive has no LED ON.	• Verify that power wiring is correctly connected to the Servo Drive. • Verify that there is 5 volts DC across pins 1&2 of the "Ext +5V" connector on the servo drive. As seen on figure 5.6C.
X-axis or Y-axis servo drive has the red LED ON and green led OFF.	• Verify that the system is not in an E-stop condition. • Verify that there is 300 VDC +/-20 volts across the Bus PWR connector. • Try to reset the fault by pressing and resetting the E-stop a couple of times. • Swap the drive with the other axis to see if the problem moved to the other axis. Note when swapping servo drive, insure that power is off completely. • One or both of the fans that are used to cool the servo amps are not working causing an excessive temperature fault. Check functionality of the fans. Note: When E-Stop is pressed or Servo-On button is not pressed the 220VAC fans will not run.
Z-axis servo drive has the red LED ON and green led OFF.	• Verify that the system is not in an E-stop condition. • Verify that there is 300 VDC +/-20 volts across the Bus PWR connector. • Try to reset the fault by pressing and resetting the E-stop a couple of times. • Utilize code 131 to identify if there are any problems with the encoder circuit of the servo drive. • One or both of the fans that are used to cool the servo amps are not working causing a excessive temperature fault. Check functionality of the fans.
All axis servo drives have the red LED ON and green LED OFF, even when the E-stop is in the out position and the Servo Reset button is on.	• Check for 300 volt DC bus at the servo drive terminals 1(-) and 2(+). See figure 5.6D • Check the power input voltage, it should be between 208 and 240 VAC. If the voltage input is okay but there is no 300 volt input to the servos, then the servo power supply has failed. • If this is the case, you can check the 7 internal fuses within the power supply as shown in figure 5.6D. The outside sheet metal on the power supply must be removed to gain access.

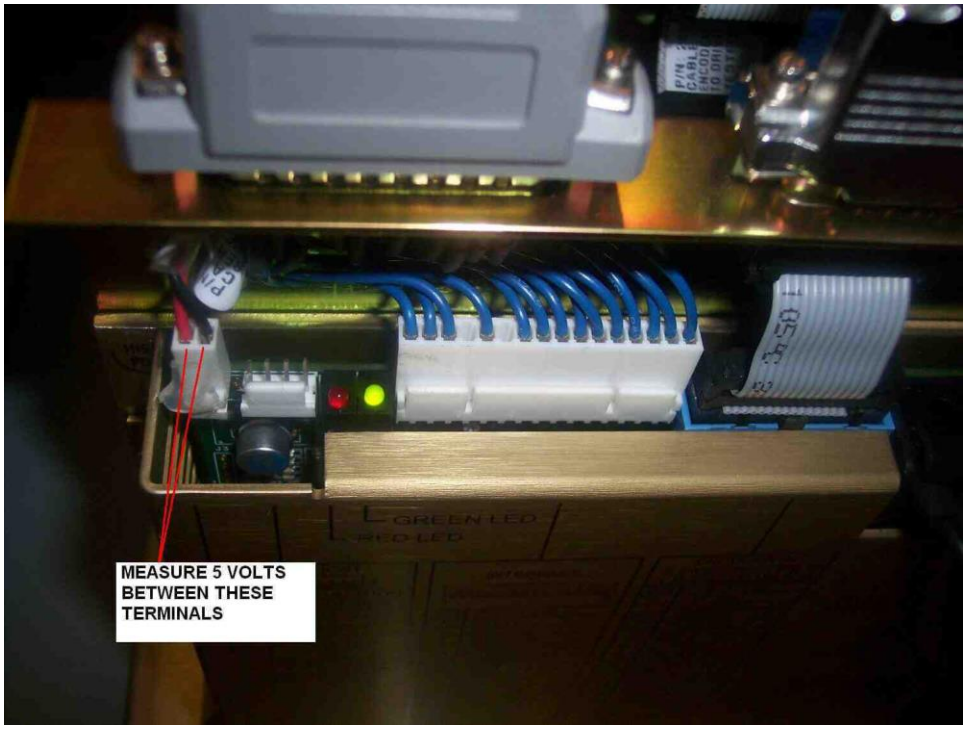


Figure 5.6C – only applicable to servo amps 26599 and 26599-1.

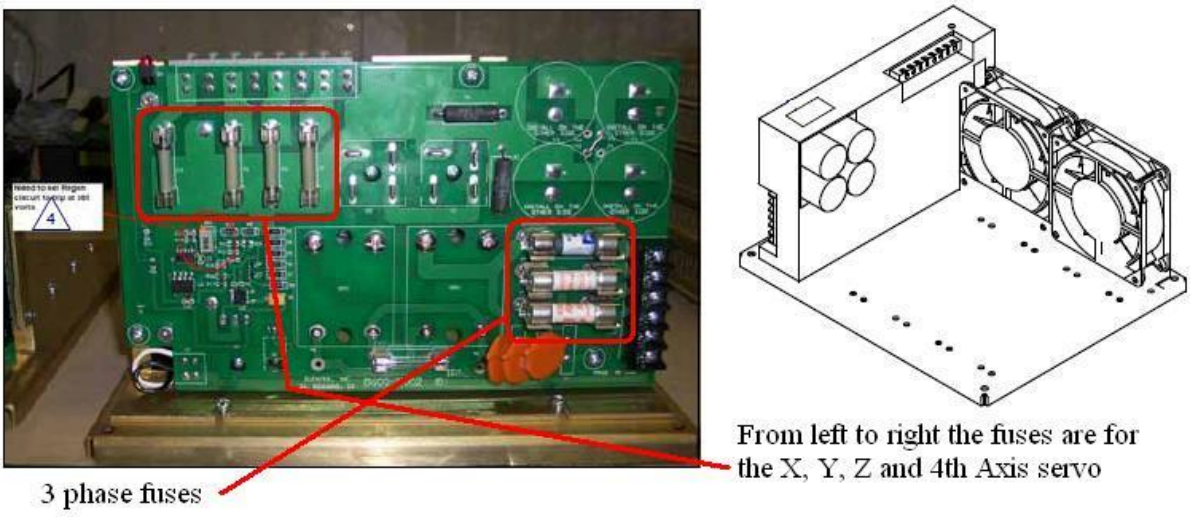


Figure 5.6D

3 phase fuses are 30 amp – part number of fuse is 27111-30
Fuses on left in picture above are 20 amp – part number of fuse is 27110-20

In mid 2012, the 3 phase fuses (p/n 27111-30) were removed from the power supply design. The circuit protection is now handled by the Q1 circuit breaker only.

5.6.2 Spindle AC Drive

The spindle AC Drive is a 10HP 3phase 220 VAC input drive. The AC drive is able to drive the spindle motor up to 8000 RPM, that is 267Hz on the AC Drive. The AC drive contains an encoder input PCB in order to perform the spindle orientation. Without the encoder input to the drive the AC drive will fault out. Once the AC drive receives the encoder input it then sends it out to the computer module. When the E-stop is pressed and power is turned off to the AC drive, the AC Drive will not send any encoder feedback to the computer module.

All the digital inputs to the drive are 24 volts DC. There are 5 digital inputs to the AC drive and 2 outputs commands to the computer module.

The AC Drive operator, seen in Figure 5.6.2C may be used to display the frequency input, frequency output, output current, and the digital inputs. As a default whenever the AC Drive is initially turned on, it will be in the Frequency input mode. Every time the Mode button is pressed the AC drive will scroll through the following modes in the following sequence.

1. Frequency Input Mode – In this mode the AC drive will display the frequency command from the computer module. Note the letter "F" on the top left of the operator will turn red when in this mode.
2. Frequency Output Mode – In this mode the AC drive will display the frequency command output to the motor. Note the letter "H" on the top left of the operator will turn red when in this mode.
3. Digital Input Mode (User Define) – In this mode the AC drive will display whatever digital input is triggered in Hexadecimal from the computer module. Note the letter "U" on the top left of the operator will turn red when in this mode. The following are the digital inputs codes.
    a. 0000 – Means that no digital input is activated.
    b. 0001 – Means that the FWD command input has been activated
    c. 0002 – Means that the REV command has been activated.
    d. 0004 – Means that the E-stop command has been activated.
    e. 0008 – Means that Reset command has been activated
    f. 0010 – Means that the Orientate command has been activated.
    g. 0020 – means that the tap mode command has been activated.
4. Current Output Mode – In this mode the AC Drive will display the current being used by the motor. Note an A will be displayed in front of the current value.
5. Upload/Download Mode – In this mode the operator will have the ability to download or upload the parameters from the AC Drive. The operator will display a "read 0" in this mode. The following steps are used to download and upload the AC Drive parameters to and from the operator.
    a. To download the parameters from the Operator to the AC Drive follow the sequence in figure 5.6.2A below.

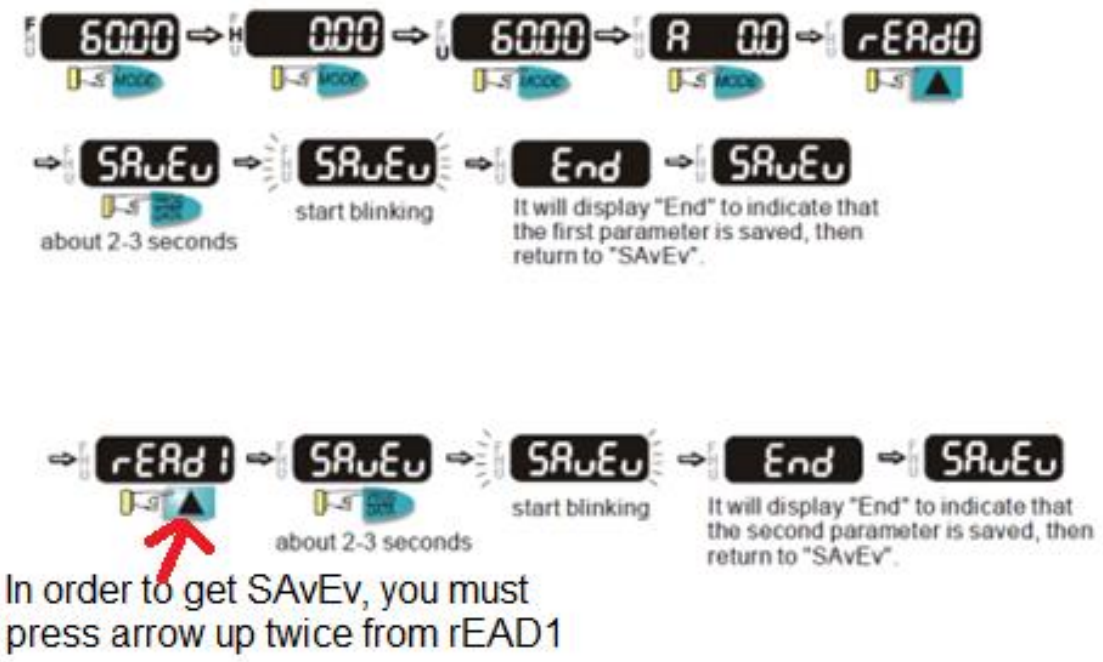
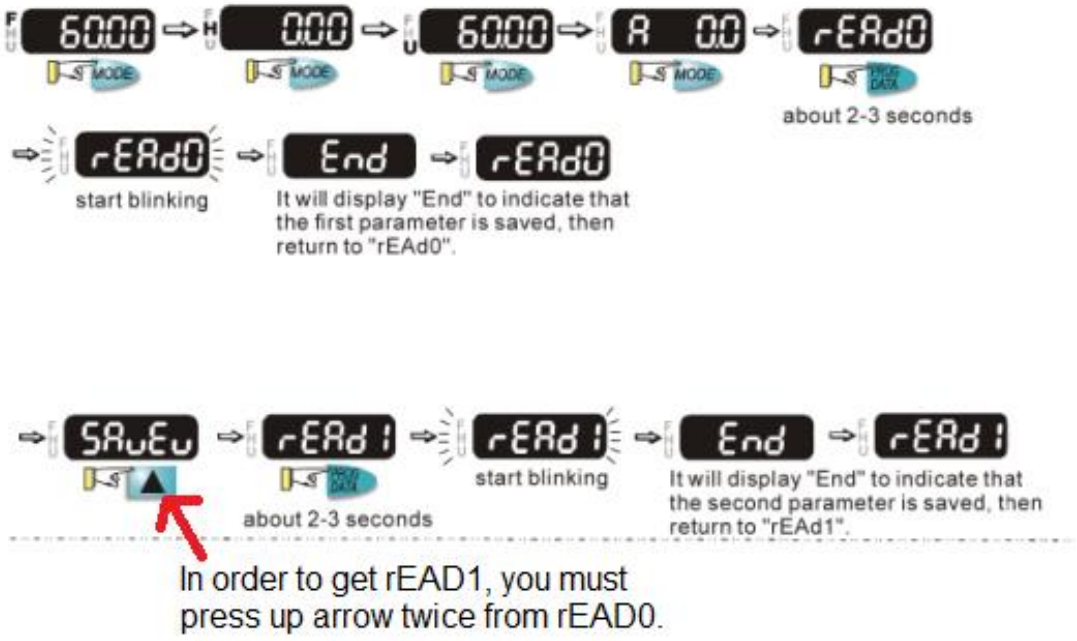


Figure 5.6.2A

b. To upload the parameters from the AC drive to the Operator follow the sequence in Figure 5.6.2B



5.6.2B

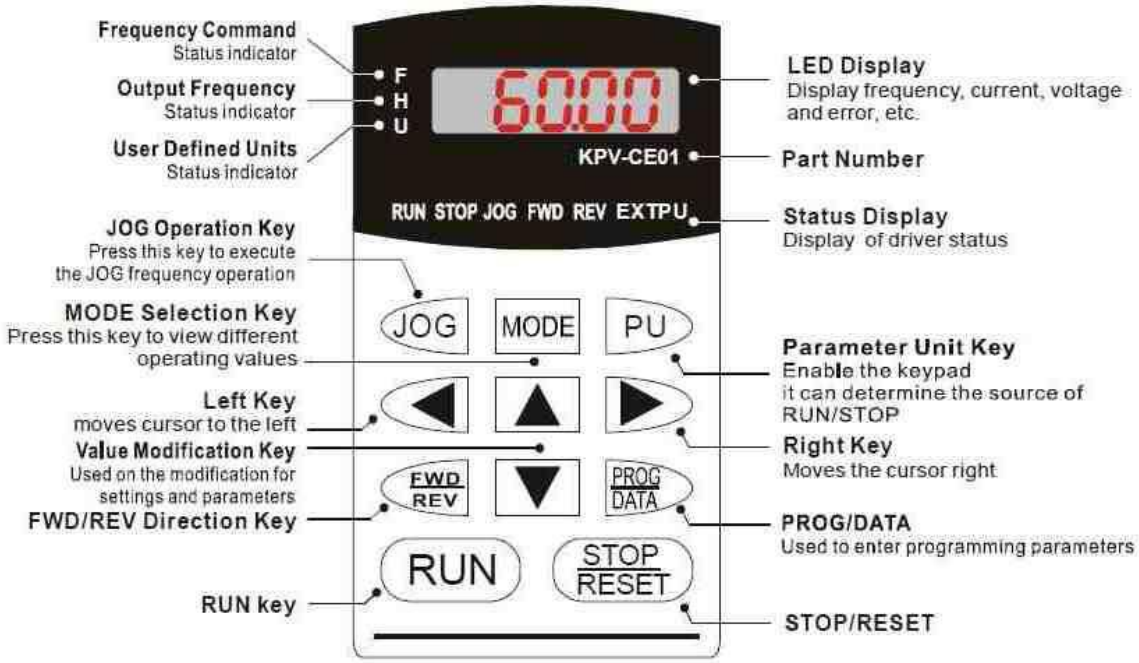


Figure 5.6.2C

Inputs

1. FWD (FWD terminal) input command, is used to tell the AC drive to rotate the spindle in the forward direction, that is CW when view the motor from the top of the motor. The command is said to be activated when the voltage between the DCM and the FWD terminals is 0 volts and deactivate when it is 24 volts DC.
2. REV (REV terminal) input command, is used to tell the AC drive to rotate the spindle in the reverse direction, that is CCW when viewed from the top of the motor. The command is said to be activated when the voltage between the DCM and the REV terminals is 0 volts and deactivate when it is 24 volts DC.
3. Orientate (MI3 terminal) input command, is used to tell the AC drive to go a specific angle that is specified on parameter 10-19. Note in order for the AC drive to accept an orientation command a FWD and Orientation command must be given at the same time. The command is said to be activated when the voltage between the DCM and the MI3 terminals is 0 volts and deactivate when it is 24 volts DC.
4. Reset (MI2 terminal) input command, is used to reset the AC Drive after a fault condition has occurred. The command is said to be activated when the voltage between the DCM and the RESET terminals is 0 volts and deactivate when it is 24 volts DC.
5. E-stop (MI1 terminal) input command, is used to inform the drive that an E-stop condition has be activated and to stop rotation immediately. The E-stop command takes precedence over any other command. The command is said to be activated when the voltage between the DCM and the MI1 terminals is 24 volts and deactivate when it is 0 volts DC.
   Note: This can be checked only for a few seconds once E-Stop is pressed, before power is completely lost.
6. Tap Mode (MI4 terminal) input command, is used to change the Acceleration time and Deceleration time.

Outputs

1. Fault (RB and RC terminals) output, is used to indicate a fault has occurred on the AC drive to the computer module. When a fault occurs the voltage between terminals RB and RC will be 5 volts DC and when it is okay it will be 0 volts.
2. Speed Agree (MRA and MRC terminals) output, is used to indicate when the actual spindle speed is equal to the commanded speed. When the spindle speed is equal to the commanded speed the voltage between the MRA and MRC terminals will be 0 volts and when it is not it will be 5 volts.

Symptoms	Diagnostics
Spindle will not perform a spindle orientate command.	• Verify that the orientation command is being sent to the AC drive by measuring 0 VDC from MI3 to DCM terminals and from the FWD to DCM terminals of the AC drive when the orientation command is triggered. • Verify that the all the parameters are set correctly on the AC Drive.
The AC Drive will fault out immediately when starting the spindle.	• Verify that the spindle AC drive encoder PCB is properly seated. • Verify that the wiring on the AC drive is correct. • Verify that the parameters on the AC drive are correct.
The AC drive has a Fault and it is unable to clear the fault.	• Verify that the spindle Reset signal is being sent to the AC drive by measuring the voltage between MI3 and DCM on the AC drive. When the reset command is given, it should be 0 VDC and 24 VDC when no reset command is given.

5.7 Electrical

5.7.1 Checking Voltages

There are 9 different voltages that need to be checked when troubleshooting a system. A digital multi meter will be necessary in order to measure the voltages. An auto adjustable digital multi meter is preferred that goes from 0 to 600 DC/AC.

1. 220VAC (208 to 240VAC), 3 phase – This is the main power to the entire machine. When measuring this voltage measure between each phase of F1, as seen in figure 5.7.1A.

2. 115VAC(100 to 130VAC), 1 phase – This voltage is produced by the transformer. It is used for power to the computer module and lube pump. If the voltage coming out of the transformer is not exactly 115VAC, it can be adjusted by moving the wire coming out of the transformer to a different terminal. For example if the 115VAC is actually 130VAC and the wire is currently on the 115VAC terminal, then move the wire to the 104 terminal so that the actual voltage drops to around 120VAC. When measuring this voltage it is best to measure at the Transformer as shown in figure 5.7.1A.

3. 24VAC(21 to 27VAC), 1 phase – This voltage is produced by the transformer. It is used for powering the work lights and motor contactor relays. When measuring this voltage it is best to measure at the Transformer as seen on figure 5.7.1A.

4. 24VDC(21 to 27VDC) – This voltage is produced by the power supply to the left of the computer module. This voltage is used for all the relays on the relay modules and all the inputs on the OM1 and OM2 modules. The voltage can be measured between pin 1 of the "Monitor Port" on the computer module and the chassis ground on the computer module, as seen on figure 5.7.1B

5. +12VDC(11 to 13VDC) – This voltage is produced by the internal power supply of the computer module, it is used to power some internal functions of the computer module and to power the LCD controller board. The voltage can be measured between pin 3 of the "Monitor Port" on the computer module and the chassis ground on the computer module, as seen on figure 5.7.1B. If this voltage is not correct the computer module will produce a DC Power Fault, that will be identified by the red DC Power LED being turn ON, on the computer module.

6. –12VDC (-11 to –13VDC) – This voltage is produced by the internal power supply of the computer module, it is used to power the internal circuits for the ±10 volts used for the axis motors. The voltage can be measured between pin 2 of the "Monitor Port" on the computer module and the chassis ground on the computer module, as seen on figure 5.7.1B. If this voltage is not correct the computer module will produce a DC Power Fault, that will be identified by the red DC Power LED being turn ON, on the computer module.

7. 10VDC – This voltage is produced by the computer module, it is used for control of the spindle motor (0 to 10 VDC) and axis motors (-10 to +10 VDC). This voltage varies depending on rpm of the motor.

8. 5VDC (4.75 to 5.25VDC) – This voltage is produced by the internal power supply of the computer module, it is used to power the internal functions of the computer module, servo drives, motor encoders, and the Overlay Interface board on the pendant. The voltage can be measured between pin 4 of the "Monitor Port" on the computer module and the chassis ground on the computer module, as seen on Figure 5.7.1B. If this voltage is not correct the computer module will produce a DC Power Fault, that will be identified by the red DC Power LED being turn ON, on the computer module.

9. 3.3VDC (3 to 3.6VDC) – This voltage is produced by the APPs board that is inside the computer module. The 3.3 volts is used for most of the internal digital I/O circuit. If this voltage is not present then the system will not detect the digital inputs nor will it output any digital output. The voltage may be verified between pin 5 of the Monitor port on the computer module and ground.

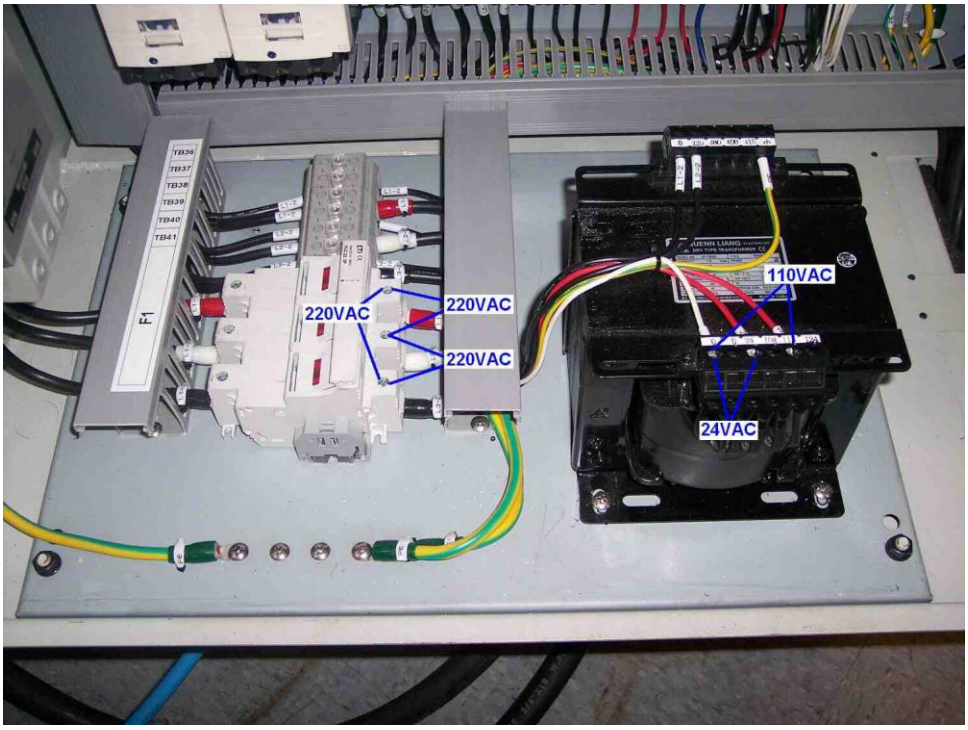


Figure 5.7.1A

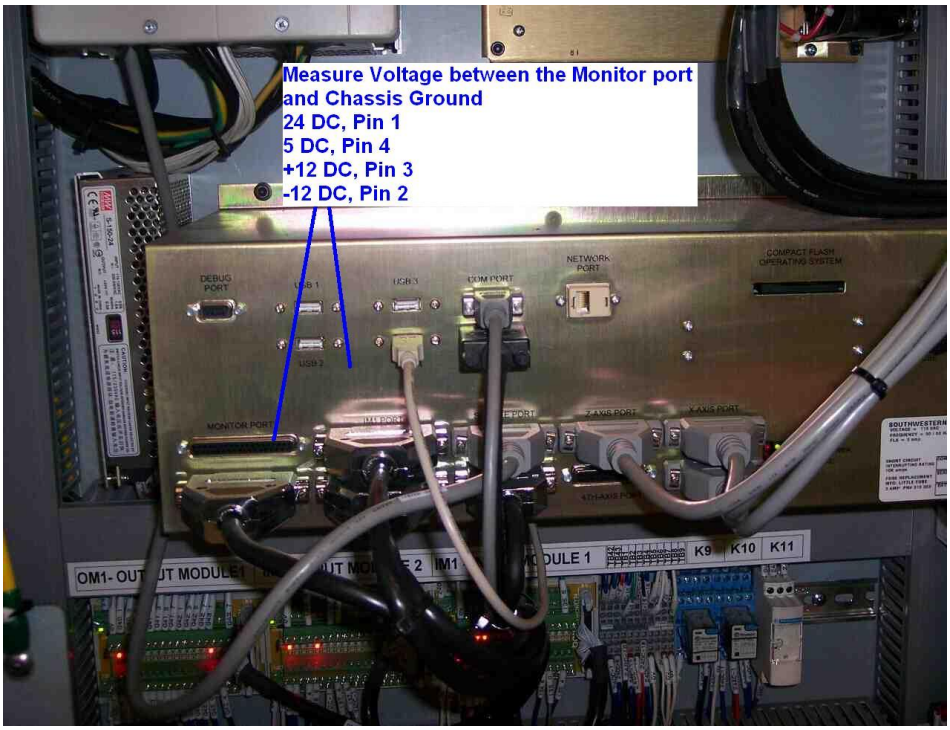


Figure 5.7.1B

The proper grounding of the machine is a vital piece in ensuring the machine functions properly. It is recommended to use a ground rod whenever possible, in order to minimize the electrical noise. A standard digital ohmmeter is not the best tool to use to measure the power ground. The best thing to do, without getting special equipment, is to perform a visual inspection of the ground wire and rod. Ensure that the connection is properly secure and that the ground wire is at least a 6 AWG size wire. See section 3.6 for more information.

Note: systems running consistently close to the low values may have problems when normal voltage fluctuations push the voltage out of the acceptable range.

5.7.2 Checking Fuses and Circuit Breakers

There are 5 field replaceable fuses in the system.

- 3 on the F1 block (80 amp)
- 1 on the computer module (3 amp)
- 1 on the lube pump (5 amp)

To check fuses:

- Use a Volt/Ohmmeter; select "OHM".
- Remove the fuse completely from the pendant, electrics box or cable breakout box.
- Place a lead of the meter on each end of the fuse.
- A good fuse reads 0 (zero) or close to it.
- A bad fuse reads Open or Infinity.

There are 12 overload protection devices on the system that may be reset. The overload protection devices are labeled Q1 through Q12. These devices are like on/off switches, and thus can be turned off and on. The following is the list of circuit breakers.

- Q1 is a 32 amp circuit breaker used for the servo drive power supply.
- Q2 is a 50 amp circuit breaker used for the Spindle AC Drive.
- Q3 is an overload relay set to 1.5 amps used for the Auger motor.
- Q4 is an overload relay set to 2 amps used for the Coolant Wash pump
- Q5 is an overload relay set to 2 amps used for the Coolant Wash pump.
- Q6 is an overload relay set to 0.75 amps used for the Tool Changer motor.
- Q7 is a 1 amp circuit breaker used for the spindle motor fan.
- Q8 is a 10 amp circuit breaker used for the single phase transformer.
- Q9 is a 16 amp circuit breaker used for the 24 VAC line from the single phase transformer.
- Q10 is a 4 amp circuit breaker used for the 110VAC line from the single phase transformer.
- Q11 is a 2 amp circuit breaker used for the Lube pump.
- Q12 is a 6 amp circuit breaker used for the 24 volt DC power.

5.7.3 Reading the Electrical Schematic

The LPM electrical schematic 26775-SCH, is the ideal drawing to use when trouble shooting an electrical problem. Every figure on the schematic represents a specific component on the machine there may be multiple figures that represent a single component. Each figure in the schematic also has a reference designator and a description name, see Figure 5.7.3A, or B for an example.

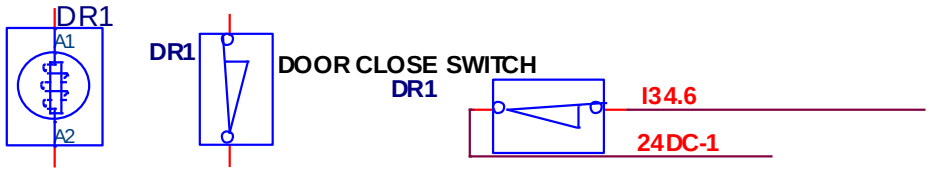


Figure 5.7.3A

Note Figure 5.7.3A contains 3 figures that all represent only one Door Interlock Switch. The Door Interlock Switch has 2 functions. The 1st function is to lock and unlock the door represented by the figure on the left. The 2nd function is a switch contact that is represented by the figure in the middle and on the right. The single switch contact signal actually does two functions itself. One is activate the Door Relay K9 and the other to send the signal to the computer module that the door is closed, as seen on the schematic.

The schematic was made so that the each net name represents a specific voltage as follows.

- All wires identified with L1, L2 or L3 have 220 AC volts across them.
- All wires identified with a U, V, W have controlled 220 AC volts across them.
- All wires identified with a 110AC- number have 110 AC volts on them.
- All wires identified with a 24AC- number have 24 AC volts on them.
- All wires identified with a 24DC- number have 24 DC volts on them.
- All wires identified with an I followed by a number (I32.1) will be a digital 24 volts DC input to the computer module.
- All wires identified with a Q followed by a number like Q40.0, will be a digital 24 volts DC output from the computer module.

Below are some of the symbols from the schematic and what they represent.

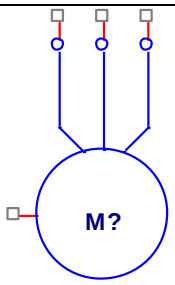
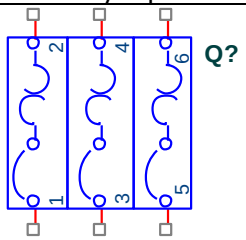
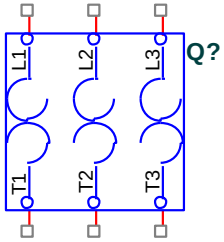
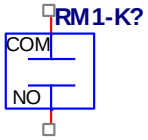
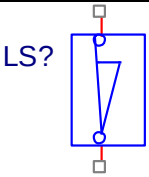
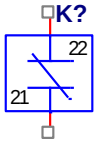
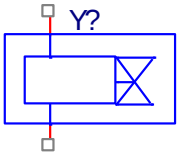
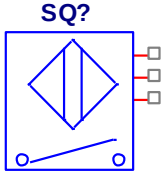
 Three Phase Motor	 Three Phase Circuit Breaker
 Three Phase Overload Relay	 Normally Open Relay Contact from RM1 Module
 Limit Switch	 Normally Close Relay Contact
 Air Solenoid Valve	 Proximity Sensor

Figure 5.7.3B

5.8 Digital Input/Output Diagnostics

WARNING!
When working inside the electrical with power ON, be aware that some components have up to 300 volts running through them.

Most of the 24 volts DC digital input/output signals are found on the OM1, IM1 and IM2 modules. These 3 modules connect to the corresponding ports on the computer module. All the inputs to the computer module are on IM1 and IM2 modules and all the outputs are located on the OM1 module.

Each signal on each module contains a LED that will indicate when voltage is supplied to or from the module. A digital voltmeter should be used in order to identify that the correct voltage is being sent to and from the modules. The voltage should be 24 volts DC ±2 volts. Use the schematic 26775-SCH in order to identify the function of each digital input/output signal.
The X-axis, Y-axis, Z-axis and 4th-axis ports carry two 5 volts digital signals. While the Spindle port carries 24 volt signals to the AC Drive. Service code F will also indicate the status of each digital input and output from the computer modules side.

Symptoms	Diagnostics
Digital input going through IM1 or IM2 is not being detected by computer module. This includes the following inputs. • ATC Counter Sensor • ATC In Switch • ATC Out Switch • ATC Home Sensor • ATC Tool Detect Sensor • X-axis Plus & Minus Limit Switch • Y-axis Plus & Minus Limit Switch • Z-axis Plus & Minus Limit Switch • Tool Unclamp Switch • Tool Clamp Switch • Tool Clamp Button • Lube Pressure Switch • Lube Low • Coolant Wash Overload • Coolant Overload • Auger Overload • ATC Overload • Air Pressure Low • Door Close • E-stop • Spindle Temperature	• Identify if the light on the corresponding sensor is turning ON when it is activated. Note that only the ATC sensors have a light to indicate when they are activated. • Identify if the light on the corresponding terminal on RM1 or RM2 is turning ON when the sensor or switch is being activate. • With a voltmeter identify if the voltage is between 22 and 26 volts DC between the corresponding terminal and ground. • Utilize Service Code F to identify if the computer module is actually seeing the signal.
Digital Output going through OM1 and either RM1 or RM2 not activating. This includes the following outputs. • Tool Unclamp • Air through Spindle • Alarm Lights • Air Blast • Door Switch • Lube Pump • Work Light • Coolant Pump • Auger • Z-axis Brake • Tool Changer Motor • Tool Changer In / Out • 4^{th} axis Unclamp • OT Override • NC Ready • Mill Indexer Output	• Utilize service code F to turn ON and OFF the digital outputs commands. • Identify if the corresponding light of the signal on OM1 is turning ON. • Verify that the corresponding LED turn ON and OFF on RM1 and RM2. • Use a Volt Meter to measure that the output voltage is between 22 and 26 volts DC with reference to Ground.

Symptoms	Diagnostics
Spindle AC drive is not accepting a forward, reverse, reset, orientate or E-stop command.	• Utilize service code F to turn ON and OFF the outputs commands to the spindle AC drive. • Measure the DC voltage between the following terminals on the AC drive for each function the voltage needs to be between 22 and 26 volts DC or 0 volts when it is activated. ➢ For Forward command between FWD and DCM. ➢ For Reverse command between REV and DCM. ➢ For Rest command between MI2 and DCM ➢ For Orientate command between MI3 and DCM ➢ For E-stop command between MI1 and DCM • If the voltage is okay then the problem is with the AC drive. Verify the AC Drive programming parameters are set correctly.
Spindle Fault or Spindle Run feedback are not being detected.	• Utilize service code F to identify if the computer module is seeing a spindle fault or run feedback from the spindle AC drive. • Measure the DC voltage at the AC drive for the Run and Fault feedback. ➢ For the Run feed back the voltage should be between 4.75 to 5.25 volts DC when it is not activated and 0 volts when it is activated. ➢ For the Fault feed back the voltage should be 0 volts with it is not activated and 4.75 to 5.25 volts DC when it is activated. • If the voltage is not changing when it is activated then verify the parameters on the AC Drive.
Checking for faulty axis enable and reset output signals to servo drive.	• **Warning when checking these signals make sure that the motors are not coupled to the ballscrew**. • Utilize service code F to trigger the axis Enable and Reset output to the servo drive. • Measure the voltage at the servo drive for the Enable signal, between pin 8 and ground of the 16 pin connector. The voltage should be between 4.75 and 5.25 volts DC when the servo drive is deactivated. Note the red LED on the servo drive should be ON. The Enable signal should be 0 volts when it is activated. • Measure the voltage at the servo drive for the Reset signal between pin 7 and ground. The Reset signal should measure between 4.75 and 5.25 volts DC when Reset signal is deactivated. The reset signal should measure 0 volts when the Reset signal is activated.
Checking for faulty axis Fault signal from the servo drive.	• Utilize service code F to identify if the computer module is seeing axis fault feedback from the servo drive. • Measure the DC voltage at the axis drive on pin 9 and ground. When the servo drive has faulted the voltage should be between 4.75 and 5.25 volts DC. When the drive has no fault and is enabled then the voltage should be 0 volts.

5.8.1 Checking Relay Modules

There are 2 main relay modules located in the electrical cabinet (RM1 and RM2). These relay modules contain relays that are controlled by 24VDC from the computer module. These relay modules have a light on to each relay to identify when power is being sent to the relay, thus turning ON. RM1 relay module contains 20 relays while the RM2 relay module contains 8 relays. All the relays on RM1 and RM2 may be replaced by simply moving aside the small clip that holds the relay in its socket and pulling on the relay so that it is removed from its socket, as seen on Figure 5.8.1A. There are some spare relays that are identified in the schematic.

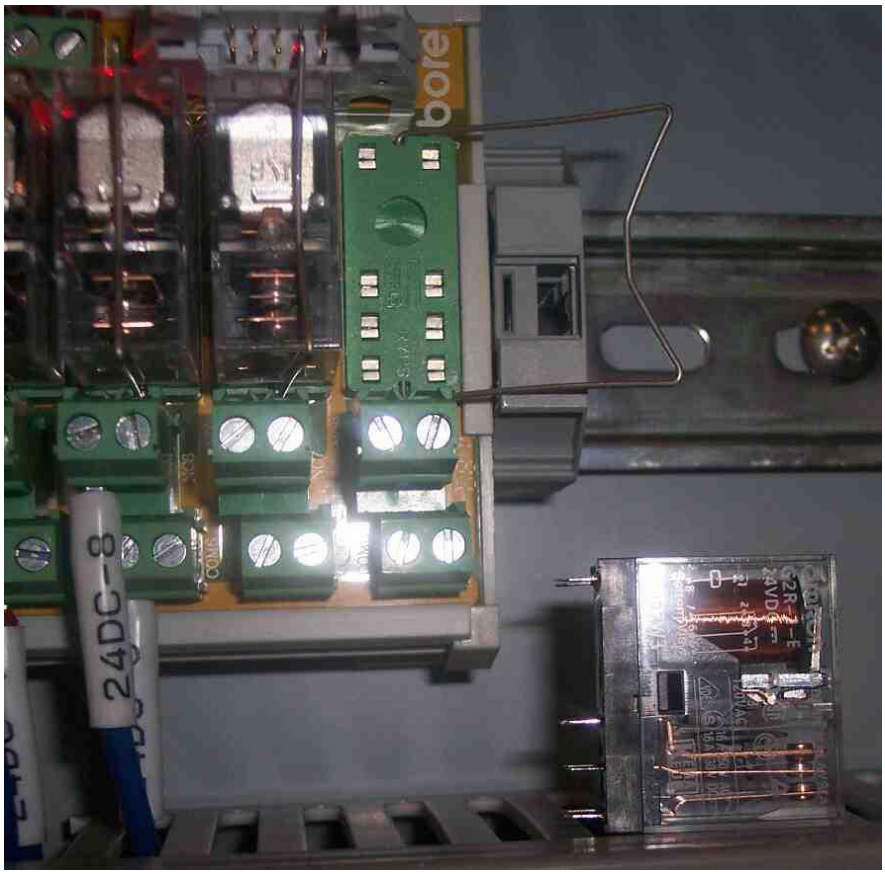


Figure 5.8.1A

The purpose of OM1, IM1 and IM2 I/O modules is to distribute the signals and for ease of troubleshooting. All the signals going in and out of the OM1, IM1 and IM2 modules are 24 volts DC.

Below are some symptoms and how to diagnose if the problem is with the relay module itself. A digital volt-meter will be need to measure DC voltage.

Symptoms	Diagnostics
The relay module LED on RM1 or MR2 turns ON but the output does not turn on.	• Using a volt-meter, in DC voltage, measure the voltage to the relay from the 0V terminal on RM1 or RM2 module to its appropriate Q number on the relay module. • Replace the relay with a spare relay, use the 26775-SCH to identify a spare relay. Note a spare relay may be identified by not having any wire going to its corresponding NC, NO and COM terminals.
The relay module LED does not turn on but there is 24VDC going to its appropriate Q number on the RM1 or RM2 module.	• Replace the relay with a spare relay, use the 26775-SCH to identify a spare relay. Note a spare relay may be identified by not having any wire going to its corresponding NC, NO and COM terminals • Remove the relay in question and measure the DC voltage across the top 2 pins in order to identify if the voltage is getting to the relay or is the problem with the relay module board.

5.9 Tool Changer Diagnostics

The Automatic Tool Changer or the ATC, as it is referred to throughout this manual, consists of two major assemblies, the ATC Assembly, Upper, as described in assembly print 26784, and the ATC Assembly, Lower, as described in assembly print 26811.

The ATC Assembly, Upper is responsible for the ATC movement toward the spindle (In) as well as the movement away from the spindle (Out). This movement is achieved by the means of a double acting pneumatic (air) cylinder. The ATC's movements In and Out are also cushioned at the end of travel by means of hydraulic cushioning cylinder.

The ATC Assembly, Lower is responsible for the ATC indexing from tool location to tool location by means of a Geneva mechanism, which consists of an indexing carousel, an indexing pin, a locking segment and a geared indexing motor.

5.9.1 Spindle Orientation

An automatic tool change requires that many components of the LPM work in concert with one another. These components include the ATC (Position relative to the centerline of the spindle), the spindle (Orientation of the spindle drive dogs relative to angle of the tool holder held in the ATC), the Z-axis (tool change height) and the Automatic Draw Bar (being in state of clamped or unclamped).

Let's start with spindle orientation. Spindle orientation is like any other setting regarding the ATC, it is a critical one, as a crash would be the result of an improper setting. Spindle orientation centers the drive dogs of the spindle for proper engagement of the CAT40 tool holder when it is held in the tool carousel of the ATC. Service code 510 will safely walk you through this procedure. Make sure to follow the procedure precisely.

5.9.2 Tool Change Height

Service code 501 will take you through the procedure for setting the tool change height. This will set the position where the Z-axis will clamp or unclamp the tool by the automatic draw bar. Like the spindle orientation, this setting is also critical.

During this procedure you will hear the "air through the spindle", this is not a nuisance, but rather a valuable tool for this procedure. As you near the proper tool change height while performing service code 501, you will hear the sound of the air slowly being blocked off, simply creep down at .010" jog feed rate until the sound of the air just disappears, then back it off one click and the slight sound of air will once again be heard. That is the proper tool change height.

It should be noted, that the tool clamping mechanism will give the CAT40 tool holder a slight bump at "Unclamp", to dislodge the tool holder from the spindle. Likewise, it will give the tool holder a slight tug at "Clamp". This action is both normal and proper.

Any improper setting of the tool change height would result in unnecessary stresses on the gripper assemblies and the tool carousel.

5.9.3 Automatic Tool Changer Position

This section refers to the centerline of the tool holder while being held in the ATC, relative to the centerline of the spindle. This setting is precisely made at the factory and it is highly unlikely that any additional adjustment would be necessary, however, it is worth mentioning to best understand how the alignment between the ATC and the spindle is achieved. See drawing 26966.

Warning!
Before making any adjustments to the ATC position in the X-axis, the air to the ATC MUST be on and at 90psi. The proper setting of the ATC position can only be achieved with the system pressurized.

If in the event that it is discovered during the tool change height setting procedure, that the tool is being deflected due to misalignment with the spindle. It should first be determined whether this condition only effects one position of the carousel, in which case the gripper assembly may be damaged, or if it effects all positions in the same fashion. If the latter is the case, then it should be suspected that there is misalignment between the carousel and the spindle.

First, the direction of the tool deflection must be determined. Follow service code 501 for setting the tool change height. With the ATC directly beneath the spindle, place the base tool for the machine you are working on into the ATC. Set up a travel indicator and load it with .100" of travel at the side of the axis where the deflection is coming from. Zero the indicator and proceed with service code 501 and bring the spindle down over the tool. Do this until the maximum amount of deflection is read on the indicator. Adjust the "Push-Pull" screws on the appropriate axis until indicator returns to zero, see drawing 26966 for ATC adjustment instructions. The alignment should now be restored. See figure 5.9.3a. This picture illustrates measuring the deflection along the X axis. Rotate the indicator for the Y axis.

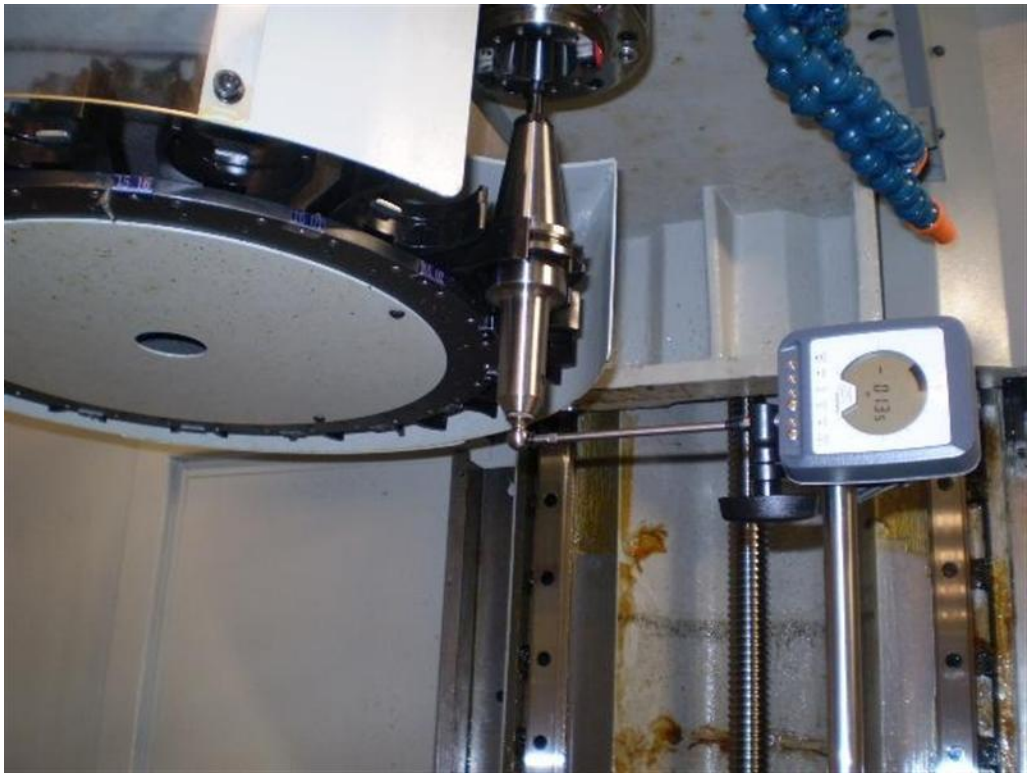


Figure 5.9.3a

5.9.4 Automatic Tool Changer Adjustments

There are six points of the ATC that can be adjusted. Refer to ATC Adjustments drawing 26966. Items 1 through 6 refer to items 1 through 6 on the drawing.

1. The sliding assembly travel adjustment screw (in) is used to set the total distance the ATC Sliding assembly needs to travel for a tool holder to be on center with the spindle centerline. DO NOT TAMPER WITH THIS ADJUSTMENT UNLESS YOU ARE CERTAIN IT IS NECESSARY. If it does require adjustment, the ATC "In" limit switch will have to be adjusted accordingly.
2. The door opening adjustment simply sets how the door closes. The further the arm is adjusted to the right, the further the door closes, and the less it opens. Vise-versa when adjusted to the left.
3. The arm level adjustment allows you to make certain that the arm is parallel with the shroud. An arm that is not level may not operate smoothly.
4. The sliding assembly travel adjustment screw (out) is used as a stop when the ATC is at the out position. There is no precise setting, but if for some reason it does require adjustment, the ATC "Out" limit switch will have to be adjusted accordingly.
5. The Push-Pull bracket in the Y-axis is used to make an adjustment to the ATC position relative to the spindle centerline on the Y-axis. Refer to section 5.9.3 if any adjustment is required.
6. The Push-Pull bracket in the X-axis is used to make an adjustment to the ATC position relative to the spindle centerline on the X-axis. Refer to section 5.9.3 if any adjustment is required. Note, the air to the ATC must be on before determining whether there is an issue regarding alignment on the X-axis.

5.9.5 Tool Clamping Mechanism

There are two forces that are used in the tool clamping mechanism. The first being the force applied by a compliment of eighty Belleville spring washers that are set to apply 1500 lbs of pull force on the CAT40 retention knob which clamps the tool holder into the spindle. The second being the force of the air cylinder that compresses the Belleville washers and releases the tool holder from the spindle.

The pull force is set at the factory and should not be modified for any reason. Modifying this setting can comprise the efficiency of the tool clamping mechanism, and/or affect its life expectancy.

The stroke of the air cylinder is mechanically controlled and has no adjustment, so it is essential that the 5mm (.200") air gap between the draw bar and the air cylinder adjusting screw be maintained, see section 6.15 of this manual, or drawing number 26854. It should be noted that the air cylinder adjusting screw has left handed threads. The purpose behind that is, in the event that the tool clamping assembly was in the unclamp state (compressing the spring washers), and the spindle was revolved in the typical forward direction, the screw would wind away from the spindle and not towards it. If the adjusting screw were to wind toward the spindle, more serious internal damage to the spindle and the tool clamping mechanism could occur.

The 5mm air gap setting provides for the proper "bump" to release the tool holder from the spindle during a tool change. Failure to have this set properly can cause serious damage to the gripper assemblies of the ATC. Such damage to the gripper assemblies, could lead to damage to the table, fixturing and/or the work piece due to a broken gripper assembly that can no longer adequately grip a tool holder.

The air gap setting is also essential for safe manual tool changes by the operator. An improper setting of the air gap will lead to unpredictable behavior of the clamping mechanism.

5.9.6 Tool Changer Sensors

The automatic tool changer as a system has seven limit switches and/or sensors that monitor its state.

- Home position sensor (proximity switch)
- ATC motor count sensor (proximity switch)
- Tool detect sensor (optical)
- ATC "In" (limit switch)
- ATC "Out" (limit switch)
- Tool "Unclamp" (limit switch) Found on milling head
- Tool "Clamp" (limit switch) Found on milling head

The Home Position Sensor is used to tell the control where home is. During the Homing sequence, the carousel will continue to index in the clockwise direction until the home position stud is detected. If for some reason the stud is not detected, the ATC will simply "time out". At which point it must be determined whether or not the sensor is functioning or not.

At the pendent, index the tool changer until it is in the home position. Run service code F to determine whether or not the sensor is detecting the home position stud.

If it is determined that the stud is not being detected, press the E-Stop and place a steel object, such as a screw driver beneath the sensor and see if the amber LED illuminates. If not, the sensor is either not receiving power, is faulty or the home position stud is not properly set.

ATC Motor Count Sensor consists of a proximity switch, and cam with a window.

One rotation of the cam represents one station index. When the cam is in the home position, the proximity switch recognizes it and illuminates an amber LED. Once the cam has rotated and the sensor recognizes the window, the logic waits for the cam to once again be recognized. Once recognized, a timer begins, and for a calculated amount of time, the motor continues to drive until home position is reached. It is critical that the cam be oriented as shown in figure 5.9.6a. This puts the locking segment in the optimum position. The sensor should be positioned in the center of black bracket you see in figure 5.9.6a.

Figure 5.9.6a

Tool Detect Sensor is used as the name suggests, to detect whether a tool is present in the tool change position in the carousel, which would crash with a tool that is already in the spindle if a tool change were attempted.

If the tool detect sensor detects a tool that is not present, check the sensor lens for contamination. Debris on the lens can cause a false detection of a tool.

The Tool detect sensor is an optical type sensor, it sends out a "fan" beam that can set as vertical, horizontal or anywhere in between. The sensor must be set to send out a vertical beam. Failure to do so runs the risk of the sensor picking up parts of the tool changer other than the tool holder itself. The tool detect sensor uses two LED's. One green LED indicates no tool is present, and one red LED indicates that a tool is present. These LED's can be found on the underside of the barrel of the tool detect sensor when it is mounted properly. The sensor should be mounted approximately one inch from the bracket sensor bracket. Set the intensity to half way between min and max. See figures 5.9.6b and 5.9.6c. See section 6.16 for replacement instructions.

The angle of the tool detect sensor bracket (20°) is designed to cast a beam that is as perpendicular as possible to the angle of the tapered shank of the CAT40 tool holder.

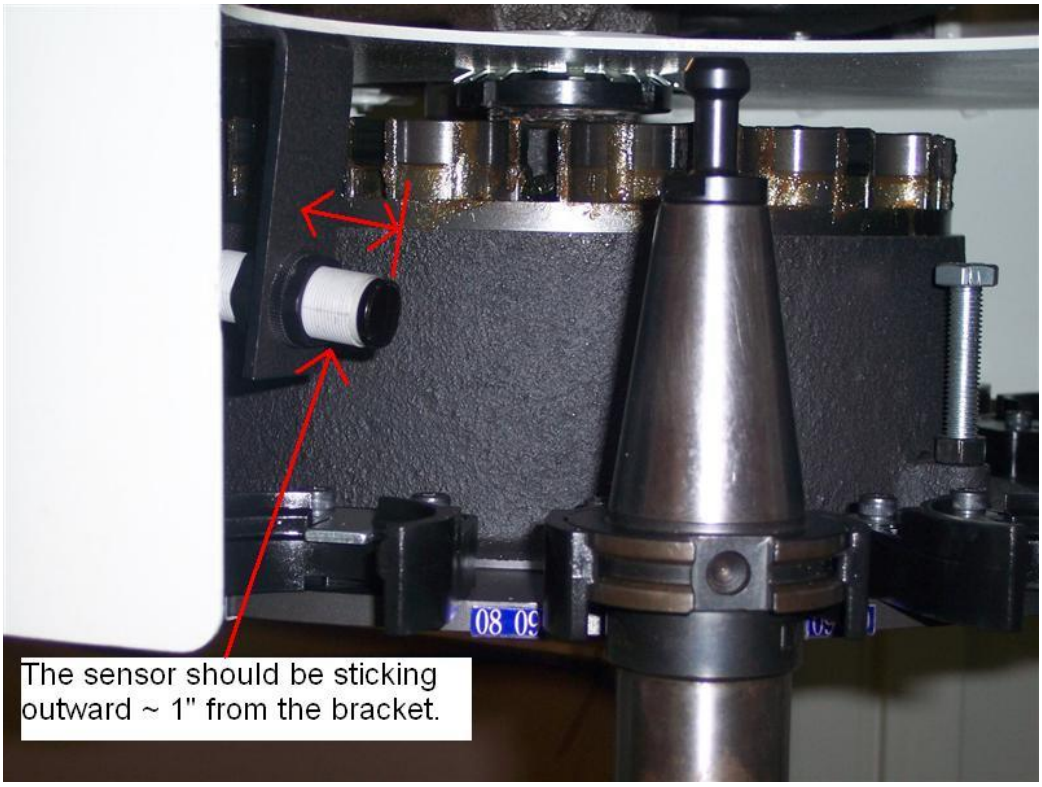


Figure 5.9.6b

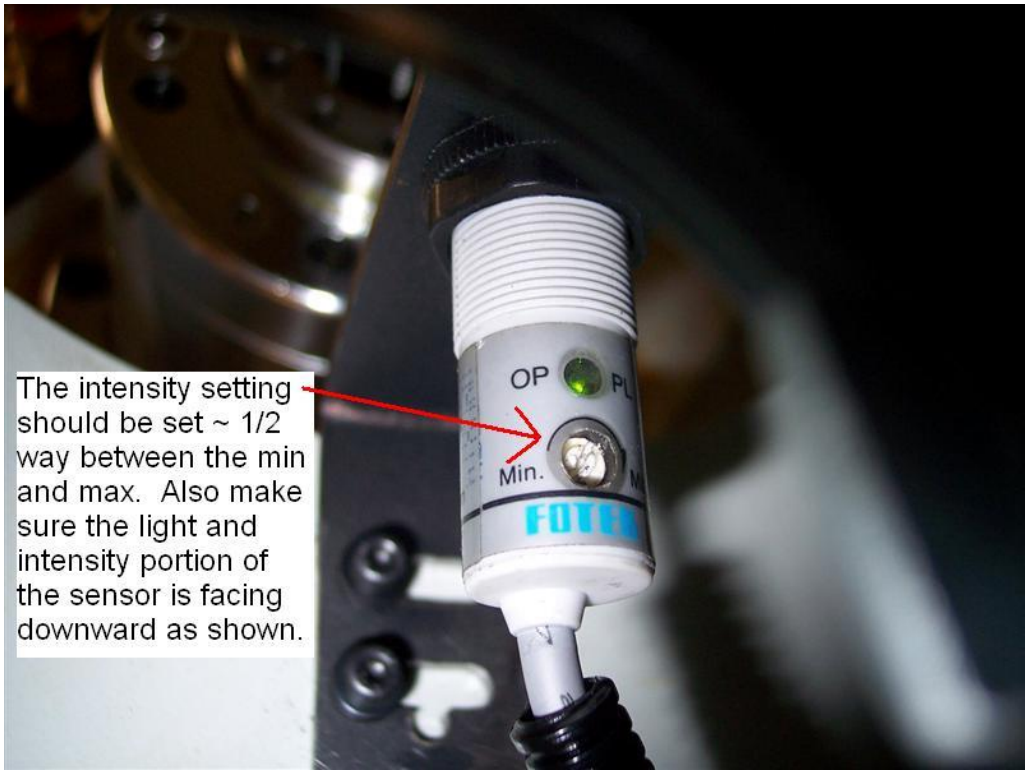


Figure 5.9.6c

ATC "In" is a limit switch that detects that the ATC has advanced all the way forward to the spindle.

ATC "Out" is a limit switch that detects that the ATC has retracted all the way back from the spindle.

Tool "Unclamp" is a limit switch that detects that the tool unclamp mechanism is in the unclamped state. If this limit switch is not set or functioning properly, there is the potential that the draw bar could get friction welded to the air cylinder adjusting screw. This switch is triggered only when you are physically loading a tool in and out of the spindle. Pressing the green button on the head puts the machine in this state.

Tool "Clamp" is a limit switch that detects that the tool clamp mechanism is in the clamped state.

5.9.7 ATC Flow Control Valves

The speed at which the ATC can move inward or outward can be controlled by the flow control valves, identified as item 4 on drawing 26930 found in this manual.

The flow control valve on the left controls the speed at which the ATC travels inward. The flow control valve on the right controls the speed at which the ATC travels outward. In the case of either valve, an adjustment in the clockwise direction reduces the speed of the ATC sliding assembly, and an adjustment in the counter clockwise direction increases the speed of the ATC sliding assembly. See section 5.10 for more information.

5.9.8 Sheet Metal Covers

All the sheet metal covers on the ATC are straight forward and self explanatory, except for the shroud door. The shroud door is mechanically opened and closed with movement of the slide assembly inward and outward. The linkage that controls the opening and closing of this door, must be properly secure or smooth movement of the door will not occur.

5.9.9 Error Messages Relating to the ATC

The following is the list of error messages that the ATC might generate.

Error 123 - The ATC encountered an error during a tool change.

Error 124 - The spindle did not orient correctly. The orientation angle in the spindle drive does not match the angle in the control.

Error 125 - The current position of the Z Axis is BELOW the tool change position. The Z-axis is not high enough to execute a tool change.

Error 126 - The spindle is in the unclamped position and needs to be clamped to proceed. The unclamp limit switch is detecting that the tool clamping mechanism is still in the unclamped state, this might occur when a tool is being called, but it is not clamped in the spindle. In this state if the ATC was to move, the tool could be dropped on the table.

Error 127 - The spindle is in the clamped position and needs to be unclamped to proceed. The clamp limit switch is detecting that the tool clamping mechanism is still in the clamped state, this might occur when a tool has been returned to the tool carousel, but is still clamped in the spindle. In this state if the Z axis was to move, the tool gripper in the ATC could be damaged.

Error 128 - The ATC carousel was unable to find its home position. This occurs if the home position sensor is not functioning properly, or the home position stud is not set properly.

Error 129 - The ATC carousel is out of position or is between its limit switches. This occurs if the ATC "In" or "Out" limit switch fails to be recognized.

Error 130 - The ATC carousel is unable to rotate position because of some obstruction or Z-axis position error. This message appears when the ATC is in, and the spindle is at tool change height. This prevents the accidental indexing of the ATC when a tool holder is captured by the spindle.

Error 131 - The ATC was unable to move to the IN position. This message appears when the ATC fails to reach the IN limit switch within five seconds of being commanded to do so.

Error 132 - The ATC was unable to move to the OUT position. This message appears when the ATC fails to reach the OUT limit switch within five seconds of being commanded to do so.

Error 133 - The Z-axis was unable to move to the unclamped position. This means the Z-axis was unable to move to approximately 4.5 inches above the tool change height within five seconds of being commanded to do so.

Error 134 - The Z-axis was unable to move to the tool change position. The Z-axis was unable to reach the tool change height within five seconds of being commanded to do so.

Error 136 - The ATC carousel was unable to rotate to the next location correctly. The ATC motor count sensor failed to recognize the cam.

Error 137 - The ATC is unable to move in because there is currently a tool in the spindle and one in the carousel location. This message appears whenever the tool detect sensor detects that there is a tool in a location of the tool carousel where the tool in the spindle is being commanded to return to.

Error 138 - The ATC is trying to unclamp the spindle but the spindle is still in motion.
This message appears when the system detects any amount of velocity from the spindle. The system will not allow the spindle to unclamp under this condition.

Error 139 - The ATC is trying to move in but the air pressure is too low. This message will occur if a tool change is requested from a program.

Error 150 - The current ATC function has timed out. This happens when the control expects another action to occur but it doesn't. For example, when performing service code 501, and the ATC is left at the "In" position

5.9.10 Diagnostics Table

There are two types of motion we discuss regarding the automatic tool changer, the inward and outward motion of the tool changer sliding assembly, and the rotational movement of the tooling carousel. The following table will attempt to simplify problem diagnosis.

Symptom	Possible Cause	Remedy
ATC will not advance towards the spindle.	• The front sliding door is open • Compressed air is not being supplied to the machine. • The in-line air switch is in the closed position • Low air pressure • The solenoid is not receiving an electrical signal. Is the solenoid LED illuminated? • The blue polyurethane tube supplying air to advance the sliding mechanism toward the spindle became pinched or obstructed. • An obstruction is preventing movement.	• Close the door or defeat the safety interlock limit switch. • Supply 90 psi air to the machine • Make certain the in-line air switch is in the open position (upward) please refer to pneumatic assembly drawing 26930 found at the rear of this manual. • Find the cause of the low air pressure. Pressure should be 90 psi at the machines regulator. • Check that the solenoid has not been manually over ridden. • • Replace and re-route pinched tubing. • Remove the obstruction
ATC will not retract away from the spindle	Automatic Draw Bar has failed to release the tool from the spindle	Re-set the air gap between the automatic draw bar actuator, and the automatic draw bar (5mm)
The ATC is commanded "In", however, the ATC advances towards the spindle, pauses then retracts on it's own.	• The ATC "IN" limit switch is not being recognized. • Air pressure is too low • Low air pressure sensor is not set or functioning properly • The ATC "IN" limit switch is not functioning properly	• Remove the obstruction that is preventing the ATC from reaching the limit switch • Check the system air pressure at the regulator, it should read 90 psi • Check the Low air pressure sensor, it is set at the factory to trigger at 60 psi • Replace the ATC "IN" limit switch
ATC carousel fails to find HOME	Home position sensor is not set or functioning properly.	Manually index ATC carousel until the Home Position Stud is aligned with the Home Position Sensor. Adjust the Home Position Stud toward the sensor until the sensor is recognized. The LED will illuminate if the sensor is functioning properly.

Symptom	Possible Cause	Remedy
ATC carousel fails to index	• There is an obstruction in the Geneva mechanism	• Check for a heavy chip or other debris that is prohibiting the indexing pin from entering the Geneva plate (the ATC motor overload relay would be tripped under this condition).
	• The indexing pin has been broken	• Find the cause of the breakage and then replace the pin
The tool holder "pops" when being removed from the spindle	Tool holder or the spindle bore taper is contaminated with dry coolant causing it to be tacky	Clean all mating surfaces
Tool holder falls from the spindle during a tool change	• The wrong retention knob is being used.	• Locate and use the proper retention knob, see section 2.4.4 of this manual.
	• The pull fingers inside the spindle are damaged or missing	• Visually inspect the pull fingers.

5.10 Pneumatic Diagnostics

Air is a vital component to the operation of the LPM machine and is used to run many key components on the machine. Air is used to run the automatic tool changer (ATC), clamp and unclamp tools in the spindle, used to clean the spindle taper during a tool changer and can be used to blow chips away from your cutting tools.

The following is a brief description of the pneumatic components used on the LPM machine. Please refer to drawing 26930 at the rear of the manual for an illustration of many of these components.

1. Supply Air Line to Machine – in order to provide the volume necessary to run the LPM you must use an air line with a minimum ID diameter of ½". The main air line is connected to the machine at the rear as shown in drawing 26930 or figure 3.7.2a in section 3 of this manual.

2. Switch that turns air on/off to the machine – Directly above the air supply input to the machine is a blue on/off valve. When this valve is in the up position it allows air to be supplied to the machine. When moved downward, air is turned off to the machine. When you turn this valve off, it triggers the air regulator to release the water that has built up in its tank. Item 3 below describes this component.

3. Air regulator (main) – the air regulator allows you to adjust the air pressure supplied to all the major components of the pneumatic system. It is set to 90 psi from the factory. The air pressure can be adjusted by lifting up on the blue cap at the top and rotated clockwise to increase the air pressure and counterclockwise to decrease the air pressure. The air pressure gage reads from 0 to 150 psi and 0 to 11 kg/cm². As mentioned above, water is released from the tank of the air regulator each time the air on/off valve is closed on the machine or when you press up on the small valve at the bottom of the air regulator. This should be done at least once per day.

4. Air regulator (air through spindle cartridge) – the small air regulator mounted to the right of the main air regulator is used to adjust the air flow through the spindle cartridge. This regulator allows a continuous flow of air to pass through the cartridge which aides in cooling the bearings. This regulator is set to 7 psi. The air pressure gage reads from 0 to 30 psi and 0 to 2 kg/cm².

5. Oiler – the oiler allows a small amount of oil to pass through the air lines and lubricate the various components in the system. The oiler should be checked every 2 weeks and filled with an AW32 or equivalent oil. The oiler is adjusted from the factory. The flow valve is opened ½ turn from its closed position. The oiler is closed by turning the screw on the top of it CW and opened by turning it CCW.

6. Air Pressure Switch – the LPM is equipped with an air pressure switch that monitors the air pressured supplied to the machine. It is set to trigger an alarm when the air pressure falls below 60 psi. When this happens, a low air pressure flashing message will appear on the screen. This message will go away automatically when the air pressure rises above this value. This switch is set at the factory to 4 kg/cm² and the range to 1.5. These values should not need to be adjusted in the field. This switch is adjusted by turned the screw on the right, which will adjust the 4 kg/cm² setting. The screw on the top left will adjust the 1.5 setting. Turning both screws CW will increase the values.

7. Solenoid Valves – the LPM has 4 solenoid valves labeled A, B, C and D as seen on drawing 26930. The solenoid valves open and close as necessary to run various aspects of the machine. The following describes the function of each solenoid valve.

    a) Valve A (controls the flow of air to the ATC air cylinder) – this is a dual valve since it supplies air to both sides of the air cylinder which in turn moves the ATC in and out from the spindle. The lower valve in this pair moves the ATC in toward the spindle.

    b) Valve B (controls the flow of air to the tool blast) – this valve allows air to flow to the air manifold at the front of the machine that allows air to flow to the cutting tool. This feature can be turned on and off by the use of the air button found on the run panel. It can be turned on manually or via the program.

    c) Valve C (controls the flow of air to the clamp/unclamp air cylinder) – this valve allows air to flow to the air cylinder found on top of the spindle which allows tools to be clamped and unclamped from the spindle.

    d) Valve D (controls the flow of air through the spindle) – this valve allows air to flow down the spindle when doing a tool change. The idea behind this is to prevent any chips from collecting on the spindle taper preventing tools from seating properly.

    e) LED lights found on relays of solenoid – each solenoid has an LED light on it which indicates when the valve is energized or in an open state. The lights may be red or green

    f) Manual Solenoid Override – each solenoid also has a manual button that can be rotated to trigger the solenoid. Turning this button CW opens the solenoid.

Warning!
Do not manual activate the valves labeled A on the ATC if the head is not in its upper most position. Failure to do so may lead to a crash of the ATC into the head. Also make sure not to activate the air tool change cylinder valve C when a tool is in the spindle.

8. Flow Control Valves – the LPM has 3 air flow control valves. The ATC air cylinder has 2 of them which control the speed at which the ATC moves in and away from the spindle. They are adjusted at the factory by opening them all the way. The 3rd air flow control valve is used to control the amount of air that comes down through the spindle during a tool change. This has been adjusted from the factory by closing the valve and then opening 6 full turns.

9. Air Blast Nozzles – at the front of the machine there are 4 nozzles that supply either air or coolant to the tools in the spindle. The 2 smaller nozzles supply air to the cutting tool. Each nozzle also has a valve that must be opened for air to flow.

10. Air Tool Change Cylinder – this is the cylinder that is mounted to the top of the spindle and allows tools to be clamped into the spindle. See drawing 26930 for a drawing of this cylinder. Please make sure to monitor the oil cup that is found in this cylinder. See drawing 27050. It is used to provide lubrication to this cylinder. Please note that 1 air line provides air to this cylinder and a 2nd air line provides the air that is directed down through the spindle. Air flows down through the clamping bolt and into the spindle.

11. ATC Air Cylinder – this is the cylinder that moves the ATC in and out from the spindle when changing tools

12. Air Nozzle – the LPM comes with an air nozzle that can be used to blow chips off of your parts. It attaches the front of the machine on a bracket and the air lines connect to the right side of the machine.

Air Quality

Air quality is very important to the pneumatic system of the LPM. Water in the air lines can have a negative impact on the longevity of various pneumatic components. It is not uncommon for many shops to have a lot of moisture in their air lines. For this reason, we strongly recommend installing an air dryer or a water separator upstream of the LPM.

The LPM does have a water separator under the air regulator but it can only handle a small amount of water per day and if you fail to drain this on a regular basis, water may move downstream of this device and cause problems with the pneumatic components.

The following is a quick reference for the types of problems that may arise if problems are noticed in these areas.

Problems with	Can contribute to
Air Pressure Switch or low air pressure	• Flashing air pressure warning message on screen • Inability to change tools or load tools in the spindle. An error message can occur when trying to perform these activities • You can check if the control is seeing this air pressure switch by performing service code F

Problems with	Can contribute to
Air Flow Valves	• ATC will move in and out either too fast or tool slow • Too little air is coming down through the spindle which can lead to chips sticking inside of the spindle taper
Lack of Lubrication	• If you fail to maintain the oiler, tool change cylinder cup you may reduce the life of the solenoids and air cylinders

5.11 Coolant Diagnostics

The coolant system consists of the 2 coolant pumps, coolant tank and various hoses that supply coolant to various aspects of the machine. See drawing 26943 for an illustration of the coolant system, which can be found in the rear of the manual.

The following summarizes various aspects of the coolant system.

1. Coolant pumps – the LPM has 2 coolant pumps. One pump supplies coolant to the cutting tool and one pump is used to wash down the chips inside of the chip enclosure. There are 2 separate buttons on the run panel for these items. See sections 5.5.3, 3.6.3 and 3.8 for more information on these pumps.

2. Auger Motor – the auger motor is considered part of the coolant/chip evacuation system. It is used to move chips into the chip cart that is placed on the left side of the machine.

3. Oil/Coolant Separator Tank – at the rear of the machine is a oil/coolant separator tank that separates the way oil used to lubrication the ballscrews and linear guides from the coolant. The oil will float to the top of the right section of the tank. This tank also has a return hose that returns coolant back to the coolant tank when the level gets too high.

4. Coolant Wash Nozzles – the coolant wash supplies coolant to the left and right side of the chip enclosure. At the bottom of each area are 4 hoses that direct the coolant in the direction that you want it. They are flexible and can be redirected as necessary.

5. Coolant Pump Overloads – each coolant pump has an overload in the electrical cabinet that is used to protect the motors and system if the current goes over a specific value. When the overload trips for the coolant pump, the control will stop the program and a error message will appear on the screen. The overload condition must be corrected before you can continue to run a program. For the coolant wash pump, a flashing message will appear when the overload trips, but we will allow you to continue to run the machine. The overloads can be reset by pressing the black button on the overload in question. See drawing 26734.

6. Chip Coolant Screen – the LPM coolant tank contains a screen to filter out any chips or debris from the coolant pumps. Please see drawing 26943, item 7 for an illustration of this item. This screen should be cleaned every month or 2.

7. Coolant Hoses – there are 5 coolant hoses attached at the rear of the machine near the coolant pumps. Please see drawing 26943.

8. Coolant Spray Gun – the LPM comes with a coolant spray gun that attaches to the front of the machine. It works based on the coolant pump. To use this spray gun, turn the

coolant to ON mode. For high pressure to come from the spray gun, we recommend you close the 2 coolant valves near the spindle so all the coolant is directed to the spray gun.

9. Drain hole – there is a drain hole at the rear of the coolant tank below the coolant pumps that can be used to drain the coolant tank.

10. Cutout for Oil Skimmer – the coolant tank sheet metal has provisions for installing an oil skimmer. There is a slot and some tapped holes for mounting. This must be purchased separately as we do not sell these.

11. Check Valves – a check valve is found directly downstream of each coolant pump. The check valve prevents coolant from flowing back into the tank once the coolant is turned off. It insures the lines are filled with coolant and hence you will get immediate coolant flow when the pumps are turned on.

5.12 Service Codes

Service codes are broken down into the following categories: software, machine setup, diagnostics, user options/defaults, lube pump, and I/O testing.

All Service Codes are accessed in the SET-UP Mode by pressing the soft key for "SERV CODES". The service codes can be found under one of the headings listed on the main screen. Press the heading you want to access the code in question. If you know code # you want, press the CODE # softkey and it will take you directly to the code in question. Press CODE #, enter the number you want, then press SET.

Warning!
Certain service codes must be performed when servicing certain items on the LPM. Failure to do so can lead to machine crashes and expensive repair work. Do not work on the TRAK LPM unless you have been trained on these service codes.

Please see a table at the end of the service code section for the list of service codes that must be run when certain machine components are worked on.

The Service Codes are divided into logical categories. The table below is a quick summary of the service codes. More detailed information can be found below.

Software

Code	Description	Comment
33	Software, Firmware and PLC versions	Displays current software versions and system settings.
141	Load configuration file from USB thumb drive	To load configuration files from a USB thumb drive to the PMX control.
142	Save configuration file to USB thumb drive	To save the configuration files for reloading later. When a computer replacement is necessary, saving the settings to a thumb drive for reloading them later is highly desirable.
316	Update Software	Runs the routine that copies new software from a USB thumb drive device to the ProtoTRAK system. Use this routine to install new ProtoTRAK software.
318	Activate Converter	To activate converters and other software options.

Machine Set-Up

Code	Description	Comment
100	Open Loop Test	Caution! Machine will move. Check for crash conditions before running. Run under the direction of service personnel.
123	Calibration Mode	Use to laser calibrate the PMX control
128	Backlash Calibration Constant	Use to load backlash compensation for each axis.
134	Friction Feed Forward Constant	Compensates for friction variance from machine to machine
135	Squareness Compensation	Used to compensate squareness errors between the X and Y axis
339	Use Z Safety Height for Z Retract	Used to run SWI test programs
400	Load foreign language MLS files	Used to download language tables that have been translated into a foreign language.
500	X, Y Ball Lock Offsets	Used to enter the offsets for ball locks A, B and C
501	Set Z Tool Change Height	Used to enter the offset for the tool changer height relative to the Z home position
502	Set Base Tool Height	Used to set the base tool height relative to the top of the table.
505	Over-travel Limits	Used to setup and troubleshoot software limits.
510	Spindle Setup	Used to calibrate spindle, orient the spindle in relation to the ATC, and troubleshoot any spindle encoder related issues.

Diagnostic Codes

Code	Description	Comment
54	Continuous Run Mode	Cycles through the program in current memory.
81	Program Panel Keyboard Test	Gives a tone feedback to a button push and highlights the button.
82	Run Panel Keyboard Test	Gives a tone feedback to a button push and highlights the button.
131	Manual DRO	Turns off servo's so you can check encoders
132	Electronic Handwheel Test	Test the EHW signals
314	Toggle Test Lights in Status Line	Used to troubleshoot control issues
319	Error Logging	Logs the machine as it runs
326	Error Message Display	Displays error messages on screen
327	Display Memory Check	Displays memory availability of various devices

Operator Defaults/Options

Code	Description	Comment
66	Metric Boot Up Default	To have the ProtoTRAK open up in mm measurement.
67	English Boot Up Default	To have the ProtoTRAK open up in inch measurement.
79	Turn On Beeper	Turn the beeper on when pressing keys on either of the front panels
80	Turn Off Beeper	Turns the beeper off when pressing keys
503	Set Maximum Feedrate	Sets the rapid speed for the machine. Default is 800 ipm
504	Set Part Change Position	Sets the part change position along the X axis for auxiliary function 6.
507	Reset Servo Fault	Must be run when servo amp faults

Code	Description	Comment
508	Toggle S Curve On/Off	Changes acceleration and deceleration of axes.
509	Select 4th Axis Type	Must be used to select the 4th axis design type being used for a particular machine

5.12.1 Section A - Software Codes

The following codes pertain to software functions in the control. To get to any of these codes go to Service Codes, press "A" and press the code you wish to view.
Note: If you are working with the SWI Customer Service Group, write the values down for Code 33. These values will be valuable for troubleshooting.

5.12.1.1 CODE 33: Software ID

The Code 33 is the software identification procedure. This will most likely be used when a customer service representative asks to identify what version(s) of software is being run on your machine.

- **Software Version** – the version of the system you have installed.
- **Firmware Version** – the version of firmware software that is installed on the motion control board.
- **PLC Versions** – lists the versions of various PLC's that are loaded on the system.
- **Operating System Version** – shows the version of the XP operating system.

5.12.1.2 CODE 141: Load Configuration File from USB flash drive

This code allows you to load your configuration file from a USB flash drive to your machine's compact flash drive. The configuration file consists of items such as calibration, backlash constants, ball lock locations, base tool length and tool changer height. This code is useful when a computer module or compact flash card has been replaced, and you want to restore a machine to its previous state.

In order to load the files correctly on the LPM, you must have the following file structure. On your thumb drive you need to have a folder called PT7, with a subfolder called CONFIG and under that will be a minimum of 6 individual files.

5.12.1.3 CODE 142: Save Configuration File to USB flash drive

This code allows you to save your configuration file to a USB flash drive. The configuration file consists of items such as calibration, backlash constants, ball lock locations, base tool length and tool changer height. This code is used when a computer module or compact flash card needs to be replaced. This stores the configuration file from the machine's compact flash drive to a portable USB flash drive. It is a good idea to do this code after the machine is initially setup so these values can be saved and used in the future. If the computer or compact flash card fails, then you will not have the ability to save the configuration file and the machine will need to be re-setup when the computer or compact flash drive is replaced.
Note: All machines will have a copy of the configuration file on the included USB flash drive located within the electrical cabinet. This will usually be drive D within the PROG I/O menu.

When you save the configuration file to a thumb drive, the file structure mentioned above in service code 141 will be created.

5.12.1.4 CODE 316: Update Software

Insert the USB flash drive that contains the software update and press this service code. New software will automatically download and the control may need to be shut down if prompted.

5.12.1.5 CODE 318: Activate Converters or Options

This service code will allow you to check the status of, or activate any available converter or option for the machine.

5.12.2 Section B - Machine Set-Up Codes

The following codes are used primarily when setting up a new machine. To get to any of these codes go to Service Codes, press "B" and press the code you wish to view.

5.12.2.1 CODE 100: Axis Open Loop Test (Note – this service code may or may not work in certain versions of software)

Code 100 is used to diagnose problems with the configuration of the system, the encoders and incoming A/C voltage.

Warning - IMPORTANT -- SAFETY NOTICE
During this procedure the designated axis will be given a command to move at maximum speed for 1 second in the direction you choose. Avoid crashes by making sure the Z axis is at a safe height and no fixture or vice that will interfere with the travel of the axis.

This procedure is to be run for either the X or Y axis, and for both the plus and minus direction for each axis. Make sure the Z axis is out of the way, and that there is no tool in the spindle or fixture mounted on the table.

1. On the Pendant display, go into the Service Codes and input the Code 100.
2. The conversation line will say: "SELECT AXIS". Input the axis. Either X or Y.
3. In the conversation line it will say "WHICH DIRECTION? PLUS".
4. If you want to run in the plus direction, press INC SET.
5. If you want to run in the minus direction, press +/-, then INC SET
6. In the conversation line it will say "PRESS GO". Pressing GO will slowly move the axis back towards the opposite soft limit of the axis you chose. From this position it will prompt you to press GO again.
7. Press GO a second time to initiate the open loop test. The axis you chose will rapid in the direction you specified earlier and eventually come to a halt.
8. Afterward the screen will display values next to the DRO position axes.
9. The values for the encoder displays should around 15 to 18".
10. If the motor reading is not within this value, then the one that is out of specification may be the problem. If one of the encoders is not reading then it will need to be replaced.
11. The max feedrate should be somewhere in the range of 900 and up to 1100 ipm.
12. If the feedrate is less than 900 ipm and inconsistent in both directions, check the incoming AC voltage and mechanics of the drive train.

5.12.2.2 CODE 123: Calibration

See Section 7.1 for a further explanation of this code.

5.12.2.3 CODE 128: Input Backlash Constant

Code 128 allows you to enter the backlash values for each axis. It displays the value after it is entered.

5.12.2.4 CODE 134: Friction Feed Forward Constant

This is a tuning parameter for adjusting the machine's friction characteristics. It is set at the factory by running a ballbar plot using a measurement probe device, such as one made by Renishaw, and adjusted to obtain minimal error. It is not recommended to change the values unless told to do so by a service representative.

5.12.2.5 CODE 135: Squareness Compensation

This service code is used to compensate any error between the X and Y axis travel as a result of them not being perfectly perpendicular to one another. The value displayed represents the error measured in micro-inches per inch or micro meter per meter, as one axis grows apart from the other. Positive and negative values are used to define in which direction to compensate the error. This is measured and set at the factory before a machine is shipped.

5.12.2.6 Code 339: Use Safety Height for Z Retract

Toggle this service code to YES, and during program run the machine will start and finish at machine's Z safety height. Toggle it to NO (default) and machine will start and finish program runs at the Z tool change height. This value is not saved across a power down and will default to NO.

5.12.2.7 Code 400: Update Foreign Language MLS Files

If you have received a foreign language update for your machine, you can put it on a USB flash drive, and enter this service code to update your control.

5.12.2.8 Code 500: XY Ball Lock Offsets

This code defines the locations of all three sets of ball locks located on the machine's table, relative to the machines home position. All programs run on the ProtoTRAK PMX are referencing from these ball lock locations. They ensure that when a fixture is mounted in place, the part's absolute zero location is always the same distance from the machine's home position. These values are set at the factory, but if the X or Y axis motors or ballscrews are ever replaced or moved, the machine must be re-homed and the ball lock locations MUST be re-located using a .00005" dial indicator and sweeping in the ball lock receiver. Major changes to the limit switches or limit switch cams may also require this.

5.12.2.9 Code 501: Set Z Tool Change Height

Sets the location, relative to home, where the Z axis will change its tools for the Automatic Tool Changer. This will need to be set if the Z motor or Z ballscrew is ever replaced. Major changes to the Z limit switches or limit switch cams may also require this.

To set the tool change height:

1. First make sure that the Z axis has been homed properly.
2. Make sure there is no tool loaded in the spindle.
3. Go into SETUP, SERV CODES, SECT B, and select CODE 501.
4. Turn on the EHW, select the Z axis, and crank it all the way to the top of its travel.
5. Press the ATC IN button, which will bring the ATC in towards the spindle.
6. Place a tool within the fingers of the ATC location currently in. Make sure it is a CAT40 tool holder with the proper retention knob.
7. Press the UNCLAMP button. Air should be purging out of the spindle.
8. Slowly start to bring the Z axis down towards the tool*.
9. Put the electronic handwheel resolution in .010" mode, and crank the Z down until it barely makes contact with the tool. You can also listen to the air purge, and when the air stops flowing due to the tool plugging up the spindle, use that as a cue to stop moving. Crank it up and down a few times to make sure you found the right spot.
10. Note the current position of the Z axis, as shown in the mini DRO, and enter that value into the text box and press ABS SET.
11. Raise the Z axis back up to the top.
12. Manually remove the tool from the ATC fingers.
13. Press the ATC OUT button.

*If the tool is not correctly aligned with the spindle, then the ATC assembly may need to be adjusted, in which case you will need a service technician to assist you with it.

5.12.2.10 Code 502: Base Tool Offset

Defines the distance from the Z axis home position to the top of the table, using the base tool that shipped with your ProtoTRAK LPM. All tool offsets defined within the Tool Management screen are referenced off of this value. If the Z axis limit switch, motor, or ballscrew is ever moved or replaced, this code will need to be used due to the Z axis home position changing. To set this value, load the base tool into the spindle and move it down until it touches the top of the table. Note the reading for the Z in the small DRO and enter this into this service code. We recommend touching the base tool off of a gage block and then subtracting this distance from the value found in the DRO.

5.12.2.11 Code 505: Over Travel Limits

When entering this service code, both the soft limits and hard limit switches will be disabled so as to allow for setup or troubleshooting. If a soft limit is triggered, it will stop the motor from moving any further, but will not fault out or kill power to the motor.

In addition to the DRO, the motor angle for each axis relative to the limit switch can be seen. This is to ensure that the index pulse for the motor is close to 180 degrees when it hits the limit switch. This is done to obtain maximum reliability when the machine performs its homing routine. The angle should be 180 degrees +/- 45 degrees. Values from 135 to 225 degrees are acceptable. Failure to set this correctly may cause the machine to not home properly which can lead to major problems.

1. **SOFT LIMIT ON / OFF** – You can choose to toggle the soft limits on or off. They will default to off when entering this service code, but will always turn back on after exiting.

2. **SET SOFT LIMITS** – This will run an automatic routine that moves all three axis to the positive and negative limit switches in order to find and set the software limits accordingly. Make sure that there is no tool loaded in the spindle, and that no fixture or vice is mounted on the table before proceeding.

3. **MOVE TO INDEX** – This will move the selected axis to the home position and then to the first index pulse of the motor of that axis.

5.12.2.12 Code 510: Electronic Spindle Setup

Use these service codes to setup or troubleshoot the electronic spindle.

1. **CAL RPM** – Running this routine will automatically calibrate the spindle over several increments from its minimum to maximum rated speed. The process should take between 5-10 minutes to complete.

2. **ORIENT SPINDLE** – This sets the orientation of the spindle in relation to the ATC when the machine performs a tool change. Follow the instructions on screen to set or verify the orientation of the spindle.

   a) ATC IN – brings the ATC in towards the spindle. Make sure the Z axis is high enough to clear the ATC before using.

   b) ATC OUT – moves the ATC back out and away from the spindle.
   c) ORIENT ON / OFF – pressing this button will make the spindle turn to the orientation offset that is currently saved, and hold position. Pressing it again will release the spindle so that it can be turned manually if necessary.

3. **ENC CHECK** – Use to verify the spindle encoder is functioning properly. For every revolution of the spindle, you should see 4096 counts on the screen. The counts should also reset to 0 once the encoder reaches the index pulse. You can turn the spindle manually, or use **SPIN SPEED** to enter an rpm, and press FWD to power on the spindle.

5.12.3 Section C - Diagnostic Codes

The following codes are used primarily when diagnosing a problem with the machine. To get to any of these codes go to Service Codes, press "C" and press the code you wish to view.

5.12.3.1 Code 54: Program Continuous Run

This Code runs a program continuously without stopping for GO commands. It is helpful in running a long period to identify an intermittent problem.
Prepare a program as you normally would.
Press **MODE**, **SET UP**, **"C"**, **Code 54**, **INC SET**. The program run will start automatically.
Press **STOP** to stop, and **GO** to continue.

5.12.3.2 Code 81: Program Panel Test

This code is used to check if the buttons located on the program panel are functioning correctly. It allows you to test each key individually. When you press the keys, the corresponding box for that key will highlight on the screen. The pendant will also beep, indicating that the key is working correctly. If one of the keys does not work, the program panel assembly may need to be replaced. If none of the keys are working, you may want to check the connections from the back of the program panel to the overlay interface board.

5.12.3.3 Code 82: Run Panel Test

This code is used to check if the buttons located on the run panel are functioning correctly. It allows you to test each key individually. When you press the keys, the corresponding box for that key will highlight on the screen. The pendant will also beep, indicating that the key is working correctly. If one of the keys does not work, the run panel assembly may need to be replaced. If none of the keys are working, chances are that the overlay interface module will need to be replaced. Note that the FWD, REV, and GO buttons do not work in this service code.

5.12.3.4 Code 131: Manual DRO

A manual diagnostic routine used to check the motors' encoders. Manually turn the X or Y axis ballscrew to display the actual DRO counts and the raw encoder counts. The DRO will display counts unaffected from calibration compensation.

5.12.3.5 CODE 132: Electronic Handwheel Test

This service code can be used to troubleshoot any issues seen with the electronic handwheel. Simply turn the handwheel in either direction while in this screen, and the display should increment 1 count per click, 100 counts per revolution.

5.12.3.6 Code 314: Toggle Test Lights 'On' in Status Line

This code toggles a group of test lights up on the top of the display when turned ON. The lights are used to help determine if there are any communication problems between the computer and the motion control hardware. They would ideally be used for issues where the control appears to be slow to respond, or not responding at all, especially when trying to run a program. An SWI service rep may ask you to turn these lights on and describe their status while troubleshooting.

5.12.3.7 Code 319: Error Log
This code when turned on captures the commands that were sent to the servo system. It includes items such as positioning commands, errors, stop and go commands, feedrates, etc. It may be helpful for identifying problems between programmed commands and executed commands. To turn the error log on / off, press the F6 softkey. Use the left and right arrow keys to scroll through the file one page at a time. Use the up and down arrow keys to scroll through the file one line at a time. The DATA BOTTOM key takes you to the bottom of the file and then changes to data top which will take you back to the top. The file will capture data until the file reaches a size of approximately 20 MB. At this time the file is saved to a backup file and the original file is cleared and data is once again captured. Once again as the file reaches a size of 20 MB it copies over the previous backup file. From here the user can save the file to a USB flash drive by pressing the F8 softkey. Once this is done it prompts you to save the file. The file will be save as a zip file to your USB device. The file will be called errorlog.zip. To clear the contents of the current log, press the CLEAR FILE button.

5.12.3.8 Code 326: Error Message Display
Useful for checking error messages if the error number is already known.

5.12.3.9 Code 327: Display Memory Check
This service code is used checking the amount of free memory available from system RAM. This can be useful for troubleshooting any issues where memory may be a factor, such as system slowing down, or intermittently not responding. Press the **DRIVE SPACE** button to check the amount of free space on the system drive as well as removable devices such as USB flash drives. A service technician may ask you to take note of these screens while troubleshooting certain computer related issues.

5.12.4 Section D - Operator Defaults/Options Codes
The following codes allow the user to set programming defaults or turn features on or off. To get to any of these codes go to Service Codes, press "D" and press the code you wish to view.

5.12.4.1 Code 66: Default Metric
This code causes the control to turn on in the metric mode.

5.12.4.2 Code 67: Default English
This code causes the control to turn on in the English mode.

5.12.4.3 Code 79: Beeper On
This turns on the beeper to the control keys.

5.15.4.4 Code 80: Beeper Off
This turns off the beeper to the control keys.

5.12.4.5 Code 503: Set Maximum Feedrate
Sets the maximum feedrate limit that the machine will run at. This affects programmed feedrates and rapid feedrates. Can be set in inches per minute or millimeters per minute.

5.12.4.6 Code 504: Set Part Change Position
Sets the X axis position relative to home for the Aux 6 part change command. Type in the X value relative to machine home.

