

TRAK™ 2^{OP} M11 Mill

Safety, Installation, Maintenance, Service and Parts List

Document: P/N 28170
Version: 062619

TRAK MACHINE
TOOLS



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- 27500-1 Rev B Spindle Head Assembly
- 27520-1 Rev B X Axis Drive Train
- 27540-1 Rev D Z Axis Drive Train
- 27542-1 Rev C Base Frame Assembly
- 27557 Rev B Coolant System
- 27563-1 Rev E Pneumatic System
- 27564-1 Rev G Y Axis Drive Train
- 27568-1 Rev E Enclosure Assembly

27587-1 Rev A ATC Assembly
27591-1 Rev B Lubrication System
27600-2 Rev C Machine Assembly
27605-1 Rev B Single Phase Option
27621-2 Rev D Electrical Cabinet Assy
27648-2 Rev D System Diagram
27650-2-SCH Rev H (D Size) Electrical Schematic
27658-1 Rev A Home Switch Assy
27682 Rev A Cover Assy
27830-1 Rev C Spindle Cartridge Assembly
28091-1 Rev E 440 Volt Option
28137 Rev C Indexer Ready Option
28156 Rev A Enclosure Assembly - Servo Drives
28160 Rev C Programming Panel Assembly
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1.0 Safety

The safe operation of the 2 OP Mill depends on its proper use and the precautions taken by each operator.

- Read and study this manual and the 2 OP 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 B11.22-2002) (R2007) & (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.

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

Safety & Information Labels Used On The TRAK 2^{OP} Milling Machine

It is forbidden by OSHA regulations and by law to deface, destroy or remove any of these labels

SAFETY INSTRUCTIONS

1. Read and understand the Operator's Manual and all warnings on this sign before operating machine.
2. Machine should only be operated by qualified personnel that have been trained in the operation and use of this machine.
3. Machine starts and moves automatically. Never place any part of your body near or on moving parts of this machine.
4. Stop spindle completely before touching the tool, work piece, or spindle.
5. Do not operate machine unless all guards, interlocks, and safety devices are installed and functioning.
6. Always clamp work piece and tool securely. Avoid excessive feeds and spindle speeds.
7. Wear safety glasses, shoes, and hearing protection when operating machine.
8. Remove rings, watches, jewelry and loose fitting clothes. Keep hair away from moving parts of the machine.
9. Installation and service must be performed by qualified personnel only, following instructions in the Maintenance Manual. Turn off and lock-out the power at the main electrical panel before servicing.
10. It is the responsibility of the user to be sure that this machine is in safe operating condition at all times, and that the operator follows the safe operating procedures described in the Operator and Maintenance Manuals.

Do not remove or disfigure this sign.

SAFETY WARNING!



1. Hazardous voltage present in the electrical equipment of this machine. Only qualified engineers are allowed to install, test, adjust or maintain it.
2. Isolate power before install, test, adjust or maintain the electrical equipment of this machine.
3. Do Not turn on the power before the protective grounding has been securely connected.
4. Do Not change any device of this machine without permission.

FAILURE TO COMPLY WITH THE ABOVE MAY RESULT IN A SERIOUS ACCIDENT

S-S1878

WARNING



1. Never open door during operation.
2. Do not operate with door removed.

Failure to observe the above may result in serious injury.

S-S3120

WARNING



Keep hands, clothing and body clear of rotating spindle. Machine starts and moves automatically. Can cause severe injury.

1. Set control in manual mode before working near spindle.
2. Isolate machine before servicing.

S-S3018

WARNING:  **PRESSURIZED VESSEL** 

THIS AIR TANK STAYS PRESSURIZED EVEN IF THE MAIN AIR IS DISCONNECTED. BEFORE DISCONNECTING THIS TANK, FIRST DISCONNECT THE MAIN AIR SUPPLY, LOWER THE FRONT DOOR ALL THE WAY DOWN, THEN RELEASE ALL AIR PRESSURE FROM THE TANK BY SLOWLY OPENING THE DRAIN VALVE LOCATED ON THE BOTTOM OF THE TANK.

CAUTION!
IN ADDITION TO THE COMPRESSED AIR, THIS TANK MAY CONTAIN SOME OIL AND WATER. USE PROPER EYE PROTECTION AND EXERCISE CAUTION WHEN OPENING THE DRAIN VALVE.

WARNING  



1. IMPROPER OPERATION OR IMPROPER MAINTENANCE OF THIS MACHINE MAY CAUSE SERIOUS BODILY INJURY OR DEATH.
2. DO NOT OPERATE THIS MACHINE UNTIL YOU HAVE RECEIVED OPERATING AND SAFETY INSTRUCTIONS FROM YOUR EMPLOYER.
3. FOLLOW ALL SAFETY PRACTICES PRESCRIBED BY YOUR EMPLOYER AND AS OUTLINED IN THE "PROGRAMMING, OPERATION AND CARE MANUAL".
4. IT IS THE RESPONSIBILITY OF THE EMPLOYER TO PROVIDE AND ENSURE POINT OF SAFEGUARDING PER ANSI R11.23-2002 & R11.23-2007.
5. 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

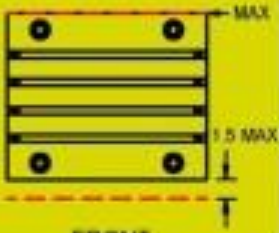
WARNING  

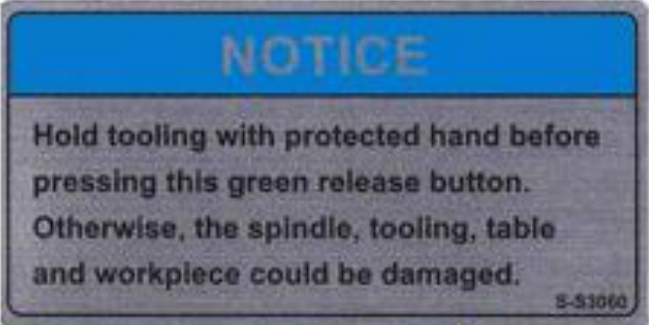
THIS COUNTERBALANCE CYLINDER STAYS PRESSURIZED EVEN IF THE MAIN AIR IS DISCONNECTED. BEFORE DISCONNECTING THIS CYLINDER, FIRST DISCONNECT THE MAIN AIR SUPPLY, LOWER THE FRONT DOOR ALL THE WAY DOWN, THEN RELEASE ALL AIR PRESSURE FROM THE AIR STORAGE TANK INSIDE THE MACHINE BY SLOWLY OPENING THE DRAIN VALVE LOCATED ON THE BOTTOM OF THE TANK.

CAUTION!
IN ADDITION TO THE COMPRESSED AIR, THIS TANK MAY ALSO CONTAIN SOME OIL AND WATER. USE PROPER EYE PROTECTION AND EXERCISE CAUTION WHEN OPENING THE DRAIN VALVE.