5.12.4.7 Code 507: Reset Servo Fault
If the servo amps are faulted this service must be performed to reset.

5.12.4.8 Code 508: Toggle S Curve Accel and Decel On/Off

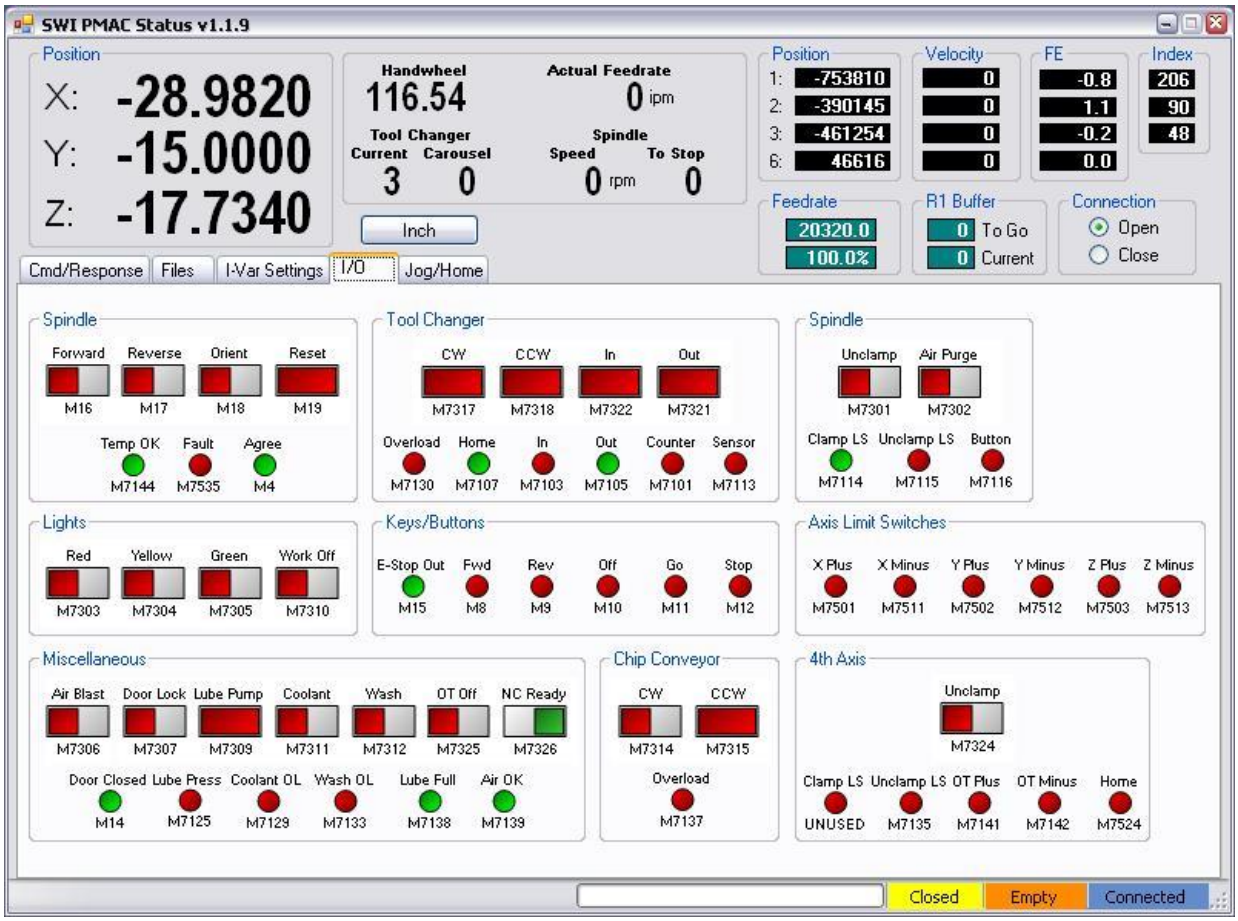
This service code changes how the machine accelerates and decelerates. Turning the S curve on will soften both of these.

5.12.4.9 Code 509: Select 4th Axis Type

The user needs to choose which 4th axis design they are using. Once this is set, it never needs to be set again. In mid-2013 we changed the design of the 4th axis unit we sell.

5.12.5 Section F - Check Control I/O

This service code will launch an external application that can be used to check all the control's inputs and outputs. A USB mouse and keyboard is required to use this screen. This service code should be used only by qualified service technicians. The following figure illustrates what this screen looks like.



5.12.5.1 Critical Service Codes that Must Be Performed

The following table summarizes the critical service codes that must be performed after working on certain aspects of the machine.

#	Service Code	When	Consequence
1	500 – setting ball lock locations for X and Y	1. Motor removed or replaced 2. Ballscrew coupling slips 3. Limit switch replaced or a major mounting adjustment is made. 4. Limit switch cam replaced or a major adjusted is made. (This only applies to the limit switch cam used for homing) 5. Ballscrew replaced 6. Angular contact bearings on motor end replaced 7. Table removed from machine and hence separated from linear guides 8. Computer module or compact flash has been replaced and the configuration file was not loaded into the new computer.	• The X and/or Y offsets saved with the users programs could now be off as much as 8 mm or 0.315". • These items only apply when working on the X or Y axis
2	501 – setting the tool change height	1. Motor removed or replaced 2. Ballscrew coupling slips 3. Limit switch replaced or a major mounting adjustment is made. 4. Limit switch cam replaced or a major adjusted is made. (This only applies to the limit switch cam used for homing) 5. ATC carousel replaced (Should be OK but this needs to be checked) 6. Spindle cartridge replaced (The height of the tool relative to Z home may be slightly different) 7. Ballscrew replaced 8. Angular contact bearings on motor end replaced 9. Head removed from machine and hence separated from linear guides 10. Computer module or compact flash has been replaced and the configuration file was not loaded into the new computer.	• The user may crash the tool into the tool changer and damage key components. Repairs could be expensive and time consuming to replace • Some of these items refer to when working on the Z axis

#	Service Code	When	Consequence
3	502 – setting the base tool height	1. If base tool is replaced with a new one 2. If base tool has been damaged but the user continues to use it 3. Motor removed or replaced 4. Ballscrew coupling slips 5. Limit switch replaced or a major mounting adjustment is made. 6. Limit switch cam replaced or a major adjusted is made. (This only applies to the limit switch cam used for homing) 7. Ballscrew replaced 8. Angular contact bearings on motor end replaced 9. Spindle cartridge replaced 10. Head removed from machine and hence separated from linear guides 11. Table is replaced with a new one 12. Computer module or compact flash has been replaced and the configuration file was not loaded into the new computer.	• The Z offset saved with the users programs could now be off as much as 8 mm or 0.315". • These items only apply when working on the Z axis
4	505 – checking the motor index angle. Must be set to 180º +/- 45º	1. Motor removed or replaced 2. Ballscrew coupling slips 3. Limit switch replaced or a major mounting adjustment is made. 4. Limit switch cam replaced or a major adjusted is made. (This only applies to the limit switch cam used for homing) 5. Ballscrew replaced 6. Angular contact bearings on motor end replaced	• This code applies to any work done to the X, Y and Z axis • As a secondary item, you should rerun this same code and reset the soft limits
5	510 – setting the spindle orientation angle	1. Spindle motor belt has been removed, replaced or has slipped during operation 2. Spindle motor has been replaced 3. AC spindle drive has been replaced (Need to reset parameter 10-19, each machine has a unique value) 4. Computer module or compact flash has been replaced and the configuration file was not loaded into the new computer.	• The user will most likely break a finger on the ATC. More severe damage could also occur which could be costly to the user
6	141 – Load configuration file	1. Replace compact flash 2. Replace entire computer module along with compact flash	• Machine will crash if 1 or more service codes are not set correctly. • The following service code settings will be wrong: 123, 128, 134, 135, 500, 501, 502, 510
7	123 – laser calibration	1. Ballscrew replaced – must pretension ballscrew first	• The old calibration values might be OK, but you will loose some accuracy

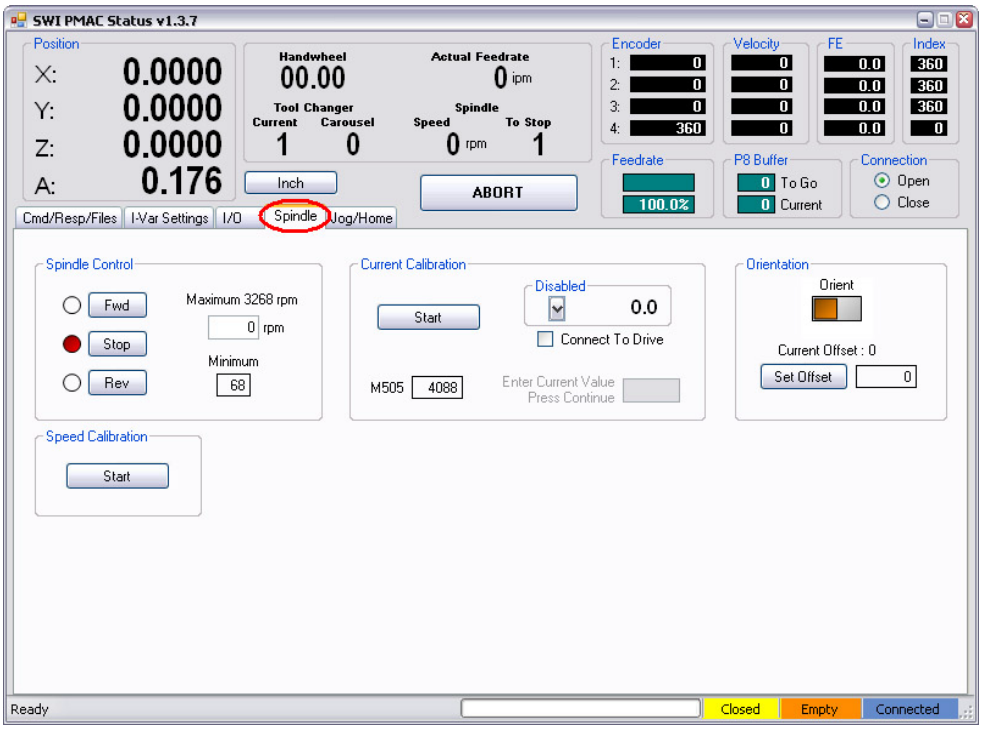
5.12.5.2 Calibrating the Spindle Load Meter

Before calibrating the Spindle Load Meter, first make sure that the machine's spindle has already been calibrated (use service code 510). You will also need to double check a parameter on the AC drive (found inside the electrical cabinet).

First we need to make sure that one of the parameters is set correctly on the AC drive:

a) Make sure the Servo On button is enabled, otherwise there will be no power to the AC drive.
b) On the AC drive, press the PROG / DATA button, you should see the left numbers flash.
c) Use the up / down arrows to change the value to 03, then press PROG / DATA again to continue.
d) Use the up / down arrow keys again to change the right half to 18, then press the PROG / DATA button again to continue.
e) You will a single number flash. Change it to 3 by pressing the up arrow. Press PROG / DATA to finish.

1. When ready, go into MACH SETUP, SERV CODES, CODE F, and then YES. This will take us into PMAC STAT.
2. Click on the SPINDLE tab.



3. Click on the START button (at the center of the window) to begin the spindle current calibration. The spindle should run at a low rpm.
4. Go into the back cabinet while the spindle is running. On the AC drive, press the MODE button until it displays A and then a number after it. This is the current from the spindle. Type this value into the box labeled "Enter Current Value", with decimal point. It is ok to approximate if the number flickers a lot.
5. Click on the CONTINUE button. The spindle will now calibrate itself according to the current that you typed in.
6. The spindle will now ramp itself up slowly to 8000 rpm while it's calibrating. Once it's done, the spindle will automatically turn off. Close the window out and return to the PMX software.
7. Press MODE and go into the DRO screen. Type in 500 for the Spindle Speed, and turn the spindle on. Make sure that the yellow spindle load meter settles around 0%. Change the speed to 1000, and then keep incrementing the speed +1000 until you get to 8000. It's normal for the load meter to spike up and then settle back down to zero. Make sure this is working correctly before leaving. If you see any abnormalities, double check the steps, or give us a call.

6.0 Replacement Procedures

6.1 Servomotor replacement

The following service codes **must** be performed when a motor is replaced. Failure to do will cause the ball lock locations to be off for the X and Y axis and base tool and tool change heights will be off in the Z axis. The machine may crash if these items are not set correctly.

- **Service Code 505** – Reset the motor index angle (machine may not home properly) and reset soft limits. Must be redone after any motor is removed.
- **Service Code 500** – Reset the X and Y ball lock locations for A, B and C. Performed after X or Y axis motor removal
- **Service Code 501** – Reset the tool change height. Performed after Z motor axis removal
- **Service Code 502** – Reset the base tool height. Performed after Z axis motor removal

1. Position the table to the approximate center of axes X and Y.
2. Press E-Stop button
3. Disassemble and remove way covers from the left and right sides of the table (see figure 6.1a)

a. Remove the nine screws that secure way cover, left. Collapse the way cover then remove.

Caution
Edges of the way covers can be sharp, use leather gloves while handling.

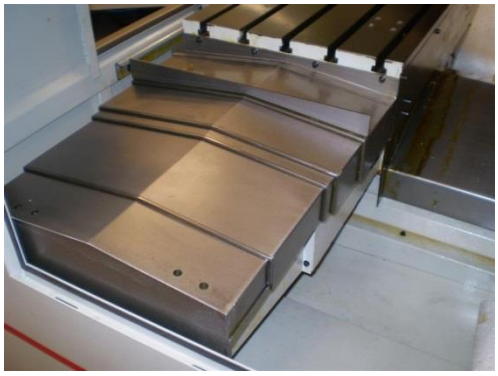


Figure 6.1a

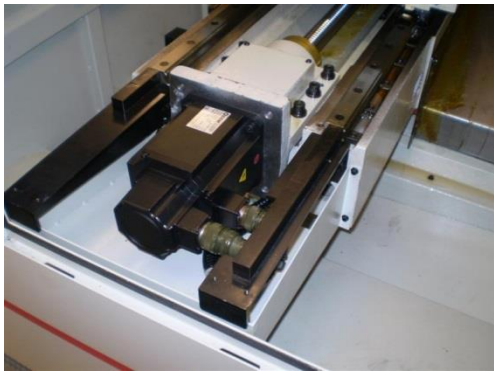


Figure 6.1b

WARNING
After completing the replacement of the servomotor or ballscrew on the X or Y axis, service codes 500 and 505 MUST be performed. See the section 5.12 of this manual for more information. Major adjustments to the limit switch position or limit switch cams may also require this service code to be done.

6.1.1 X-Axis Servomotor Removal

1. **Turn off the power at the machines disconnect switch, and use a lockout tag.**
2. Remove the coupling cover from the motor mounting bracket.
3. Make note of the orientation of the clamping screws on the motor coupling (ballscrew side), rotate the coupling until the slot is at twelve o'clock and you have equal access to the jack screw and the two clamping screws. Place a reference mark on the ball screw relative to the coupling.
   a. Slacken the two cap screws.
   b. Rotate the Coupling half of a turn to get to the jack screw, gently tighten the jack screw to release the tension on the shaft.
4. Remove the X-axis motor cover, lower, see figure 6.1b.
5. Individually identify both servomotor cables then disconnect them.
6. Remove the four bolts securing the motor to the motor mounting bracket, and remove the motor.

CAUTION!
Do not touch the ball screw or linear ways with your bare hands.
Wear latex or other suitable gloves to protect precision surfaces from your hands.

6.1.2 X Axis Servomotor Replacement

1. Installing the new motor:
   a. Remove the coupling from the old motor, examine the polyurethane spider element for excessive wear (There should be no visible backlash) If it is suitable for reuse, install it onto replacement motor shaft until it bottoms against the shaft shoulder.
   b. Install the new motor into the motor mounting bracket, If the old coupling is reused, align the reference marks, if a new coupling was required, apply a reference mark to the new coupling.
   c. Set a gap of approximately 0.050" between each coupling half where they come together.
   d. Loosen the jack screw (Ball screw side), then tighten the two clamp screws opposite the jack screw.
   e. Reconnect the power and encoder cables to the servo motor.
2. Set the index pulse relative to the limit switch cam, positive side.
   a. Perform service code 505, refer to section 5.12. Reset soft limits as well.
   b. Perform service code 500

WARNING
After completing the replacement of the servomotor or ballscrew on the X or Y axis, service codes 500 and 505 MUST be performed. See the section 5.12 of this manual for more information. Major adjustments to the limit switch position or limit switch cams may also require this service code to be done.

6.1.3 Y Axis Servomotor Removal

1. Jog the Y-axis toward the operator as far as possible.
2. Turn off the power at the machines disconnect switch, and use a lockout tag
3. Remove the coupling cover from the motor mounting bracket.
4. Make note of the orientation of the clamping screws on the motor coupling (ball screw side), rotate the coupling until the slot is at twelve o'clock, you will have equal access to the jack screw and the two clamping screws. Place a reference mark on the ball screw relative to the coupling.
   a. Slacken the two cap screws.
   b. Rotate the Coupling half of a turn to get to the jack screw, gently tighten the jack screw to release the tension on the shaft.
5. Individually identify both servomotor cables then disconnect them.
6. Remove the four bolts securing the motor to the motor mounting bracket, and remove the motor. Make certain that the motor adaptor ring stays in the pilot bore of the motor mounting bracket.

CAUTION!
Do not touch the ball screw or linear ways with your bare hands. Wear latex or other suitable gloves to protect precision surfaces from your hands.

6.1.4 Y Axis Servomotor Replacement

1. Installing the new motor
   a. Remove the coupling from the old motor, examine the polyurethane spider element for excessive wear (There should be no visible backlash between the coupling and the spider) If it is suitable for reuse, install it onto replacement motor shaft until it bottoms against the shaft shoulder.
   b. Install the new motor into the motor mounting bracket, If the old coupling is reused, align the reference marks, if a new coupling was required, apply a reference mark to the new coupling.
   c. Set a gap of approximately 0.050" between each coupling half where they come together.
   d. Loosen the jack screw (Ball screw side), then tighten the two clamp screws opposite the jack screw.
   e. Reconnect the power and encoder cables to the servo motor.
2. Set the index pulse relative to the limit switch cam, positive side.
   a. Perform service code 505, refer to section 5.12. Reset soft limits as well.
   b. Perform service code 500

WARNING
After completing the replacement of the servo motor or ballscrew on the Z axis, service codes 501, 502 and 505 MUST be performed. See the section 5.12 of this manual for more information. Major adjustments to the limit switch position or limit switch cams may also require this service code to be done.

6.1.5 Z Axis Servomotor Removal

1. Position the table to the approximate center of axis X and Y.
2. Jog the Z-axis upward and clear enough to allow the head support bracket to be placed beneath it.
3. Place the head support (supplied with the machine) on the protected table as shown in figure 6.1.5a and 6.1.5b

Figure 6.1.5a

Figure 6.1.5b

4. Jog the Z-axis until the head is nearly in contact with head support.
5. Secure the head support bracket to the head with two M10 SHCS, then *very* gently jog head downward until contact is made with the table. USE EXTREME CARE NOT TO PUT ANY UNNECESSARY FORCES ONTO THE TABLE!
6. Press E-Stop
7. **Turn off the power at the machines disconnect switch, and use a lockout tag.**
8. Remove the coupling cover from the motor mounting bracket located behind the spindle drive motor. The coupling slot should be facing outward toward the front of the machine.

CAUTION!
Do not touch the ball screw or linear ways with your bare hands. Wear latex or other suitable gloves to protect precision surfaces from your hands.

6.1.6 Z-Axis Servomotor Replacement

1. Installing the new motor

a. Remove the coupling from the old motor, examine the polyurethane spider element for excessive wear (There should be no visible backlash) If it is suitable for reuse, install it onto the replacement motor shaft until it bottoms against the shaft shoulder.

b. Install the coupling onto the new motor, loosen the two SHCS that clamp the coupling, tighten the jack screw to open the coupling.

c. Set a gap of approximately 0.050" between each coupling half where they come together.

d. Install the motor onto the ball screw.

e. Loosen the jack screw (ball screw side), then tighten the two clamp screws opposite the jack screw.

2. Release the support bracket.

a. With the Z-axis servomotor securely clamped to the ball screw, rotate the motor clockwise two complete turns, this will raise the head approximately 5/8". If the clearance between the support and the head is not 5/8", the brake in the motor is not functioning properly. Do not proceed until the fault is found for why the brake is not functioning

3. Reconnect the power and encoder cables to the servo motor. Turn the power on at the disconnect switch.

4. Set the index pulse relative to the limit switch cam, positive end, perform service code 505, refer to section 5.12 of this manual. Reset the soft limits as well in service code 505.
5. Set the tool change height, perform service code 501, refer to section 5.12 of this manual.
6. Set the base tool height with service code 502.

6.2 Servo Driver Replacement

1. Turn off the power to the machine at the electrical cabinet. Allow machine to sit for a few minutes so any residual energy can dissipate.
2. Remove all connections from the servo drive.
   a. Remove the communication cable.
   b. Remove the Servo cable.
   c. Disconnect the black and red wire (from left to right) coming from the servo drive power module.
   d. Disconnect wires identified as "W", "V" and "U" (from left to right).
   e. Disconnect the ground wire (green and yellow) that is attached to the chassis of the servo drive.
3. Remove the servo drive from the servo drive power module.
   a. Remove the two sheet metal screws that attach the servo drive to the servo drive power module.
4. Check the part number label to verify that you are installing the appropriate drive for the axis that has failed. Note, axes X and Y are interchangeable, but axis Z is unique and cannot be interchanged. Drives are mounted X, Y and Z from top to bottom, as shown in figure 6.2a.

Figure 6.2a

5. Install the replacement servo drive to the servo drive power module.
   a. Attach the drive with the two sheet metal screws that secured the previous drive.

6. Make all connections as they were on the previous drive.
   a. Attach the ground wire (green and yellow) to the chassis of the servo drive.
   b. Attach wires identified as "W", "V" and "U" (from left to right) as shown in figure 6.2b.
   c. Attach the Black and Red wires as shown in figure 6.2b.
   d. Attach the servo and communication cables.

7. Verify that the new servo drive will initialize properly.
   a. With the door open, restore power to the machine by rotating the main power switch while lifting the safety interlock lever located on the lower right hand side of the main power switch.
   b. Observe the LED's on the underside of the servo drive. Once initialized, both the red and green LED's should be illuminated (old style servo amps). This represents a ready, but not active state. If this is not the state of the servo drive, refer to section 5.6 of this manual. In mid 2013, the servo amps were replaced with a new servo that uses a LED segment to give status. See section 5.6 for more information.

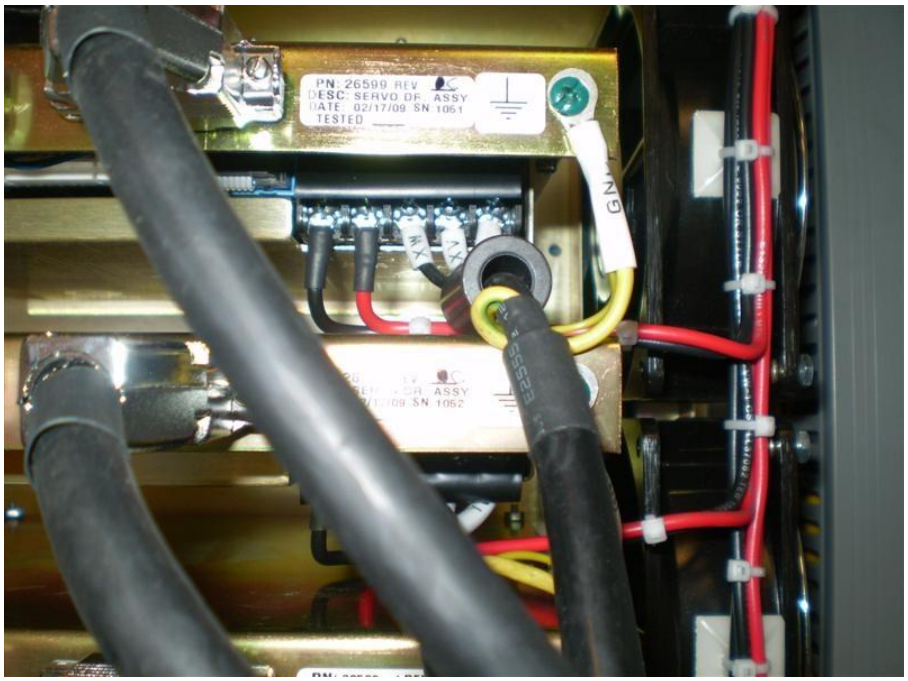


Figure 6.2b

6.3 AC Spindle Drive Replacement

WARNING!
The AC Drive uses 220 AC volts to operate, utilize care when working with these components. There is possibility of death by electrocution!

The following service code **must** be performed when an AC drive is replaced. Failure to do so will cause the tool changer to orientate incorrectly and crash.

- **Service Code 510** – reset orientation angle of the spindle

1. Press the E-stop to disconnect power from the drive.
2. Turn the power off to the machine.
3. Open the electrical cabinet door.

4. Disconnect the cable that runs from the spindle drive to the computer module. It is plugged into a port called spindle port. A new cable will come on the replacement AC drive, so do not disconnect this from the drive you are removing.
5. Remove the front cover of the AC drive. It is held in place with a couple of screws.
6. Remove the wires that are used to hook up the spindle encoder. Please see drawing 26734 for which wires go where. You will need to hook up these wires on the new AC drive.
7. Remove the remaining 10 large wires. They are used to provide power to the drive, provide power from the drive to the spindle motor, dump the energy during braking to the braking resistors and provide grounds for the components.
8. Remove the AC drive from the machine, it is held in place with 4 screws.
9. Follow these steps in reverse order install the replacement drive.

It should be noted that the replacement drive has already been programmed, but 1 parameter will need to be reset since it is unique for each machine. The parameter in question controls the orientation of the spindle.

1. Go to service code 510 and press the orientate spindle button. The offset should appear at the bottom of the screen and must be added to the new AC drive which will allow tool changes to work correctly.

WARNING!
Failure to perform this step will cause the tool changer to crash and damage may occur.

2. Now go to the Delta AC drive and enter this value under parameter 10-19. To do so, follow these steps.
    a. Press the Program/Data button on the drive
    b. Use the up and down arrows to scroll to 10 and press Program/Data
    c. Now use the up and down arrows to scroll to 19 and press Program/Data
    d. Enter the offset found in service code 510 and press Program/Data
    e. Press Mode button to return to frequency reading.
3. Lastly, go back to service code 510 and re-calibrate the spindle. Press the CAL RPM button and following the instructions on the screen.

6.4 Computer Module Replacement

Caution!
Make sure you have a back up copy of the machines configuration file when replacing the computer. This is only true if you must replace the compact flash card at the same time. Failure to do so will require you to re-laser calibrate the machine and reset all the important machine parameters such as ball lock locations, tool change height, base tool height, etc.

The following service code **must** be performed when a computer is replaced. Failure to do so will cause many parameters to be incorrect and will lead to the machine crashing.

- **Service Code 141** – Load the configuration file back into the new computer that contains all important machine parameters.

Refer to section 5.3 for a drawing of the computer module and cable connections.

1. If you do not have a copy of your configuration file and the computer module is still functional, perform service code 142 and save your machines configuration file to a thumb drive. If you are not able to run this service code, then contact Southwestern Industries. We should be able to email you a backup copy of this file.
2. Turn power off to the control and machine.

Note – steps 1 and 7 can be avoided if you are able to reuse the compact flash card, which contains the operating system and your machines configuration. See section 6.5.

3. Remove all cables and thumb drives from the computer module.
4. Remove the screws that hold the computer module in place.
5. Fasten the new computer module in place and connect all cables. Make sure to plug in the USB devices you removed from the old computer.
6. Turn power on to the machine.
7. Go to service code 141 to load in the saved configuration file.
8. If you have networked you old computer, you will need to go back through and redo the setup.

6.5 Compact Flash Replacement

Caution!
Make sure you have a back up copy of the machines configuration file when replacing the compact flash card. Failure to do so will require you to laser calibrate the machine and reset all the important machine parameters such as ball lock locations, tool change height, base tool height, etc.

The following service code **must** be performed when a compact flash is replaced. Failure to do so will cause many parameters to be incorrect and will lead to the machine crashing.

- **Service Code 141** – Load the configuration file back into the new computer that contains all important machine parameters. The parameters are saved on the compact flash.

Refer to section 5.3 for a drawing of the computer module and compact flash card.

1. If you do not have a copy of your configuration file and the computer module is still functional, perform service code 142 and save your machines configuration file to a thumb drive. If you are not able to run this service code, then contact Southwestern Industries. We should be able to email you a backup copy of this file.
2. Turn power off to the control and machine.
3. Press the little button next to the compact flash to remove the card.
4. Insert the new card, in the proper orientation, and make sure it clicks in place. **Note** – the compact flash is keyed and should only go in one way, but if you are not careful, you may be able to insert it backward and damage the card or computer module.

6.6 Cable Routing in Electrical Box

The routing of cables in the LPM electrical box is very important. Certain cables need to be routed in a certain fashion to minimize any possible problems with noise being introduced into the system. As a general rule, it is very important to isolate power cables from logic cables. Power cables are referred to as 220 volt or 110 volt power. Logic cables carry signals that are typically 24 volts and below. When you mix 220 volt power with low voltage signals, noise can be generated in these cables. Noise can then generate intermittent inputs or outputs to be seen by the computer. When this happens, the control may perform an unexpected task. See figure 6.6a.

For example, if noise was generated on the door switch cable, the control may intermittently think the door was open when it actually was physically shut. This would cause the program you are running to come to a halt since the control saw the door as being open, even if it was only for a brief second.

As a general rule, always route the new cable or wire in the same fashion as it was prior to you changing it. Also make sure to provide adequate bend radius for all cables and wires.

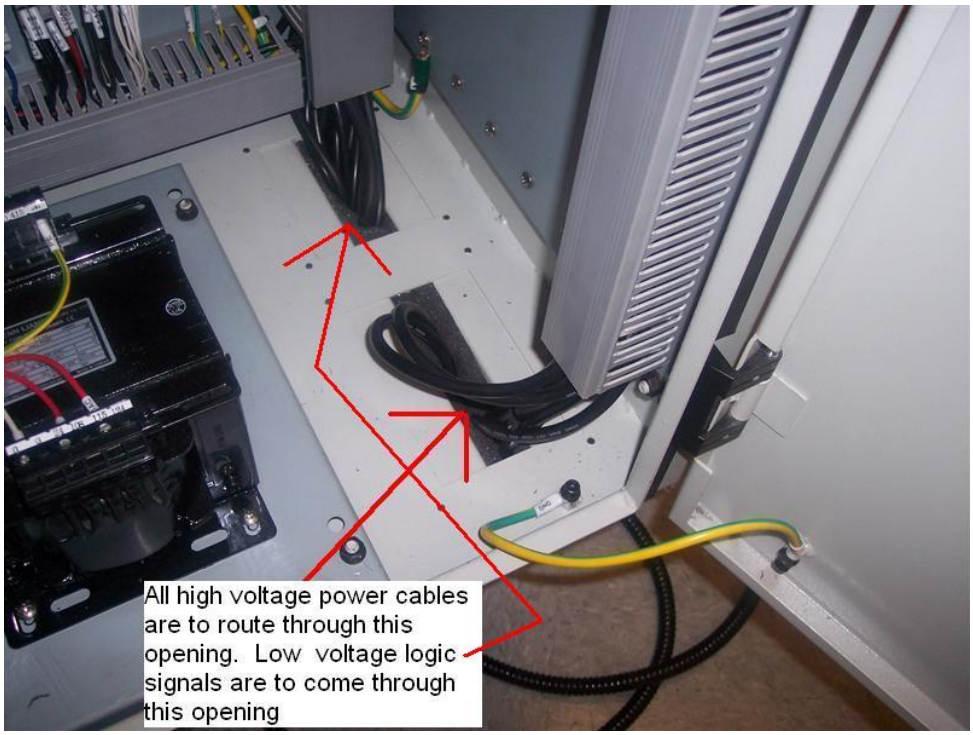


Figure 6.6a

6.7 Linear Guide Replacement

The linear guides that have come with the LPM should be trouble free for many years as long as they are properly lubricated per the specifications stated in this manual. Should the time come when a linear guide will need to be replaced, a machine tool builder will need to be hired to do this work. In order to replace the linear guides, major castings will need to be removed. For example, if the Z linear guides needed replacing, the head of the machine would need to be removed. All linear guide spare parts would be purchased through Southwestern Industries and we would also organize finding a machine tool rebuilder to do the work.

6.8 Ballscrew Replacement, X Axis

The following will describe how the X-axis Ballscrew is removed, replaced and then pre-tensioned. It is essential that the pre-tensioning procedure be followed to the letter.

Throughout the following procedure, assembly drawing 26772 will be referenced by item number. For example, "Ballscrew (17)" references item 17 on the assembly drawing 26772 found in this manual.

The following service codes **must** be performed when an X ballscrew is replaced. Failure to do will cause the ball lock locations to be off for the X and Y axis. The machine may crash if these items are not set correctly.

- **Service Code 505** – reset the motor index angle (machine may not home properly) and reset soft limits. Must be redone after any motor is changed or removed for any reason.
- **Service Code 500** – reset the X and Y ball lock locations for A, B and C. Performed after X or Y axis motor change or removal.

6.8.1 X Axis Ballscrew, Removal

1. Position the table to the approximate center of axes X and Y.
2. Press E-Stop button
3. Disassemble and remove way covers left (40) and right (39). Remove the nine screws that secure way cover, left. Collapse the way cover then remove.

a. Remove the nine screws that secure way cover, right. Collapse the way cover then remove.

Caution **Edges of the way covers can be sharp, use leather gloves while handling.**

4. Remove X-Axis Servomotor – see section 6.1

5. Remove the Bearing locknuts, both motor and support end (20)

    a. At the motor end, slacken the four M4 bearing locknut SHCS, and completely remove two opposing screws.
    b. Install SWI pre-tensioning socket onto the bearing locknut as shown if figure 6.8.1a. The photo below shows the non-motor end bearing housing. This tool mounts to the motor end in the same fashion.

Figure 6.8.1a

c. Insert a 8mm hex key into the ball screw to prevent rotation and remove the bearing locknut as shown in figure 6.8.1b

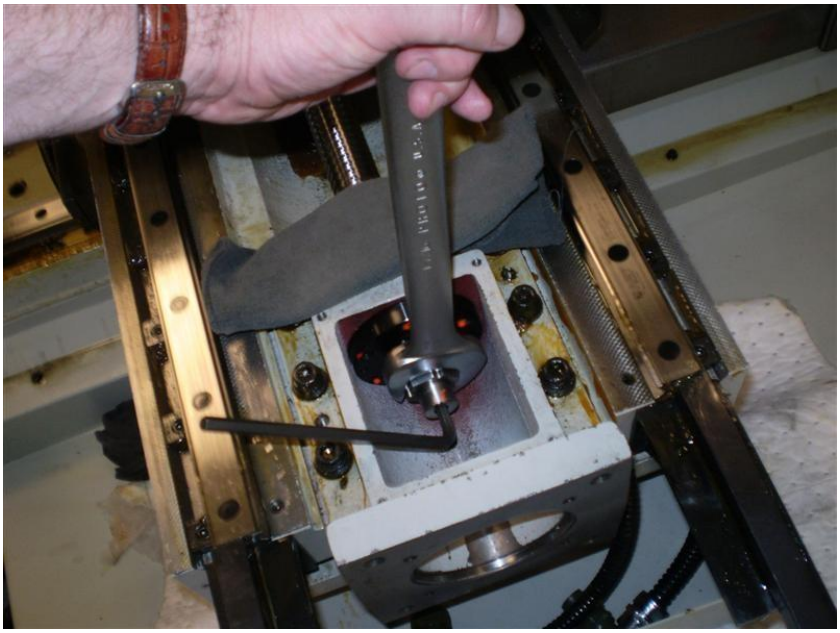


Figure 6.8.1b

d. At the support end, slacken the four M4 bearing locknut (20) SHCS, and completely remove two opposing screws
e. Transfer the SWI pre-tensioning socket onto the bearing locknut as shown in figure 6.8.1c. Insert a 8mm hex key at the motor end of the Ballscrew to prevent rotation.

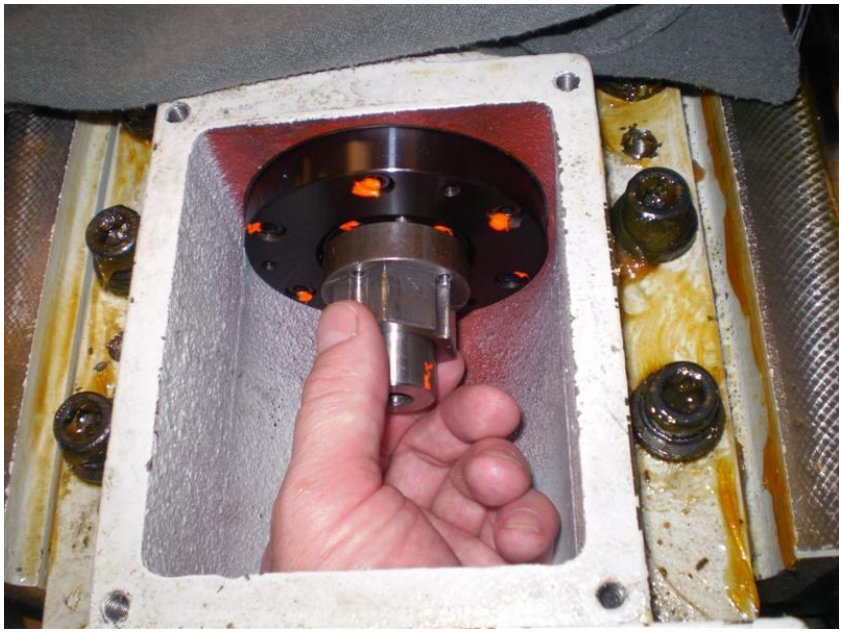


Figure 6.8.1c

f. Remove the bearing locknut from the support end.

6. Remove the support end bearing housing.
    a. Remove the four M12 SHCS that secure the bearing housing (14) to the saddle (2).
    b. Remove the two tapered locating pins (38) from the bearing housing.
    c. Slide the bearing housing off the Ballscrew and set aside.
7. Remove the ball screw.
    a. With a 8mm hex socket extended by four feet, remove the five M10 SHCS that secure the ball nut (a component of the ballscrew 17) to the yoke(3) located beneath the center of the table.
    b. Absent of second pair of helping hands, place cardboard or other protective material beneath the Ballscrew and slide the ballscrew out through the access door, left.

Caution:
We highly advise that the angular contact bearings are replaced at both ends prior to installing a new Ballscrew, see section 6.11

6.8.2 X Axis Ballscrew, Installation

1. With a second pair of hands, carefully slide the ballscrew (17) beneath the table (1) and through the table yoke(3), until it engages the angular contact bearings at the motor end. Slide the Ballscrew until both the ball nut and the ball screw are seated completely.
2. Orient the ball nut, "flat side down" then insert the five M10 SHCS finger tight.
3. Install bearing housing, support end (14)
    a. Align the bearing housing tapered pin holes with the saddle, insert the tapered pins and push them in, give the a light tap to seat. Do not drive in the tapered pins, they are for locating purposes only.
    b. Install the four M12 SHCS that secure the bearing housing (14) to the saddle (2) and tighten in a crisscross pattern, to a torque value of 50 ft lbs.

4. Install the bearing locknut (20) at the motor end.
    a. Insert a 8mm hex key at the support end of the Ballscrew to prevent rotation. Do not allow the hex key to rest against the guideway rail, place a ¾" piece of aluminum stock on the saddle and against the guideway to protect the precision linear guideway.
    b. Install the SWI Pre-tensioning socket onto the bearing locknut at the motor end. See figure 6.8.1a
    c. With a 36mm socket, tighten the bearing locknut (20) to a torque value of 40 ft lbs or 54 N-m, "click" the torque wrench several times to ensure the proper seating of the inner races.
    d. In a crisscross pattern, tighten the four bearing locknut (20) clamping screws. The screws must be tightened evenly. These 4 screws should be torqued to no more than 30 in-lbs. Values greater than this may damage the threads on the ballscrew which could lead to problems when you try to remove the next time.
    e. Do not attach the X-axis servomotor to the LPM at this time.

6.8.3 X Axis Ballscrew, Pre-tensioning

Warning!
Pre-tensioning must be performed when the machine is in its cold state (Ambient temperature) or the Ballscrew will be over tensioned and will render unpredictable results.

Warning!
Before pre-tensioning the ballscrews, make sure to press the E-stop so the servo's are turned off.

Note – the ballscrew ballnut should not be fastened to the yoke when pre-tensioning.

1. Set-up a .0001 test indicator at motor end. Load the indicator approximately .003" then reset the dial to zero as shown in figure 6.8.3a. This indicator will measure "Pull Through" not pre-tension.
2. Install the bearing locknut (Threads lubricated with SAE 20W) onto the Ballscrew support end and tighten firmly several times to seat the bearings. Loosen the bearing locknut, then tighten snuggly by hand.
3. Install the SWI pre-tensioning socket onto the bearing locknut (support end) as shown in figure 6.8.3a
4. Insert a 8mm hex key into the Ballscrew hex drive at the motor end to prevent the rotation of the Ballscrew while pre-tensioning, see figure 6.8.3b
5. Set-up an indicator at the support end as shown in figure 6.8.3b, loaded approximately .002" then reset to zero. This indicator will measure pre-tension. Pre-tension is the indicated reading at the support end, less the indicated reading at the motor end. i.e. if the motor end indicator reads .0008", the indicated reading at the support end must read .0038" giving us the desired net pre-tension of .0030".
6. Using a 36mm open end wrench on the pre-tensioning socket, tighten the bearing locknut until the indicator at the support end reads .0030" plus the indicated reading at the motor end. DO NOT DEVIATE FROM THIS VALUE.
7. Have a second set of eyes observe the indicator at the motor end. Pre-tensioning begins when the indicator reading at the support end exceeds the indicator reading at the motor end.

8. IF THE PRE-TENSION VALUE IS EXCEEDED, YOU MUST RELEASE THE PRE-TENSION AND REPEAT STEP 6. This could be a sign you did not preload the bearings correctly.
9. IF THE PULL-THROUGH IS GREATER THAN .0007", YOU MUST RETURN TO STEP 1. If this condition repeats itself, the bearing installation must be examined, refer to section 6.11.
10. Once the .0030" pre-tension has been achieved, remove the indicators from both ends of the Ballscrew, snug the four M4 SHCS (Threads lubricated with SAE 20W) in a crisscross pattern, then repeat to tighten, screws must be tightened evenly. These 4 screws should be torqued to no more than 30 in-lbs. Values greater than this may damage the threads on the ballscrew which could lead to problems when you try to remove the next time,
11. Install the servo motor, refer to section 6.1
12. Tighten in a crisscross pattern the five M10 SHCS that secure the ball nut to the yoke to a torque value of 40 ft lbs.
13. Connect the servomotor power and encoder cables.

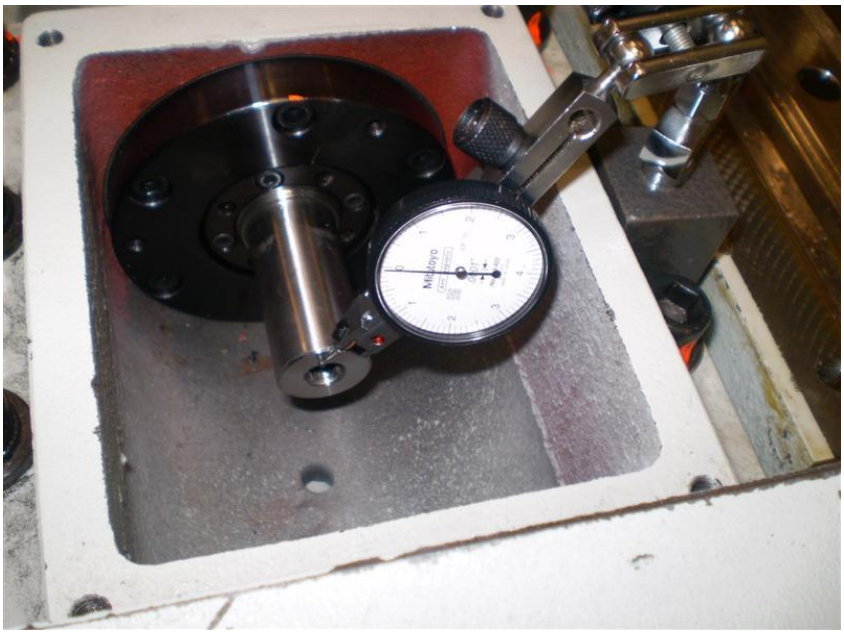


Figure 6.8.3a

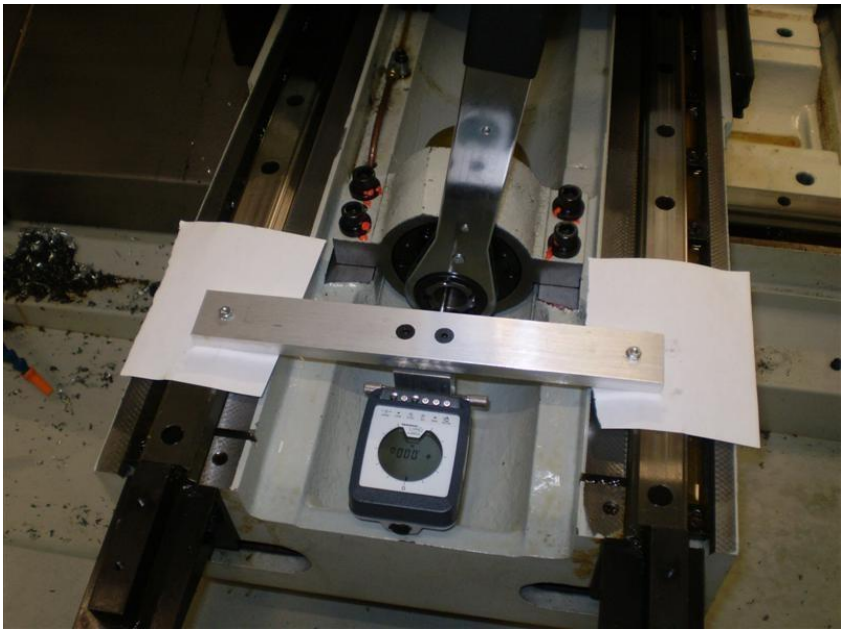


Figure 6.8.3b

14. Replace covers
    a. X-axis motor cover, lower (34)
    b. X-axis coupling cover (12)
    c. X-axis way covers, left and right (40,39)
15. Perform all necessary service codes
    a. Service code 128- Input Backlash Constant
    b. Service code 500- X and Y axis ball lock offsets
    c. Service code 505- Soft Limits

6.9 Ballscrew Replacement, Y Axis

The following will describe how the Y-axis ballscrew is removed, replaced and then pre-tensioned. It is essential that the pre-tensioning procedure be followed to the letter.

Throughout the following procedure, assembly drawing 26817 will be referenced by item number. For example, "bearing housing (12)" references item 12 on the assembly drawing 26817 found in this manual.

The following service codes **must** be performed when a Y ballscrew is replaced. Failure to do will cause the ball lock locations to be off for the X and Y axis. The machine may crash if these items are not set correctly.

- **Service Code 505** – reset the motor index angle (machine may not home properly) and reset soft limits. Must be redone after any motor is changed or removed for any reason.
- **Service Code 500** – reset the X and Y ball lock locations for A, B and C. Performed after X or Y axis motor change or removal.

6.9.1 Y Axis Ballscrew, Removal

1. Disassemble from the saddle the Y-axis way cover, front (2) and remove
2. Jog the table towards the front of the machine
3. Press E-Stop button

Caution
Edges of the way covers can be sharp, use leather gloves while handling.

4. Remove Y-Axis Servomotor – see section 6.1
5. Remove the Ballscrew
   a. At the motor end, slacken the four M4 bearing locknut SHCS, and completely remove two opposing screws.
   b. Install SWI pre-tensioning socket onto the bearing locknut (15) at the motor end.
   c. Insert a 8mm hex key at the support end of the ballscrew to prevent rotation of the ballscrew.
   d. Allow the hex key to rest against the base of the machine.
   e. Remove the bearing locknut (15) from the motor end with the aid of a 36mm six point socket with extension ¾".
   f. At the support end, slacken the four M4 bearing locknut SHCS, and completely remove two opposing screws.
   g. Transfer the SWI pre-tensioning socket onto the bearing locknut as shown in figure 6.9.1a.
   h. Insert a 8mm hex key at the motor end of the ball screw to prevent rotation
   i. Remove the bearing locknut from the support end.

Figure 6.9.1a

   j. Remove the six M12 SHCS that secure the motor mounting bracket (10) to the base (1).
   k. Remove the two tapered locating pins (25) from the motor mounting bracket.
   l. Slide the motor mounting bracket off the ballscrew and set aside.
   m. With a 8MM hex socket extended by four feet, remove the five M10 SHCS that secure the ball nut to the yoke beneath the center of the saddle.
   n. Absent of second pair of helping hands, place cardboard or other protective material beneath the ballscrew and slide the ballscrew out through the opening at the rear of the machine.

Attention:
We highly advise that the angular contact bearings be replaced at both ends prior to installing a new ballscrew, see section 6.11

6.9.2 Y Axis Ballscrew, Installation

1. Carefully slide the ballscrew through the yoke. While the ball nut slides into the yoke, have a second pair of hands support the ballscrew at motor end as it engages the angular contact bearings. Slide the ballscrew until the ball nut seats against the face of the yoke. Orient the ball nut, "flat side down" then insert the five M10 SHCS finger tight.

2. Install motor mounting bracket (10)
   a. Align the bearing housing tapered pin holes with the base, insert the tapered pins and push them in to seat, do not drive the tapered pins in, they are for locating purposes only.
   b. Install the six M12 SHCS that secure the motor mounting bracket (10) to the base (1) and tighten in a crisscross pattern, to a torque value of 50 ft lbs.

3. Install the bearing locknut at the motor end.
   a. Insert a 8mm hex key at the support end of the ballscrew to prevent rotation.
   b. Install the SWI Pre-tensioning socket onto the bearing locknut at the motor end.
   c. With a 36mm socket, tighten the bearing locknut (15) to a torque value of 40 ft lbs or 54 N-m, "click" the torque wrench several times to ensure the proper seating of the inner races.
   d. Remove the SWI pre-tensioning socket. In a crisscross pattern, tighten the four bearing locknut clamping screws. These 4 set screws should be torqued to no more than 30 in-lbs. Values greater than this may damage the threads on the ballscrew which could lead to problems when you try to remove the next time
   e. Do not attach the Y-axis servomotor to the LPM at this time.

6.9.3 Y Axis Ballscrew, Pre-tensioning

Warning!
Before pre-tensioning the ballscrews, make sure to press the E-stop so the servos are turned off.

Note – the ballscrew ballnut should not be fastened to the yoke when pre-tensioning.

1. Set-up a .0001 test indicator at motor end. Load the indicator approximately .003" then reset the dial to zero as shown in figure 6.8.3a. This indicator will measure "Pull Through" not pre-tension.

2. Install the bearing locknut (lubricated) onto the ballscrew support end and tighten firmly several times to seat the bearings. Loosen the bearing locknut, then tighten snuggly by hand.

3. Install the SWI pre-tensioning socket onto the bearing locknut (support end) as shown in figure 6.9.1a

4. Insert a 8mm hex key into the ballscrew hex drive at the motor end to prevent the rotation of the ballscrew while pre-tensioning.

5. Set-up an indicator at the support end as shown in figure 6.9.3a, loaded approximately .002" then reset to zero. This indicator will measure pre-tension. Pre-tension is the indicated reading at the support end, less the indicated reading at the motor end. i.e. if the motor end

indicator reads .0008", the indicated reading at the support end must read .0031" giving us the desired net pre-tension of .0023".

6. Using a 36mm open end wrench on the pre-tensioning socket, tighten the bearing locknut until the indicator at the support end reads .0023" plus the indicated reading at the motor end. DO NOT DEVIATE FROM THIS VALUE.
7. Have a second set of eyes observe the indicator at the motor end. Pre-tensioning begins when the indicator reading at the support end exceeds the indicator reading at the motor end.
8. IF THE PRE-TENSION VALUE IS EXCEEDED, YOU MUST RELEASE THE PRE-TENSION AND REPEAT STEP 4 through 6. This could be a sign you did not preload the bearings correctly.
9. IF THE PULL-THROUGH IS GREATER THAN .001", YOU MUST RETURN TO STEP 1. If this condition repeats itself, the bearing installation must be examined, refer to section 6.11.
10. Once the .0023" pre-tension has been achieved, remove the indicators from both ends of the ballscrew, snug the four M4 SHCS (lubricated) in a crisscross pattern, then repeat to tighten, screws must be tightened evenly. These 4 screws should be torqued to no more than 30 in-lbs. Values greater than this may damage the threads on the ballscrew which could lead to problems when you try to remove the next time
11. Install the Y-axis servo motor, refer to section 6.1
12. Tighten in a crisscross pattern the five M10 SHCS that secure the ball nut to the yoke to a torque value of 40 ft lbs.
13. Connect the servomotor power and encoder cables.

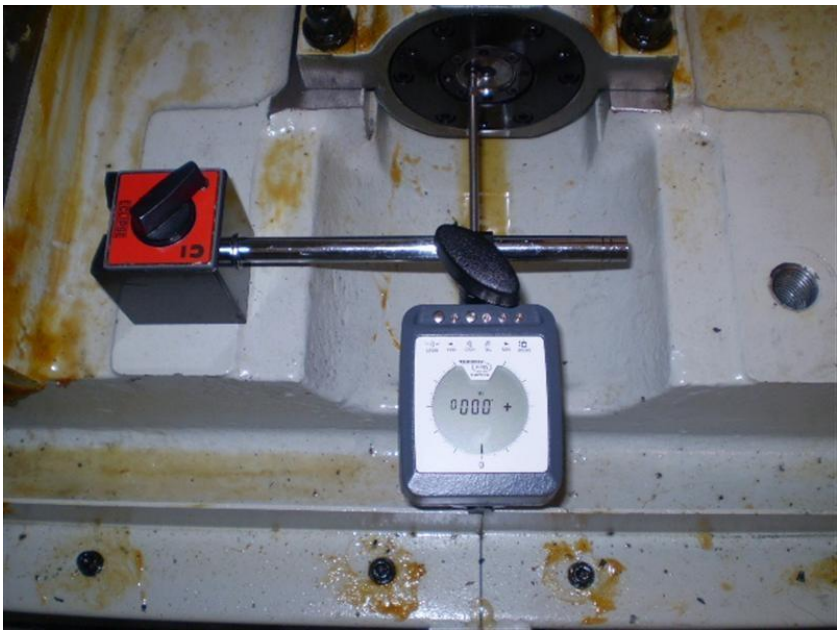


Figure 6.9.3a

14. Replace all covers

15. Perform all necessary service codes

    a. Service code 128- Input Backlash Constant
    b. Service code 500- X and Y axis ball lock offsets
    c. Service code 505- Soft Limits

6.10 Ballscrew Replacement, Z Axis

The following will describe how the Z-axis ballscrew is removed, replaced and then pre-tensioned. It is essential that the pre-tensioning procedure be followed to the letter.

Throughout the following procedure, assembly drawing 26756 will be referenced by item number. For example, "Ballscrew (12)" references item 12 on the assembly drawing 26756 found in this manual.
The following service codes **must** be performed when a Z ballscrew is replaced. Failure to do will cause the base tool and tool change height to be off. The machine may crash if these items are not set correctly.

- **Service Code 505** – reset the motor index angle (machine may not home properly) and reset soft limits. Must be redone after any motor is changed or removed for any reason.
- **Service Code 501** – reset the tool change height. Performed after Z motor axis change or removal
- **Service Code 502** – reset the base tool height. Performed after Z axis motor change or removal

6.10.1 Z Axis Ballscrew, Removal

1. Position the table as shown in figure 6.10.1a
   a. Remove the four cap screws that secure the lower way cover to the underside of the head. Collapse the cover downward.
   b. b. Jog in positive Z to the full upward position.
   c. c. Remove the six cap screws (three per side) that secure the way cover assembly to the column (see figure 6.10.1a), and remove the assembly.

Caution **Edges of the way covers can be sharp, use leather gloves while handling.**

2. Position the table to the approximate center of the axis X and Y.
3. Place the head support (supplied with the machine) on the protected table as shown in figure 6.10.1a and 6.10.1b.
4. Jog in negative Z until the head (the casting portion) is nearly in contact with head support.
5. Secure the support to the head with two cap screws, then very gently jog head down until contact is made with the table. USE EXTREME CARE NOT TO PUT ANY UNNECESSARY FORCES ONTO THE TABLE!

Figure 6.10.1a

Figure 6.10.1b

a. Press E-Stop
b. **Turn off the power at the machines disconnect switch, and use a lockout tag.**
c. Remove the coupling cover from the motor mounting bracket located behind the spindle drive motor.

Caution!
Do not touch the ballscrew or linear ways with your bare hands. Wear latex or other suitable gloves to protect precision surfaces from your hands.

d. Remove the Z axis motor – section 6.1.
e. Remove the Z-axis ballscrew.

6. a. Insert a 8mm hex key at the support end of the ballscrew to prevent rotation.
7. b. Attach the SWI pre-tensioning socket onto the bearing locknut at the motor end remove the bearing locknut.
8. c. At the support end, slacken the four M4 bearing locknut SHCS, and completely remove two opposing screws.
9. Transfer the SWI pre-tensioning socket onto the bearing locknut as shown in figure 6.9.1a
10. Remove the bearing locknut from the support end.
11. Remove the six M12 SHCS that secure the motor mounting bracket to the column, remove the two tapered locating pins and remove the motor mounting bracket.
12. a. Remove the four M12 SHCS that secure the bearing housing (9) to the column (1).
13. b. Remove the two tapered locating pins (22) from the bearing housing.
14. c. Slide the bearing housing off the ballscrew and set aside.
15. d. With a 10MM hex socket extended by four feet, remove the five M10 SHCS that secure the ball nut to the yoke beneath the center of the spindle head.

Caution:
We highly advise that the angular contact bearings are replaced at both ends prior to installing a new ballscrew, see section 6.11

6.10.2 Z Axis Ballscrew, Installation

1. Carefully slide the ballscrew through the spindle head yoke (11). Slide the ballscrew until the ball nut seats against the face of the yoke. Orient the ball nut, "flat side towards the back of the LPM" then insert the five M10 SHCS that secure the ball nut to the yoke, make them hand tight.
2. Install bearing housing, motor end (6)

a. Align the bearing housing tapered pin holes with the saddle, insert the tapered pins and push them in to seat, do not drive the tapered pins in, they are for locating purposes only.
b. Install the four M12 SHCS that secure the bearing housing (9) to the column (1) and tighten in a crisscross pattern, to a torque value of 50 ft lbs.

3. Install the bearing locknut at the motor end.

a. Insert a 8mm hex key at the support end of the ballscrew to prevent rotation. Install the SWI Pre-tensioning socket onto the bearing locknut at the motor end.
b. With a 36mm socket, tighten the bearing locknut (16) to a torque value of 40 ft lbs or 54 N-m, repeat several times to ensure the proper seating of the inner races.
c. In a crisscross pattern, tighten the four bearing locknut clamping screws. These 4 screws should be torqued to no more than 30 in-lbs. Values greater than this may damage the threads on the ballscrew which could lead to problems when you try to remove the next time.
d. Tighten the ball nut to the yoke and tighten screws to 40 ft-lbs.
e. Attach the Z-axis servomotor to the LPM.

6.10.3 Z Axis Ballscrew, Pre-tensioning

Warning!
Before pre-tensioning the ballscrews, make sure to press the E-stop so the servo's are turned off.

1. Due to the weight of the head, we do not need to setup an indicator on the motor end of the ballscrew to monitor ballscrew pull through. Therefore do not remove the Z axis motor.
2. Install the bearing locknut (lubricated) onto the ballscrew support end and tighten firmly several times to seat the bearings. Loosen the bearing locknut and then tighten snuggly by hand.
3. Install the SWI pre-tensioning socket onto the bearing locknut (support end) as shown in figure 6.9.1a
4. On the support end of the ballscrew, insert a 8mm hex key to prevent the rotation of the ballscrew while pre-tensioning. A special tool is required to do this.
5. Set-up an indicator at the support end as shown in figure 6.10.3a, loaded approximately .002" then reset to zero. This indicator will measure pre-tension.
6. Using a 36mm open end wrench on the pre-tensioning socket, tighten the bearing locknut until the indicator at the support end reads .0023". DO NOT DEVIATE FROM THIS VALUE.
7. Once the .0023" pre-tension has been achieved, remove the indicator and snug the four M4 SHCS (lubricated) in a crisscross pattern, then repeat to tighten, screws must be tightened evenly. These 4 screws should be torqued to no more than 30 in-lbs. Values greater than this may damage the threads on the ballscrew which could lead to problems when you try to remove the next time.
8. Power up the machine.
9. Jog the Z-axis all the way upward. Press the E-Stop.

Figure 6.10.3a

10. Replace cover Z-axis motor cover, lower (37)
11. Replace Z-axis coupling cover.
12. Check service code 502 – base tool height

6.11 Angular Contact Bearing Replacement

The following will describe how to remove, replace and preload the angular contact bearings that are used on the ball screws of the X, Y and Z axes. It is essential that the following procedure be followed to the letter. Failure to do so will have **serious consequences** to the performance of the LPM and could jeopardize the life expectancy of the bearings.

In the following procedure, we will be referring to the bearing housing at the motor end, and the bearing housing at the support end. This procedure is the same regardless of what axis or what housing is being worked on.

Please refer to sections 6.8, 6.9 or 6.10 for detailed instructions for removing the bearing housing from the X, Y and Z axes.

Caution!
Do not remove new bearings from the packaging until they you are ready to install them. Also, do not handle the bearings with your bare hands. Use latex gloves that are tight enough to allow your hands to remain dexterous.

6.11.1 Angular Contact Bearing Removal

1. Remove the two SHCS that secure the ball screw cushion to the bearing housing.
2. Remove the six SHCS that secure the bearing cap to the bearing housing.
3. Insert two M4 jackscrews into the two threaded holes found beneath the cushion.
4. Thread the screws down until they touch the outer bearing race.
5. Simultaneously tighten the screws to push the bearings out of the casting. See figure 6.11.1a

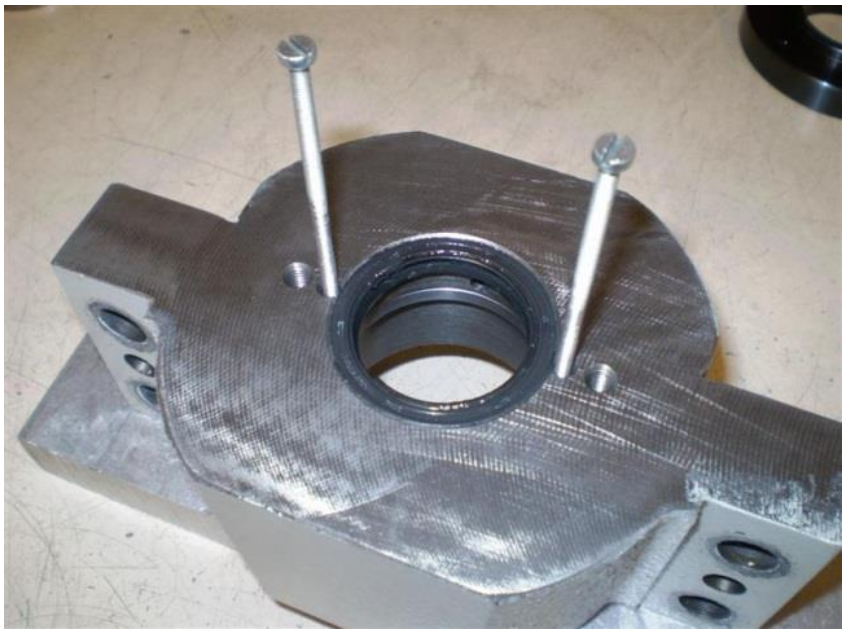


Figure 6.11.1a

Warning!
Do not attempt to "drive" the bearings out with a punch, the inner race will separate and scarring of the bore wall will likely occur!

6. Remove the jackscrews from the bearing housing.
7. Thoroughly clean the bearing housing.
    a. Chase the six threaded M8 holes with a M8 tap, with a blast of air, clear out any loose particles from the threaded holes.
    b. Wash the bearing bore and threaded holes with clean solvent, i.e. Lacquer thinners, Acetone or even denatured alcohol. Use compressed air to dry completely.

6.11.2 Angular Contact Bearing Installation

1. Smear a thin coat of light lubricating oil on the wall of the bearing bore only.
2. The bearings are to be mounted into the bearing housing in a "face to face" arrangement. Please observe the markings on the inner and outer races. Consult the insert found in the bearing packaging if the following markings differ.
    a. An arrow (**>**) will be found on the outside diameter of the outer race.
    b. A burnish mark (**o**) on the face of the inner race.
    c. The arrows must be pointed toward each other (**><**) and the "**o**'s" should be aligned with each other, see figure 6.11.2a However, it is not a concern if there is no "**o**" found on the inner race, this simply means that no measurable high-spot was found by the bearing manufacturer.

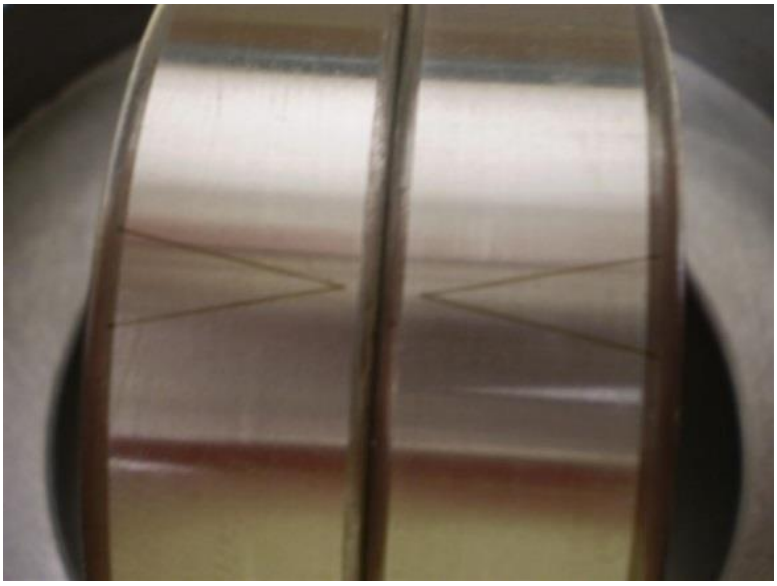


Figure 6.11.2a

3. Place the first bearing squarely at the beginning of the bearing bore. Orient the arrow toward the top of the bearing housing as shown in figure 6.11.2b. It is also helpful to make a reference mark on the face of the bearing cap counter bore to ensure the correct arrow alignment of the second bearing.

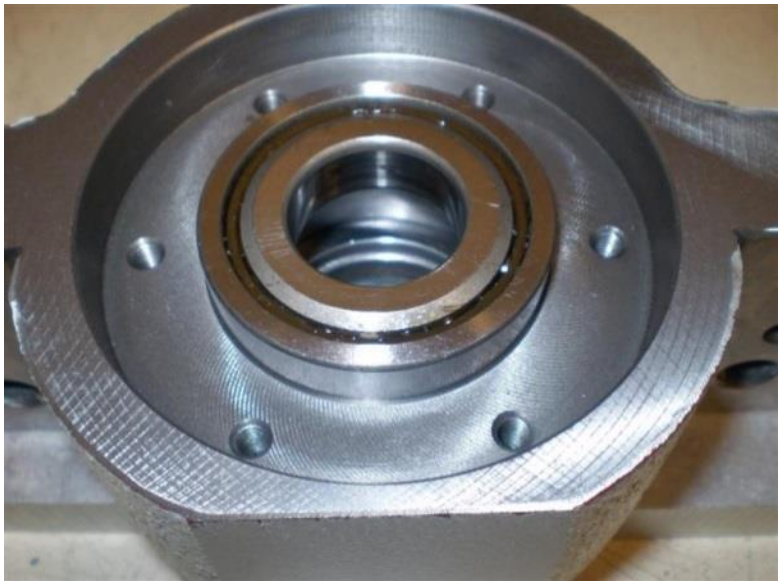


Figure 6.11.2b

4. Ideally, the bearing should be pressed into the bore by means of a suitable arbor press and a ring that is approximately .010" smaller than the outside diameter of the outer race of the bearing. **Only** the outer race should be used to press the bearing into the bore.

5. Barring the availability of such a press, the bearing can also be installed in the following manner.

a. With a soft punch, gently tap the outer race from side to side, gradually walking the bearing into the bore. Be patient, otherwise you will likely get the bearing jammed into the bore.
b. Once the outer race is near flush to the top of the bore, place the second bearing on top of the first (remember, face to face) and continue to tap the two bearings downward until the second bearing is near flush with the top of the bore.
c. Place the bearing cap on top of the bearings and continue tapping downward.
d. Once the M6 SHCS can engage the threaded holes of the bearing housing, discontinue tapping the bearing cap, and use two SHCS supplied with the bearings to walk the bearings to the bottom of the bearing bore.
e. First apply two drops of LocTite® 222 to the ends of the six SHCS, and one drop in each of the six threaded holes. The screws should be tightened simultaneously. The bearings will move easily if equal pressure is applied. Only use finger pressure when the bearing reaches the bottom of the bore.
f. Install the remaining four SHCS that retain the bearing cap, finger tight only. Use the new SHCS supplied with the bearings.
g. Using the short end of a 5mm hex key, tighten in a crisscross pattern until you can no longer tighten any of the screws. See figure 6.11.2c

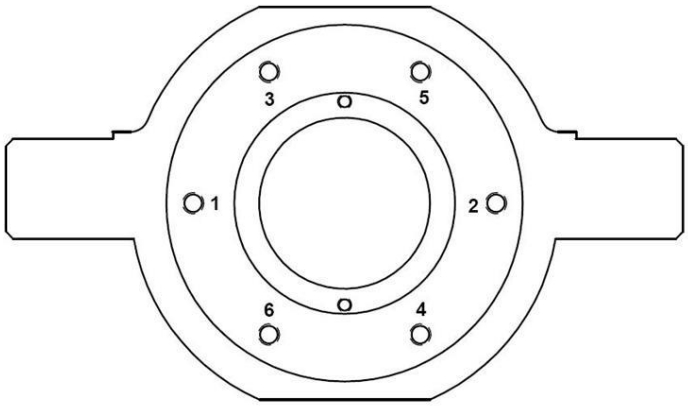


Figure 6.11.2c

6.11.3 Setting the Preload

1. The tightening pattern described in figure 6.11.2c must be followed to properly preload the angular contact bearings.
2. Tighten in the pattern shown in figure 6.11.2c to a torque value of 7 ft lbs (84 in-lbs), do not however, do this in one pass, the pattern should be followed two or three times until 7 ft lbs of torque is achieved. DO NOT CONTINUE TIGHTENING after the "click" of the torque wrench.

Warning!
Do not over tighten the SHCS that hold the bearing cap in place more than the specidied torque. This will over preload the bearing and may damage the bearing reducing bearing life. It is very important to tighten the bearings down to a specific torque with a torque wrench. A low strength LocTite must also be used.

3. Place a new inspection stripe across the bearing cap and each of the SHCS as shown in figure 6.11.3 a.

Figure 6.11.3a

6.12 Spindle Motor Replacement

The following service code **must** be performed when a spindle motor removed or replaced for any reason. Failure to do will cause the tool changer to orientate incorrectly and crash.

- **Service Code 510** – reset orientation angle of the spindle

See drawing 26854 in the rear of the manual for reference.

1. Move the head down to within a few inches of the table.
2. Press the E stop button
3. Remove the front sheet metal covers.
4. Remove the spindle Drive belt by loosening the four M12 SHCS that secure motor adjusting plate to the spindle head.
5. Release the jam nut from the two belt tensioning screws. Loosen the belt tensioning screws completely and pull the motor toward the front of the LPM.
6. Remove the belt from the spindle motor.
7. Remove the 4 bolts that hold the motor down in place.
8. Remove the spindle encoder cable.
9. Unwire the motor taking note how the motor is wired. See section 6.13 for spindle motor wiring.
10. With the proper lifting equipment, lift the motor up and remove from the machine. Do not attempt to lift the motor by hand as it weighs approximately 180 lbs.
11. Place the replacement motor in its place and following these procedures in the reverse order.
12. Tension the belt until you have approximately ¼" of deflection at the midpoint of the belt.
13. Make sure to reset the orientation angle for the spindle using service code 510. This pertains to whenever the motor is replaced or the spindle belt has moved on the pulleys.

6.13 Spindle Motor Wiring

Wire the spindle motor by via the following diagram.

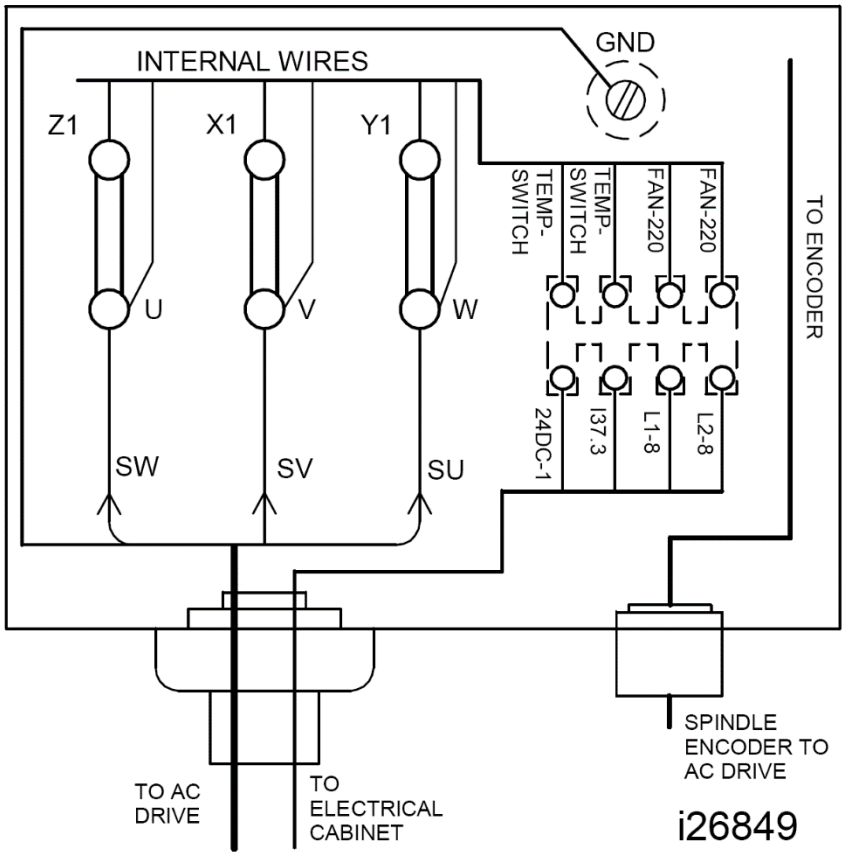


Figure 6.13a

6.14 Spindle Cartridge Replacement

The spindle cartridge is a non-field serviceable item. In the event that it requires replacement, the removal tooling will accompany the new replacement spindle cartridge, and shall be returned with the old spindle in the original SWI crating.

Throughout the following procedure, assembly drawing 26854 will be referenced by item number. For example, "spindle cartridge (2)" references item 2 on the assembly drawing 26854 found in this manual.

The following service code **must** be performed when a spindle cartridge is removed. Failure to do will cause the tool changer to orientate incorrect and crash. The same is true if the spindle belt has been removed and replaced.

- **Service Code 510** – reset orientation angle of the spindle

6.14.1 Spindle Cartridge Removal

1. Jog the Z-axis until it is approximately six inches from the table.
2. Remove the four Phillips head screws that attach the Clamp/ Unclamp pushbutton to the spindle cover, front. Slide the Clamp/ Unclamp button inside the opening on the spindle cover, front
3. Remove the spindle cover, front and the spindle cover, right.
4. Disconnect the air supply to the machine.
5. Press the E-Stop.
6. Remove the Clamp/Unclamp air cylinder (19) also see figure 6.14.1a

a. Remove the black 12mm poly tubing from the inlet port at the top of the air cylinder (Clamp). The hose is easy to remove when you use a 13 mm open end wrench to collapse collar.
b. Remove the blue 12mm poly tubing from the inlet port at the bottom of the air cylinder (Unclamp).
c. Remove the small blue hose from the bottom of the tool change cylinder.
d. Loosen the two SHCS that secure the Clamp/ Unclamp limit switch bracket to the cylinder mounting plate and set aside. Protect from grease and coolant.
e. Remove the four M10 SHCS that secure the cylinder to the base and remove the cylinder.

Figure 6.14.1a

7. Remove the Spindle Drive belt.

a. Loosen the four M12 SHCS that secure motor adjusting plate to the spindle head. You may need to remove 3 of these bolts and pivot the motor to get the belt off.
b. Release the jam nut from the two belt tensioning screws. Loosen the belt tensioning screws completely with a 13 mm wrench and pull the motor toward the front of the LPM. See figure 6.14.1b
c. Remove the belt from the spindle drive pulley (motor) and remove from the spindle head. Set the belt aside.

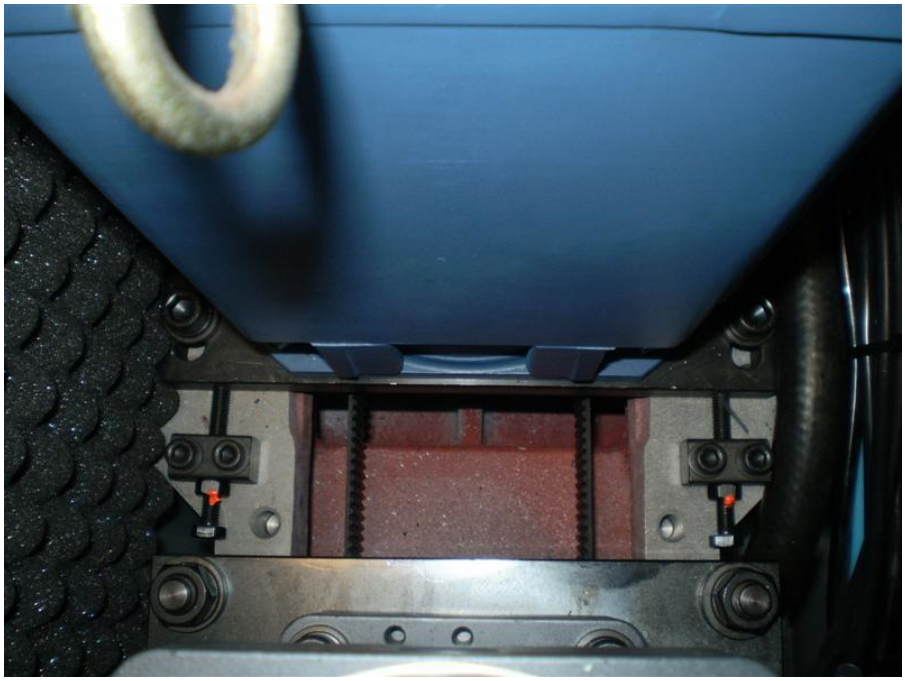


Figure 6.14.1b

8. Remove the spindle cartridge.
a. Fit the SWI Removal Tool to the spindle end cap (with the M12 threaded stock removed). Secure the tool with two M8 SHCS, then back out the screws two turns. See figure 6.14.1c
b. Fit the SWI Support Plate into the bore of the cylinder mounting plate. See figure 6.14.1d.

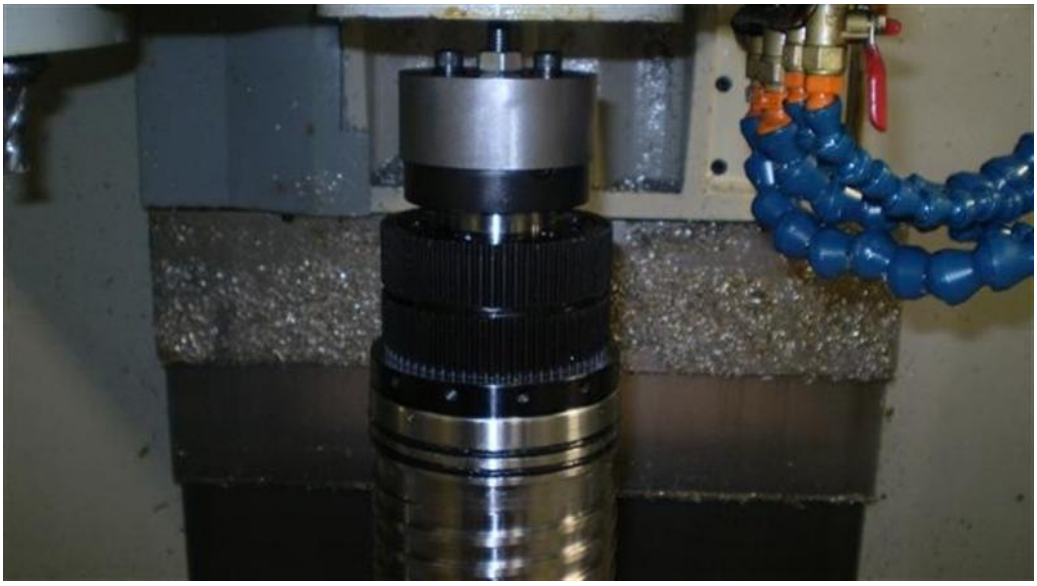


Figure 6.14.1c

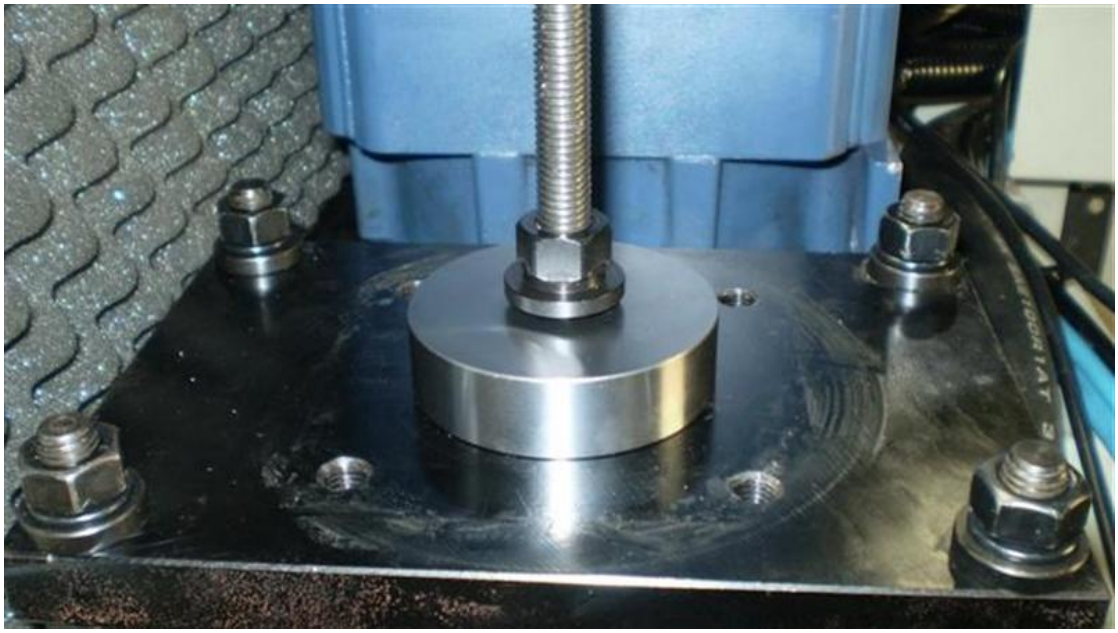


Figure 6.14.1d

c. Insert the M12 threaded stock through the SWI Support Plate and thread it into the SWI Removal Tool until it bottoms.
d. Tighten the two M8 SHCS to lock the M12 threaded stock in place.
e. Thread the M12 flange hex nut onto the treaded stock until it comes in contact with the SWI Support plate (see figure 6.14.1d). Note, a small amount of grease between the flange nut and the support plate is helpful.
f. Place a sheet of plywood or other suitable material to protect the table. For safety purposes, do not allow the wood to overhang the front of the table.
g. Remove the drive dogs from the spindle nose and place into a bag inside the returning shipping crate.

Caution!
If the spindle has been shimmed for tram purposes, make note where the shims were placed when removing the spindle cartridge.

h. Remove the six M8 SHCS that secure the spindle cartridge to the spindle head, see figure 6.14.1e
i. With a 19 mm ratcheting box end wrench, begin to unwind (CCW) the flange nut. Make certain that the spindle is dropping as you loosen the nut, if it is not, the spindle may require a little "encouragement" with a soft mallet against the top of the M12 threaded stock to start. Once it has broken free, the spindle should drop with little to no resistance. See figure 6.14.1f. You may need to pry the spindle cartridge between the bracket shown in figure 6.14.1f and the spindle cap to get the spindle to move downward.

Figure 6.14.1e

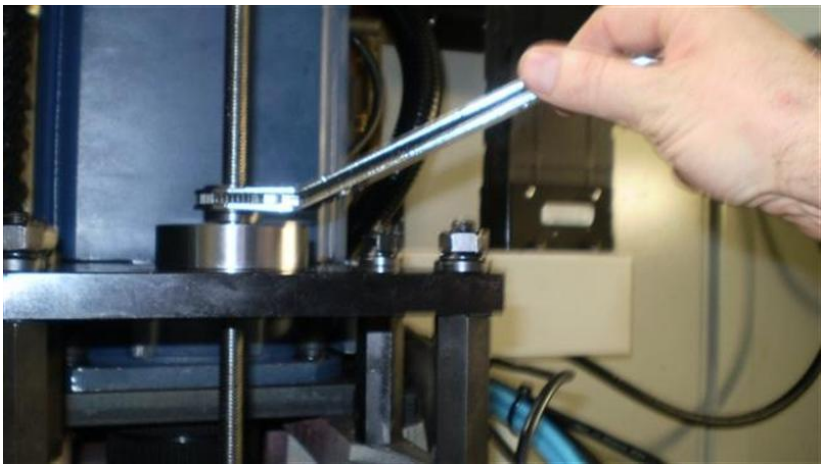


Figure 6.14.1f

Warning!
NEVER ATTEMPT TO PRY THE SPINDLE LOOSE BETWEEN THE SPINDLE FLANGE AND THE SPINDLE HEAD

j. Continue to unwind the M12 flange hex nut until the spindle rests on the protected table.
k. Loosen the two M8 SHCS securing the SWI Removal Tool to the spindle end cap and remove the M12 threaded stock.
l. Remove the spindle cartridge from the enclosure and place on a suitable work surface. Use care, as the spindle cartridge is heavy, approximately 75 lbs.

6.14.2 Spindle Cartridge Installation

1. Remove the SWI Removal Tool and fit it to the new cartridge.
    a. Secure the tool with two M8 SHCS, then back out the screws two turns.
2. Place the spindle cartridge on the table of the LPM and position it beneath the M12 threaded stock (wind in the flange nut so that the threaded stock dangles just above the spindle cartridge)
3. Insert the M12 threaded stock through the SWI Support Plate and thread it into the SWI Removal Tool until it bottoms.
4. Tighten the two M8 SHCS to lock the M12 threaded stock in place.
5. Begin to tighten the M8 flange nut until the spindle cartridge is suspended just above the table.
6. Attach a plumb line to the spindle head that is aligned with the forward most mounting screw hole. See figure 6.14.2a

Figure 6.14.2a

7. Rotate the spindle cartridge until the etching "OI" is facing you and the bolt hole in the spindle cartridge flange is aligned with the plumb bob. This will serve as an alignment reference as the cartridge enters the spindle head. Once the O-rings have entered the bore, rotational adjustments for bolt hole alignment must be minimal.
8. Make certain that the O-rings have a light coating of grease before it is installed.
9. Tighten the M8 flange to raise the spindle cartridge into the spindle head.
10. Gravity will vertically align the spindle cartridge, do not attempt to aid in this alignment.
11. Once the spindle cartridge reaches the first O-ring, verify that the bolt hole is aligned with the plumb bob. Continue to pull the cartridge into the spindle head until there is approximately 3/8" of clearance between the spindle flange and the spindle head.
12. Insert the six M8 SHCS that will secure the cartridge to the spindle head, tighten in a crisscross pattern until the flange is mated up with spindle head.
13. Tighten the M8 SHCS in the same manner to a torque value of 40 ft lbs or 54 N-m.
14. Remove SWI tooling and place in the returning shipping crate along with the replaced spindle cartridge.
15. Replace the Spindle Drive belt. Through the opening at the front of the spindle head, feed the drive belt up and over the pulley/ drawbar and then down and back in through the spindle head. Pull the belt around the back of the drive pulley.

16. Install the Clamp/ Unclamp Air Cylinder.

    a. Install the clamp and unclamp air cylinder and cylinder mounting plate to the four standoffs, secure with the four 12mm hex nuts and split lock washers.
    b. Install the Clamp/ Unclamp limit switch bracket to the cylinder mounting plate and secure with the two SHCS.
    c. Reconnect the blue 12mm poly tubing to the inlet port at the bottom of the air cylinder (Unclamp).
    d. Reconnect the black 12mm poly tubing to the inlet port at the top of the air cylinder (clamp).
    e. Reconnect the air supply to the LPM.
    f. Verify that the air gap between the air cylinder adjusting bolt and the draw bar is 5mm (with the air supply on). If the air gap is other than 5mm, release the two SHCS that secure the clamping collar, and adjust the LH adjusting screw accordingly. See figure 6.15.2b.
    g. Perform service code F to verify that the Clamp and Unclamp limit switches are being met. If they are not, they must be adjusted accordingly by loosening the two SHCS that secure the switch(s), slide the switch until the switch is recognized, tighten in place.

17. Replace all covers
18. Feed the clamp/unclamp pushbutton through the spindle cover, front. Install the cover
19. Make sure to reset the orientation angle for the spindle using service code 510.
20. Also double check your tool change height with service code 501.

6.15 Tool Clamp Mechanism Replacement (Spindle Drawbar and Retention Knob Finger Replacement)

When we talk about the Tool Clamp Mechanism, we are talking about two elements, the air cylinder that actuates the tool clamp cartridge and releases the tool from the spindle, and the tool clamp drawbar cartridge itself. The tool clamp cartridge mechanically clamps the tool holder into the spindle by means of a series of Belleville washers (Spring washers) and a set of retention knob pull fingers.

The following service code **must** be performed when a spindle belt is removed, which is done during this procedure. Failure to do will cause the tool changer to orientate incorrectly and crash.

- **Service Code 510** – reset orientation angle of the spindle

6.15.1 Tool Clamp Assembly, Removal

See drawing 26848 for an illustration of the spindle assembly and drawing 26854 for the head assembly.

1. Jog the Z-axis until it is approximately six inches from the table.
2. Remove the four Phillips head screws that attach the Clamp/ Unclamp pushbutton to the spindle cover, front. Slide the Clamp/ Unclamp inside the opening on the spindle cover, front
3. Remove the spindle cover, front and the spindle cover, right.
4. Disconnect the air supply to the machine.
5. Jog the Z-axis upward until it is approximately sixteen inches from the table.
6. Press the E-Stop.
7. Remove the Clamp/Unclamp air cylinder (item 19 from drawing 26854) also see figure 6.14.1a.

a. Remove the black 12mm poly tubing from the inlet port at the top of the air cylinder (Clamp).
b. Remove the blue 12mm poly tubing from the inlet port at the bottom of the air cylinder (Unclamp).
c. Remove the small blue hose from the bottom of the tool change cylinder.
d. Remove the two SHCS that secure the Clamp/ Unclamp limit switch bracket to the cylinder mounting plate and set aside.
e. Remove the four M10 SHCS that secure the cylinder to the base and remove the cylinder.

8. Remove the Spindle Drive belt.

a. Loosen the four M12 SHCS that secure motor adjusting plate to the spindle head. You may need to remove 3 of these bolts and pivot the motor to get the belt off.

b. Release the jam nut from the two belt tensioning screws. Loosen the belt tensioning screws completely with a 13 mm wrench and pull the motor toward the front of the LPM. See figure 6.14.1b

c. Remove the belt from the spindle drive pulley (motor) and remove from the spindle head. Set the belt aside.

9. Mark item 16 found on drawing 26848 relative to the spindle or spindle pulley. This spindle cap must be put back on in the same orientation to ensure the balancing of the spindle is not affected. See figure 6.15.1c below.

Warning:
In the following steps, you will remove the spindle end cap, which is used by the factory for dynamic balancing the spindle. DO NOT TAMPER WITH THE SCREWS CONTAINED WITHIN THE END CAP. Remove only the screws that you are instructed to remove, failure to do so will jeopardize the dynamic balancing of the spindle.

10. Remove the top bracket that holds the tool clamp cylinder. Item 26 on drawing 26854.
11. Use the flat on the drawbar to hold the spindle from turning and remove the bolts from the spindle end cap. Items 46 on drawing 26848.
12. Put the guides that come with the spindle end cap tool into the 2 empty tapped holes in the spindle end cap and then put the end cap tool over these. They are used to align the tool properly. Once in place, remove the guides and finger tighten the 2 SHCS that come with the guide. See figure 6.15.1b below.
13. Use the large M12 jackscrew to remove the spindle end cap. Figure 6.15.1b is shown with the spindle out of the machine just for clarity. The spindle does not need to be removed.
14.

Caution
Do not attempt to pry the cap off. Attempting this will cause the cap to become jammed onto the spindle and possibly cause damage to the spindle pulley, driven.
Shortcuts can turn a simple service into a complicated one.

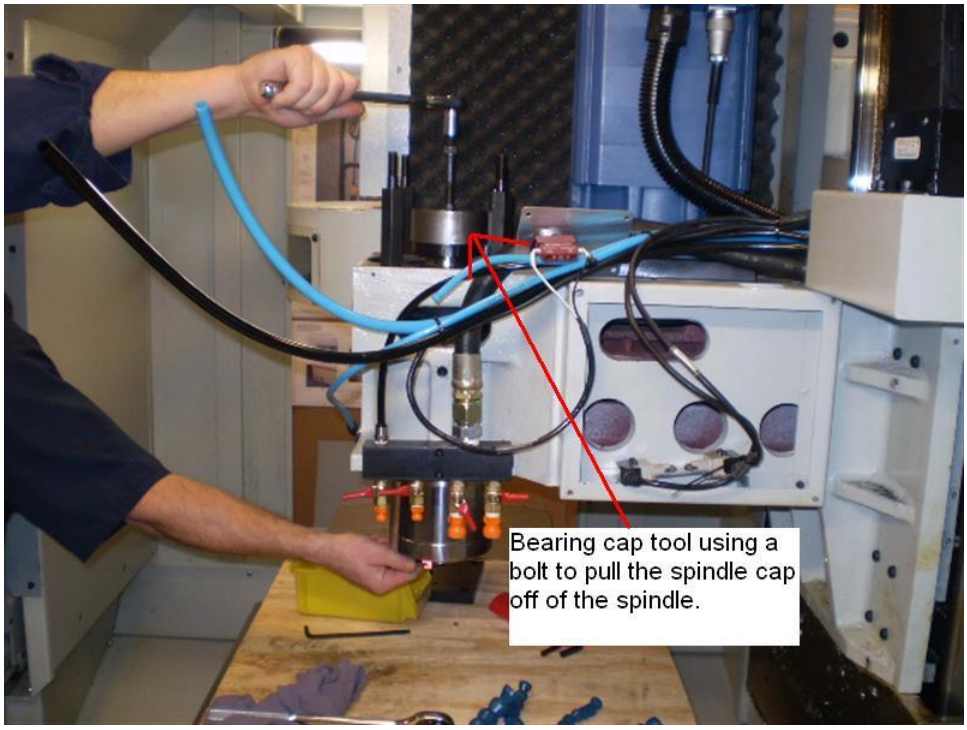


Figure 6.15.1a


Figure 6.15.1b

14. Place a 12mm open end wrench across the flats at the top of the draw bar to prevent it from rotating.
15. With a 5mm hex bit socket and an extension, loosen the retention knob pull fingers three turns, tap the clamping cartridge upward through the tapered end of the spindle bore to free it. Loosen the retention knob pull fingers completely.
16. Remove the drawbar clamping cartridge by pulling it upwards through the spindle bore until it is free of the spindle. Remove the drawbar clamping cartridge from the spindle. It consists of items 27, 17, 33 34, 35 and 36 found on assembly drawing 26848.
17. With a long drift made of a soft material, gently tap the retention knob pull fingers downward through the bore of the spindle until the fingers snap free of the spindle bore. Caution, protect the table as the retention knob pull fingers will fall from the spindle.

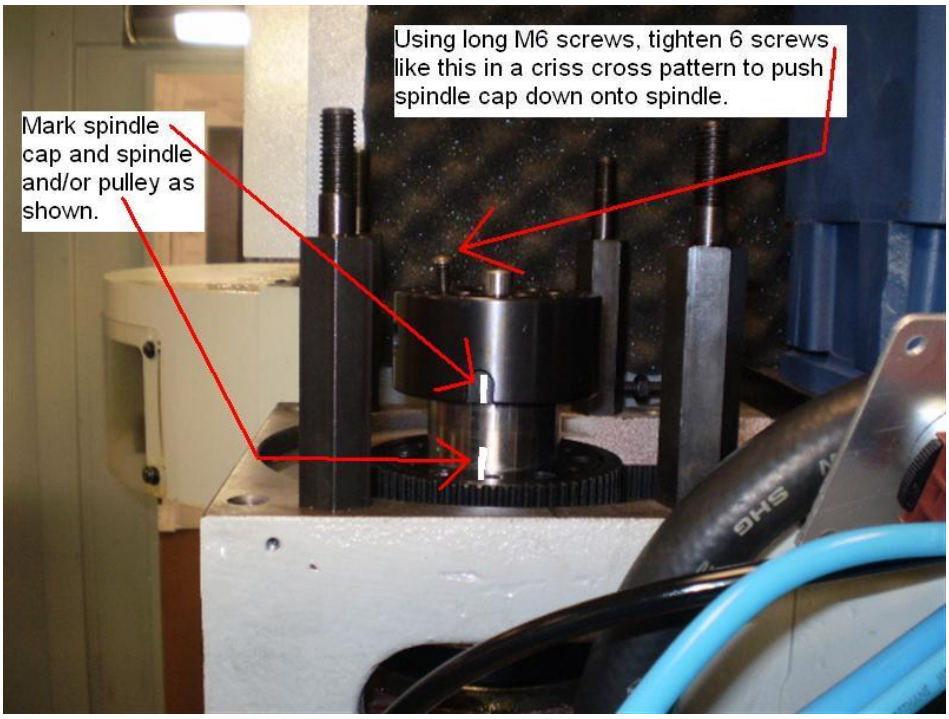


Figure 6.15.1c

6.15.2 Tool Clamp Assembly, Installation

1. Install the clamping cartridge through the top of the spindle bore. The clamping cartridge will be a snug fit and will require gentle tapping into place. Use a drift made of a soft material. Tap the clamping cartridge until approximately 2 ½" of the clamping cartridge is exposed above the top of the spindle. Do not tap the clamping cartridge to the bottom of the spindle bore.
2. Place two 8mm x 40mm set screws at opposing threaded holes on the back face of the spindle, see figure 6.15.2a

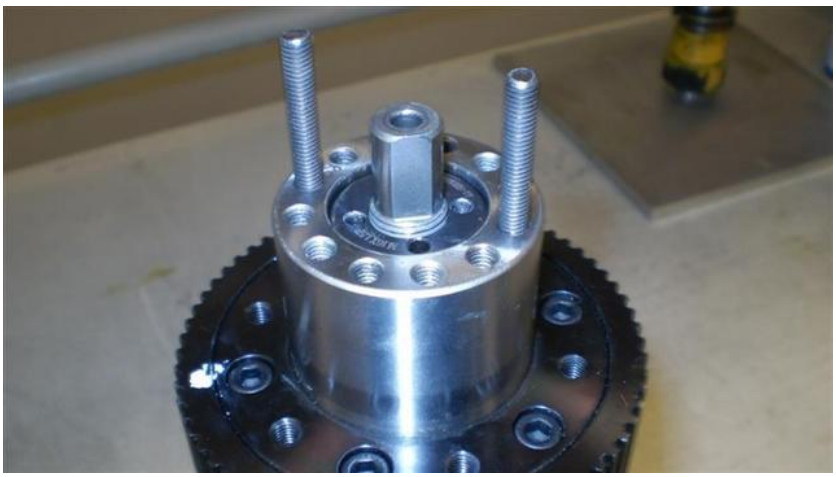


Figure 6.15.2a

3. Place spindle end cap onto the clamping cartridge, then align the reference marks between the spindle and the spindle end cap using the set screws to align the end cap to the spindle.

4. Gently ease the end cap over the spindle, take care not to allow the end cap to become twisted on the spindle.
5. With the aid of the six SHCS, gradually tighten in a crisscross pattern, walk the cap downward until it seats. Tighten in the same manner to 10 ft lbs.
6. With a 5mm hex bit socket with an extension, install the retention knob pull fingers through the bottom bore of the spindle, tighten to 10 ft lbs.
7. Re-install the spindle belt. Fasten the motor back down and using belt tensioning bolts to tighten belt.
8. Install the two forward most standoffs.
9. Install the clamp and unclamp air cylinder and cylinder mounting plate to the four standoffs, secure with the four 12mm hex nuts and split lock washers.
10. Install the Clamp/ Unclamp limit switch bracket to the cylinder mounting plate and secure with the two SHCS.
11. Reconnect the blue 12mm poly tubing to the inlet port at the bottom of the air cylinder (Unclamp).
12. Reconnect the black 12mm poly tubing to the inlet port at the top of the air cylinder (clamp).
13. Reconnect the small blue poly tubing to the bottom of the tool unclamp cylinder.
14. Reconnect the air supply to the LPM.
15. Verify that the air gap between the air cylinder adjusting bolt and the draw bar is 5mm (with the air supply on). If the air gap is other than 5mm, release the two SHCS that secure the clamping collar, and adjust the LH adjusting screw accordingly. See figure 6.15.2b.

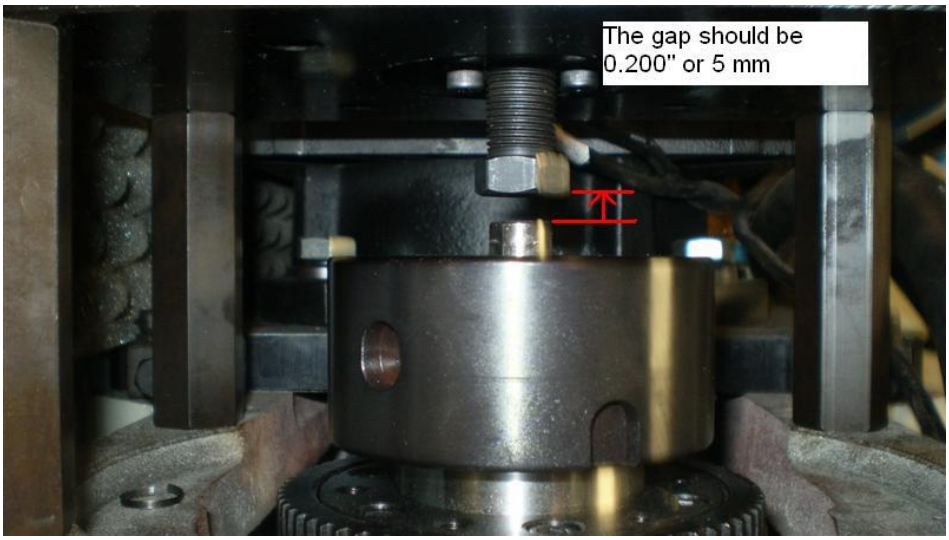


Figure 6.15.2b

16. Perform service code F to verify that the Clamp and Unclamp limit switches are being met. If they are not, they must be adjusted accordingly by loosening the two SHCS that secure the switch(s), slide the switch until the switch is recognized, tighten in place.
17. Replace right side spindle cover.
18. Feed the clamp/unclamp pushbutton through the front of the spindle cover, and then install the cover.
19. Reset the orientation angle of the spindle using service code 510.

6.16 Automatic Tool Changer (ATC) Replacement

The following will describe how the Automatic Tool Changer is removed and replaced.

Throughout the following procedure, assembly drawings 26811 and *26784* will be referenced by item number. For example, "Limit Switch (40)" references item 40 on the assembly drawing 26811 and *Arbor(3)* references item 3 on the assembly drawing 26784. Both of which are found in this manual.

6.16.1 Removing the Tool Carousel Assembly

1. Remove the tool changer slide guards
a. Remove the five button head socket screws that secure the tool changer slide guard (25), left
b. Remove the four SHCS that secure the tool changer slide guard, upper (24), and remove.
2. Remove the two screws that secure the home position sensor *(16)* to the tool changer shroud, remove the home position sensor and set it aside.
3. Remove the two M8X20 SHCS that secure the door actuator bracket (18) to the Siding Assembly end plate (19).
4. Remove the tool detect sensor *(17)* from the tool detect sensor bracket *(18)* (adjacent the tool changer door). Slide the sensor out through the shroud seal, and set it aside.
5. Jog the table until it is beneath the ATC.
6. Place the Column support beneath the Tool Carousel Assembly as shown in figure 6.16.1b.
7. Press the E-Stop button.
8. Remove the two M6X 35 SHCS that retain the Tool Changer shroud.
9. Remove the M12X50 SHCS and let the ATC rest on top of the support and wood. Replace the M12X50 SHCS with a 3-foot length of M12 threaded stock, winding it in at least ten turns. See figure 6.16.1b.
10. Tighten the "free" nut downward until Tool Carousel Assembly is raised off of the support. Remove the wood from the support.
11. While holding the "fixed" nut on the SWI removal tool, back off the "free" nut allowing the Tool Carousel Assembly to lower to the support bracket. DO NOT allow the Tool Carousel Assembly to spin freely. DO NOT allow the M12 threaded stock to unwind or unthread out of the Tool Carousel Assembly.
12. Once the ATC carousel is safely resting on the support stand, remove the threaded stock from the Tool Carousel Assembly. The table should be carefully jogged toward the front sliding door, where it can be removed from the machine.

Caution
The ATC is heavy and awkward to handle. It weighs approximately 80 lbs. Get help when moving.

Note:
If you are replacing the Geneva mechanism with a new one, you may have to remove the carousel numbers from the old mechanism and transfer them to the new one you are going to install. Make sure to attach the labels in the correct locations.

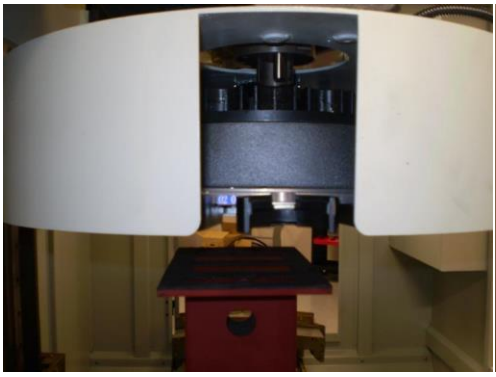


Figure 6.16.1a

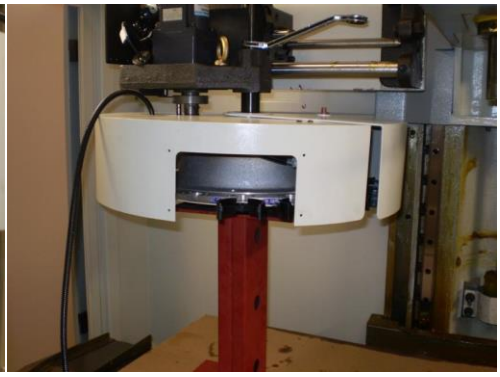


Figure 6.16.1b

6.16.2 Installing the Tool Carousel Assembly

1. Place the Support stand on the left side of the table in the same place it was during the removal of the ATC carousel assembly.
2. Place the ATC carousel assembly on the support bracket, make certain that it is centered and is resting safely.
3. Release the E-Stop, then press the green button on the side of the pendant to start the servos.
4. Using the jog button, maneuver the table until the threaded stock threads into the tool Carousel Assembly without difficulty.
5. Thread in the M12 threaded stock at least ten turns.
6. Tighten the "free" nut downward until the tool carousel assembly is raised up to the tool changer slide assembly.
7. Once the mandrel has just entered the changer slide assembly, continue raising the Tool Carousel Assembly ONLY from the access door, left.
8. Make certain that the Geneva plate *(1)* properly engages the locking segment (24) by gently rocking it back and forth while raising the mechanism (see Figure 6.16.2a).

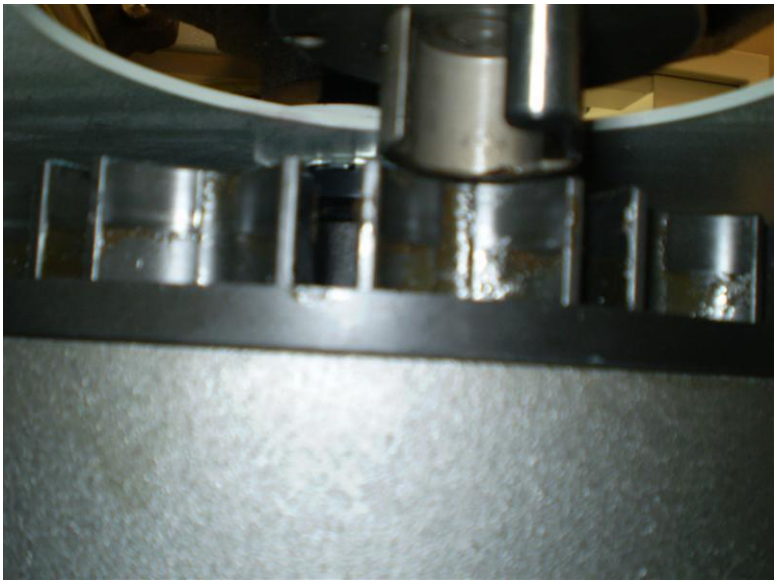


Figure 6.16.2a

9. Raise the Tool Carousel Assembly to its full upward position.
10. Place a 2X4 or other suitable spacer between the column support bracket and the Tool Carousel Assembly to take up the gap.
11. Lower the Tool Carousel Assembly until it rests on the support bracket and wood spacer.

12. Remove the M12 threaded stock and replace with the M12X50 SHCS, tighten the screw finger tight, but do not raise the carousel up at this time.
13. Rotate the tool carousel shroud *(12)* until it lines up with the two M6X35 SHCS that secure the Shroud *(12)* to the ATC sliding body, install the screws.
14. Tighten the M12X50 SHCS that secures the Tool Carousel Assembly to the sliding mechanism to 50 ft-lbs. Make certain that the door moves freely and is not bound up on the Delran spacers *(14), (15)* also see figure 6.16.2a
15. Slide the Tool Detect Sensor *(17)* through the shroud seal and reassemble it to the sensor bracket, making sure that the orientation is that which is shown in figure 6.16.2d. The LED should be pointing downward and the sensor lens should protrude approximately one inch from the bracket sensor bracket.
16. Install the two M5X10 BHCS that secure the Tool Detect Sensor Bracket (18), make certain that the actuator arm is level, and then tighten down.

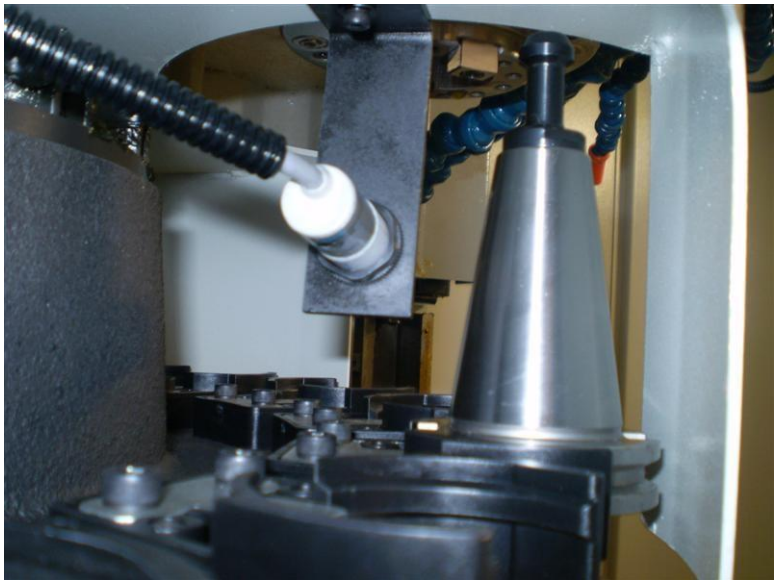


Figure 6.16.2b

17. Install the home proximity sensor *(16)* into the shroud and secure with two M5 BHCS
18. The air gap between the home proximity sensor *(16)* and home position stud should be approximately 0.100" as shown in figure 6.16.2c. Check that the LED light comes on when set.
19. Replace the ATC covers.

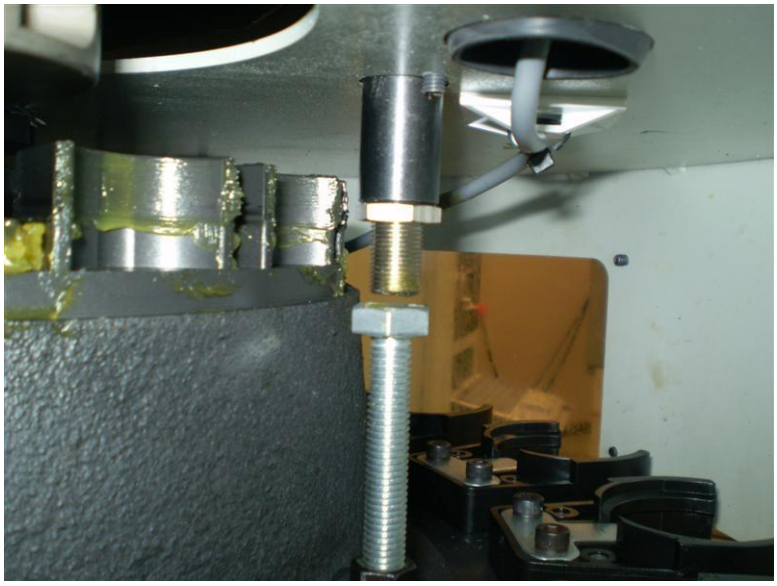


Figure 6.16.2c

6.16.3 Replacing the Home Position Sensor

1. Press the E-Stop button.
2. Remove the tool changer slide guards

a. Remove the five button head socket screws that secure the tool changer slide guard (25), left.

b. Remove the four SHCS that secure the tool changer slide guard, upper (24), and remove.

3. Remove the two screws that secure the home position sensor *(16)* to the tool changer shroud, and set aside.
4. Remove the sheet metal cover above the distribution box.
5. Remove the four Phillips head screws that attach the distribution box cover and remove the cover. The distribution box is located on top of the ATC support bracket as shown in figure 6.16.3a.

Figure 6.16.3a

6. The following wiring connections can be found on electrical diagram 26734 sheet 3.
7. Make the following disconnections

a. Disconnect 24VDC-1 (brown wire) from terminal point TB1.4.
b. Disconnect OV (blue wire) from terminal point TB2.2.

c. Disconnect I32.6 (black wire) from terminal point TB4.2.

8. Attach a light cord of about five feet in length to the end of the sensor cable to aid in feeding the cable of the new sensor.
9. Gently pull the sensor cable through the cable carrier allowing the cord to follow.
10. Remove the cord and attach it to the new sensor cable.
11. Carefully fish the new cable through the cable carrier by pulling the cord through. If the cable sticks, remove the segment(s) at the area where the cable is stuck and shift the cables around until the cable moves freely once again. DO NOT force the cable at any time, pulling the cable with force can cause damage to the small wires that are inside the cable.
12. Make the following connections.
    a. Connect I32.6 (black wire) from terminal point TB4.2.
    b. Connect OV (blue wire) from terminal point TB2.2.
    c. Connect 24VDC-1 (brown wire) from terminal point TB1.4.
13. Replace the distribution box cover, and attach with the four Phillips head screws.
14. Install the home proximity sensor *(16)* into the shroud and secure with two M5 BHCS
15. Set the air gap between the home proximity sensor *(16)* and home position stud to approximately 0.100" as shown in figure 6.16.2e. Check that the LED light comes on when set.
16. Perform service code F to verify that the home position sensor is functioning properly.
17. Install the tool changer slide guards.
14. Re-home the machine and make sure it works.

6.16.4 Replacing the Tool Detect Sensor

1. Press the E-Stop button.
2. Remove the tool changer slide guards

a. Remove the five button head socket screws that secure the tool changer slide guard (25), left
b. Remove the four SHCS that secure the tool changer slide guard, upper (24), and remove.

3. Remove the tool detect sensor *(17)* from the tool detect sensor bracket *(18)* (adjacent the tool changer door). Slide the sensor out through the shroud seal, and set it aside. See figure 6.16.2d
4. Remove the sheet metal cover above the distribution box.
5. Remove the four Phillips head screws that attach the distribution box cover and remove the cover. The distribution box is located on top of the ATC support bracket as shown in figure 6.16.3a
6. The following wiring connections can be found on electrical diagram 26734 sheet 3, at zone A-7.
7. Make the following disconnections
    a. Disconnect 24VDC-1 (brown wire) from terminal point TB1.4.
    b. Disconnect OV (blue wire) from terminal point TB2.4.
    c. Disconnect I33.4 (black wire) from terminal point TB7.2.
8. Attach a light cord of about five feet in length to the end of the sensor cable to aid in feeding the cable of the new sensor.
9. Gently pull the sensor cable through the cable carrier allowing the cord to follow.
10. Remove the cord and attach it to the new sensor cable.
11. Carefully fish the new cable through the cable carrier by pulling the cord through. If the cable sticks, remove the segment(s) at the area where the cable is stuck and shift the cables around until the cable moves freely once again. DO NOT force the cable at any time, pulling the cable with force can cause damage to the small wires that are inside the cable.
12. Make the following connections.

a. Connect I33.4 (black wire) to terminal point TB7.2.
b. Connect OV (blue wire) to terminal point TB2.4.
c. Connect 24VDC-1 (brown wire) to terminal point TB1.4.

13. Replace the distribution box cover, and attach with the four Phillips head screws.
14. Slide the Tool Detect Sensor *(17)* through the shroud seal and reassemble it to the sensor bracket, making sure that the orientation is that which is shown in figure 6.16.2d. The LED should be pointing downward and the sensor lens should protrude approximately one inch from the bracket sensor. Set the intensity to half way between min and max.
15. Perform service code F to verify that the tool detect sensor is functioning properly.
16. Install the tool changer slide guards.

6.16.5 Replacing the Tool Counting Sensor

1. Press the E-Stop button.
2. Remove the tool changer slide guards

a. Remove the five button head socket screws that secure the tool changer slide guard (25), left
b. Remove the four SHCS that secure the tool changer slide guard, upper (24), and remove.

3. Remove the two screws that secure the Tool Changer Counter sensor *(8)* to the sliding body (13), and set aside.
4. Remove the sheet metal cover above the distribution box.
5. Remove the four Phillips head screws that attach the distribution box cover and remove the cover. The distribution box is located on top of the ATC support bracket as shown in figure 6.16.3a.
6. The following wiring connections can be found on electrical diagram 26734 sheet 3, at zone A-7.
7. Make the following disconnections
    a. Disconnect 24VDC-1 (brown wire) from terminal point TB1.4.
    b. Disconnect OV (blue wire) from terminal point TB2.2.
    c. Disconnect I33.0 (black wire) from terminal point TB3.2.
8. Attach a light cord of about five feet in length to the end of the sensor cable to aid in feeding the cable of the new sensor.
9. Gently pull the sensor cable through the cable carrier allowing the cord to follow.
10. Remove the cord and attach it to the new sensor cable.
11. Carefully fish the new cable through the cable carrier by pulling the cord through. If the cable sticks, remove the segment(s) at the area where the cable is stuck and shift the cables around until the cable moves freely once again. DO NOT force the cable at any time, pulling the cable with force can cause damage to the small wires that are inside the cable.
12. Make the following connections.

a. Connect I33.0 (black wire) to terminal point TB3.2.
b. Connect OV (blue wire) to terminal point TB2.2.
c. Connect 24VDC-1 (brown wire) to terminal point TB1.4.

13. Replace the distribution box cover, and attach it with the four Phillips head screws.
14. Slide the Tool Changer Counter Sensor (8) through the support bracket and reassemble it to the sliding body. The LED should be pointing downward and the sensor lens should protrude approximately one inch from the sliding body.
15. Perform service code F to verify that the tool counting sensor is functioning properly and the LED light comes on when it should.
16. Install the tool changer slide guards.

6.16.6 Replacing the ATC motor

The following will describe how to replace the ATC indexing motor. The ATC motor (2) along with the ATC gearbox (3) are two separate units only the motor need be removed.

Throughout the following procedure, assembly drawing 26811 will be referenced by item number. For example, "Cable carrier (4)" references item 4 on the assembly drawing 26811 found in this found in this manual.

1. Press the E-Stop button.
2. Remove the tool changer slide guards
a. Remove the five button head socket screws that secure the tool changer slide guard (25), left
b. Remove the four SHCS that secure the tool changer slide guard, upper (24), and remove.
3. Remove the distribution box cover as shown in figure 6.16.3a.
4. Make a note of the wire connections, they should be as follows:
a. Disconnect U from terminal point 13
b. Disconnect V from terminal point 12
c. Disconnect W from terminal point 11
d. Disconnect G from terminal point 10
5. Attach a light cord of about five feet in length to the end of the power cable to aid in feeding the power cable of the new motor.
6. Gently pull the power cable through the cable carrier allowing the cord to follow.
7. Remove the four SHCS that secure the tool changer motor. Remove only the motor.
8. Align the motor shaft key with the keyway in the transmission. Orient the motor so that the rectifier is facing the left side of the machine as shown on ATC Assembly print 26811, item 2
9. Secure the motor with the four SHCS
10. Attach the cord to the power cable of the new motor, and carefully fish the power cord through the cable carrier.
11. At the distribution box, make the following connections:
    a. Connect U to terminal point 13
    b. Connect V to terminal point 12
    c. Connect W to terminal point 11
    d. Connect G to terminal point 10
12. Replace the distribution box cover.
13. Replace the ATC sheet metal covers.
14. Verify that the ATC is revolving in the proper direction, forward is clockwise when viewed from above.

6.16.7 Replacing a Tool Gripper

1. It is not necessary to remove any guards to replace a retaining finger.
2. Jog carousel until the Retaining finger that requires replacement is accessible through the cutout on the left hand side of the carousel shroud.
3. Press E-Stop button.
4. Remove the tool gripper.

a. Remove the two cap screws that secure the retaining finger to the magazine. Remove the locating pins if necessary.

5. Install the new tool gripper with the two locating pins.
6. Install the steel locating key.
7. Install the two SHCS that secure the gripper to the carousel, and tighten.

6.17 Coolant Pump Replacement

The LPM has 2 coolant pumps. One provides coolant to the cutting tools and one supplies coolant to the coolant wash system. Both pumps are replaced in the same fashion.

See drawing 26943.

1. Turn power off to the machine.
2. Remove the flexible coolant hoses associated with the pump you are placing. It is recommended that you close the coolant nozzle valves at the spindle before removing the hose associated with this. This will minimize the amount of coolant that leaks out of the hose.

3. Remove the fitting that threads into the pump.
4. Remove 4 screws that hold the pump down.
5. Undo the wiring from the old pump and rewire the new pump in the same fashion.
6. Turn the pump on and make sure it is going in the correct direction. If not, switch any 2 of the wires.

6.18 Pneumatic Part Replacements

The pneumatic system is made up of a number of different parts. The following explains how to replace them.

See drawing 26930.

Air solenoids and relays – the air solenoids and relays are to be replaced as a unit.

1. Turn the air off to the machine.
2. Unscrew item 1 to free items 2 and 3 from item 4 the solenoid valve. See figure 6.18a below.
3. Remove the cable from item 3 by removing the screw that holds the plastic clear cover to the relay.
4. Disconnect the 2 wires from the terminals in the relay.
5. Remove item 4 by removing 2 screws that hold it to the air manifold.
6. Disconnect any other fittings going into the solenoid.
7. Mount the new solenoid in the reverse order.

Air tubing – the air tubing is connected via quick disconnect fittings as well as compression fittings. For the quick disconnect fittings, press down on the fitting while pulling on the air hose to disconnect the hose. For the compression fittings, you will need to unscrew the compression nut to disconnect the hoses. You may need to replace these fittings when loosening these type of fittings.

Note - make sure to use Teflon tape or thread sealant when replacing all fittings and making new connections.

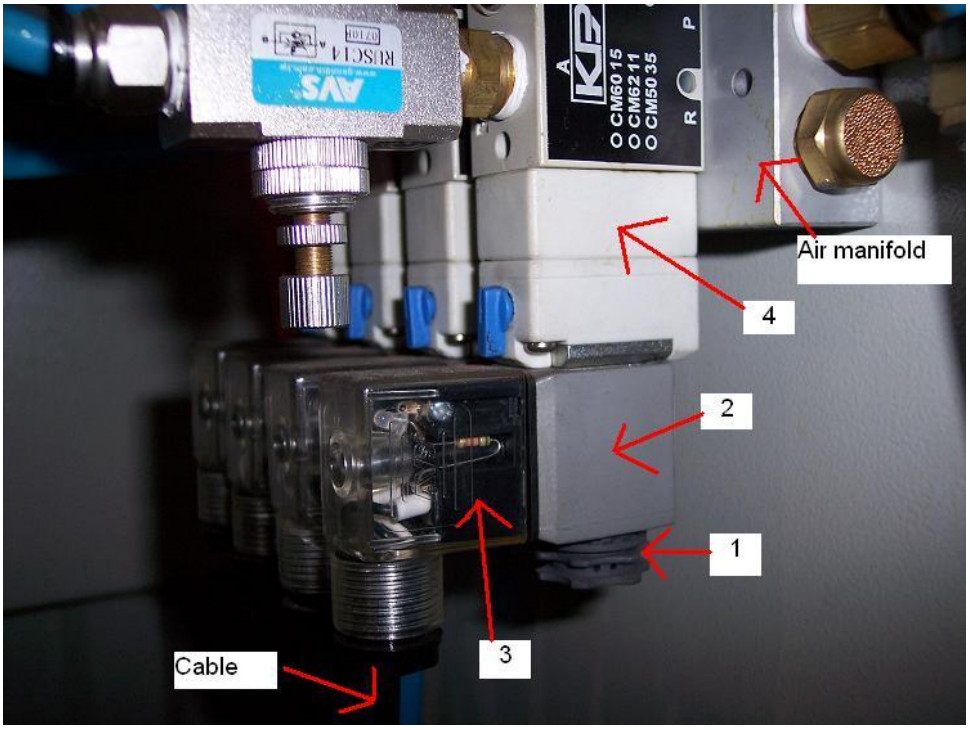


Figure 6.18a

6.19 Auger Motor Replacement

The auger motor is found within the coolant system sheet metal. It can be found in the right hand corner when standing in front of the machine.

See drawing 26943.

1. Turn power off to the machine.
2. Slide the coolant system out toward the front of the machine.
3. Remove the screws that hold the auger screw to the auger motor.
4. Disconnect the wires from the old motor.
5. Remove the motor by removing 4 screws holding it in place.
6. Wire up the new motor and following these procedures in reverse order.

6.20 Programming and Run Panel Replacement

See drawing 26584.

1. Turn the power off to the machine.
2. Pivot the pendant out to the operator.
3. Remove the rear sheet metal panel.
4. Unfasten any cables that plug into either panel.
5. To remove either panel, undo the 8 nuts that hold it in place.
6. Put the replacement panel back in its place and follow these procedures in reverse order.

6.21 Limit/Home Switch Replacement

The following service codes may need to be performed when major changes are made to the limit switches. Failure to do will cause the ball lock locations to be off for the X and Y axis and base tool and tool change heights will be off in the Z axis. The machine may crash if these items are not set correctly.

- **Service Code 505** – reset the motor index angle (machine may not home properly) and resets soft limits. Must be redone after any limit switch is adjusted.
- **Service Code 500** – reset the X and Y ball lock locations for A, B and C. May need to be performed after X or Y axis limit switch work
- **Service Code 501** – reset the tool change height. May need to be performed after Z axis limit switch work
- **Service Code 502** – reset the base tool height. May need to be performed after Z axis limit switch work.

See drawing 26827

1. Remove all necessary covers to gain access to the limit switch in question.
2. Unfasten the limit switch from the bracket that holds it in place.
3. Remove the cable from the limit switch and note the wiring as you will hook up the new limit switch in the same fashion.
4. Mount the new limit switch and snug the screws that hold it in place.
5. Make sure to line up the switch with the limit switch cams. The bracket can be adjusted up and down and in and out.
6. Perform service code 505 if you have replaced or adjusted any limit switch.
7. Perform service code 500 if you have replaced the limit switch on the X or Y axis.
8. Perform service codes 501 and 502 if you have replaced the limit switch on the Z axis.

7.0 Maintenance

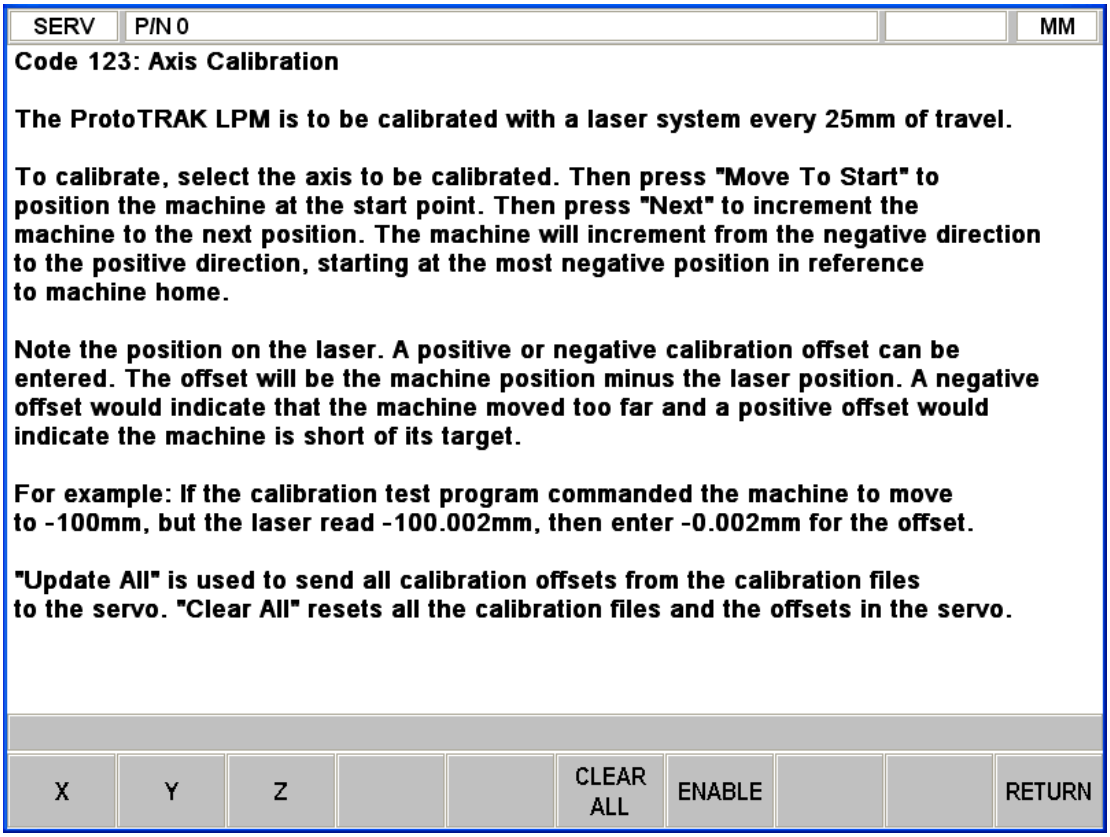
7.1 Laser Calibration

7.1.1 Accuracy

Your ProtoTRAK LPM is calibrated before it is shipped out to you using a highly accurate laser interferometer system. It is calibrated over 25mm increments along the length of each ballscrew, and saved onto a table within service code 123. There is also a backup of the calibration located within the USB flash drive that shipped with your machine, located in the main electrical cabinet. The ProtoTRAK software will most likely recognize this as drive D.

7.1.2 CODE 123: Calibration

From the main ProtoTRAK screen, go into PROG SETUP, SERV CODES, CODE #, then type in 123 and press ABS SET. This will bring up the calibration page.



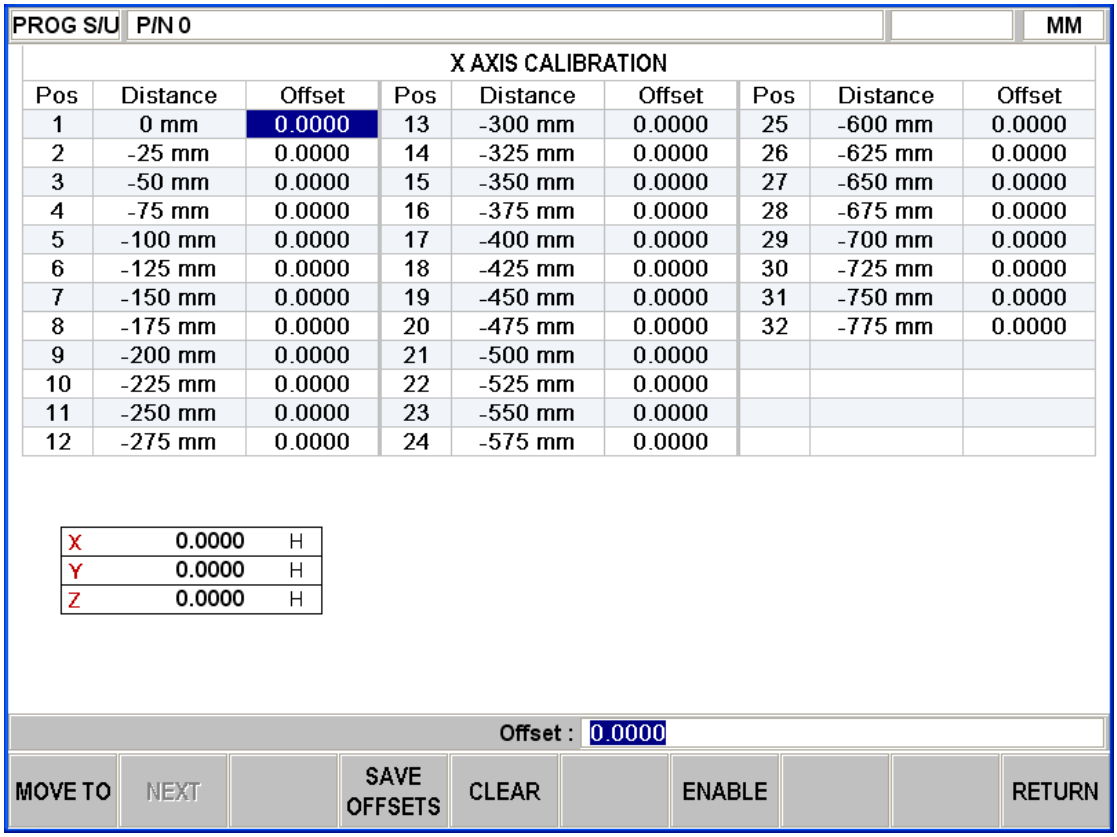
X, Y, or Z – will take you to the calibration offsets of the axis selected.

CLEAR ALL – this will erase all values within the calibration tables, for X, Y, and Z axis. This should only be used in the event that the system is being recalibrated by a qualified technician.

ENABLE / DISABLE – This will toggle whether or not the values currently stored in X, Y, and Z axis will be used. This can be used for troubleshooting purposes.

7.1.3 Calibration Table

Once an axis is selected, you will see the table where all the calibration offsets are stored.



PROG S/U | P/N 0 | | MM

X AXIS CALIBRATION

Pos	Distance	Offset	Pos	Distance	Offset	Pos	Distance	Offset
1	0 mm	0.0000	13	-300 mm	0.0000	25	-600 mm	0.0000
2	-25 mm	0.0000	14	-325 mm	0.0000	26	-625 mm	0.0000
3	-50 mm	0.0000	15	-350 mm	0.0000	27	-650 mm	0.0000
4	-75 mm	0.0000	16	-375 mm	0.0000	28	-675 mm	0.0000
5	-100 mm	0.0000	17	-400 mm	0.0000	29	-700 mm	0.0000
6	-125 mm	0.0000	18	-425 mm	0.0000	30	-725 mm	0.0000
7	-150 mm	0.0000	19	-450 mm	0.0000	31	-750 mm	0.0000
8	-175 mm	0.0000	20	-475 mm	0.0000	32	-775 mm	0.0000
9	-200 mm	0.0000	21	-500 mm	0.0000			
10	-225 mm	0.0000	22	-525 mm	0.0000			
11	-250 mm	0.0000	23	-550 mm	0.0000			
12	-275 mm	0.0000	24	-575 mm	0.0000			

X	0.0000	H
Y	0.0000	H
Z	0.0000	H

Offset : 0.0000

MOVE TO | NEXT | | SAVE OFFSETS | CLEAR | | ENABLE | | | RETURN

The first offset position will always be highlighted. Press the **MOVE TO** button, followed by the GO button to have the machine move to the home position of the axis you are calibrating. The other two axis will stay wherever they are. The first offset should always have a 0 value for its offset, since it's the starting point. Once the machine is at home, the **NEXT** button should become available. Press it, followed by the GO key, to have the machine move to the next position.

Assuming that you have a laser system or some means of measuring the amount of table movement, you can now compare the actual distanced traveled versus what is displayed on the mini-DRO. Enter the difference between the two into the offset field. Enter a positive value in order to increase the travel, or a negative value in order to decrease the travel. So for example, if after moving to the first position the mini-DRO read –25.000mm, but your laser system measured –25.002mm of actual movement, you would enter –0.002 as the offset value. Note that this calibration table will always display metric values.

Press the **NEXT** button again to move to the next position. Keep entering the offset values for each position as described above. Once you have finished calibrating the axis, press the **SAVE OFFSETS** button to save the table to the machine. From then on it will begin using the calibration offsets. If you press MODE or RETURN before pressing **SAVE OFFSETS**, the values will not be saved.

> **CLEAR** – this button will wipe out all the values from the current calibration table. Only recommended if you know you need to recalibrate the machine.

ENABLE / DISABLE – This button will toggle whether or not the machine is applying the calibration offsets for all three axis when moving. Disabling the calibration is the same as having all zeros for offset values. If offsets already exist and you want to recalibrate, you should disable them. But if you just calibrated and want to double check accuracy, you will want them enabled.

7.2 Backlash Compensation

Every mechanical system has at least a little backlash or lost motion. It is produced by the small amount of play between the mechanical components, and mostly by the accumulative bending or elasticity of all the parts of the drive train under load. The backlash constants are factory set, but may need to be adjusted periodically. These are set at the factory by running a ballbar test using a Reinshaw probe. If a ballbar is not available, then the following procedure will work.

1. Set a .0001-inch dial indicator in the spindle, and touch off on a block or the vise along the direction (X, Y or Z) you wish to check.
2. The backlash can also be found manually with a .0001" indicator with the following method.
3. Load the indicator to zero from one direction and zero out the DRO.
4. Move the indicator to .002" and then back to zero. Do not over shoot 0, otherwise start over.
5. Whatever number appears on the screen is the backlash value.
6. Enter this value into service code 128.
7. After entering this number, redo the process. The DRO and indicator should now both read 0.

Typical values for backlash should be .0005" or less. Most machines will exhibit only a tenth or 2. Larger values could mean the machine has a mechanical problem.

7.3 Limit Switch Adjustments

The following service codes may need to be performed when major adjustment are made to the limit switches. Failure to do will cause the ball lock locations to be off for the X and Y axis and base tool and tool change heights will be off in the Z axis. The machine may crash if these items are not set correctly.

- **Service Code 505** – reset the motor index angle (machine may not home properly) and resets soft limits. Must be redone after any limit switch is adjusted.
- **Service Code 500** – reset the X and Y ball lock locations for A, B and C. May need to be performed after X or Y axis limit switch work
- **Service Code 501** – reset the tool change height. May need to be performed after Z axis limit switch work
- **Service Code 502** – reset the base tool height. May need to be performed after Z axis limit switch work.

The limit switches that come on the LPM should not need to be adjusted unless a component that is part of the drive train is changed, such as an axis motor or ballscrew.

The limit switches on the machines serve 2 purposes: (1) are used to home the machine, (2) are used to prevent an over travel condition, which could damage the machine. When a machine hits a hard limit switch, the power to the spindle and axis motors are turned off. It should be

noted that prior to hitting a limit switch, the machine should stop at the soft limits that are set by the software.

The limit switches are set from the factory to be approximately ½" from the hard stop on the machine. From there the soft limits are set approximately 0.200" from each side. When setting this ½" distance at the factory, we turn power off to the machine and manually move the ballscrew until the given access hits the hard stop. We then turn the ballscrew in the opposite direction approximately 1 ½ turns (since the ballscrew has a 8 mm pitch, 12 mm = ~ ½") and then set the cam.

The limit switches on all 3 axis are adjusted in a similar fashion. The Y and Z axis are a little harder to adjust because they are hard to reach. Use the following procedure to adjust the limit switches.

As was stated earlier, the cams should never have to be adjusted unless a motor or ballscrew is replaced or if the motor is removed for any reason. Once the motor is removed, we need to make sure the motor index pulse on the motor encoder is approximately 180 degrees (+/- 45 degrees) from the limit switch cam, this will ensure the homing algorithm works very reliability. Service code 505 is used to check the angle of the motor encoder versus the limit switch cam. It is recommended to move the cam toward the hard stop of the machine when adjusting so you make sure to maximum the available travel to the user.

See drawing 26827.

1. Remove the covers that surround the limit switch and limit switch brackets.
2. Adjust the cams by loosening the 2 set screws that hold it in place. The setscrews push 2 steel balls up against the slot the cam resides in to hold it in place.
3. Move the cam and tighten the setscrews back down. The cam should never have to be moved more than 0.150".
4. Perform service code 505 to reset the motor index pulse.
5. Double check service code 500 if you have made major adjustments to the cam on the X or Y axis.
6. Double check service codes 501 and 502 if you have made major adjustments to the cam on the Z axis.

7.4 Periodic Maintenance

The following table lists the periodic maintenance that must be done on a daily, weekly, month(s) and yearly basis.

See section 3.11 for more information on lubrication related checks.

Maintenance Time Period	Items
Daily	1. Drain the water from the air regulator assembly by either turning off the air to the machine or depressing the valve at the bottom of the water collector tank. 2. Check to make sure there are no obvious oil leaks to the lubrication system. 3. Check coolant level.
Weekly	1. Check the level of the lubrication pump. 2. Check the oil level in the oiler that supplies oil to the pneumatic components.
Month(s)	1. Check the oil level of the Tool Change Air Cylinder Oil Cup, which is found under the sheet metal that surrounds the head. You can view this oil cup when the sheet metal is on by looking down from above.

	2. Every few months we recommend you remove the coolant tank and clean all debris and replace the coolant. 3. Remove the air filters in the electrical cabinet every few months and clean. 4. Check the level and tram of the machine every 6 months and adjust as necessary. 5. Check the spindle motor belt tension every 6 months.
Yearly	1. Check backlash on each axis and adjust as necessary. See section 7.2. 2. Remove all covers and clean chips and debris that may have built up. 3. Inspect the ATC by removing the covers 4. Inspect the tool change air cylinder 5. Apply grease to the grease fittings on the ATC unit.

8.0 4th Axis Option

In the first quarter of 2013, we began manufacturing our own 4th axis unit (it is called the SWI 8" model throughout this manual). Figure 8.0 illustrates what this new design entails. A few key items are as follows:

1. This unit no longer requires air
2. The unit is more compact and now allows 4 ball lock clamping shanks to be used to fasten it down
3. This design runs quieter
4. The drive unit is sealed and lubricated for 20000 hours of operation so no maintenance is required.

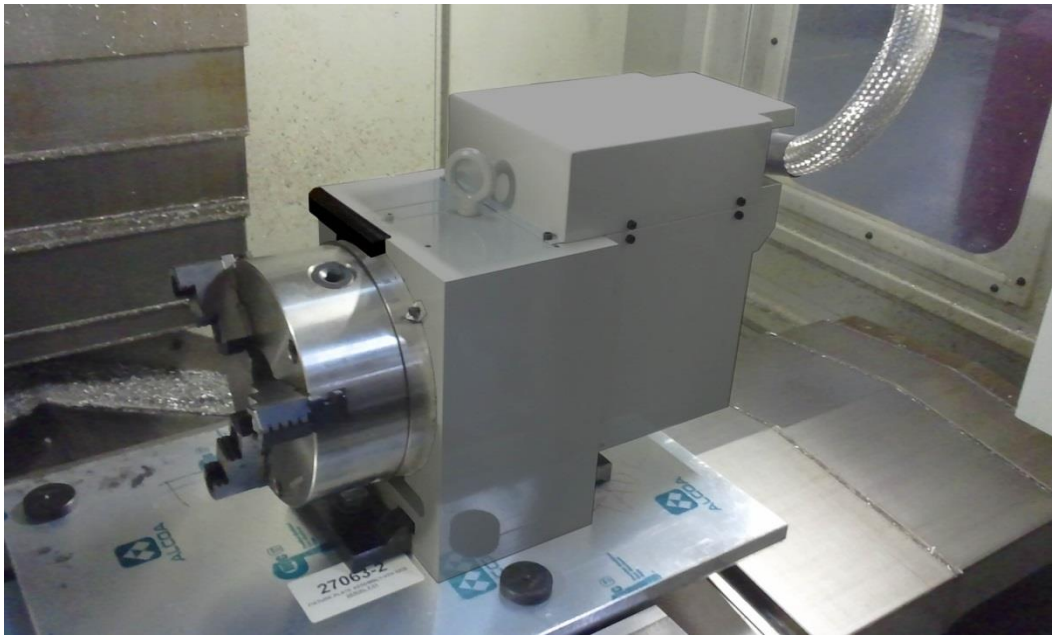


Figure 8.0

8.1 4th Axis Specifications

The following are the specifications for the 4th axis unit.

	201RB Model	**200RB Model**	**SWI 8" Model**
Spindle Diameter	7.874" or 200 mm	7.874" or 200 mm	8.07" or 205 mm
Chuck Diameter	7.874" or 200 mm	7.874" or 200 mm	7.874" or 200 mm
Overall Height of 4th Axis	11.811" or 300 mm	12.79" or 325 mm	13.86" or 352 mm
Centerline Height of Spindle	5.315" or 135 mm	6.3" or 160 mm	6.3" or 160 mm
Minimum Resolution of System	0.001º	0.001º	0.001º
Maximum RPM	22	22	22
Repeatability	+/- 2 arc seconds	uni 4 arc seconds, bi 8 arc seconds	+/- 2 arc seconds
Indexing Accuracy	20 arc seconds	25 arc seconds	25 arc seconds
4th Axis Weight	185 lbs or 84 Kg	220 lbs or 100 Kg	185 lbs or 84 Kg
4th Axis Keyway Size	18 mm	18 mm	18 mm
Max distance between 4th axis with chuck (without chuck) & tailstock with center	22.5" (26.25")	22.5" (26.25")	21.7" (24.7")

8.2 Mounting of the 4th Axis

The following photos show how the 4th axis unit and tailstock mount to the LPM machine via ball locks A and C respectively. The 4th axis ball lock plate does require 1 clamp to hold the lower right hand corner down to the table. The 4th axis unit has an eyebolt attached to the top of the unit for lifting purposes. As you can also see, the tailstock ball lock plate has a keyway and a set of tapped holes that runs along the length of the plate so you can adjust where you place the tailstock.

The 4th axis unit requires 1 cable and 1 air line to be removed and hooked up each time you add or remove the unit from the machine. See figure 8.2d. The air line controls the clamping and unclamping of the turret and the cable is the electrical hookup to the servomotor and solenoid. Make sure the cable and air line are securely fastened and locked in place.

Note – The SWI 8" 4th axis fastens down with 4 ball lock clamps and hence the separate clamp is not required. The new 4th axis also will not require the separate air line cable found in figure 8.2d.

Figure 8.2a

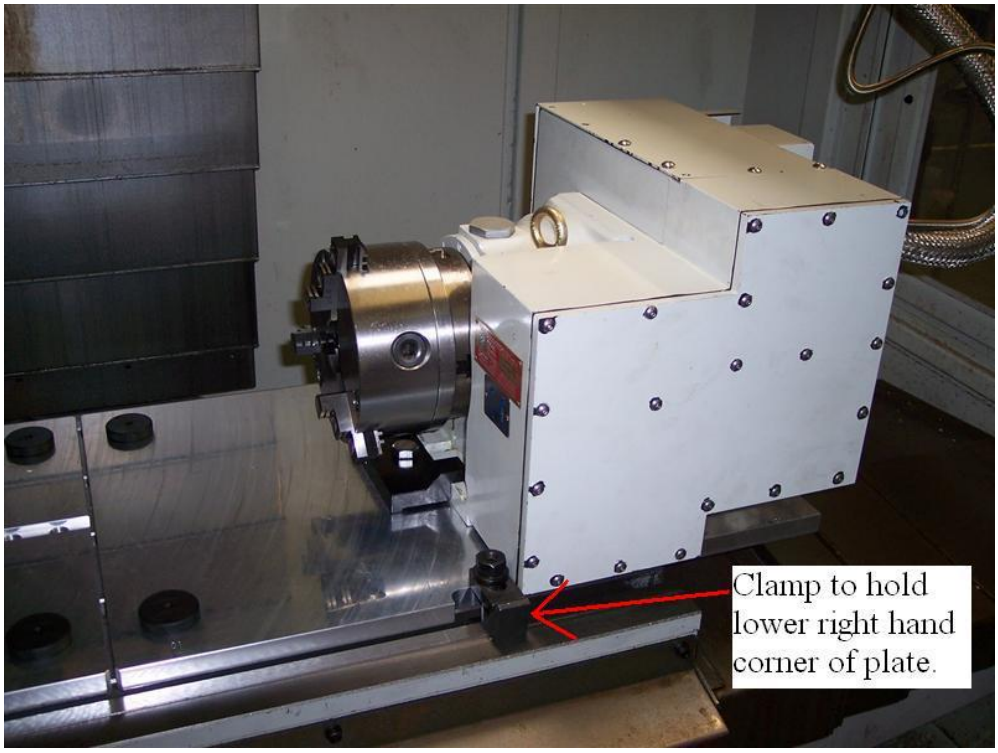


Figure 8.2b

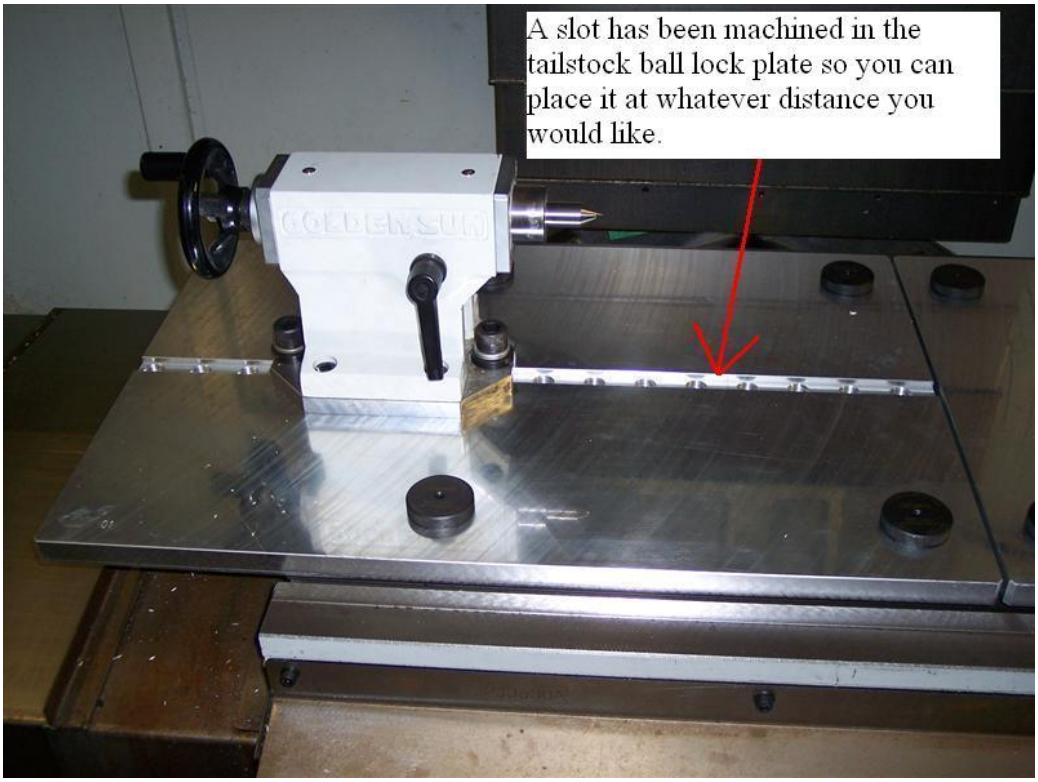


Figure 8.2c

Figure 8.2d

8.3 Installation Checklist of the 4th Axis

Installer – Use this checklist to assure a complete install and setup of the 4th axis on the LPM. Some of the steps assume the installation was not completed at the factory.

Reference drawing 27066-4 or -6 at the rear of the manual for an illustration of how to install the unit.

☐	1. Press the E-stop on the machine.
☐	2. Remove knock outs in sheet metal or make holes in sheet metal tunnel that carries cables from the control box to the electrical cabinet and install bracket and internal cables. See figure 8.2d for the location.
☐	3. Turn off power to the machine when doing the electrical wiring in the electrical cabinet.
☐	4. Install the 4th Axis servo amp to the servo amp module. Remove 1 set of red and black wires from the Z axis amp and wire to the 4th axis amp.
☐	5. Route all electrical wires as shown on drawing 27066-4 or -6 as shown in details A, B and C.
☐	6. Route new air line that supplies air to the 4th axis unit. The air line is connected to the air manifold at the rear of the machine. (not applicable for new SWI 8" model)
☐	7. Mount the 2 ball lock fixture plates to the table of the LPM. We have found it easier to turn the 4th axis on its side and then attach the ball lock plate into the keys on the bottom of the 4th axis. Then fasten the plate to the 4th axis with (2) M14 bolts and clamps. From here, use a lift that attaches to the eye bolt of the 4th axis unit and place the assembly down on the table. Bolt the tailstock down as shown in the drawing. Make sure to use the correct hardware when fastening down the 4th axis and tailstock to the ball lock plates. See drawing 27066.
☐	8. Hook up the power and air cables that come with the 4th axis to the top of the LPM.

☐	9. If required, download new software into the LPM to turn on the 4th axis software. Go to service code 509 to select which type of 4th axis you are installing.
☐	10. Make sure the machines option key has been programmed for this option by checking it with service code 318.
☐	11. Turn the 4th axis option on by going to MACHINE SETUP and pressing the 4th axis on softkey.
☐	12. Home the machine and verify the 4th axis homes correctly. The spindle should end up at 0º on the vernier dial on the unit. If it does not, you can adjust it by moving the adjustable dial or going to service code 506 and adding an A offset.
☐	13. Go to DRO and turn on the EHW and the 4th axis jog button. Make sure the 4th axis unit moves when turning the EHW. Turn the EHW in the positive direction should move the turret CW when viewed from the front of the unit looking toward the spindle.
☐	14. Verify the adaptor plate and chuck have less than .0003" or 0.008 mm of runout. Adjust as necessary. See section 8.8.3.
☐	15. Perform or check that service code 506 has been set correctly.
☐	16. Perform or check that the backlash is set correctly in service code 128. The value is to be entered in decimal degrees.
☐	17. Set the A axis to 0º and set an indicator to 0 off of 1 of the chuck jaws, then move the 4th axis 1 complete revolution and make sure you get 360º, the DRO will read 0º. Use an indicator to make sure turret is in the correct position. Mount your indicator to the spindle and move X axis away and then start rotating the turret. Once you move 1 revolution, move the indicator back and note the reading. Your indicator should show no more than 0.0005" error.
☐	18. Run test program called 4th Axis Test. Set ball lock location to 4th. Run program with the spindle empty.
☐	19. Verify the tailstock barrel moves in and out freely and the barrel lock works.

8.4 Air Connection (not applicable to new SWI 8" 4th Axis)

The 4th axis unit requires air to clamp and unclamp the turret when it is holding position. The air supply comes from the rear of the machine as shown on drawing 27066-4.

The 4th axis unit requires 90 psi or 6.3 kg/cm² of air to work properly, which happens to be the same pressure that we set the air regulator to.

8.5 Lubrication (not applicable to new SWI 8" 4th Axis)

The 4th axis unit has 2 different places where oil is added. Oil is used to lubricate the worm shaft as well as the gearbox. Please see the figure 8.5a below for these locations as well as where to fill and drain the oil.

The oil should be replaced every 6 months under normal operation. If the unit is used continuously over several shifts per day, then we recommend changing the oil every 3 months.

The oil should be a 30-weight oil or ISO grade oil of around 100.

Lastly, there are 2 lubrication inlets on the tailstock that should be greased every few months as shown below.

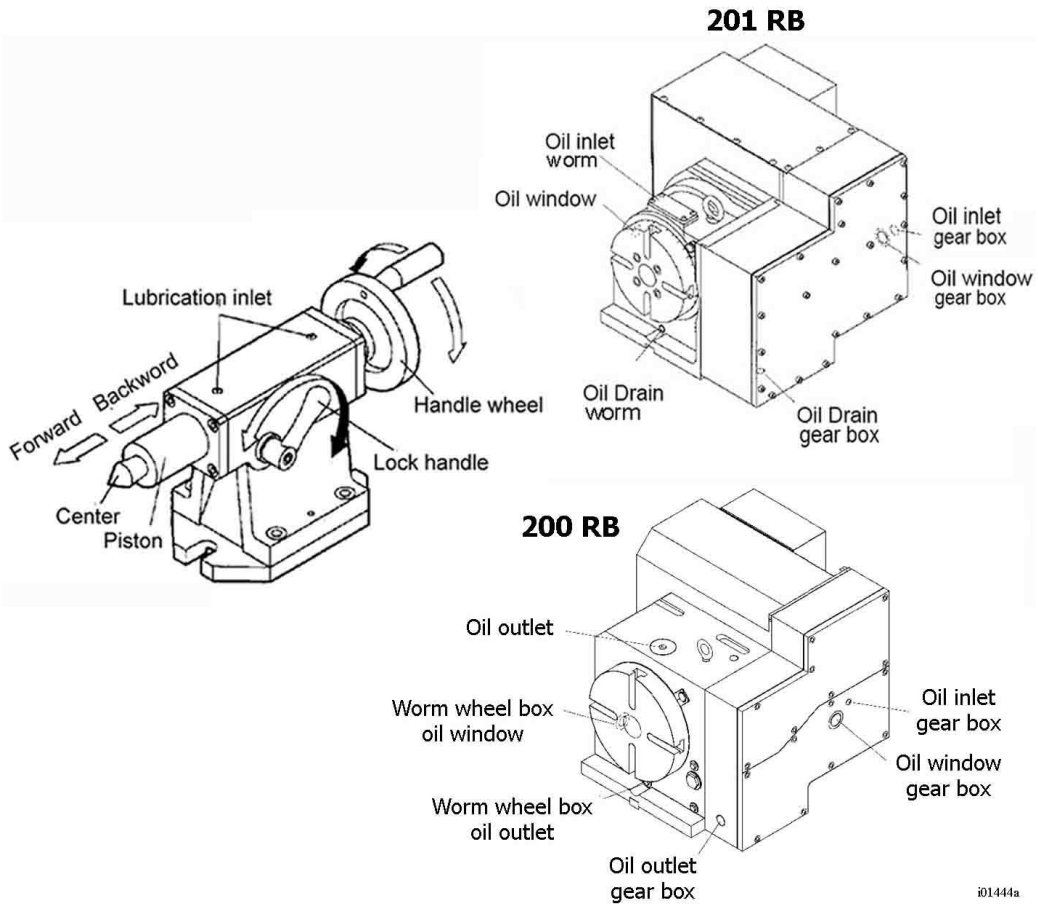


Figure 8.5a

8.6 4th Axis Specific Service Codes

The following service codes are specific to the 4th axis option.

8.6.1 CODE 128: Input Backlash Constant

The following service code enters a backlash compensation value for each axis on the LPM. The A axis backlash is to be entered in a decimal angle.

The following is a procedure to check your backlash.

1. Mount an indicator on the 4th axis unit as shown in figure 8.6.1a
2. Go to DRO mode and load your indicator a few thousandths or 50 microns from one direction and set zero on your indicator and on your DRO. It is best to use the .0001" or 0.002 mm button when using the EHW for this.
3. Rotate the 4th axis in the same direction until you see a few thousandths or 50 microns of movement on the indicator
4. Reverse the axis and go back to zero on the indicator. The amount of error you see on your DRO screen is your backlash.
5. Enter this into service code 128.
6. Now redo this procedure and make sure the DRO and indicator both come back to zero. Adjust as necessary.

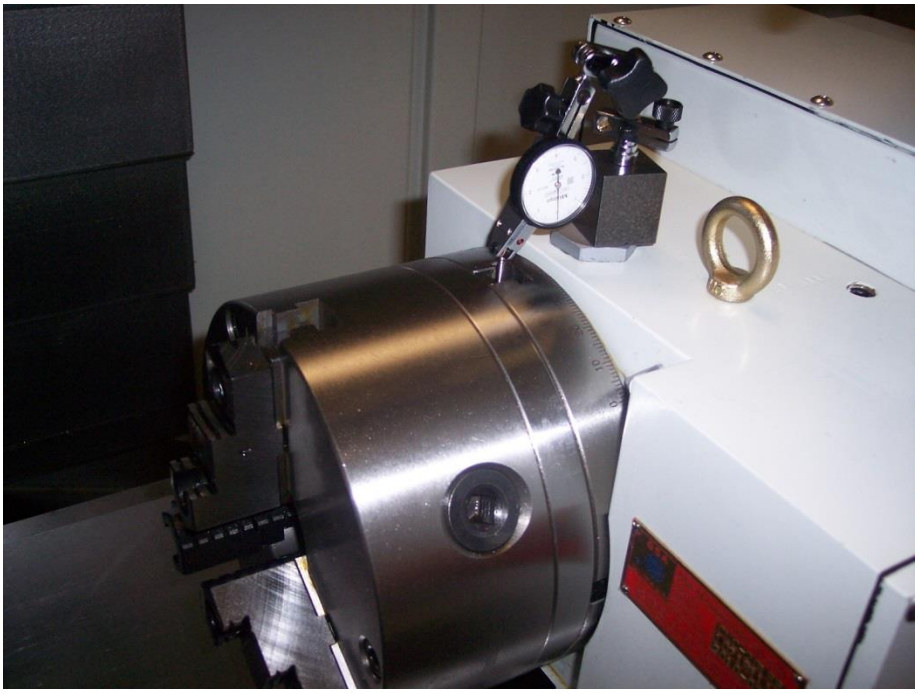


Figure 8.6.1a

8.6.2 CODE 506: Set 4th Axis Offsets

The following service code sets the X, Y, Z and A offsets for the 4th axis unit. The follow describes what each offset is.

1. X Offset - the distance along the X-axis from the face of the 4th axis to the center of ball lock C.
2. Y Offset - the distance along the Y-axis from the centerline of the 4th axis to the center of ball lock C. The Y offset should be set to 6.0000" based on how the 4th axis is keyed to the ball lock plate.
3. Z Offset – the distance along the Z-axis from the top of the table to the centerline of the 4th axis.
4. Home Offset – the offset in degrees you need to enter to get the 4th axis vernier dial to line up with the marker on the 4th axis casting.

For the Z offset, there are a couple ways we recommend measuring this offset.

Gage Pin Method

1. Mount a ground gage pin in the chuck of the 4th axis.
2. Make sure the pin is running true before measuring the height. Adjust the pin in the jaws as necessary to minimize runout. You may also want to make sure the chuck is running true before clamping down on the pin.
3. Take a dial indicator and set the indicator and DRO of the control to zero when touching the top of the table.
4. Now take the indicator and move the Z axis up and zero the indicator out on top of the pin. Find the highest point of the pin.
5. Take this DRO Z value and subtract ½ of the diameter of your ground pin. This is your Z offset.

Cutting a Part Method

1. Mount a round part in the 4th axis.
2. Cut a flat at 0° on the part.
3. Rotate the part 180° and cut another flat on the part. Make sure to cut the flat at the same Z depth for both cuts.
4. Take a micrometer and measure the distance between the flats and note this value.
5. Take a dial indicator and set the indicator and DRO of the control to zero when touching the top of the table.
6. Now take the indicator and move the Z axis up and zero the indicator out on top of the flat on your part.
7. Take this DRO Z value and subtract ½ of the number you came up with in step 4. This is your Z offset.

This service code is automatically backed up when you save your configuration file in service code 142.

8.7 Troubleshooting by Symptom

The following table lists a number of symptoms you may come across with the 4th axis unit

Symptoms	Diagnostics or Possible Causes
4th axis will not home or homes incorrectly	1. Make sure the 4th axis option is turned on. Go to Machine Setup Mode. 2. Verify the 4th axis can jog in DRO mode 3. Verify the home switch inside of the 4th axis is being noticed by our control. When the switch is engaged (triggered when homing), the B7 LED on IM1 should be illuminated. (applies to non SWI 8" 4th axis models) 4. Verify the home switch inside of the 4th axis is being noticed by our control. When the sensor is triggered when homing, the B7 LED on IM1 will NOT be illuminated. The LED for the home switch is on all the time when the 4th axis is running except when the home sensor is trigger, which may be something like 5°. (applies to SWI 8" 4th axis models only)
Turret will not move when attempting to jog	1. Make sure the 4th axis option is turned on. Go to Machine Setup Mode. 2. If a fault appears, double check all motor connections in the electrical cabinet. Check LED status on servo amp. 3. Make sure the 4th axis is not in a clamped state causing the turret to not move. Check the status of LED light K4 on RM2. This should be on when the unit is in an unclamped state. (not applicable to new SWI 8" 4th Axis) 4. Make sure the unclamp LED is turned on. Check IM1 B10 LED, wire I34.1. (not applicable to new SWI 8" 4th Axis)

Symptoms	Diagnostics or Possible Causes
4th axis is not coming back to zero	1. Go to service code 509 and make sure you have selected the correct 4th axis model. 2. Make sure the 4th axis homed properly. Go to service code 506 to home the 4th axis individually. 3. Make sure the backlash compensation is set correctly in service code 128 4. Motor encoder may not be reading correctly 5. Check to see if the motor pulley is coming back to a zero position. You will have to drain the oil to do this. (not applicable to new SWI 8" 4th Axis)
Cutter is chattering when cutting	1. Make sure the 4th axis is locking in place when you do a X, Y or Z cut when the A axis is stationary. It defaults to clamping unless you use an aux function to change this. (not applicable to new SWI 8" 4th Axis) 2. Make sure you setup is tight. Ball locks, clamp on 4th axis plate, chuck and adaptor plate, etc. 3. Make sure the unit does not have excessive backlash.
Part are not accurate	1. Possible programming error. Check your program. 2. Make sure the 4th axis homed properly. Go to service code 506 to home the 4th axis individually. 3. Make sure you have set your part zero's correctly. 4. Double check if service code 506 is set correctly. If these offsets are wrong, your part will come out wrong. 5. Check to make sure your backlash compensation is set correctly.

8.8 Replacement Procedures

8.8.1 Servomotor replacement (non SWI 8" Models)

The following service codes are to be performed when a motor is replaced.

- **Service Code 505** – check the motor index angle, it should be 180° +/- 45°
- **Service Code 506** – reset A offset

f. Press the E-stop button on the machine
g. Drain the oil from the 4th axis gearbox
h. Remove the side cover on the 4th axis
i. Loosen the 4 screws that hold the servomotor in place.
j. Remove motor from 4th axis and transfer the pulley to the replacement motor. Make sure to mount in the correct location. See drawing 27065-2 for an illustration.
k. Fasten motor back in place.
l. Hook up the motor power and encoder cables.
m. You may need to adjust the backlash between the gears. See page 2 on drawing 27065-2 for more information and the figure below.

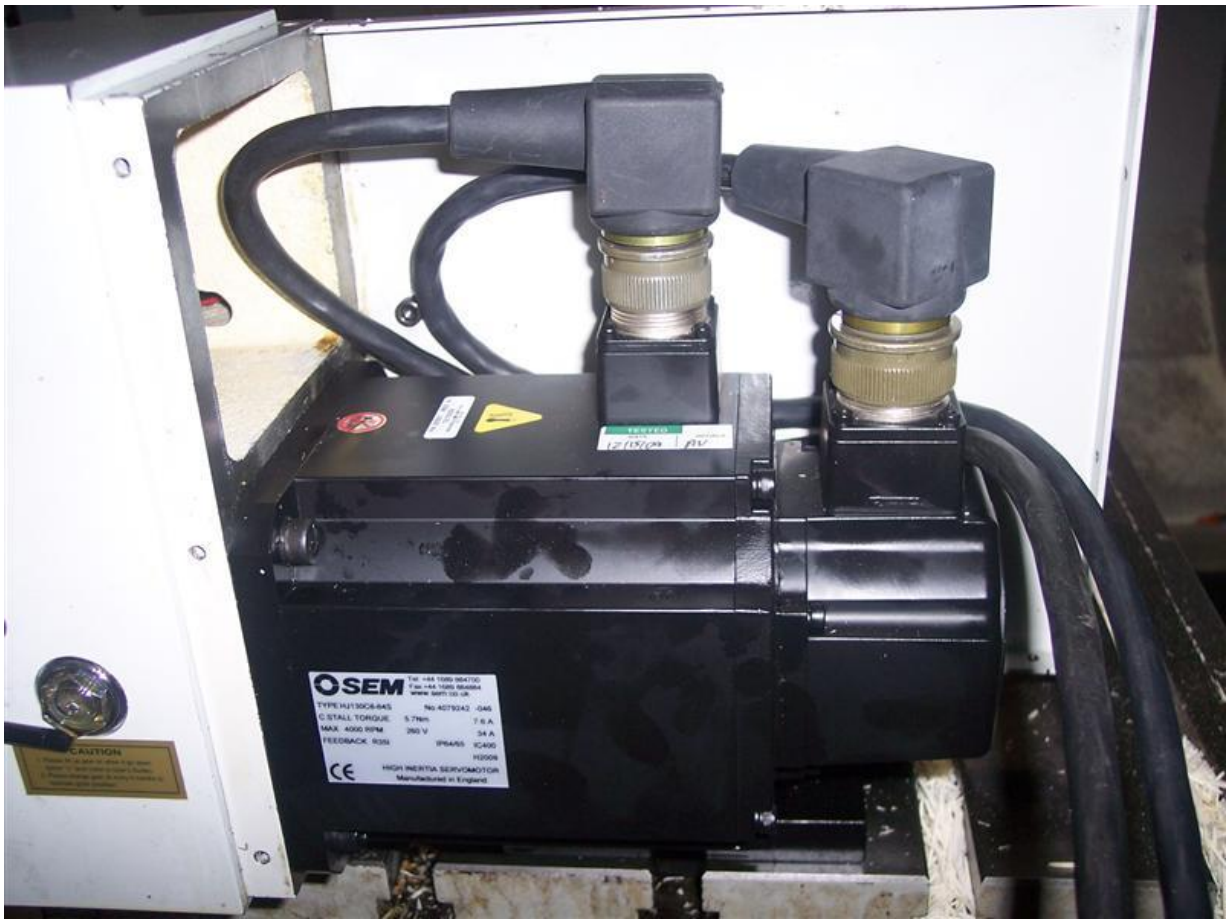


Figure 8.8.1a

8.8.1.1 Servomotor replacement (SWI 8" Models)

See drawing 28060 at the rear of the manual.

The following service codes are to be performed when a motor is replaced.

- **Service Code 505** – check the motor index angle, it should be 180° +/- 45°
- **Service Code 506** – reset A offset

Tools required:
1. Preferably a socket ratchet handle with an 8" extension, 5/32" allen socket and a 6 mm allen socket, or a 5/32" and 6 mm T-handle allen wrench with an 8" reach.
2. Torque wrench

1. Press the e stop button.
2. Disconnect the Cable Harness Assembly plug from the machine.
3. The chuck and adaptor plate do not need to be removed when replacing the motor, but it may be easier if you remove them.
4. Remove the motor shaft key retaining screw (item 45), retaining washer (item 47), and an O-ring seal (item 30), refer to 28060 assembly drawing. Use a socket wrench with a 8" extension and 5/32" allen socket, or a 5/32 T-handle wrench.
5. Remove (4) screws mounting the Cable Harness assembly sheet metal bracket (item 14) and the Cable Clamp (item 16).
6. Remove all Upper and the Lower sheet metal cover mtg. screws (items 10 and 11).
7. Disconnect the motor cables from the motor

8. Remove (4) motor mounting screws (item 38), use the socket wrench with 8" extension and 6 mm allen wrench.
9. Remove the old motor and install a new one (caution, motor shaft key might have a snug fit and require a slight help using an 10" long brass or aluminum drift pin/rod and a hammer to drive out) Torque the motor mtg screws to 25 ft-lbs.
10. Connect the motor cables
11. Install the Upper and Lower sheet metal covers
12. Install the Cable Harness sheet metal bracket on the back of the covers
13. Install the Cable Clamp
14. Install the motor shaft key retaining screw, washer, and seal
15. Connect the Cable Harness assembly to the machine.
16. Test the 4th axis to make sure it operates properly.

8.8.2 Solenoid & Air Pressure Sensor replacement (not applicable to new SWI 8" 4th Axis)
The solenoid and air pressure sensor replacement is found under the cover where the servomotor is located.

1. Press the e-stop button.
2. Remove the cover where the servomotor is found.
3. Disconnect the corresponding air and electrical lines for the component you are replacing. See drawing 27065-2 for where these components are located. See drawing 26775-SCH for a schematic of how these are wired into the electrical box.

8.8.3 Chuck and Adaptor Plate Removal and Replacement
The chuck that comes with the 4th axis unit fastens to an adaptor plate, which in turn fastens to the spindle face of the unit. The chuck is held on to the adaptor plate with 3 screws and the adaptor plate is held on to the spindle face with 4 screws and t nuts. For the SWI 8" model, the adaptor plate is held to the spindle face with 6 bolts. See figure 8.8.3a.

Figure 8.8.3a

1. Remove the 3 screws that hold the chuck to the adaptor plate.
2. Remove the 4 or 6 screws that hold the adaptor plate to the spindle face. If need be, remove the t nuts from the spindle face slots. T nuts are not applicable to the SWI 8" 4th axis unit.
3. Re-install the adaptor plate and snug up the 4 or 6 screws that hold it to the spindle face.
4. Now use an indicator to check the runout between the adaptor and 4th axis unit. Tap the adaptor plate until the runout is less than .0003" or 0.008 mm. Try to get it as close as you can to zero.
5. Tighten the screws holding the adaptor plate.
6. Install the chuck with 3 screws.
7. Now use an indicator to check the runout between the chuck and 4th axis unit. Tap the chuck until the runout is less than .0003" or 0.008 mm. Try to get it as close as you can to zero.
8. Tighten the 3 screws holding the chuck.

TRAK Machine Tools
Southwestern Industries, Inc

TRAK Warranty Policy

Warranty

TRAK products are warranted to the original purchaser to be free from defects in workmanship and materials for the following periods:

Product	**Warranty Period**	
	Materials	**Factory Labor**
New TRAK/ProtoTRAK	1 Year	1 Year
Any EXCHANGE Unit	90 Days	90 Days

The warranty period starts on the date of the invoice to the original purchaser from Southwestern Industries, Inc. (SWI) or their authorized distributor.

If a product, subsystem or component proves to be defective in workmanship and fails within the warranty period, it will be repaired or exchanged at our option for a properly functioning unit in similar or better condition. Such repairs or exchanges will be made FOB Factory/Los Angeles or the location of our nearest factory representative or authorized distributor.

Warranty Disclaimers

- This warranty is expressly in lieu of any other warranties, express or implied, including any implied warranty of merchantability or fitness for a particular purpose, and of any other obligations or liability on the part of SWI (or any producing entity, if different).
- Warranty repairs/exchanges do not cover incidental costs such as installation, labor, freight, etc.
- SWI is not responsible for consequential damages from use or misuse of any of its products.
- TRAK products are precision mechanical/electromechanical/electronic systems and must be given the reasonable care that these types of products require. Evidence that the product does not receive adequate Preventative Maintenance may invalidate the warranty. Excessive chips built up around ballscrews and way surfaces is an example of this evidence.
- Accidental damage, beyond the control of SWI, is not covered by the warranty. Thus, the warranty does not apply if a product has been abused, dropped, hit or disassembled.
- Improper installation by or at the direction of the customer in such a way that the product consequently fails, is considered to be beyond the control of the manufacturer and outside the scope of the warranty.
- Warranty does not cover wear items that are consumed under normal use of the product. These items include, but are not limited to: windows, bellows, wipers, filters, drawbars and belts.

Rev: 02/06/2020

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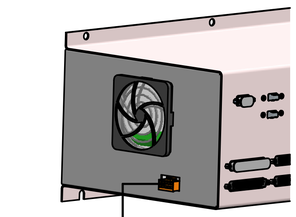
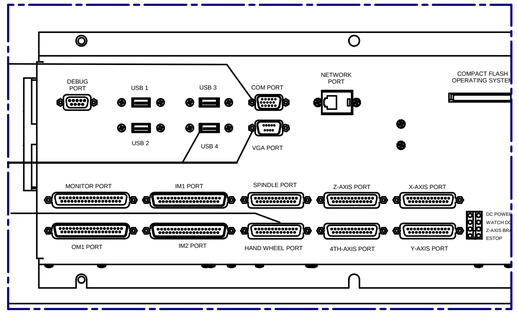
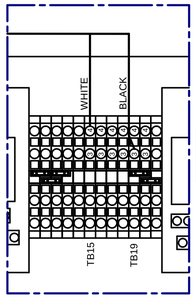
REVISIONS					
REV	DESCRIPTION	ECN	DATE	DFT	ENG
F	SHT 4D5: STATUS LIGHT (26768) WAS: ALARM LIGHT (26685-1); ADDED: BULB (26768)	14522	5.11.16	CC	AW
G	ADDED 26538 REV B DETAIL C CONFIGURATION.	14986	03/12/19	Sal	RO



OVERLAY POWER CABLE

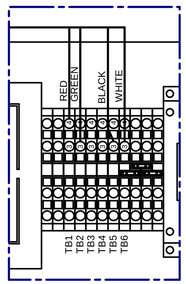


DETAIL D



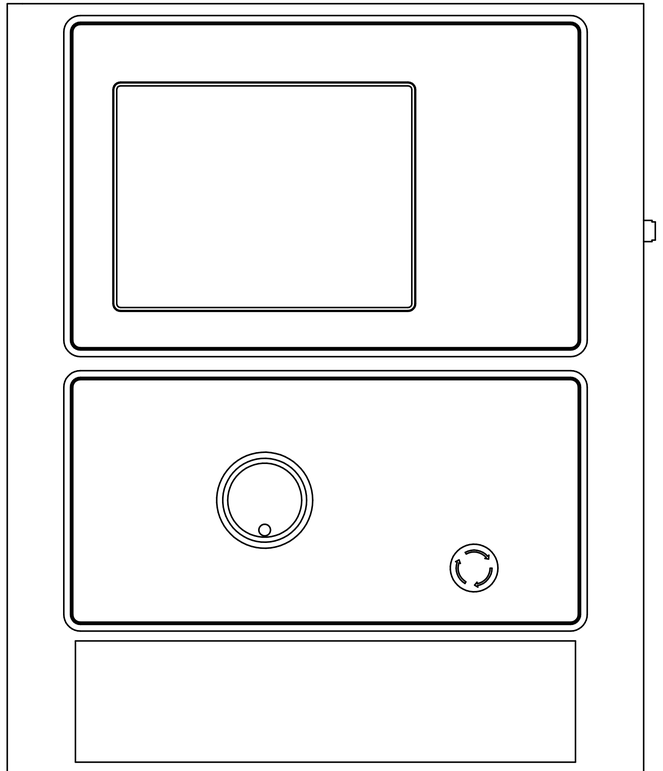
DETAIL E

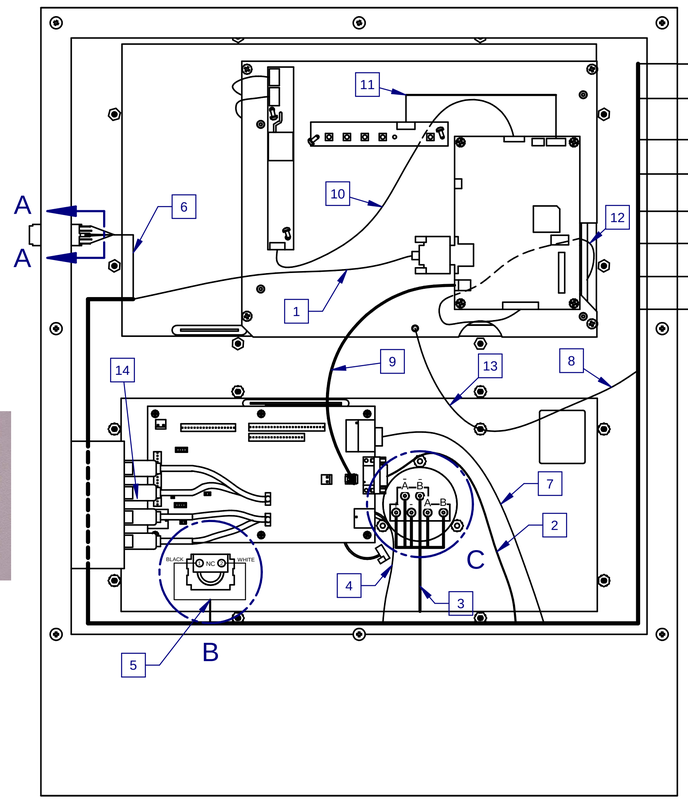
CABLE LABEL	SWI P/N	WIRE FROM	LABEL	COLOR
E-STOP CABLE	26508-1	TB15-4	24DC-8	WHITE
		TB19-3	24DC-1	BLACK



DETAIL F

CABLE LABEL	SWI P/N	WIRE FROM	LABEL	COLOR
SERVO ON BUTTON CABLE	26591	TB1-4	24DC-9	RED
		TB2-3	24DC-10	GREEN
		TB5-3	24DC-16	BLACK
		TB6-3	0V	WHITE





1- VGA CABLE(26511-240)
2- COM PORT CABLE (25700-180)
3- HANDWHEEL CABLE (26515)
4- USB CABLE (26510-5.0)
5- E-STOP CABLE (26508-1)
6- SERVO-ON ASSY (26591)
7- OVERLAY POWER CABLE (26513)
8- GROUND WIRE

9 - LCD POWER CABLE (26516)

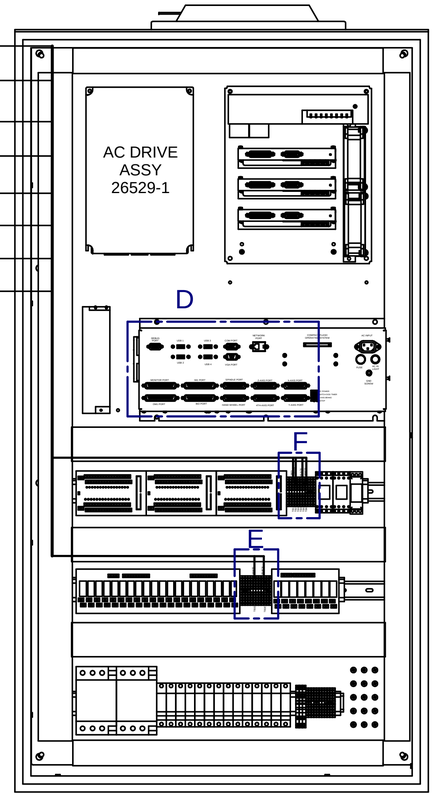
10 - LCD INVERTER POWER CABLE (26580-6)

11 - LCD USER INTERFACE CABLE (26580-5)

12 - LCD CABLE (26580-4)

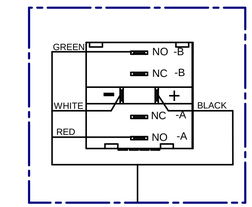
13 - GROUND WIRE

14 - USB CABLE (24047-6) **2X**



PICTURE 1

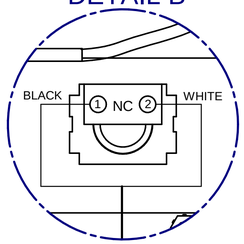
1



SECTION A-A

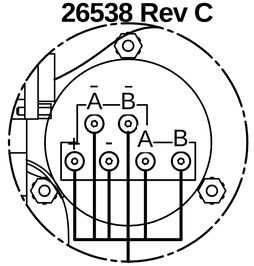
SERVO "ON" BUTTON		
SWITCH PINS	COLOR	FUNCTION /LABEL
NO-A	RED	24DC-9
NO-B	GREEN	24DC-10
-	WHITE	OV
+	BLACK	24DC-16

DETAIL B



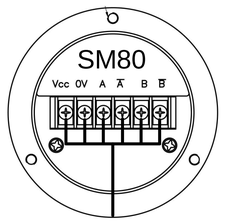
CABLE	SWI P/N	WIRE FROM	LABEL	COLOR
E-STOP CABLE	26508-1	2	24DC-8	WHITE
		1	24DC-1	BLACK

Detail C
26538 Rev C



26538 Rev B & C	
Handwheel Terminals	**Color**
Vcc (+)	RED
OV (-)	BLACK
A	BLUE
-A	BLUE/BLACK
B	YELLOW

Detail C
26538 Rev B



7

OVERLAY POWER CABLE			
P1	COLOR	P2	FUNCTION
1	BLACK	1	VCC IN
2	WHITE	2	GND
3	RED	3	12 VDC
4	GREEN	4	GND
5	BROWN	5	KEY-COM
6	BLUE	6	SPD-FWD
7	ORANGE	7	SPD-REV
8	YELLOW	8	SPD-OFF
9	VIOLET	9	GO KEY
10	GRAY	10	STOP KEY
11	PINK	11	OUT_RGG
12	TAN	12	GND
12	DRAIN	12	SHIELD

NOTE: UNLESS OTHERWISE SPECIFIED.