WISE & FIXTURE WARNING  

Vise or fixture must not protrude beyond the back edge of the worktable to avoid collision with the ATC. It may not protrude more than 1.5 inches beyond the front of the worktable to avoid collision with the front door. Use SWI modified Kurt vise P/N VISE-20PM10 or Kurt vise 3600V-INT or equivalent.





MAINTENANCE SCHEDULE

DAILY

- Remove majority of chips from around the axis slide ways, work table and way covers, especially between table and ATC.
- Empty chip tray.
- Visually check lubrication pump oil level and make sure it is always above the minimum line.
- Visually check the coolant level and add if it is low.
- Visually check the air regulator filter.

MONTHLY OR AS SPECIFIED

- Remove rear ATC and Y-axis motor compartment access covers and clean chips and other debris. Cleanup any oil or coolant accumulated on the bottom panel of the machine base.
- Visually inspect the condition of way and ball screw covers. Clean if showing chip build up.
- Check and if needed replace the air regulator filter element.
- Every two months drain and remove the coolant tank and clean inside, including pump screen. Fill with new coolant.
- Visually check the tool unclamp oil reservoir level.
- Remove all air filters in the electrical cabinet and transformer enclosure every two months and clean.

YEARLY

- Remove all covers. Vacuum chips, debris, and wipe down machine from top to bottom.
- Check backlash on each axis and adjust if needed. Refer to the machine manual for more information.
- Inspect machine for any unusual wear and play.
- Check cables and pneumatic lines for any excessive abrasions or cuts.
- Inspect the ATC air cylinder and grease the ATC linear rail bearing blocks.
- Please contact SWI Service Dept. for help with any machine maintenance procedures. Service Dept. contact number is 1-800-367-3165.

I27694-20

1.3 Safety Precautions

1. Do not operate this machine before the **2 OP 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 use 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 workpiece 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 2 OP mill 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, System Description 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 TRAK 2^{OP} machine.

Overall Machine Dimensions

| | |
|-----------------------------------------------------------------------------------------------------------------|-------|
| Width of machine | 30.5" |
| Depth of machine | 52" |
| Height of mill with head all the way up | 101" |
| Minimum height to fit mill through doorway (Z cable carrier collapsed, resistor cover and resistors removed) | 92" |

Machine Specifications

Table Dimensions

| | |
|-------------------------------|--------------------------------|
| Table size | 18" x 15" |
| Number of tee slots and pitch | 4 @ 63 mm |
| Tee slot width | 0.630" or 16 mm |
| Table maximum load | 500 lbs. |
| Ball Lock ® hold down force | 2250 lbs @ 35 in/lbs of torque |
| Machine Weight | ~2825 lbs |
| Machine Shipping Weight | ~3175 lbs |

Travel

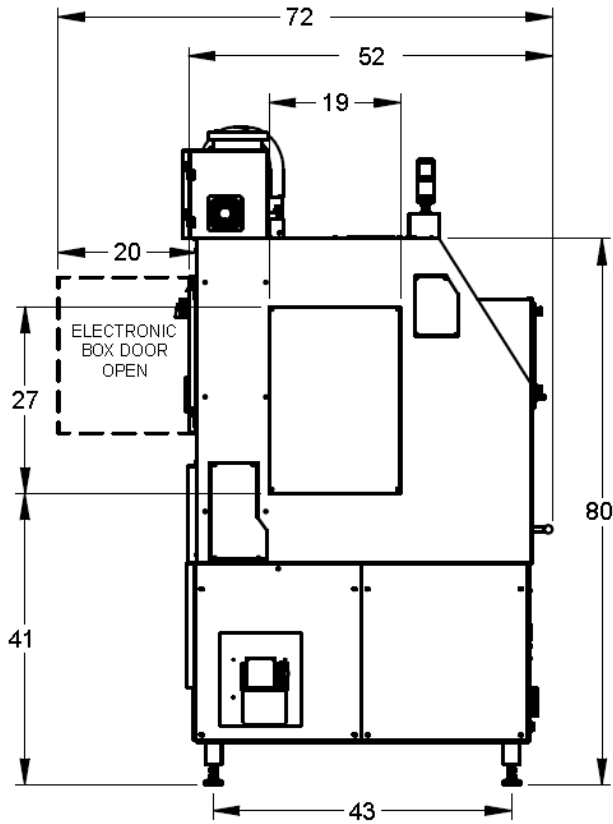
| | |
|-------------------------------------------------------|-------------------------------|
| X-axis | 14" |
| Y-axis | 18" (12" of machining travel) |
| Z-axis | 17" |
| Maximum distance from spindle nose table surface | 20.25" |
| Minimum distance from spindle nose table surface | 2.75" |
| Maximum swing clearance from spindle center to column | 14" |
| Maximum Rapid speed X, Y & Z-axis, inches per minute | 600 |

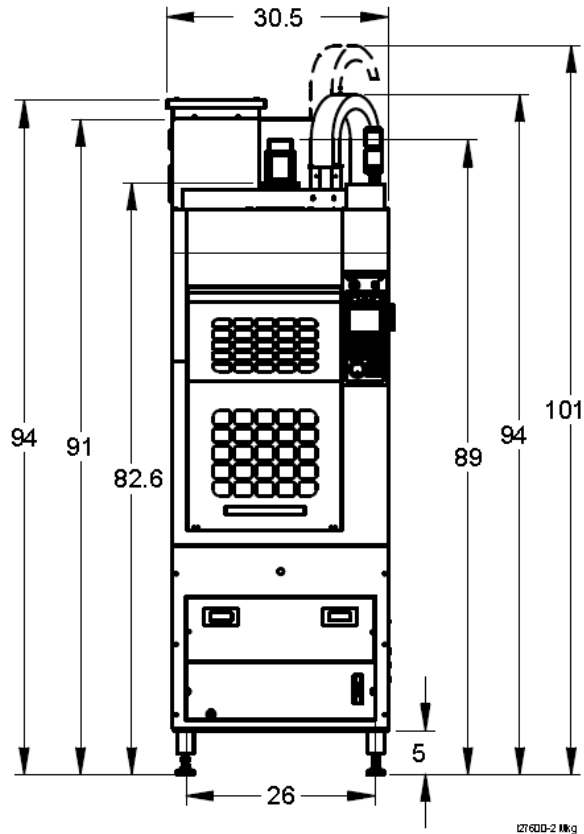
Spindle

| | |
|-----------------------|---------------|
| Tool holder type | BT30 |
| Spindle nose diameter | 2.2" or 56 mm |
| Maximum RPM | 6000 |