1 MOUNT ALL THE USB CONNECTORS IN THE SAME DIRECTIONS AS SHOWN ON PICTURE 1 (1B6).

2. LAST DETAIL USED 'V'.

(SEE ADDITIONAL NOTES ON SHEETS 2, 3, & 5.)

APPROVALS		DATE
DRAWN BY	RC	10/30/08
ENGINEER	RO	7/16/09
CHECKER		
FE		
THIRD ANGLE PROJECTION		

TRAK MACHINE TOOLS
SOUTHWESTERN INDUSTRIES, INC.

TITLE: DIAGRAM-SYSTEM-LPM

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26734	G

SCALE: - SHEET 1 OF 5

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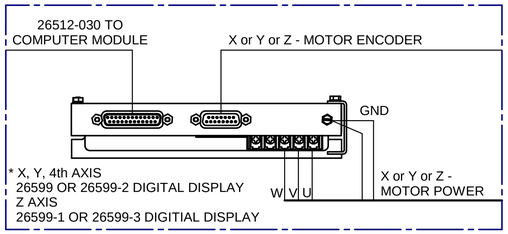
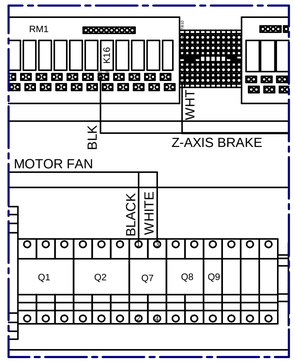
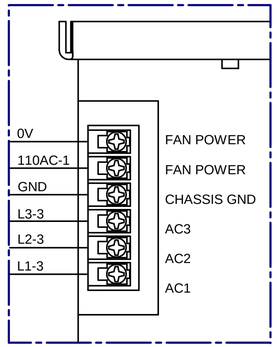
DETAIL K



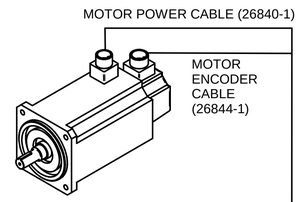


DETAIL H

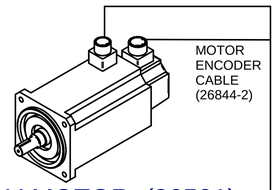
CABLE	SWI P/N	WIRE FROM	LABEL	COLOR
SPINDLE MOTOR FAN CABLE	26514	Q7-1	L1-8	BLACK
		Q7-3	L2-8	WHITE
Z-AXIS BRAKE CABLE	26683-1	RM1-K16-NO	24DC-22	BLACK
		TB10-1	OV	WHITE



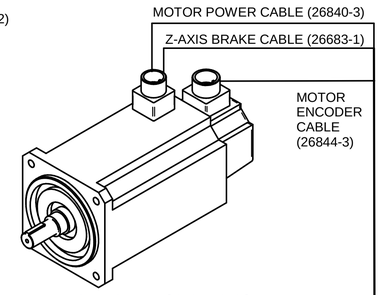
DETAIL L
TOP VIEW



X-MOTOR (26501)

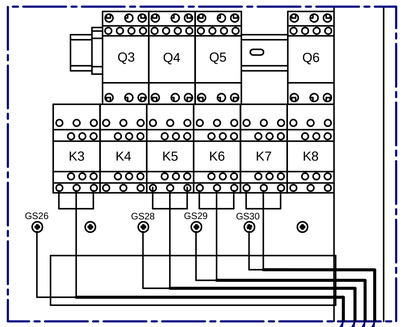


Y-MOTOR (26501)



Z-MOTOR (26502)

CABLE	SWI P/N	WIRE FROM	WIRE LABEL	COLOR
TOOL CHANGER POWER CABLE	26684-4	K7-T1	U1	BLACK-1
		K7-T2	V1	BLACK-2
		K7-T3	W1	BLACK-3
		GS30	GND	GREEN
COOLANT POWER CABLE	26684-1	K6-T1	U4	BLACK-1
		K6-T2	V4	BLACK-2
		K6-T3	W4	BLACK-3
		GS29	GND	GREEN
WASH COOLANT POWER CABLE	26684-2	K5-T1	U2	BLACK-1
		K5-T2	V2	BLACK-2
		K5-T3	W2	BLACK-3
		GS28	GND	GREEN
CONVEY/ AUGER POWER CABLE	26684-3	K3-T1	U6	BLACK-1
		K3-T2	V6	BLACK-2
		K3-T3	W6	BLACK-3
		GS26	GND	GREEN

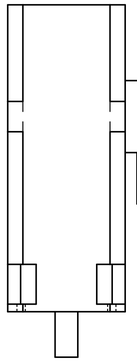


DETAIL I

26684-3
26684-2
26684-1
26684-4

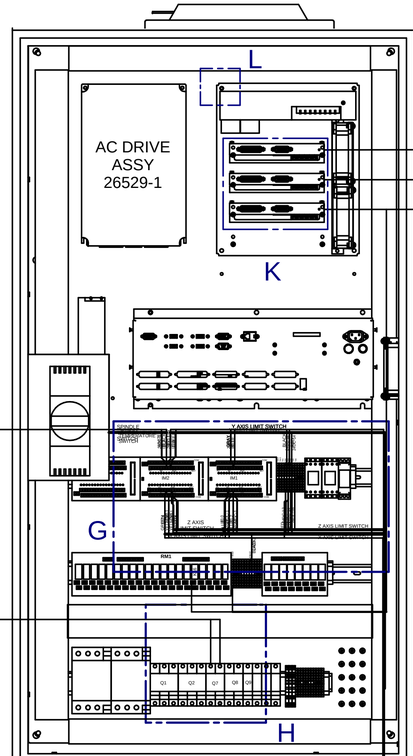
TABLE/ FUNCTION	TERMINAL BLOCK	COLOR	TO
U1	TB13-2	BLACK-1	TOOL CHANGER MOTOR
V1	TB12-2	BLACK-2	
W1	TB11-2	BLACK-3	
GND	TB10-2	GREEN	
U1	TB13-1	BLACK-1	ELECTRICAL CABINET
V1	TB12-1	BLACK-2	
W1	TB11-1	BLACK-3	
GND	TB10-1	GREEN	

SPINDLE MOTOR



SPINDLE TEMPERATURE SWITCH (26686)

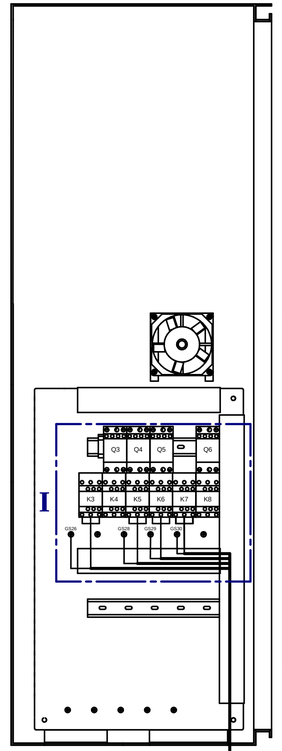
MOTOR FAN (26514)

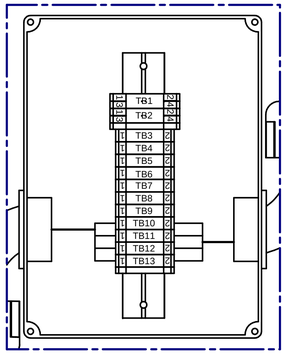


Z-LIMIT SWITCH
SEE DETAIL "G"

Y-LIMIT SWITCH
SEE DETAIL "G"

X-LIMIT SWITCH
SEE DETAIL "G"





DETAIL J

TOOL CHANGER DISTRIBUTION BOX
3

J

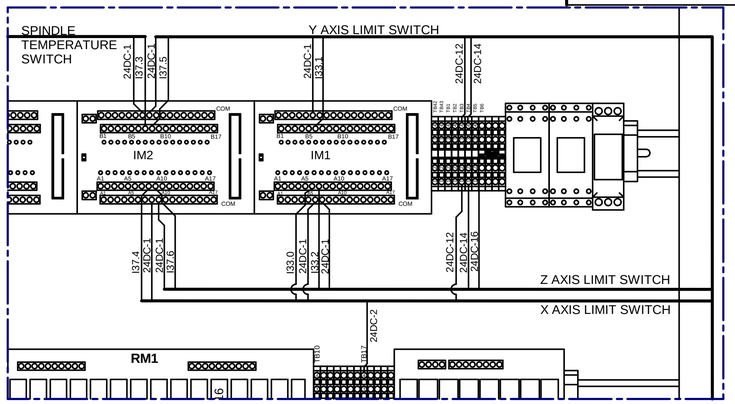
TOOL CHANGER MOTOR
SEE DETAIL "J"

COOLANT PUMP
SEE DETAIL "I"

COOLANT WASH PUMP
SEE DETAIL "I"

AUGER MOTOR
SEE DETAIL "I"

CABLE	SWI P/N	WIRE FROM	LABEL	PJ COLOR CODE	SWI COLOR CODE
Z AXIS LIMIT SWITCH ASSY	22551-5 (CA 22551-8)	TB5-2	24DC-16	RED	RED
		TB4-1	24DC-14	BLACK	BLACK
		IM1-A7	I33.2	BLUE	ORANGE
		IM1-A7-COM	24DC-1	GRAY	BROWN
		IM2-A9	I37.6	GREEN	GREEN
		IM2-A9-COM	24DC-1	YELLOW	YELLOW
X AXIS LIMIT SWITCH ASSY	22551-3 (CA 22551-6)	TB3-1	24DC-12	RED	RED
		TB17-4	24DC-2	BLACK	BLACK
		IM1-A6	I33.0	BLUE	ORANGE
		IM1-A6-COM	24DC-1	GRAY	BROWN
		IM2-A8	I37.4	GREEN	GREEN
		IM2-A8-COM	24DC-1	YELLOW	YELLOW
Y AXIS LIMIT SWITCH ASSY	22551-4 (CA 22551-7)	IM2-B8	I37.5	GREEN	GREEN
		IM2-B8-COM	24DC-1	YELLOW	YELLOW
		IM1-B6	I33.1	BLUE	ORANGE
		IM1-B6-COM	24DC-1	GRAY	BROWN
		TB3-4	24DC-12	BLACK	BLACK
		TB4-4	24DC-14	RED	RED
SPINDLE TEMPERATURE SWITCH	26686	IM2-B7	I37.3	BLACK	
		IM2-B7-COM	24DC-1	WHITE	



DETAIL G

3 TOOL CHANGER DISTRIBUTION BOX CONTAINS TOOL CHANGER, MOTOR POWER, AND TOOL CHANGER LIMIT SWITCH INPUTS. (2B2, 3A5)

APPROVALS	DATE
DRAWN BY RC	10/30/08
ENGINEER RO	7/16/09
CHECKER	
FE	
THIRD ANGLE PROJECTION	

TRAK MACHINE TOOLS — SOUTHWESTERN INDUSTRIES, INC.

TITLE: DIAGRAM-SYSTEM-LPM

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26734	G

SCALE: - SHEET 2 OF 5

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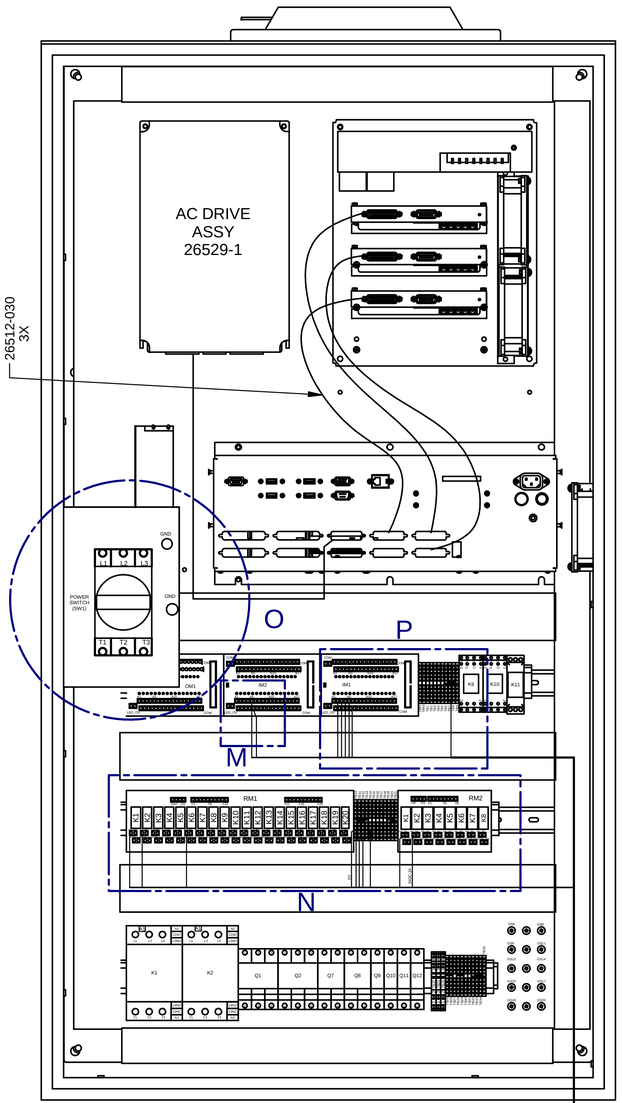
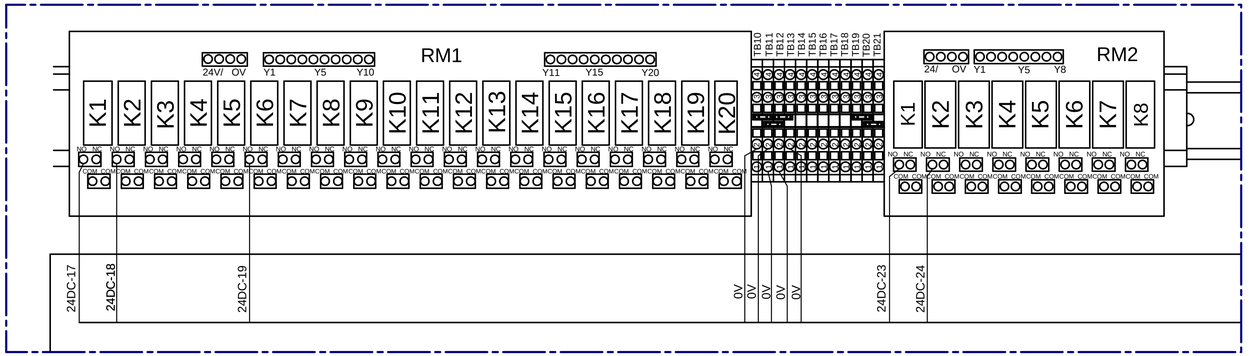
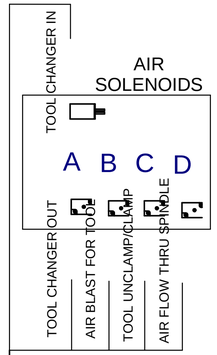
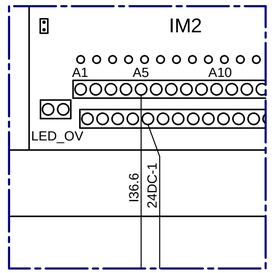




DETAIL N

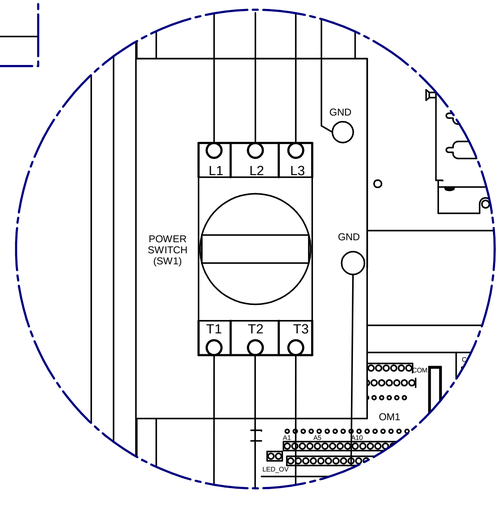


DETAIL N WIRING CHART				
CABLE LABEL	SWI P/N	WIRE FROM	LABEL	COLOR
AIR FLOW THRU SPINDLE	26673-4	RM1-K2-NO	24DC-18	BLACK
		TB11-1	0V	WHITE
AIR BLAST FOR TOOL	26673-5	RM1-K6-NO	24DC-19	BLACK
		TB11-2	0V	WHITE
TOOL CHANGER OUT	26673-2	RM2-K1-NO	24DC-23	BLACK
		TB13-2	0V	WHITE
TOOL UNCLAMP/ CLAMP	26673-1	RM1-K1-NO	24DC-17	BLACK
		TB12-1	0V	WHITE
TOOL CHANGER IN	26673-3	RM2-K2-NO	24DC-24	BLACK
		TB10-2	0V	WHITE

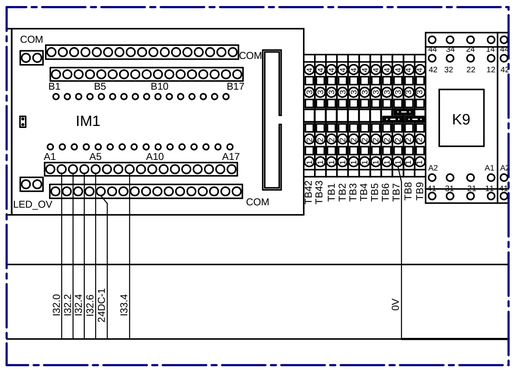


DETAIL M

DETAIL M WIRING CHART				
CABEL LABEL	SWI P/N	WIRE FROM	LABEL	COLOR
AIR PRESSURE LOW CABLE	(26675-1)	IM2-A5	I36.6	BLACK
		IM2-A5-COM	24DC-1	WHITE



DETAIL O



DETAIL P

DETAIL P WIRING CHART				
CABLE LABEL	SWI P/N	WIRE FROM	LABEL	COLOR
TOOL CHANGER DISTRIBUTION BOX	26672	IM1-A2	I32.0	RED
		IM1-A3	I32.2	BLACK
		IM1-A4	I32.4	GRAY
		IM1-A5	I32.6	BROWN
		IM1-A8	I33.4	YELLOW
		TB7-1	0V	WHITE
		IM1-A5-COM	24DC-1	BLUE

PROXIMITY SWITCH
TOOL CHANGER
TOOL DETECT
OPTICAL SENSOR
(26074-1)

PROXIMITY SWITCH
TOOL CHANGER
COUNTER
(26074-2)

PROXIMITY SWITCH
TOOL CHANGER
HOME
(26074-2)

LIMIT SWITCH
TOOL CHANGER OUT
(WIRED NORMALLY OPEN)
(26677-3)

LIMIT SWITCH
TOOL CHANGER IN
(WIRED NORMALLY OPEN)
(26677-4)

LABEL FUNCTION	TERMINAL BLOCKS	TOOL CHANGER COUNTER	TOOL CHANGER HOME	TOOL CHANGER IN	TOOL CHANGER OUT	TOOL DETECT	TOOL CHANGER CABLE TO ELECTRICAL
24VDC-1	TB1-2	-	-	WHITE (1)	WHITE (1)	-	
	TB1-4	BROWN (1)	BROWN (1)	-	-	BROWN (1)	-
0V	TB2-2	BLUE (2)	BLUE (2)	-	-	-	-
	TB2-4	-	-	-	-	BLUE (2)	-
I32.0	TB3-2	BLACK (3)	-	-	-	-	-
I32.6	TB4-2	-	BLACK (4)	-	-	-	-
I32.2	TB5-2	-	-	BLACK (5)	-	-	-
I32.4	TB6-2	-	-	-	BLACK (6)	-	-
I33.4	TB7-2	-	-	-	-	BLACK (7)	-
24DC-1	TB1-1	-	-	-	-	-	BLUE
0V	TB2-1	-	-	-	-	-	WHITE
I32.0	TB3-1	-	-	-	-	-	RED
I32.6	TB4-1	-	-	-	-	-	BROWN
I32.2	TB5-1	-	-	-	-	-	BLACK
I32.4	TB6-1	-	-	-	-	-	GRAY
I33.4	TB7-1	-	-	-	-	-	YELLOW

APPROVALS		DATE
DRAWN BY	RC	10/30/08
ENGINEER	RO	7/16/09
CHECKER		
FE		
THIRD ANGLE PROJECTION		

TRAK MACHINE TOOLS
SOUTHWESTERN INDUSTRIES, INC.

TITLE: DIAGRAM-SYSTEM-LPM

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26734	G

SCALE: - SHEET 3 OF 5

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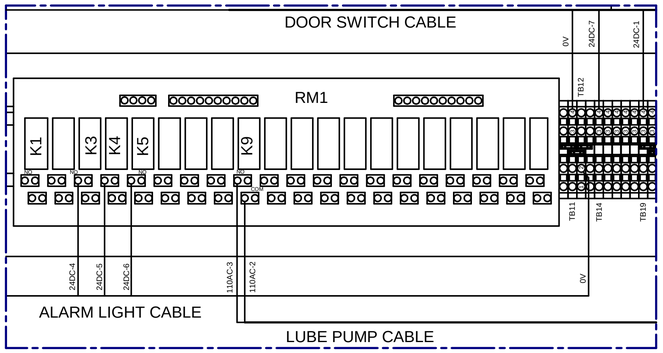
DOOR SWITCH CABLE INTERCONNECTION CHART (26682-6)				
SWITCH PINS	**PIN FUNCTION**	**WIRE COLOR**	**LABEL**	**CONNECTED TO**
A1	COIL	BLUE	24DC-7	TB14-4
A2	COIL	WHITE	0V	TB11-4
11	COMPUTER INPUT	BLACK	I34.6	IM1-A13
12	+24V	RED	24DC-1	IM1-A13-COM
21	K9 RELAY	YELLOW	24DC-20	K9-14
22	+24V	GREEN	24DC-1	TB19-4

DOOR SWITCH WIRING

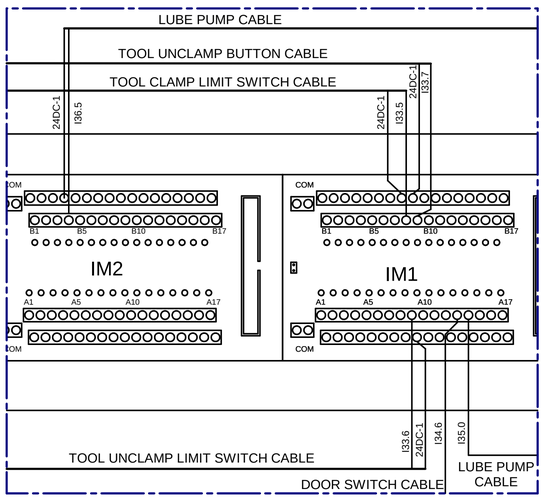
a) WIRE COLOR CHANGED BETWEEN REVISIONS. FOR TROUBLESHOOTING USE DESCRIPTION ON LABELS.

b) K9 COIL WIRING CHANGED BETWEEN REVISIONS:
A1 COIL CONNECTION IS EQUIVALENT TO 14 ON UPDATED RELAY BASE.
A2 COIL CONNECTION IS EQUIVALENT TO 13 ON UPDATED RELAY BASE.



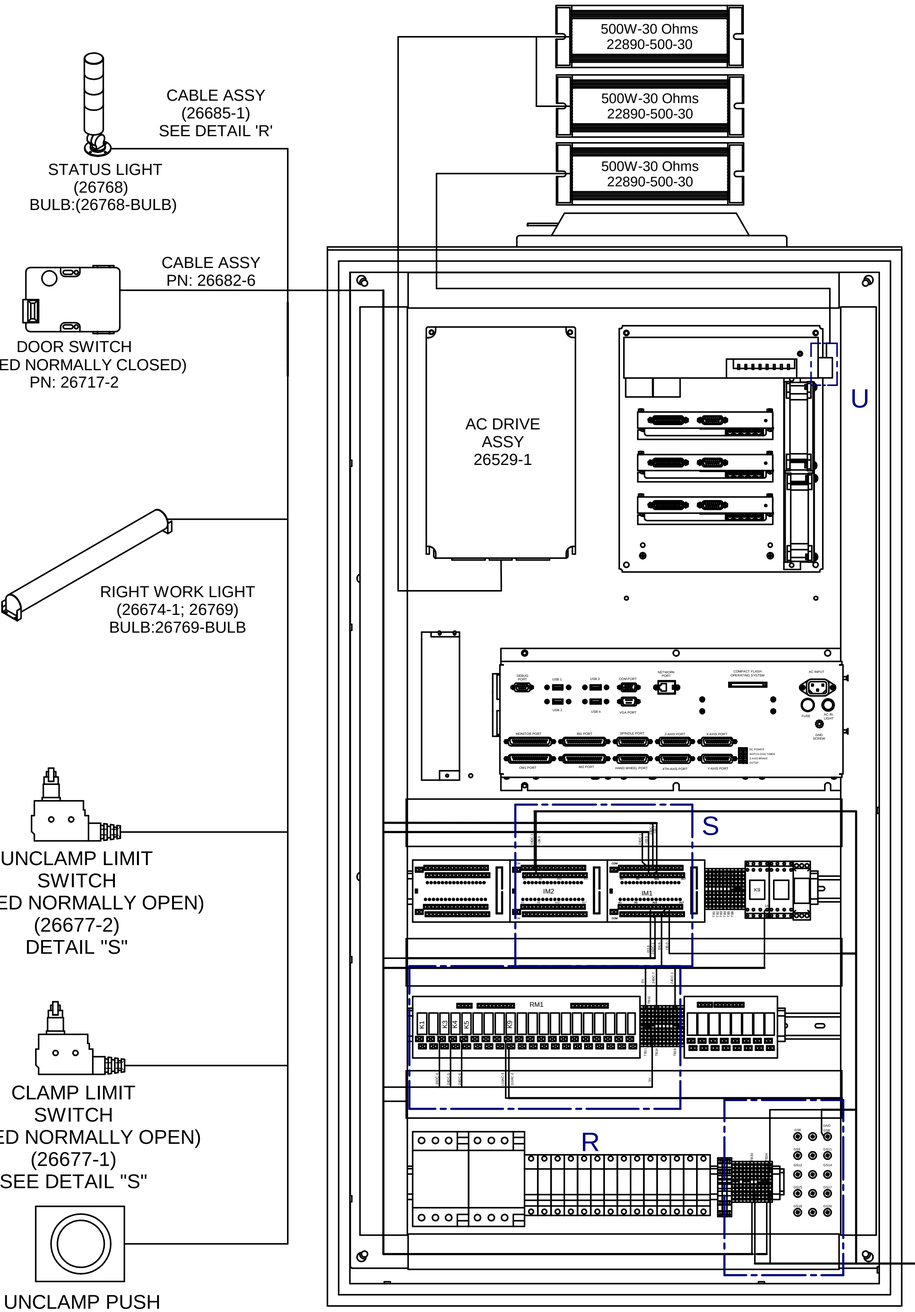
DETAIL R

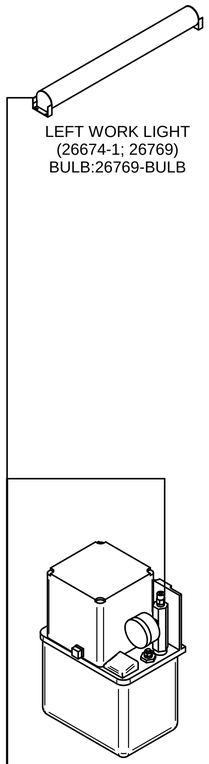
CABLE	SWI P/N	WIRE FROM	LABEL	COLOR
ALARM LIGHT CABLE	(26685-1)	RM1-K3-NO	24DC-4	RED
		RM1-K4-NO	24DC-5	BLACK
		RM1-K5-NO	24DC-6	GREEN
		TB12-2	0V	WHITE

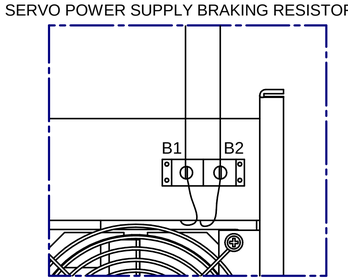


DETAIL S

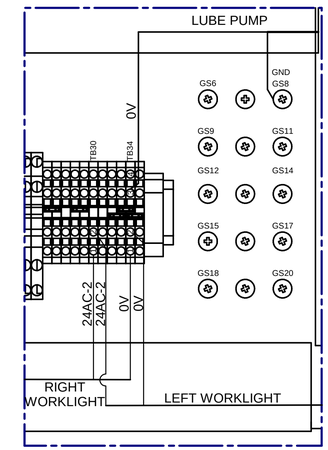
CABLE	SWI P/N	WIRE FROM	LABEL	COLOR
TOOL CLAMP LIMIT SWITCH CABLE	26677-1	IM1-B8	I33.5	BLACK
		IM1-B8-COM	24DC-1	WHITE
TOOL UNCLAMP BUTTON CABLE	26673-6	IM1-B9	I33.7	BLACK
		IM1-B9-COM	24DC-1	WHITE
TOOL UNCLAMP LIMIT SWITCH CABLE	26677-2	IM1-A9	I33.6	BLACK
		IM1-A9-COM	24DC-1	WHITE





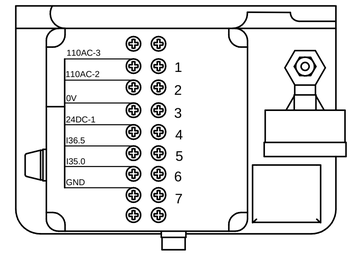


DETAIL U



DETAIL Q

CABEL LABEL	SWI P/N	WIRE FROM	LABEL	COLOR
RIGHT WORK LIGHT	26674-1	TB30-1	24AC-2	BLACK
		TB34-1	0V	WHITE
LEFT WORK LIGHT	26674-2	TB30-2	24AC-2	BLACK
		TB34-2	0V	WHITE



CABLE LABEL	SWI P/N	WIRE FROM	LABEL	COLOR	WIRE DETAIL
LUBE PUMP CABLE	26681-1	RM1-K9-NO	110AC-3	RED	R
		RM1-K9-COM	110AC-2	BLACK	
		IM2-B4-COM	24DC-1	BLUE	S
		IM2-B4	I36.5	YELLOW	
		IM1-A14	I35.0	BROWN	
		GS8	GND	GREEN	Q
		TB34-3	0V	WHITE	

APPROVALS	DATE
DRAWN BY RC	10/30/08
ENGINEER RO	7/16/09
CHECKER	
FE	
THIRD ANGLE PROJECTION	

TRAK MACHINE TOOLS
SOUTHWESTERN INDUSTRIES, INC.

TITLE: DIAGRAM-SYSTEM-LPM

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26734	G

SCALE: - SHEET 4 OF 5

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CABLE CHART	SWI P/N	WIRE FROM	WIRE LABEL	COLOR	CABLE TO
COMPUTER MODULE POWER CABLE	26592	TB26-1	110AC-1	BLACK	COMPUTER MODULE
		TB32-2	0V	WHITE	
		GS15	GND	GREEN	

MOTOR ENCODER
(26940)

MOTOR POWER
(26671-1)

SPINDLE MOTOR
ENCODER CABLE
(26940)

ENCODER OUTPUT/
SPINDLE CONTROL
CABLE
(22443-3)

AO
-AO
BO
-BO
ZO
-ZO

A1, -A1, B1, -B1, Z1, DCM, VP, A2, -A2, B2, -B2

PA, +PA, PB, +PB, PZ, +PZ, 0V, 5V

MRA RA RC MCM +24 FWD MI1 MI3 MI5 DFM +10V AVI ACM
MRC RB MO1 MO2 DCM REV MI2 MI4 MI6 AFM AUI ACI GND

GND,R/L1,S/L2,T/L3,+1,+2/B1, -, B2, U/T1,V/T2,W/T3,GND

L1-7 L2-7 L3-7 B1 B2 SU SV SW GND

4

GND

POWER INPUT
WIRES

BRAKING
RESISTOR WIRES

SPINDLE MOTOR
POWER CABLE

AC DRIVE
TAP ACCEL/DECEL
CABLE

SPINDLE MOTOR

GS6 GS8 GS9 GS11 GS12 GS14 GS15 GS17 GS18 GS20

TB26 TB26 TB27 TB28 TB29 TB30 TB31 TB32 TB33 TB34 TB35

BLACK WHITE GREEN

DETAIL V

AC DRIVE
ASSY
26529-1

RM1

W

V

Q1 Q2 Q7 Q8 Q9

RM1

K18 K19 K20

NO NC NO NC NO NC
COM COM COM COM COM COM

K18 K20

DETAIL W

CABLE CHART	SWI P/N	WIRE FROM	WIRE LABEL	COLOR	CABLE TO
TAP ACCEL/DECEL	26994	RM1-K20-NO	MI4	BLACK	AC DRIVE
		RM1-K20-COM	DCM	RED	

PIN #	Wire Color	FUNCTION	AC Drive Terminal / Label Text
1	BLACK	+5V	-
2	BROWN	DAC5+	AVI
3	RED	ADCIN_5	AFM
4	ORANGE	AENA5-	-
5	YELLOW	E-SPD_COM	MI1
6	GREEN	SPD_REV	REV
7	BLUE	SPD_RESET	MI2
8	PURPLE	IN-FAULT_5	RB
9	GRAY	I30-4	MRA
10	WHITE	CHA5+	AO
11	PINK	CHB5+	BO
12	LIGHT GREEN	CHC5+	ZO
13	BLACK / WHITE	GND	-
14	BROWN / WHITE	GND	ACM
15	RED / WHITE	DAC5-	-
16	ORANGE / WHITE	AGND3	ACM
17	GREEN / WHITE		-
18	BLUE / WHITE	SPD_FWD	FWD
19	PURPLE / WHITE	SPD_ORT	MI3
20	RED / BLACK	SPD_COM	DCM
21	ORANGE / BLACK	GND	RC
22	YELLOW / BLACK	GND	MRC
23	GREEN / BLACK	CHA5-	-AO
24	GRAY / BLACK	CHB5-	-BO
25	PINK / BLACK	CHC5-	-ZO

4 ROUTE ALL WIRES AND CABLES INTO THE AC DRIVE AS SHOWN (5B8).

APPROVALS	DATE
DRAWN BY RC	10/30/08
ENGINEER RO	7/16/09
CHECKER	
FE	
THIRD ANGLE PROJECTION	

TRAK MACHINE TOOLS
SOUTHWESTERN INDUSTRIES, INC.

TITLE: DIAGRAM-SYSTEM-LPM

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26734	G

SCALE: - SHEET 5 OF 5

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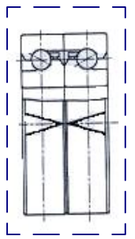
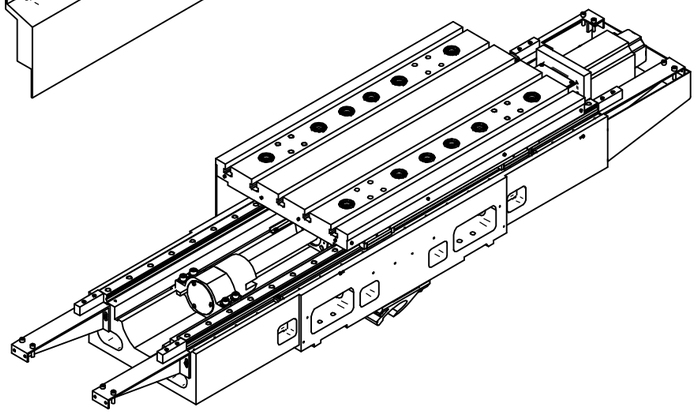
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13542	10.1.09	LG
A	ADDED ITEMS 53 - 57(B5, C7)	13975	5/3/12	SH

DETAIL "A"





NOTES: (UNLESS OTHERWISE SPECIFIED).

1. MOUNT BEARINGS (ITEM 9) IN A "FACE TO FACE" ARRANGEMENT AS SHOWN IN DETAIL "A" (C3,B7)

SEE SEPARATE "A" SIZE SHEET FOR PARTS LIST

SOLID EDGE RESELLER COPY

NEXT ASSY	USED ON	DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0°30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS	DATE
APPLICATION		MATERIAL -	DRAWN BY SA	01-05-09
		FINISH -	ENGINEER LG	10-1-09
			ENGINEER	
			FE	
		THIRD ANGLE PROJECTION		

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: X AXIS DRIVE TRAIN ASSY

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26772	A

SCALE: - SHEET 1 OF 1

Parts List for Assembly P/N: 26772

Printed 6/1/2012

26772

X AXIS DRIVE TRAIN ASSY

WHEN UPDATING THIS DOCUMENT REVISE MANUAL
26727, 26500 & 26500-1

Type	PL	Dwg Size	D
Revision	A	Product	LPM
Status	R	Engineer	LG
Date	1/5/2009	Planner Code	
By	SA	Comm Code	

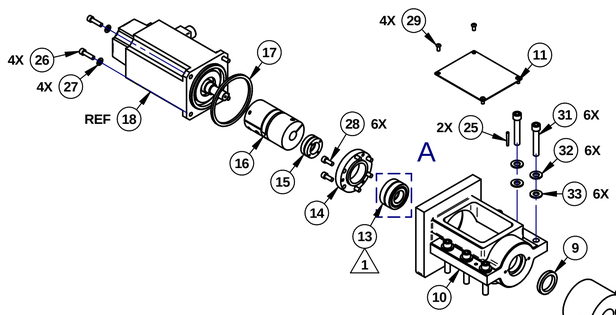
Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(m)	Mfr
1	26550	TABLE - LPM		A	EA	1	R		
2	26739	SADDLE X-AXIS		-	EA	1	R		PING JENG
3	26746	YOKE - AXIS X,Y,Z, LPM		-	EA	2	R		PING JENG
4	26743	SUPPORT -END- WAY COVER		-	EA	1	R		PING JENG
5	26744	SUPPORT - END-WAY COVER		-	EA	2	R		PING JENG
6	26755	SUPPORT - END-WAY COVER		-	EA	1	R		PING JENG
7	26749	BEARING - CAP-DRIVE END		-	EA	1	R		PING JENG
8	26747	BEARING CAP-SUPPORT END		-	EA	2	R		PING JENG
9	26752	BEARING - ANGULAR CONTACT		-	EA	4	R		PING JENG
10	26741	COUPLING - MOTOR BALL SCREW		-	EA	1	R		PING JENG
11	26745	SEAL - BEARING		-	EA	2	R		PING JENG
12	26753	COVER - BEARING HOUSING		-	EA	1	R		PING JENG
13	26740	GUIDE-LINEAR-SET-X AXIS-LPM	1560mm	A	EA	1	R		PING JENG
14	26742	HOUSING - BEARING		-	EA	1	R		PING JENG
15	26738	HOUSING - BEARING - MOTOR		-	EA	1	R		PING JENG
16	26754	WEDGE-LINEAR GUIDE		-	EA	40	R		PING JENG
17	26748	BALLSCREW	X-AXIS	-	EA	1	R		PING JENG
18	26711	RECEIVER - BALL LOCK-FACE MOUNT		-	EA	12	R		
19	26501	MOTOR-AXIS - 5.7 N-m		A	EA	0	R		
20	26762	NUT-LOCK-BALL SCREW		-	EA	2	R		YINSH
21	27001	RING , MOTOR		-	EA	1	R		PING JENG

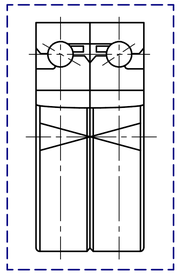
Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(m)	Mfr
22	M8-1.25X35 25B	SCREW-SHCS-STL-BO			EA	16	R		
23	M8-1.25X30 25B	SCREW-SHCS-STL-BO			EA	44	R		
24	M10-1.5X25 25B	SCREW-SHCS-STL-BO			EA	5	R		
25	M6-1.0X10 25B	SCREW-SHCS-STL-BO			EA	40	R		
26	27002	CUSHION - BALL SCREW	1.6" (40.6mm)	-	EA	2	R		PING JENG
27	27003	CAP - SCHS HOLE		-	EA	56	R		
28	M5-0.8X12 10B	SCREW-PH-PHIL-STL-BO			EA	3	R		
29	M8-1.25X25 25B	SCREW-SHCS-STL-BO			EA	8	R		
30	M12-1.75X50 25B	SCREW-SHCS-STL-BO		-	EA	8	R		
31	M12-71B	WASHER-STL-BO		-	EA	10	R		
32	M12 73B	WASHER-SPLIT LOCK-STL-BO			EA	10	R		WEY YII
33	M12-1.75X70 25B	SCREW-SHCS-STL-BO			EA	10	R		
34	26777	COVER-MOTOR X-AXIS		-	EA	1	R		
38	26823	PIN-TAPERED		-	EA	8	R		
39	26824	COVER-TELESCOPIC X-AXIS-RIGHT		-	EA	1	R		PING JENG
40	26824-1	COVER-TELESCOPIC X-AXIS-LEFT		-	EA	1	R		PING JENG
41	M6-1.0X12 27B	SCREW-BHCS-STL-BO			EA	4	R		
43	24009-1	WASHER - BELLEVILLE LOCK	5/16" OR M8 - SERRATED	-	EA	4	R		
44	M6-1.0X16 25B	SCREW-SHCS-STL-BO		-	EA	12	R		
45	M6-1.0X20 25B	SCREW-SHCS-STL-BO			EA	12	R		
46	M5-0.8X10 25B	SCREW-SHCS-STL-BO	NON STOCKABLE		EA	4	R		
47	M6-1.0X12 25B	SCREW-SHCS-STL-BO			EA	18	R		
48	26771	STOP - GUIDE LINEAR		-	EA	4	R		PING JENG

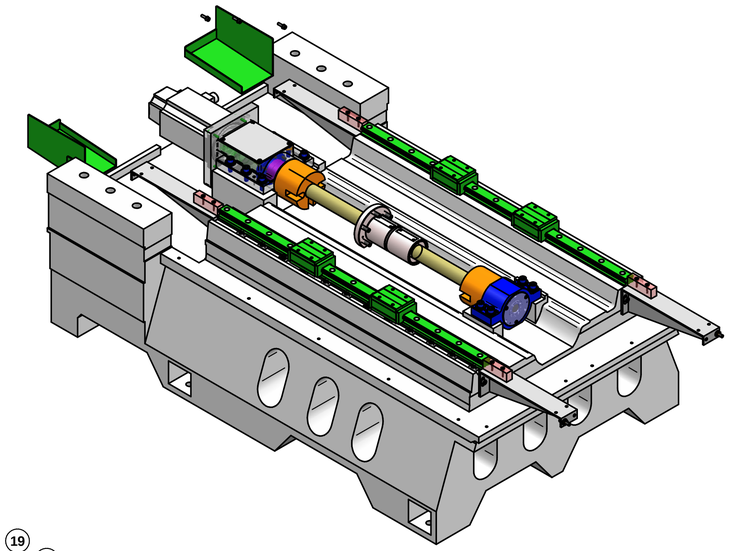
Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(m)	Mfr
49	10-32X3/8 25B	SCREW-SHCS-STL-BO			EA	36	R		
50	M6-1.0X80 25B	SCREW-SHCS-STL-BO			EA	8	R		
51	26818-4	COVER-WAY X-AXIS-FRONT		-	EA	1	R		PING JENG
52	26818-5	COVER-WAY X-AXIS-REAR		-	EA	1	R		PING JENG
53	26916	BRACKET-GUIDE-CABLE CARRIER-X AXIS		-	EA	1	R		
54	27178	CABLE CARRIER-X AXIS-LPM		-	EA	(1)	R		
55	M5 71B	WASHER-FLAT SAE-STL-BO	NON-STOCKABLE	-	EA	2	R		
56	M5 73B	WASHER-SPLIT LOCK-STL-BO		-	EA	2	R		
57	M5-0.8X14 25B	SCREW-SHCS-STL-BO	NON STOCKABLE	-	EA	2	R		

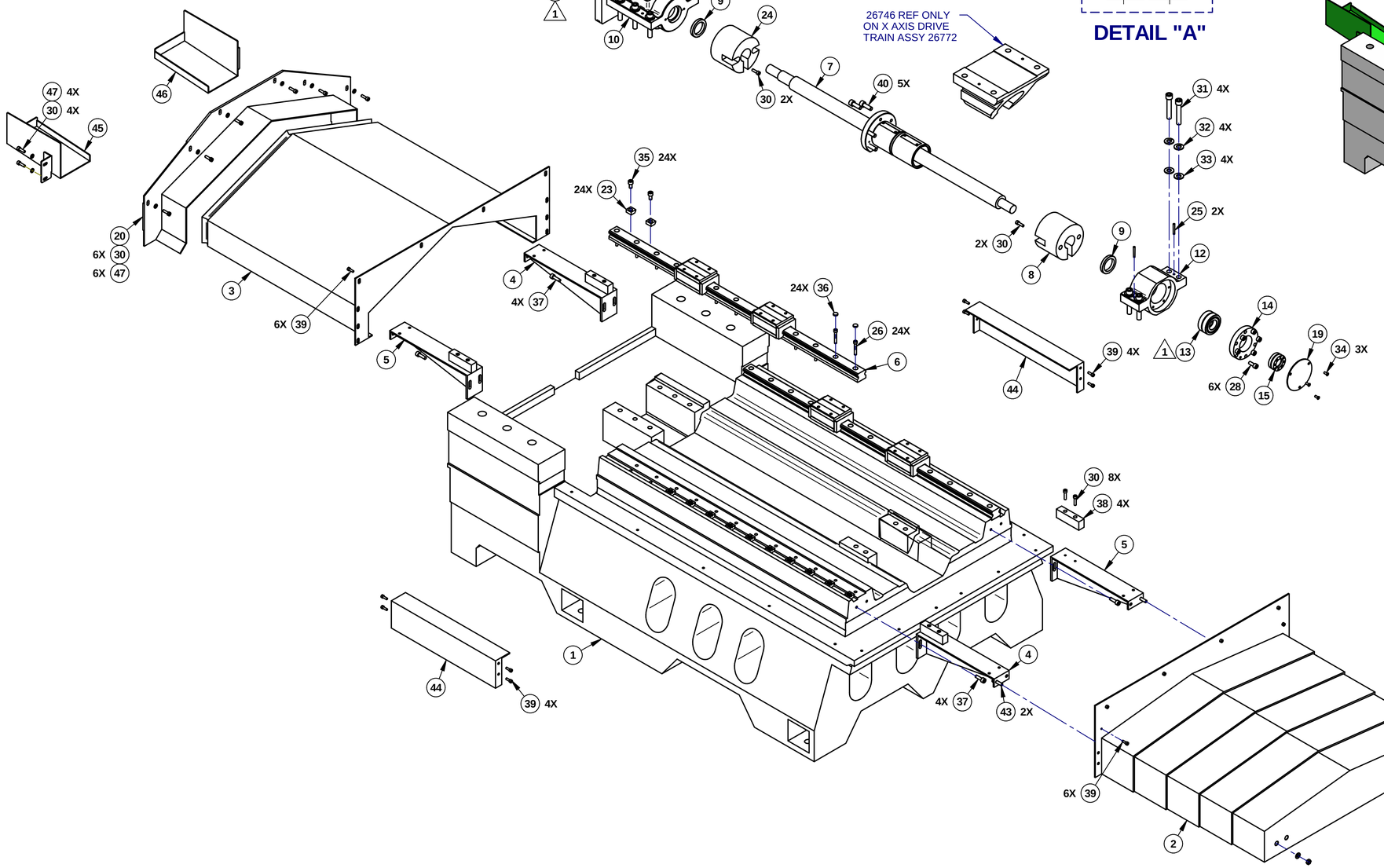
NOTICE: THIS DESIGN WAS ORIGINATED BY AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN OWNED BY SOUTHWESTERN INDUSTRIES. IT IS DISCLOSED IN CONFIDENCE FOR A SPECIFIC PURPOSE AND THE RECIPIENT HEREOF AGREES NOT TO MAKE ANY REPRODUCTION, DISCLOSURE OR OTHER USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES.

REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13542	10.1.09	LG
A	REVISED: ITEMS: 3 (PICTORIAL), 30 & 47 QTY WAS: 16 & 4. ADDED ITEM 20	14112	05/22/13	SH
B	ITEMS 3, 45, 46 WAS: 26818-1, 26971-1, 26971. ADDED NOTE 2.	14191	10/24/14	PM









NOTES: (UNLESS OTHERWISE SPECIFIED).

1. MOUNT BEARINGS (ITEM13) IN A "FACE TO FACE" ARRANGEMENT AS SHOWN IN DETAIL A. (D3 & D6)
2. TO PREVENT COOLANT & CHIPS FROM ENTERING INTO Y AXIS CAVITY THE REAR COVER, WIPER COVER ASSY, COOLANT DRIP TRAY LEFT & RIGHT (ITEMS 3, 20, 45, 46) HAVE BEEN MODIFIED ON REV B & HIGHER. WIPER COVER ASSY (ITEM 20) IS COMPATIBLE FOR CURRENT & ORIGINAL STYLE.

NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0'30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS		DATE
DRAWN BY	RC	2/24/09
ENGINEER	LG	10.1.09
ENGINEER		
FE		

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: Y AXIS DRIVE TRAIN ASSY

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26817	B

SCALE: - SHEET 1 OF 1

Reason:

Parts List for Assembly P/N: 26817

Printed 10/24/2014

26817
Y AXIS DRIVE TRAIN ASSY

WHEN UPDATING THIS DOCUMENT REVISE MANUAL 26727.

Type	PL	Dwg Size	D
Revision	B	Product	LPM
Status	R	Engineer	LG
Date	2/24/2009	Planner Code	
By	RC	Comm Code	

Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
1	26817-1	BASE-CASTING		1	EA	-	R	PS	PING JENG	80001001
2	26818	COVER-TELESCOPIC Y-AXIS FRONT		1	EA	-	R	PS	PING JENG	80006079
3	26818-8	COVER-Y AXIS REAR	SEE 26817	1	EA	A	R	PS	PING JENG	80006076
4	26819	SUPPORT-WAY COVER-LT FRT & RR		2	EA	-	R	PL	PING JENG	80006041
5	26819-1	SUPPORT WAY COVER-RT FRT & RR		2	EA	-	R	PL	PING JENG	80006040
6	26740-1	GUIDE-LINEAR-SET-Y AXIS-LPM	1000mm	1	EA	A	R	PL	PING JENG	80006001
7	26748-1	BALLSCREW	Y & Z - AXIS	1	EA	-	R	PL	PING JENG	80015014
8	27002	CUSHION - BALL SCREW	1.6" (40.6mm)	1	EA	-	R	PL	PING JENG	3202031090
9	26745	SEAL - BEARING		2	EA	-	R	PL	PING JENG	MD - 40x52x8
10	26738	HOUSING - BEARING - MOTOR		1	EA	-	R	PL	PING JENG	80006006
11	26753	COVER - BEARING HOUSING		1	EA	-	R	PL	PING JENG	80006018
12	26742	HOUSING - BEARING		1	EA	-	R	PL	PING JENG	80006005
13	26752	BEARING - ANGULAR CONTACT		4	EA	-	R	PL	PING JENG	30TAC62B-SUC10PN7B
14	26747	BEARING CAP-SUPPORT END		2	EA	-	R	PL	PING JENG	6106007B
15	26762	NUT-LOCK-BALL SCREW		2	EA	-	R	DWG		
16	26741	COUPLING - MOTOR BALL SCREW		1	EA	-	R	PL	PING JENG	50030003
17	27001	RING , MOTOR		1	EA	-	R	PL	PING JENG	64006009A
18	26501	MOTOR-AXIS - 5.7 N-m		(1)	EA	A	R	DWG		
19	26749	BEARING - CAP-DRIVE END		1	EA	-	R	PL	PING JENG	6106012
20	26818-6	WIPER COVER ASSY-Y AXIS REAR-LPM		1	EA	A	R	PL	PING JENG	3218095131
23	26754	WEDGE-LINEAR GUIDE		24	EA	-	R	PL	PING JENG	80006010

Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
24	27002-2	CUSHION - BALL SCREW	2.565" (65.15mm)	1	EA	-	R	PL	PING JENG	3218072010
25	26823	PIN-TAPERED	MP12-8X701	4	EA	-	R	PL	PING JENG	50240829
26	M8-1.25X30 25B	SCREW-SHCS-STL-BO		28	EA		R	PS		
27	24009-1	WASHER-BELLEVILLE LOCK-5/16	OR M8-SERRATED	4	EA	-	R	PS		
28	M6-1.0X16 25B	SCREW-SHCS-STL-BO		12	EA	-	R	PS		
29	M6-1.0X12 27B	SCREW-BHCS-STL-BO		4	EA		R	PS		
30	M6-1.0X20 25B	SCREW-SHCS-STL-BO		22	EA		R	PS		
31	M12-1.75X70 25B	SCREW-SHCS-STL-BO		10	EA		R	PS		
32	M12 73B	WASHER-SPLIT LOCK-STL-BO		10	EA		R	PS		
33	M12-71B	WASHER-STL-BO		10	EA	-	R	PL		
34	M5-0.8X12 10B	SCREW-PH-PHIL-STL-BO		3	EA		R	PS		
35	M6-1.0X10 25B	SCREW-SHCS-STL-BO		24	EA		R	PS		
36	27003	CAP - SCHS HOLE		24	EA	-	R	PL		
37	M8-1.25X25 25B	SCREW-SHCS-STL-BO		8	EA		R	PS		
38	26771	STOP - GUIDE LINEAR		4	EA	-	R	PL	PING JENG	MTRB010A
39	M6-1.0X12 25B	SCREW-SHCS-STL-BO		20	EA		R	PS		
40	M10-1.5X25 25B	SCREW-SHCS-STL-BO		5	EA		R	PS		
41	M6 73B	WASHER-SPLIT LOCK-STL-BO		2	EA	-	R	PS		
42	M6-1.0 50B	NUT-HEX-STL-BO		2	EA		R	PS		
43	M6-1.0X25 25B	SCREW-SHCS-STL-BO		2	EA		R	PS		
44	26818-2	COVER-WAY Y-AXIS SIDE		2	EA	-	R	PS	PING JENG	
45	26971-3	TRAY-COOLANT DRIP-RIGHT		1	EA	A	R	PS		
46	26971-2	TRAY-COOLANT DRIP-LEFT		1	EA	A	R	PS		
47	M6 70B	WASHER-FLAT USS-STL-BO		10	EA	-	R	PS		

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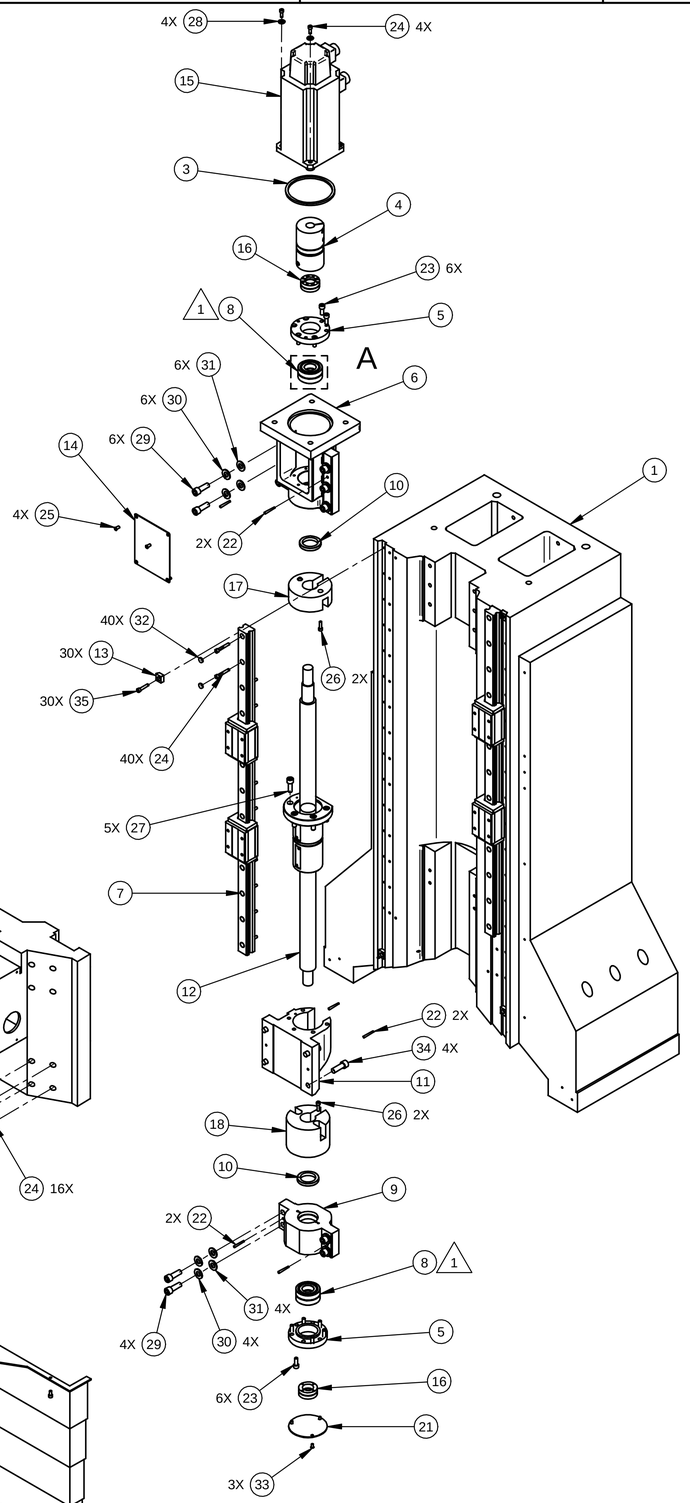
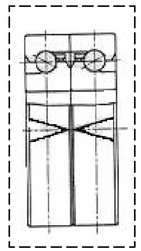
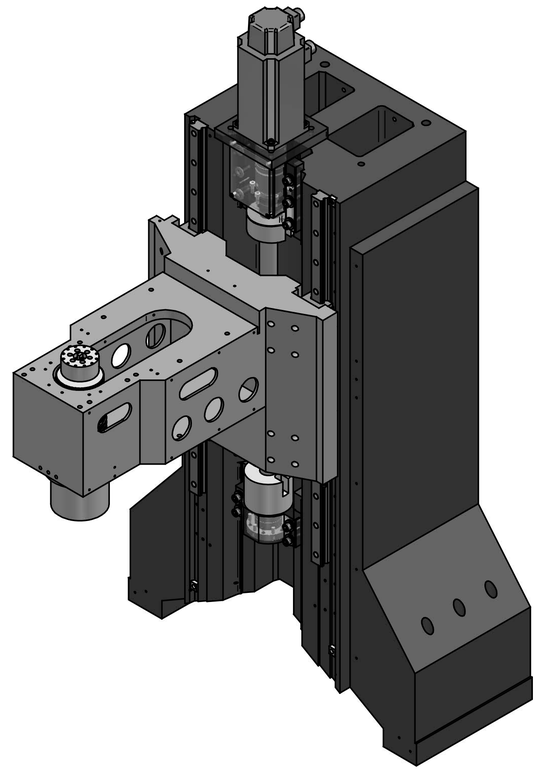
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13542	10.1.09	LG





DETAIL "A"



NOTES: (UNLESS OTHERWISE SPECIFIED).

1. MOUNT BEARINGS (ITEM 8) IN A "FACE TO FACE" ARRANGEMENT AS SHOWN IN DETAIL "A". (A5,D6)

SEE SEPARATE "A" SIZE SHEET FOR PARTS LIST

		DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0°30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS	DATE	SOUTHWESTERN INDUSTRIES, INC. 2615 HOMESTEAD PLACE RANCHO DOMINGUEZ, CA 90220-5610
			DRAWN BY RC	5.5.09	
			ENGINEER LG	10.1.09	TITLE: Z AXIS DRIVE TRAIN ASSY
			ENGINEER		
		MATERIAL -	FE		SIZE D · CODE IDENT. NO. 06238 · DWG NO. 26756 · REV -
NEXT ASSY	USED ON	FINISH -	THIRD ANGLE PROJECTION		SCALE: - · SHEET 1 OF 1
APPLICATION					

Parts List for Assembly P/N: 26756

Printed 10/14/2009

26756
Z AXIS DRIVE TRAIN ASSY

WHEN UPDATING THIS DOCUMENT REVISE MANUAL 26727

Type	PL	Dwg Size	D
Revision	-	Product	LPM
Status	R	Engineer	LG
Date	12/8/2008	Planner Code	
By	RC	Comm Code	

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(t)	Mfr	Mfr P/N
1	26757	COLUMN CASTING		-	EA	1	R		PING JENG	700A0603
2	26758	BRACKET SPINDLE- Z AXIS		-	EA	1	R		PING JENG	700A001
3	27001	RING , MOTOR		-	EA	1	R		PING JENG	64006009A
4	26741-1	COUPLING - MOTOR BALL SCREW	Z-AXIS	-	EA	1	R		PING JENG	50030032
5	26747	BEARING CAP-SUPPORT END		-	EA	2	R		PING JENG	6106007B
6	26738	HOUSING - BEARING - MOTOR		-	EA	1	R		PING JENG	80006006
7	26740-2	GUIDES - LINEAR	Z-AXIS, 1 SET	-	EA	1	R		PING JENG	80006003
8	26752	BEARING - ANGULAR CONTACT		-	EA	4	R		PING JENG	30TAC62B-SUC10PN7B
9	26742	HOUSING - BEARING		-	EA	1	R		PING JENG	80006005
10	26745	SEAL - BEARING		-	EA	2	R		PING JENG	MD - 40x52x8
11	26746	YOKE - AXIS X,Y,Z, LPM		-	EA	1	R		PING JENG	80006011
12	26748-1	BALLSCREW	Y & Z - AXIS	-	EA	1	R		PING JENG	80015014
13	26754	WEDGE-LINEAR GUIDE		-	EA	30	R		PING JENG	80006010
14	26753	COVER - BEARING HOUSING		-	EA	1	R		PING JENG	80006018
15	26502	MOTOR-AXIS 11.5 Nm-WITH BRAKE	Z AXIS MOTOR	A	EA	0	R			
16	26762	NUT-LOCK-BALL SCREW		-	EA	2	R		YINSH	YSK-M30X1.5P
17	27002-1	CUSHION - BALL SCREW	0.9" (22.8mm)	-	EA	1	R		PING JENG	3202031140
18	27002	CUSHION - BALL SCREW	1.6" (40.6mm)	-	EA	1	R		PING JENG	3202031090
21	26749	BEARING - CAP-DRIVE END		-	EA	1	R		PING JENG	6106012
22	26823	PIN-TAPERED		-	EA	6	R			MP12-8X701

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(t)	Mfr	Mfr P/N
23	M6-1.0X16 25B	SCREW-SHCS-STL-BO		-	EA	12	R			
24	M8-1.25X30 25B	SCREW-SHCS-STL-BO			EA	60	R			
25	M6-1.0X12 27B	SCREW-BHCS-STL-BO			EA	4	R			
26	M6-1.0X20 25B	SCREW-SHCS-STL-BO			EA	4	R			
27	M10-1.5X25 25B	SCREW-SHCS-STL-BO			EA	5	R			
28	24009-1	WASHER - BELLEVILLE LOCK	5/16" OR M8 - SERRATED	-	EA	4	R		MCMASTER-CARR	93501A030
29	M12-1.75X70 25B	SCREW-SHCS-STL-BO			EA	10	R			
30	M12 73B	WASHER-SPLIT LOCK-STL-BO			EA	10	R		WEY YII	
31	M12-71B	WASHER-STL-BO		-	EA	10	R			
32	27003	CAP - SCHS HOLE		-	EA	40	R			
33	M5-0.8X12 10B	SCREW-PH-PHIL-STL-BO			EA	3	R			
34	M12-1.75X50 25B	SCREW-SHCS-STL-BO		-	EA	4	R			
35	M6-1.0X10 25B	SCREW-SHCS-STL-BO			EA	30	R		PJ	
37	26818-3	COVER-TELESCOPIC Z-AXIS-LOWER		-	EA	1	R		PING JENG	80006022
38	M6-1.0X12 25B	SCREW-SHCS-STL-BO			EA	4	R			

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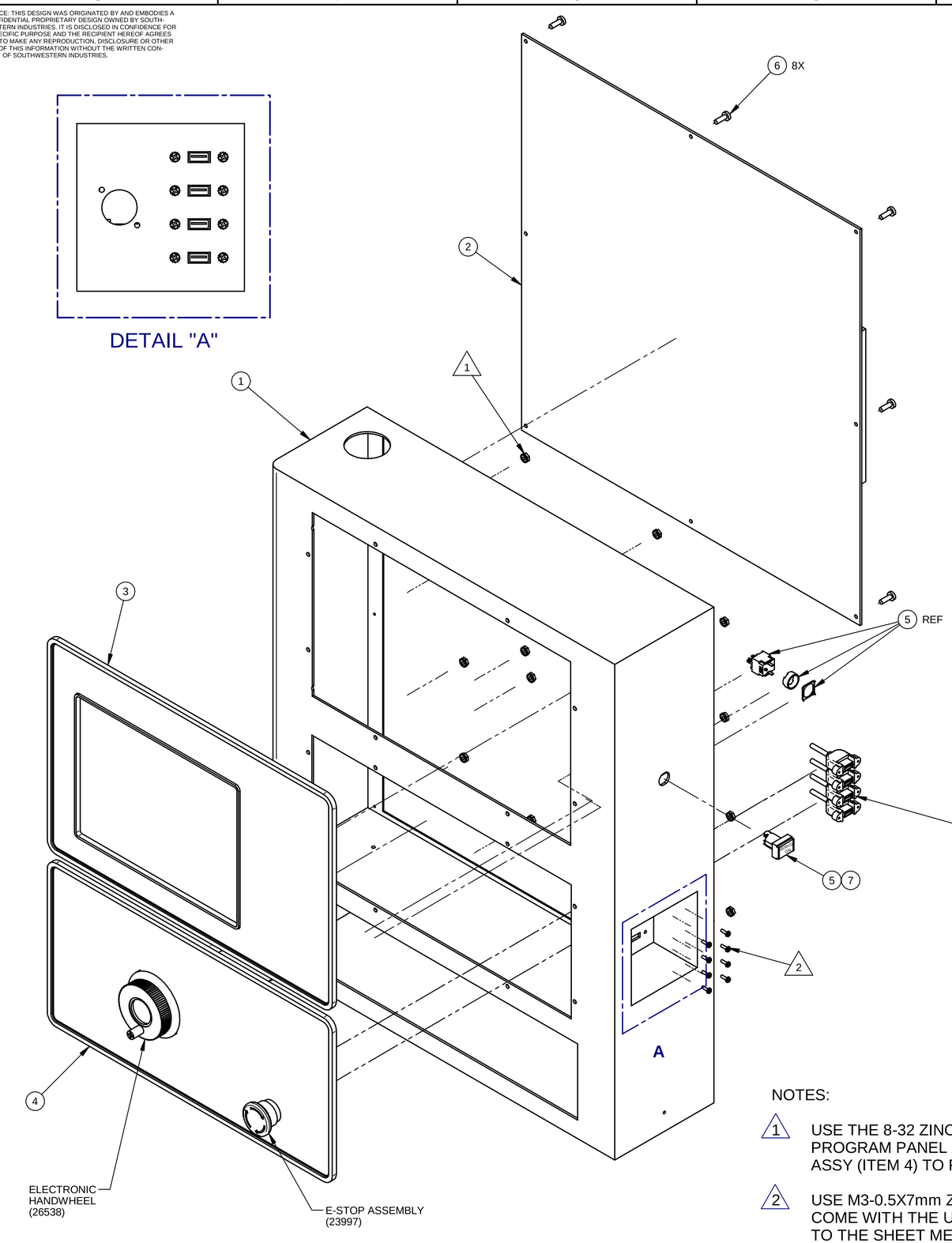
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13546	11.20.09	LG

DETAIL "A"



1 - VGA CABLE(26511-240)

2 - COM PORT CABLE (25700-180)

3 - HANDWHEEL CABLE (26515)

4 - USB CABLE (26510-5.0)

5 - E-STOP CABLE (26508-1)

6 - SERVO-ON ASSY (26591)

7 - OVERLAY POWER CABLE (26513)

8 - GROUND WIRE

9 - LCD POWER CABLE (26516)

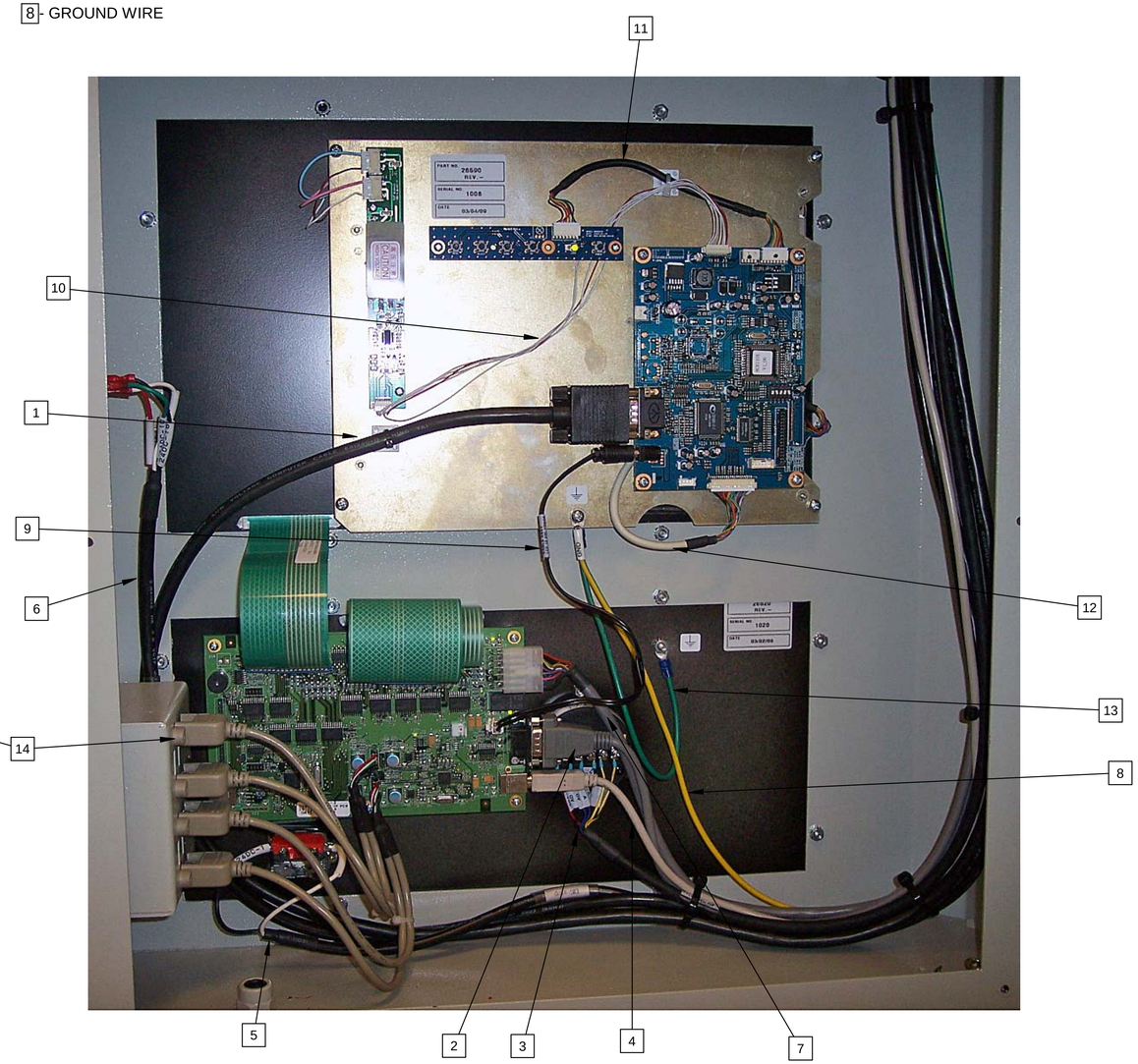
10 - LCD INVERTER POWER CABLE (26580-6)

11 - LCD USER INTERFACE CABLE (26580-5)

12 - LCD CABLE (26580-4)

13 - GROUND WIRE

14 - USB CABLE (24047-6) **2X**



NOTES:

1. USE THE 8-32 ZINC NUTS THAT COME WITH PROGRAM PANEL ASSY (ITEM 3) AND RUN PANEL ASSY (ITEM 4) TO FASTEN TO SHEET METAL.

2. USE M3-0.5X7mm ZINC PHILIPS SCREW , THAT COME WITH THE USB CABLES TO FASTEN THEM TO THE SHEET METAL.

SEE SEPARATE "A" SIZE SHEET FOR PARTS LIST

	PT7
NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0°30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS		DATE
DRAWN BY	RC	04-14-08
ENGINEER	LG	11/20/09
ENGINEER		
FE		

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: PENDANT ASSEMBLY

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26584	-

SCALE: - SHEET 1 OF 1

Parts List for Assembly P/N: 26584

Printed 11/20/2009

26584

PENDANT ASSEMBLY
LPM

Type	PL	Dwg Size	D
Revision	-	Product	LPM
Status	R	Engineer	LG
Date	4/17/2008	Planner Code	
By	RC	Comm Code	

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(t)	Mfr	Mfr P/N
1	26584-1	SHEETMETAL - CONTROL PANEL	LPM	-	EA	1	R			
2	26584-2	SHEETMETAL-CONTROL-BACK PANEL	LPM	-	EA	1	R			
3	26590	PANEL ASSY-PROGRAM		-	EA	1	R			
4	26520	PANEL ASSY-RUN		-	EA	1	R			
5	26716	PUSH BUTTON-MOMENTARY-ILLUMINATED		-	EA	1	R		PING JENG	40801824
6	M5-0.8X12 10Z	SCREW-PH-PHIL-STL-ZINC			EA	8	R			
7	27627	LABEL-TEXT-SERVO ON		-	EA	1	R		BROTHER	TZ-241

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

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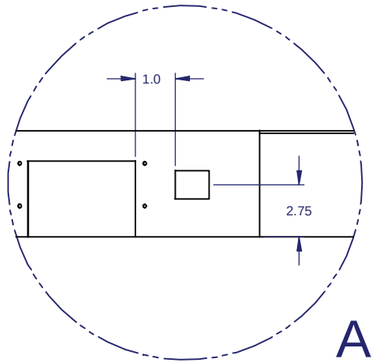
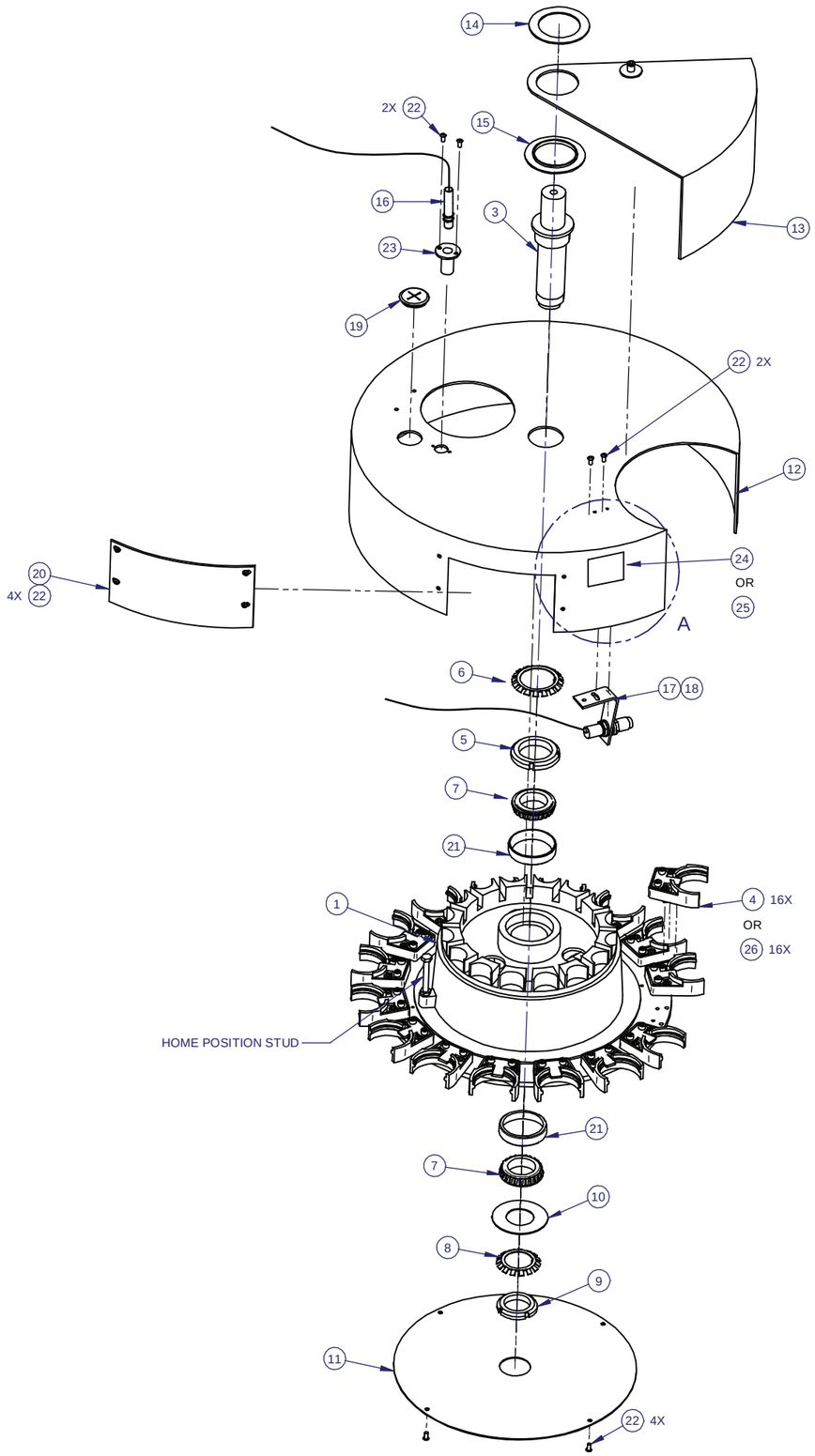
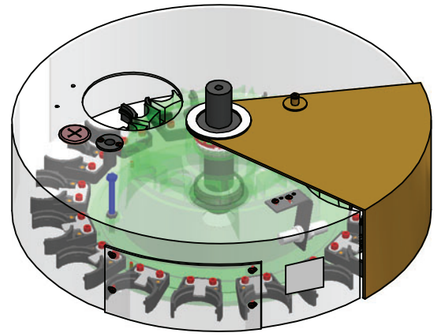
REVISIONS

REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13543	9.23.09	LG
A	ADDED ITEMS 23-26, ITEM 16 WAS: -3	13863	10.10.11	LG







SEE SEPARATE "A" SIZE SHEET FOR PARTS LIST

NOTES: (UNLESS OTHERWISE SPECIFIED).

NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0°30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS		DATE
DRAWN BY	RC	1/15/09
ENGINEER	LG	9/23/09
ENGINEER		
FE		

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: ATC ASSY-LOWER

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26784	A

SCALE: - SHEET 1 OF 1

Parts List for Assembly P/N: 26784

Printed 10/10/2011

26784
ATC ASSY-LOWER

WHEN UPDATING THIS DOCUMENT REVISE PURCHASING SPEC 26500

Type	PL	Dwg Size	D
Revision	A	Product	LPM
Status	R	Engineer	LG
Date	1/13/2009	Planner Code	
By	RC	Comm Code	

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(t	Mfr	Mfr P/N
1	26781	PLATE-MAGAZINE/GENEVA		-	EA	1	R		PING JENG	DAX470360
3	26786	ARBOR		-	EA	1	R		PING JENG	DCX410470
4	26802	GRIPPER ASSY - TOOL CHANGER-CAT 40		A	EA	16	R			
5	26787	SHAFT-LOCK NUT		-	EA	1	R		PING JENG	GHWB00040
6	26788	SHAFT-LOCK WASHER		-	EA	1	R		PING JENG	GHWA00040
7	26789	BEARING-TAPER ROLLER		-	EA	2	R		PING JENG	GKW032008
8	26790	SHAFT-LOCK WASHER		-	EA	1	R		PING JENG	GHWA00050
9	26791	SHAFT-LOCK NUT		-	EA	1	R		PING JENG	GHWB00050
10	26792	COVER-BEARING		-	EA	1	R		PING JENG	ILC3019A
11	26793	COVER-LOWER		-	EA	1	R		PING JENG	ILE1040A
12	26794	SHROUD		-	EA	1	R		PING JENG	DAX431740
13	26795	SHROUD-DOOR		-	EA	1	R		PING JENG	DAX430110
14	26796	WASHER-NYLON-FLAT		-	EA	1	R		PING JENG	DEX410270
15	26797	WASHER-NYLON-STEP		-	EA	1	R		PING JENG	DEX410260
16	26074-2	SENSOR-ATC MOTOR COUNTER/HOME PROXIMITY		A	EA	1	R		PING JENG	EAWB00001A
17	26074-1	SENSOR-ATC TOOL DETECT		A	EA	1	R			CDR-10XB
18	26815-1	BRACKET-TOOL DETECT SENSOR		A	EA	1	R		PING JENG	F1000001/ILC1018A
19	26779	GROMMET-SEAL		-	EA	1	R			
20	26778	WINDOW-TOOL		-	EA	1	R			
21	26789-1	RING-TAPER ROLLER BEARING		-	EA	2	R		PING JENG	G1300M50

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(t	Mfr	Mfr P/N
22	M5-0.8X10 27B	SCREW-BHCS-STL-BO		-	EA	12	R			
23	26365	SENSOR-HOLDER		-	EA	1	R			
24	23837-1	LABEL-CAT40 TOOLING		-	EA	1	R			
25	23837-2	LABEL-BT40 TOOLING		-	EA	(1)	R			
26	26802-1	GRIPPER ASSY - TOOL CHANGER-BT-40		A	EA	(16)	R			

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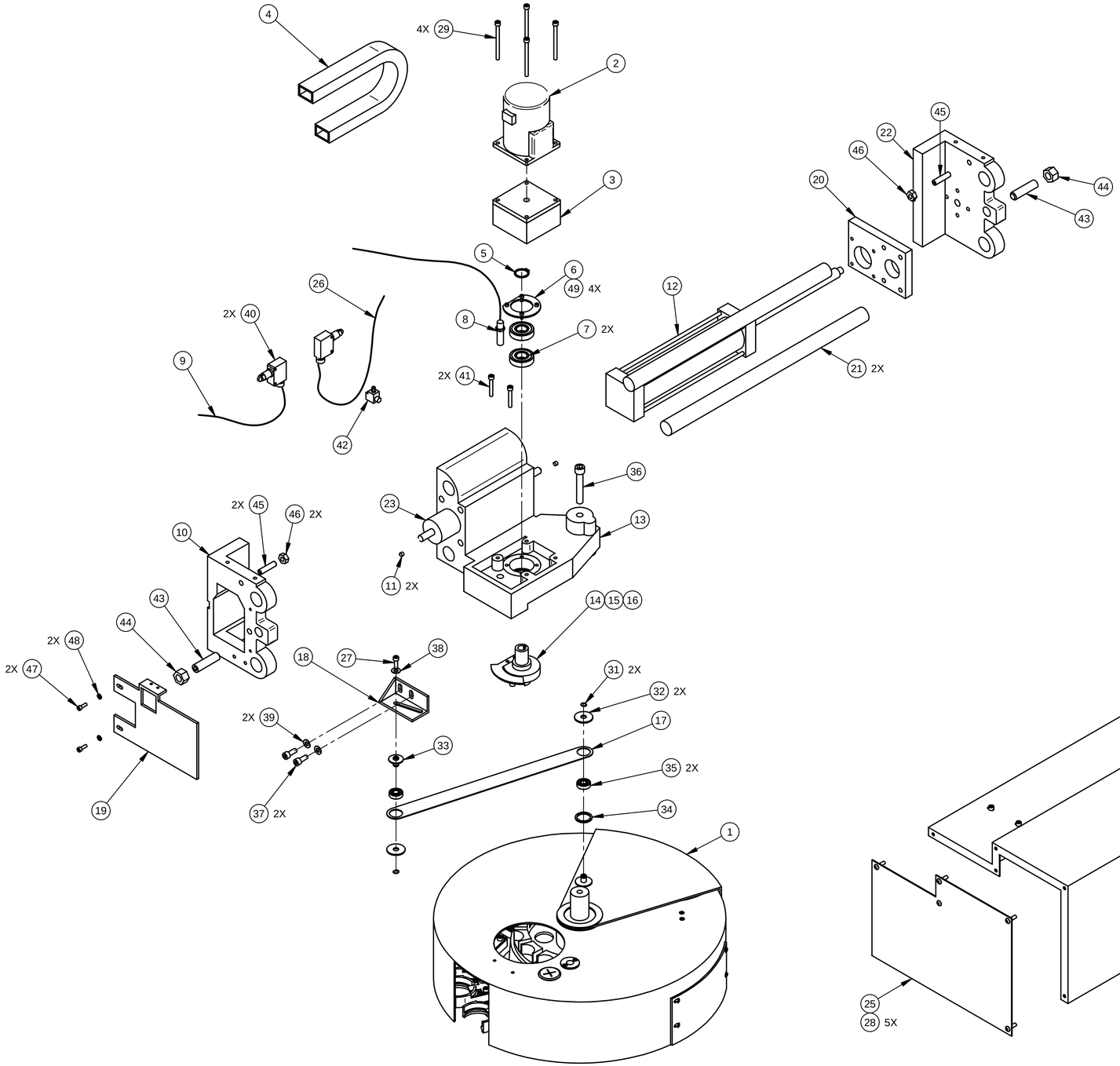
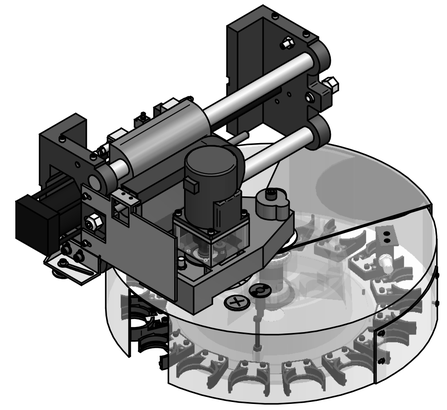
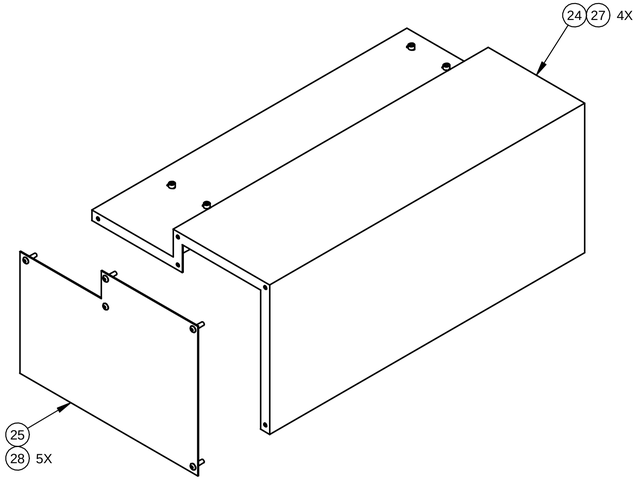
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13543	9.23.09	LG







SEE SEPARATE "A" SIZE SHEET FOR PARTS LIST

NOTES: (UNLESS OTHERWISE SPECIFIED).

		DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0°30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS	DATE	SOUTHWESTERN INDUSTRIES, INC. 2615 HOMESTEAD PLACE RANCHO DOMINGUEZ, CA 90220-5610	
			DRAWN BY RC	2/16/09		
			ENGINEER LG	9/23/09	TITLE: ATC ASSY-UPPER	
			ENGINEER			
			FE			
NEXT ASSY	USED ON	MATERIAL: -	THIRD ANGLE PROJECTION		SIZE: D	CODE IDENT. NO.: 06238	DWG NO.: 26811	REV: -
APPLICATION		FINISH: -			SCALE: -		SHEET 1 OF 1	

Parts List for Assembly P/N: 26811

Printed 9/23/2009

26811
ATC ASSY-UPPER

Type	PL	Dwg Size	C
Revision	-	Product	LPM
Status	R	Engineer	LG
Date	2/10/2009	Planner Code	
By	RC	Comm Code	

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(t)	Mfr	Mfr P/N
1	26784	ATC ASSY-LOWER		-	EA	1	R		PING JENG	700A0702
2	26735	MOTOR-3 PHASE INDUCTOR-TOOL CHANGER WITH BRAKE		-	EA	1	R		LI MING	CM09G905B
3	26735-1	GEAR BOX-ATC MOTOR		-	EA	1	R		LI MING	CG09825S15
4	26811-13	CARRIER-CABLE		-	EA	1	R		PING JENG	DAX480240
5	26811-8	RING-RETAINING		-	EA	1	R		PING JENG	F6300S25
6	26811-6	PLATE-BEARING RETAINER		-	EA	1	R		PING JENG	ILC1034A
7	6005ZZ	BEARING-DEEP GROOVE		-	EA	2	R			6005ZZ
8	26074-2	SENSOR-ATC MOTOR COUNTER		-	EA	1	R		PING JENG	EAWB00001A
9	26677-3	CABLE ASSY - LIMIT SWITCH - TOOL CHANGER OUT		-	EA	1	R			EAWA00001
10	26811-17	BRACKET-SLIDING BODY SUPPORT	LEFT	-	EA	1	R		PING JENG	DA42001A
11	26811-18	CUSHION		-	EA	2	R		PING JENG	DAX410130
12	26811-2	CYLINDER-IN & OUT TOOL CHANGE	(230mm STROKE)	-	EA	1	R		AIR TAC	SC63X230
13	26811-16	BODY-SLIDING		-	EA	1	R		PING JENG	DA42003A
14	26811-10	WHEEL-INDEXING AND LOCKING SEGMENT		-	EA	1	R		PING JENG	DCX410440
15	26811-11	PLATE-SENSOR		-	EA	1	R		PING JENG	DA43009A
16	26811-19	SHAFT-CAM DRIVE		-	EA	1	R		PING JENG	DCX410270
17	26811-14	PLATE-DOOR COVER PULLING LINKAGE		-	EA	1	R		PING JENG	DA43008A
18	26811-15	BRACKET-DOOR PULLING		-	EA	1	R		PING JENG	DA43005A

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(t)	Mfr	Mfr P/N
19	26811-12	BRACKET-CABLE CARRIER SUPPORT		-	EA	1	R		PING JENG	
20	26811-4	BRACKET-CYLINDER		-	EA	1	R		PING JENG	DA41004A
21	26811-3	WAY-ROUND BAR		-	EA	2	R		PING JENG	DAX410150
22	26811-1	BRACKET-SLIDING BODY SUPPORT	RIGHT	-	EA	1	R		PING JENG	DA42002A
23	26811-5	CYLINDER-CUSHION		-	EA	1	R		PING JENG	DA4900001
24	26811-20	COVER-TOP		-	EA	1	R		PING JENG	DA43015A
25	26811-21	COVER-SIDE		-	EA	1	R		PING JENG	
26	26677-4	CABLE ASSY - LIMIT SWITCH - TOOL CHANGER IN		-	EA	1	R			
27	M6-1.0X15 25B	SCREW-SHCS-STL-BO			EA	5	R			
28	M6-1.0X10 27B	SCREW-BHCS-STL-BO			EA	5	R			
29	M6-1.0X80 25B	SCREW-SHCS-STL-BO			EA	4	R			
31	26811-25	RETAINING RING		-	EA	2	R		PING JENG	
32	26811-22	SPACER		-	EA	2	R		PING JENG	
33	26811-23	STUD		-	EA	1	R		PING JENG	
34	26811-24	SPACER		-	EA	1	R		PING JENG	
35	6000Z	BEARING-DEEP GROVE		-	EA	2	R			
36	M12-1.75X50 25B	SCREW-SHCS-STL-BO		-	EA	1	R			
37	M8-1.25X20 25B	SCREW-SHCS-STL-BO			EA	2	R			
38	M6 70B	WASHER-FLAT USS-STL-BO		-	EA	1	R			
39	M8 70B	WASHER-FLAT USS-STL-BO			EA	2	R			
40	22680-3	SWITCH-LIMIT-ATC CYLINDER IN & OUT		-	EA	2	R		PING JENG	EAWA00001
41	M6-1.0X35 25B	SCREW-SHCS-STL-BO		-	EA	2	R		GOSAN	92235
42	26969	FITTING-GREASE-ATC UPPER		-	EA	1	R			

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(t)	Mfr	Mfr P/N
43	M20-2.5 X50	ADJUSTMENT SCREW		-	EA	2	R			
44	M20-2.5 50B	NUT-HEX-STL-BO		-	EA	2	R		PJ	
45	M10-1.5 X40	ADJUSTMENT SCREW		-	EA	2	R		WEY YII	
46	M10-1.5 50B	NUT-HEX-STL-BO			EA	2	R		PJ	
47	M5-0.8X20 25B	SCREW-SHCS-STL-BO		-	EA	2	R		PJ	
48	M5 70B	WASHER-FLAT USS-STL-BO			EA	2	R			
49	M4-0.7X10 25B	SCREW-SHCS-STL-BO			EA	4	R			

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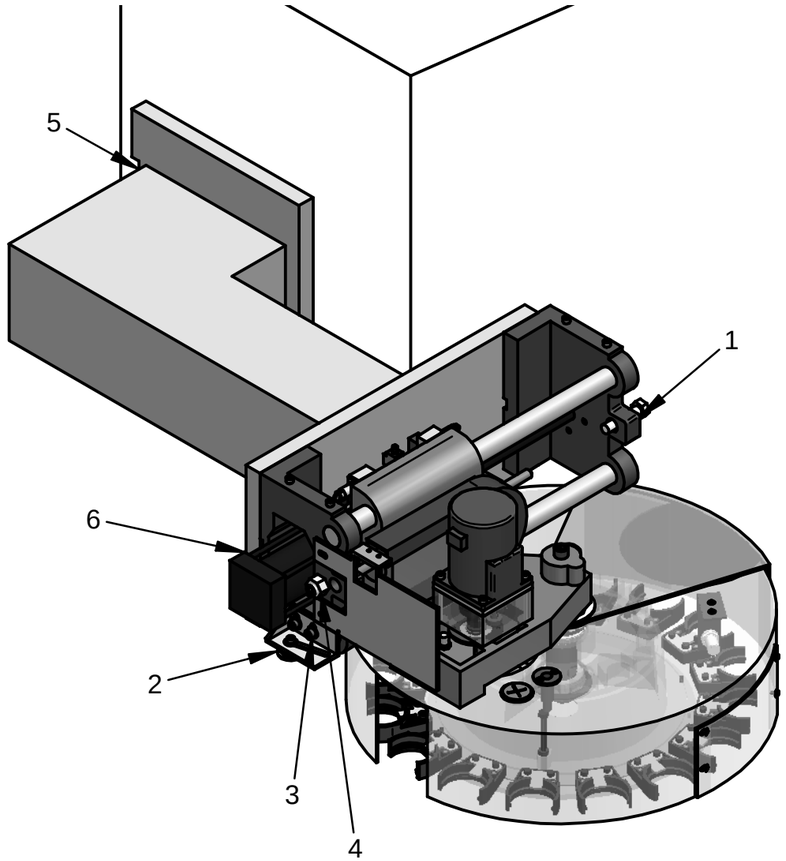
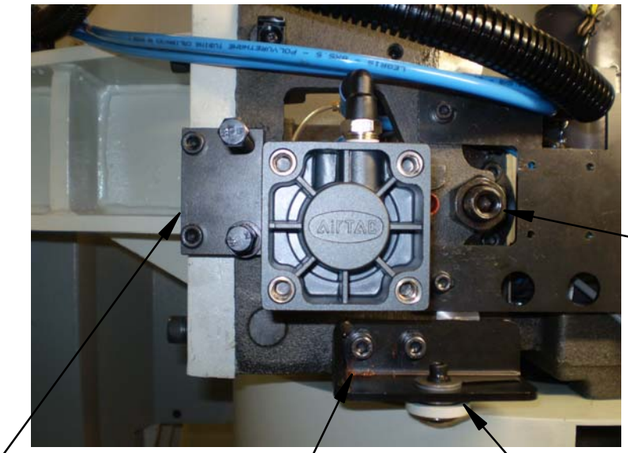
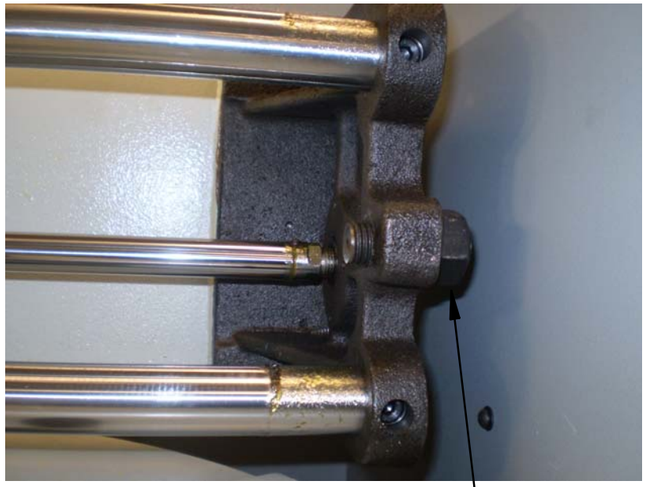
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13543	9.23.09	LG



PUSH-PULL BRACKET
IN THE "Y" DIRECTION (5)



SLIDING ASSEMBLY, TRAVEL
ADJUSTMENT SCREW, OUT (4)



SLIDING ASSEMBLY, TRAVEL
ADJUSTMENT SCREW, IN (1)

PUSH-PULL BRACKET
IN THE "X" DIRECTION (6)

ARM LEVEL
ADJUSTMENT (3)

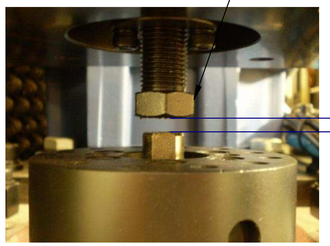
DOOR OPENING
ADJUSTMENT (2)

		DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0°30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS / DATE	**SOUTHWESTERN INDUSTRIES, INC.** 2615 HOMESTEAD PLACE RANCHO DOMINGUEZ, CA 90220-5610
			DRAWN BY RC 8/6/09	TITLE: ATC- ADJUSTMENTS
			ENGINEER LG 9/23/09	
			ENGINEER	
		MATERIAL: -	FE	SIZE: B; CODE IDENT. NO.: 06238; DWG NO.: 26966; REV: -
NEXT ASSY	USED ON		THIRD ANGLE PROJECTION	
APPLICATION		FINISH: -		SCALE: - ; SHEET 1 OF 1

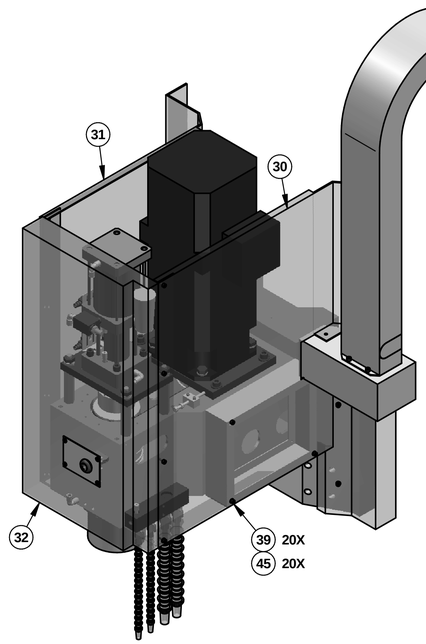
NOTICE: THIS DESIGN WAS ORIGINATED BY AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN OWNED BY SOUTHWESTERN INDUSTRIES. IT IS DISCLOSED IN CONFIDENCE FOR A SPECIFIC PURPOSE AND THE RECIPIENT HEREOF AGREES NOT TO MAKE ANY REPRODUCTION, DISCLOSURE OR OTHER USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES.

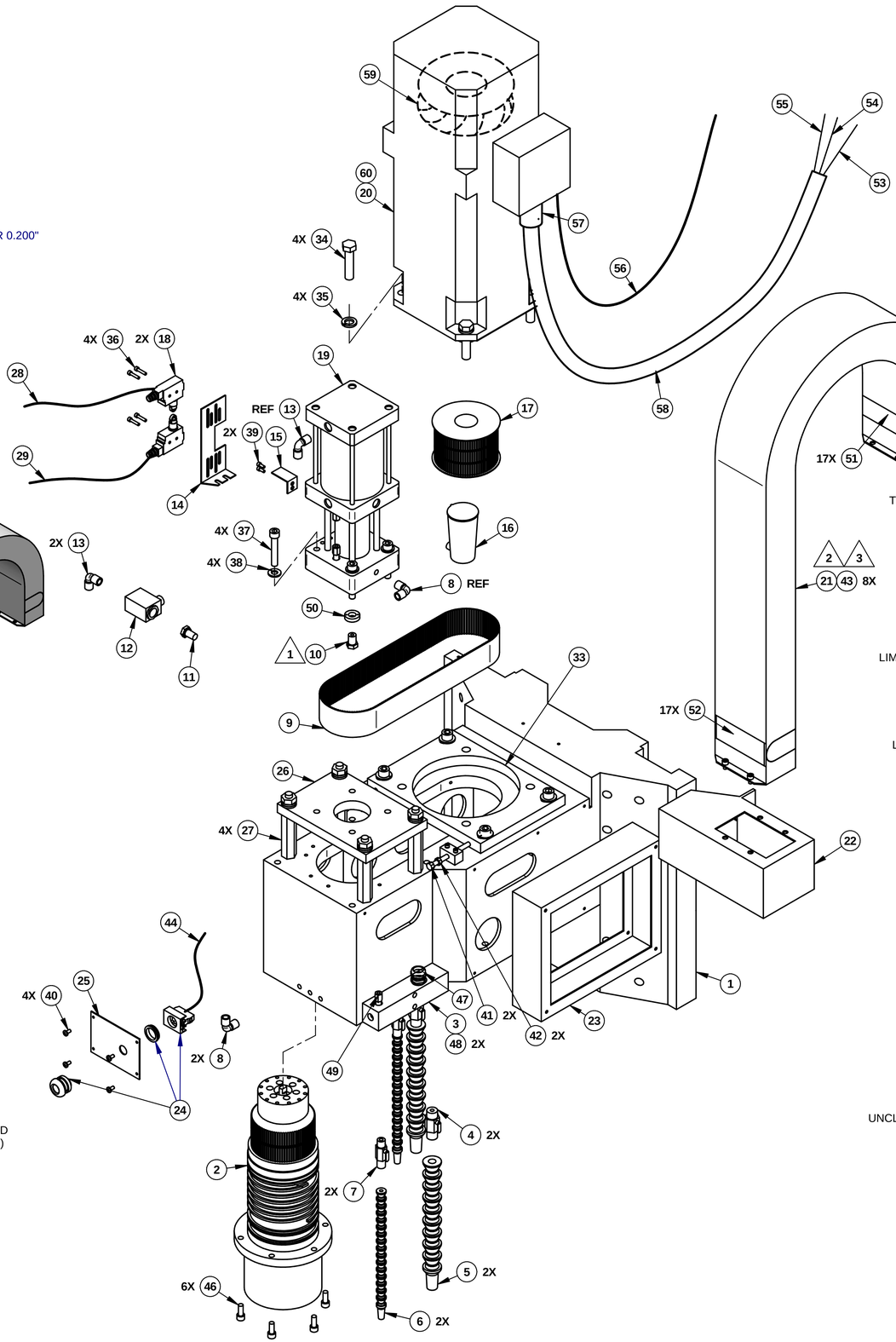
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13547	11.16.09	LG
A	ADDED ITEMS 53-58	13591	1.20.10	RO
B	ADDED ITEM 59 & NOTE 3	13679	11.5.10	LG
C	REVISED NOTES 2 & 3, ITEM 21 WAS:26891, ITEM 51 WAS:27625, ITEM 52 WAS:27625-1	13835	5.16.11	PM
D	ADDED ITEM 60	14125	9¦13¦13	LG

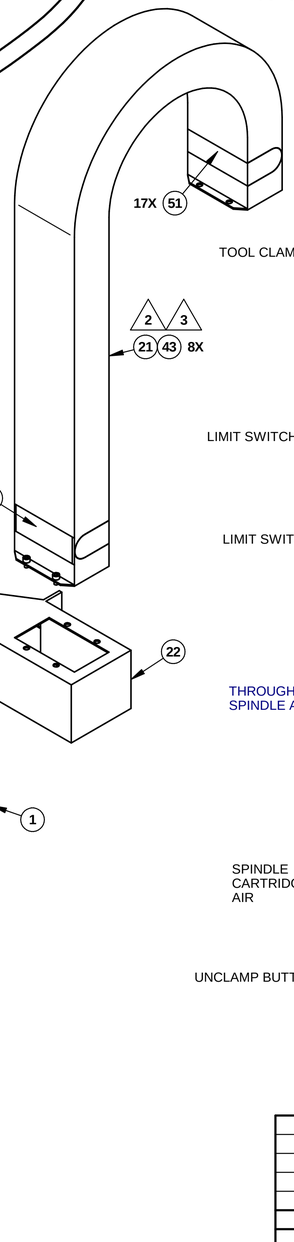
PICTURE 1



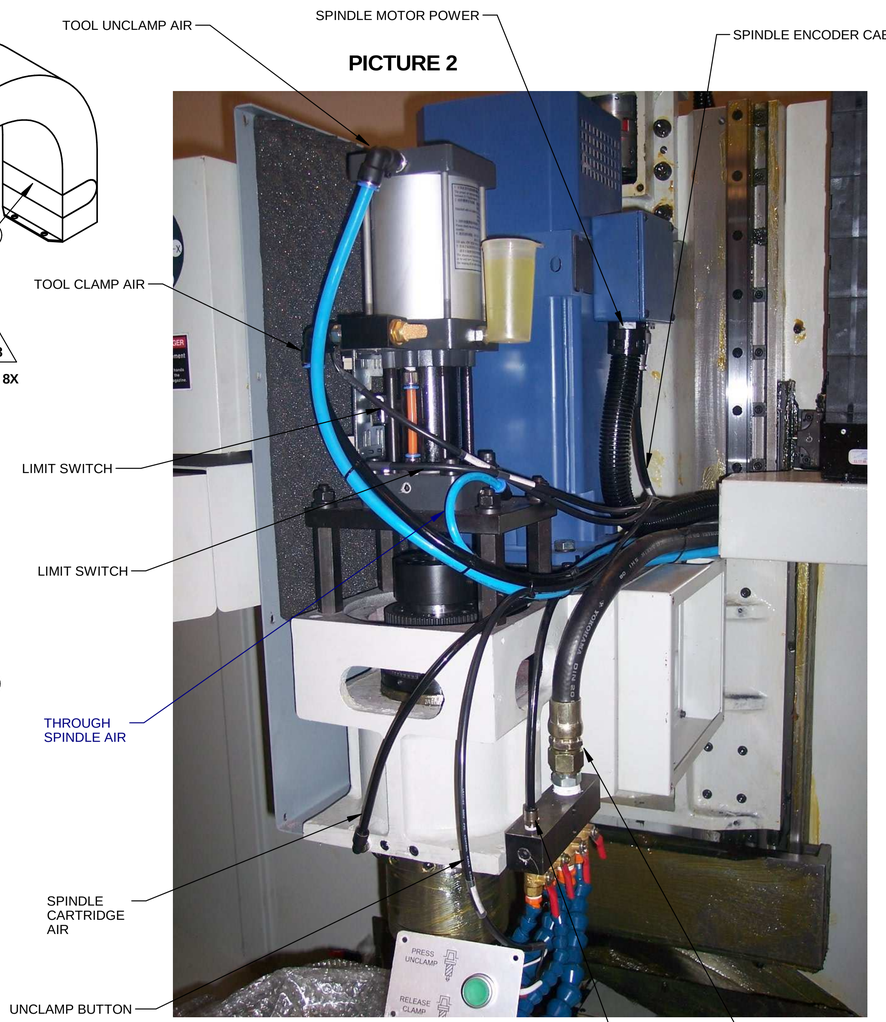
ADJUSTING UNCLAMP CYLINDER BOLT







PICTURE 2



NOTES: (UNLESS OTHERWISE SPECIFIED).

1. UNCLAMP CYLINDER BOLT (ITEM 10) IS A LEFT HANDED THREAD AND TO BE ADJUSTED TO 5mm OR 0.200" GAP. (SEE PICTURE 1)
2. CURRENT CABLE CARRIER AS OF 4/2011 ITEM 21 (26891-3) CONSISTS OF ITEM 51 (27625-4) AND ITEM 52 (27625-5).
3. THERE ARE THREE GENEARATIONS OF CABLE CARRIERS SEE LINKS BELOW:

   FIRST GENERATION 26891-2 CONSISTS OF 27625-2 & 27625-3.

   SECOND GENERATION 26891 CONSISTS OF 27625 & 27625-1.

   THIRD GENERATION 26891-3 CONSISTS OF 27625-4 & 27625-5.

SEE SEPARATE "A" SIZE SHEET FOR PARTS LIST

		DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0'30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS	DATE	SOUTHWESTERN INDUSTRIES, INC. 2615 HOMESTEAD PLACE RANCHO DOMINGUEZ, CA 90220-5610	
			DRAWN BY RC	6/18/09		
			ENGINEER LG	11/16/09	TITLE: HEAD ASSY	
			ENGINEER			
		MATERIAL -	FE			
NEXT ASSY	USED ON		THIRD ANGLE PROJECTION		SIZE D	CODE IDENT. NO. 06238	DWG NO. 26854	REV D
APPLICATION		FINISH -			SCALE: -		SHEET 1 OF 1	

Parts List for Assembly P/N: 26854

Printed 9/13/2013

26854
HEAD ASSY

Type	PL	Dwg Size	D
Revision	D	Product	LPM
Status	R	Engineer	LG
Date	6/12/2009	Planner Code	
By	RC	Comm Code	

Item	P/N	Title	Detail	Rev	Qty	UseAs	Stat	Type	Mfr	Mfr P/N
1	26757	COLUMN CASTING		-	1	EA	R	PL	PING JENG	700A0603
2	26848	SPINDLE CARTRIDGE ASSY		-	1	EA	R	PL	ROYAL	RB4076
3	26893	MANIFOLD-AIR/COOLANT		-	1	EA	R	PS		
4	26899-1	VALVE-ON/OFF-COOLANT-NOZZLE	3/8"	-	2	EA	R	PS	PING JENG	50160151
5	20714-1	NOZZLE-COOLANT	3/8"	-	2	EA	R	DWG		
6	20714-2	NOZZLE-AIR BLAST/COOLANT WASH-LONG	1/4"	-	2	EA	R	DWG		
7	26899	VALVE-ON/OFF-AIR-NOZZLE	1/4"	-	2	EA	R	PS	PING JENG	50060155
8	26898	FITTING-AIR-90°		-	2	EA	R	PS	MSC	48683445
9	26856	BELT-SPINDLE-PULLEY		-	1	EA	R	PS	GATES	830-5GT-40
10	26853-1	BOLT-ADJUSTING-UNCLAMP CYLINDER		-	1	EA	R	PS		
11	26858	MUFFLER-CONE FILTER		-	1	EA	R	PS		
12	26857	MANIFOLD-AIR-CYLINDER		-	1	EA	R	PS	PING JENG	5011006
13	26898-1	FITTING-AIR-90°		-	2	EA	R	PS	MSC	48682876
14	26861	BRACKET-LIMIT SWITCH		-	1	EA	R	PS		
15	26861-1	BRACKET-L-LIMIT SWITCH		-	1	EA	R	PS		
16	26859	RESERVOIR-OIL-AIR CYLINDER		-	1	EA	R	PS	PING JENG	50309013
17	26855	PULLEY-SPINDLE MOTOR		-	1	EA	R	PS	PING JENG	64000040
18	22680-2	SWITCH - LIMIT		-	2	EA	R	PS	OMRON	SHL-Q2255
19	26853	CYLINDER-TOOL CLAMP/UNCLAMP		-	1	EA	R	PS	PING JENG	50110038
20	26849	MOTOR-SPINDLE-INDUCTION-10HP		-	1	EA	R	PS	SOL POWER	SVM-100M-15
21	26891-3	CARRIER-CABLE	THIRD GENERATION	-	1	EA	R	PS		

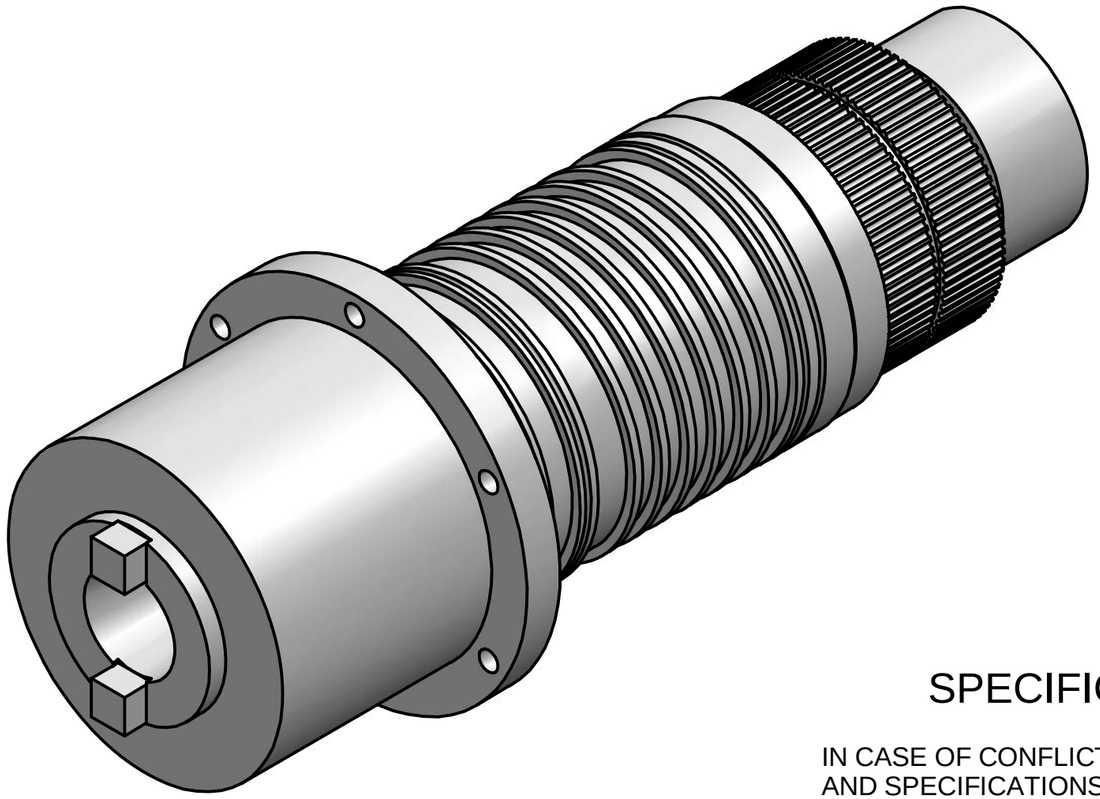
Item	P/N	Title	Detail	Rev	Qty	UseAs	Stat	Type	Mfr	Mfr P/N
22	26879	BRACKET-CABLE CARRIER		-	1	EA	R	PS		
23	26880	BRACKET-COVER		-	1	EA	R	PS		
24	22874-1	PUSH BUTTON-RESET-N.O. CONTACT	TOOL UNCLAMP	B	1	EA	R	DWG		
25	26921	SHEET METAL-UNCLAMP-BUTTON		-	1	EA	R	PS		
26	26851	BRACKET-AIR CYLINDER		-	1	EA	R	PL		
27	26852	POST-CYLINDER SEAT		-	4	EA	R	PL		
28	26677-1	CABLE ASSY-LIMIT SWITCH-TOOL CLAMP		-	1	EA	R	PL		
29	26677-2	CABLE ASSY-LIMIT SWITCH-TOOL UNCLAMP		-	1	EA	R	PL		
30	26892	COVER-HEAD ASSY	RIGHT	-	1	EA	R	PS		
31	26892-1	COVER-HEAD ASSY	LEFT	-	1	EA	R	PS		
32	26892-2	COVER-HEAD ASSY	FRONT	-	1	EA	R	PS		
33	26850	BRACKET-SPINDLE MOTOR		-	1	EA	R	PS		
34	M12-1.75X40 24B	SCREW-HEX HD-STL-BO		-	4	EA	R	PS		
35	M12 73B	WASHER-SPLIT LOCK-STL-BO			4	EA	R	PS	WEY YII	
36	M5-0.8X25 25B	SCREW-SHCS-STL-BO	NON STOCKABLE	-	4	EA	R	PS		
37	M10-1.5X50 25B	SCREW-SHCS-STL-BO			4	EA	R	PS		
38	M10 73B	WASHER-SPLIT LOCK-STL-BO		-	4	EA	R	PS		
39	M5-0.8X12 25B	SCREW-SHCS-STL-BO		-	22	EA	R	PS		
40	M5-0.8X12 10B	SCREW-PH-PHIL-STL-BO			4	EA	R	PS		
41	M8-1.25X60 24B	SCREW-HEX HEAD-STL-BO		-	2	EA	R	PS		
42	M8-1.25 50B	NUT-HEX-BLK OX	NON-STOCKABLE	-	2	EA	R	PS		
43	M6-1.0X12 25B	SCREW-SHCS-STL-BO			8	EA	R	PS		
44	26673-6	CABLE ASSY-TOOL UNCLAMP BUTTON		-	1	EA	R	PL	PING JENG	40805643

Item	P/N	Title	Detail	Rev	Qty	UseAs	Stat	Type	Mfr	Mfr P/N
45	M5 70B	WASHER-FLAT USS-STL-BO			20	EA	R	PS		
46	M8-1.25X20 25B	SCREW-SHCS-STL-BO			6	EA	R	PS		
47	26974	FITTING-HYDRAULIC-STAIGHT		-	1	EA	R	PS		
48	M5-0.8X35 25B	SCREW-SHCS-STL-BO		-	2	EA	R	PS		
49	26898-2	FITTING-STRAIGHT-8MM QUICK DISCONNECT		-	1	EA	R	PS	MSC	48680813
50	26992	COLLAR-CLAMPING		-	1	EA	R	PS		
51	27625-4	SEGMENT-CABLE CARRIER		-	19	EA	R	PS		
52	27625-5	COVER-CABLE CARRIER-SEGMENT		-	19	EA	R	PS		
53	26671-1	CABLE ASSY-SPINDLE MOTOR-POWER		-	1	EA	R	PL		
54	26514	CABLE ASSY-SPINDLE MOTOR FAN		-	1	EA	R	PL		
55	26686	CABLE ASSY-SPINDLE MOTOR-TEMPERATURE SWITCH		-	1	EA	R	PL		
56	26940	CABLE ASSY-SPINDLE MOTOR-ENCODER		-	1	EA	R	PL	PING JENG	40805628
57	26834-13	FITTING-CONDUIT-STRAIGHT-THRU-METRIC	34mm BLACK	-	1	EA	R	PS	HEYCO	F8576
58	26835-5	TUBING-CONDUIT-NYLON	34mm	-	460	MM	R	DWG	HEYCO	F8434
59	26348	FAN - SPINDLE MOTOR		-	1	EA	R	PS		
60	26497	REPLACEMENT KIT-SPINDLE ENCODER-LPM		-	1	EA	R	PL		

NOTICE: THIS DESIGN WAS ORIGINATED BY AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN OWNED BY SOUTH-WESTERN INDUSTRIES. IT IS DISCLOSED IN CONFIDENCE FOR A SPECIFIC PURPOSE AND THE RECIPIENT HEREOF AGREES NOT TO MAKE ANY REPRODUCTION, DISCLOSURE OR OTHER USE OF THIS INFORMATION WITHOUT THE WRITTEN CON-SENT OF SOUTHWESTERN INDUSTRIES.

REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13547	11/16/09	LG

SPECIFICATIONS:



SPECIFICATION CONTROL DRAWING

IN CASE OF CONFLICT BETWEEN VENDOR SPECIFICATIONS FOR THIS PART AND SPECIFICATIONS OF THIS DRAWING, THE LATTER CONTROLS.

IDENTIFICATION OF THE "SUGGESTED SOURCE(S) OF SUPPLY" HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THE ITEM(S) DESCRIBED ON THE DRAWING.

NOTES: (UNLESS OTHERWISE SPECIFIED).

1. CHANGES BY VENDOR(S) AFFECTING THESE REQUIREMENTS MUST BE APPROVED BY ENGINEERING.

SWI P/N	SUPPLIER P/N	SUPPLIER	MFG P/N	MFG	DESCRIPTION
26848	50180546	PENG JING	RB4076	ROYAL	SPINDLE

SUGGESTED SOURCE (S) OF SUPPLY

NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0°30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS	DATE
DRAWN BY RC	6/11/09
ENGINEER LG	
MFE	
FE	

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA. 90220-5610

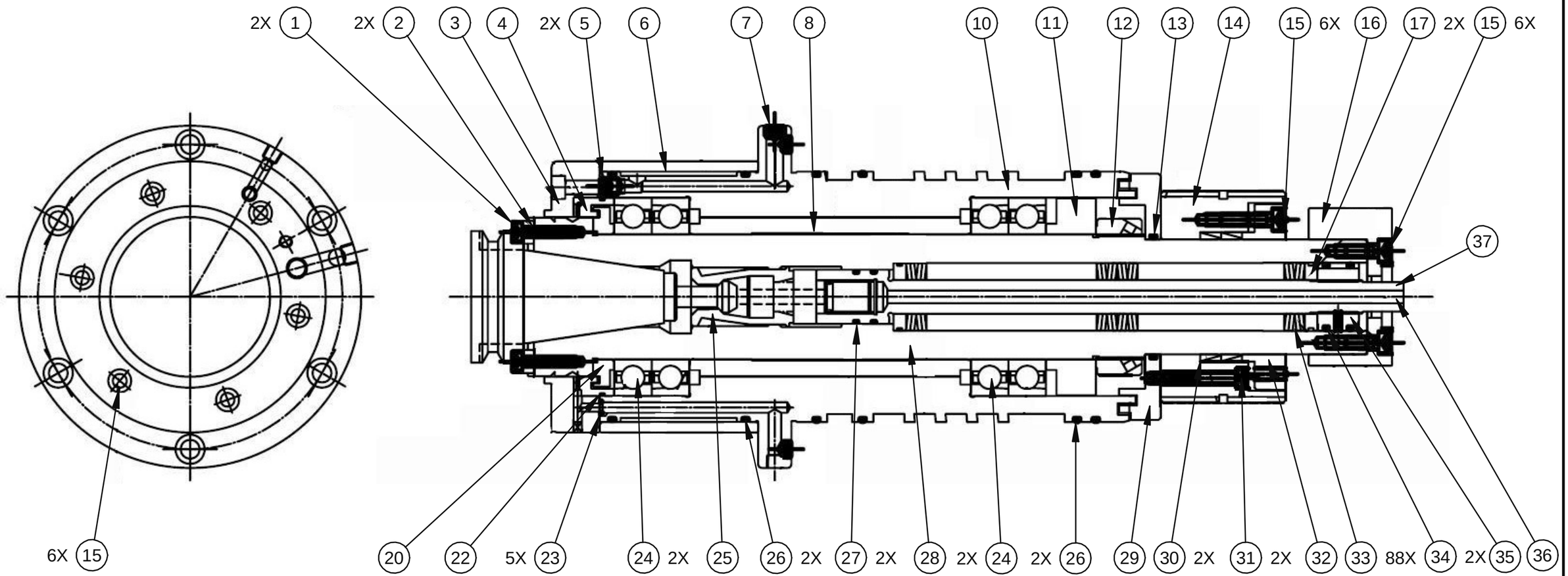
TITLE: SPINDLE CARTRIDGE ASSY

SIZE	CODE IDENT. NO.	DWG NO.	REV
B	06238	26848	-

SCALE: - SHEET 1 OF 2

NOTICE: THIS DESIGN WAS ORIGINATED BY AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN OWNED BY SOUTH-WESTERN INDUSTRIES. IT IS DISCLOSED IN CONFIDENCE FOR A SPECIFIC PURPOSE AND THE RECIPIENT HEREOF AGREES NOT TO MAKE ANY REPRODUCTION, DISCLOSURE OR OTHER USE OF THIS INFORMATION WITHOUT THE WRITTEN CON-SENT OF SOUTHWESTERN INDUSTRIES.

REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13547	11/16/09	LG



NOTES: (UNLESS OTHERWISE SPECIFIED).

2. ITEM 37 CONSISTS OF ITEMS 17, 27, 33, 34, 35, AND 36.

SEE SEPARATE "A" SIZE SHEET FOR PARTS LIST

NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0°30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS	DATE
DRAWN BY RC	6/11/09
ENGINEER LG	
MFE	
FE	

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA. 90220-5610

TITLE: SPINDLE CARTRIDGE ASSY

SIZE	CODE IDENT. NO.	DWG NO.	REV
B	06238	26848	-

SCALE: - SHEET 2 OF 2

Parts List for Assembly P/N: 26848

Printed 11/16/2009

26848
SPINDLE CARTRIDGE ASSY

Type	PL	Dwg Size	B
Revision	-	Product	LPM
Status	R	Engineer	LG
Date	6/10/2009	Planner Code	
By	RC	Comm Code	

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(t)	Mfr	Mfr P/N
1	M5-0.8X10 25B	SCREW-SHCS-STL-BO			EA	2	R		PJ	
2	26848-1	DRIVE-DOG		-	EA	2	R		PING JENG	R1055B
3	26848-2	COVER-FRONT		-	EA	1	R		PING JENG	R1076B-1
4	26848-3	COLLAR-INTERNAL		-	EA	1	R		PING JENG	R1082B
5	26848-30	PLUG	.062-28 BSPT	-	EA	2	R		PING JENG	PT 1/16X10
6	26848-4	COLLAR		-	EA	1	R		PING JENG	R1762A
7	26848-31	PLUG	.25-19 BSPT	-	EA	1	R		PING JENG	PT 18X6
8	26848-5	COLLAR-INTERNAL		-	EA	1	R		PING JENG	R1078C
10	26848-7	SPINDLE		-	EA	1	R		PING JENG	R1712B
11	26848-8	COLLAR		-	EA	1	R		PING JENG	R1118A
12	26848-9	SCREW-LOCK		-	EA	1	R		PING JENG	YFM602
13	26848-10	O-RING		-	EA	1	R		PING JENG	G05500
14	26848-11	PULLEY-SPINDLE		-	EA	1	R		PING JENG	R1080B
15	M6-1.0X25 25B	SCREW-SHCS-STL-BO			EA	18	R			
16	26848-12	WHEEL-POSITIONING		-	EA	1	R		PING JENG	R1722B
17	26848-13	SPACER		-	EA	2	R		PING JENG	R1121B-2
20	26848-14	COLLAR-OUTER		-	EA	1	R		PING JENG	R1042B
22	26848-16	O-RING		-	EA	1	R		PING JENG	C0 3010
23	26848-17	O-RING		-	EA	5	R		PING JENG	P00500
24	26848-18	BEARING - ANGULAR CONTACT		-	EA	4	R		PING JENG	701230
25	26848-19	FINGERS-CLAMPING		-	EA	1	R		PING JENG	BT40

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(t)	Mfr	Mfr P/N
26	26848-20	O-RING		-	EA	4	R		PING JENG	G11000
27	26848-21	O-RING		-	EA	2	R		PING JENG	P02200
28	26848-22	SPINDLE		-	EA	1	R		PING JENG	R1070D
29	26848-23	COLLAR		-	EA	1	R		PING JENG	R1079B-2
30	26848-24	KEY-CONE-SHAPE RING		-	EA	2	R		PING JENG	TLK300 55X62
31	M5-0.8X45 25B	SCREW-SHCS-STL-BO		-	EA	2	R			
32	26848-25	CAP-PULLEY RETAINING		-	EA	1	R		PING JENG	R1191A
33	26848-26	WASHER-BELLEVILLE		-	EA	88	R		PING JENG	31.5X16.3X2
34	26848-27	O-RING		-	EA	2	R		PING JENG	BP26x3.5
35	26848-28	LOCKNUT		-	EA	1	R		PING JENG	R1366B
36	26848-29	DRAW-BAR		-	EA	1	R		PING JENG	R1161D
37	27626	DRAW-BAR ASSY		-	EA	1	R			

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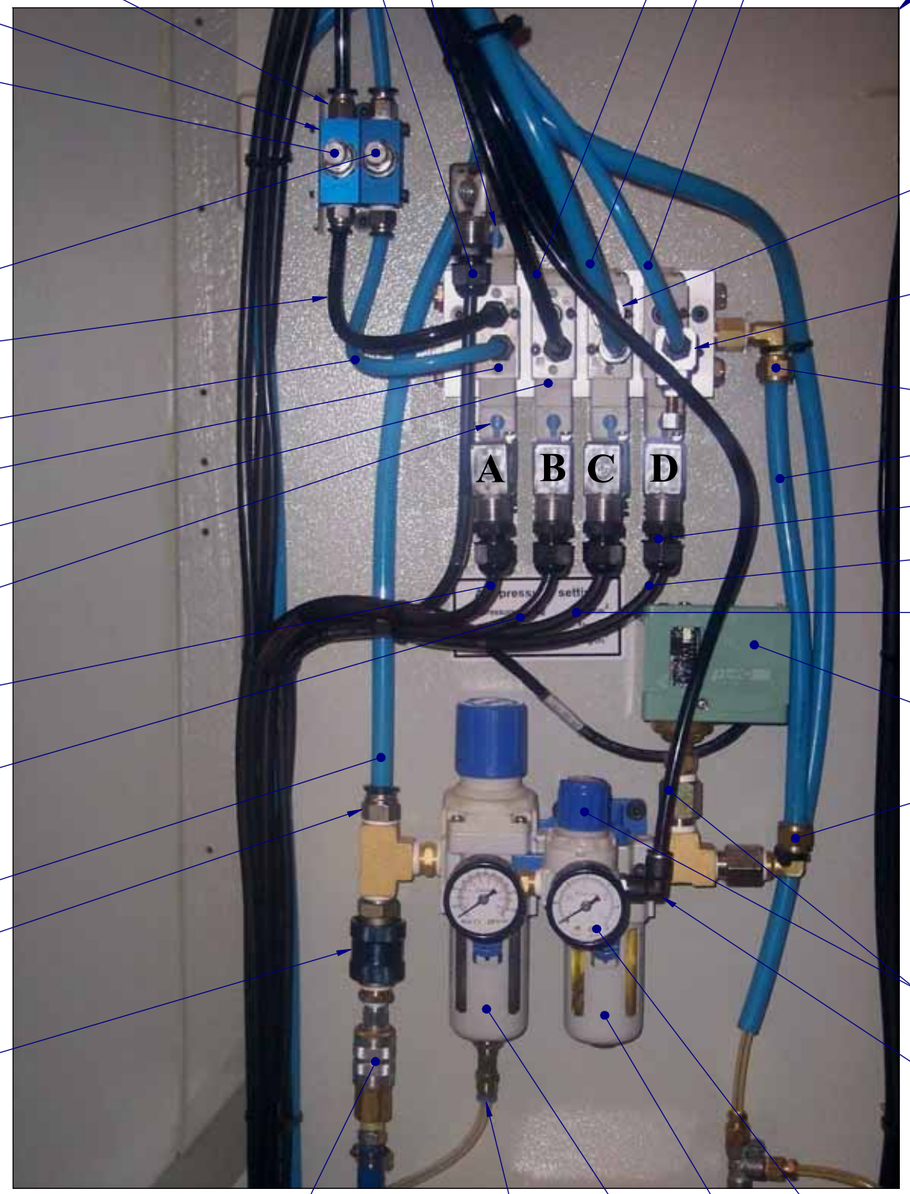
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13545	11/17/09	LG
A	UPDATED PRESUURE SWITCH NOTE ON SHEET 2.	13591	1.20.10	LG
B	ITEM 4 QTY WAS: 2; ITEM 6 WAS: 26936, ITEM 7 QTY WAS: 26938; ADDED ITEM 26,27	13686	12/15/10	RO



MANUAL OVERRIDE FOR SOLENOIDS OUT

FROM ELECTRICAL CABINET TB10-2 & RM2-K2-NO TOOL CHANGER IN (10)

7X (17)

2X (4)

AIR FLOW CONTROL VALVE ATC IN

AIR FLOW CONTROL VALVE ATC OUT

(14)

(16)

(7)

(B,C,D) 3X (6)

MANUAL OVERRIDE FOR SOLENOIDS IN

FROM ELECTRICAL CABINET TB13-2 & RM2-K1-NO TOOL CHANGER OUT (9)

FROM ELECTRICAL CABINET TB11-2 & RM1-K6-NO AIR TOOL BLAST (12)

TO AIR NOZZLE (15)

(21)

TURNS AIR OFF WHEN MOVED DOWNWARD (25)

AIR SUPPLY

(2)

(3)

(5)

AUTOMATIC MOISTURE DRAIN INTO AIR/COOLANT SEPARATOR ACTIVATES WHEN AIR PRESSURE TURNED OFF

TO AIR BLAST SPINDLE TOOL

(5) TO UNCLAMP SPINDLE TOOL

TO AIR PURGE THRU SPINDLE

SEE SHEET 2 FOR PNEUMATIC SCHEMATIC

(23) 2X

(27) VALVE CONTROLS AIR FLOW THRU SPINDLE

(18) 2X

(15)

(26) 5X

(11) FROM ELECTRICAL CABINET TB11-1 & RM1-K2-NO AIR FLOW THRU SPINDLE

(8) FROM ELECTRICAL CABINET TB12-1 & RM1-K1-NO TOOL UNCLAMP/CLAMP

(1)

(18) REF

AIR REGULATOR THAT CONTROLS AIR FLOW THRU SPINDLE CARTRIDGE

(20)

2X (22)

(24)

FROM UNCLAMP SPINDLE TOOL SOLENOID

FROM CLAMP SPINDLE TOOL SOLENOID (13)

FROM AIR FLOW THRU SPINDLE

(17)

FROM AIR FLOW THRU SPINDLE CARTRIDGE

(20)

FROM AIR BLAST

NOTES: UNLESS OTHERWISE SPECIFIED).

1. SOLENOID FUNCTIONS:
   A=ATC IN/OUT
   B=AIR BLAST
   C=DRAWBAR CLAMP/UNCLAMP TOOL
   D=AIR FLOW THRU SPINDLE

		DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0°30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS	DATE
			DRAWN BY SAL	06/19/09
			ENGINEER	
			ENGINEER	
		MATERIAL -	FE	
NEXT ASSY	USED ON	FINISH -	THIRD ANGLE PROJECTION	
APPLICATION				

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

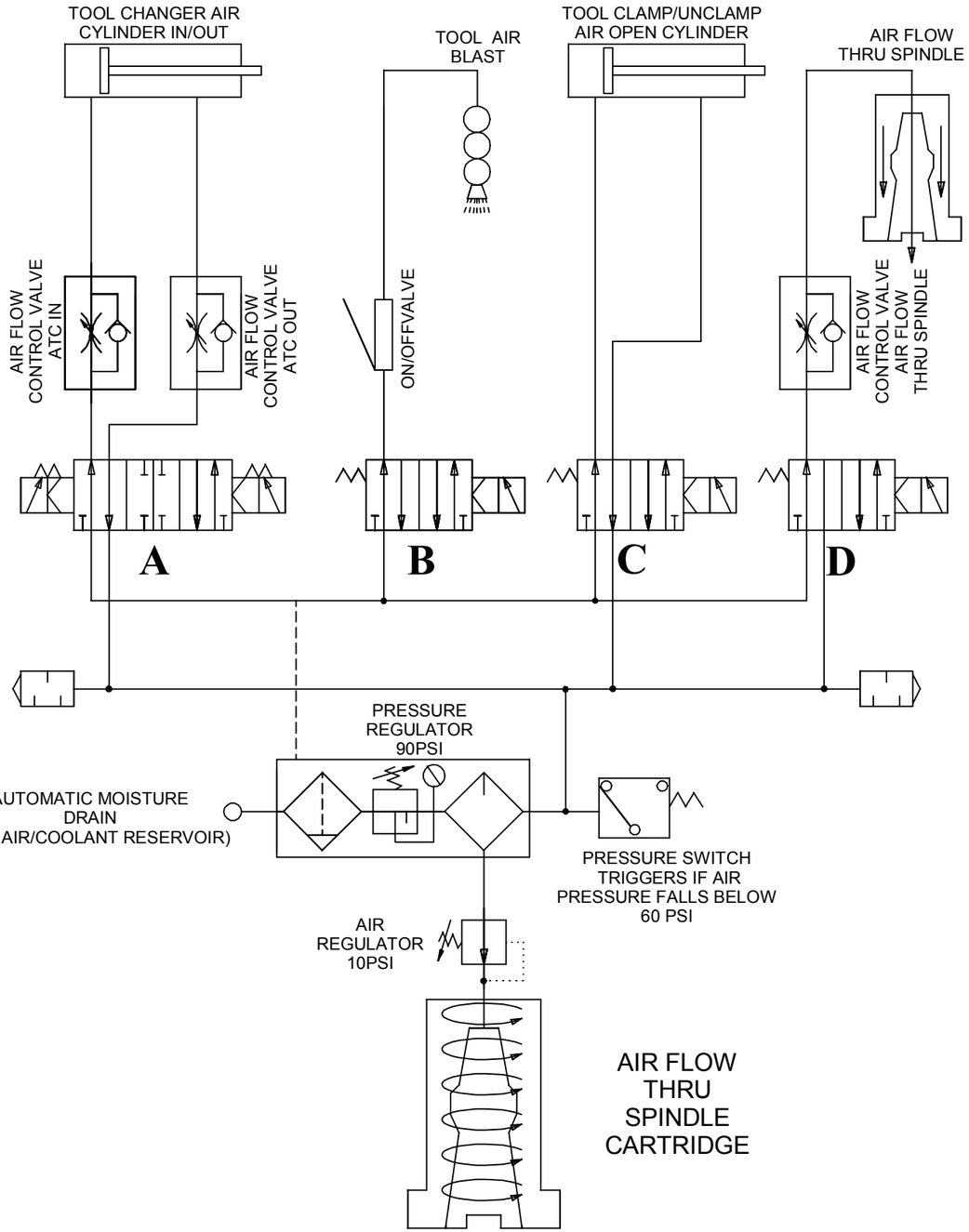
TITLE: PNEUMATIC ASSY-LPM

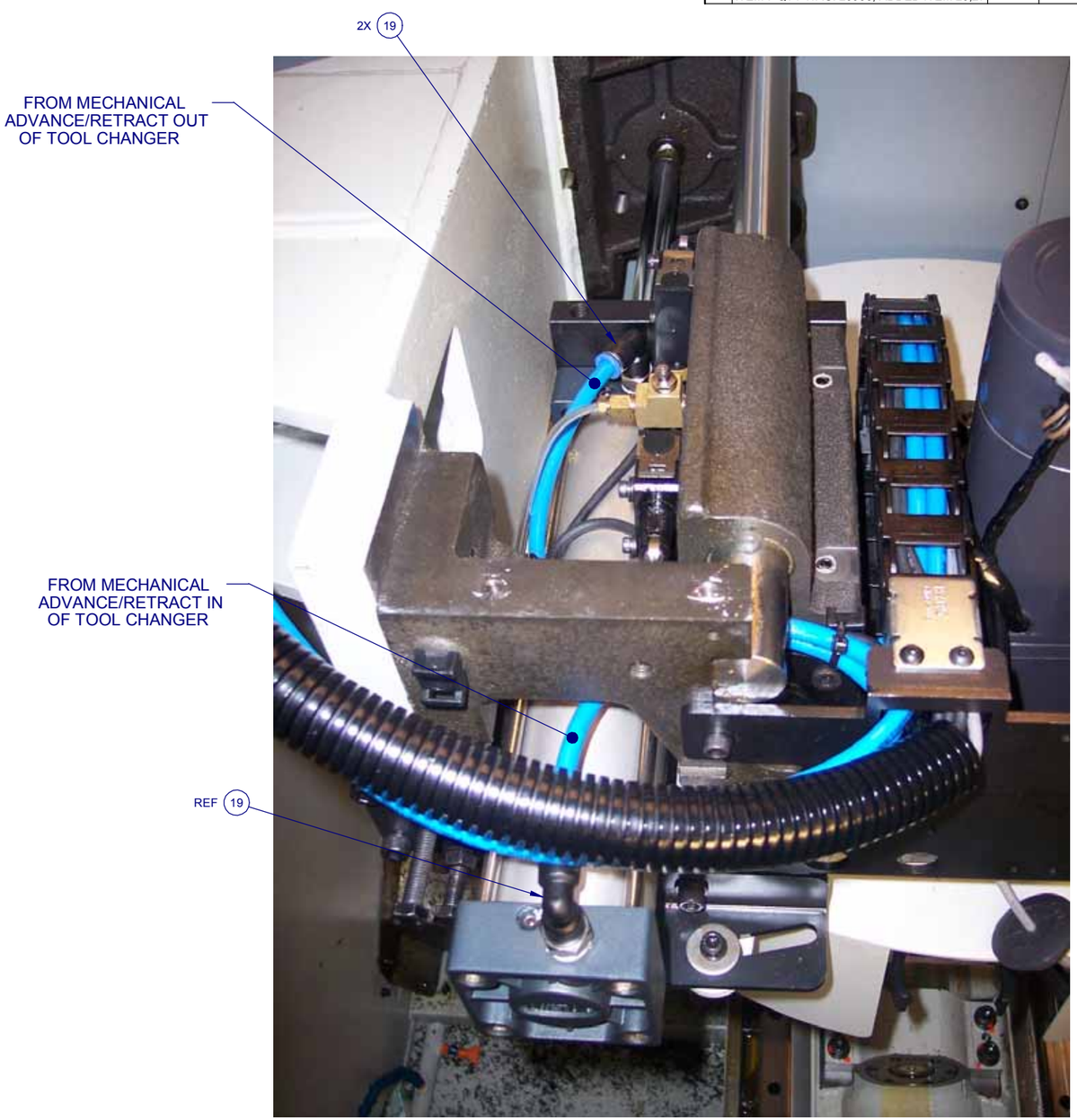
SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26930	B

SCALE: - SHEET 1 OF 2

NOTICE: THIS DESIGN WAS ORIGINATED BY AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN OWNED BY SOUTHWESTERN INDUSTRIES. IT IS DISCLOSED IN CONFIDENCE FOR A SPECIFIC PURPOSE AND THE RECIPIENT HEREOF AGREES NOT TO MAKE ANY REPRODUCTION, DISCLOSURE OR OTHER USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES.

REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13545	11/17/09	LG
A	UPDATED PRESUURE SWITCH NOTE ON SHEET 2.	13591	1.20.10	LG
B	ITEM 4 QTY WAS: 2; ITEM 6 WAS: 26936, ITEM 7 QTY WAS: 26938; ADDED ITEM 26,27	13686	12/15/10	RO





		DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0°30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5 MATERIAL - FINISH -	APPROVALS	DATE	SOUTHWESTERN INDUSTRIES, INC. 2615 HOMESTEAD PLACE RANCHO DOMINGUEZ, CA 90220-5610
			DRAWN BY SAL	06/19/09	TITLE: PNEUMATIC ASSY-LPM
			ENGINEER		
			ENGINEER		
			FE		
NEXT ASSY	USED ON		THIRD ANGLE PROJECTION		SIZE D · CODE IDENT. NO. 06238 · DWG NO. 26930 · REV B
APPLICATION					SCALE: - · SHEET 2 OF 2

Parts List for Assembly P/N: 26930

Printed 1/3/2011

26930

PNEUMATIC ASSY-LPM

WHEN UPDATING THIS DOCUMENT REVISE MANUAL
26727,26500 & 26500-1

Type	PL	Dwg Size	D
Revision	B	Product	LPM
Status	R	Engineer	LG
Date	6/19/2009	Planner Code	
By	SAL	Comm Code	

Item	P/N	Title	Qty	UseAs	Rev	Stat	Reference(t)
1	26931	AIR PRESSURE SWITCH	1	EA	-	R	
2	26932	AIR REGULATOR ASSY	1	EA	-	R	
3	26933	LUBRICATOR ASSY	1	EA	-	R	
4	26934	VALVE-METERING-ATC IN/OUT	3	EA	-	R	
5	26935	VALVE-METERING-AIR FLOW THRU SPINDLE	1	EA	-	R	
6	26938-1	SOLENOID VALVE ASSY-SINGLE	2	EA	-	R	
7	26938-3	SOLENOID VALVE ASSY-DUAL	1	EA	-	R	
8	26673-1	CABLE ASSY-SOLENOID-TOOL UNCLAMP	1	EA	-	R	
9	26673-2	CABLE ASSY-SOLENOID-TOOL CHANGER OUT	1	EA	-	R	
10	26673-3	CABLE ASSY-SOLENOID-TOOL CHANGER IN	1	EA	-	R	
11	26673-4	CABLE ASSY-SOLENOID-AIR FLOW THRU SPINDLE	1	EA	-	R	
12	26673-5	CABLE ASSY-SOLENOID-AIR TOOL FOR BLAST	1	EA	-	R	
13	26981	TUBING-8mm ID x 12mm OD-BLACK	A/R	IN	-	R	
14	26980	TUBING-5mm ID x 8mm OD-BLACK	A/R	IN	-	R	
15	26980-1	TUBING-5mm ID x 8mm OD-BLUE	A/R	IN	-	R	
16	26981-1	TUBING-8mm ID x 12mm OD-BLUE	A/R	IN	-	R	
17	27016	FITTING-ADAPTER-MALE PIPE	8	EA	-	R	
18	27017	FITTING-COMPRESSION TUBE	2	EA	-	R	
19	27018	FITTING-PUSH-TO-CONNECT	2	EA	-	R	
20	27019	FITTING-NYLON PUSH-TO-CONNECT	2	EA	-	R	
21	27020	FITTING-NYLON PUSH-TO-CONNECT	1	EA	-	R	
22	26898-1	FITTING-AIR-90°	2	EA	-	R	
23	26898-2	FITTING-STRAIGHT-8MM QUICK DISCONNECT	1	EA	-	R	

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

Item	P/N	Title	Qty	UseAs	Rev	Stat	Reference(t)
24	26898	FITTING-AIR-90°	1	EA	-	R	
25	26993	VALVE-ON/OFF	1	EA	-	R	
26	24211	LIQUID TIGHT FITTING-PG9	5	EA	-	R	
27	26934-1	VALVE-AIR FLOW THRU SPDL	1	EA	-	R	

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

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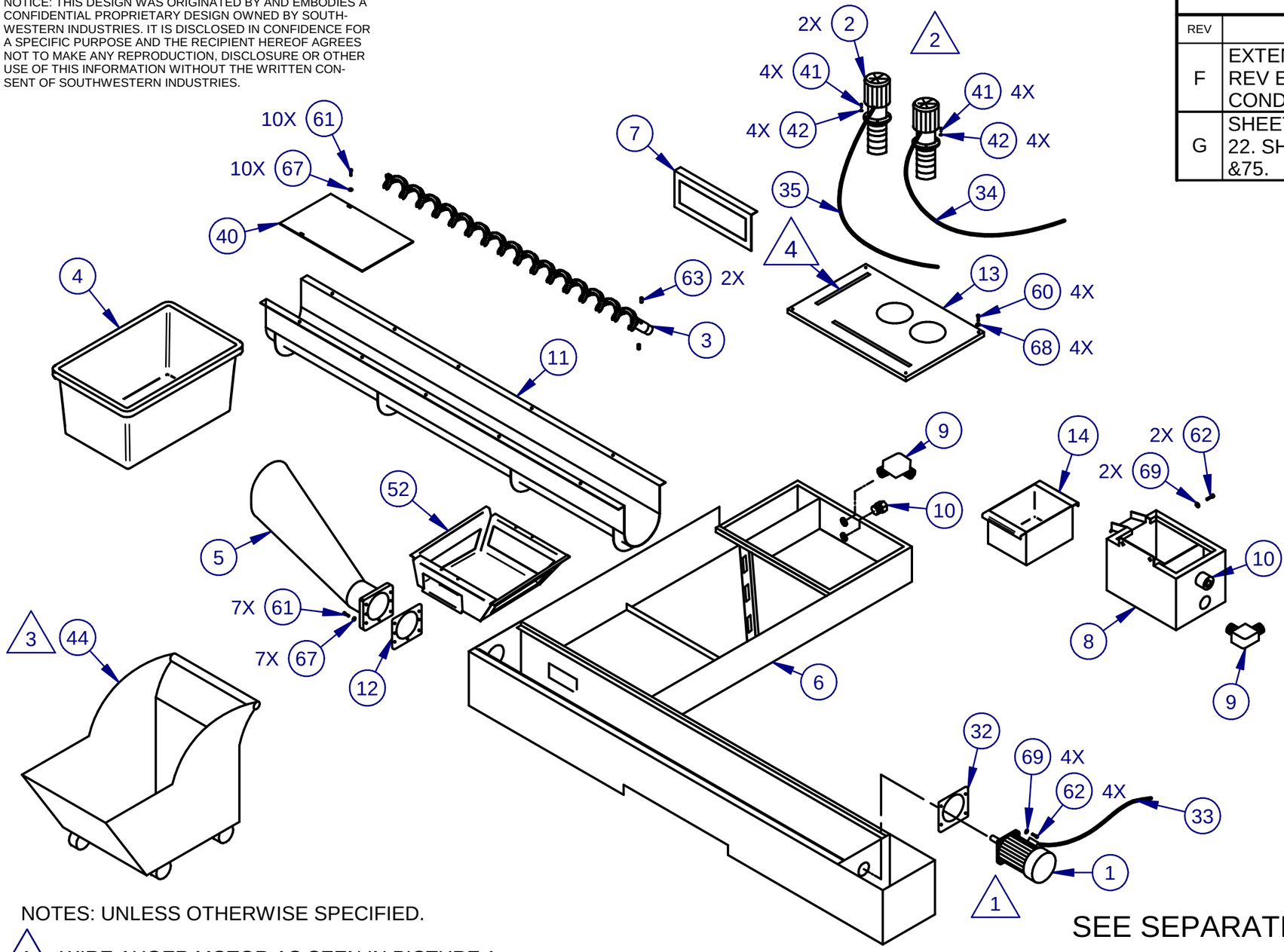
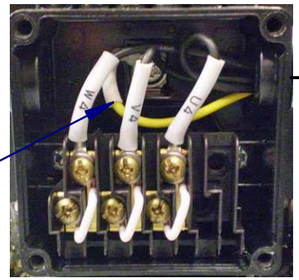
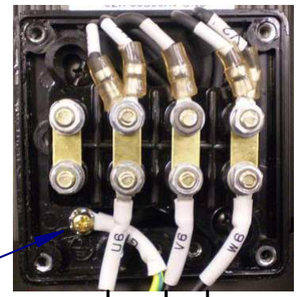
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
F	EXTENSIVELY REVISED SEE REV E FOR PREVIOUS CONDITION	14243	1/16/15	TO
G	SHEET 3 ITEM 41 WAS: ITEM 22. SHEET 4 ADDED ITEMS 64 &75.	14403	06/23/15	PM



COOLANT/WASH PUMP MOTOR PICTURE 2



AUGER MOTOR PICTURE 1



NOTES: UNLESS OTHERWISE SPECIFIED.

1. WIRE AUGER MOTOR AS SEEN IN PICTURE 1.
2. WIRE COOLANT/WASH PUMP MOTORS AS SEEN IN PICTURE 2.
3. SOLD WITH EURO MACHINE ONLY.
4. ITEM 48 REFERENCES AN OIL SKIMMER THAT FITS OUR COOLANT TANK DESIGN IN THE DESIGNATED SLOT.
   SEE DRAWING ITEM 48 FOR INFORMATION ON SKIMMER. SHOWN FOR REF.

SEE SEPARATE "A" SIZE SHEET FOR PARTS LIST

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0'30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS		DATE
DRAWN BY	RC	7/29/09
ENGINEER	LG	9/29/09
CHECKER	SAL	05/23/14
FE		

THIRD ANGLE PROJECTION

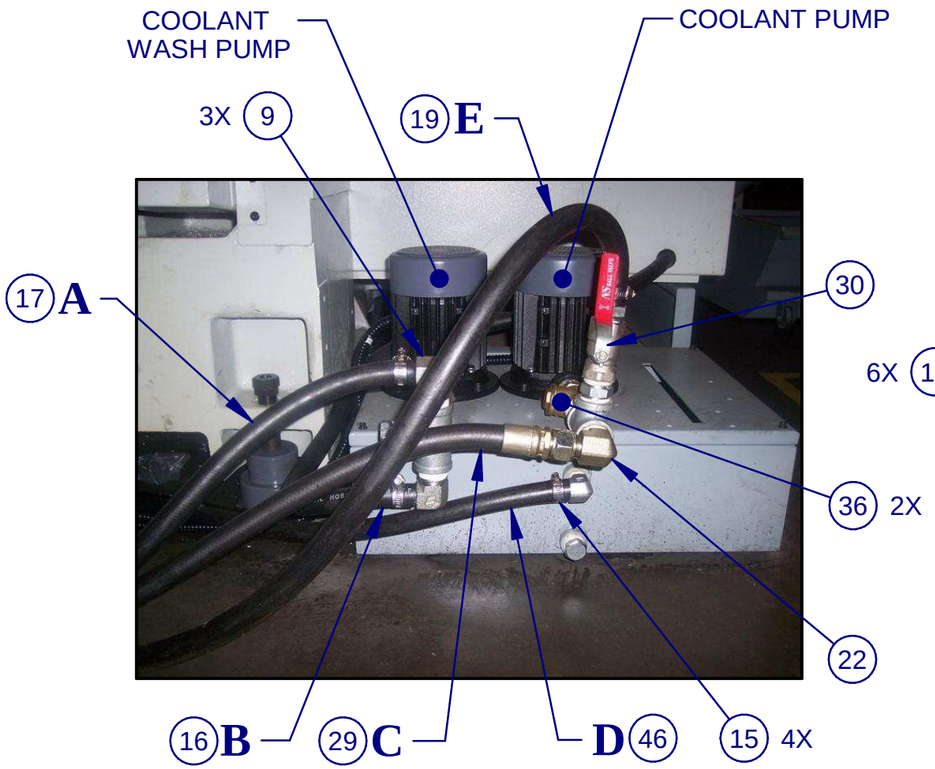
SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: COOLANT - SYSTEM

SIZE	CODE IDENT. NO.	DWG NO.	REV
B	06238	26943	G

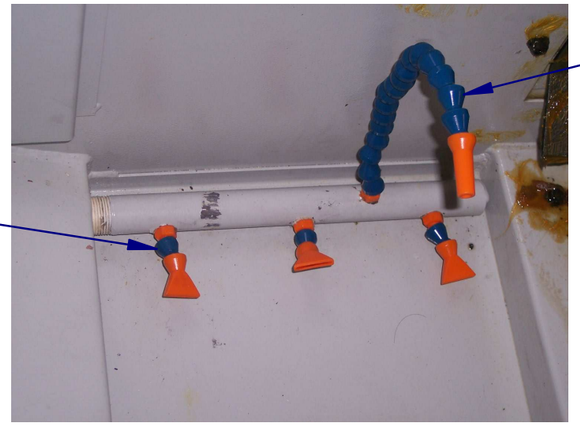
SCALE: - SHEET 1 OF 4

NOTICE: THIS DESIGN WAS ORIGINATED BY AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN OWNED BY SOUTH-WESTERN INDUSTRIES. IT IS DISCLOSED IN CONFIDENCE FOR A SPECIFIC PURPOSE AND THE RECIPIENT HEREOF AGREES NOT TO MAKE ANY REPRODUCTION, DISCLOSURE OR OTHER USE OF THIS INFORMATION WITHOUT THE WRITTEN CON-SENT OF SOUTHWESTERN INDUSTRIES.



PORT	DESTINATION
A	COOLANT WASH, LEFT (WHEN VIEWED FROM REAR)
B	COOLANT WASH, RIGHT (WHEN VIEWED FROM REAR)
C	COOLANT TO SPINDLE TOOL NOZZLES
D	RETURN LINE FROM OVERFLOW TANK
E	TO COOLANT GUN

B=COOLANT WASH, LEFT SIDE OF MACHINE WHEN VIEWED FROM THE FRONT



A=COOLANT WASH,RIGHT SIDE OF MACHINE WHEN VIEWED FROM THE FRONT

WASH DOWN PORT, LEFT (PICTURE TAKEN FROM FRONT OF MACINE)

WASH DOWN PORT, RIGHT (PICTURE TAKEN FROM FRONT OF MACHINE)

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0'30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS		DATE
DRAWN BY	RC	7/29/09
ENGINEER	LG	9/29/09
CHECKER	SAL	05/23/14
FE		

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: COOLANT - SYSTEM

SIZE	CODE IDENT. NO.	DWG NO.	REV
B	06238	26943	G

SCALE: - SHEET 2 OF 4

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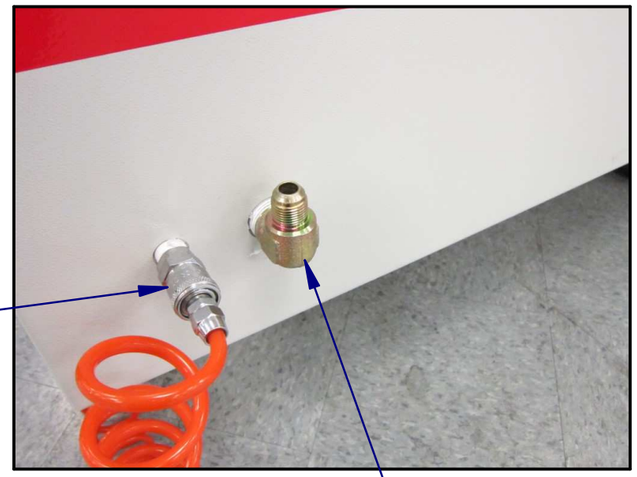
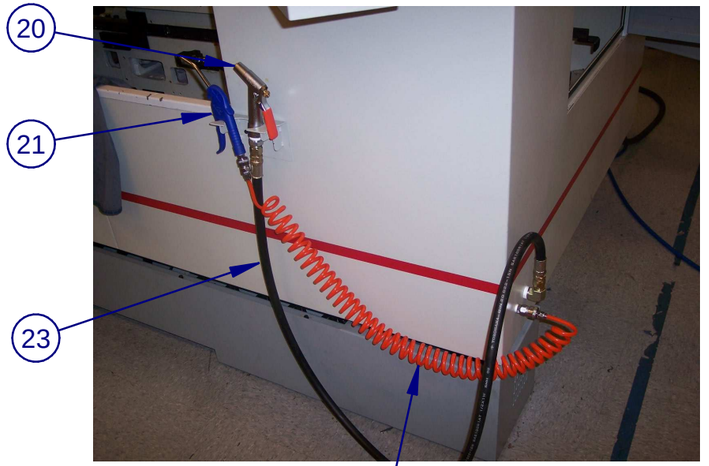
TO WASH DOWN, NOZZLE PORT

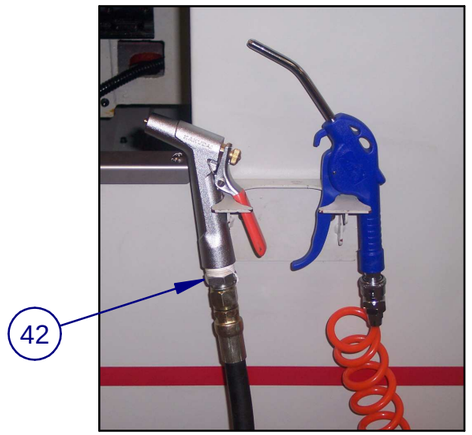
WASH DOWN PORT, OUTSIDE



WASH DOWN PORT, INSIDE

WASH DOWN NOZZLE AND BRACKET (C)





DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0'30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS	DATE
MATERIAL -	DRAWN BY RC	7/29/09
	ENGINEER LG	9/29/09
	CHECKER SAL	05/23/14
	FE	
FINISH -	THIRD ANGLE PROJECTION	

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE
COOLANT - SYSTEM

SIZE	CODE IDENT. NO.	DWG NO.	REV
B	06238	26943	G

SCALE: - SHEET 3 OF 4

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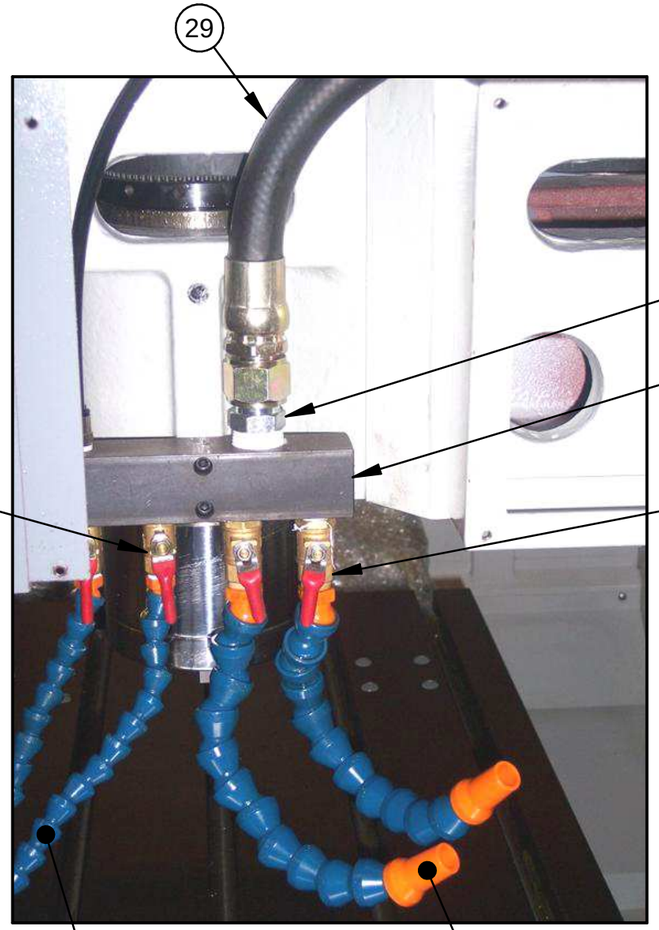
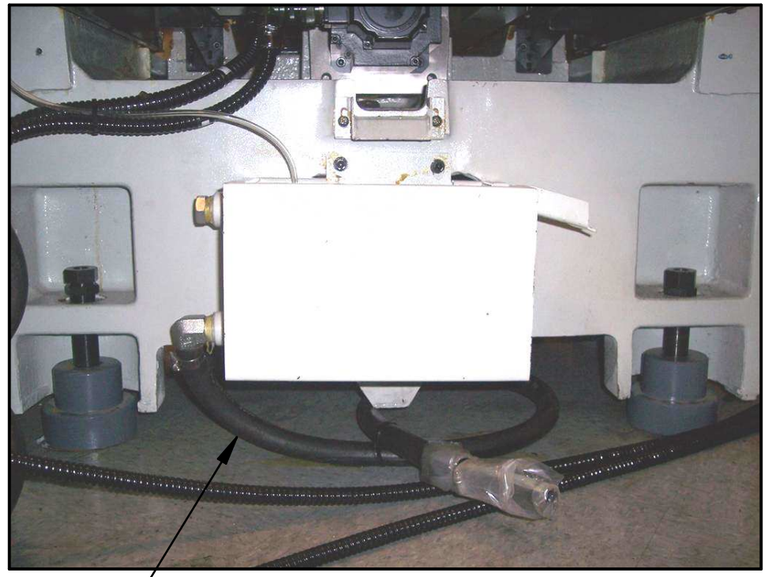
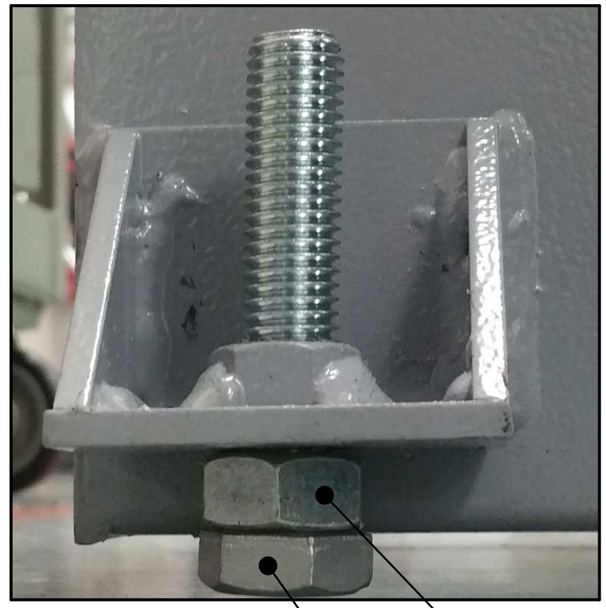
AIR BLAST AND WORK COOLANT MANIFOLD (D)



OIL / COOLANT SEPARATOR TANK (E)



LEVELING BOLTS & NUTS



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MATERIAL -	DRAWN BY RC	7/29/09	TITLE COOLANT - SYSTEM
FINISH -	ENGINEER LG	9/29/09	SIZE B | CODE IDENT. NO. 06238 | DWG NO. 26943 | REV G
	CHECKER SAL	05/23/14	SCALE: - | SHEET 4 OF 4
	FE		
	THIRD ANGLE PROJECTION		

Parts List for Assembly P/N: 26943

Printed 6/24/2015

26943
COOLANT SYSTEM

WHEN UPDATING THIS DOCUMENT REVISE MANUAL 26727

Type	PL	Dwg Size	B
Revision	G	Product	LPM
Status	R	Engineer	LG
Date	7/29/2009	Planner Code	
By	RC	Comm Code	

Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
1	26736	MOTOR-3 PHASE INDUCTOR-AUGER		1	EA	-	R	PS		
2	26944	MOTOR-3 PHASE-PUMP-COOLANT/WASH		2	EA	-	R	PS		
3	26945	SCREW-AUGER		1	EA	-	R	PS	PING JENG	50230124
4	27041	CHIP-BIN		1	EA	-	R	PS		
5	26946	OUTPUT TUBE-AUGER		1	EA	-	R	PS	PING JENG	3202103350
6	26948	TANK-COOLANT		1	EA	-	R	PS	PING JENG	
7	26949	GUARD-FILTER		1	EA	-	R	PS	PING JENG	
8	26951	BOX-OIL/COOLANT SEPARATOR		1	EA	-	R	PS		
9	26952	FITTING-90° COOLANT-BARBED		5	EA	-	R	PS		
10	26953	PLUG-DRAIN		2	EA	-	R	PS		
11	26948-1	TROUGH-CHIP		1	EA	-	R	PS	PING JENG	
12	26946-1	GASKET-OUTPUT TUBE-AUGER		1	EA	-	R	PS	PING JENG	
13	26950	PLATE-COOLANT/WASH PUMP-MOUNTING		1	EA	-	R	PS		
14	27045	TANK-COOLANT OVERFLOW		1	EA	-	R	PS		
15	26957	CLAMP-COOLANT HOSE	1"	8	EA	-	R	PS		
16	26956-5	HOSE-COOLANT	1" OD	5	FT	-	R	PS	PING JENG	50283491
17	26956-10	HOSE-COOLANT	1" OD	10	FT	-	R	PS	PING JENG	50283491
18	26955	NOZZLE-COOLANT WASH	SHORT	6	EA	-	R	PS	PING JENG	50080050
19	26956-15	HOSE-COOLANT	1" OD	15	FT	-	R	PS	PING JENG	50283491
20	26958	GUN-COOLANT		1	EA	-	R	PS	PING JENG	50020010
21	26960	GUN-AIR		1	EA	-	R	PS	PING JENG	
22	26952-1	ELBOW-3/4PT x 3/4PH-90°		1	EA	A	R	PS		

Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
23	26959	HOSE-COOLANT GUN	6' LONG	1	EA	-	R	PS		
24	26961	HOSE-AIR GUN		1	EA	-	R	PS		
25	26899	VALVE-ON/OFF-AIR-NOZZLE	1/4"	2	EA	-	R	PS	PING JENG	50060155
26	20714-2	NOZZLE-AIR BLAST/COOLANT WASH-LONG	1/4"	4	EA	-	R	DWG		
27	20714-1	NOZZLE-COOLANT	3/8"	2	EA	-	R	DWG		
28	26899-1	VALVE-ON/OFF-COOLANT-NOZZLE	3/8"	2	EA	-	R	PS	PING JENG	50160151
29	26962	HOSE-WORK COOLANT	23' LONG	1	EA	A	R	PS		
30	26963	VALVE-BALL		1	EA	-	R	PS		
32	26946-2	GASKET-AUGER-MOTOR		1	EA	-	R	PS	PING JENG	
33	26684-3	CABLE ASSY - POWER - AUGER		1	EA	-	R	PL		
34	26684-2	CABLE ASSY - POWER - COOLANT WASH		1	EA	-	R	PL		
35	26684-1	CABLE ASSY-4 COND POWER-COOLANT		1	EA	-	R	PL		
36	26972	VALVE-CHECK		2	EA	-	R	PS	PING JENG	
37	26973	FITTING-AIR-QUICK DISCONNECT		1	EA	-	R	PS		
38	26974	FITTING-HYDRAULIC-STAIGHT		1	EA	-	R	PS		
39	26893	MANIFOLD-AIR/COOLANT		1	EA	-	R	PS		
40	26975	COVER -SHEET METAL		1	EA	-	R	PS	PING JENG	
41	28464-2	ELBOW-3/4PT x 1/2PH-90°		1	EA	A	R	PS	KING RICH	A-316-021
42	27076	FITTING-HYDRAULIC		1	EA	-	R	PS	PING JENG	501-635
44	26947	CART-CHIP		1	EA	-	R	PS	PING JENG	3112103350
46	26956-7	HOSE-COOLANT	1" OD	7	FT	-	R	PS	PING JENG	50283491
48	27037	OIL-SKIMMER ASSY		0	EA	-	R	PS		
52	28128	FILTER TRAY-FINE CHIP-COOLANT	STAINLESS STEEL	(1)	EA	A	R	DWG		
60	M5-0.8X35 25B	SCREW-SHCS-STL-BO		6	EA	-	R	PS		
61	M6-1.0X15 25B	SCREW-SHCS-STL-BO		25	EA		R	PS		

Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
62	M8-1.25X25 25B	SCREW-SHCS-STL-BO		6	EA		R	PS		
63	M6-1.0X10 40B	SCREW-SOC SET-STL-BO-CUP		2	EA		R	PS		
64	M14-2.0X70 24Z	SCREW-HEX HD-STL-BO	NON-STOCKABLE	3	EA	A	R	PS	PJ	
67	M6 73B	WASHER-SPLIT LOCK-STL-BO		25	EA	-	R	PS		
68	M5 70B	WASHER-FLAT USS-STL-BO		4	EA		R	PS		
69	M8 73B	WASHER-SPLIT LOCK-STL-BO		6	EA		R	PS		
75	M14-2.0 50Z	NUT-HEX-STL-ZINC		3	EA		R	PS		

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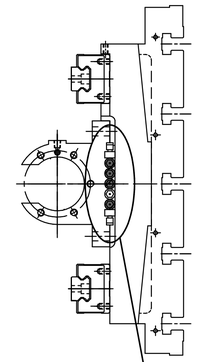
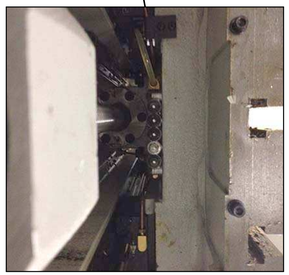
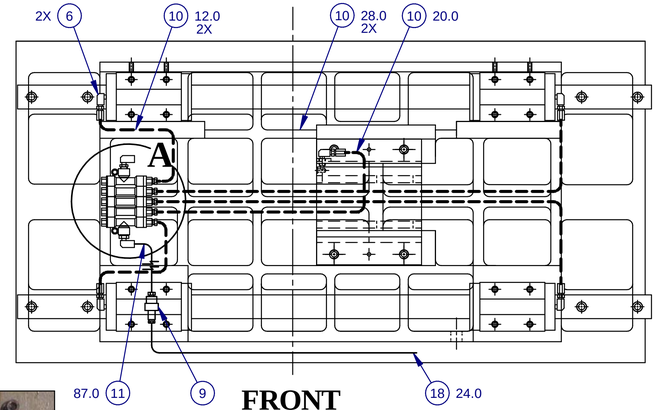
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
A	REVISED EXTENSIVELY. SEE ECN.	13691	2/18/11	LG
B	X, Y, Z REVISED DISTRIBUTOR & DETAILS. ADDED PICTURES, CHART & ITEMS 12 & 13. (A1-C4)	14147	11/24/14	TO

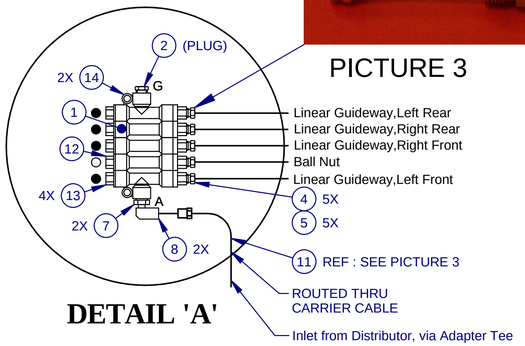
TABLE 'X'





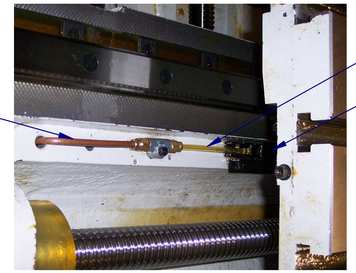


FRONT



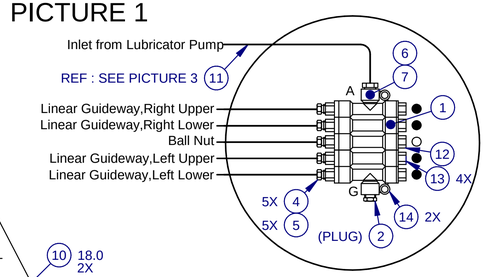
DETAIL 'A'

PICTURE 3



PICTURE 1

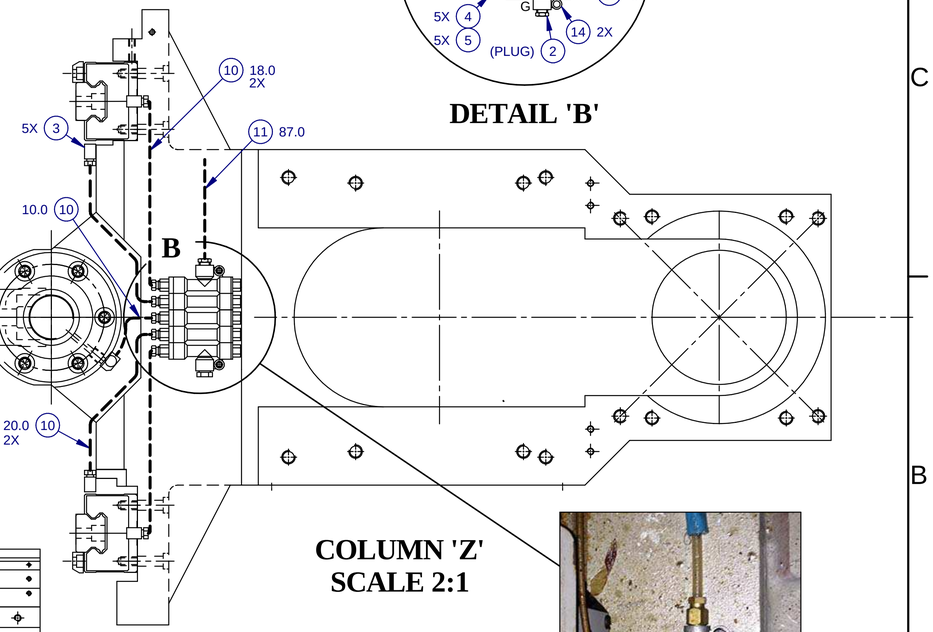
METERING UNIT CHART			
SYM	SIZE	APPLICATION	COLOR
○	05 METERING UNITS	BALL NUTS	SILVER
●	03 METERING UNITS	LINEAR BLOCKS	BRASS

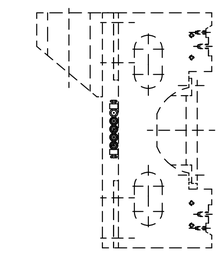


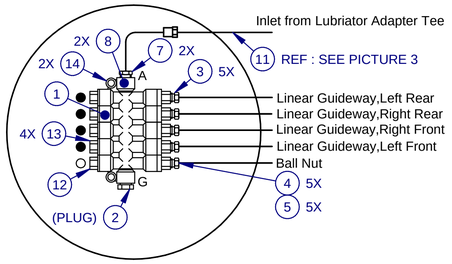
DETAIL 'B'

6MM INNER SLEEVE 4
NOT SHOWN 5
72.0 17
72.0 16
TO Z AXIS PORT A DETAIL 'B'

PICTURE 2

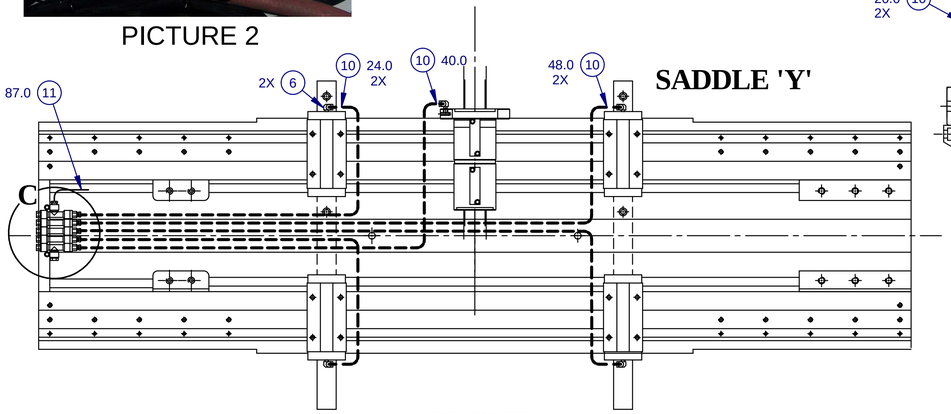




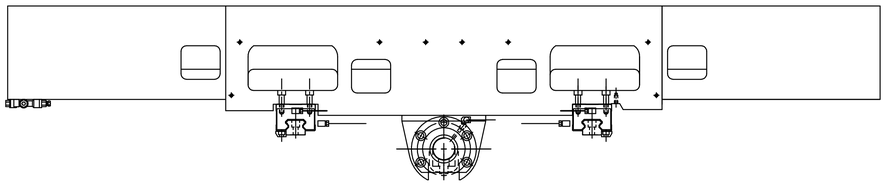


DETAIL 'C'

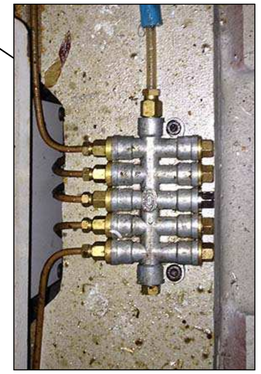
SADDLE 'Y'



FRONT



COLUMN 'Z' SCALE 2:1



		DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0°30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS	DATE	SOUTHWESTERN INDUSTRIES, INC. 2615 HOMESTEAD PLACE RANCHO DOMINGUEZ, CA 90220-5610	
			DRAWN BY SAL	05/12/09	TITLE	LUBRICATION SYSTEM- TABLE, COLUMN, SADDLE
			ENGINEER			
			ENGINEER			
		MATERIAL -	FE		SIZE D	CODE IDENT. NO. 06238 / DWG NO. 27050 / REV B
NEXT ASSY	USED ON	FINISH -	THIRD ANGLE PROJECTION		SCALE: -	SHEET 1 OF 2
APPLICATION						

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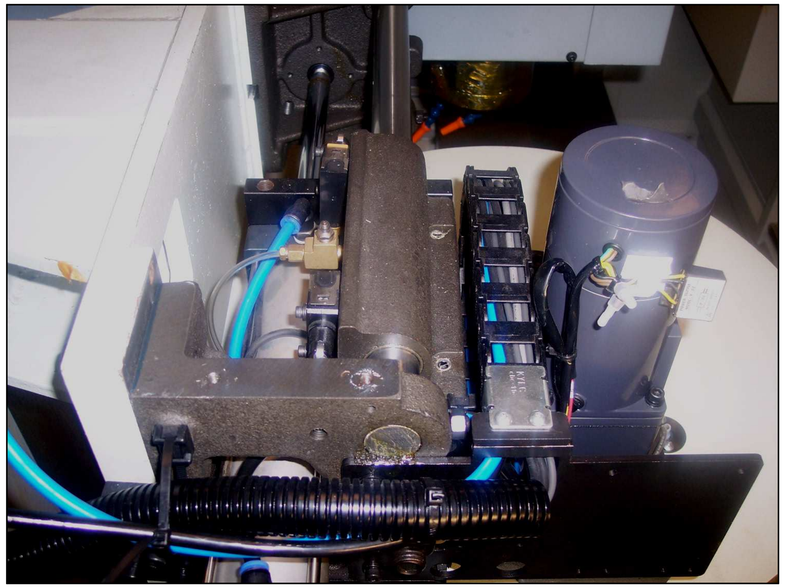
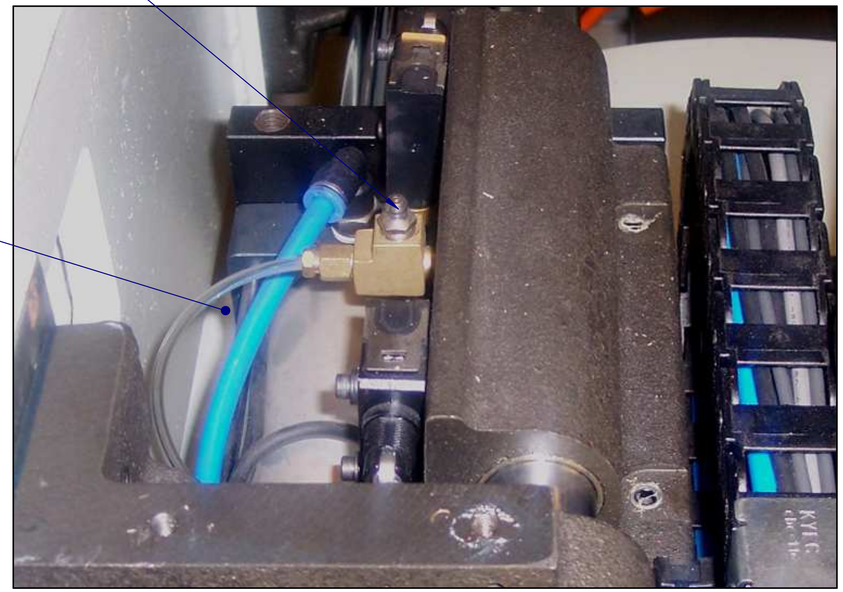
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
A	REVISED EXTENSIVELY. SEE ECN.	13691	2/18/11	LG
B	X, Y, Z REVISED DISTRIBUTOR & DETAILS. ADDED PICTURES, CHART & ITEMS 12 & 13. (A1-C4)	14147	11/24/14	TO

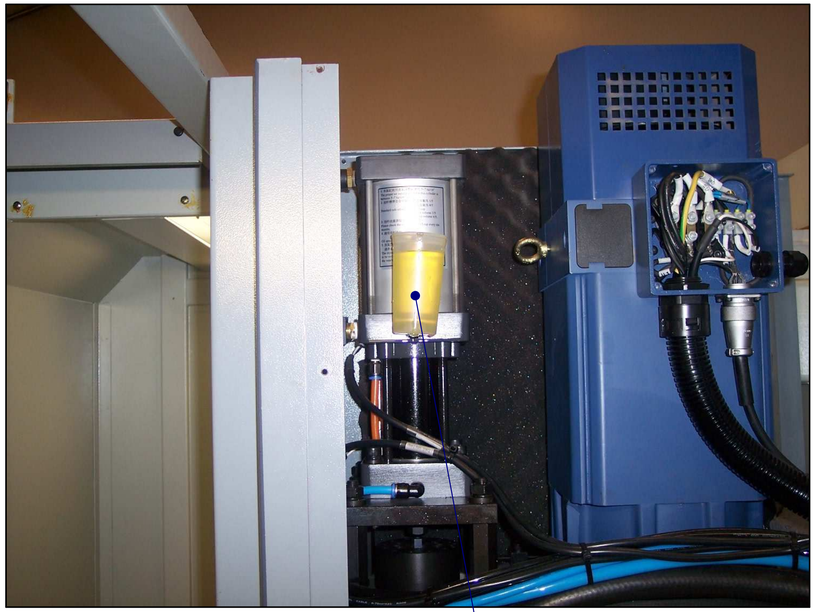
AUTOMATIC TOOL CHANGER TOP VIEW



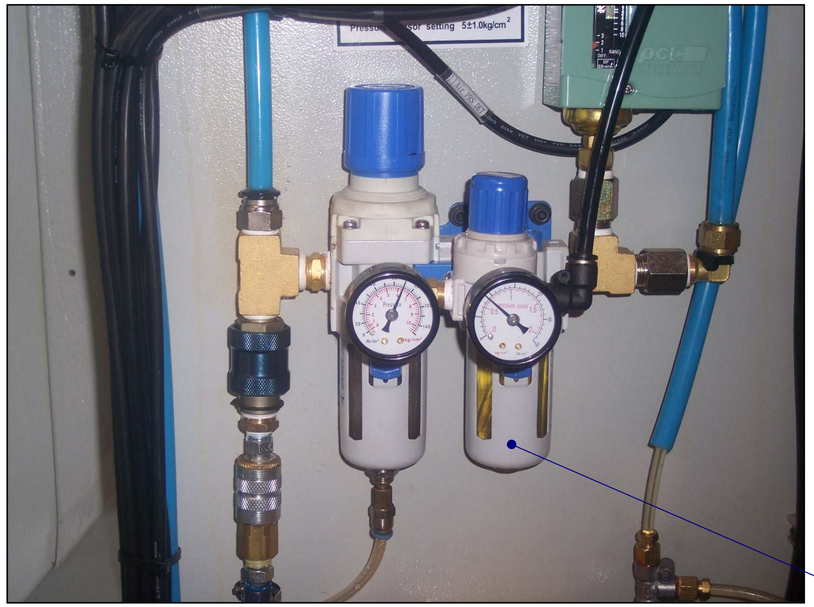
GREASE FITTING ON TOOL CHANGER



TOOL CHANGE AIR CYLINDER



LUBRICATION ASSY/OILER



		DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0'30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS	DATE	SOUTHWESTERN INDUSTRIES, INC. 2615 HOMESTEAD PLACE RANCHO DOMINGUEZ, CA 90220-5610
			DRAWN BY SAL	05/12/09	TITLE LUBRICATION SYSTEM- TABLE, COLUMN, SADDLE
			ENGINEER		
			ENGINEER		
			FE		SIZE D / CODE IDENT. NO. 06238 / DWG NO. 27050 / REV B
NEXT ASSY	USED ON	MATERIAL -	THIRD ANGLE PROJECTION		SCALE: - / SHEET 2 OF 2
APPLICATION		FINISH -			

27050

LUBRICATION SYSTEM-TABLE, COLUMN, SADDLE

WHEN UPDATING THIS DOCUMENT REVISE MANUAL 26727.

Type	PL	Dwg Size	D
Revision	B	Product	LPM
Status	R	Engineer	TO
Date	8/5/2009	Planner Code	
By	Sal	Comm Code	

Item	P/N	Title	Detail	Rev	Qty	UseAs	Stat	Type	Mfr	Mfr P/N
1	26977	DISTRIBUTOR		-	3	EA	R	PS	PING JENG	MJ-DB-D
2	PG006	PLUG-M4 X		-	3	EA	R	PS		
3	PD401	ADAPTER			10	EA	R	PS		
4	PA4	NUT-COMPRESSION 4mm			17	EA	R	PS	CHIBA	
5	PB4	SLEEVE-COMPRESSION 4mm			17	EA	R	PS	CHIBA	
6	PA6	VALVE CAP		-	5	EA	R	PS		
7	PB6	CHECK VALVE		-	5	EA	R	PS		
8	PD601	ADAPTER		-	4	EA	R	PS		
9	PKD6	TEE ADAPTER		-	1	EA	R	PS		
10	26978	TUBING-4mm COPPER		-	370	IN	R	PS	PING JENG	60142001
11	26979	TUBING-PLASTIC-SOFT 4mm ID x 6mm OD	REPLACES 5549K11	-	168	IN	R	PS	PING JENG	50110121
12	27257	RESTRICTOR-OIL-0.5cc		-	3	EA	R	DWG		
13	27257-1	RESTRICTOR-OIL-0.3cc		-	12	EA	R	DWG		
14	M5-0.8X10 25B	SCREW-SHCS-STL-BO		-	6	EA	R	PS		
15	26718	LUBE PUMP		B	1	EA	R	PS	PING JENG	50150068
16	26981-1	TUBING-8mm ID x 12mm OD-BLUE		-	144	IN	R	PS	PING JENG	50110107
17	26979-1	TUBING-PLASTIC-HARD 4mm ID x 6mm OD		-	72	IN	R	PL	PING JENG	50110122
18	26978-1	TUBING-6mm COPPER		-	24	IN	R	PS	PING JENG	60142002

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

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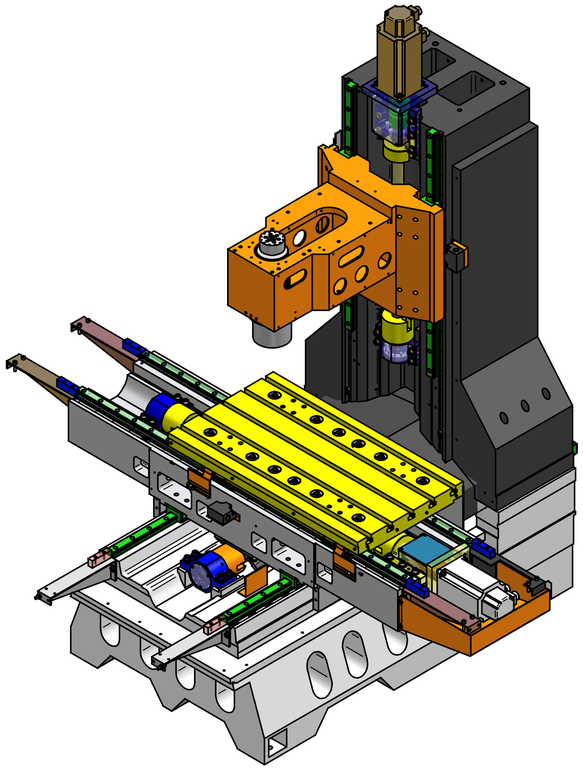
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13546	11.20.09	LG



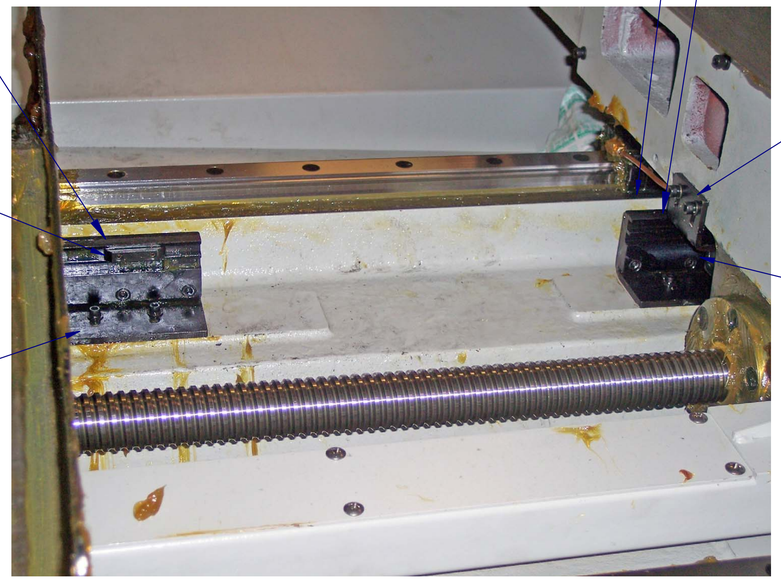
Z-AXIS LIMIT SWITCH

1 2X
2 8X
3 4X
Z MINUS (-)
8
17 2X
18 2X
15
16
19 2X
18 2X
21 2X
20 2X
12
17 2X
18 2X
Z PLUS (+)
9
2X 17
2X 18

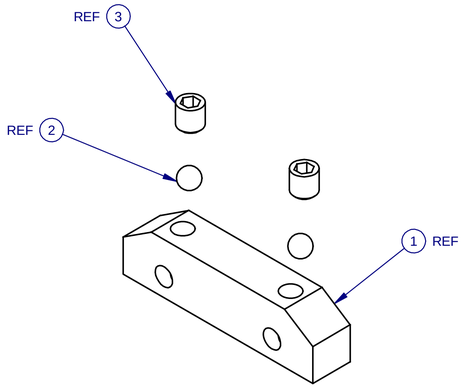
X-AXIS LIMIT SWITCH

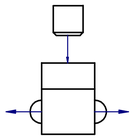
X PLUS (+)
X MINUS (-)
4
2X 17
2X 18
2X 1
8X 2
4X 3
5
17 2X
18 2X
10
2X 17
2X 18
16
19 2X
18 2X
21 2X
20 2X
13

Y-AXIS LIMIT SWITCH



Y PLUS (+)
Y MINUS (-)
17 2X
18 2X
6
11
17 2X
18 2X
2X 1
8X 2
4X 3
14
16
2
19 2X
18 2X
21 2X
20 2X
7
2X 17
2X 18





1 3X

NOTES: (UNLESS OTHERWISE SPECIFIED).

1 AS SET SCREW PUSHES DOWN, STEEL BALLS PUSH OUTWARD TOWARD CAM HOLDER WALL AND LOCK CAM IN PLACE. ONE OR TWO BALLS WILL WORK.

2 Y LIMIT SWITCH, AND CABLE ASSY'S ITEMS 16 & 14 ARE NOT SHOWN OR NOT VISIBLE.

		DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0°30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS	DATE	SOUTHWESTERN INDUSTRIES, INC. 2615 HOMESTEAD PLACE RANCHO DOMINGUEZ, CA 90220-5610
			DRAWN BY RC	3/4/09	
			ENGINEER LG	11/20/09	TITLE: LIMIT SWITCH ASSEMBLY
			ENGINEER		
		MATERIAL: -	FE		SIZE: D · CODE IDENT. NO.: 06238 · DWG NO.: 26827 · REV: -
NEXT ASSY	USED ON	FINISH: -	THIRD ANGLE PROJECTION		SCALE: - · SHEET 1 OF 1
APPLICATION					

Parts List for Assembly P/N: 26827

Printed 11/20/2009

26827
LIMIT SWITCH ASSY

Type	PL	Dwg Size	D
Revision	-	Product	LPM
Status	R	Engineer	LG
Date	3/4/2009	Planner Code	
By	RC	Comm Code	

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(t)	Mfr	Mfr P/N
1	22108-1	CAM-LIMIT SWITCH		-	EA	6	R			
2	24920	BALLS - STAINLESS STEEL		-	EA	24	R			
3	M5-0.8X6 40B	SCREW-SOC SET-STL-BO-CUP			EA	12	R			
4	26826-1	BRACKET-X-AXIS-CAM LIMIT SWITCH	LEFT	-	EA	1	R			
5	26826-2	BRACKET-X-AXIS-CAM LIMIT SWITCH	RIGHT	-	EA	1	R			
6	26826-3	BRACKET-Y-AXIS-CAM LIMIT SWITCH	FRONT	-	EA	1	R			
7	26826-4	BRACKET-Y-AXIS-CAM LIMIT SWITCH	BACK	-	EA	1	R			
8	26826-5	BRACKET-Z-AXIS-CAM LIMIT SWITCH	UPPER	-	EA	1	R			
9	26826-6	BRACKET-Z-AXIS-CAM LIMIT SWITCH	LOWER	-	EA	1	R			
10	26825	BRACKET-LIMIT SWITCH	X-AXIS	-	EA	1	R			
11	26825-1	BRACKET-LIMIT SWITCH	Y-AXIS	-	EA	1	R			
12	26825-2	BRACKET-LIMIT SWITCH	Z-AXIS	-	EA	1	R			
13	22551-6	CABLE ASSY - X-AXIS LIMIT SWITCH		-	EA	1	R			
14	22551-7	CABLE- ASSY - Y-AXIS LIMIT SWITCH		-	EA	1	R			
15	22551-8	CABLE- ASSY - Z-AXIS LIMIT SWITCH		-	EA	1	R			
16	22408	LIMIT SWITCH		C	EA	3	R		BALLUFF	LR50067, BNS-543-B02-D12-61-12-10 ,
17	M6-1.0X16 25B	SCREW-SHCS-STL-BO		-	EA	18	R			

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(t)	Mfr	Mfr P/N
18	M6 70B	WASHER-FLAT USS-STL-BO		-	EA	24	R			
19	M6-1.0X25 25B	SCREW-SHCS-STL-BO			EA	6	R			
20	M6-1.0 50B	NUT-HEX-STL-BO			EA	6	R		PJ	
21	M6 73B	WASHER-SPLIT LOCK-STL-BO		-	EA	6	R			

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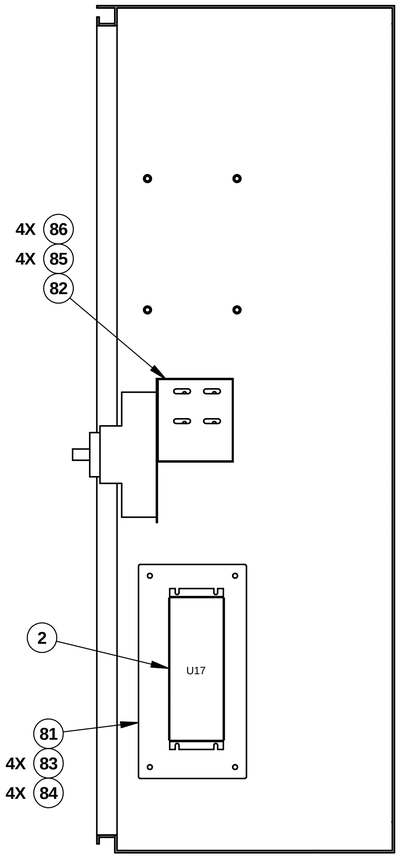
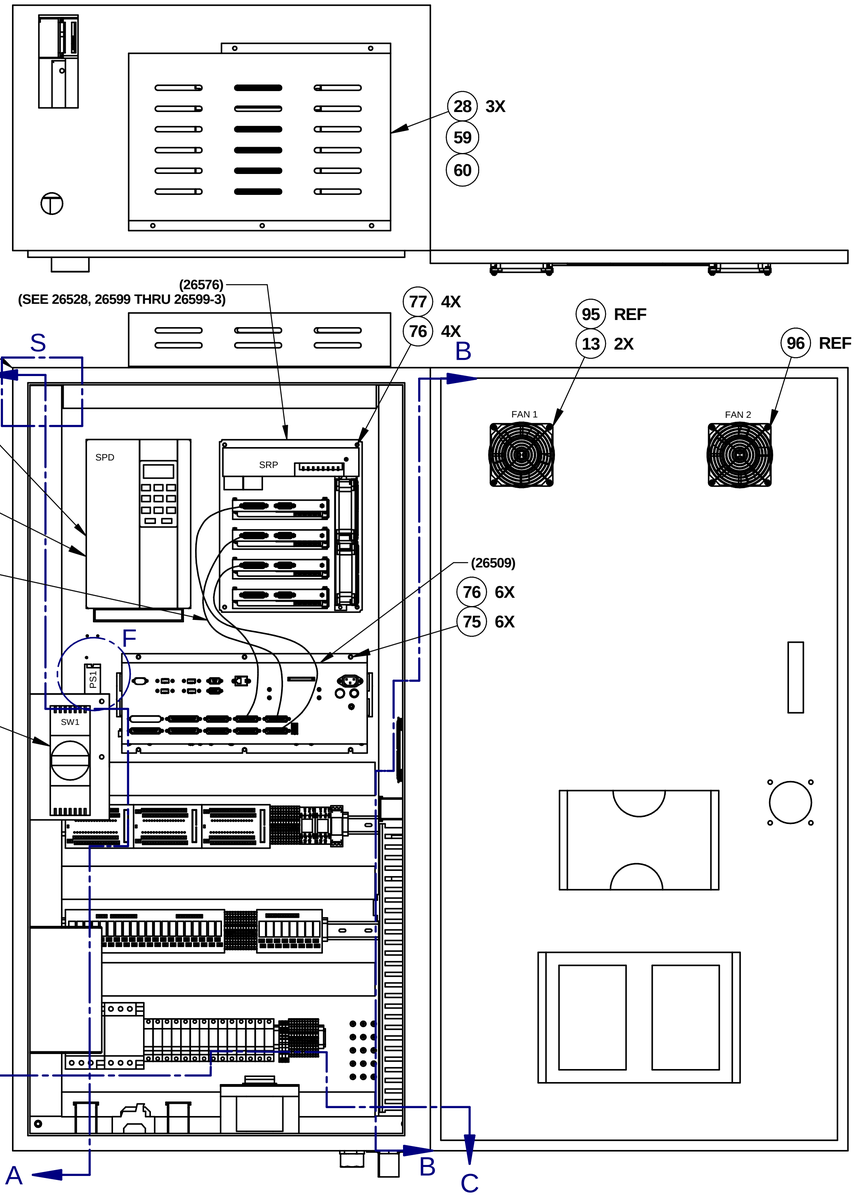
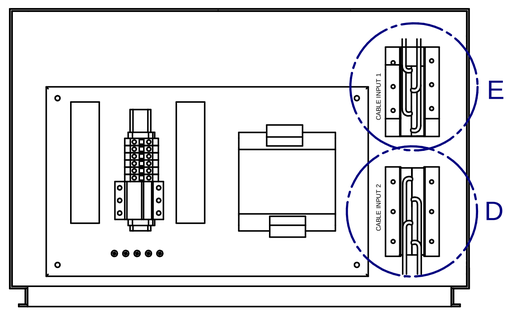
REVISIONS

REV	DESCRIPTION	ECN	DATE	DFT	ENG
P	ITEM 11 WAS: 26559. ITEM 14 WAS: 24483. REVISED: NOTES 3 AND 5, W166 AND W167. ADDED ITEM 120.	14572	10/16/17	AC	RO

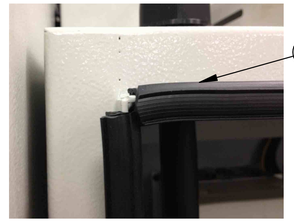


SECTION A-A

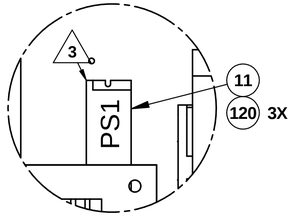




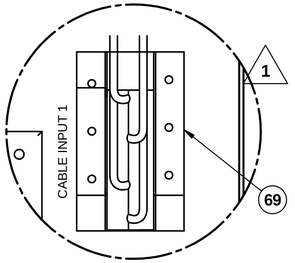
SECTION C-C



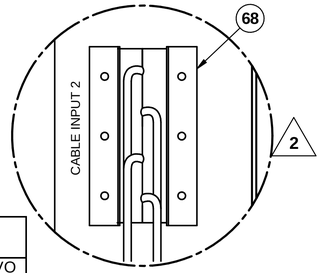
DETAIL S



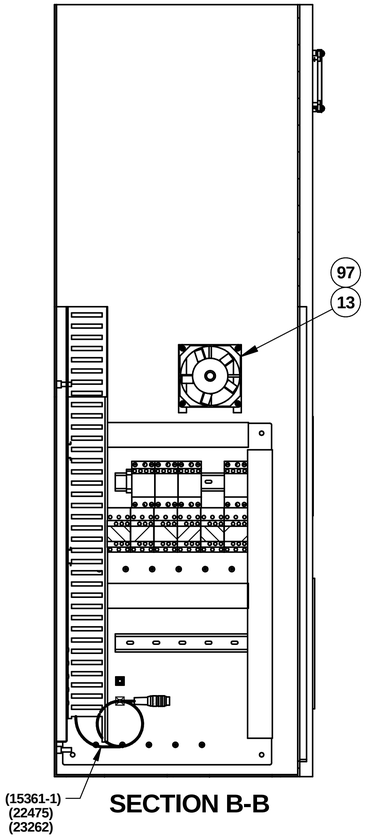
DETAIL F



DETAIL E



DETAIL D



SECTION B-B

NOTES: UNLESS OTHERWISE SPECIFIED.

1 ROUTE CABLE BELOW THROUGH CABLE INPUT 1(1B2).
- 1 X-MOTOR ENCODER CABLE
- 2 Y-MOTOR ENCODER CABLE
- 3 Z-MOTOR ENCODER CABLE
- 4 TOOL CHANGER FEEDBACK CABLE
- 5 UNCLAMP SOLENOID CABLE
- 6 TOOL CHANGER HOME SOLENOID CABLE
- 7 TOOL CHANGER SPINDLE SOLENOID CABLE
- 8 LAMP 1 CABLE
- 9 TOOL AIR SOLENOID CABLE
- 10 TOOL BLAST SOLENOID CABLE
- 11 AIR PRESSURE LOW CABLE
- 12 X-LIMIT SWITCH CABLE
- 13 Y-LIMIT SWITCH CABLE

2 ROUTE CABLE BELOW THROUGH CABLE INPUT 2 (1A1 & 1A2).
- 1 X-MOTOR POWER CABLE
- 2 Y-MOTOR POWER CABLE
- 3 Z-MOTOR POWER CABLE
- 4 COOLANT POWER CABLE
- 5 WASH COOLANT POWER CABLE
- 6 LUBE PUMP POWER CABLE
- 7 AUGER POWER CABLE
- 8 TOOL CHANGER POWER CABLE

3 POWER SUPPLY (ITEM 11) IS TO BE SET TO 115 VAC INPUT(1C3)

4. LAST DETAIL USED 'S'

(SEE SHEETS 4 & 5 FOR ADDITIONAL NOTES)

SERVO DRIVE MODULE ASSY (26576)	POWER MODULE (26528)	
	X, Y & 4th AXIS SERVO DRIVE (26599)	X, Y & 4th AXIS SERVO DRIVE WITH DIGITAL DISPLAY (26599-2)
	Z AXIS SERVO DRIVE (26599-1)	Z AXIS SERVO DRIVE WITH DIGITAL DISPLAY (26599-3)

SEE SEPARATE "A" SIZE SHEET FOR PARTS LIST

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0'30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS		DATE
DRAWN BY	RC	2/21/08
ENGINEER	RO	7/16/09
ENGINEER		
FE		

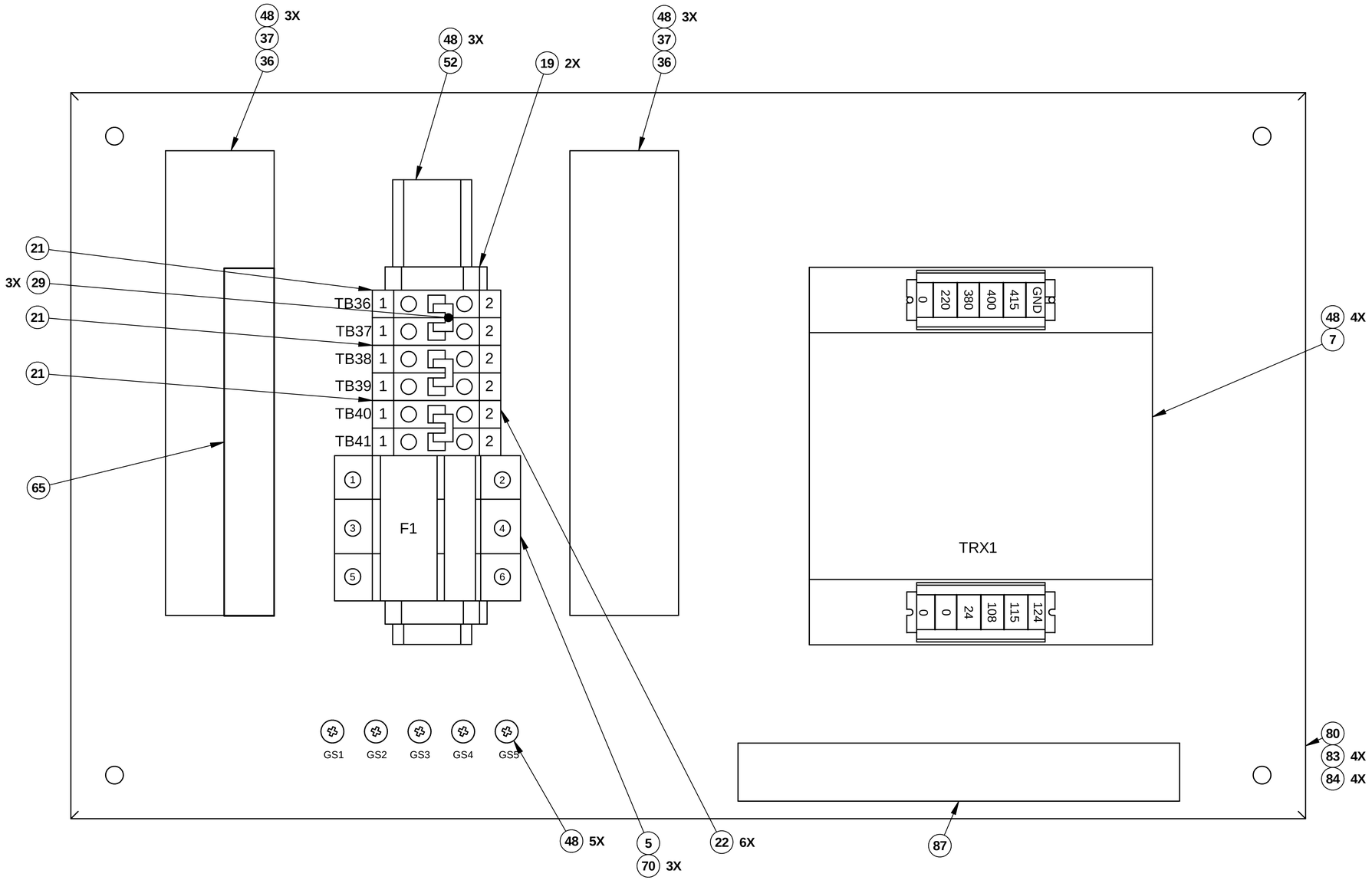
THIRD ANGLE PROJECTION

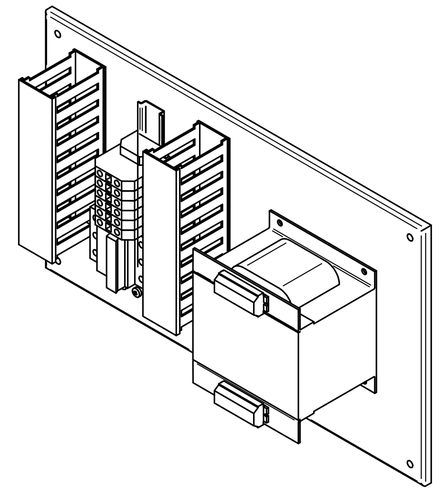
TRAK MACHINE TOOLS

TITLE: ELECTRICAL ENCL ASSY-LPM

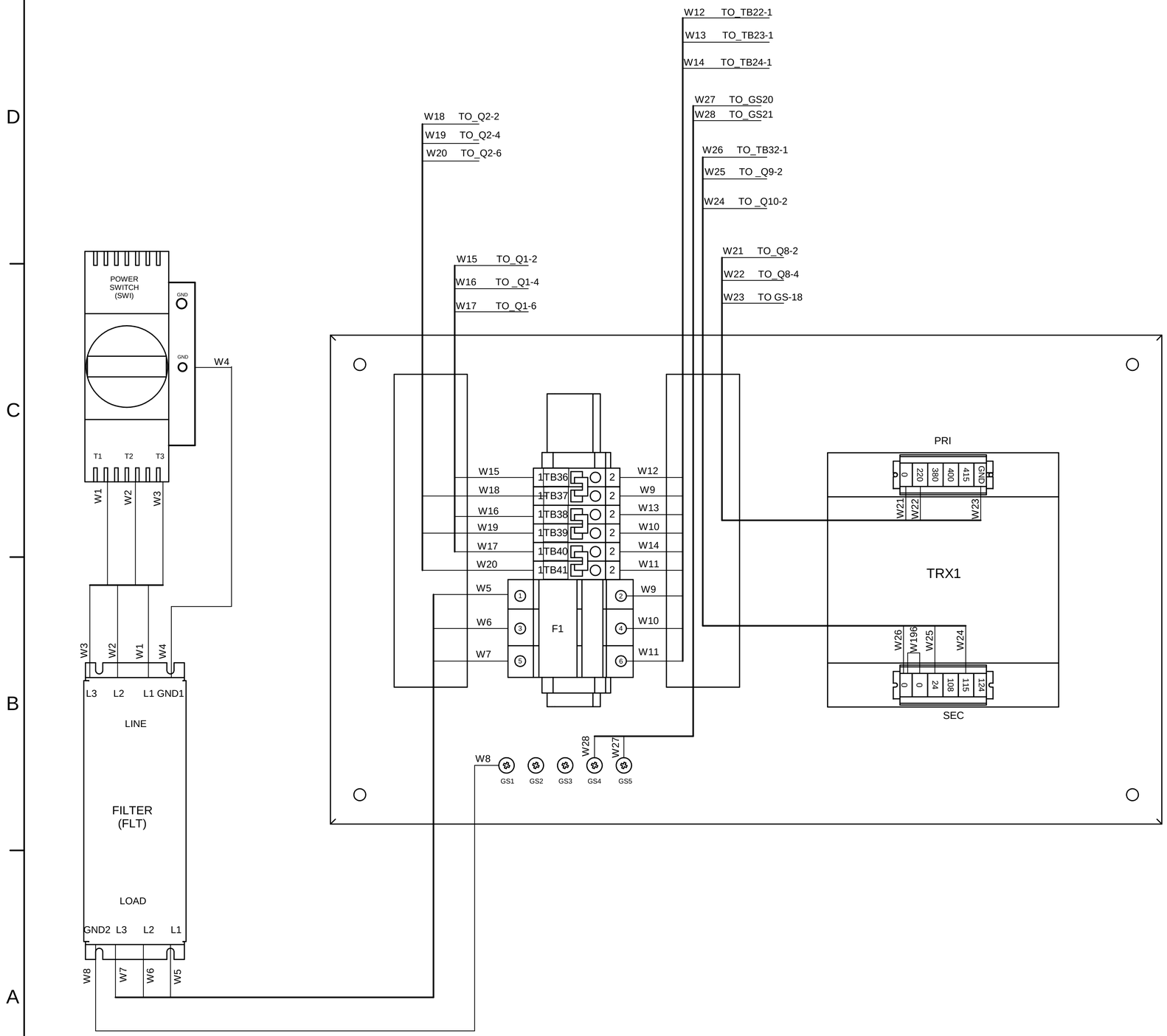
SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26571	P

SCALE: - SHEET 1 OF 16

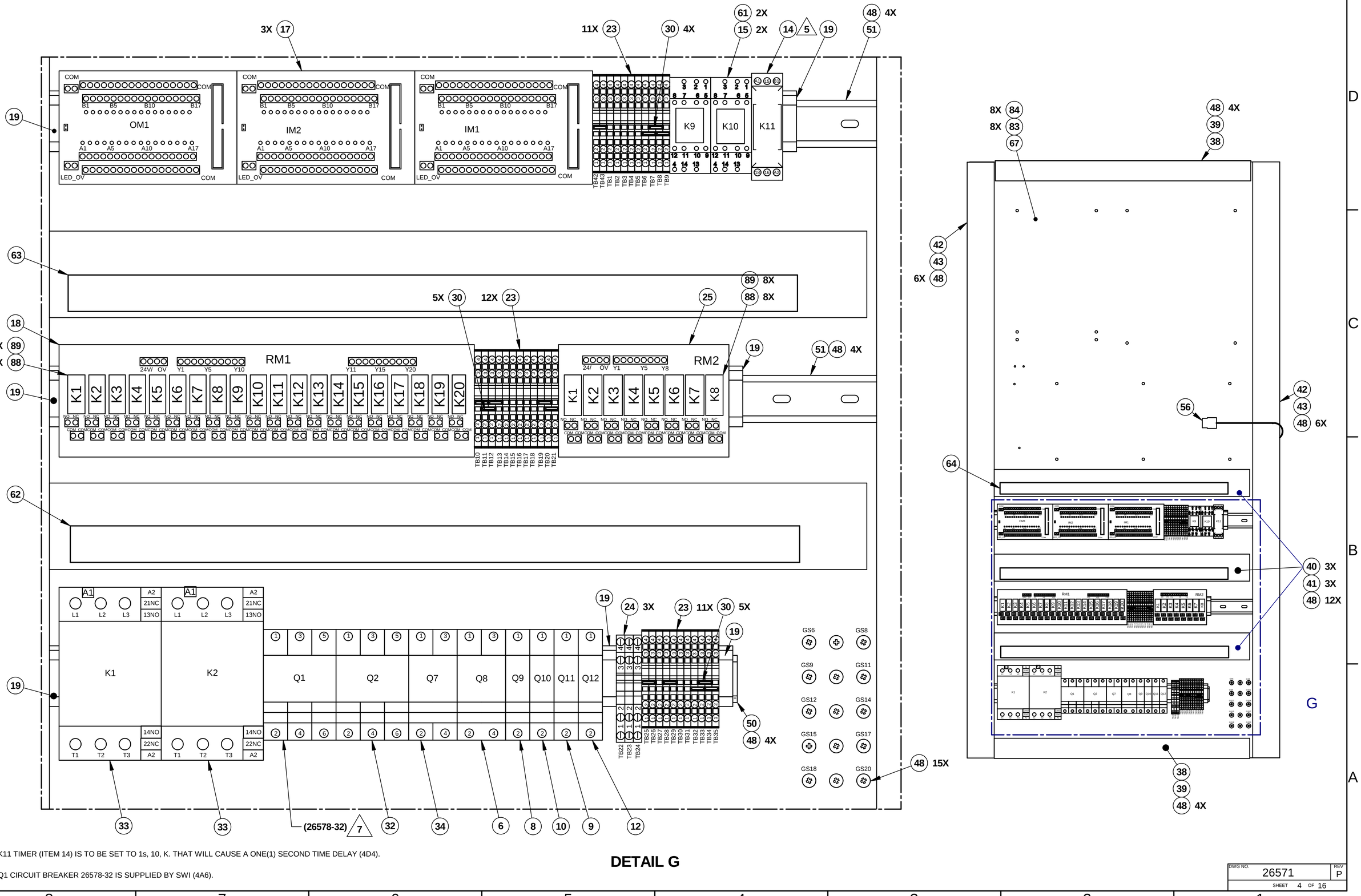




DWG NO.	REV
26571	P
SHEET 2 OF 16	



WIRE	WIRE FROM	WIRE LABEL	WIRE GAGE	COLOR	WIRE TO
W1	SW1-T1	L1	14mm²	BLACK	FLT-LINE-L1
W2	SW1-T2	L2	14mm²	BLACK	FLT-LINE-L2
W3	SW1-T3	L3	14mm²	BLACK	FLT-LINE-L3
W4	SW1-GND	PE	14mm²	GREEN	FLT-GND1
W5	FLT-LOAD-L1	L1-1	14mm²	BLACK	F1-1
W6	FLT-LOAD-L2	L2-1	14mm²	BLACK	F1-3
W7	FLT-LOAD-L3	L3-1	14mm²	BLACK	F1-5
W8	FLT-GND 2	PE	14mm²	GREEN	GS1
W9	F1-2	L1-2	14mm²	BLACK	TB37-2
W10	F1-4	L2-2	14mm²	BLACK	TB39-2
W11	F1-6	L3-2	14mm²	BLACK	TB41-2
W12	TB36-2	L1-2	2mm²	BLACK	TB22-1
W13	TB38-2	L2-2	2mm²	BLACK	TB23-1
W14	TB40-2	L3-2	2mm²	BLACK	TB24-1
W15	TB36-1	L1-2	8mm²	BLACK	Q1-2
W16	TB38-1	L2-2	8mm²	BLACK	Q1-4
W17	TB40-1	L3-2	8mm²	BLACK	Q1-6
W18	TB37-1	L1-2	8mm²	BLACK	Q2-2
W19	TB39-1	L2-2	8mm²	BLACK	Q2-4
W20	TB41-1	L3-2	8mm²	BLACK	Q2-6
W21	TRX1-PRI-0	L1-5	2mm²	BLACK	Q8-2
W22	TRX1-PRI-220	L2-5	2mm²	BLACK	Q8-4
W23	TRX1-PRI-GND	PE	2mm²	GREEN	GS18
W24	TRX1-SEC-115	110 AC	1.25mm²	RED	Q10-2
W25	TRX1-SEC-24	24 AC	1.25mm²	RED	Q9-2
W26	TRX1-SEC-0	OV	1.25mm²	WHITE	TB32-1
W27	GS5	PE	14mm²	GREEN	GS20
W28	GS4	PE	14mm²	GREEN	GS21
W196	TRX1-SEC-0	OV	1.25mm²	WHITE	TRX1-SEC-0



5 K11 TIMER (ITEM 14) IS TO BE SET TO 1s, 10, K. THAT WILL CAUSE A ONE(1) SECOND TIME DELAY (4D4).

7 Q1 CIRCUIT BREAKER 26578-32 IS SUPPLIED BY SWI (4A6).

DETAIL G

DWG NO.	REV
26571	P
SHEET 4 OF 16	

W38 TO SPD-L1

W39 TO SPD-L2

W40 TO SPD-L3

W41 TO SPD-GND

CABLE CHART	SWI P/N	WIRE FROM	WIRE LABEL	GAGE	COLOR	CABLE TO
COMPUTER MODULE POWER CABLE	26592 (ITEM 56)	TB26-1	110AC-1		BLACK	COMPUTER MODULE
		TB32-2	OV		WHITE	
		GS15	GND		GREEN	

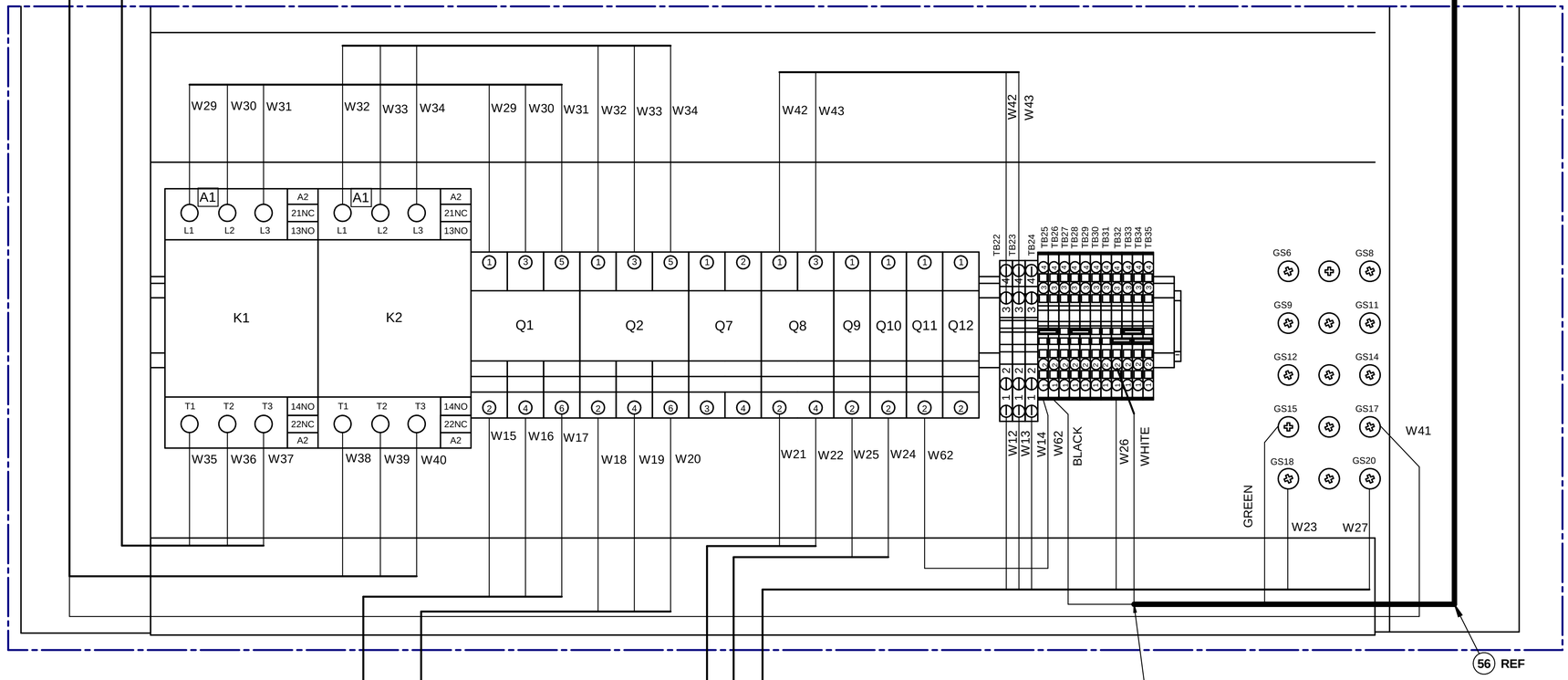
COMPUTER MODULE POWER CABLE

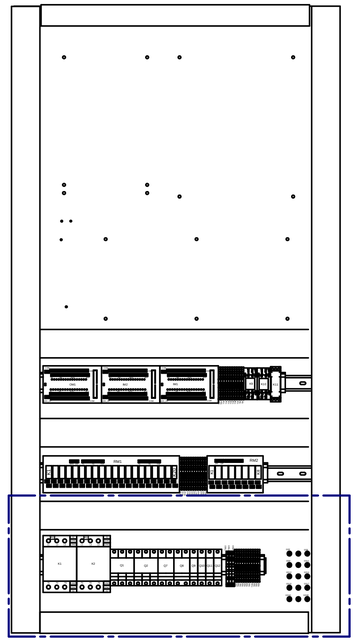
W35 TO SRP-1

W36 TO SRP-2

W37 TO SRP-3

DETAIL H



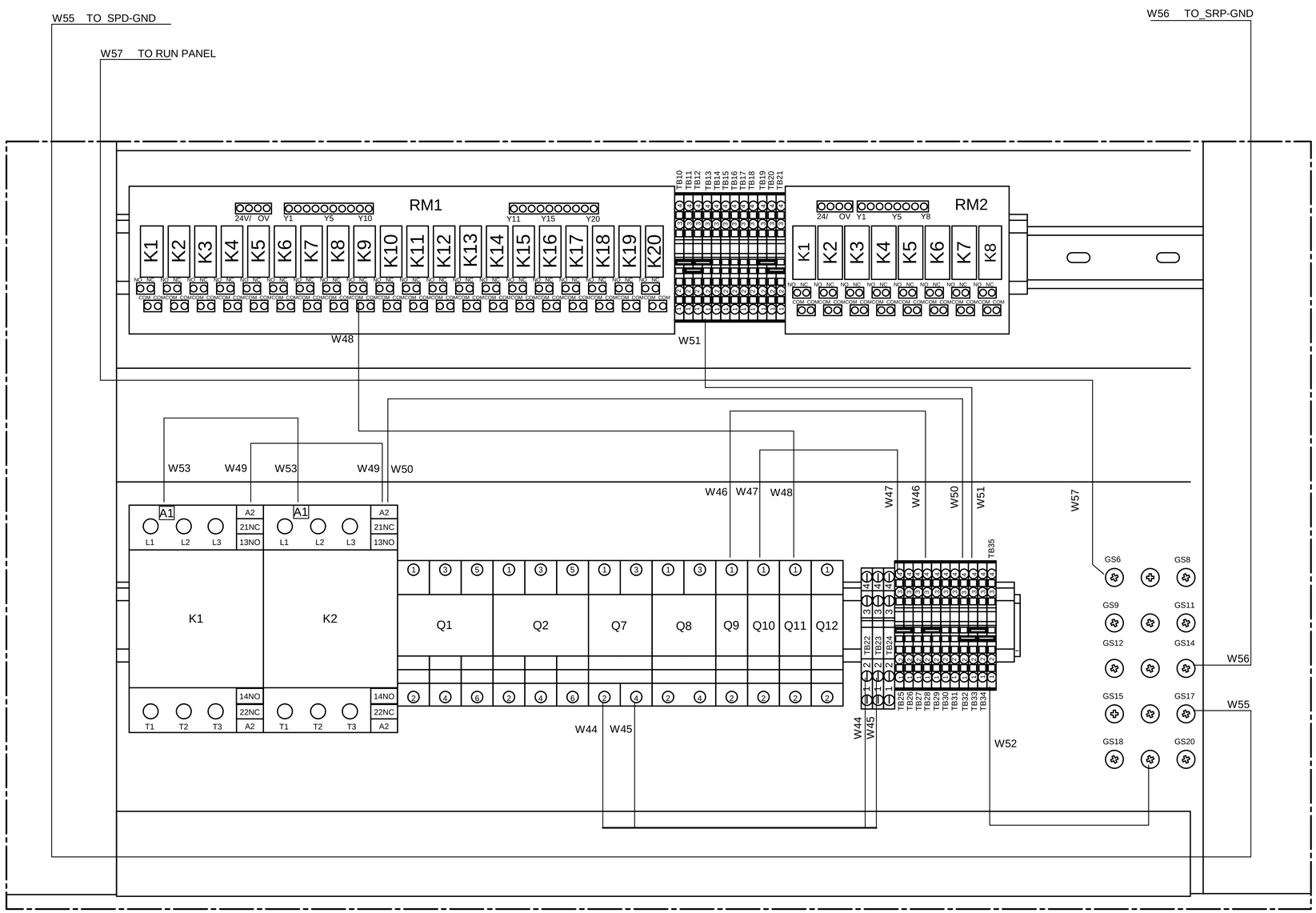


WIRE	WIRE FROM	WIRE LABEL	WIRE GAGE	COLOR	WIRE TO
W29	Q1-1	L1-4	8mm²	BLACK	K1-L1
W30	Q1-3	L2-4	8mm²	BLACK	K1-L2
W31	Q1-5	L3-4	8mm²	BLACK	K1-L3
W32	Q2-1	L1-6	8mm²	BLACK	K2-L1
W33	Q2-3	L2-6	8mm²	BLACK	K2-L2
W34	Q2-5	L3-6	8mm²	BLACK	K2-L3
W35	K1-T1	L1-3	8mm²	BLACK	SRP-1
W36	K1-T2	L2-3	8mm²	BLACK	SRP-2
W37	K1-T3	L3-3	8mm²	BLACK	SRP-3
W38	K2-T1	L1-7	8mm²	BLACK	SPD-L1
W39	K2-T2	L2-7	8mm²	BLACK	SPD-L2
W40	K2-T3	L3-7	8mm²	BLACK	SPD-L3
W41	GS17	GND	8mm²	GREEN	SPD-GND
W42	TB22-3	L1-2	2mm²	BLACK	Q8-1
W43	TB23-3	L2-2	2mm²	BLACK	Q8-3
W62	TB25-1	110AC-1	1.25mm²	RED	Q11-2

6 STRIP CABLE AT THIS POINT AND EXTEND WIRE TO CONNECTION FROM THIS POINT(SHEETS 5, 7-11).

DWG NO. 26571 REV P

SHEET 5 OF 16



J

DETAIL J

WIRE	WIRE FROM	WIRE LABEL	WIRE GAGE	COLOR	WIRE TO
W44	TB22-2	L1-2	2mm²	BLACK	Q7-2
W45	TB23-2	L2-2	2mm²	BLACK	Q7-4
W46	TB28-4	24AC-1	1.25mm²	RED	Q9-1
W47	TB25-4	110AC-1	1.25mm²	RED	Q10-1
W48	Q11-1	110AC-2	1.25mm²	RED	RM1-K9-COM
W49	K1-A2	OV	1.25mm²	WHITE	K2-A2
W50	K2-A2	OV	1.25mm²	WHITE	TB32-4
W51	TB33-4	OV	1.25mm²	WHITE	TB13-1
W52	TB35-1	GND	1.25mm²	GREEN	GS19
W53	K1-A1	24AC-16	1.25mm²	RED	K2-A1
W55	GS17	GND	8mm²	GREEN	SPD-GND
W56	GS14	GND	2mm²	GREEN	SRP-GND
W57	GS6	GND	2mm²	GREEN	RUN PANEL

DWG NO. 26571 REV P
SHEET 6 OF 16

WIRE	WIRE FROM	WIRE LABEL	WIRE GAGE	COLOR	WIRE TO
W58	Q12-2	24DC	1.25mm²	BLUE	PS1-V+
W59	Q12-1	24DC-1	1.25mm²	BLUE	TB21-1
W60	TB22-4	L1-2	2mm²	BLACK	Q3-L1
W61	TB23-4	L2-2	2mm²	BLACK	Q3-L2
W66	TB24-4	L3-2	2mm²	BLACK	Q3-L3
W63	TB25-3	110AC-1	1.25mm²	RED	PS1-L
W64	TB34-4	OV	1.25mm²	WHITE	PS1-N
W65	GS7	GND	2mm²	GREEN	PS1-FG

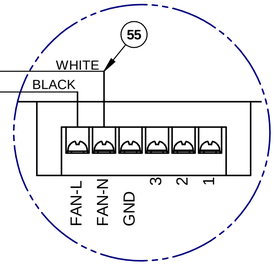
CABLE CHART	SWI P/N	WIRE FROM	LABEL	GAGE	COLOR	CABLE TO
SPINDLE MOTOR FAN CABLE	(26514)	Q7-1	L1-8	2mm²	BLACK	SPINDLE
		Q7-3	L2-8	2mm²	WHITE	MOTOR
SERVO PWR SUPPLY FANS	26514-2 (ITEM 55)	Q7-1	L1-8	2mm²	BLACK	SERVO
		Q7-3	L2-8	2mm²	WHITE	PWR
Z-AXIS BRAKE CABLE	26683-1 (ITEM 98)	RM1-K16-NO	24DC-22	0.75mm²	BLACK	Z AXIS
		TB10-1	OV	0.75mm²	WHITE	BRAKE

W58 TO PS1-V+

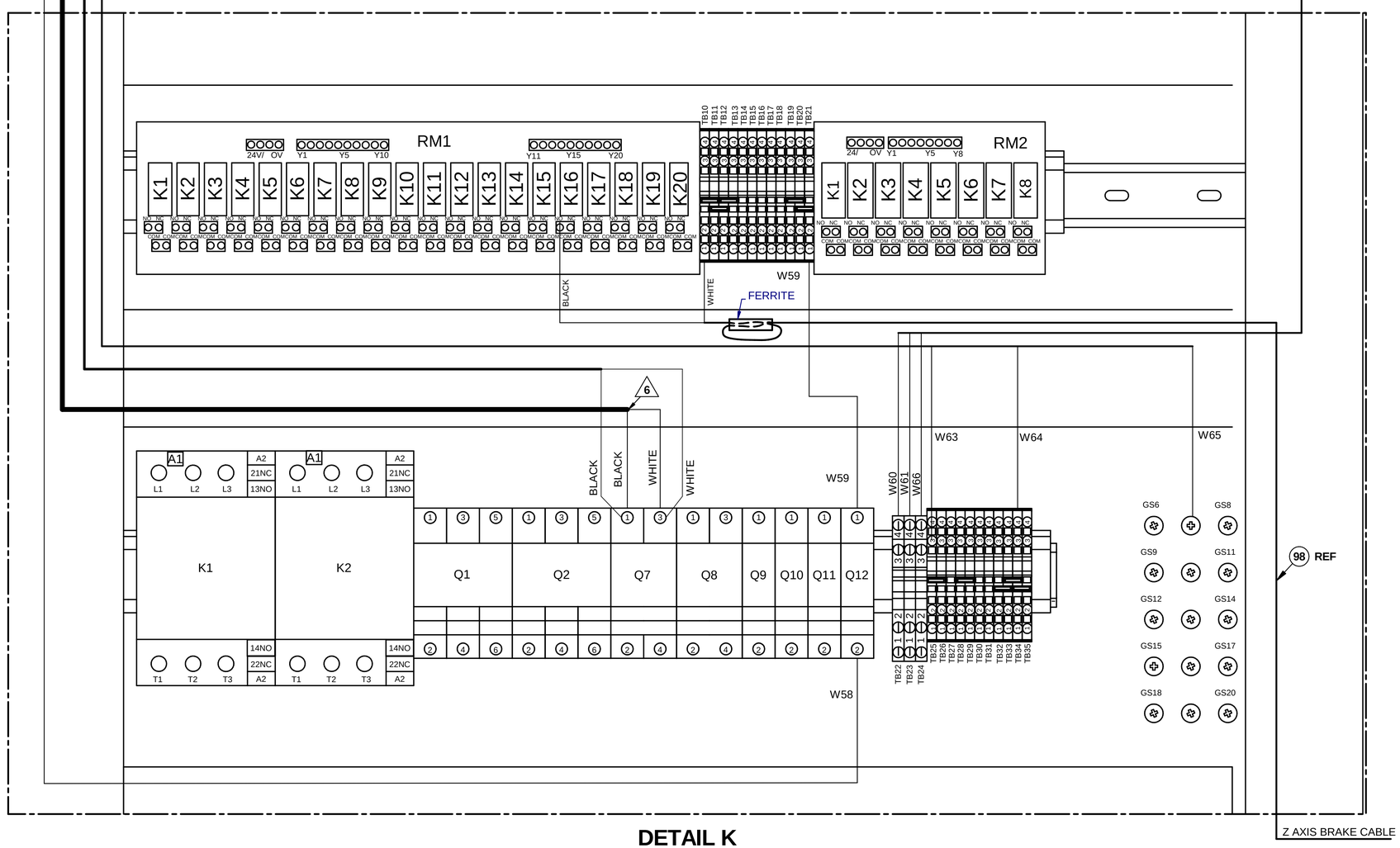
SPINDLE MOTOR FAN CABLE

W63 TO PS1-L
W64 TO PS1-N
W65 TO PS1-FG

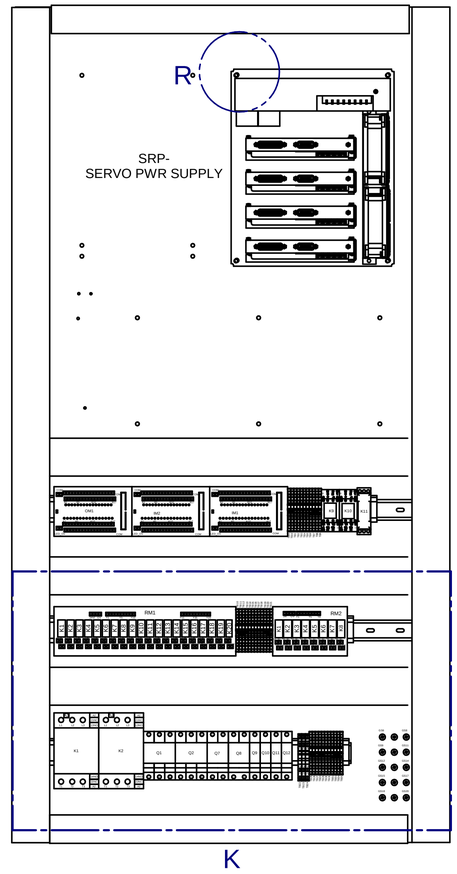
W60 TO Q3-L1
W61 TO Q3-L2
W66 TO Q3-L3



DETAIL R



DETAIL K



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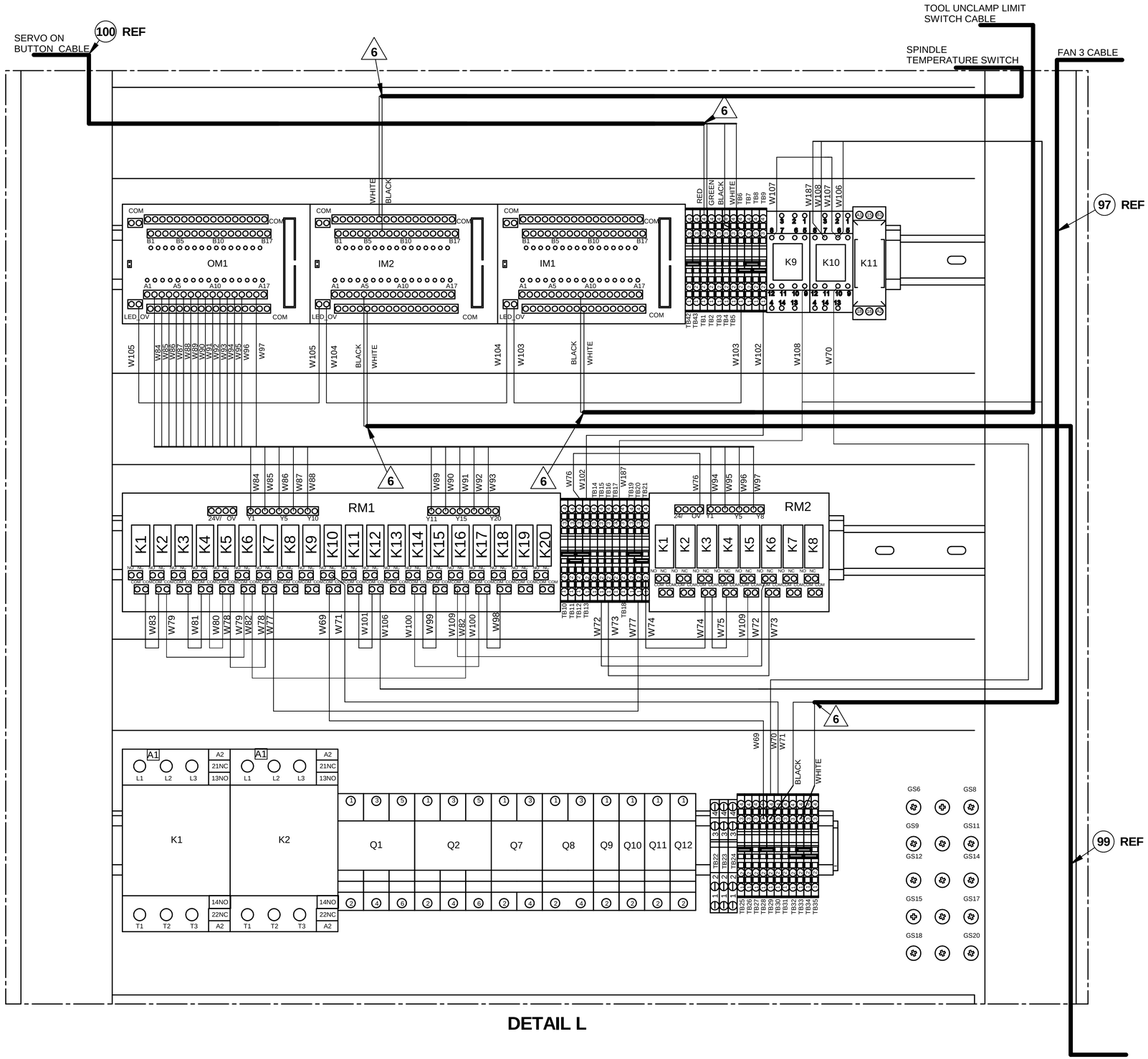
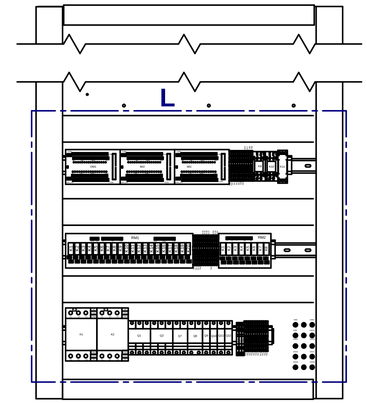


DETAIL L



CABLE LABEL	SWI P/N	WIRE FROM	LABEL	GAGE	COLOR	CABLE TO
FAN 3 CABLE	26673-9 (ITEM 97)	TB29-3	24AC-1	0.75mm²	BLACK	FAN 3
		TB33-3	OV	0.75mm²	WHITE	
TOOL UNCLAMP LIMIT SWITCH CABLE	(26677-2)	IM1-A9	I33.6	0.75mm²	BLACK	TOOL UNCLAMP LIMIT SWITCH
		IM1-A9-COM	24DC-1	0.75mm²	WHITE	
AIR PRESSURE LOW CABLE	26675-1 (ITEM 99)	IM2-A5	I36.6	0.75mm²	BLACK	AIR PRESSURE LOW
		IM2-A5-COM	24DC-1	0.75mm²	WHITE	
SPINDLE TEMPERATURE SWITCH CABLE	(26686)	IM2-B7	I37.3	0.75mm²	BLACK	SPINDLE TEMPERATURE SWITCH
		IM2-B7-COM	24DC-1	0.75mm²	WHITE	
SERVO ON BUTTON CABLE	26591 (ITEM 100)	TB1-4	24DC-9	0.5mm²	RED	SERVO ON BUTTON
		TB2-3	24DC-10	0.5mm²	GREEN	
		TB5-3	24DC-16	0.5mm²	BLACK	
		TB6-3	OV	0.5mm²	WHITE	

WIRE	WIRE FROM	WIRE LABEL	WIRE GAGE	COLOR	WIRE TO
W69	TB28-3	24AC-1	1.25mm²	RED	RM1-K10-COM
W70	TB29-4	24AC-1	1.25mm²	RED	K10-10
W71	TB30-4	24AC-2	1.25mm²	RED	RM1-K10-NC
W72	TB15-1	24DC-8	1.25mm²	BLUE	RM2-K6-NO
W73	TB16-1	24DC-9	1.25mm²	BLUE	RM2-K6-COM
W74	TB21-2	24DC-1	1.25mm²	BLUE	RM2-K3-COM
W75	RM2-K3-COM	24DC-1	1.25mm²	BLUE	RM2-K4-COM
W76	TB12-4	OV	1.25mm²	WHITE	RM2-OV
W77	TB20-1	24DC-1	1.25mm²	BLUE	RM1-K7-COM
W78	RM1-K7-COM	24DC-1	1.25mm²	BLUE	RM1-K5-COM
W79	RM1-K6-COM	24DC-2	1.25mm²	BLUE	RM1-K2-COM
W80	RM1-K5-COM	24DC-1	1.25mm²	BLUE	RM1-K4-COM
W81	RM1-K4-COM	24DC-1	1.25mm²	BLUE	RM1-K3-COM
W82	RM1-K6-COM	24DC-2	1.25mm²	BLUE	RM1-K16-COM
W83	RM1-K2-COM	24DC-2	1.25mm²	BLUE	RM1-K1-COM
W84	OM1-A2	Q40.0	1.25mm²	BLUE	RM1-Y1
W85	OM1-A3	Q40.2	1.25mm²	BLUE	RM1-Y3
W86	OM1-A4	Q40.4	1.25mm²	BLUE	RM1-Y5
W87	OM1-A5	Q40.6	1.25mm²	BLUE	RM1-Y7
W88	OM1-A6	Q41.0	1.25mm²	BLUE	RM1-Y9
W89	OM1-A7	Q41.2	1.25mm²	BLUE	RM1-Y11
W90	OM1-A8	Q41.4	1.25mm²	BLUE	RM1-Y13
W91	OM1-A9	Q41.6	1.25mm²	BLUE	RM1-Y15
W92	OM1-A10	Q42.0	1.25mm²	BLUE	RM1-Y17
W93	OM1-A11	Q42.2	1.25mm²	BLUE	RM1-Y19
W94	OM1-A12	Q42.4	1.25mm²	BLUE	RM2-Y1
W95	OM1-A13	Q42.6	1.25mm²	BLUE	RM2-Y3
W96	OM1-A14	Q43.0	1.25mm²	BLUE	RM2-Y5
W97	OM1-A16	Q43.4	1.25mm²	BLUE	RM2-Y7
W98	RM1-K18-COM	24AC-5	1.25mm²	RED	RM1-K17-COM
W99	RM1-K15-COM	24AC-5	1.25mm²	RED	RM1-K14-COM
W100	RM1-K14-COM	24AC-5	1.25mm²	RED	RM1-K17-COM
W101	RM1-K12-COM	24AC-3	1.25mm²	RED	RM1-K11-COM
W102	TB13-4	OV	1.25mm²	WHITE	TB9-1
W103	TB6-1	OV	1.25mm²	WHITE	IM1-LED-OV
W104	IM1-LED-OV	OV	1.25mm²	WHITE	IM2-LED-OV
W105	IM2-LED-OV	OV	1.25mm²	WHITE	OM1-LED-OV
W106	RM1-K12-COM	24AC-3	1.25mm²	RED	K10-6
W107	K10-6	24AC-3	1.25mm²	RED	K9-8
W108	K10-7	24DC-2	1.25mm²	BLUE	K9-9
W109	RM2-K5-COM	24DC-2	1.25mm²	BLUE	RM1-K16-COM
W187	TB17-3	24DC-2	1.25mm²	BLUE	K10-7

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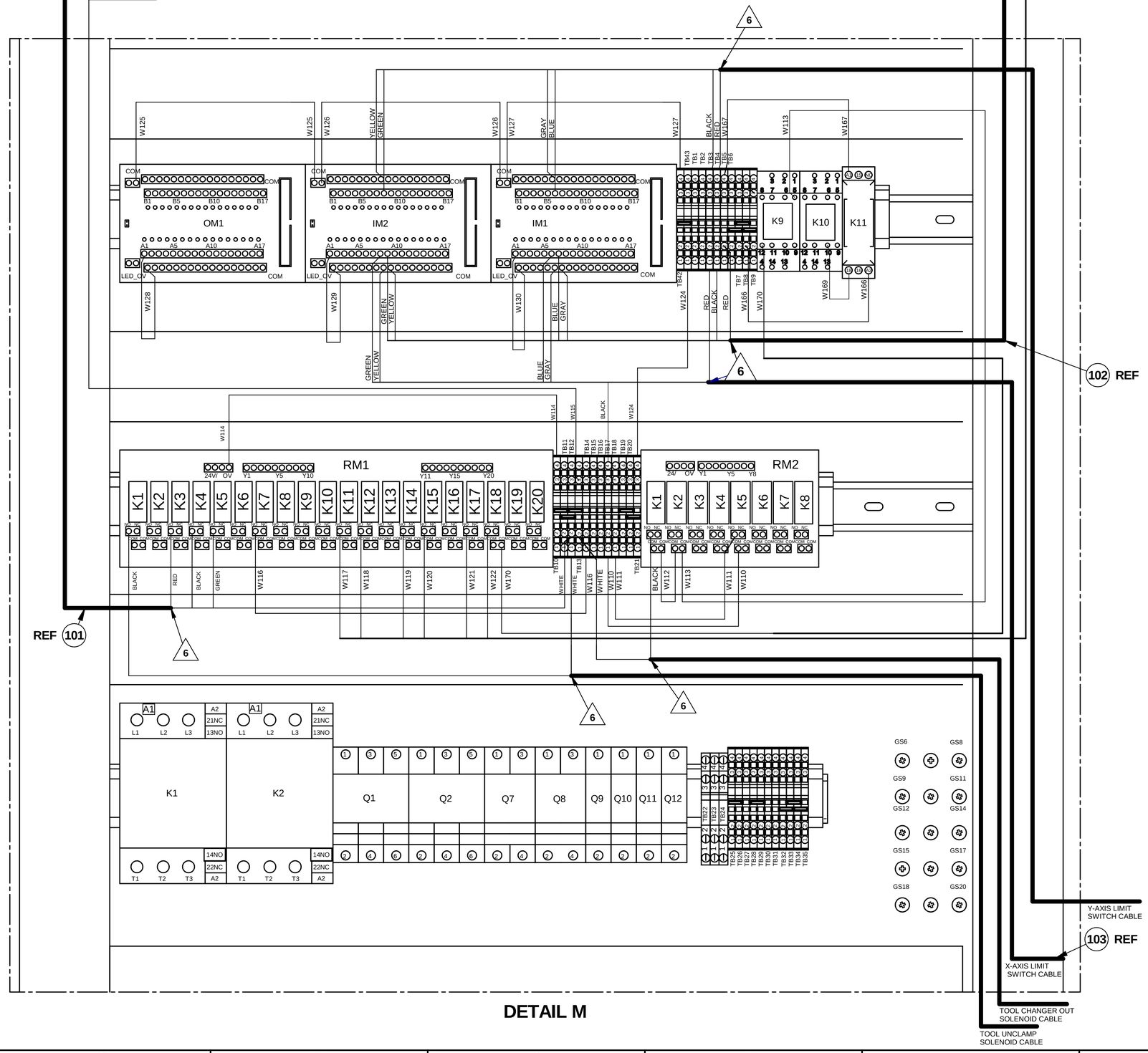
W117 TO K6-A1
W118 TO K5-A1
W119 TO K4-22
W120 TO K3-22
W121 TO K8-22
W122 TO K7-22

ALARM LIGHT CABLE

W115 TO PS1-V-

Z-AXIS LIMIT SWITCH CABLE



DETAIL M

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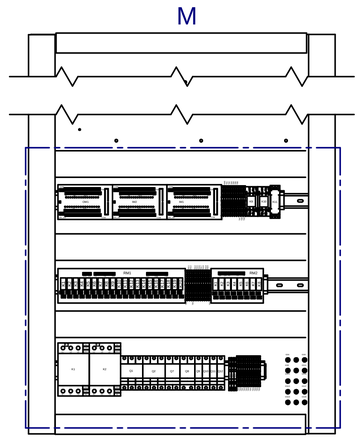

WIRE	WIRE FROM	LABLE	WIRE GAGE	COLOR	WIRE TO
W110	TB17-1	24DC-2	1.25mm²	BLUE	RM2-K5-COM
W111	TB18-1	24DC-16	1.25mm²	BLUE	RM2-K5-NO
W112	RM2-K1-COM	24DC-3	1.25mm²	BLUE	RM2-K2-COM
W113	RM2-K2-COM	24DC-3	1.25mm²	BLUE	K9-5
W114	RM1-OV	OV	1.25mm²	WHITE	TB10-4
W115	PS1-V-	OV	1.25mm²	WHITE	TB13-3
W116	RM1-K7-NO	24DC-7	1.25mm²	BLUE	TB14-1
W117	RM1-K11-NO	24AC-10	1.25mm²	RED	K6-A1
W118	RM1-K12-NO	24AC-11	1.25mm²	RED	K5-A1
W119	RM1-K14-NO	24AC-12	1.25mm²	RED	K4-22
W120	RM1-K15-NO	24AC-14	1.25mm²	RED	K3-22
W121	RM1-K17-NO	24AC-6	1.25mm²	RED	K8-22
W122	RM1-K18-NO	24AC-8	1.25mm²	RED	K7-22
W124	TB21-4	24DC-1	1.25mm²	BLUE	TB43-1
W125	OM1-COM	24DC-1	1.25mm²	BLUE	IM2-COM
W126	IM2-COM	24DC-1	1.25mm²	BLUE	IM1-COM
W127	IM1-COM	24DC-1	1.25mm²	BLUE	TB42-4
W128	OM1-A1	24DC-1	1.25mm²	BLUE	OM1-A1-COM
W129	IM2-A1	24DC-1	1.25mm²	BLUE	IM2-A1-COM
W130	IM1-A1	24DC-1	1.25mm²	BLUE	IM1-A1-COM
W166	TB8-2	OV	1.25mm²	WHITE	K11-A2
W167	TB5-4	24DC-16	1.25mm²	BLUE	K11-A1
W169	K10-10	24AC-1	1.25mm²	RED	K11-18
W170	RM1-K18-COM	24AC-5	1.25mm²	RED	K9-12

CABLE LABEL	SWI P/N	WIRE FROM	LABLE	GAGE	COLOR	CABLE TO
ALARM LIGHT CABLE	26685-1 (ITEM 101)	RM1-K3-NO	24DC-4	0.5mm²	RED	ALARM LIGHT
		RM1-K4-NO	24DC-5	0.5mm²	BLACK	
		RM1-K5-NO	24DC-6	0.5mm²	GREEN	
		TB12-2	OV	0.5mm²	WHITE	
Z-AXIS LIMIT SWITCH CABLE	22551-5 (ITEM 102)	TB5-2	24DC-16	0.5mm²	RED	Z-AXIS LIMIT SWITCH
		TB4-1	24DC-14	0.5mm²	BLACK	
		IM1-A7	I33.2	0.5mm²	BLUE	
		IM1-A7-COM	24DC-1	0.5mm²	GRAY	
		IM2-A9	I37.6	0.5mm²	GREEN	
		IM2-A9-COM	24DC-1	0.5mm²	YELLOW	
X-AXIS LIMIT SWITCH CABLE	22551-3 (ITEM 103)	TB3-1	24DC-12	0.5mm²	RED	X-AXIS LIMIT SWITCH
		TB17-4	24DC-2	0.5mm²	BLACK	
		IM1-A6	I33.0	0.5mm²	BLUE	
		IM1-A6-COM	24DC-1	0.5mm²	GRAY	
		IM2-A8	I37.4	0.5mm²	GREEN	
		IM2-A8-COM	24DC-1	0.5mm²	YELLOW	
TOOL UNCLAMP SOLENOID CABLE	(26673-1)	RM1-K1-NO	24DC-17	0.75mm²	BLACK	TOOL UNCLAMP SOLENOID
		TB12-1	OV	0.75mm²	WHITE	
TOOL CHANGER OUT SOLENOID CABLE	(26673-2)	RM2-K1-NO	24DC-23	0.75mm²	BLACK	TOOL CHANGER OUT SOLENOID
		TB13-2	OV	0.75mm²	WHITE	
Y-AXIS LIMIT SWITCH CABLE	(22551-4)	IM2-B8	I37.5	0.75mm²	GREEN	Y-AXIS LIMIT SWITCH
		IM2-B8-COM	24DC-1	0.75mm²	YELLOW	
		IM1-B6	I33.1	0.75mm²	BLUE	
		IM1-B6-COM	24DC-1	0.75mm²	GRAY	
		TB3-4	24DC-12	0.75mm²	BLACK	
		TB4-4	24DC-14	0.75mm²	RED	

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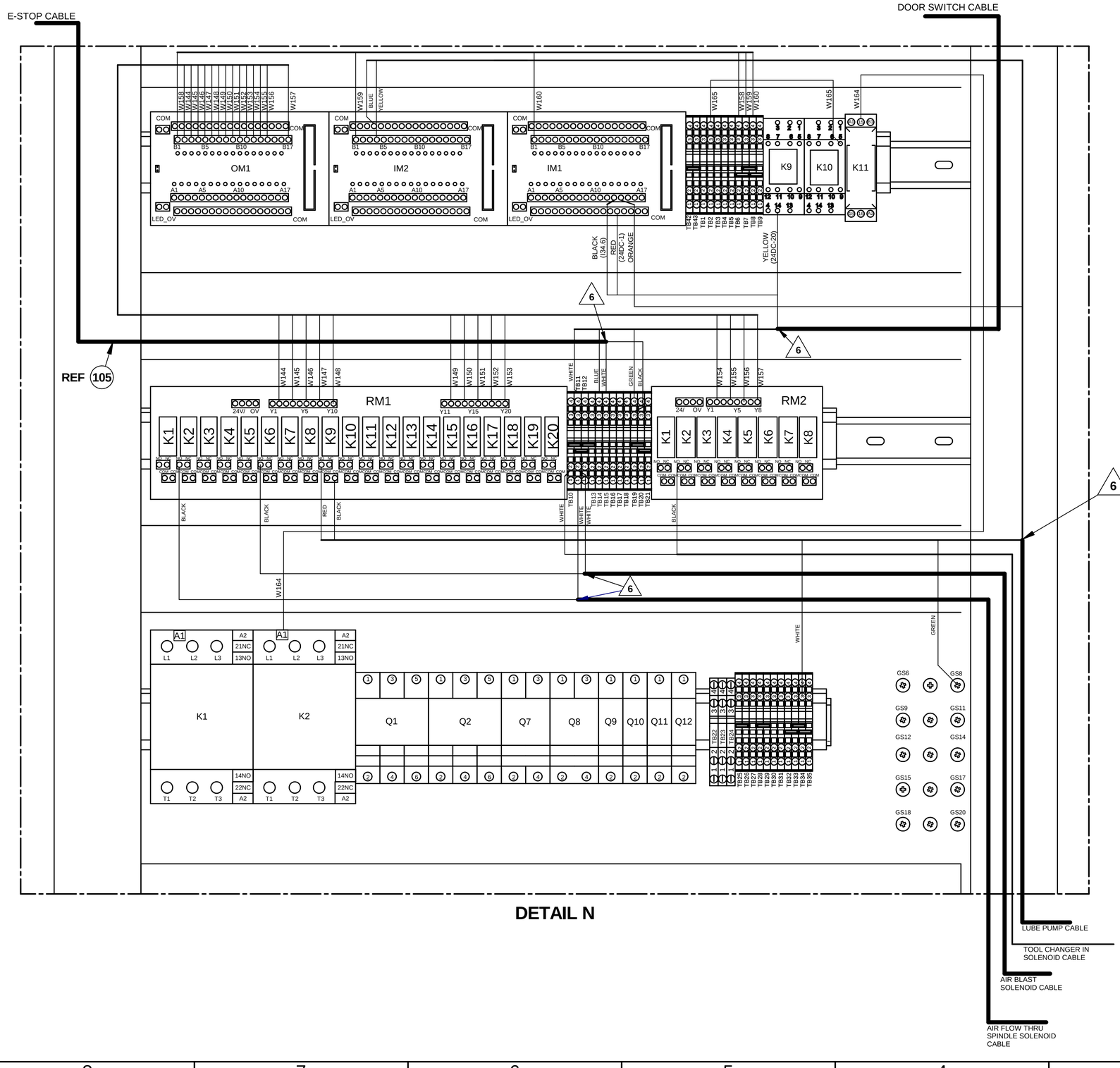
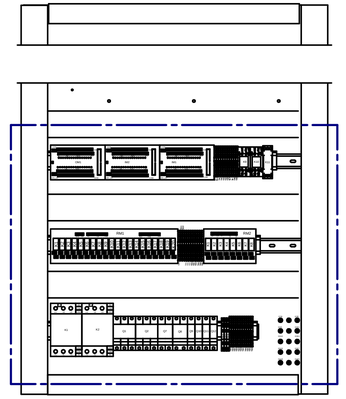


DETAIL N



WIRE	WIRE FROM	LABEL	GAGE	COLOR	WIRE TO
W144	OM1-B2	Q40.1	1.25mm²	BLUE	RM1-Y2
W145	OM1-B3	Q40.3	1.25mm²	BLUE	RM1-Y4
W146	OM1-B4	Q40.5	1.25mm²	BLUE	RM1-Y6
W147	OM1-B5	Q40.7	1.25mm²	BLUE	RM1-Y8
W148	OM1-B6	Q41.1	1.25mm²	BLUE	RM1-Y10
W149	OM1-B7	Q41.3	1.25mm²	BLUE	RM1-Y12
W150	OM1-B8	Q41.5	1.25mm²	BLUE	RM1-Y14
W151	OM1-B9	Q41.7	1.25mm²	BLUE	RM1-Y16
W152	OM1-B10	Q42.1	1.25mm²	BLUE	RM1-Y18
W153	OM1-B11	Q42.3	1.25mm²	BLUE	RM1-Y20
W154	OM1-B12	Q42.5	1.25mm²	BLUE	RM2-Y2
W155	OM1-B13	Q42.7	1.25mm²	BLUE	RM2-Y4
W156	OM1-B14	Q43.1	1.25mm²	BLUE	RM2-Y6
W157	OM1-B17	Q43.7	1.25mm²	BLUE	RM2-Y8
W158	TB6-4	OV	1.25mm²	WHITE	OM1-B1
W159	TB7-4	OV	1.25mm²	WHITE	IM2-B1
W160	TB8-4	OV	1.25mm²	WHITE	IM1-B1
W164	K2-A1	24AC-16	1.25mm²	RED	K11-15
W165	TB2-4	24DC-10	1.25mm²	BLUE	K10-5

CABLE LABEL	SWI P/N	WIRE FROM	LABEL	GAGE	COLOR	CABLE TO
LUBE PUMP CABLE	26681-2 (ITEM 104)	RM1-K9-NO	110AC-3	0.5mm²	RED	LUBE PUMP
		RM1-K9-COM	110AC-2	0.5mm²	BLACK	
		TB34-3	OV	0.5mm²	WHITE	
		IM2-B4-COM	24DC-1	0.5mm²	BLUE	
		IM2-B4	I36.5	0.5mm²	YELLOW	
		IM1-A14	I35.0	0.5mm²	ORANGE	
		GS8	GND	0.5mm²	GREEN	
AIR BLAST SOLENOID CABLE	(26673-5)	RM1-K6-NO	24DC-19	0.75mm²	BLACK	AIR BLAST SOLENOID
		TB11-2	OV	0.75mm²	WHITE	
AIR FLOW THRU SPINDLE SOLENOID CABLE	(26673-4)	RM1-K2-NO	24DC-18	0.75mm²	BLACK	AIR FLOW THRU SPINDLE SOLENOID
		TB11-1	OV	0.75mm²	WHITE	
E-STOP CABLE	26508-1 (ITEM 105)	TB15-4	24DC-8	0.75mm²	WHITE	E-STOP
		RB19-3	24DC-1	0.75mm²	BLACK	
DOOR SWITCH CABLE	(26682-6)	TB11-4	OV	0.5mm²	WHITE	DOOR SWITCH
		TB14-4	24DC-7	0.5mm²	BLUE	
		TB19-4	24DC-1	0.5mm²	GREEN	
		K9-14	24DC-20	0.5mm²	YELLOW	
		IM1-A13	I34.6	0.5mm²	BLACK	
		IM1-A13-COM	24DC-1	0.5mm²	RED	
TOOL CHANGER IN SOLENOID CABLE	(26673-3)	RM2-K2-NO	24DC-24	0.75mm²	BLACK	TOOL CHANGER IN SOLENOID
		TB10-2	OV	0.75mm²	WHITE	

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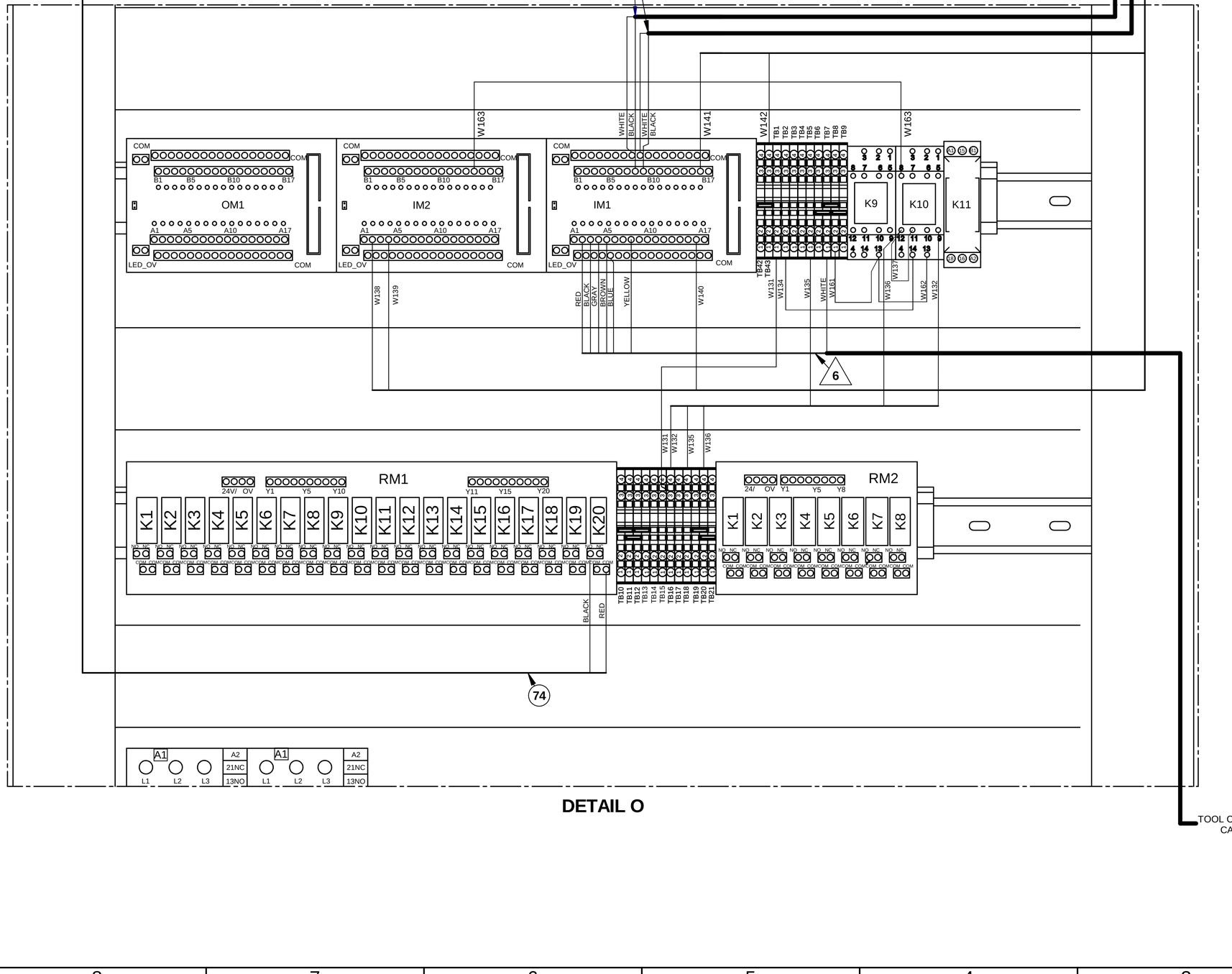
TOOL UNCLAMP BUTTON CABLE

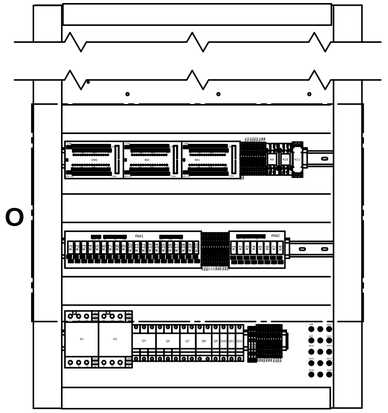
TOOL CLAMP LIMIT SWITCH CABLE

W138 TO Q4-22
W139 TO Q3-22
W140 TO Q5-22
W141 TO Q6-22
W142 TO Q3-21

TAP ACCEL/DECEL CABLE (13A8)



DETAIL O



WIRE	WIRE FROM	LABEL	GAGE	LENGTH	COLOR	WIRE TO
W131	TB16-3	24DC-9	1.25mm²		BLUE	TB1-1
W132	TB16-4	24DC-9	1.25mm²		BLUE	K10-9
W134	TB2-1	24DC-10	1.25mm²		BLUE	K10-14
W135	TB18-4	24DC-16	1.25mm²		BLUE	TB5-1
W136	TB20-4	24DC-1	1.25mm²		BLUE	K10-12
W137	K10-12	24DC-1	1.25mm²		BLUE	K10-11
W138	IM2-A2	I36.0	1.25mm²	890	BLUE	Q4-22
W139	IM2-A4	I36.4	1.25mm²	890	BLUE	Q3-22
W140	IM1-A16	I35.4	1.25mm²	760	BLUE	Q5-22
W141	IM1-B16	I35.5	1.25mm²	760	BLUE	Q6-22
W142	TB43-4	24DC-1	1.25mm²	635	BLUE	Q3-21
W161	TB8-1	OV	1.25mm²		WHITE	K9-13
W162	K9-13	OV	1.25mm²		WHITE	K10-13
W163	IM2-B14	I39.1	1.25mm²		BLUE	K10-8

CABLE LABEL	SWI P/N	WIRE FROM	LABEL	GAGE	COLOR	WIRE TO
TOOL CHANGER CABLE	(26672)	IM1-A2	I32.0	0.5mm²	RED	TOOL CHANGER DISTRIBUTION BOX
		IM1-A3	I32.2	0.5mm²	BLACK	
		IM1-A4	I32.4	0.5mm²	GRAY	
		IM1-A5	I32.6	0.5mm²	BROWN	
		IM1-A5-COM	24DC-1	0.5mm²	BLUE	
		TB7-1	OV	0.5mm²	WHITE	
		IM1-A8	I33.4	0.5mm²	YELLOW	
TOOL CLAMP LIMIT SWITCH CABLE	(26677-1)	IM1-B8	I33.5	0.75mm²	BLACK	TOOL CLAMP LIMIT SWITCH
		IM1-B8-COM	24DC-1	0.75mm²	WHITE	
TOOL UNCLAMP BUTTON CABLE	(26673-6)	IM1-B9	I33.7	0.75mm²	BLACK	TOOL UNCLAMP BUTTON
		IM1-B9-COM	24DC-1	0.75mm²	WHITE	
TAP ACCEL/DECEL CABLE	26994 (ITEM 74)	RM1-K20-NO	MI4	22AWG	BLACK	SPD-MI4
		RM1-K20-COM	DCM	22AWG	RED	SPD-DCM

TOOL CHANGER CABLE

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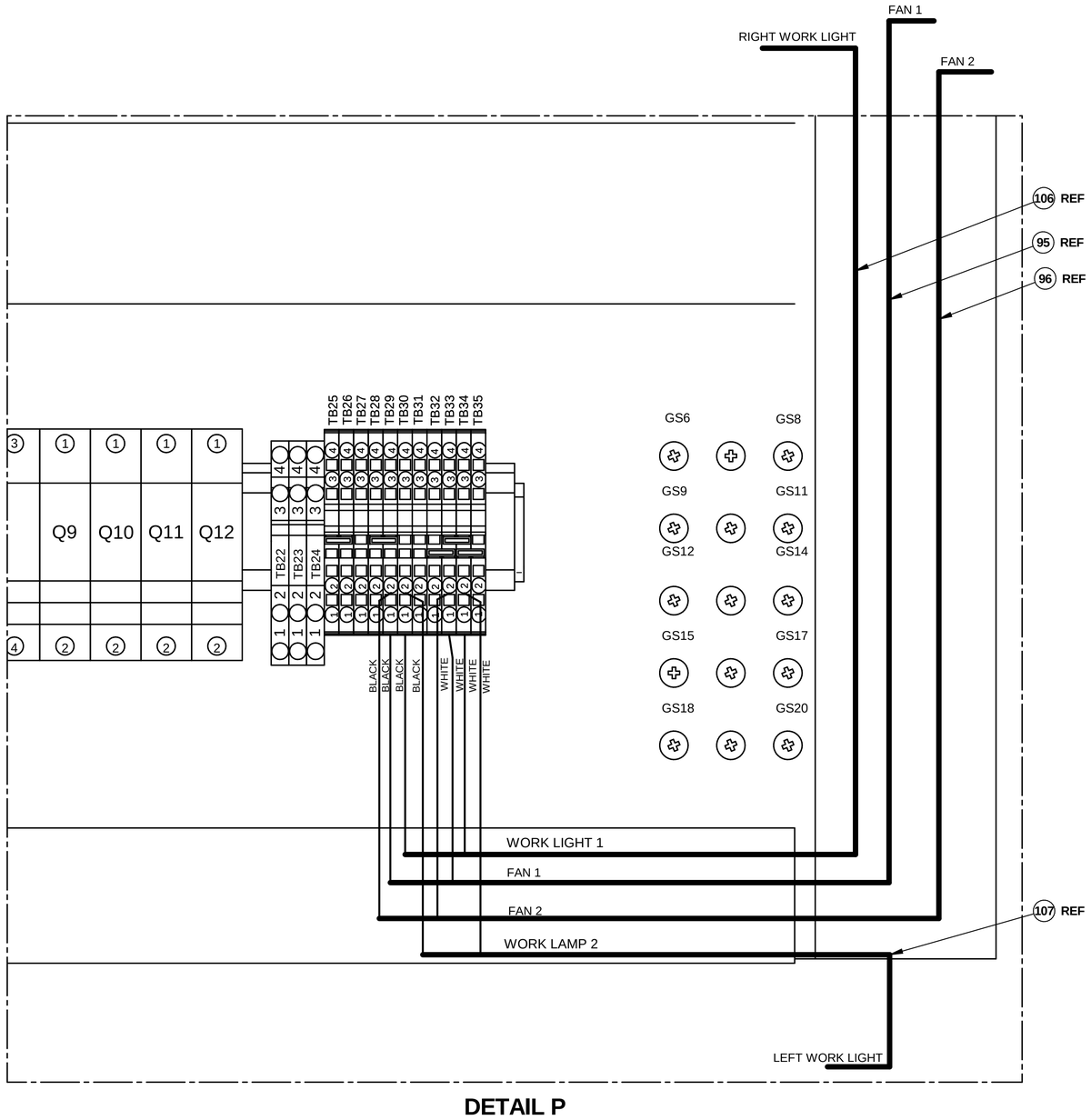

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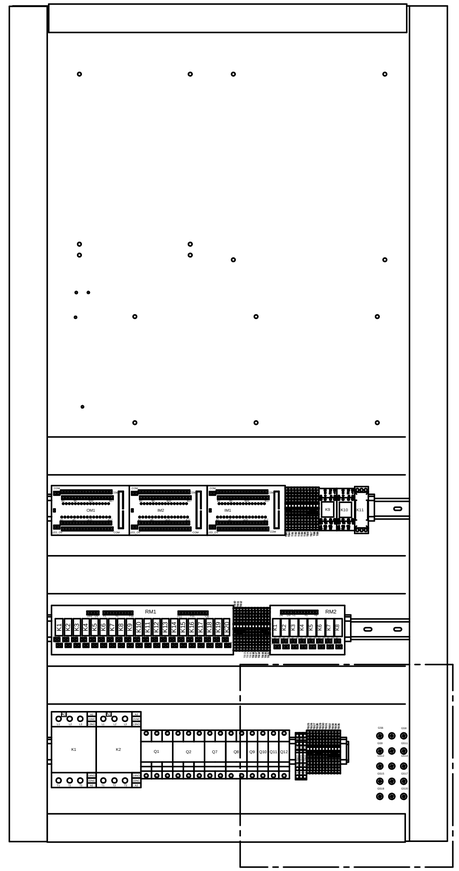