Automatic Tool Carrier

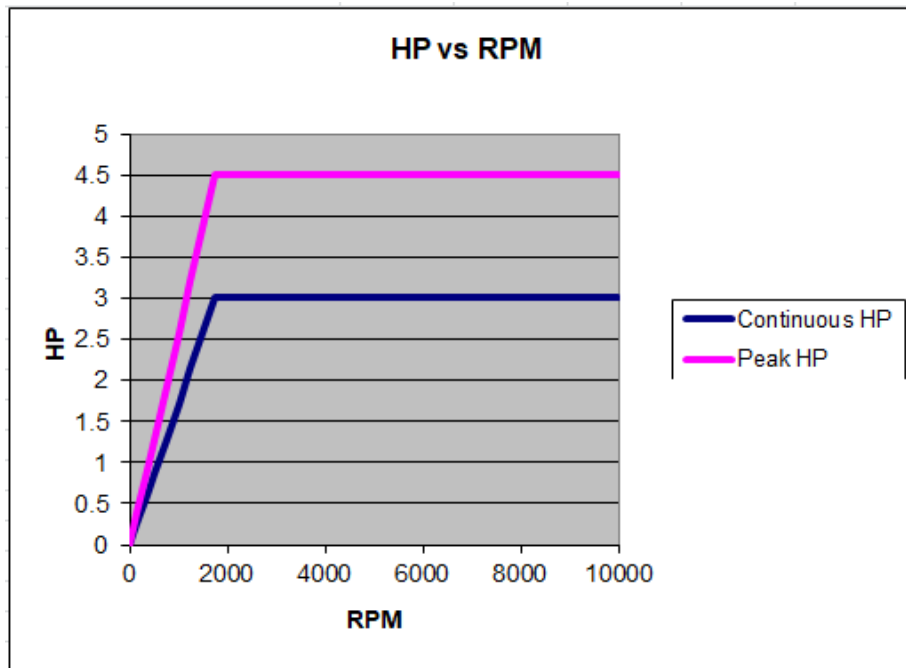
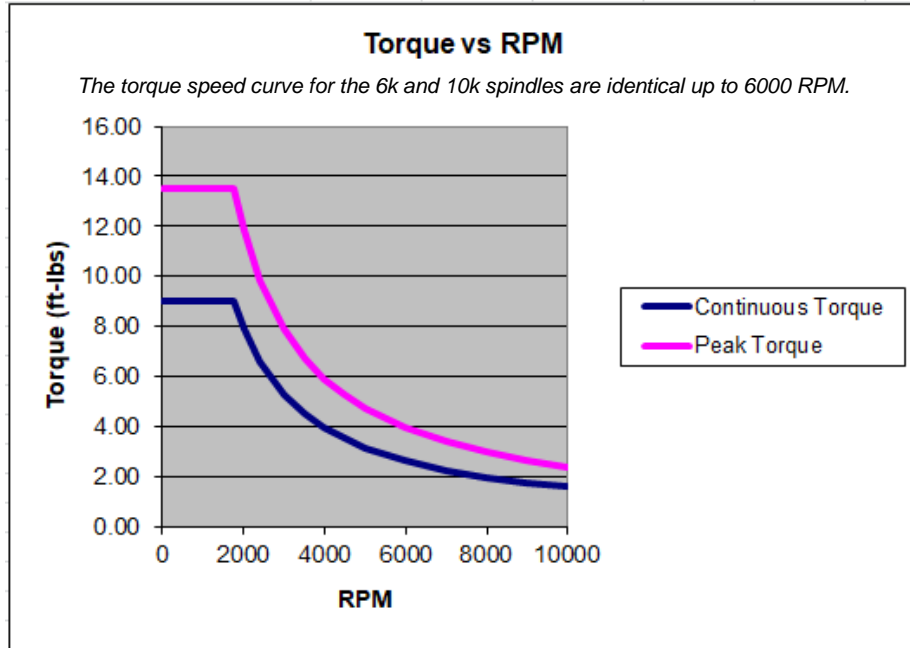
| | |
|-------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| Tool Capacity | 8 |
| Maximum tool diameter | 2 or ~50 mm |
| Retention knob | See section 3.4.4 |
| Longest Tool that can be use in ATC – length measured from bottom of drive dog flange on holder | 6.75" |
| <u>Air Requirements</u> | |
| Pressure | 90 psi |
| Quality | Air dried/filtered water separator upstream of the machine |
| CFM | 2.5 @ 90 psi |
| SCFM | 18 |





2.2 Maximum Spindle Torque and Horsepower

The following graphs illustrate the continuous and peak torque vs RPM and horsepower vs RPM for the 2 OP M11 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 TMX Control Hardware

2.3.1 Programming Panel Assembly

The programming panel assembly on the 2 OP is mounted to the front right side of the machine.

The panel consists of the program overlay, electronic handwheel (EHW), 5.7" LCD and a servo on button. There are 2 USB ports mounted on the right side of the machine next to the programming panel. They are used to save programs and/or plug in a keyboard and mouse.

There are 6 cables that route from the programming panel to the computer module. They are the VGA cable, 2 USB cables, COM port cable, overlay power cable and EHW cable. The VGA cable carries video signals from the computer module to LCD controller board. The LCD interface board gives the user the ability to modify the brightness, color and position of the image. The USB cables extend 2 of the USB ports on the computer module up to the right side of the machine, next to the programming panel. The COM port provides the communication between the computer and the Overlay Interface board. The Overlay power cable provides power to the LCD and Overlay Interface board, it also feeds back the critical keys (GO, STOP, etc) to the computer module. The EHW cable carries the signals from the EHW down to the computer module.

2.3.2 Electrical Cabinet

The electrical cabinet is found at the rear of the machine. The electrical cabinet contains the main control hardware for the machine. The main components are the computer module and AC spindle drive. See drawing 27621-2 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 programming panel assembly, AC spindle drive, servo drives, motor signals and feedback and all the inputs and outputs. 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 2 USB ports. Both USB ports extend with 2 cables to the front of the machine to ease access from the front of the machine.

2.3.4 Servo Motors

The TRAK 2^{OP} mill uses 3 servo motors with servo drives to run the X, Y and Z axes. The motors for the X and Y axis produce 21 in-lbs of continuous torque

and 63 in-lbs of peak torque. The Z axis motor produces all produces 28 in-lbs of continuous torque and 84 in-lbs of peak torque. The servo motors run off of 220 volt single phase power.

2.3.5 Servo Drives

The TRAK 2^{OP} mill uses 3 servo amps that are mounted in an enclosure that is mounted to the top of the machine. The servo amps are the same for both the X and Y axis. The Z axis uses a larger servo amp to drive the larger Z axis motor. A separate braking resistor is part of the Z axis servo amp circuit to dissipate heat generated when the motor is decelerating. The resistor is mounted to the top of this enclosure.

2.4 Machine Major Subassemblies

2.4.1 Spindle

The spindle is contained within a cartridge and BT30 tool holders must be used. The spindle bearings are permanently lubricated and require no additional attention by the user. The spindle 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. The spindle cartridge design is also pressurized by air to prevent contaminants from getting up inside the spindle. A spindle ring is also attached to the bottom of the spindle via the drive dogs and prevents debris like coolant from getting up inside the spindle.

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 3 HP and directly drives the spindle via a coupling. The RPM range for this machine is 50 to 6000 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 1000 lbs is generated to clamp the toolholder to the spindle. The Automatic Draw Bar Assembly uses full system air and hydraulic oil and requires no adjustment. There is an oil reservoir for the hydraulics that should be monitored on a regular basis. If there is a leak in the system the oil in

this reservoir will go down. This leak will need to be fixed. This oil cup is found on top of the machine behind the spindle motor.

2.4.4 Retention Knobs

The TRAK 2^{OP} Mill uses BT30 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 RETN KNOB-2OPM11. Our retention knobs should be torqued to 30 ft-lbs. It should be noted that lesser quality retention knobs will be torqued to something less than this.

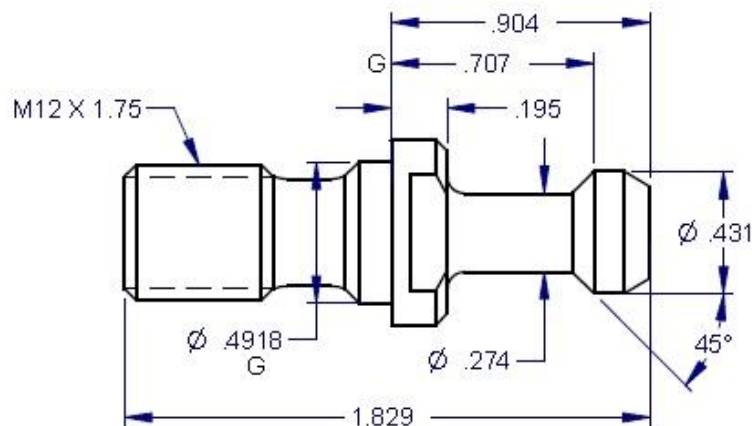


Figure 2.4.4a

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 2 OP mill 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 (Carrier)

The tool changer is an 8 station mechanism that is actuated along the Y axis. It is hidden from view while the machine is cutting. The ATC mechanism slides forward on the Y axis linear guides and is actuated via an air cylinder.

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 a 6 mm pitch ballscrew. The

axis motors drive each axis via a timing belt except on the Z axis where it is directly driven.

2.4.7 Worktable

The 2 OP 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 2 OP mill allows the user to save the X and Y location of your program relative to the lower left hand corner ball lock. See the programming manual for more information. There are 4 ball lock receivers mounted in the table and they are separated by 12". The front 2 ball lock receivers are to be used to locate your fixture and the rear two are for clamping purposes.

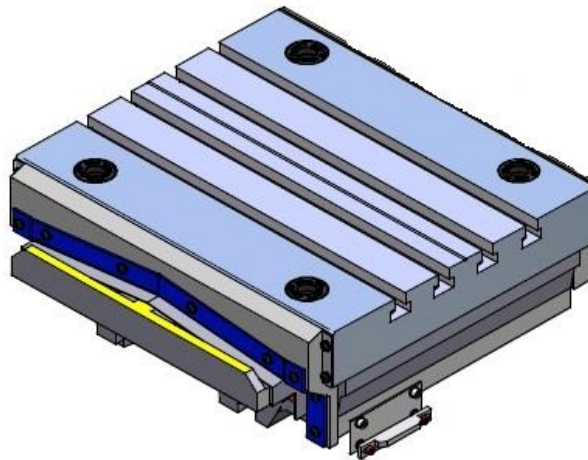


Figure 2.4.7a

2.4.8 Home switches

Each axis has a home switch which is used to home the mill. The machine must be homed each time the control is powered on.

Warning

It is not recommended that the position of the home switches be changed. They are preset at the factory and should require no additional adjustments. Should any major adjustments be done, service codes 500, 505, and 520 may need to be performed.

2.4.9 Lubrication System

The automatic lubricating system is a centralized system. It is located on the left side of the machine. While the system is automatic, it is recommended that after long idle periods, the machine be manually lubricated by using service code 300. Cycle the lube pump two to three times. The lubrication reservoir should be maintained on a daily basis, filling only with high quality lubricating oil. See section 3.9

2.4.10 Coolant and Coolant Wash System

The coolant and coolant wash system uses 1 pump to provide coolant to the work and also to wash chip away from the area where the ATC comes out. Wash areas can be controlled by the flexible coolant lines found at the base of the enclosure.

The coolant tank holds approximately 15 gallons of coolant.

See drawing 27557 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 1/2" I.D, minimum is 3/8" ID. Air pressure to pneumatic components, the ATC slide mechanism, and air purge (internal spindle) can be controlled individually by means of the adjusting valves located at the back of the 2 OP mill. See drawing 27563-1 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. This includes the axis motors and spindle.

The enclosure is also equipped with left and right doors that are bolted in place.

CAUTION!

Do not Attempt to Disable or Override the Safety Interlock.

2.4.13 Status Light

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

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TRAK Machine Tools

Southwestern Industries, Inc.

TRAK 2OP Installation, Maintenance, Service and Parts List Manual

- a. The green light is illuminated when the machine is running a program.
- b. The green light is flashing once per second when the operator input is required, like when a part needs to be changed.
- c. The green light flashes 3 times per second when a fault condition exists.

2.4.14 Chip Removal

The chip pan is located in the front of the mill. To remove, lift up on the pan and pull forward.

2.4.15 Work Lamp

The 2 OP mill comes equipped with a fluorescent work lamp, which comes on automatically when the power is turned on.

2.4.16 Transformer

The TRAK 2^{OP} mill must be ordered for 200 to 240 or 400 to 480 volts. A transformer outputs 115 and 24 volts. During the installation of the machine, the wires to the transformer may need to be moved to adjust the output voltage. From the factory the wires on the transformer will be placed on the 220 or 440 volt tap and 115 volt tap on the output side. It should be noted that the transformer is physically different for 220 volt machines versus 440 volt machines.

Warning

The input voltage to the machine should not exceed 240 or 480 volts. The spindle inverter is not rated for voltages higher than this. If the shop has voltages that exceed these numbers, they will need a step down transformer to lower the voltage. Voltages higher than this may void your warranty.

DANGER

You must turn the power off to the machine before adjusting the wires on the transformer. Failure to do so may cause death by electrocution.

Figure 2.4.17a shows the terminal blocks where you can switch the wiring. For example, the machine is most likely shipped from the factory with the wire in the 220 volt terminal. This wire needs to be moved to the 200 or 240 terminal if the input voltage to the machine measures this amount.