P

CABLE CHART	SWI P/N	CABLE FROM	LABEL	GAGE	COLOR	CABLE TO
RIGHT WORK LIGHT	26674-1 (ITEM 106)	TB30-1	24AC-2	0.75mm²	BLACK	RIGHT WORK LIGHT
		TB34-1	OV	0.75mm²	WHITE	
LEFT WORK LIGHT	26674-2 (ITEM 107)	TB30-2	24AC-2	0.75mm²	BLACK	LEFT WORK LIGHT
		TB34-2	OV	0.75mm²	WHITE	
FAN 1	26673-7 (ITEM 95)	TB29-1	24AC-1	0.75mm²	BLACK	FAN 1
		TB33-1	OV	0.75mm²	WHITE	
FAN 2	26673-8 (ITEM 96)	TB29-2	24AC-1	0.75mm²	BLACK	FAN 2
		TB33-2	OV	0.75mm²	WHITE	

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BR3 SERVO
BRAKING RESISTOR

SPINDLE MOTOR POWER CABLE

BR1 AND BR2 SPINDLE
BRAKING RESISTORS

SPINDLE MOTOR
ENCODER CABLE

W56
W68
W67
W37
W36
W35

150mm

100mm

300mm

180mm

80mm

230mm

350mm

280mm

400mm

230mm

W38
W39
W40
W41

COMPUTER MODULE
POWER CABLE

500mm

(11D7) TAP ACCEL/DECEL CABLE

Q

DETAIL Q

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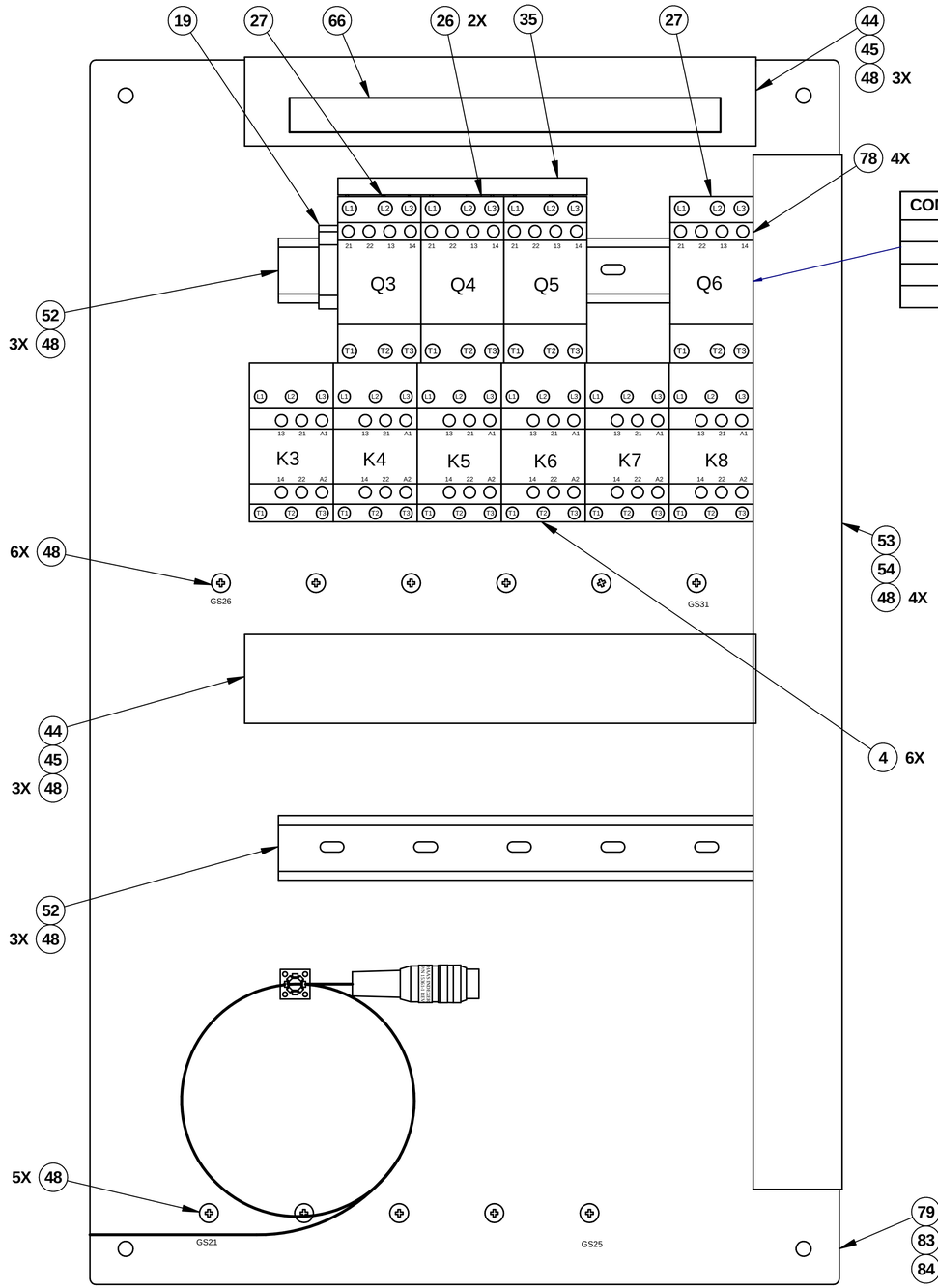
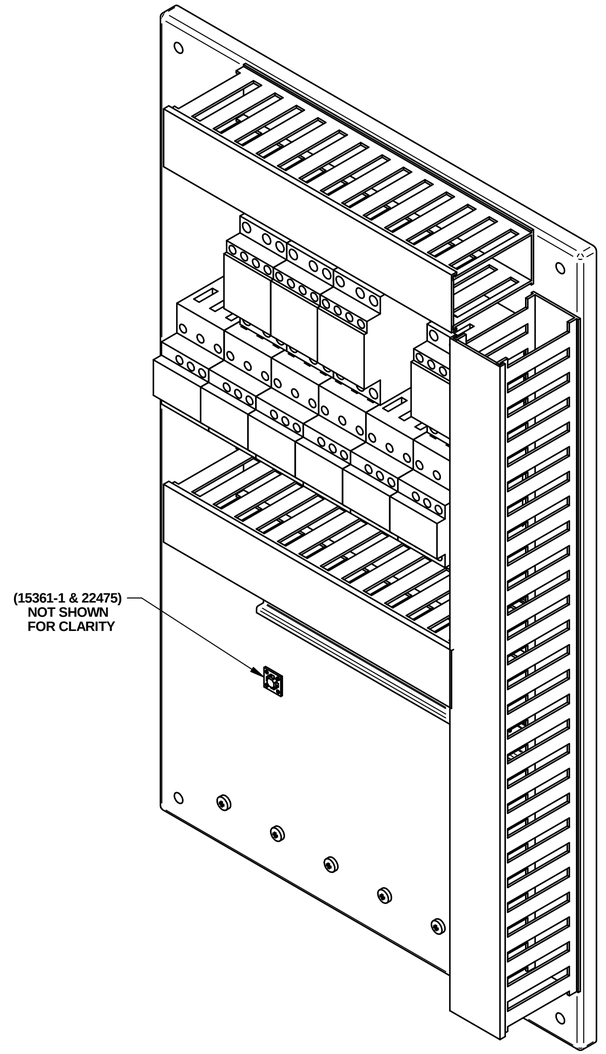


COMPONENT	AMP SETTING
Q3	1.5
Q4	2
Q5	2
Q6	0.75



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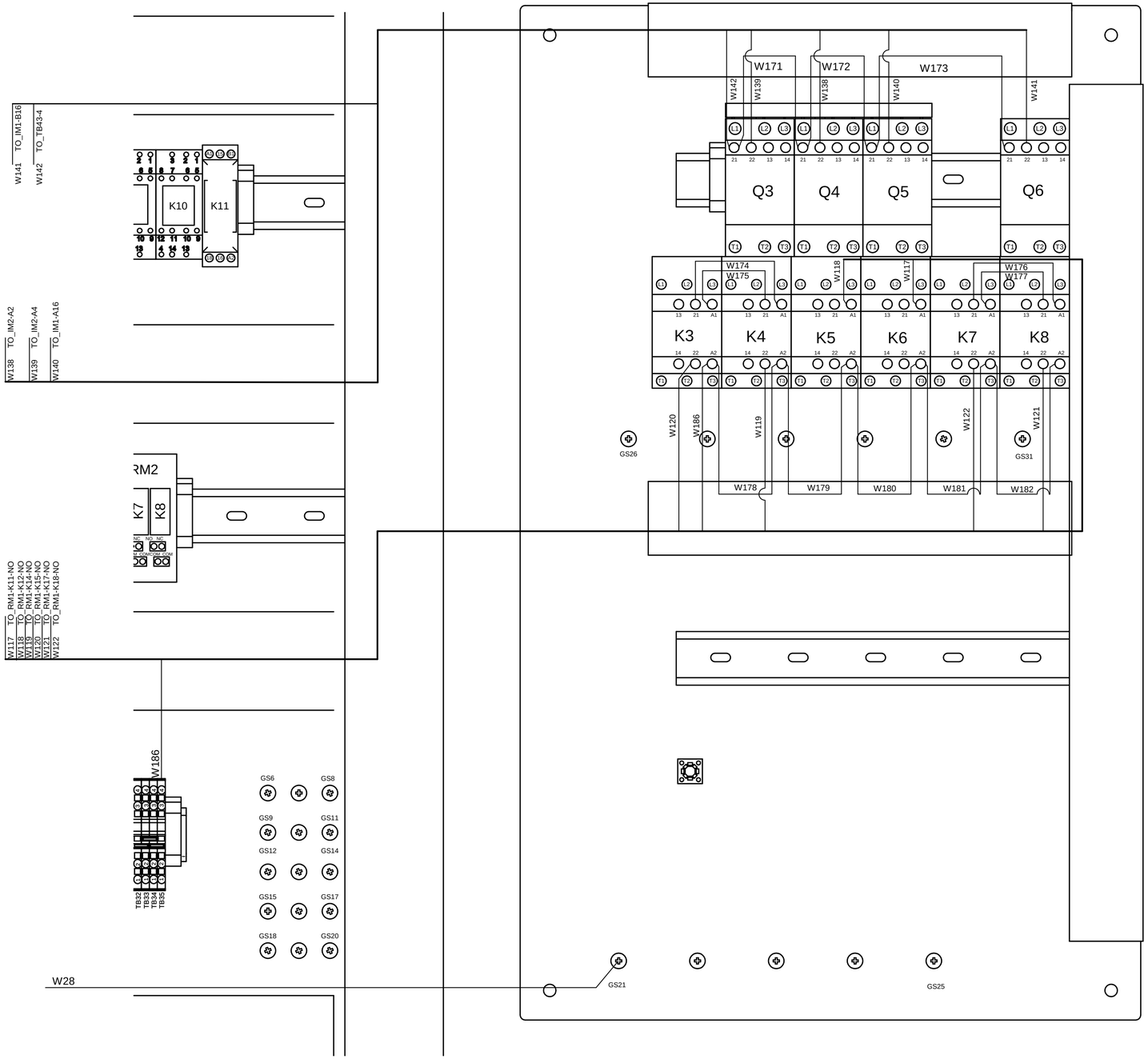
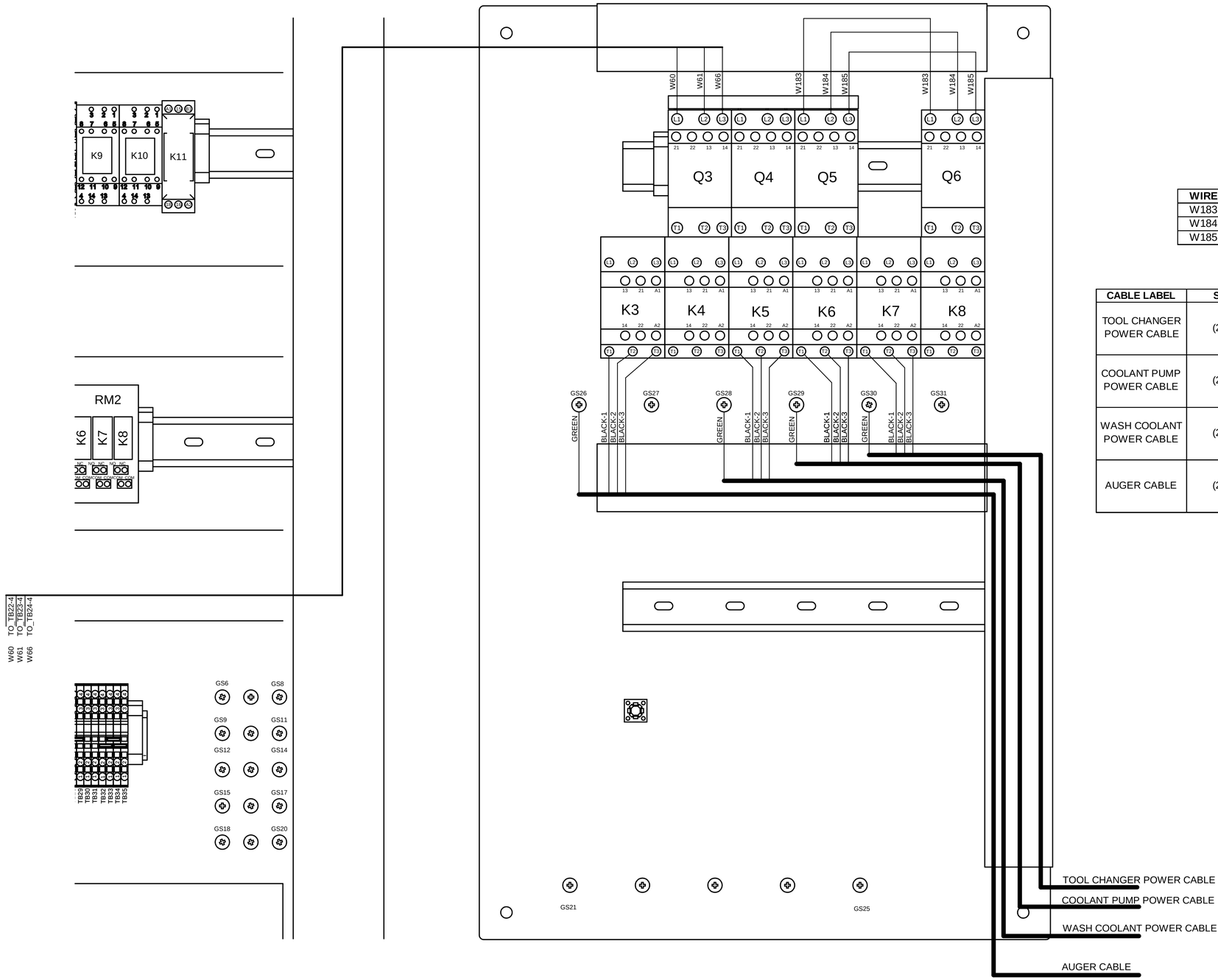
26571	P
SHEET 14 OF 16	



WIRE	WIRE FROM	LABEL	GAGE	COLOR	WIRE TO
W171	Q3-21	24DC-1	1.25mm²	BLUE	Q4-21
W172	Q4-21	24DC-1	1.25mm²	BLUE	Q5-21
W173	Q5-21	24DC-1	1.25mm²	BLUE	Q6-21
W174	K3-21	24AC-15	1.25mm²	RED	K4-A1
W175	K4-21	24AC-13	1.25mm²	RED	K3-A1
W176	K7-21	24AC-9	1.25mm²	RED	K8-A1
W177	K8-21	24AC-7	1.25mm²	RED	K7-A1
W178	K3-A2	OV	1.25mm²	WHITE	K4-A2
W179	K4-A2	OV	1.25mm²	WHITE	K5-A2
W180	K5-A2	OV	1.25mm²	WHITE	K6-A2
W181	K6-A2	OV	1.25mm²	WHITE	K7-A2
W182	K7-A2	OV	1.25mm²	WHITE	K8-A2
W186	TB35-4	OV	1.25mm²	WHITE	K3-A2

DWG NO. 26571 REV P
SHEET 15 OF 16



WIRE	WIRE FROM	LABEL	GAGE	COLOR	WIRE TO
W183	Q5-L1	L1-2	2mm²	BLACK	Q6-L1
W184	Q5-L2	L2-2	2mm²	BLACK	Q6-L2
W185	Q5-L3	L3-2	2mm²	BLACK	Q6-L3

CABLE LABEL	SWI P/N	WIRE FROM	WIRE LABEL	GAGE	COLOR	CABLE TO
TOOL CHANGER POWER CABLE	(26684-4)	K7-T1	U1	1.25mm²	BLACK-1	TOOL CHANGER
		K7-T2	V1	1.25mm²	BLACK-2	
		K7-T3	W1	1.25mm²	BLACK-3	
		GS30	GND	1.25mm²	GREEN	
COOLANT PUMP POWER CABLE	(26684-1)	K6-T1	U4	1.25mm²	BLACK-1	COOLANT PUMP
		K6-T2	V4	1.25mm²	BLACK-2	
		K6-T3	W4	1.25mm²	BLACK-3	
		GS29	GND	1.25mm²	GREEN	
WASH COOLANT POWER CABLE	(26684-2)	K5-T1	U2	1.25mm²	BLACK-1	WASH/COOLANT PUMP MOTOR
		K5-T2	V2	1.25mm²	BLACK-2	
		K5-T3	W2	1.25mm²	BLACK-3	
		GS28	GND	1.25mm²	GREEN	
AUGER CABLE	(26684-3)	K3-T1	U6	1.25mm²	BLACK-1	CONVEY/ AUGER
		K3-T2	V6	1.25mm²	BLACK-2	
		K3-T3	W6	1.25mm²	BLACK-3	
		GS26	GND	1.25mm²	GREEN	

DWG NO.	REV
26571	P
SHEET 16 OF 16	

Parts List for Assembly P/N: 26571

Printed 10/16/2017

26571

ELECTRICAL ENCLOSURE ASSY-LPM
SEE 26571-1 & 26775-SCH.

WHEN UPDATING THIS DOCUMENT REVISE PURCHASING SPEC 26500-1

Type	PL	Dwg Size	D
Revision	P	Product	LPM
Status	R	Engineer	RO
Date	2/21/2008	Planner Code	
By	RC	Comm Code	

Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
1	26553	SWITCH-DISCONNECT-CIRCUIT BREAKER-100A		1	EA	A	R	DWG		
2	24394-1	FILTER-EMC-3 PHASE-100AMPS		1	EA	-	R	DWG		
4	22892-4	CONTACTOR-220VAC, 2.2kW-COIL 50/60 24VAC		6	EA	B	R	DWG		
5	23036-2	FUSEHOLDER-3 POLE		1	EA	-	R	DWG		
6	26557-10	CIRCUIT BREAKER-2-POLE-D CURVE	10 AMP	1	EA	A	R	DWG		
7	21258-3	TRANSFORMER-1.6kVA		1	EA	-	R	DWG		
8	26558-16	CIRCUIT BREAKER-1-POLE	16 AMP	1	EA	A	R	DWG		
9	26558-02	CIRCUIT BREAKER-1-POLE	2 AMP	1	EA	A	R	DWG		
10	26558-04	CIRCUIT BREAKER-1-POLE	4 AMP	1	EA	A	R	DWG		
11	26559-3	POWER SUPPLY- SINGLE OUTPUT-24 VDC-150W	LRS-150-24	1	EA	A	R	DWG		
12	26558-06	CIRCUIT BREAKER-1-POLE	6 AMP	1	EA	A	R	DWG		
13	26564	FAN-24 VAC		3	EA	-	R	DWG		
14	24483-2	RELAY-TIMER-OFF DELAY		1	EA	A	R	DWG		
15	26567-1	RELAY-24DC COIL-4PDT		2	EA	-	R	DWG	OMRON	MY4NDC24
17	26808	MODULE- I/O INTERFACE		3	EA	-	R	DWG		
18	26809	MODULE-RELAY		1	EA	A	R	DWG		
19	23095-1	TERMINAL BLOCK-RAIL END STOP		10	EA	-	R	DWG		
21	24282-1	TERMINAL BLOCK-END SECTION		3	EA	-	R	DWG		
22	22557-3	TERMINAL BLOCK		6	EA	-	R	DWG		
23	22557-10	TERMINAL BLOCK-DIN RAIL-4POS-20 AMPS		34	EA	A	R	DWG		
24	22557-5	TERMINAL BLOCK		3	EA	-	R	DWG		

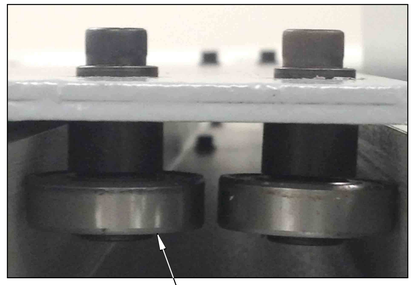
Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
25	26809-1	MODULE-RELAY-(RM2)		1	EA	A	R	DWG		
26	23821-2	RELAY-OVERLOAD-1.6 TO 2.5A		2	EA	-	R	DWG		
27	23821-3	RELAY-OVERLOAD-1 TO 1.6A		2	EA	-	R	DWG		
28	22890-500-30	RESISTOR-BRAKING		3	EA	G	R	DWG		
29	26574-1	TERMINAL BLOCK-JUMPER		3	EA	-	R	DWG		
30	22557-9-J1	TERMINAL BLOCK- JUMPER		14	EA	-	R	DWG		
32	26578-50	CIRCUIT BREAKER-3 POLE-D CURVE	50 AMP	1	EA	B	R	DWG		
33	22892-5	CONTACTOR-220VAC, 15kW, COIL 50/60 24VAC		2	EA	B	R	DWG		
34	26557-01	CIRCUIT BREAKER-2-POLE-D CURVE	1 AMP	1	EA	A	R	DWG		
35	26586-3	CONTACTOR-BUSBAR 3-POLE		1	EA	-	R	DWG		
36	26587-0205	WIRE WAY-GRAY-6mm SLOTS-45mm WIDE		2	EA	-	R	DWG		
37	26598-0205	COVER-WIRE WAY-45mm WIDE		2	EA	-	R	DWG		
38	26587-0575	WIRE WAY-GRAY-6mm SLOTS-45mm WIDE		2	EA	-	R	DWG		
39	26598-0575	COVER-WIRE WAY-45mm WIDE		2	EA	-	R	DWG		
40	26588-0585	WIRE WAY-GRAY-6mm SLOTS-65mm x 65mm		3	EA	-	R	DWG		
41	26597-0585	COVER-WIRE WAY-65mm WIDE		3	EA	-	R	DWG		
42	26588-1245	WIRE WAY-6mm SLOTS-65mm x 65mm		2	EA	-	R	DWG		
43	26597-1245	COVER-WIRE WAY-65mm WIDE		2	EA	-	R	DWG		
44	26587-0275	WIRE WAY-GRAY-6mm SLOTS-45mm WIDE		2	EA	-	R	DWG		
45	26598-0275	COVER-WIRE WAY-45mm WIDE		2	EA	-	R	DWG		
48	M5-0.8X10 10Z	SCREW-PH-PHIL-STL-ZINC		104	EA	-	R	PS		
50	26589-0510	DIN RAIL-SLOTTED	510mm	1	EA	A	R	DWG		
51	26589-0585	DIN RAIL-SLOTTED	585mm	2	EA	A	R	DWG		
52	26589-0255	DIN RAIL-SLOTTED	255mm	3	EA	A	R	DWG		

Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
53	26587-0550	WIRE WAY-45mm WIDE		1	EA	-	R	DWG		
54	26598-0550	COVER-WIRE WAY-45mm WIDE		1	EA	-	R	DWG		
55	26514-2	CABLE ASSY-SERVO PWR SUPPLY FANS		1	EA	B	R	PL		
56	26592	CABLE ASSY-COMPUTER MODULE POWER		1	EA	-	R	PL		
58	26541	SHEET METAL-CABINET- ELEC-PT7		1	EA	A	R	DWG		
59	26764	SHEET METAL-RESISTORS		1	EA	-	R	DWG		
60	26765	SHEET METAL-RESISTOR COVER		1	EA	-	R	DWG		
61	23434-3	SOCKET-RELAY-RAIL MOUNT		2	EA	-	R	DWG		
62	26571-LB1	LABEL-TEXT		1	EA	C	R	DWG		
63	26571-LB2	LABEL-TEXT		1	EA	C	R	DWG		
64	26571-LB3	LABEL-TEXT		1	EA	C	R	DWG		
65	26571-LB4	LABEL-TEXT		1	EA	C	R	DWG		
66	26571-LB5	LABEL-TEXT		1	EA	C	R	DWG		
67	26581	SHEET METAL-BACK PANEL		1	EA	A	R	PS		
68	26690	BRACKET-ASSY-CABLE WAY		1	EA	-	R	PL		
69	26691	BRACKET-ASSY-CABLE WAY		1	EA	-	R	PL		
70	26822-80	FUSE-GG SERIES-(22X58mm)	80 AMP	3	EA	B	R	DWG		
74	26994	CABLE ASSY-TAP ACCEL/DECEL		1	EA	-	R	PL		
75	M6-1.0X15 25B	SCREW-SHCS-STL-BO		10	EA		R	PS		
76	24009-3	WASHER-BELLEVILLE SPRING LK-SERRATED	.264 ID x .374 OD x .024 THK-1/4 or M6	14	EA	D	R	DWG		
77	M6-1.0X25 25B	SCREW-SHCS-STL-BO		4	EA	A	R	PS		
78	23821-5	RELAY-OVERLOAD-AUXILIARY CONTACT		4	EA	A	R	DWG		
79	26581-1	SHEET METAL - RIGHT PANEL		1	EA	-	R	PS		

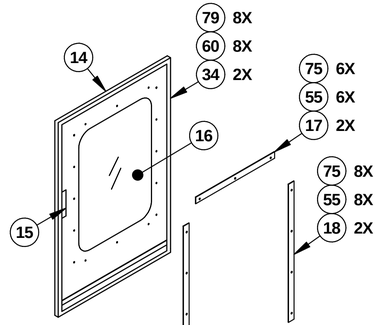
Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
80	26581-2	SHEET METAL - BOTTOM PANEL		1	EA	-	R	PS		
81	26581-3	SHEET METAL - LEFT PANEL		1	EA	-	R	PS		
82	26581-4	SHEET METAL - POWER SWITCH PANEL		1	EA	-	R	PS		
83	M8 70B	WASHER-FLAT USS-STL-BO		20	EA		R	PS		
84	M8-1.25 50B	NUT-HEX-BLK OX	NON STOCKABLE	20	EA	-	R	PS		
85	M6-1.0X20 25B	SCREW-SHCS-STL-BO		4	EA	-	R	PS		
86	M6 70B	WASHER-FLAT USS-STL-BO		4	EA	-	R	PS		
87	26571-LB7	LABEL-TEXT-ELEC BOX	SEE REV LEVEL ON 26775-SCH & 26571	1	EA	-	R	DWG		
88	26807-1	RELAY-24VDC COIL-SPDT		28	EA	-	R	DWG		
89	27148	RETAINING CLIP-RELAY 15.7mm		28	EA	-	R	DWG		
90	26998	SEAL-EDGE-GRIP-ADJUSTABLE-100 FT		170	IN	-	R	DWG		
95	26673-7	CABLE ASSY-DOOR FAN 1		(1)	EA	-	R	PL	PING JENG	
96	26673-8	CABLE ASSY-DOOR FAN 2		(1)	EA	-	R	PL	PING JENG	
97	26673-9	CABLE ASSY-DOOR FAN 3		(1)	EA	-	R	PL	PING JENG	40805643
98	26683-1	CABLE ASSY-Z-AXIS BRAKE		(1)	EA	-	R	PL		
99	26675-1	CABLE ASSY-AIR PRESSURE LOW		(1)	EA	-	R	PS		
100	26591	PUSH BUTTON ASSY-SERVO ON		(1)	EA	-	R	PL		
101	26685-1	CABLE ASSY-ALARM LIGHT		(1)	EA	-	R	PS		
102	22551-5	LIMIT SWITCH ASSY-Z AXIS-LPM	FOR CABLE ASSY REPL SEE 22551-8	(1)	EA	B	R	PL		
103	22551-3	LIMIT SWITCH ASSY-X AXIS	FOR CABLE ASSY REPL SEE 22551-6	(1)	EA	D	R	PL		
104	26681-2	CABLE ASSY-LUBE PUMP		1	EA	A	R	PL	PING JENG	40805634

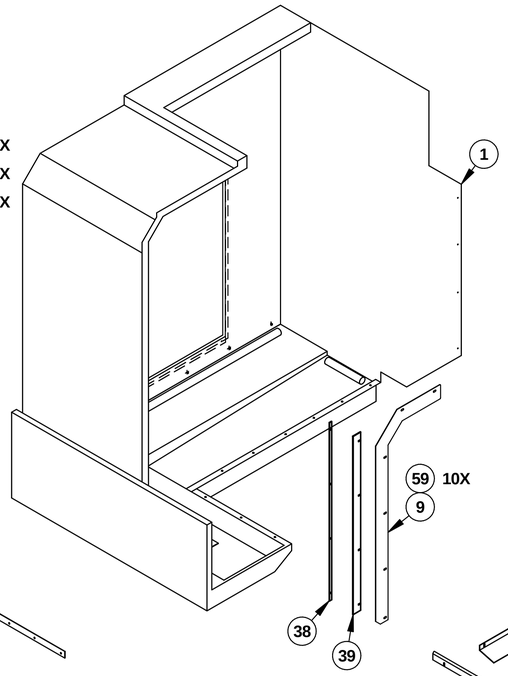
Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
105	26508-1	CABLE ASSY-E-STOP		(1)	EA	-	R	PL		
106	26674-1	WORK LIGHT ASSY-RIGHT-24VAC		(1)	EA	-	R	PL		
107	26674-2	WORK LIGHT ASSY-LEFT-24VAC		(1)	EA	-	R	PL		
120	M3-0.5X5 25B	SCREW-SHCS-STL-BO		3	EA	-	R	PS		

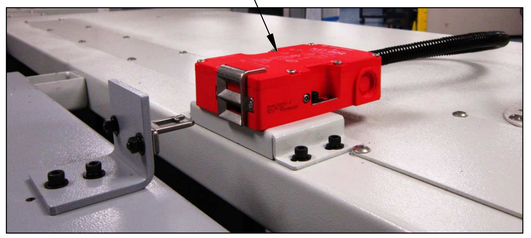
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
G	EXTENSIVELY REVISED: DOOR SWITCH & HARDWARE.	14243	1/16/15	AW
H	(2B1-3) REVISED INTERCONNECTION CHART.	14362	2/27/15	AW
J	ITEM 85 WAS: M5-0.8 56Z	14450	09/4/15	AW
K	ITEM 9 PJ P/N WAS :M7H005. ADDED ITEMS 38 & 39. ITEM 59 WAS: M6-1.0X10 12B	14479	01/08/16	LG

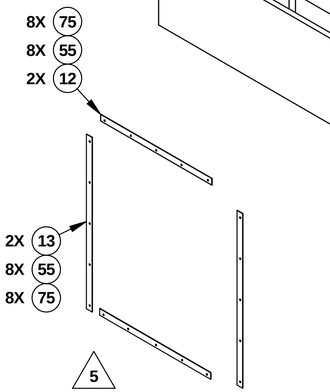


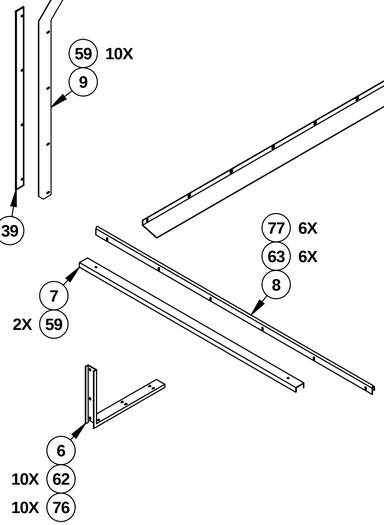
32 REF
35 REF
62 REF
76 REF

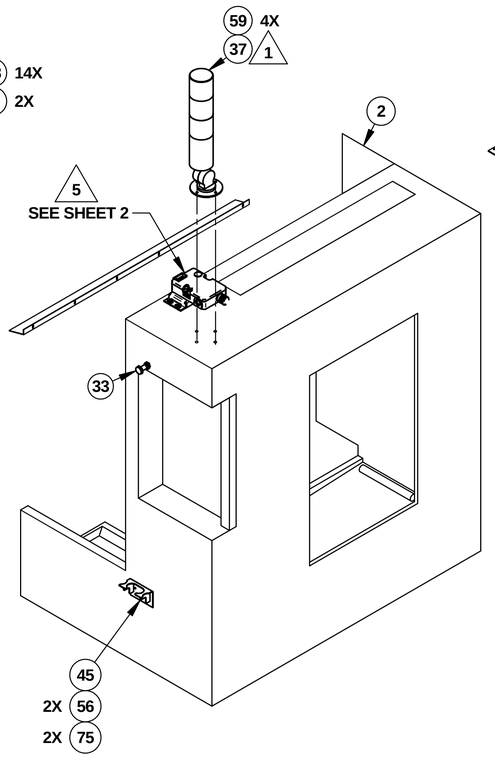


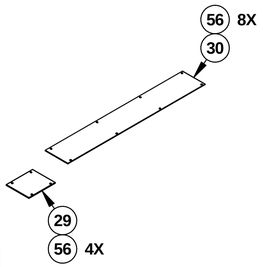


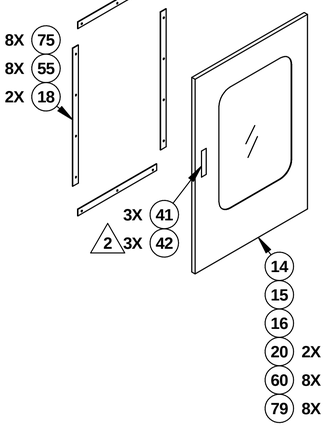


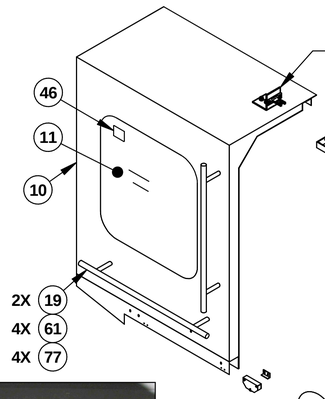


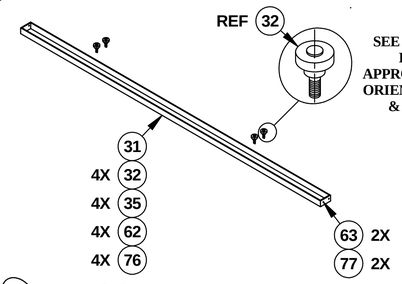


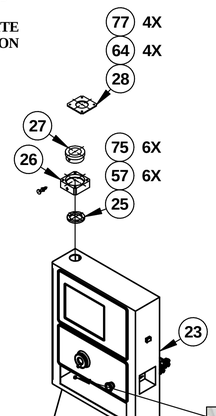


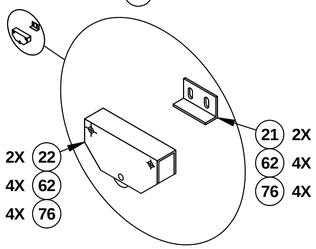


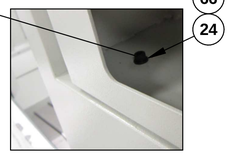












AS SEEN WITHIN ENCLOSURE

REF 46 3

NOTES: (UNLESS OTHERWISE SPECIFIED).

1. FOR BULB REPLACEMENT SEE 26768-BULB. (1C3)
2. KEYS (ITEM 42) FOR ELECTRICAL CABINET. (1B1)
3. FOR WINDOWS REPLACEMENT SEE 28073. (1A8)

(SEE SHEET 2 FOR ADDITIONAL NOTES)

NOTICE: THIS DESIGN WAS ORIGINATED BY AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN OWNED BY SOUTHWESTERN INDUSTRIES. IT IS DISCLOSED IN CONFIDENCE FOR A SPECIFIC PURPOSE AND THE RECIPIENT HEREOF AGREES NOT TO MAKE ANY REPRODUCTION, DISCLOSURE OR OTHER USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES.

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0'30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS		DATE
DRAWN BY	SAL	06/17/09
ENGINEER	LG	11/24/09
CHECKER		
FE		

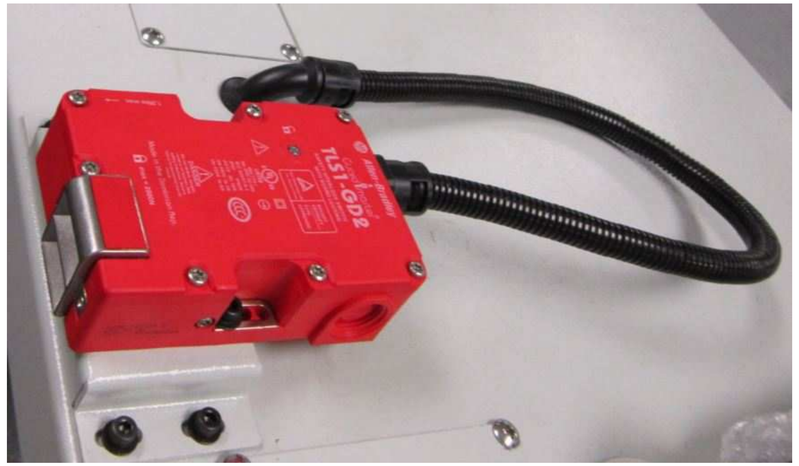
THIRD ANGLE PROJECTION

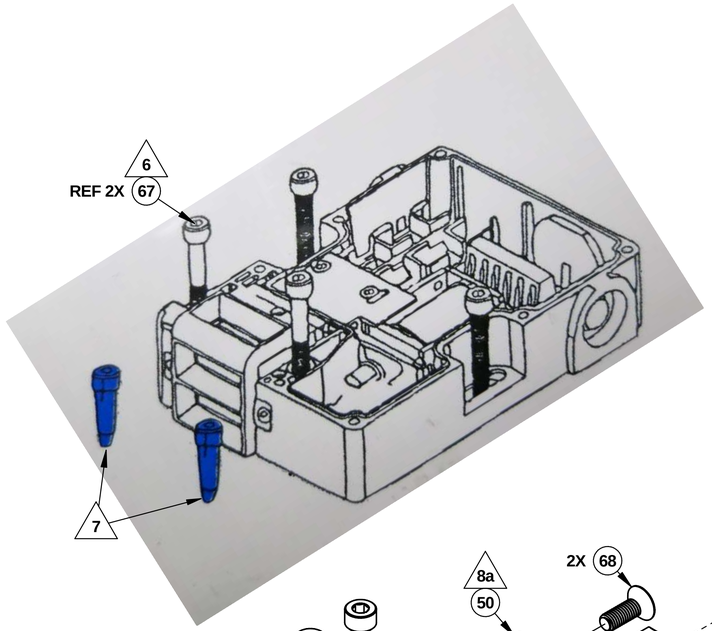
SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

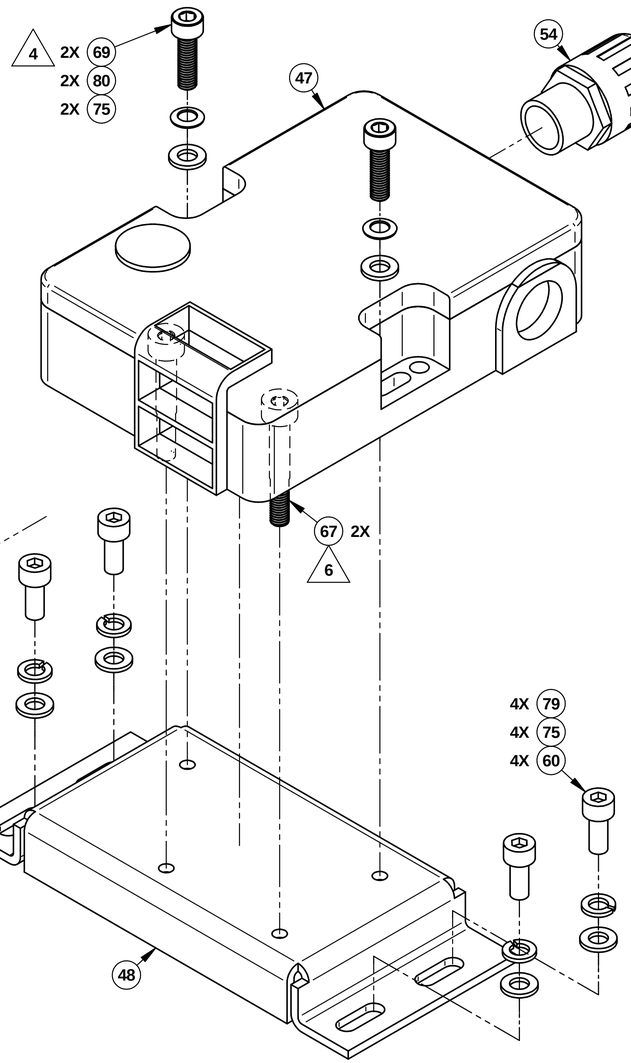
TITLE: ENCLOSURE ASSY-LPM

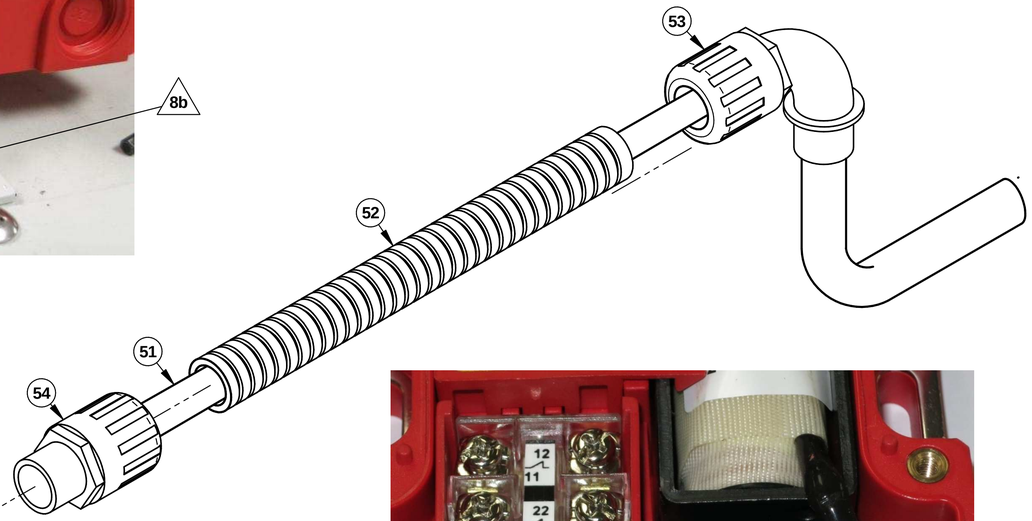
SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26862	K

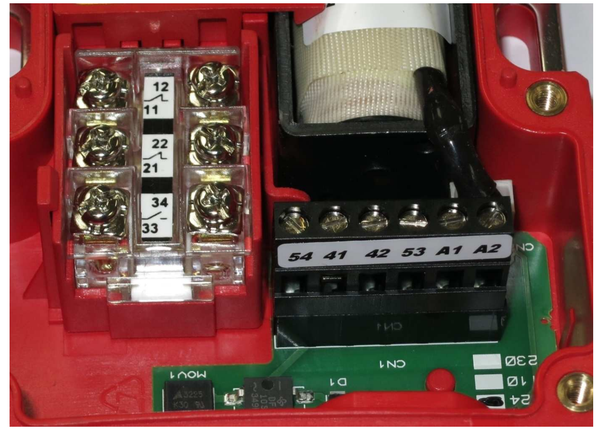
SCALE: - SHEET 1 OF 2

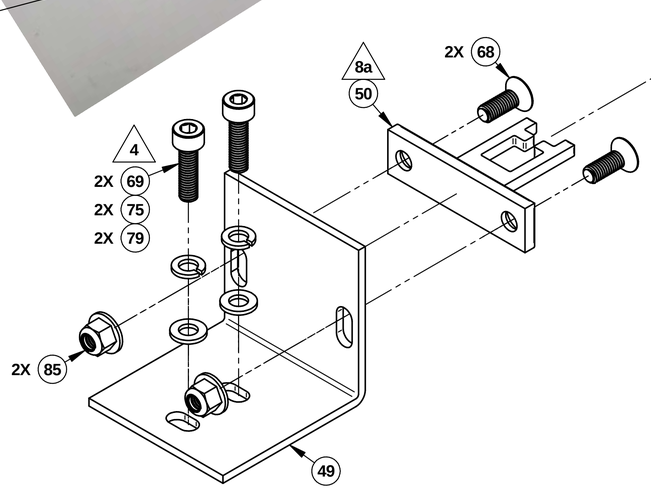












INTERCONNECTION CHART				
SWITCH PINS	PIN FUNCTION	WIRE COLOR	LABEL	CONNECTED TO
A1	COIL	BLUE	24DC-7	TB14-4
A2	COIL	WHITE	0V	TB11-4
11	COMPUTER INPUT	BLACK	I34.6	IM1-A13
12	+24V	RED	24DC-1	IM1-A13-COM
21	K9 RELAY	YELLOW	24DC-20	K9-14
22	+24V	GREEN	24DC-1	TB19-4

4 APPLY VIBRA-TITE VC3 TO THE END OF ITEM 69. SEE ES-295 FOR VIBRA-TITE VC3 USAGE PROCEDURE. (2B8, 2C6)

5 ITEMS SHOWN ON THIS SHEET 2 ARE FOR UPGRADED SWITCH KIT BEGINNING IN 3rd QUARTER 2014. (1B6, 1C3, 1D4).

6 SCREW MUST HAVE AT LEAST 10mm NON-THREADED SHANK (2B5).

7 DISCARD PLASTIC HEAD RETAINING BOLTS AND REPLACE WITH M5-0.8X35 25B (ITEM 67) (2C8).

8 ACTUATOR ADJUSTMENT:
- a) ENSURE THAT ACTUATOR (ITEM 50) SLIDES STRAIGHT INTO THE OPENING OF THE HEAD, & IS CENTERED BOTH VERTICALLY & HORIZONTALLY. THIS IS BEING ACHIEVED BY ADJUSTING THE POSITION WITH THE SCREWS HOLDING THE ACTUATOR TO ITS BRACKET (2B7).
- b) WHEN ACTUATOR SLIDES INTO HE HEAD EFFORTLESSLY- THEN LOOSEN THE BRACKET (ITEM 48) MOUNTING SCREWS & ADJUST THE ACTUATOR DISTANCE FROM THE SWITCH WITH DOOR FORCE CLOSED. THE DISTANCE SHOULD BE 0.060" & THE ACTUATOR SHOULD NEVER HIT THE SWITCH UPON THE DOOR CLOSING (2D3, 2C6).

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DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0'30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS		DATE
DRAWN BY	SAL	06/17/09
ENGINEER	LG	11/24/09
CHECKER		
FE		

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: ENCLOSURE ASSY-LPM

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26862	K

SCALE: - SHEET 2 OF 2

26862

ENCLOSURE ASSY-LPM

Type	PL	Dwg Size	D
Revision	K	Product	LPM
Status	R	Engineer	LG
Date	6/16/2009	Planner Code	
By	SAL	Comm Code	

Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
1	26863	COVER-LEFT HOUSING		1	EA	-	R	PS	PING JENG	M7H001
2	26864	COVER-RIGHT HOUSING		1	EA	-	R	PS	PING JENG	M7H002
4	26865	PLATE-LF & RT ANGLE		2	EA	-	R	PS	PING JENG	M7H004
6	26866	BRACE-L HOUSING		1	EA	-	R	PS	PING JENG	M7H007
7	26867	PLATE-C HOUSING		1	EA	-	R	PS	PING JENG	M7H008
8	26868	RAIL-DOOR HOUSING		1	EA	-	R	PS	PING JENG	154098
9	26869	PLATE-COVERS HOUSING		1	EA	-	R	PS	PING JENG	3218091105
10	26870	DOOR-SLIDING HOUSING		1	EA	-	R	PS	PING JENG	M7H003
11	26871	WINDOW-FRONT DOOR		1	EA	A	R	DWG	PING JENG	50272003
12	26872	PLATE-WINDOW TOP & BOT		2	EA	-	R	PS	PING JENG	MCVL021
13	26873	PLATE-WINDOW LF & RT		2	EA	-	R	PS	PING JENG	MCVL022
14	26874	DOOR-ACCESS LF & RT		2	EA	-	R	PS	PING JENG	1509047
15	26875	HANDLE-DOORS LF & RT COVERS		2	EA	-	R	PS		
16	26876	WINDOW-SIDE DOOR		2	EA	A	R	DWG	PING JENG	3301091040
17	26877	PLATE-WINDOW TOP & BOT		4	EA	-	R	PS	PING JENG	1509122
18	26878	PLATE-WINDOW LF & RT		4	EA	-	R	PS	PING JENG	1509035
19	26881	HANDLE-SLIDING DOOR		2	EA	-	R	PS		
20	28044	HINGE-RIGHT SIDE DOOR-LPM		2	EA	-	R	PS	PING JENG	
21	26882	BRACKET-L WHEEL GUIDE		2	EA	-	R	PS	PING JENG	165013
22	26883	WHEEL-FRONT DOOR		2	EA	-	R	PS	PING JENG	154099
23	26584	PENDANT ASSY-LPM		1	EA	-	R	PL		
24	27867	NUT-PIVOT- M6 x Ø16 x 20L		1	EA	A	R	DWG	PING JENG	50020016

Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
25	26886	SPACER-OP BOX		1	EA	-	R	PS	PING JENG	70008027
26	26887	HOUSING-SPACER		1	EA	-	R	PS	PING JENG	70006006
27	26888	SEAT-OP BOX		1	EA	-	R	PS	PING JENG	70006005
28	26889	PLATE-SEAT		1	EA	-	R	PS	PING JENG	70008028
29	26894	PLATE-RT COVER 6 X 5.75		1	EA	-	R	PS	PING JENG	M7H009
30	26895	PLATE-RT COVER 4 x 35		1	EA	-	R	PS	PING JENG	M7H009
31	26890	CHANNEL-SLIDING DOOR		1	EA	-	R	PS	PING JENG	
32	26990	BEARING		4	EA	-	R	PS	PING JENG	50010101
33	26897	LOCK PIN		1	EA	A	R	PS	PING JENG	50020039
34	28044-1	HINGE-LEFT SIDE DOOR-LPM		2	EA	-	R	PS	PING JENG	
35	26358	SPACER-ID 6mm x OD 20mm x 20 mm L		4	EA	-	R	PS		
37	26768	STATUS LIGHT	TO REPL BULB SEE 26768-BULB	1	EA	-	R	PS		
38	27234-2	PLATE-SEAL		1	EA	A	R	PS	PING JENG	3218091430
39	27234-1	SEAL-RUBBER-DOOR		1	EA	A	R	PS	PING JENG	3218092010
41	26988	LOCK & KEYS-SIDE DOOR		3	EA	-	R	PS	PING JENG	50020007
42	26989	KEYS-ELECTRICAL CABINET		3	EA	-	R	PS	PING JENG	50010501
45	27044	BRACKET-COOLANT AND AIR		1	EA	-	R	PS		
46	24927-15	LABEL-WINDOWS-LPM		1	EA	A	R	DWG		
47	26717-2	SWITCH-SAFETY-LOCKING-POWER TO RELEASE		1	EA	A	R	DWG		
48	26717-3	BRACKET-MOUNTING-SWITCH-SAFETY		1	EA	A	R	DWG		
49	26717-4	BRACKET-MOUNTING-ACTUATOR-SWITCH-SAFETY		1	EA	A	R	DWG		
50	26717-5	ACTUATOR-STANDARD-GD2		1	EA	A	R	DWG		
51	26682-6	CABLE ASSY-DOOR SWITCH		1	EA	B	R	PL		
52	26835-2	TUBING-CONDUIT-NYLON	16mm	1	MM	-	R	DWG		

Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
53	26839-7	FITTING-CONDUIT-RIGHT ANGLE-METRIC		1	EA	-	R	PS		
54	26834-7	FITTING-CONDUIT-STRAIGHT-THRU-METRIC	16mm BLACK	1	EA	A	R	DWG		
55	M5-0.8X10 25B	SCREW-SHCS-STL-BO		44	EA	-	R	PS		
56	M5-0.8X10 10B	SCREW-PH-PHIL-STL-BO		14	EA	-	R	PS		
57	M5-0.8X16 25B	SCREW-SHCS-STL-BO		6	EA		R	PS		
58	M6-1.0X16 12B	SCREW-FH-PHIL-STL-BO		14	EA		R	PS		
59	M5-0.8X10 22Z	SCREW-TH-PHIL-STL-ZINC	NON STOCKABLE	16	EA	-	R	PS		
60	M5-0.8X12 25B	SCREW-SHCS-STL-BO		20	EA	-	R	PS		
61	M8-1.25X15 25B	SCREW-SHCS-STL-BO		4	EA		R	PS		
62	M6-1.0X12 25B	SCREW-SHCS-STL-BO		22	EA		R	PS		
63	M8-1.25X20 25B	SCREW-SHCS-STL-BO		8	EA		R	PS	KING RICH	ASM608020
64	M8-1.25X55 25B	SCREW-SHCS-STL-BO		4	EA		R	PS		
66	M6-1.0X20 25B	SCREW-SHCS-STL-BO		1	EA		R	PS		
67	M5-0.8X35 25B	SCREW-SHCS-STL-BO		2	EA	-	R	PS		
68	M5-0.8X14 26B	SCREW-FHCS-STL-BO		2	EA	-	R	PS		
69	M5-0.8X18 25B	SCREW-SHCS-STL-BO		4	EA	-	R	PS		
75	M5 70B	WASHER-FLAT USS-STL-BO		60	EA		R	PS		
76	M6 70B	WASHER-FLAT USS-STL-BO		23	EA	-	R	PS		
77	M8 70B	WASHER-FLAT USS-STL-BO		16	EA		R	PS		
79	M5 73B	WASHER-SPLIT LOCK-STL-BO		22	EA	-	R	PS		
80	24009-4	WASHER-BELLEVILLE SPRING LK-SERRATED-10 OR M5		2	EA	C	R	DWG		
85	M5-0.8 64Z	NUT-NYLON-FLANGE-NON MARRING-STL-ZINC		2	EA	A	R	PS		

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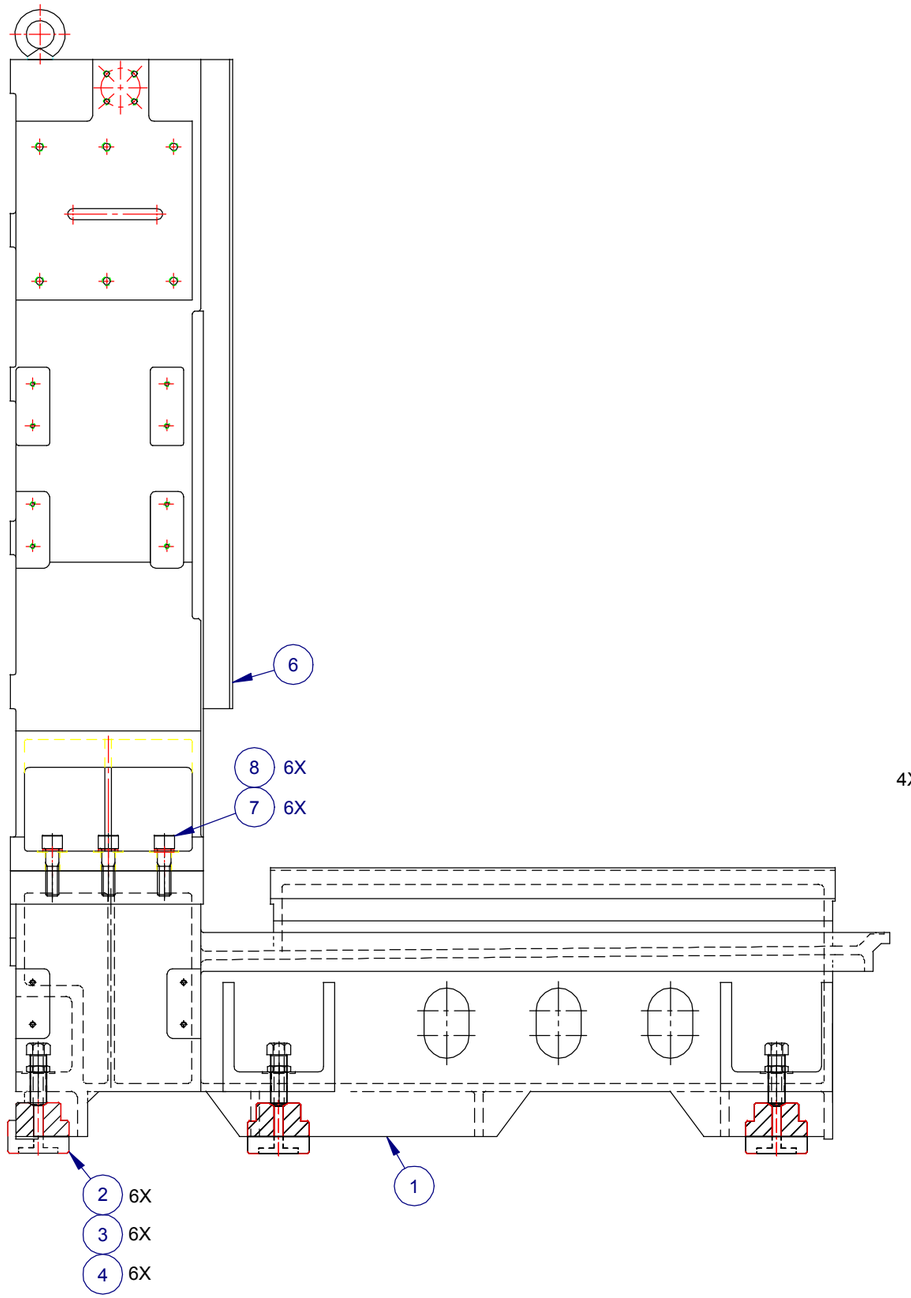
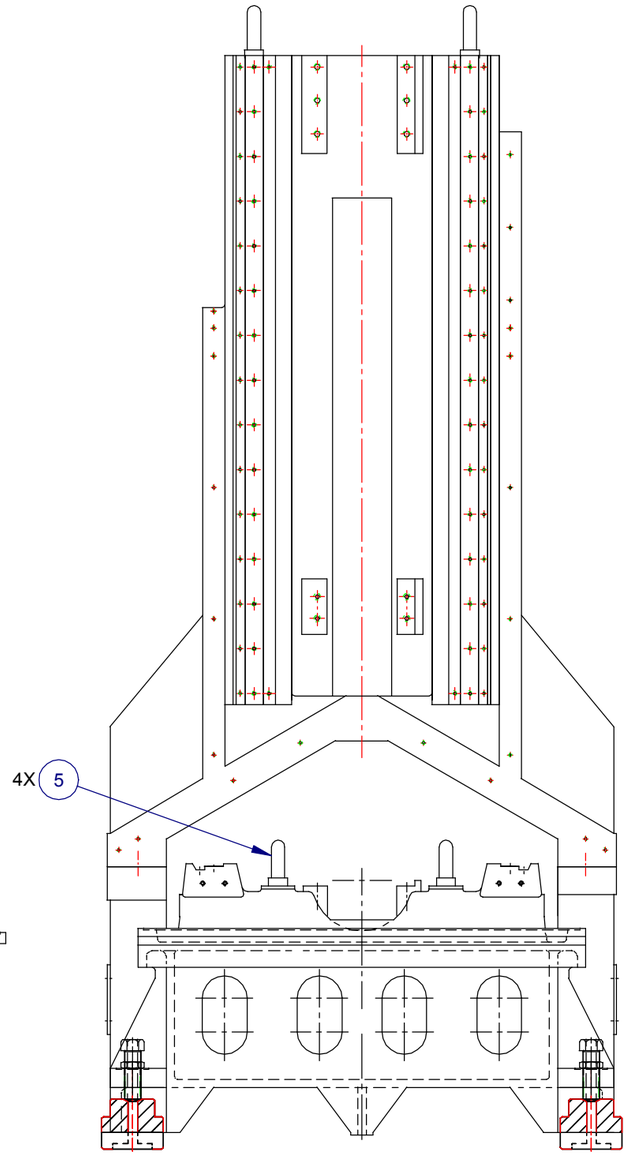
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13544	12/03/09	LG





NOTES: (UNLESS OTHERWISE SPECIFIED).

NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
DEC. X = ±.1, XX = ±.01, XXX = ±.005,
ANGLES .XX = ±0°30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS	DATE
DRAWN BY SAL	06/17/09
ENGINEER	
ENGINEER	
FE	

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: MACHINE CASTING ASSY-LPM

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26910	-

SCALE: - SHEET 1 OF 1

Parts List for Assembly P/N: 26910

Printed 12/3/2009

26910

MACHINE CASTING ASSY-LPM

WHEN UPDATING THIS DOCUMENT REVISE MANUAL
26727 & 26500

Type	PL	Dwg Size	
Revision	-	Product	
Status	R	Engineer	
Date	6/18/2009	Planner Code	
By	SAL	Comm Code	

Item	P/N	Title	Detail	Reference(t)	Rev	Use	Qty	Stat	Mfr	Mfr P/N
1	26817-1	BASE-CASTING			-	EA	1	R	PING JENG	80001001
2	26922	LEVELING PAD			-	EA	6	R	PING JENG	80001003
3	26923	NUT-LEVELING PAD			-	EA	6	R	PING JENG	3205021030
4	26924	LEVELING BOLT			-	EA	6	R	PING JENG	320602102A
5	26925	LIFTING POST			-	EA	4	R	PING JENG	M24x3.0P
6	26757	COLUMN CASTING			-	EA	1	R	PING JENG	700A0603
7	26926	SCREW-SHCS M24-3 x 90L 25B			-	EA	6	R	PING JENG	M24-3 x 90L
8	26927	WASHER-SPRING M24			-	EA	6	R	PING JENG	M24

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

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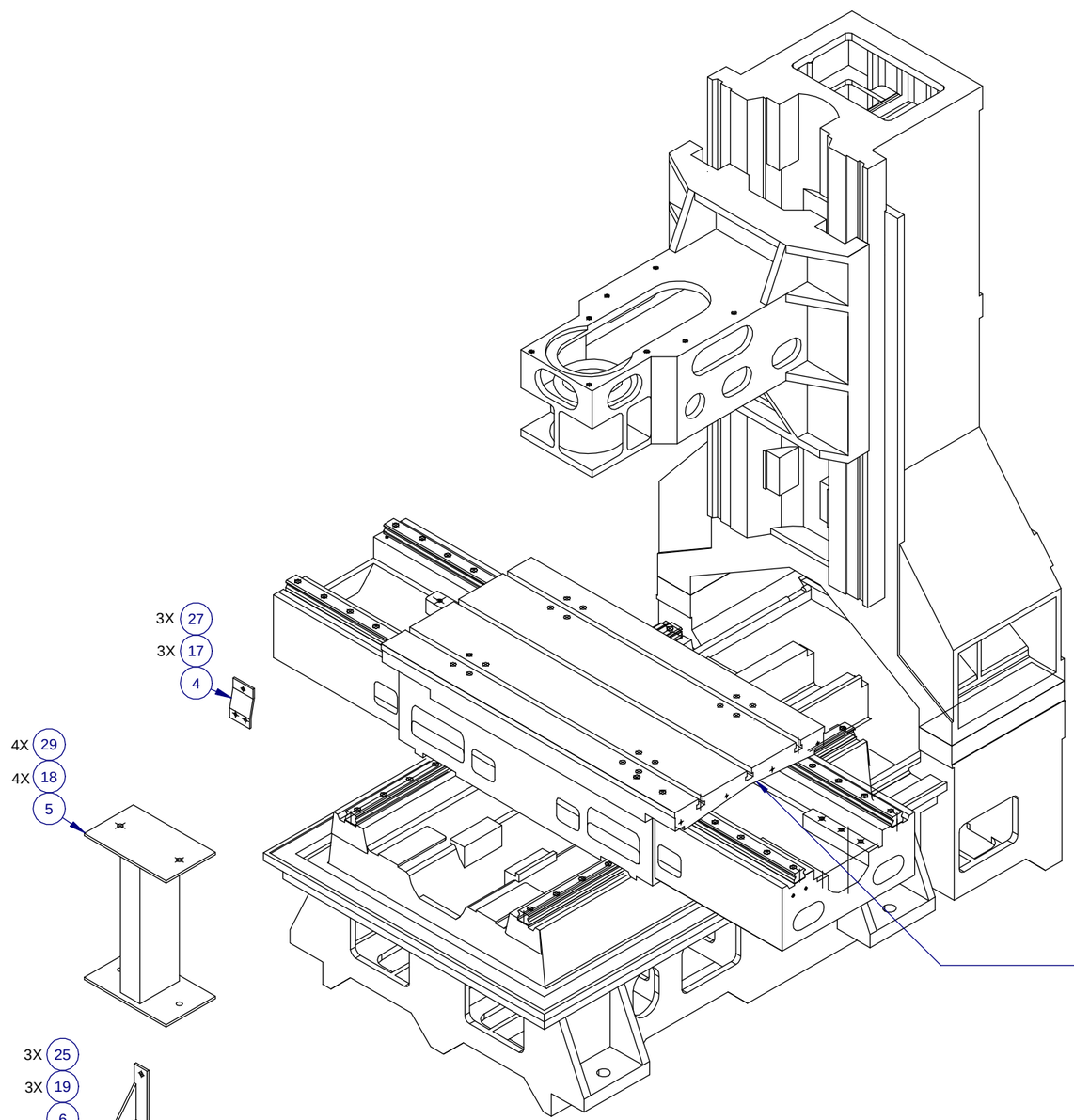
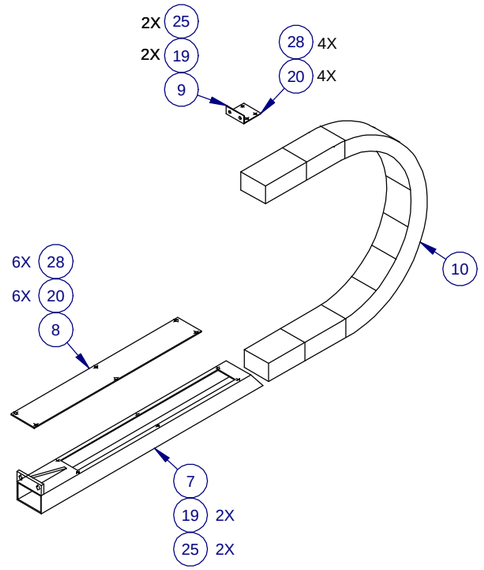
REVISIONS

REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13544	12/03/09	LG
A	ADDED ITEMS 11, 12, 21 & 30.	13975	5/3/12	SH





NOTES: UNLESS OTHERWISE SPECIFIED.

		DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0°30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS	DATE	SOUTHWESTERN INDUSTRIES, INC. 2615 HOMESTEAD PLACE RANCHO DOMINGUEZ, CA 90220-5610
			DRAWN BY SAL	06/17/09	CABLE CARRIER ASSY & SHIPPING BRACKETS
			ENGINEER		
			ENGINEER		
		MATERIAL -	FE		SIZE D · CODE IDENT. NO. 06238 · DWG NO. 26900 · REV A
NEXT ASSY	USED ON	FINISH -	THIRD ANGLE PROJECTION		SCALE: - · SHEET 1 OF 1
APPLICATION					

SOLID EDGE RESELLER COPY

Parts List for Assembly P/N: 26900

Printed 6/1/2012

26900

CABLE CARRIER ASSY & SHIPPING BRACKETS

Type	PL	Dwg Size	D
Revision	A	Product	
Status	R	Engineer	
Date	6/17/2009	Planner Code	
By	SAL	Comm Code	

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Reference(m)	Mfr
4	26904	PLATE-SHIPPING X		-	EA	1	R		PING JENG
5	26905	STAND-SHIPPING Z		-	EA	1	R		PING JENG
6	26906	BRACKET-GUSSET SHIPPING Y		-	EA	1	R		PING JENG
7	26907	TROUGH-CABLE CARRIER		-	EA	1	R		PING JENG
8	26908	COVER-TROUGH		-	EA	1	R		PING JENG
9	26909	BRACKET-L CABLE CARRIER		-	EA	1	R		PING JENG
10	26891-1	CABLE CARRIER-Y AXIS COLUMN REAR		-	EA	1	R		PING JENG
11	26916	BRACKET-GUIDE-CABLE CARRIER-X AXIS		-	EA	(1)	R		
12	27178	CABLE CARRIER-X AXIS-LPM		-	EA	1	R		
17	M8-1.25X20 25B	SCREW-SHCS-STL-BO			EA	3	R		
18	M12-1.75X30 25B	SCREW-SHCS-STL-BO			EA	4	R		PJ
19	M6-1.0X16 25B	SCREW-SHCS-STL-BO		-	EA	7	R		
20	M5-0.8X10 25B	SCREW-SHCS-STL-BO	NON STOCKABLE		EA	10	R		
21	M4-0.7X10 27B	SCREW-BHCS-STL-BO		-	EA	4	R		
25	M6 70B	WASHER-FLAT USS-STL-BO		-	EA	7	R		
27	24009-1	WASHER - BELLEVILLE LOCK	5/16" OR M8 - SERRATED	-	EA	3	R		
28	M5 70B	WASHER-FLAT USS-STL-BO			EA	10	R		
29	1/2 70B	WASHER-FLAT USS-STL-BO		-	EA	4	R		
30	M5 73B	WASHER-SPLIT LOCK-STL-BO		-	EA	4	R		

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

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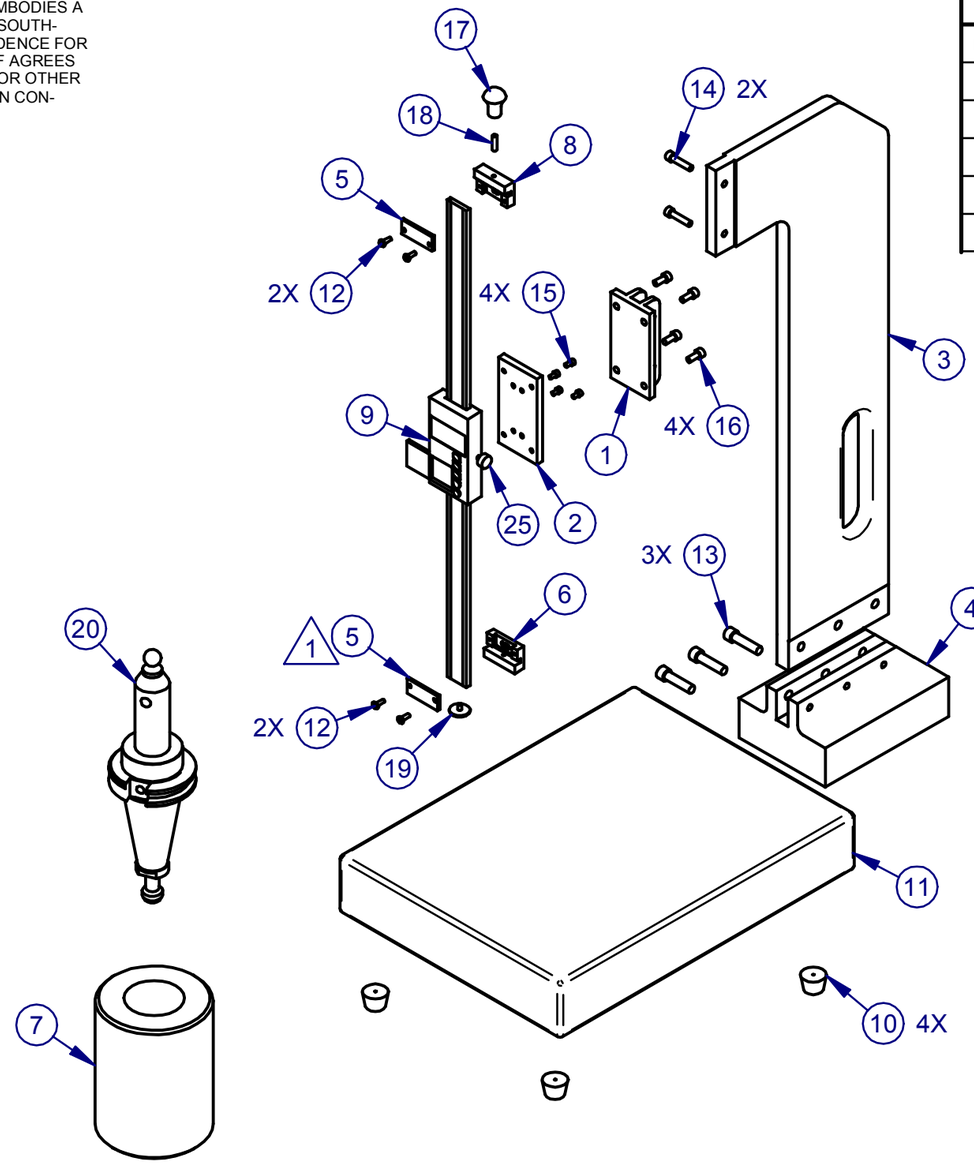
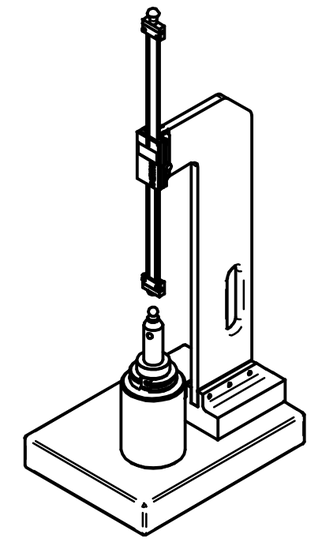
REVISIONS

REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13432	3.31.09	JG
A	ADDED ITEM 24	13525	6.24.09	LG
B	ADDED NOTE 1ADDED NOTE 1.	13541	08/27/09	LG
C	ADDED REPLACEMENT NOTE.	13612	01/25/10	LG
D	REVISED NOTES 2 & 3. ADDED ITEM 25.	13874	08/09/11	LG





NOTES: UNLESS OTHERWISE SPECIFIED.

1. REMOVE & DISCARD MANUFACTURER PROVIDED MOUNTING BRACKETS & REPLACE WITH END BLOCKS & CLAMP PLATES (ITEMS 5, 6, & 8).
2. FOR REPLACEMENT KIT SEE 26773.
3. FOR TESTING PROCEDURE SEE ES-505.
4. ITEM 25 SUPPLIED WITH SCALE.

(SEE SHEET 2 FOR ADDITIONAL NOTES)

SEE SEPARATE "A" SIZE SHEETS FOR PARTS LIST

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0°30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS		DATE
DRAWN BY	PY	8-21-08
ENGINEER	JG	3/31/09
ENGINEER		
FE		

THIRD ANGLE PROJECTION

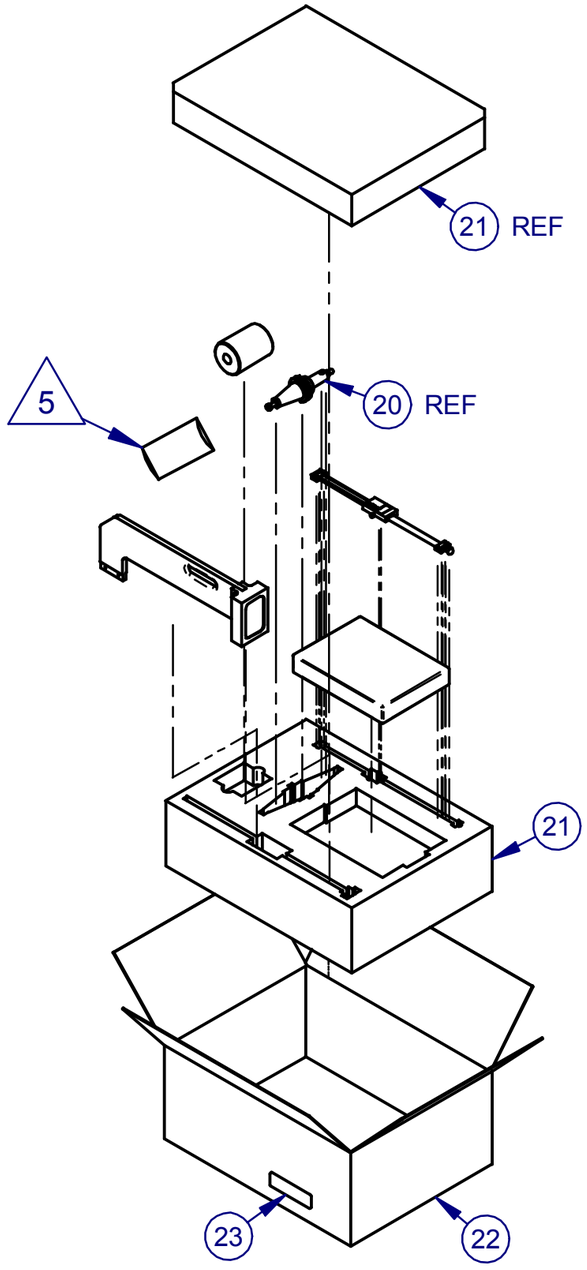
SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: GAGE ASSY - TOOL SETTING

SIZE	CODE IDENT. NO.	DWG NO.	REV
B	06238	26534	D

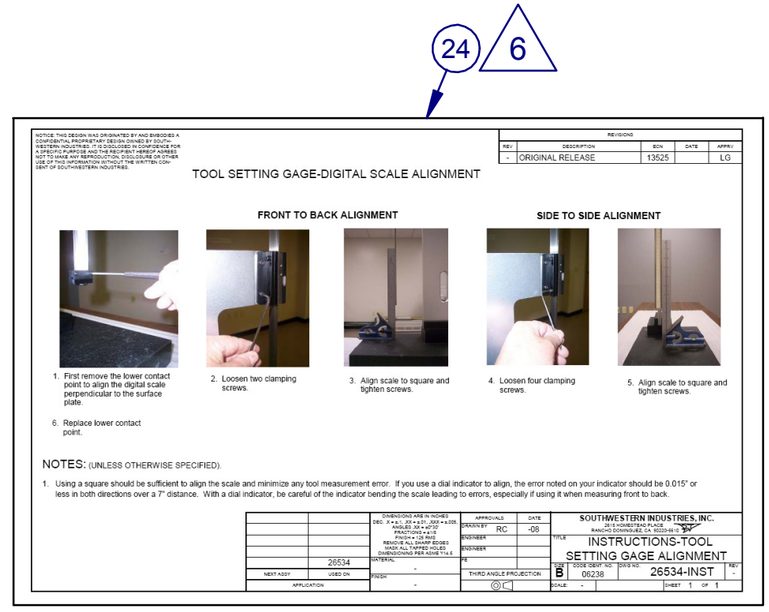
SCALE: - SHEET 1 OF 2

NOTICE: THIS DESIGN WAS ORIGINATED BY AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN OWNED BY SOUTHWESTERN INDUSTRIES. IT IS DISCLOSED IN CONFIDENCE FOR A SPECIFIC PURPOSE AND THE RECIPIENT HEREOF AGREES NOT TO MAKE ANY REPRODUCTION, DISCLOSURE OR OTHER USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES.



REVISIONS

REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13432	3.31.09	JG
A	ADDED ITEM 24	13525	6.24.09	LG
B	ADDED NOTE 1ADDED NOTE 1.	13541	08/27/09	LG
C	ADDED REPLACEMENT NOTE.	13612	01/25/10	LG
D	REVISED NOTES 2 & 3. ADDED ITEM 25.	13874	08/09/11	LG



5 GREASE BASE TOOL (ITEM 20) AND PLACE IN A 8X10 POLY BAG.

6 USE "B" SIZE PRINT IN KIT

DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0°30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS	DATE	SOUTHWESTERN INDUSTRIES, INC. 2615 HOMESTEAD PLACE RANCHO DOMINGUEZ, CA 90220-5610
MATERIAL -	DRAWN BY PY	8-21-08	TITLE GAGE ASSY - TOOL SETTING
FINISH -	ENGINEER JG	3/31/09	SIZE B / CODE IDENT. NO. 06238 / DWG NO. 26534 / REV D
	ENGINEER		SCALE: - / SHEET 2 OF 2
	FE		
	THIRD ANGLE PROJECTION		

Parts List for Assembly P/N: 26534

Printed 8/19/2011

26534

GAGE ASSY-TOOL SETTING

Type	PL	Dwg Size	B
Revision	D	Product	LPM
Status	R	Engineer	JG
Date	8/18/2008	Planner Code	
By	PY	Comm Code	

Item	P/N	Title	Qty	UseAs	Rev	Detail	Stat	Mfr	Mfr P/N
1	26534-1	BRACKET - GAGE - TOOL SETTING	1	EA	A		R		
2	26534-2	MOUNTING PLATE - GAGE - TOOL SETTING	1	EA	-		R		
3	26534-3	UPRIGHT - GAGE - TOOL SETTING	1	EA	A		R		
4	26534-4	BASE - GAGE - TOOL SETTING	1	EA	A		R		
5	26534-5	CLAMP PLATE - GAGE - TOOL SETTING	2	EA	-		R		
6	26534-6	END BLOCK - GAGE - TOOL SETTING	1	EA	A		R		
7	26534-7	TOOL HOLDER-GAGE-TOOL SETTING	1	EA	A		R		
8	26534-8	END BLOCK - GAGE - TOOL SETTING	1	EA	A		R		
9	26534-9	SCALE-DIGITAL GAGE ASSY-TOOL SETTING	1	EA	B		R		
10	24007	BUMPON-POLYURETHANE	4	EA	-		R		
11	26534-11	SURFACE PLATE-GAGE-TOOL SETTING	1	EA	-		R		
12	4-40X5/16 31B	SCREW-PH-PHIL-EXT SEMS-STL-BO	4	EA			R	ACCUTITE FASTENERS	PPXS004C0005STBO
13	1/4-20X1 25B	SCREW-SHCS-STL-BO	3	EA			R		
14	8-32X3/4 25B	SCREW-SHCS-STL-BO	2	EA	-		R		
15	M3-0.5X5 10Z	SCREW-PH-PHIL-STL-ZINC	4	EA			R	ACCUTITE FASTENERS	PPMS030C005ZIST B384 ST
16	8-32X3/8 25B	SCREW-SHCS-STL-BO	4	EA			R		
17	26534-17	PULL KNOB - GAGE - TOOL SETTING	1	EA	-		R		
18	6-32X1/2 40B	SCREW-SOC SET-STL-BO-CUP	1	EA	-		R		
19	26534-19	CONTACT POINT - FLAT - GAGE - TOOL SETTING	1	EA	-		R		
20	26800	TOOL - BASE - ASSY - CAT40	1	EA	A		R		
21	26534-PKG	FOAM SET-TOOL SETTING GAGE	1	EA	-		R		
22	26806-1	BOX-CARDBOARD 24 3/4 X 18 3/4 X 10 3/4	1	EA	-	24 3/4 X 18 3/4 X 10 3/4	R		

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

Item	P/N	Title	Qty	UseAs	Rev	Detail	Stat	Mfr	Mfr P/N
23	26534-LB1	TEXT-LABEL-TOOL SETTING GAGE ASSY	1	EA	-		R		
24	26534-INST	INSTRUCTIONS-TOOL SETTING GAGE ALIGNMENT	1	EA	-		R		
25	26534-25	THUMBSCREW-MEASUREMENT SCALE	(1)	EA	-		R		

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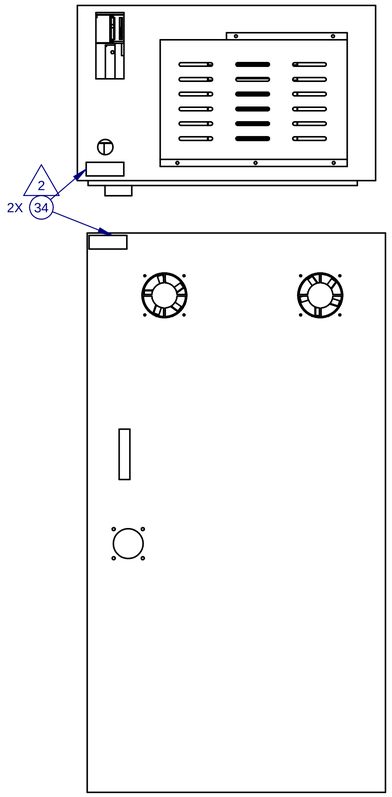
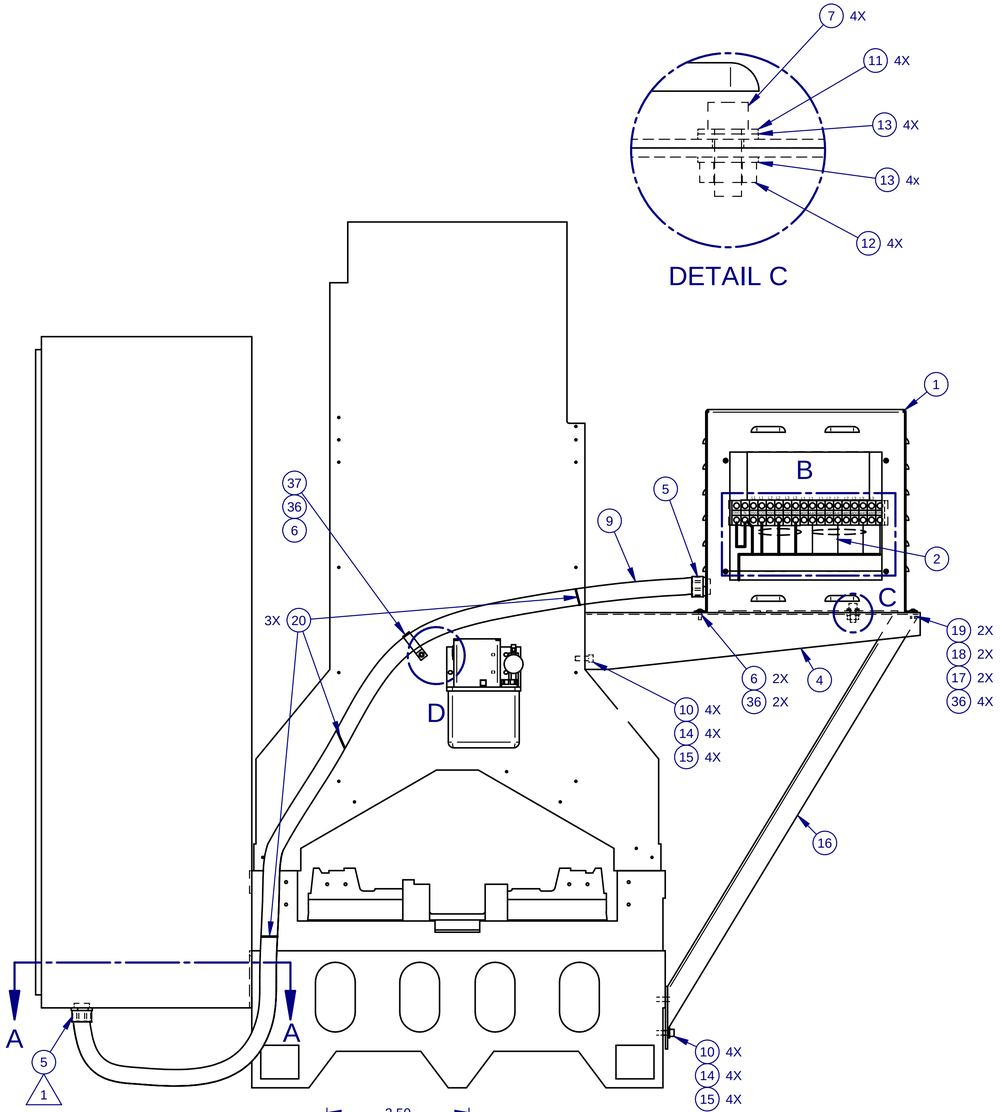
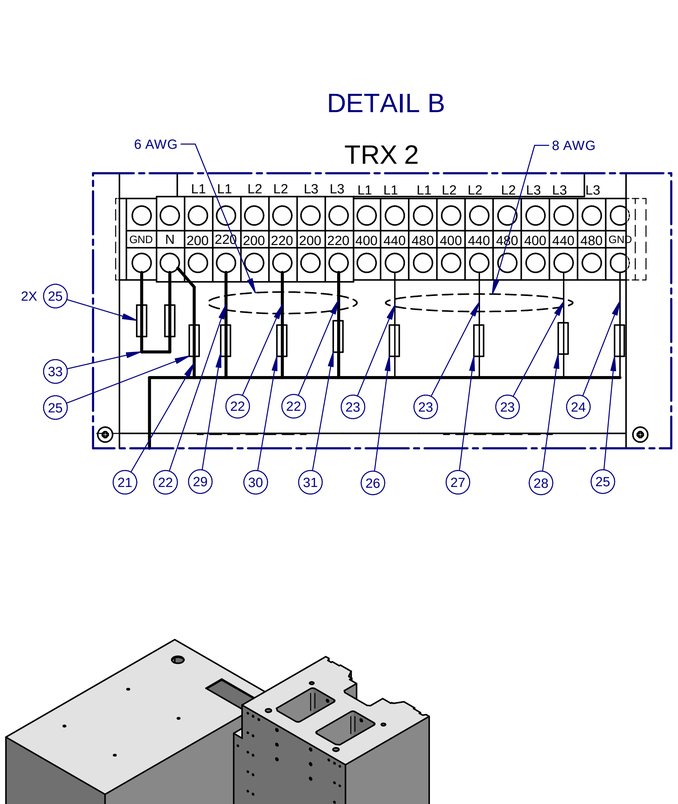
REVISIONS					
REV	DESCRIPTION	ECN	DATE	DFT	ENG
C	ITEM 7 WAS : M12-1.75X30 25B	13839	6/2/11	BD	LG
D	ADDED ITEMS 40 & 41.	14721	04/16/18	Sal	RC

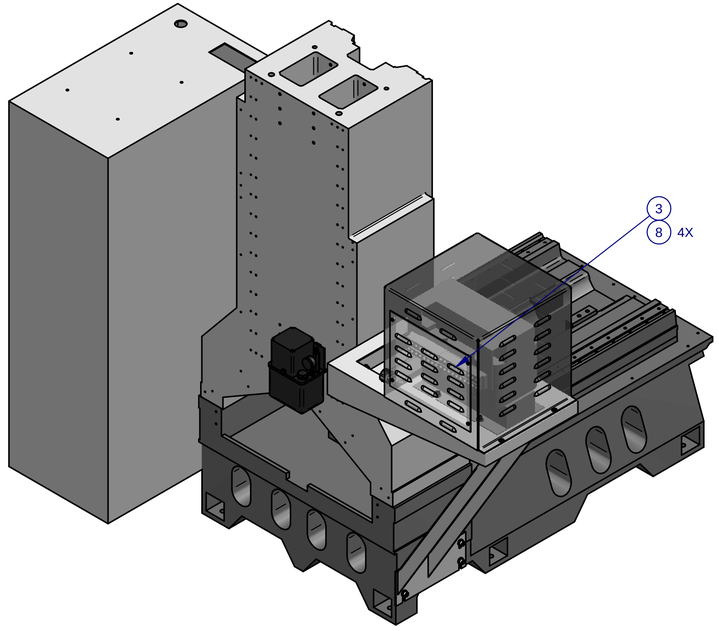


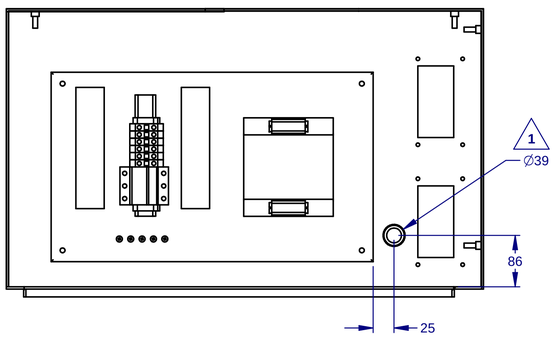




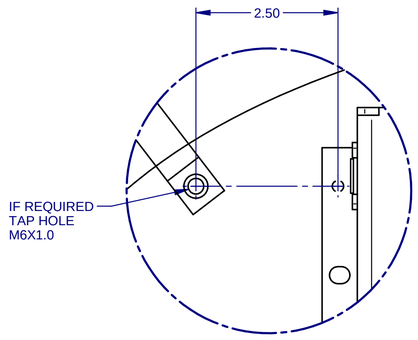
DETAIL C

DETAIL B





SECTION A-A



DETAIL D

NOTES: (UNLESS OTHERWISE SPECIFIED).