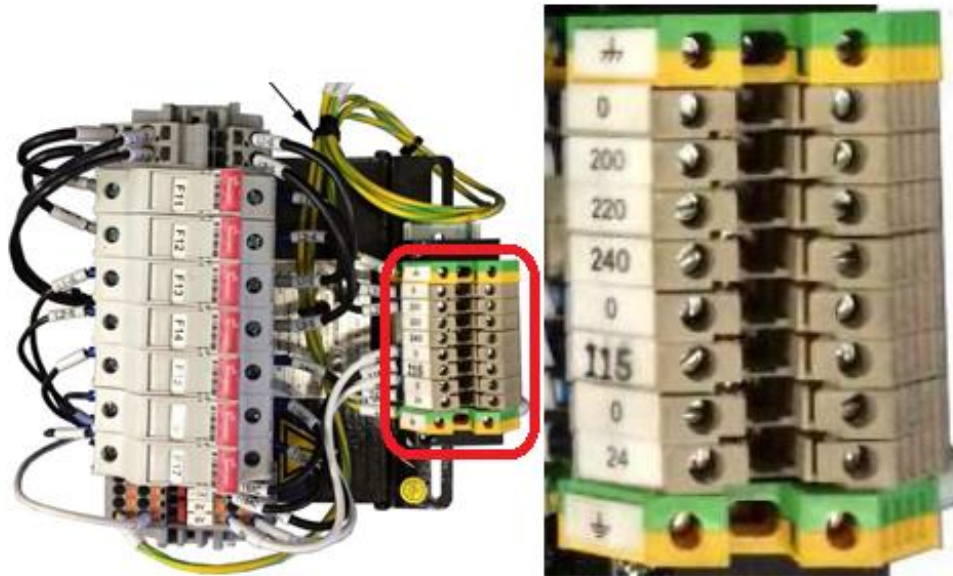


Figure 2.4.17a – Transformer used on 220 volt machines

Figure 2.4.17b shows the terminal blocks for a 440 volt machine where you can switch the wiring. For example, the machine is most likely shipped from the factory with the wire in the 440 volt terminal. This wire needs to be moved to the 400 or 480 terminal if the input voltage to the machine measures this amount. The 380 volt terminal will most likely not be used on USA machines.

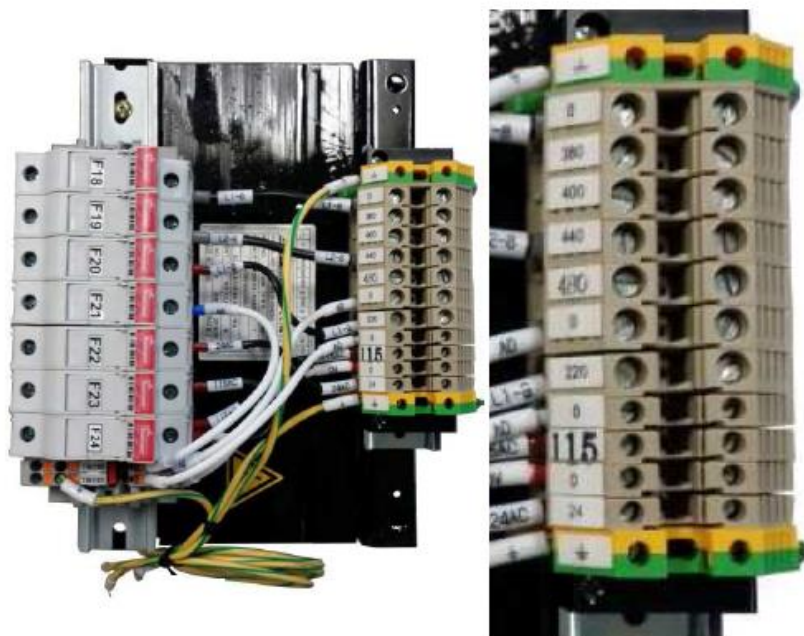


Figure 2.4.17b – Transformer used on 440 volt machines

Please see drawing 27648-2 at the rear of the manual for more information.

2.4.17 Single Phase Power Option

The TRAK 2^{OP} mill has an optional single phase option for 220 volts. It needs to be noted that running the machine on single phase power reduces the spindle power by about 40% as compared to 3 phase 220 volt power. In other words, the spindle will not produce 3 HP. A different style electric cord plug is used with single phase power. As part of the single phase kit, we will provide an adaptor cable that allows the user to plug the machine into a 3 phase 220 volt power connector. Please note that the machine will still only run on single phase power with this adaptor. In order to convert the machine back to 3 phase power, a number of changes need to be done to the machine. See section 3.5 for an illustration of what that plug looks like.

3.0 Installation

3.1 Lifting the 2 OP Mill

The 2 OP mill must be lifted and/or moved from the pallet with a forklift with a minimum capacity of 5,000 lbs. Make sure the forks extend all the way through the machine if lifted from the front, side or rear.



Figure 3.1a



Figure 3.1b



Figure 3.1c

Important
Before lowering the machine make certain that the 4 leveling feet have been re-attached to the machine. Remove the shipping plates and add the leveling feet. Thread in the leveling feet until the machine sits about 5 1/2" above the ground.



Figure 3.1d

3.2 Uncrating the 2 OP

1. Remove the loose articles from the pallet and check them against the loose Inventory Checklist (Section 3.3).
2. Unfasten the head support bracket as shown in figure 3.2.
3. Remove the brackets that hold the bridge casting (X axis) to the column. Remove side covers to gain access. Brackets are held on with (4) M8 screws. See figure 3.2a
4. Unstrap the ATC cylinder so it is free to move.
5. Undo the mechanism used to hold the ATC door in place during shipment.

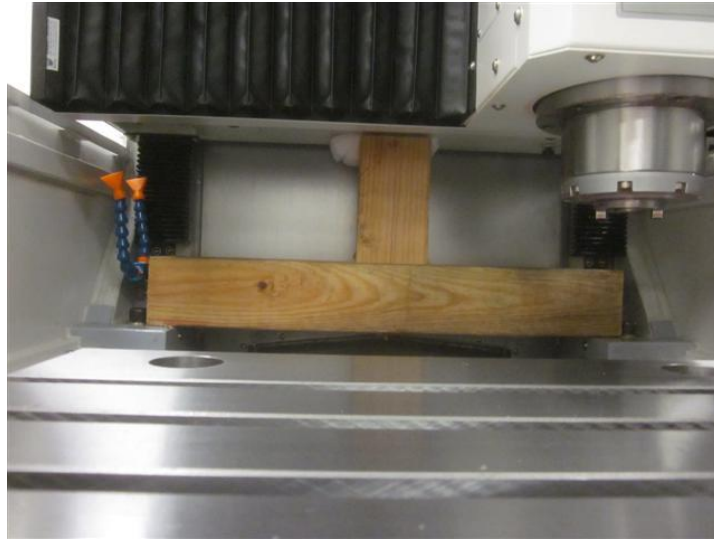


Figure 3.2



Figure 3.2a

3.3 Shortages: Inventory Checklist

The following items will come with the 2 OP mill. Please note if 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

Pallet Jack – see figure 3.1b above.

Box #1

- (1) Set of touch-up paint (1 can RAL 7035, 1 can RAL 7040 & 1 can of hardener)
- (4) leveling feet

Bracket fastened to machine and need removal

Head shipping bracket

2 side brackets shown in figure 3.2a

Hardware Kit Box – P/N 27651

- 1. 27182 – CD containing 2 OP Programming and Service Manuals
- 2. 28171 – 2 OP Programming and Operating Manual

Potential Optional Items

- 1. Fixture Plate

2. Vise Fixture Plate Kit – includes aluminum fixture plate, fence and vise stop assembly
3. Vise Stop Assembly
4. Retention Knobs – a kit of 8 knobs
5. Primary Liner Kit – comes with 8 liners
6. Secondary Liner Kit – comes with 8 liners
7. Ball Lock Clamping Kit – comes with 4 clamping shanks
8. 6" Kurt Vise
9. USB Memory
10. BT30 Tooling Kit
11. Tooling Cart
12. Indexer Ready Kit – used in conjunction with a Hardinge indexer purchased through them.

3.4 Installation Checklist

Installer – Use this checklist to assure a complete setup on the 2 OP mill.

| | |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> | 1. Shut off power to the machine and disconnect the quick disconnect power cord from the machine. |
| <input type="checkbox"/> | 2. Attach rear panel which contains our air regulator, pressure sensor and ATC solenoid and make all connections. See figure 3.6 below along with instructions for what needs to be done. |
| <input type="checkbox"/> | 3. Visually inspect the 220 volt cable (or 440 volt cable if 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 or 400 and 480 volts. Have the customer resolve any voltage discrepancies coming into the machine. Do not turn on machine if voltage is outside of ranges listed above. |
| <input type="checkbox"/> | 4. Move the wires on the transformer depending on the incoming voltage coming into the machine. Note - the transformer is different between a 220 and 440 volt machine. For 220 volt machines, the transformer has 3 taps labeled 200, 220 and 240. Place the wires into the tap that matches the incoming voltage. For 440 volt machines, the transformer has 3 taps labeled 400, 440 and 480. Adjusting the input wires to the transformer will control the 115 volt output from the transformer (there is no adjustment on the secondary side of the transformer). In any case measure the output voltage from the transformer to confirm the reading is 115 volts +/- 5 volts. Note any discrepancies that you see. |
| <input type="checkbox"/> | 5. Clean the machine if needed and remove any remaining protective grease or oil. |
| <input type="checkbox"/> | 6. Remove the head support bracket, parts used to hold the ATC in place and 2 side brackets that hold bridge to column. Remove side covers to gain access. Reinstall brackets shipped loosely with machine where the shipping bracket was fastened. WARNING! Refer to section 3.2 before proceeding. Install the door handle on front door. |
| <input type="checkbox"/> | 7. Re-attach the Z cable carrier if it has been disconnected for shipping purposes. |
| <input type="checkbox"/> | 8. Remove the tape that is holding a plug in the network port. The networking plug is found on the upper sheet metal on the right side of the machine. |
| <input type="checkbox"/> | 9. Turn on the power to the machine. |
| <input type="checkbox"/> | 10. Press the servo on button to make sure the axis motors are activated. The screen should change from saying SERVO OFF to SERVO ON. The lube pump should also cycle 1 time when the SERVO ON button is pressed. You can use service code 300 to manually lubricate the machine. |
| <input type="checkbox"/> | 11. Check that the air pressure on the air regulator is set to 90 psi |

| | |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> | 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? |
| <input type="checkbox"/> | 13. Adjust leveling feet as necessary to insure good spindle tram. We recommend the tram be checked each time the machine moves around the shop. Make sure the leveling feet are threading into the spacer blocks so the machine sits about 5 1/2" off the ground. |
| <input type="checkbox"/> | 14. In DRO mode, turn the spindle on and then turn the coolant pump on by pressing the coolant AUX button. |
| <input type="checkbox"/> | 15. Go to DRO mode and move each axis in a positive direction. Select the X axis, does the spindle head move to the right 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 0.020" mode is in fact 0.020". |
| <input type="checkbox"/> | 16. Double check the motor index angle for each axis using service code 505. If this needs to be modified, then the ATC tool change locations and ball lock location may need to be reset in services codes 520 and 500 respectively. |
| <input type="checkbox"/> | 17. Final test each axis by jogging (turning EHW) at 0.020" speed into the soft limits. Verify the machine does not hit the hard stop on the machine. Re-adjust limit switch cam if it does. Service Code 500 and 520 may need to be performed if major adjustments have been made to the X and Y axis limit/home locations. Within service code 505 you can manual adjust the soft limit values in the table provided. |
| <input type="checkbox"/> | 18. Check to make sure that the E-Stop button is functioning correctly. Turn spindle on and jog an axis using the EHW. Press the E-stop button during this operation and verify the spindle and axis stops. 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. |
| <input type="checkbox"/> | 19. Is the spindle motor fan running? Air should be blowing down over the spindle motor. |
| <input type="checkbox"/> | 20. 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. |
| <input type="checkbox"/> | 21. Verify the door opens and closes with a minimal amount of force and moves smoothly. We set the air regulator for the door to be between 70 and 75 psi (verify) which equates to roughly 8 to 10 lbs of force to lift the door. Make sure the door fully closes under its own weight. Make sure hardware that holds door rollers is tight. |
| <input type="checkbox"/> | 22. 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 27563-1. Put a tool in the spindle and verify the tool clamps once the green button is released. |
| <input type="checkbox"/> | 23. Go to SETUP mode and press LOAD TOOLS. Follow the message and press GO. The ATC should come forward. Remember the door must be shut. Hit RETURN once it comes out and it should prompt you to press GO again to move it back. |
| <input type="checkbox"/> | 24. Physically load a tool in and out of the ATC to make sure the orientation angle and tool change height are correct. This can be done by pressing the TOOL IN ATC or TOOL OUT ATC buttons. Check all 8 stations to make sure tools load properly. If there is a problem with the X or Y location, adjust tool locations with service code 520. The Z tool change height can also be adjusted with code 520. |
| <input type="checkbox"/> | 25. Verify the ATC sensors that tell the control if the ATC is in or out are properly tightened. Remove the rear cover on the machine to check them. |

| | |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> | 26. Turn off air to the machine and verify the control recognizes low air pressure. There should be a warning message on the screen that says low air pressure. |
| <input type="checkbox"/> | 27. Run spindle in DRO at low speeds. |
| <input type="checkbox"/> | 28. Spindle head test Run spindle at 1000 RPM for 5 minutes Run spindle at 6000 RPM for 5 minutes. Make sure the spindle brakes properly from 6000 RPM. It should stop in 6 seconds or less. 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. |
| <input type="checkbox"/> | 29. Write a simple program with multiple tools called out and run program to make sure everything runs properly, including changing tools in the ATC. Try to use actual tools when running this program. |
| <input type="checkbox"/> | 30. Double check the position of lower left hand corner ball lock location. Modify service 500 as necessary. |
| <input type="checkbox"/> | 31. Make sure coolant wash down lines are adjusted properly. See section 5.10 for a picture of how they should be adjusted. One line should be directed toward the rear door and one toward the rear of the table to wash chips away so they do not interfere with the ATC. |
| <input type="checkbox"/> | 32. Make sure fine chip filter is installed on top of coolant tank. |

3.5 Electrical Connections

The 2 OP mill comes with a 220 or 440 volt power cord/plug so the machine can be easily moved around the shop. The female connector that needs to be provided by the end user should match the connector that we provide. Attached is a picture of the plugs we provide. From left to right they are as follows: 220 volt 3 phase 30 amp plug, 440 volt 3 phase 20 amp plug and single phase 220 volt 30 amp plug.