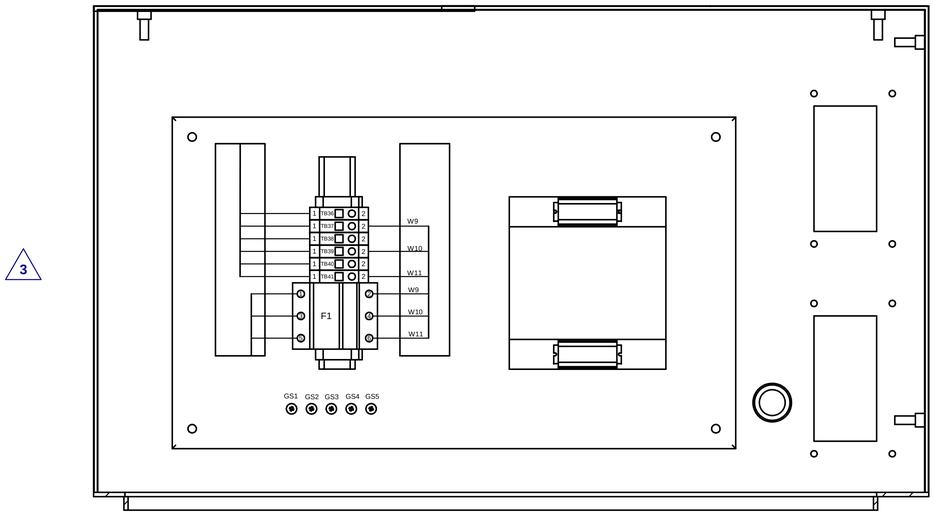
1. SHEET METAL KNOCKOUT TO BE REMOVED IN ORDER TO PLACE ITEM 5 (26838-7). IF NO KNOCKOUT IS PRESENT REFER TO SECTION A-A FOR HOLE DIMENSIONS.
2. REMOVE 230VAC LABEL FROM ELECTRICAL CABINET AND REPLACE WITH ITEM 34 (440VAC LABEL).

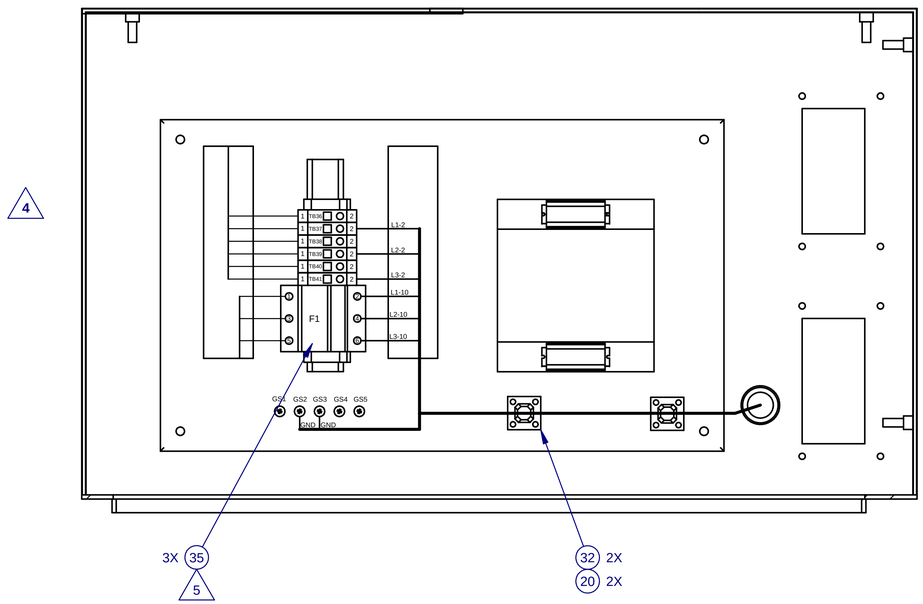
(SEE SHEET 2 FOR ADDITIONAL NOTES)

SEE SEPARATE "A" SIZE SHEET FOR PARTS LIST

METRIC UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONS PER ASME Y14.5	APPROVALS	DATE	SOUTHWESTERN INDUSTRIES, INC. 2615 HOMESTEAD PLACE RANCHO DOMINGUEZ, CA 90220-5610
	DRAWN BY RC	10/13/09	
	ENGINEER RO	2/22/10	TITLE: TRANSFORMER OPTION-440VAC-LPM
	ENGINEER		
MATERIAL -	FE		SIZE D · CODE IDENT. NO. 06238 · DWG NO. 26939 · REV D
FINISH -	THIRD ANGLE PROJECTION		SCALE: - · SHEET 1 OF 2

NOTICE: THIS DESIGN WAS ORIGINATED BY AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN OWNED BY SOUTHWESTERN INDUSTRIES. IT IS DISCLOSED IN CONFIDENCE FOR A SPECIFIC PURPOSE AND THE RECIPIENT HEREOF AGREES NOT TO MAKE ANY REPRODUCTION, DISCLOSURE OR OTHER USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES.





WIRING CHART				
WIRE GAGE	WIRE FROM	WIRE TO	LABLE	ITEM #
8 awg	TRX 2-L1-440	F1-2	L1-10	26
8 awg	TRX 2-L2-440	F1-4	L2-10	27
8 awg	TRX 2-L3-440	F1-6	L3-10	28
6 awg	TRX 2-L1-220	TB37-2	L1-2	29
6 awg	TRX 2-L2-220	TB39-2	L2-2	30
6 awg	TRX 2-L3-220	TB41-2	L3-2	31
6 awg	TRX 2-N	GS2	GND	25
6 awg	TRX 2-GND	GS3	GND	25

3 REMOVE WIRES W11 (F1-6 TO TB41-2), W10 (FI-4 TO TB39-2), AND W9 (F1-2 TO TB37-2).

4 PLACE TRANSFORMER WIRES AS SEEN ON DWG AND ON WIRE CHART.

5 REMOVE THE 80 amp FUSE AND REPLACE WITH ITEM 35 (50 amp FUSE).

METRIC
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONS PER ASME Y14.5
MATERIAL -
FINISH -

APPROVALS		DATE
DRAWN BY	RC	10/13/09
ENGINEER	RO	2/22/10
ENGINEER		
FE		

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: TRANSFORMER OPTION-440VAC-LPM

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	26939	D

SCALE: - SHEET 2 OF 2

26939

TRANSFORMER OPTION-LPM-440VAC

Type	PL	Dwg Size	D
Revision	D	Product	LPM
Status	R	Engineer	LG
Date	9/15/2009	Planner Code	
By	RO	Comm Code	

Item	P/N	Title	Detail	Reference	Qty	UseA	Rev	Stat	Type	Mfr	Mfr P/N
1	26901	SHEET METAL-ENCLOSURE-TRANSFORMER			1	EA	A	R	PS	PING JENG	80008003A
2	22794-1	TRANSFORMER-3PHASE-30KVA			1	EA	-	R	DWG	SUENN LIANG ELECTRIC CO., LTD	SP-TBSM-30 30K
3	26901-1	SHEET METAL-ENCLOSURE-COVER-TRANSFORMER			1	EA	-	R	DWG		
4	26902	SHEET METAL-TRANSFORMER MOUNT			1	EA	-	R	PS	PING JENG	80008025
5	26836-7	FITTING-METALLIC-CONDUIT-STRAIGHT-THRU	1"		2	EA	A	R	DWG		
6	M6-1.0X10 25B	SCREW-SHCS-STL-BO			3	EA		R	PS		
7	M12-1.75X35 25B	SCREW-SHCS-STL-BO			4	EA		R	PS		
8	M5-0.8X10 10Z	SCREW-PH-PHIL-STL-ZINC			4	EA	-	R	PS		
9	26837-4	CONDUIT-TUBING-GALVANIZED STEEL WITH PVC	1"		2250	MM	-	R	DWG		
10	M10-1.5X30 25B	SCREW-SHCS-STL-BO			8	EA		R	PS		
11	M12 73B	WASHER-SPLIT LOCK-STL-BO			4	EA		R	PS		
12	M12-1.75 50Z	NUT-HEX-STL-ZINC			4	EA		R	PS		
13	M12 71B	WASHER-STL-BO			8	EA	-	R	PL		
14	M10 73B	WASHER-SPLIT LOCK-STL-BO			8	EA	-	R	PS		
15	M10 71B	WASHER-FLAT SAE-STL-BO			8	EA	-	R	PS		
16	26991	BRACKET-TRANSFORMER SUPPORT			1	EA	-	R	PS		
17	M6-1.0 50B	NUT-HEX-STL-BO			2	EA		R	PS		
18	M6 73B	WASHER-SPLIT LOCK-STL-BO			2	EA	-	R	PS		

Item	P/N	Title	Detail	Reference	Qty	UseA	Rev	Stat	Type	Mfr	Mfr P/N
19	M6-1.0X30 25B	SCREW-SHCS-STL-BO			2	EA	A	R	PS		
20	21968	CABLE TIE-PLASTIC 8 IN LONG (TCA1)			5	EA	-	R	DWG		
21	24593-A92424-1180	WIRE ASSY-6 AWG-GREEN-118"			1	EA	-	R	PS		
22	24593-A32417-1290	WIRE ASSY-6 AWG-BLACK-129"			3	EA	-	R	PS		
23	24593-A22316-1270	WIRE ASSY-8 AWG-BLACK-127"			3	EA	-	R	PS		
24	24593-A92424-1280	WIRE ASSY-6 AWG-GREEN-128"			1	EA	-	R	PS		
25	26967-1	LABEL-TEXT-WIRE SLEEVE-WHITE-1 x .50 Ø	GND		6	EA	B	R	DWG		
26	26967-14	LABEL-TEXT-WIRE SLEEVE-WHITE-1 x .50 Ø	L1-10		2	EA	B	R	DWG		
27	26967-15	LABEL-TEXT-WIRE SLEEVE-WHITE-1 x .50 Ø	L2-10		2	EA	B	R	DWG		
28	26967-16	LABEL-TEXT-WIRE SLEEVE-WHITE-1 x .50 Ø	L3-10		2	EA	B	R	DWG		
29	26967-8	LABEL-TEXT-WIRE SLEEVE-WHITE-1 x .50 Ø	L1-2		2	EA	B	R	DWG		
30	26967-9	LABEL-TEXT-WIRE SLEEVE-WHITE-1 x .50 Ø	L2-2		2	EA	B	R	DWG		
31	26967-10	LABEL-TEXT-WIRE SLEEVE-WHITE-1 x .50 Ø	L3-2		2	EA	B	R	DWG		
32	23262-1	CABLE CLAMP-1.5"X1.5"			2	EA	-	R	DWG		
33	24593-A92424-0050	WIRE ASSY-6 AWG-GREEN-5"			1	EA	-	R	PS		
34	22537-440	LABEL-440 VOLTS			1	EA	-	R	DWG		
35	26822-50	FUSE-GG SERIES-(22X58mm)	50 AMP		3	EA	B	R	DWG		
36	M6 70B	WASHER-FLAT USS-STL-BO			7	EA	-	R	PS		
37	22637-1	CLAMP-ONE HOLE-METAL-1"			1	EA	-	R	PS		
40	21214-1	NAMEPLATE-SERIAL NUMBER			1	EA	C	R	PL		
41	21214-43	NAMEPLATE-S/N-LPM-440V	SEE 21214-1 WHEN UPDATING		(1)	EA	B	R	DWG		

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REVISIONS

REV	DESCRIPTION	ECN	DATE	DRFT	APPRV
C	EXTENSIVELY REVISED	13686	10/28/10		RO
D	PS3 AC-N TO L1-8 & AC-L TO L2-8 WAS: AC-N TO K1-T3 & AC-L TO K1-T2	13894	12.21.11		RO
E	(A5) REVISED DOOR CLOSE SWITCH. (C2) TB33-3 WAS: TB35-4. (D3) TB32-1 WAS: TB32-2. (C4) NO WAS: NC. TB35-1 & TB33-3 WAS: TB35-2 & TB35-3. ADDED TB35-4 0V_TO K3-A2	14243	1/16/15		AW
F	(A5) REVISED DOOR CLOSE SWITCH. (B3) DELETED TB19-4 CONNECTION.	14362	2/27/15		AW
G	(B2) TB5-4 TO K11-A1 WAS:... TO K11-B1; TB8-2 TO K11-A2 WAS: TB9-3	14572	10/16/17	AC	AW RO

POWER INPUT REQUIRMENTS
INPUT WIRES MINIMUM 14mm²
220 VAC
3PHASE 60 HZ
440 VAC WHEN TRANSFORMER
OPTION IS INSTALLED

DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0°30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS	DATE
	DRAWN BY RC	11/14/08
	ENGINEER RO	9/11/09
	ENGINEER	
MATERIAL -	FE	
FINISH -	THIRD ANGLE PROJECTION	

TRAK MACHINE TOOLS

TITLE	SCHEMATIC-ELECTRICAL-LPM		
SIZE D	CODE IDENT. NO. 06238	DWG NO. 26775-SCH	REV G
SCALE: -		SHEET 1 OF 1	

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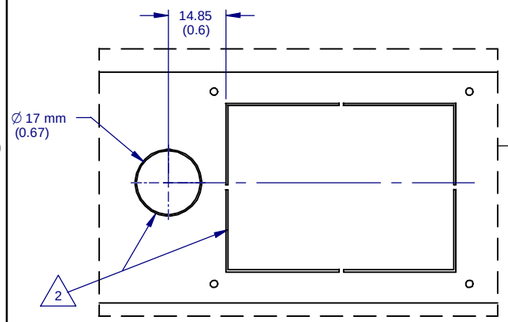
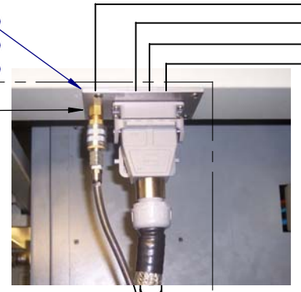
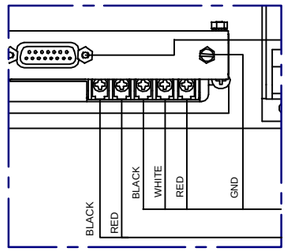
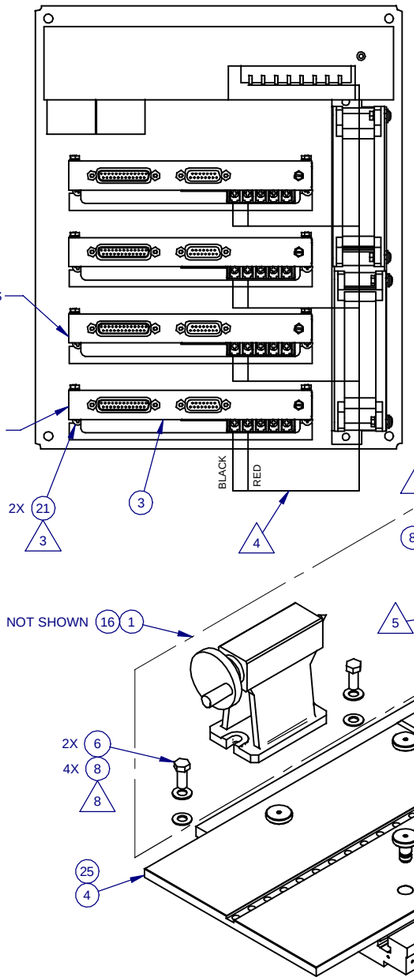
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13775	10/18/11	PM

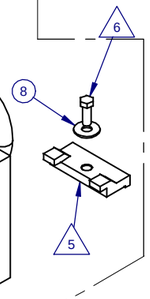


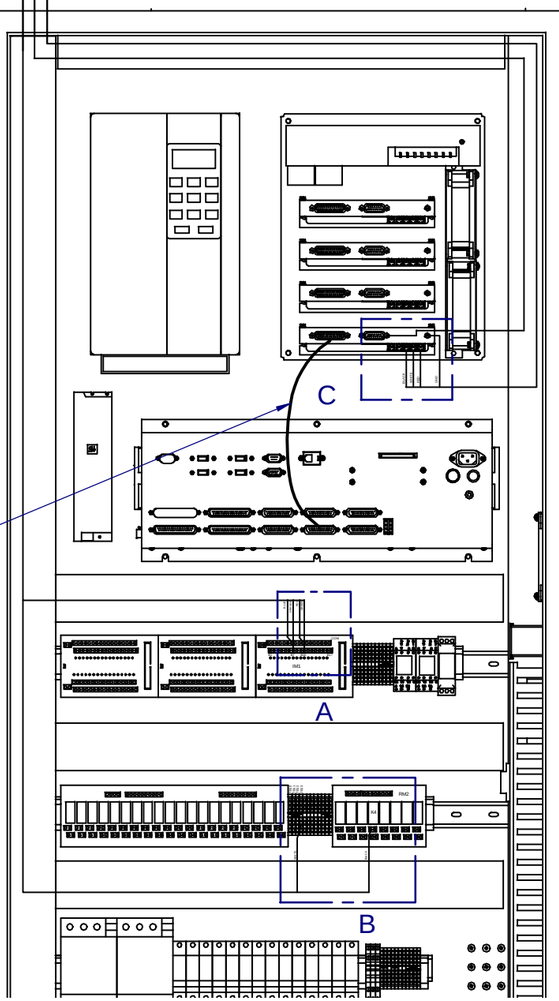


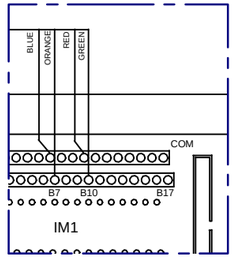


DETAIL C

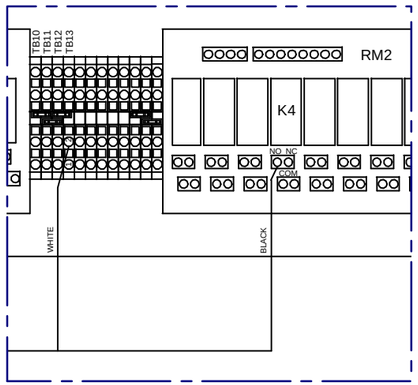








DETAIL A



DETAIL B

LOGIC CABLE		
COLOR	FUNCTION LABEL	LOCATION "TO"
WHITE	0V	TB13-2
BLACK	24DC-21	RM2-K4-NO
ORANGE	I33.1	IM1-B7
BLUE	24DC-1	IM1-B7-COM
GREEN	I34.0	IM1-B10
RED	24DC-1	IM1-B10-COM

NOTES: (UNLESS OTHERWISE SPECIFIED).

1 ROUTE ALL CABLES AND AIR HOSES AS SEEN ON DWG.

2 REMOVE KNOCK-OUTS. IF NO KNOCK-OUT EXISTS MAKE HOLES PER DRAWING. MOUNTING PLATE FROM ITEM 2 MAY ALSO BE USED AS TEMPLAT FOR MAKING HOLES.

3 MOUNT SERVO DRIVE USING EXISTING SCREWS ON POWER DRIVE, IF NO SCREWS AVAILABLE USE ITEM 21.

4 REMOVE ONE SET OF BLACK AND RED WIRES (DC BUS) FROM Z-AXIS DRIVE AND CONNECT TO 4TH-AXIS DRIVE.

5 BRACKETS ARE ALSO USED AS SHIPPING HARDWARE.

6 PART OF ITEM 16 (M14-20X40 24Z) .

7 THE 4 BALL LOCK CLAMPS FOR THE TAILSTOCK PLATE COME WITH THE MACHINE STANDARD.

8 USE 2 5/8 FLAT WASHERS ON EACH BOLT OF TAILSTOCK.

9. EXTRA T-NUTS & BOLTS IN HARDWARE KIT CAN BE USED TO SECURE 4TH AXIS DIRECTLY TO TABLE IF FIXTURE PLATES ARE NOT USED.

NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0°30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS		DATE
DRAWN BY	BD	9/29/11
ENGINEER	PM	9/29/11
ENGINEER		
FE		

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: 4th AXIS OPTION-
LPM-8"-CNC-200RB

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	27066-4	-

SCALE: - SHEET 1 OF 1

Parts List for Assembly P/N: 27066-4

Printed 10/18/2011

27066-4

4TH AXIS OPTION - LPM-8"-CNC-200RB

Type	PL	Dwg Size	D
Revision	-	Product	LPM
Status	R	Engineer	RO
Date	9/29/2011	Planner Code	
By	BD	Comm Code	

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Mfr	Mfr P/N
1	27065-2	ROTARY TABLE ASSY-4TH AXIS-8"-CNC-200RB		-	EA	1	R		
2	27064-1	CABLE HARNESS ASSY-4TH AXIS-INTERNAL		A	EA	1	R		
3	26599	SERVO DRIVER ASSY- 5.7 Nm MOTOR		C	EA	1	R		
4	27063-1	FIXTURE PLATE ASSY-TAILSTOCK		-	EA	0	R		
5	27063-2	FIXTURE PLATE ASSY-4TH AXIS		-	EA	0	R		
6	5/8-11X1 1/2 25B	SCREW-SHCS-STL-BO		-	EA	2	R		
8	5/8 71P	WASHER-FLAT SAE-STL-PLAIN			EA	6	R		
9	26512-030	CABLE ASSY- DB25 MALE/FEMALE - 30 INCHES		-	EA	1	R		
10	27016	FITTING-ADAPTER-MALE PIPE		-	EA	1	R		
11	27069	HOSE-AIR-TUBING-8mm-BLACK		A	IN	2100mm	R		
12	27120	STUD-THREADED	1/2-13	-	EA	1	R		
13	27121	NUT-FLANGE HEX-1/2"-13		-	EA	1	R		
14	27122	BLOCK-SERRATED STEP		-	EA	1	R		
15	27123	CLAMP-STEP		-	EA	1	R		
16	27124-2	KIT-HARDWARE 4TH AXIS-8" CNC-200RB		-	EA	1	R		
17	26712	SHANK - CLAMPING - BALL LOCK		-	EA	3	R		
20	27139	NUT-T-SLOT	1/2-13	-	EA	1	R		
21	8-32X1/2 31Z	SCREW-PH-PHIL-EXT SEMS-STL-ZINC			EA	2	R		
22	M5-0.8X12 25B	SCREW-SHCS-STL-BO			EA	4	R		
23	M5 73B	WASHER-SPLIT LOCK-STL-BO		-	EA	4	R		

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Mfr	Mfr P/N
24	27066-4-DOC	4TH AXIS OPTION - LPM-8"		-	EA	1	R		
25	27063-3	FIXTURE PLATE ASSY-TAILSTOCK-300mm		-	EA	0	R		
26	27063-4	FIXTURE PLATE ASSY-4TH AXIS-300mm		-	EA	0	R		

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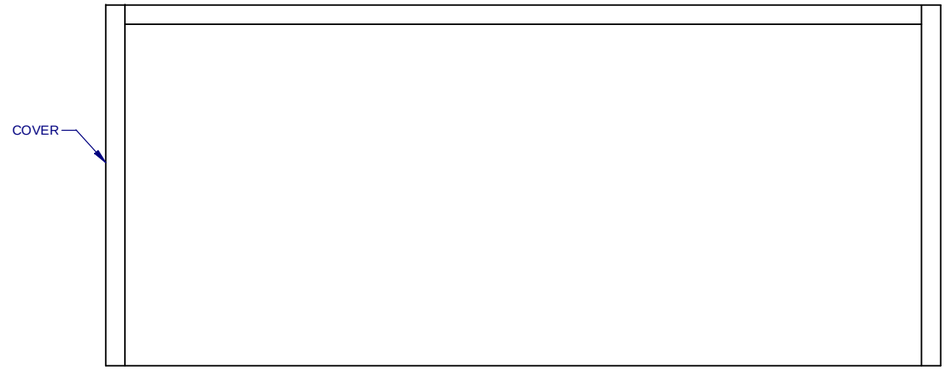
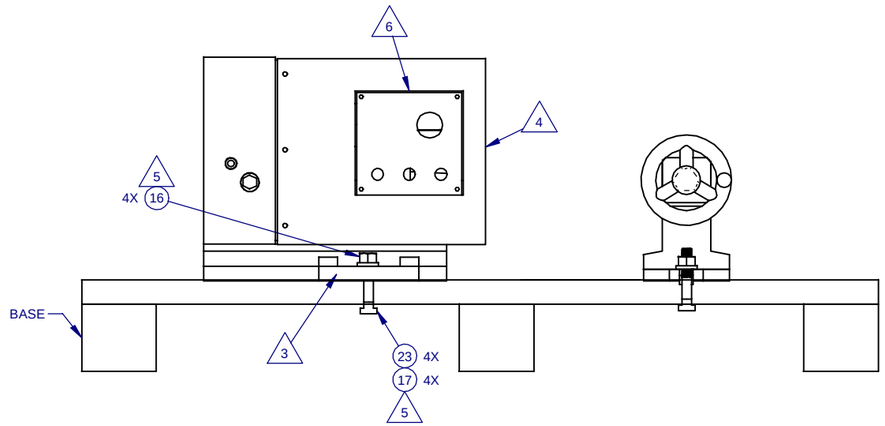
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13775	10/18/11	PM

ALL ITEMS IN DASHED BOX ARE REFERENCE. (18)

27123, 27120, 27122, 27121, 26712 3X, 5/8 71P 6X

HARDWARE BOX
27124-2
(1)





NOTES: (UNLESS OTHERWISE SPECIFIED).

1. REMOVE AND INVENTORY ITEMS SHOWN FROM 27060 (ITEM 1) AND ADD OTHER HARDWARE FROM 27066-2, ITEMS 6,8,10,12-15,17, & 20. PLACE BACK INTO HARDWARE BOX. MARK BOX 27124-2 AND PUT IN TO STOCK AS SEPARATE ITEM.(1B6)
2. MODIFIED AIR HOSE ASSY PER DRAWING ON PAGE 4 TO P/N: 27054-1.(1C6)
3. BRACKETS ARE TO BE USED FOR MOUNTING 4TH AXIS ON MACHINE.(1B4)
4. FINISHED ASSEMBLY TO BE PLACED BACK IN SHIPPING CRATE.(1B3)
5. PART OF ITEM 1. SEE DRAWING 27060 FOR DETAILS (1 B4, 1 A3, 2 D3, 2 C8, 4 C2)(SHEET5)
6. SHEET METAL COVER 27097 NEEDS TO BE REMOVED AND PLACED IN STOCK, AS ITEM 3 (27064) ALREADY CONTAINS THIS PART.(1B3)

(SEE SHEET 2-4 FOR ADDITIONAL NOTES)

NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0°30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5
MATERIAL: -
FINISH: -

APPROVALS		DATE
DRAWN BY	BD	9/20/11
ENGINEER	PM	9/20/11
ENGINEER		
FE		

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

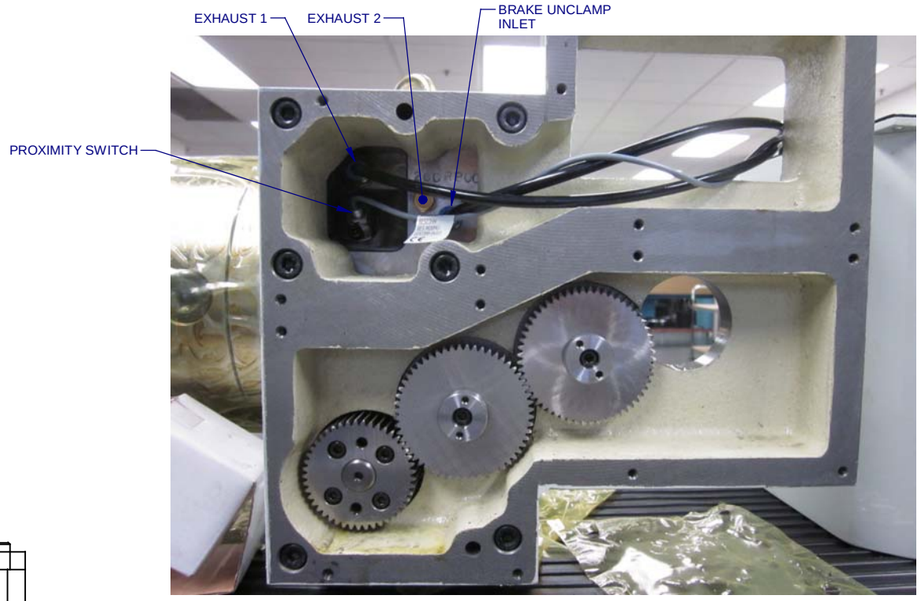
TITLE: ROTARY TABLE ASSY-
4th AXIS-8"-CNC-200RB

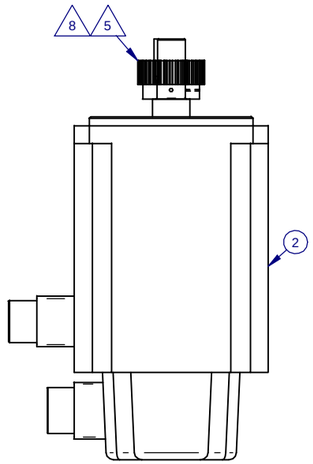
SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	27065-2	-

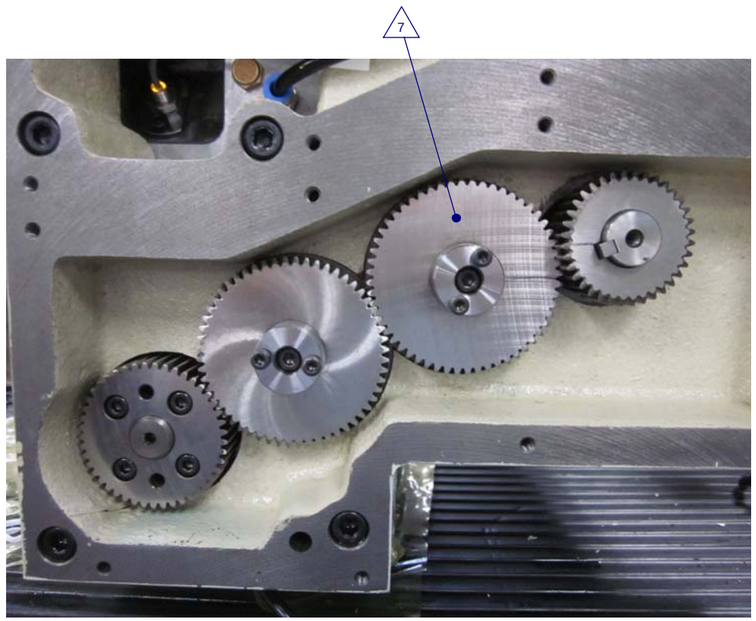
SCALE: - SHEET 1 OF 4

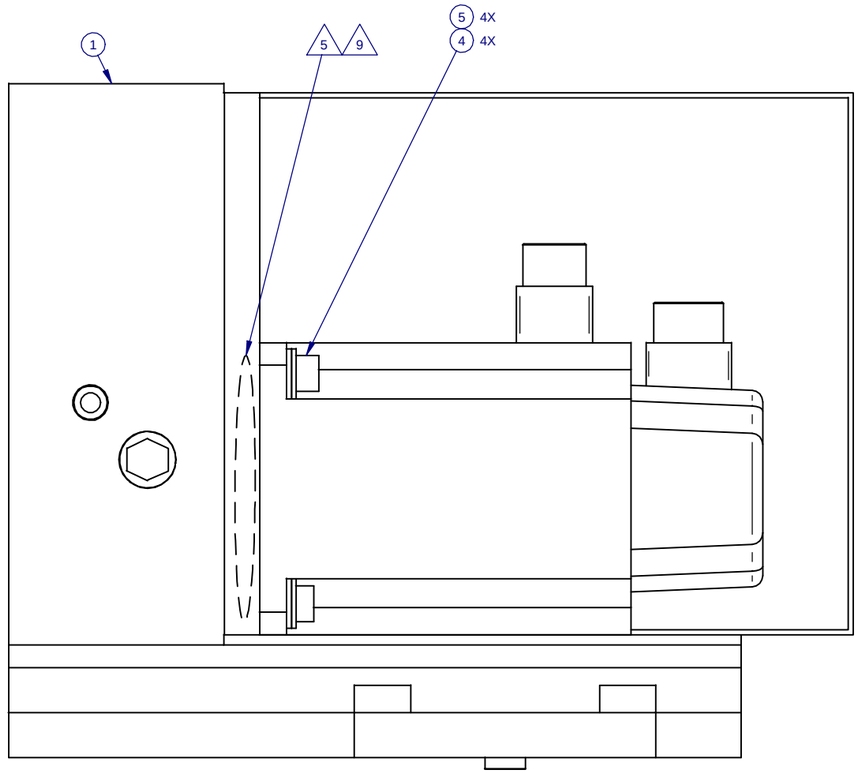
NOTICE: THIS DESIGN WAS ORIGINATED BY AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN OWNED BY SOUTH-WESTERN INDUSTRIES. IT IS DISCLOSED IN CONFIDENCE FOR A SPECIFIC PURPOSE AND THE RECIPIENT HEREOF AGREES NOT TO MAKE ANY REPRODUCTION, DISCLOSURE OR OTHER USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES.

REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13775	10/18/11	PM









7 ADJUSTMENTS ARE MADE BY ROTATING GEAR ON CENTER SHAFT - ECCENTRIC. FOR ADJUSTMENT PROCEDURE SEE ES-453.(1C6)

8 APPLY LOCTITE TO SET SCREWS, USE LOCTITE 222 (LOW STRENGTH) TORQUE TO 26 IN-LBS.(2C8)

9 ADD O-RING SEAL PRIOR TO INSTALLING MOTOR.

NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0°30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS		DATE
DRAWN BY	BD	9/20/11
ENGINEER	PM	9/20/11
ENGINEER		
FE		

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

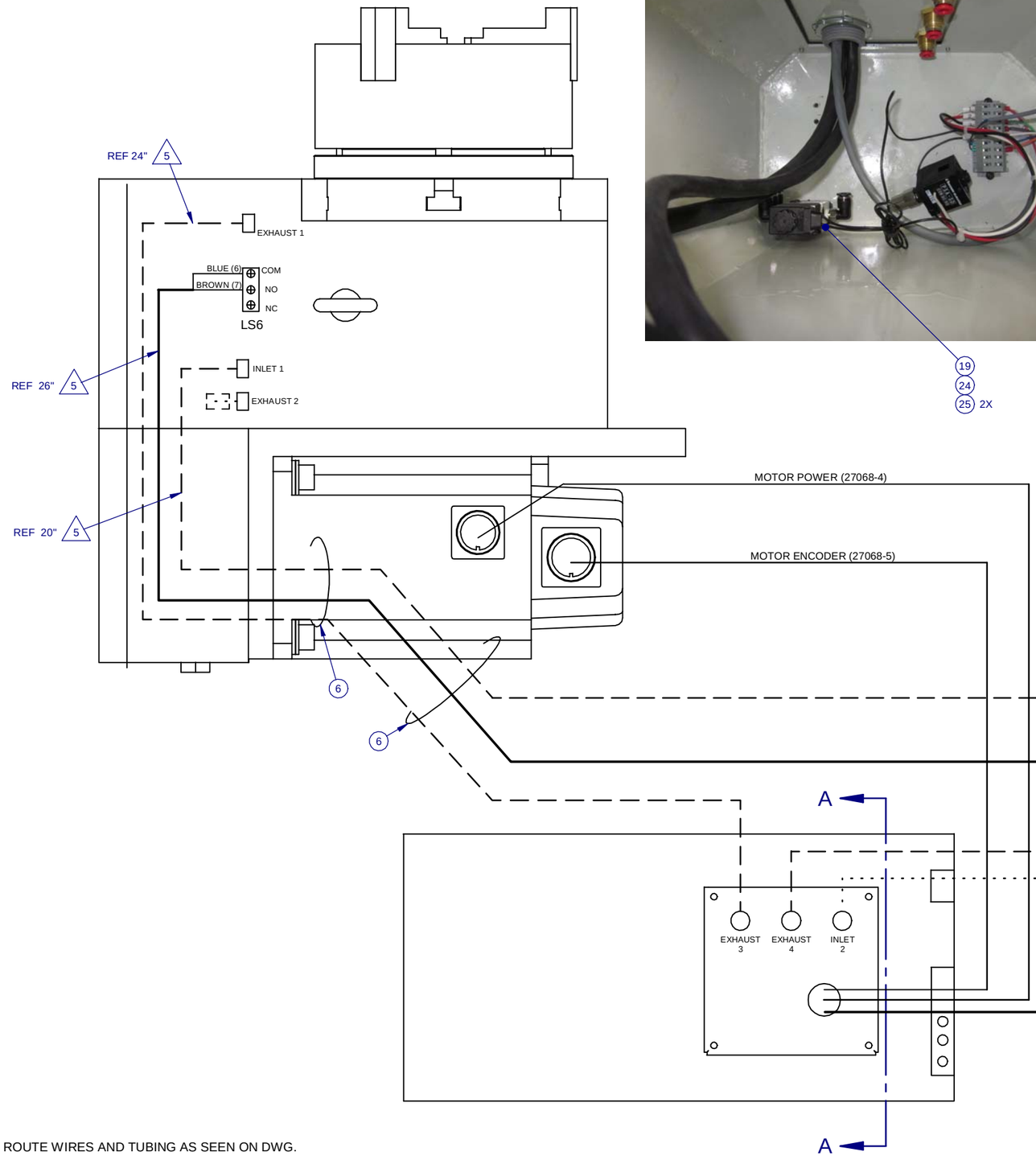
TITLE: ROTARY TABLE ASSY-
4th AXIS-8"-CNC-200RB

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	27065-2	-

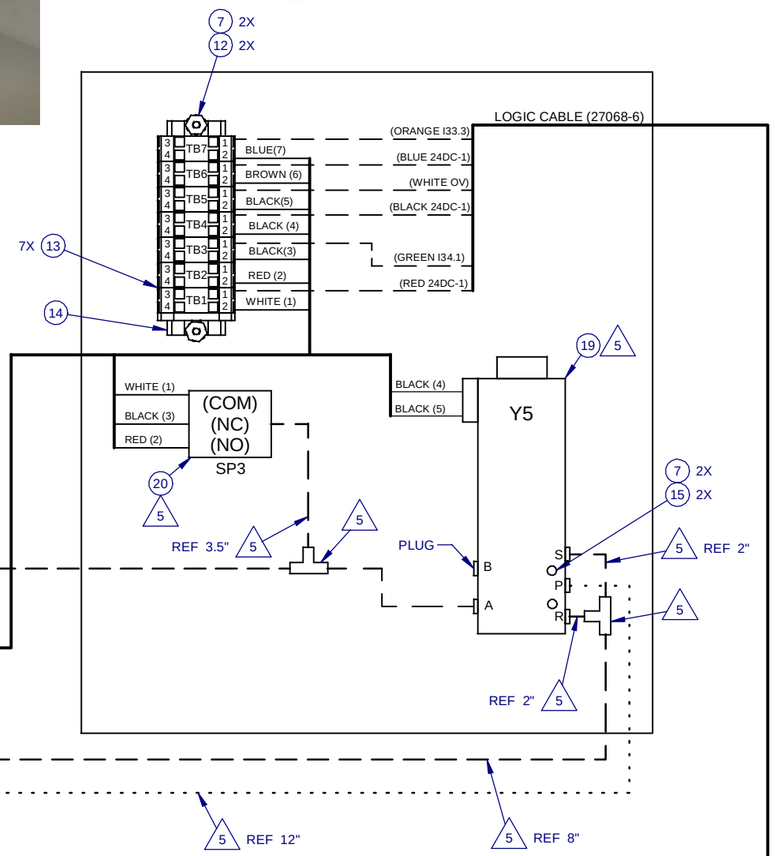
SCALE: - SHEET 2 OF 4

NOTICE: THIS DESIGN WAS ORIGINATED BY AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN OWNED BY SOUTH-WESTERN INDUSTRIES. IT IS DISCLOSED IN CONFIDENCE FOR A SPECIFIC PURPOSE AND THE RECIPIENT HEREOF AGREES NOT TO MAKE ANY REPRODUCTION, DISCLOSURE OR OTHER USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES.

REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13775	10/18/11	PM



SECTION A-A



10. ROUTE WIRES AND TUBING AS SEEN ON DWG.

		DIMENSIONS ARE IN INCHES DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005, ANGLES .XX = ±0°30' FRACTIONS = ±1/8 FINISH = 125 RMS REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONING PER ASME Y14.5	APPROVALS	DATE	SOUTHWESTERN INDUSTRIES, INC. 2615 HOMESTEAD PLACE RANCHO DOMINGUEZ, CA 90220-5610	
			DRAWN BY BD	9/20/11	TITLE: ROTARY TABLE ASSY- 4th AXIS-8"-CNC-200RB	
			ENGINEER PM	9/20/11		
			ENGINEER			
		MATERIAL -	FE		SIZE: D	CODE IDENT. NO.: 06238
NEXT ASSY	USED ON		THIRD ANGLE PROJECTION			DWG NO.: 27065-2
APPLICATION		FINISH -			SCALE: -	SHEET 3 OF 4

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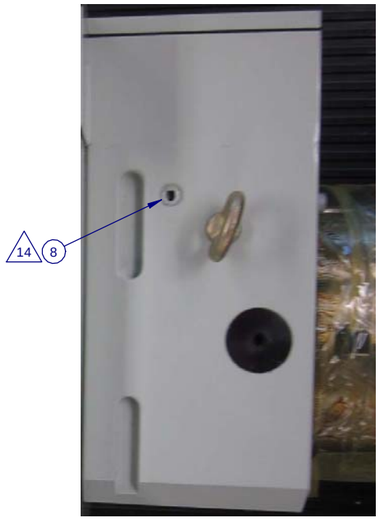
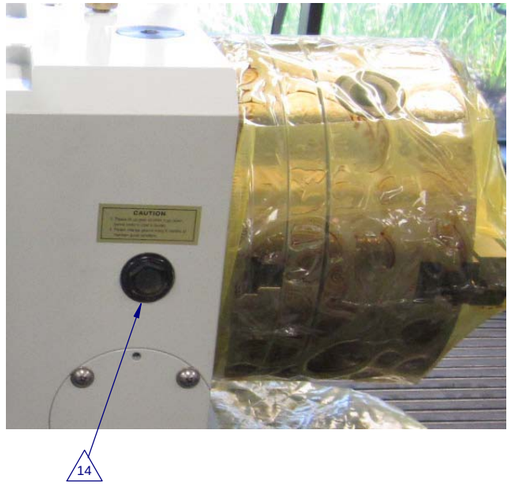
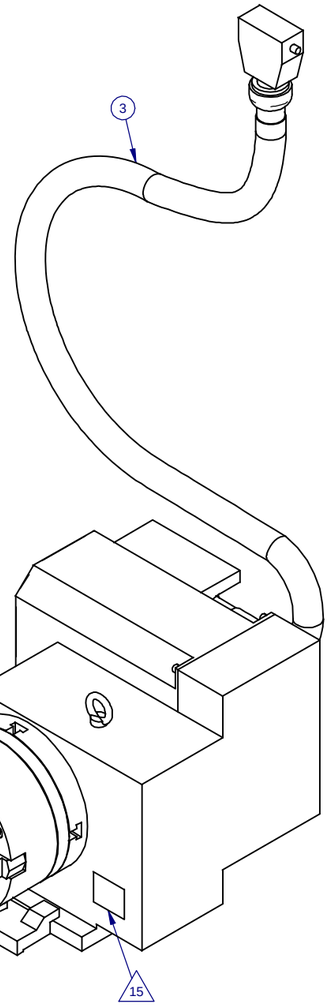
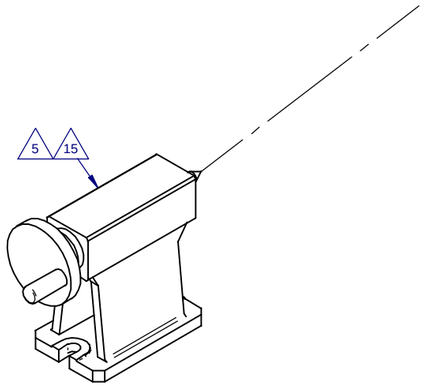
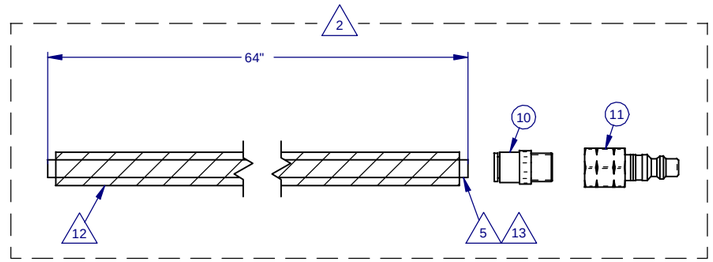
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	13775	10/18/11	PM

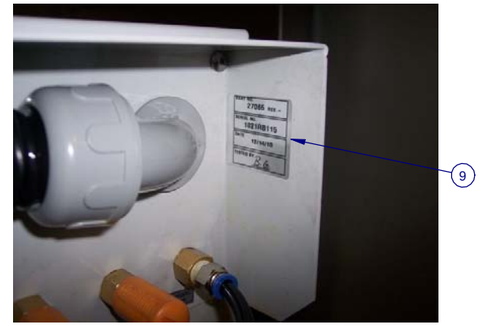


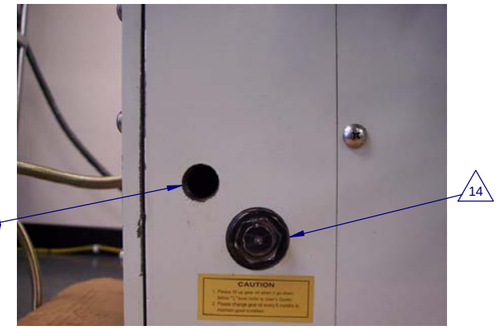












11. FOR MECHANICAL INSPECTION AND TESTING SEE ES-453.

12 DO NOT CUT SPRING SHIELD ONLY CUT TUBING.(4D3)

13 REMOVE EXISTING FITTING AND REPLACE WITH ITEMS 10 AND 11.(4D1)

14 VERIFY OIL LEVEL IS NOT LOW. ADD AS REQUIRED. (4A1,4A2,4B8,4D8)

15 "MFG NO" ON ROTARY TABLE MUST MATCH ONE ON TAIL STOCK. THIS ENSURES THE CENTER HEIGHT IS THE SAME.(4B4,4B6)

NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1 .XX = ±.01 .XXX = ±.005
ANGLES .XX = ±0°30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5
MATERIAL -
FINISH -

APPROVALS		DATE
DRAWN BY	BD	9/20/11
ENGINEER	PM	9/20/11
ENGINEER		
FE		

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: ROTARY TABLE ASSY-
4th AXIS-8"-CNC-200RB

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	27065-2	-

SCALE: - SHEET 4 OF 4

Parts List for Assembly P/N: 27065-2

Printed 10/18/2011

27065-2

ROTARY TABLE ASSY-4TH AXIS-8"-CNC-200RB

Type	PL	Dwg Size	D
Revision	-	Product	LPM
Status	R	Engineer	RO
Date	7/15/2011	Planner Code	
By	BD	Comm Code	

NOTE:
MANUFACTURE AND MANFACTURE PART NUMBER MAY NOT BE UP TO DATE . VERIFY INFORMATION WITH THE CORRESPONDING SPECIFICATION DRAWINGS FOR LATEST INFORMATION.

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Mfr	Mfr P/N
1	27060-2	PURCHASING SPECIFICATION-4TH AXS-8" CNC-200RB		-	EA	1	R		
2	26501-1	MOTOR-BRUSHLESS-5.7NM WITH SEAL		-	EA	1	R		
3	27064	CABLE HARNESS ASSY-4TH AXIS-EXTERNAL		A	EA	1	R		
4	M8-1.25X25 25B	SCREW-SHCS-STL-BO			EA	4	R		
5	24009-1	WASHER - BELLEVILLE LOCK	5/16" OR M8 - SERRATED	-	EA	4	R		
6	22475	TIE WRAP-4 IN-PLASTIC		-	EA	2	R		
7	M3 61Z	NUT-KEP-STL-ZINC		-	EA	(4)	R		
8	27112	OIL-SAE 30-VRSA SUPER PLUS		-	EA	AR	R	CHEVRON	
9	27065-2-LB1	LABEL-TEXT-4TH AXIS		-	EA	1	R		
10	27016	FITTING-ADAPTER-MALE PIPE		-	EA	2	R		
11	27092	COUPLING-QUICK-DISCONNET HOSE		-	EA	1	R		
12	M3-0.5X20 10Z	SCREW-PH-PHIL-STL-ZINC		-	EA	(2)	R		
13	22868	TERMINAL BLOCK		-	EA	(7)	R		
14	22869	END PLATE		-	EA	(1)	R		
15	M3-0.5X30 10Z	SCREW-PH-PHIL-STL-ZINC		-	EA	(2)	R		
16	27120-1	NUT-FLANGE HEX-M14		-	EA	(4)	R		
17	27121-1	WASHER-FLAT-M14		-	EA	(4)	R		
18	27124-2	KIT-HARDWARE 4TH AXIS-8" CNC-200RB		-	EA	(1)	R		
19	27127	SOLENOID-AIR		-	EA	(1)	R		

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

Item	P/N	Title	Detail	Rev	UseAs	Qty	Stat	Mfr	Mfr P/N
20	27129	SENSOR-AIR PRESSURE		-	EA	(1)	R		
21	27149	CLAMP-METAL LOOP		-	EA	1	R		
22	15759	WASHER-1/4 HARD BLK OX 1/8 THK		-	EA	1	R		
23	27048	STUD-M14 x 115mmL		-	EA	(4)	R		
24	27172	SOLENOID-BRACKET		-	EA	(1)	R		
25	M4-0.7.X6 27B	SCREW-BHCS-STL-BO		-	EA	(2)	R		
26	M6-1.0X15 25B	SCREW-SHCS-STL-BO			EA	(4)	R		

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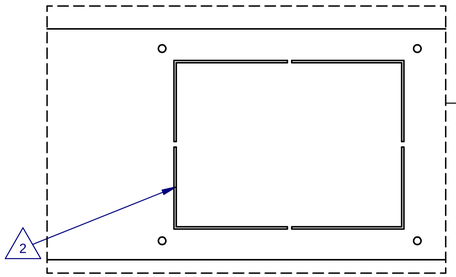
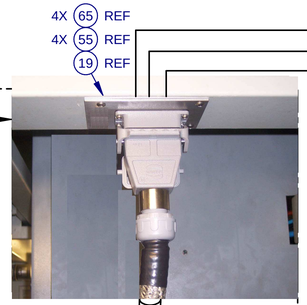
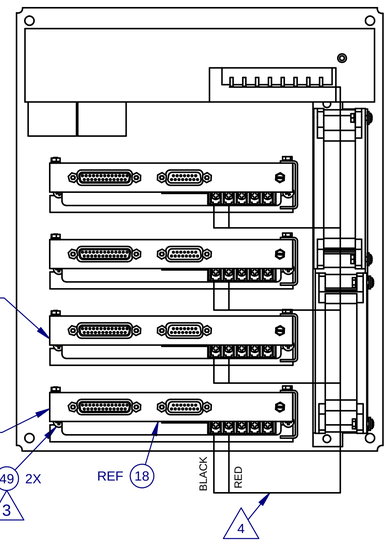
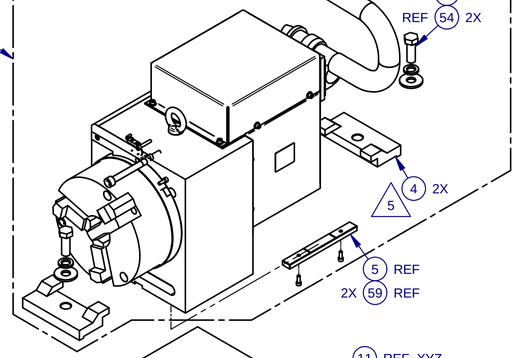
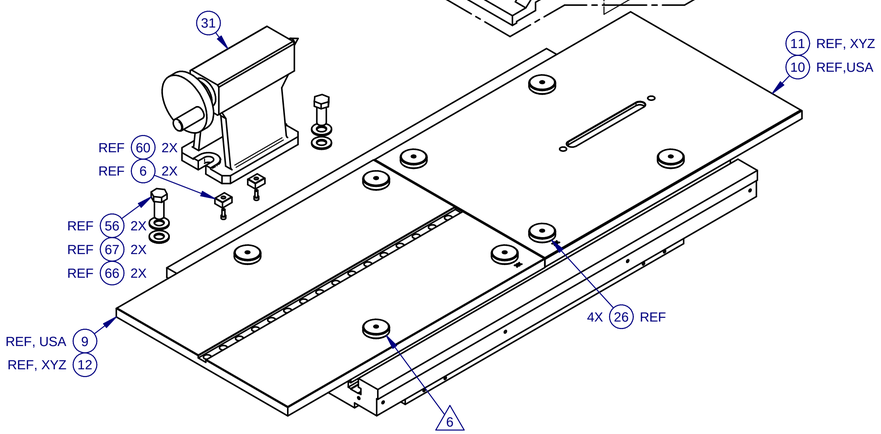
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	14031	10/10/12	NC
A	2A1 ITEM 60 WAS: 59. 2C4 ADDED "PLACEMENT OF SERVO BOX" NOTE. ITEM 59 QTY (2) WAS: (4). ADDED ITEM 60.	14133	9¦30¦13	PM
B	ITEM 70 1/2 66Z WAS: 1/2 71Z	14335	12/5/14	LG

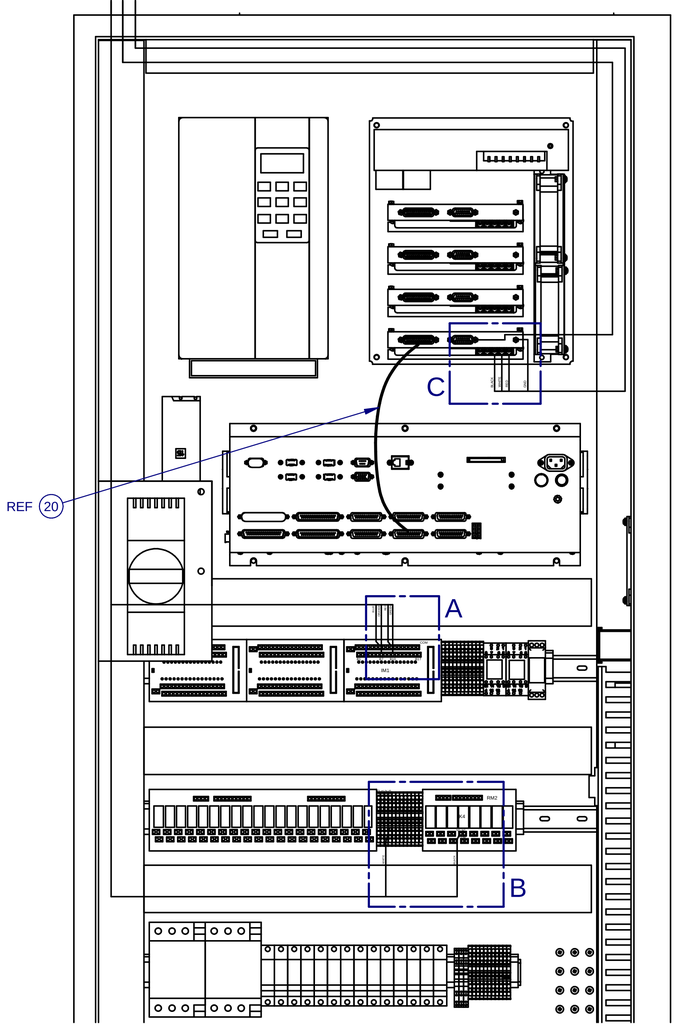


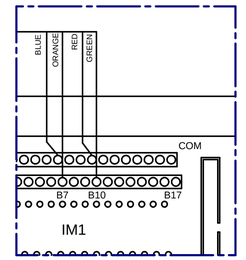




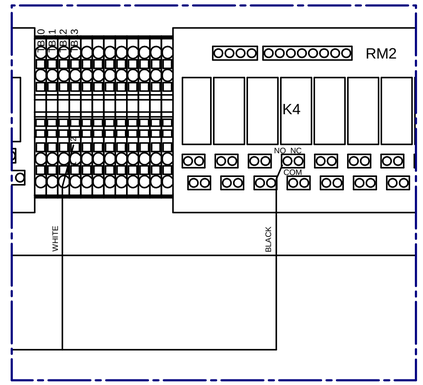




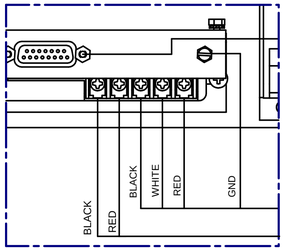




DETAIL A



DETAIL B



DETAIL C

LOGIC CABLE		
COLOR	FUNCTION LABEL	LOCATION "TO"
WHITE	0V	TB13-2
BLACK	24DC-21	RM2-K4-NO
ORANGE	I33.1	IM1-B7
BLUE	24DC-1	IM1-B7-COM
GREEN	I34.0	IM1-B10
RED	24DC-1	IM1-B10-COM

NOTES: (UNLESS OTHERWISE SPECIFIED).

1. ROUTE ALL CABLES AS SHOWN.

2. REMOVE KNOCK-OUTS. IF NO KNOCK-OUT EXISTS MAKE HOLES USING MOUNTING PLATE FROM ITEM 19 AS TEMPLATE (1D8).

3. MOUNT SERVO DRIVE USING EXISTING SCREWS ON POWER DRIVE, IF NO SCREWS AVAILABLE USE ITEM 49 (1B8).

4. REMOVE ONE SET OF BLACK AND RED WIRES (DC BUS) FROM Z-AXIS DRIVE AND CONNECT TO 4TH-AXIS DRIVE (1B7).

5. CLAMPING BLOCKS (ITEM 4) ALSO USED AS SHIPPING HARDWARE (1B5, 2B7).

6. 4 BALL LOCK CLAMPS (26712) FOR THE TAILSTOCK PLATE COME WITH THE LPM (1A7).

(FOR ADDITIONAL NOTES SEE SHEET 2)

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0'30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL: -

FINISH: -

APPROVALS		DATE
DRAWN BY	Sal	10/10/12
ENGINEER	NC	10/10/12
ENGINEER		
FE		

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: 4TH AXIS-
8" SWI-LPM (USA & EURO)

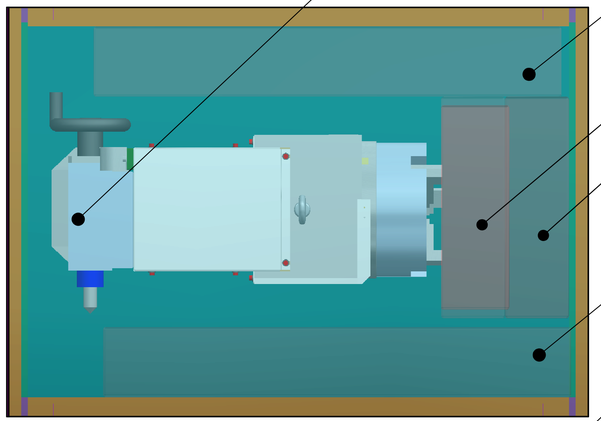
SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	27066-6	B

SCALE: - SHEET 1 OF 2

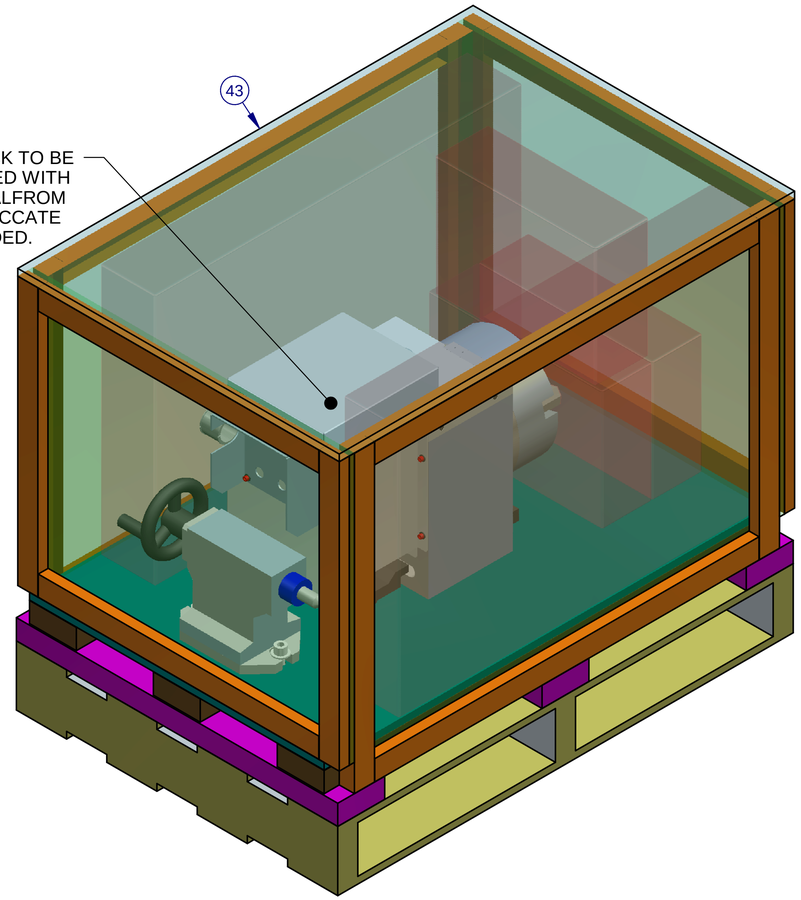
NOTICE: THIS DESIGN WAS ORIGINATED BY AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN OWNED BY SOUTH-WESTERN INDUSTRIES. IT IS DISCLOSED IN CONFIDENCE FOR A SPECIFIC PURPOSE AND THE RECIPIENT HEREOF AGREES NOT TO MAKE ANY REPRODUCTION, DISCLOSURE OR OTHER USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES.

SHOWN FOR REFERENCE ONLY

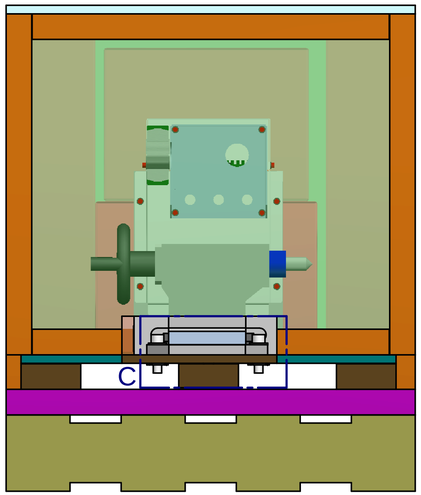
PRIOR TO MOUNTING TAILSTOCK ONTO CRATE REMOVE KEYS AND HARDWARE FOR SHIPPING STABILITY AND PLACE INTO HARDWARE KIT.

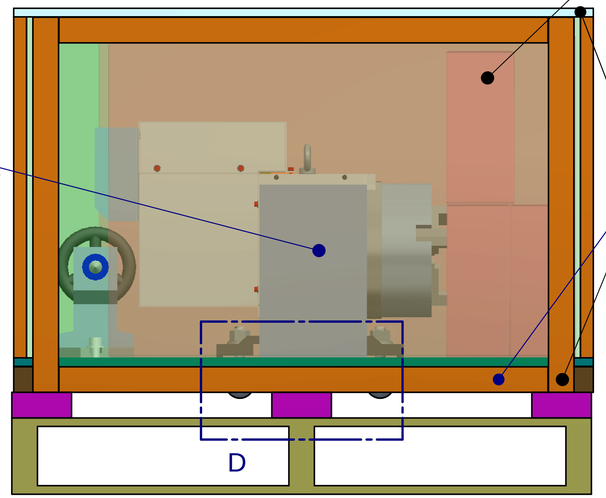


4th AXIS AND TAILSTOCK TO BE COMPLETELY WRAPPED WITH PLASTIC FILM TO SEALFROM MOISTURE. ADD DESICCATE PACKETS AS NEEDED.

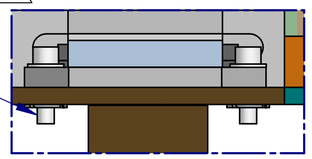


PLACEMENT OF SERVO BOX WITHIN CRATE SUBJECT TO DISCRETION OF PACKAGER.

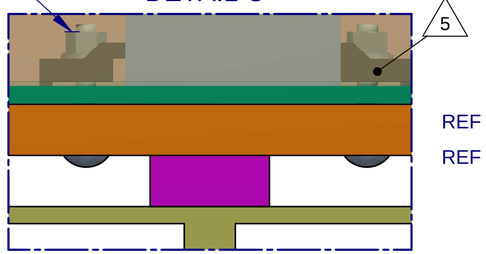




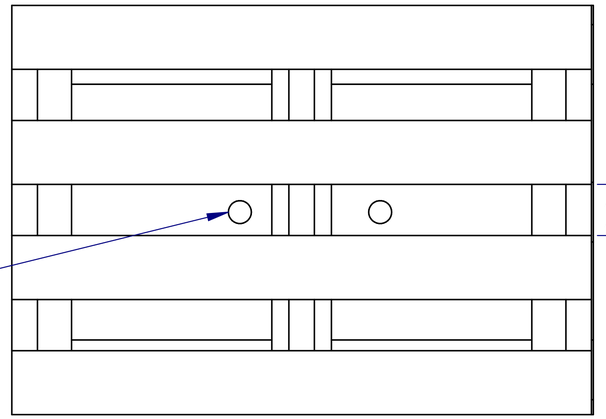
ASSEMBLE PANELS (4) & COVER USING DRYWALL SCREWS



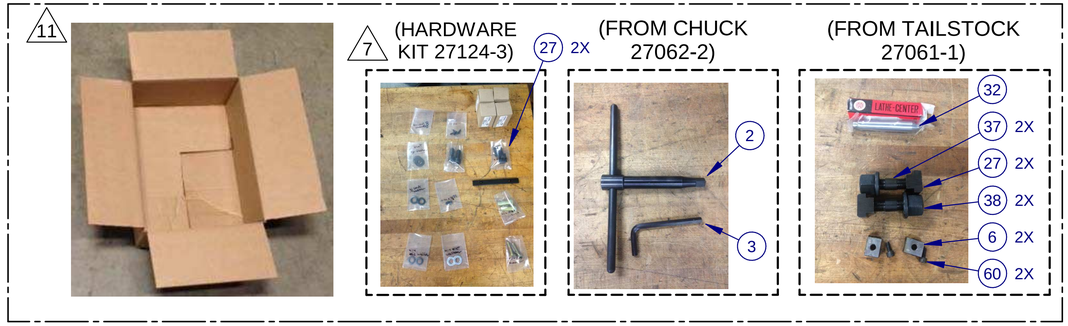
DETAIL C



DETAIL D



ALLOW 3.0 CLEARANCE TO ACCESS CARRIAGE BOLTS



7 EXTRA T-NUTS & BOLTS IN HARDWARE KIT (ITEM 25) CAN BE USED TO SECURE 4TH AXIS DIRECTLY TO TABLE IF FIXTURE PLATES ARE NOT USED (2B1, 2D4).

8 FINISHED ASSEMBLY TO BE PLACED INTO SHIPPING CRATE.(2C6).

9 WRAP & TAPE STEEL BRAIDED CABLE WITH 3/32 STARFOAM (2D7).

10. FOR MECHANICAL INSPECTION AND TESTING SEE ES-462.

11 PLACE COMPONENTS SHOWN IN PICTURES INTO BOX HARDWARE KIT (27124-3) & REMOVE PART NUMBER LABEL FROM BOX IF IT EXISTS (2B4).

12 INSTALL TEE NUT (ITEM 76) PRIOR TO INSTALLING ITEMS 58 AND 70 (2B8).

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	27066-6	B
SCALE: -		SHEET 2 OF 2	

Parts List for Assembly P/N: 27066-6

Printed 12/1/2017

27066-6

4TH AXIS-8" -SWI-LPM (USA & EURO)

Type	PL	Dwg Size	D
Revision	B	Product	
Status	R	Engineer	NC
Date	9/21/2012	Planner Code	
By	Sal	Comm Code	

Item	P/N	Title	Detail	Reference(t)	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
1	28060	4TH AXIS ASSY-SWI			1	EA	B	R	PL		
2	27115	T-HANDLE	SEE 27066-6		(1)	EA	-	R	PL		
3	27643-1	WRENCH-ALLEN-6mm	SEE 27066-6		(1)	EA	-	R	PS		
4	27053-1	CLAMPING BLOCK-4TH AXIS-SWI			2	EA	-	R	PL		
5	28058	KEY-BASE-4TH AXIS-SWI			(1)	EA	-	R	DWG		
6	28058-1	KEY-TAILSTOCK-4TH AXIS-SWI			(2)	EA	A	R	DWG		
9	27063-5	FIXTURE PLATE ASSY-TAILSTOCK-SWI			(1)	EA	-	R	PL		
10	27063-6	FIXTURE PLATE ASSY-4TH AXIS-SWI			(1)	EA	-	R	PL		
11	27063-7	FIXTURE PLATE ASSY-TAILSTOCK-300mm-SWI-XYZ			(1)	EA	-	R	PL		
12	27063-8	FIXTURE PLATE ASSY-4th AXIS-300mm-SWI-XYZ			(1)	EA	-	R	PL		
17	27124-4	KIT-ELECTRONICS-4TH AXIS-8"-SWI			1	EA	A	R	PL		
18	26599	SERVO DRIVE ASSY-5.7 Nm MOTOR			(1)	EA	E	R	PL		
19	27064-2	CABLE HARNESS ASSY-4TH AXIS SWI-INTERNAL			(1)	EA	-	R	PL		
20	26512-030	CABLE ASSY-DB25 MALE/FEMALE	2.5 FT		(1)	EA	A	U	DWG		
25	27124-3	KIT-HARDWARE-4TH AXIS-8"-SWI			1	EA	A	R	PL		
26	26712	SHANK-CLAMPING-BALL LOCK			(4)	EA	-	R	DWG		
27	27119	NUT-T SLOT-M16-2.0			(4)	EA	B	R	DWG		
31	27061-1	TAILSTOCK-4TH AXIS-TS-A160			1	EA	B	R	PL		
32	27113	DEAD CENTER-TAPER MT#2			(1)	EA	A	R	DWG		
37	27058	STUD-M16			(2)	EA	B	R	DWG		

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

Item	P/N	Title	Detail	Reference(t)	Qty	UseAs	Rev	Stat	Type	Mfr	Mfr P/N
38	27059	NUT-FLANGE-M16			(2)	EA	B	R	DWG		
43	28036	CRATE-SHIPPING-4th AXIS-SWI			1	EA	B	R	PL		
49	8-32X1/2 31Z	SCREW-PH-PHIL-EXT SEMS-STL-ZINC			(2)	EA		R	PS		
54	M14-2.0X40 24Z	SCREW-HEX HD-ZINC			(2)	EA	-	R	PS		
55	M5-0.8X12 25B	SCREW-SHCS-STL-BO			(4)	EA	-	R	PS		
56	5/8-11X1 1/2 25B	SCREW-SHCS-STL-BO			(2)	EA	-	R	PS		
57	5/8-11X3 1/2 2Z	SCREW-CARRIAGE-STEEL-ZINC			2	EA	A	R	PS		
58	1/2-13X1 3/4 25B	SCREW-SHCS-STL-BO			2	EA		R	PS		
59	10-32X1/2 25B	SCREW-SHCS-STL-BO			(2)	EA	-	R	PS		
60	M6-1.0X12 25B	SCREW-SHCS-STL-BO			(2)	EA		R	PS		
63	M14 70P	WASHER-FLAT USS-STL-PLAIN			(2)	EA		R	PS		
64	M14 73B	WASHER-SPLIT LOCK-STL-BO			(2)	EA		R	PS		
65	M5 73B	WASHER-SPLIT LOCK-STL-BO			(4)	EA	-	R	PS		
66	5/8 71P	WASHER-FLAT SAE-STL-PLAIN			(2)	EA		R	PS		
67	5/8 73B	WASHER-SPLIT LOCK-STL-BO			(2)	EA		R	PS		
70	1/2 66Z	WASHER-FLAT-NARROW-ANSI TYPE B			2	EA	-	R	PS		
75	23793	FLANGE NUT 5/8-11	5/8-11		2	EA	A	R	DWG		
76	27862	TEE NUT-WOOD			2	EA	-	R	PS		
80	27066-6-DOC	4TH AXIS OPTION-LPM-8"-SWI			1	EA	-	R	DWG		

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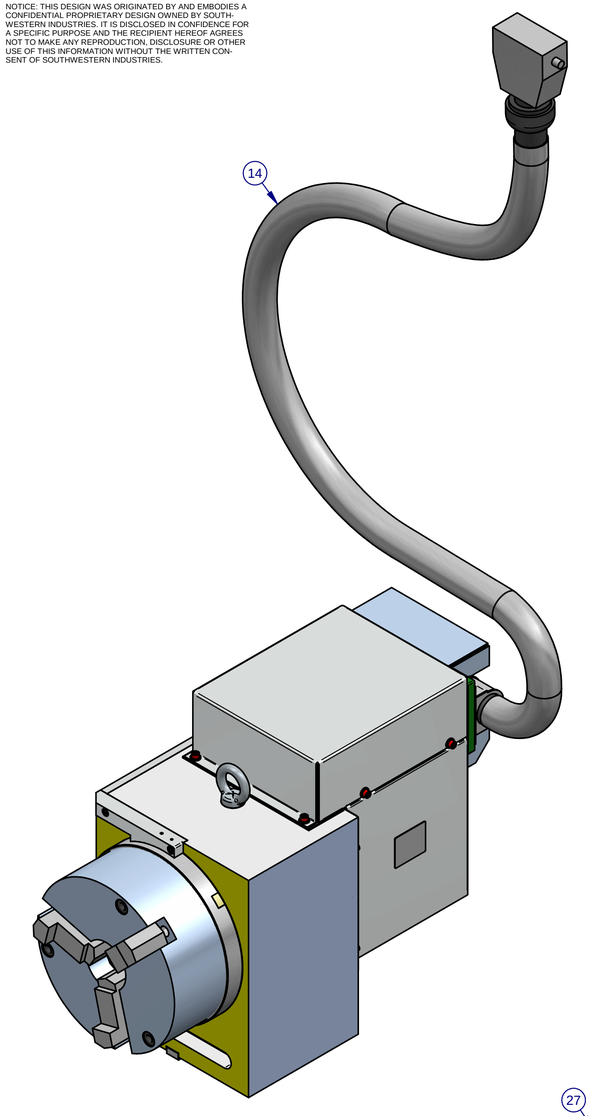
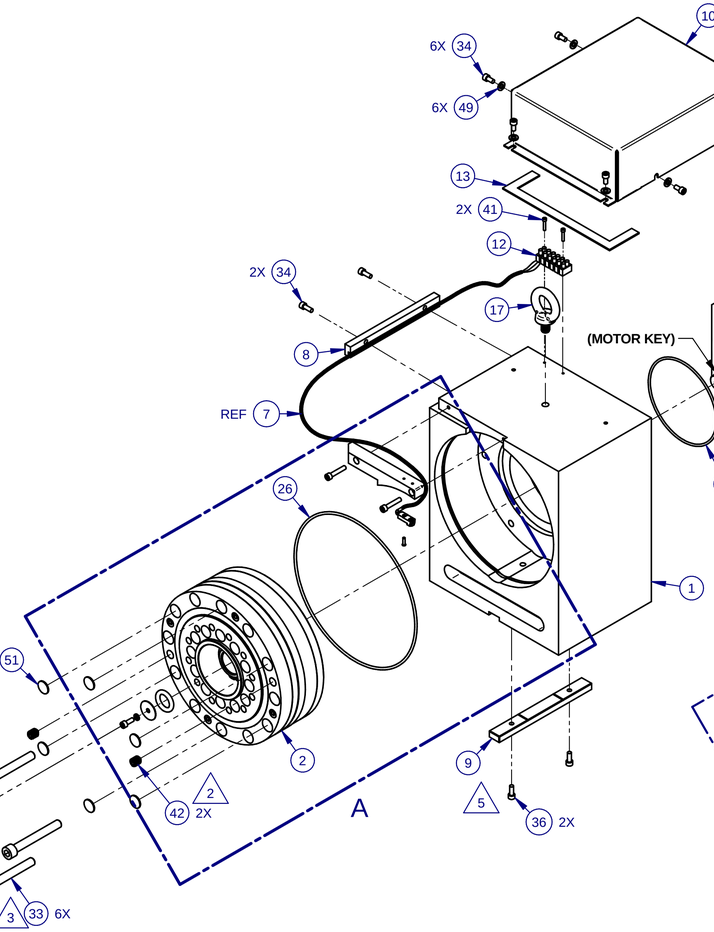
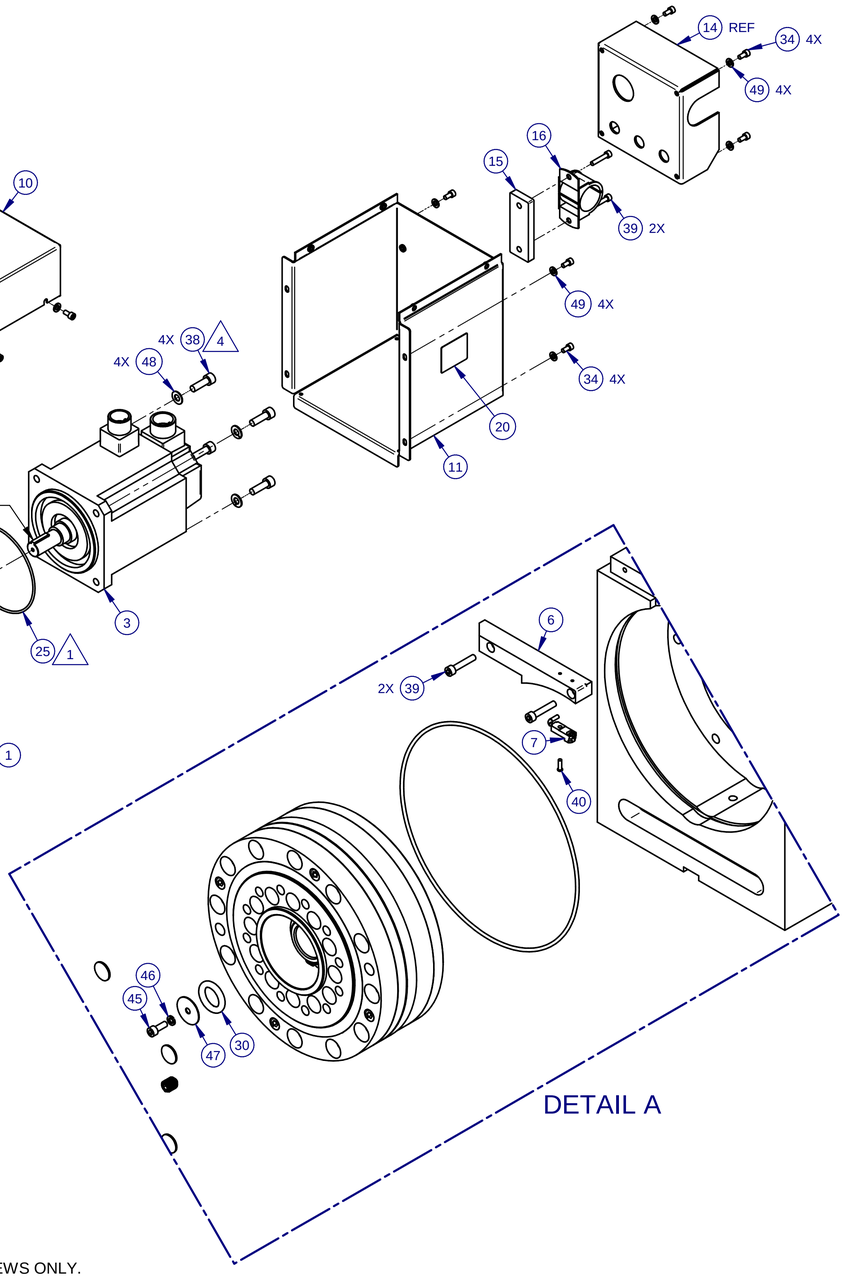
REVISIONS				
REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	14031	10.8.12	TO
A	ITEMS 9 & 36 QTY 1 & 3 WAS: (1) & (3).	14133	9¦30¦13	PM
B	ITEM 40 QTY 1 WAS: 3. ADDED ITEM 41.	14188	05-05-14	CH







NOTES: (UNLESS OTHERWISE SPECIFIED).

1. ADD O-RING (ITEM 25) PRIOR TO INSTALLING MOTOR (ITEM 3). (C3)
2. ADD LOCTITE #515 PRIOR TO INSTALLING M8 SET SCREWS (ITEM 42). THESE ARE PLUG SCREWS ONLY. THREAD IN UNTIL THEY TOUCH & BACK OFF 1/4 TURN. DO NOT TIGHTEN. (B5)
3. LUBRICATE THREADS AND BEARING AREAS WITH PLAIN, MEDIUM VISCOSITY OIL AND TORQUE TO 50 FT-LBS. (A6)
4. LUBRICATE THREADS AND BEARING AREAS WITH PLAIN, MEDIUM VISCOSITY OIL AND TORQUE TO 25 FT-LBS. (A7, C3)
5. TEST ASSEMBLY USING ES-338. AFTER TEST REMOVE KEY AND HARDWARE (ITEMS 9 & 36) AND PLACE INTO HARDWARE KIT (27124-3). (B4)
6. FOR OTHER RELATIVE INFORMATION SEE EE00076, EE00094, EE00099.

DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0'30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5

MATERIAL

FINISH

APPROVALS		DATE
DRAWN BY	NC	10/5/2012
ENGINEER	TO	10/8/2012
ENGINEER		
FE		

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: 4TH AXIS ASSY-SWI

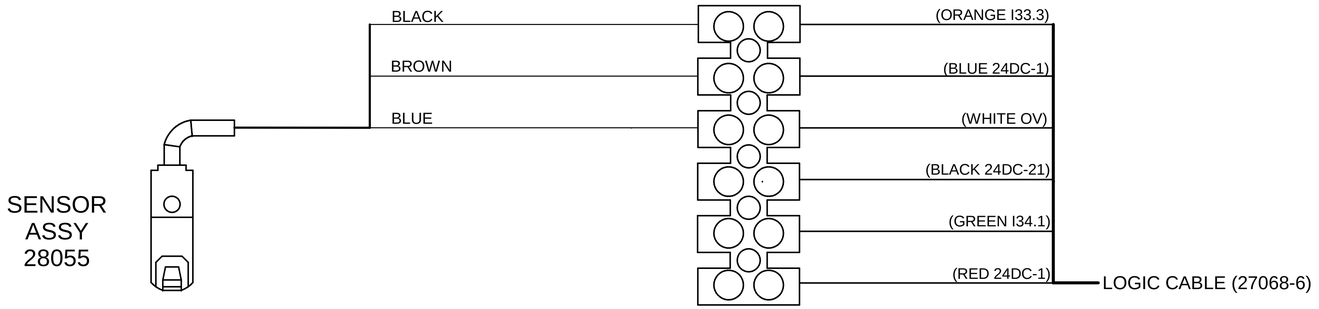
SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	28060	B

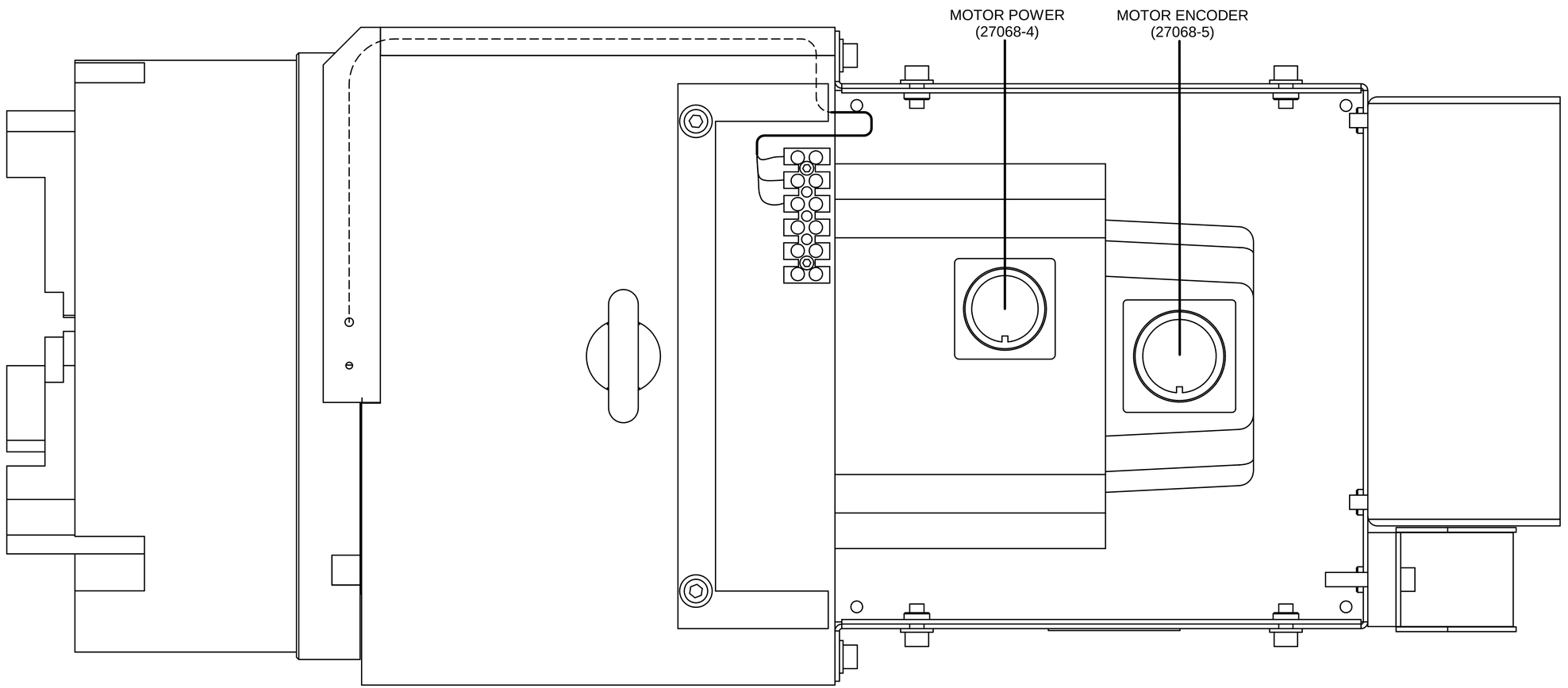
SCALE: 1 : 4 | 0.0 lbm | SHEET 1 OF 2

NOTICE: THIS DESIGN WAS ORIGINATED BY AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN OWNED BY SOUTHWESTERN INDUSTRIES. IT IS DISCLOSED IN CONFIDENCE FOR A SPECIFIC PURPOSE AND THE RECIPIENT HEREOF AGREES NOT TO MAKE ANY REPRODUCTION, DISCLOSURE OR OTHER USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES.

REVISIONS

REV	DESCRIPTION	ECN	DATE	APPRV
-	ORIGINAL RELEASE	14031	10.8.12	TO
A	ITEMS 9 & 36 QTY 1 & 3 WAS: (1) & (3).	14133	9¦30¦13	PM
B	ITEM 40 QTY 1 WAS: 3. ADDED ITEM 41.	14188	05-05-14	CH





DIMENSIONS ARE IN INCHES
DEC. .X = ±.1, .XX = ±.01, .XXX = ±.005,
ANGLES .XX = ±0°30'
FRACTIONS = ±1/8
FINISH = 125 RMS
REMOVE ALL SHARP EDGES
MASK ALL TAPPED HOLES
DIMENSIONING PER ASME Y14.5
MATERIAL
FINISH

APPROVALS	DATE
DRAWN BY NC	10/5/2012
ENGINEER TO	10/8/2012
ENGINEER	
FE	

THIRD ANGLE PROJECTION

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE
RANCHO DOMINGUEZ, CA 90220-5610

TITLE: 4TH AXIS ASSY-SWI

SIZE	CODE IDENT. NO.	DWG NO.	REV
D	06238	28060	B

SCALE: 1 : 4 | 0.0 lbm | SHEET 2 OF 2

Parts List for Assembly P/N: 28060

Printed 8/5/2015

28060
4TH AXIS ASSY-SWI

Type	PL	Dwg Size	D
Revision	B	Product	
Status	R	Engineer	NC
Date	9/7/2012	Planner Code	
By	Nick	Comm Code	

Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr
1	28050	BASE-MACHINED-4TH AXIS-SWI		1	EA	-	R	PL	
2	28056	CYCLOIDAL DRIVE ASSY-4TH AXIS-SWI		1	EA	-	R	PS	
3	26501	MOTOR-AXIS - 5.7 N-m		1	EA	A	R	DWG	
4	28057	ADAPTER PLATE-8 IN-4TH AXIS-SWI		1	EA	A	R	PL	
5	28061	BLOCK-HOME INDICATOR-4TH AXIS-SWI		1	EA	-	R	DWG	
6	28054	BLOCK-HOME SENSOR-4TH AXIS-SWI		1	EA	-	R	DWG	
7	28055	SWITCH ASSY-SENSOR-PROXIMITY-4TH AXIS-SWI		1	EA	-	R	PL	
8	28053	BLOCK-CABLE GUARD-4TH AXIS-SWI		1	EA	-	R	DWG	
9	28058	KEY-BASE-4TH AXIS-SWI		1	EA	-	R	DWG	
10	28051	SHEET METAL-UPPER-4TH AXIS-SWI		1	EA	-	R	DWG	
11	28052	SHEET METAL-LOWER-4TH AXIS-SWI		1	EA	A	R	DWG	
12	28082	TERMINAL BLOCK-8mm EURO STRIP-WIRE GUARD-6 POS		1	EA	-	R	PS	
13	27669-1	GASKET-BEZEL-ROLL		1 FT	MM	-	R	DWG	
14	27064	CABLE HARNESS ASSY-4TH AXIS-EXTERNAL		1	EA	B	R	PL	
15	28063	PLATE-CLAMP STANDOFF-4th AXIS-SWI		1	EA	-	R	DWG	
16	28064	CLAMP-HARNESS-4TH AXIS-SWI		1	EA	-	R	PS	
17	27056	BOLT-EYE-M10		1	EA	A	R	DWG	
18	27062-2	CHUCK-3 JAW-4TH AXIS-SWI-8 INCH-MANUAL	SK8	1	EA	-	R	PS	
20	27065-3-LB1	LABEL-TEXT-4TH AXIS SWI		1	EA	-	R	PS	
21	27115	T-HANDLE	SEE 27066-6	(1)	EA	-	R	PL	
22	27643-1	WRENCH-ALLEN-6mm	SEE 27066-6	(1)	EA	-	R	PS	

SOUTHWESTERN INDUSTRIES, INC.
2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
1-310-608-4422 Fax 1-310-764-2668

Item	P/N	Title	Detail	Qty	UseAs	Rev	Stat	Type	Mfr
25	27805-10	O-RING-4.693 OD x 4.487 ID x .103 THK-AS568A 157		1	EA	A	R	DWG	
26	27805-11	O-RING-211 OD x 205 ID x 3 THK	205X3BN70	1	EA	A	R	DWG	
27	27805-12	O-RING-ID 103mm W 2.5mm	130X2.5BN70	1	EA	A	R	DWG	
28	27805-9	O-RING-3.129 OD x 2.989 ID x .070 THK-AS568A 041		1	EA	A	R	DWG	
29	27805-8	O-RING-.566 OD x .426 ID x .070 THK-AS568A 013		6	EA	A	R	DWG	
30	27805-13	O-RING-1.145 OD x .725 ID x .210 THK-AS568A 314		1	EA	A	R	DWG	
33	28081	SCREW-SHCS-M10-1.5X80-25B-SEALING		6	EA	-	R	DWG	
34	10-32X3/8 25B	SCREW-SHCS-STL-BO		16	EA		R	PS	
35	M10-1.5X80 25B	SCREW-SHCS-STL-BO		(3)	EA	-	R	PS	
36	10-32X1/2 25B	SCREW-SHCS-STL-BO		3	EA	-	R	PS	
37	M10-1.5X30 25B	SCREW-SHCS-STL-BO		6	EA		R	PS	
38	M8-1.25X25 25B	SCREW-SHCS-STL-BO		4	EA		R	PS	
39	10-32X1 25B	SCREW-SHCS-STL-BO		4	EA		R	PS	
40	4-40X3/8 10Z	SCREW-PH-PHIL-STL-ZINC		1	EA		R	PS	
41	4-40X9/16 25B	SCREW-SHCS-STL-BO		2	EA	-	R	PS	
42	M10-1.5X12 41B	SCREW-SOC SET-STL-BO-FLAT	SEE 28060	2	EA	-	R	PL	
45	10-32X1/2 01B	SCREW-SHCS-STL-BO-SELF LOCKING	SEE 28060	1	EA	-	R	PL	
46	10 73B	WASHER-SPLIT LOCK-STL-BO		1	EA		R	PS	
47	10 79Z	WASHER-FENDER-1.0 OD-ZINC	SEE 28060	1	EA	-	R	PL	
48	24009-1	WASHER-BELLEVILLE SPRING LOCK-SERRATED	5/16 OR M8	4	EA	C	U	PS	
49	M5 70B	WASHER-FLAT USS-STL-BO		14	EA		R	PS	
51	28075	CAP-SCHS-M10	RAIL CAPS FOR LWE45	6	EA	-	R	PS	