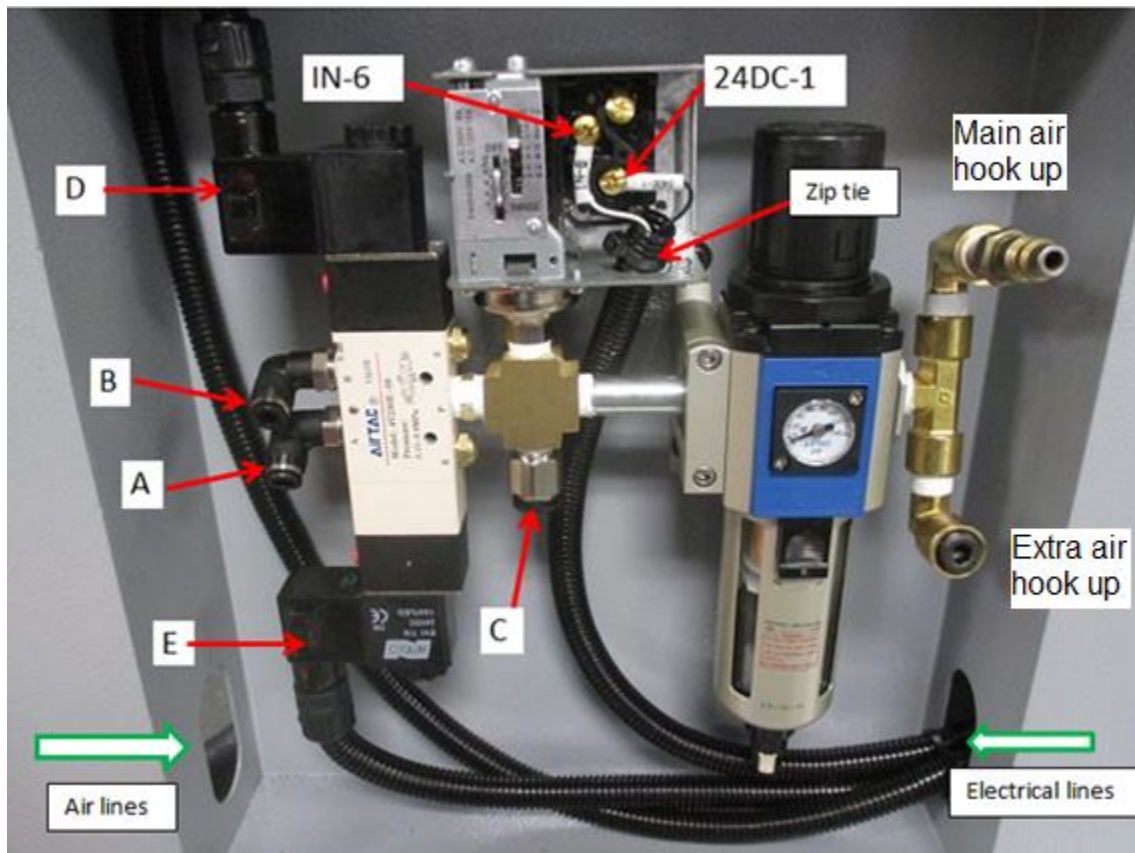
Figure 3.5

The user must provide a power circuit that provides 3 phase 220 voltage 20 amp capacity (208 – 240 V acceptable) or 3 phase 440 voltage 10 amp capacity (400 to 480 V acceptable).

3.6 Connections

3.6.1 Air Regulator/Air Pressure Switch/Solenoid Assembly Mounting

This assembly ships separately from the machine and hence needs to be mounted and hooked back up. Follow the procedure below.



See figure 3.6

1. Run electrical connection thru right hand opening and pneumatic lines thru left hand opening
2. Install 1 orange 6 mm air line labeled A into the solenoid labeled A. Install 1 blue 6 mm air line labeled B into the solenoid labeled B.
3. Install black 10mm air line into port C
4. Install wire and shielding into pressure switch and use a zip tie to prevent shielding from slipping
5. Install connections on solenoid D & E

3.6.2 Air Connection

Connect the air supply to the quick disconnect coupling to the left of the pressure regulator. The air supply line should have a minimum of 3/8" inside diameter. It is recommended that a water separator or air dryer be installed upstream of the 2 OP air supply. See the pneumatic drawing 27563-1 for where the air is connected to the machine and all other pneumatic information.

3.6.3 Air Regulators and Solenoids

The 2 OP consists of a main air regulator, air pressure switch, door pressure regulator, spindle air regulator, multiple air flow valves, 2 solenoid valves, check valve and an exhaust valve. 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. The regulator is adjusted by pulling the cap upward and rotating the cap clockwise to increase the air pressure and CCW to decrease the air pressure. The air regulator/filter will filter out debris and some water or oil. Once the regulator is filled with up to a point with water or oil, it will automatically drain this water or oil out through the black cap found at the bottom of the assembly.

3.7 Cleaning the 2 OP

Warning!

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

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, head left and right, up and down when cleaning.
3. When cleaning the front window, use a suitable cleaner that DOES NOT contain ammonia or solvents that could damage that polycarbonate windows.

3.8 Leveling Procedure

Leveling the 2 OP mill in the field consists of adjusting the leveling feet to make sure the tram of the spindle is perpendicular to the table. There is no need to level the table surface with respect to the floor.

Modifying 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 .001 TIR, adjust the leveling feet according to the error you see. It is common to need to adjust the front left or right corner to adjust the tram along the X axis.
3. Once complete, lock all leveling screws in place with the lock nuts. Make sure all 4 leveling feet are touching the floor.

3.9 Lubrication

3.9.1 Way Lubrication

The auto lube system provides centralized automatic lubrication for the linear guides and ballscrews. The lube pump's 1-liter reservoir is serviced with Mobil Vactra Oil No. 1 or equivalent. The lube pump cycles automatically 1 time upon initial startup after pressing the SERVO ON button of the control and then 1 cycle for every 30 minutes of axis movement time. Each cycle of the lube pump lasts for 4 seconds or so and provides oil to the linear guides and ballscrews.

Discharge Pressure - Approximately 140 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.

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 linear guides and ballscrews.

To manually activate the lube pump, use service code 300. Repeat this process 2 or 3 times.

Logic for Lube Pump Operation

1. The pump has signals for low fluid level and low operating pressure. These signals are combined together as a single input that will be held high when fluid level and pressure are normal. If the pressure does not get up to the desired level when the pump is commanded on for longer than 2 seconds, then this will trigger a warning. If the level is low when the pump is not commanded on, then this will trigger a warning.
2. While the low level warning is active, we will display a flashing orange safety message "LUBE LEVEL LOW". This message will be cleared when the warning is no longer active.
3. If the low pressure warning happens, it will be latched until the pump cycles and pressure is normal. The flashing orange safety message "LUBE PRESS LOW" will be displayed while the warning is latched. The warning will be cleared when the pump is cycled (either through the normal operation or through the manual cycle from service code 300).
4. When the warning goes active, we allow the machine to run until the next lube cycle and at that time latch an internal signal that the lube cycle failed.
5. When the next lube cycle happens and the problem has not been resolved, then we do not allow the user to run a program. The following error messages will appear depending on which one is active. If both are active, we display the LEVEL LOW message:
 - a. ERROR 5265 - LUBE LEVEL LOW – The lube pump level is low. You will not be able to run until the lube level is resolved. Check the fluid level and refill.
 - b. ERROR 5266 - LUBE PRESSURE LOW – The lube pressure is low. You will not be able to run until this condition is resolved. Check the lube pressure, and use Service Code 300 to manually discharge the pump and clear this fault condition.

See lubrication system drawing 27591-1 for an overview of the system.

3.9.2 Other Lubrication Points

1. Tool Change Air Cylinder Oil Cup supplies oil to the "Air Over Oil" cylinder and should not require replenishment. If it does, there is likely a leak in the system. However, if required, fill the oil cup on the front of this cylinder with an ISO32 oil or equivalent.
2. Grease fittings on ATC
Apply a good grade of general-purpose lithium based grease (#1.5 or 2) like Shell Gadus S5 V460 1.5 or equivalent through the grease fittings found at the rear of the machine that supply grease to the ATC linear guide blocks. The manufacturer of the linear guide blocks

recommends 1 cm³ of grease every 100 kilometers of travel. This equates to ~ 100000 tool changes. The frequency of adding grease should be based on how many tools changes you make per day. See figure 3.9.

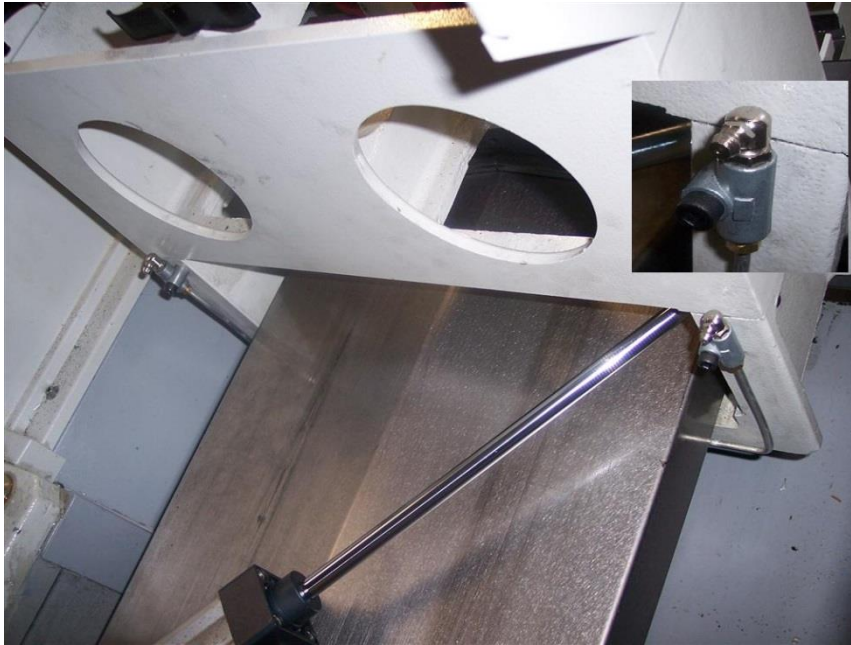


Figure 3.9

3.10 Moving the 2 OP Mill Around the Shop

The 2 OP mill was designed so it can be easily moved around the shop with the pallet jack that comes with the machine. Please follow the instructions below when moving the machine.

- I Machine relocation must be done by employees who are qualified and properly trained.
- II When moving machine using the SWI supplied pallet jack, following conditions must be satisfied:
 1. The floor must be structurally rated to support and transport this machine (total machine weight without any accessories is approximately 2500 lbs).
 2. The floor must be relatively flat and with a maximum slope not to exceed ¼ inch /foot anywhere along the transportation path.
 3. Any steps, gaps or cracks in the floor that the pallet jack must go over, must be less than ½ inch high, wide, or deep.
 4. The minimum door opening for machine to go through is 32 x 94 inches.
 5. For best results, clear a 4' wide path for transportation prior to actually moving the machine.

TO MOVE THE MACHINE, PLEASE FOLLOW THE STEPS BELOW:

1. To prepare machine for relocation, move the X-axis to the approximate center, move the Y-axis all the way toward the door (front) until the (soft) limit is reached, move the Z-axis down until (soft) limit switch is reached.
2. Power down, and disconnect the machine's electrical power cord, and any other accessory cables connected to the machine.
3. Disconnect the machine's compressed air supply hose, and any other accessory hoses or attachments connected to the machine.
4. Close front door and check to make sure that nothing else is attached to the machine.
5. Check to make sure that the floor is free of any objects which may obstruct the movement of the pallet jack wheels or the machine along its transportation path.
6. Make sure that the door openings along the transportation path are adequate for the machine to go through.
7. For Front or Rear pickup; roll the pallet jack under the machine (roughly centered), as far as possible. Make sure that the pallet jack rails will positively support the front and rear structural cross-members of the base casting. From the Right or left side pickup, roll the pallet jack all the way as far as possible, where indicated on the side of the machine, to properly balance the machine load.
8. Lift the machine about 1/2-3/4 inches off the floor. **Note: never push or pull machine using the door handle.** While pulling, pushing and steering, monitor the movement of the machine to make sure that it does not run into or catch on anything during transportation. Carefully move the machine to the new location.
9. Once at the new location, **Slowly and Carefully** lower the machine down to the floor, and stow away the pallet jack.
10. Connect the electrical power cord, compressed air hose, and any other accessories disconnected before the move.
11. Power up the machine and check machine's tram, if necessary, adjust the machine leveling feet to achieve the desired tram result. All four legs must touch the floor.

3.11 Cutting the Euclid Test Block

The test part may be machined at the completion of the installation. (see figure 3.11)

Material Specification: Aluminum, 6061-T6 or T4

Blank Size: (minimum dimensions) 3 x 3 x 1"

Tool: 1/2" 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 into the ProtoTRAK TMX C drive, it is part number 99999998.PT4.
4. 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.
5. Go to the tool table and set the Z offset height for your tool.
6. Load this tool into the spindle.
7. Press the AUX button to turn the coolant on if you are going to use flood coolant.
8. Begin to run the program by pressing RUN, START and GO. The part will be machined in the following sequence:

| Description | Depth of Cut |
|------------------------------------------------------------------------------|--------------|
| circle pocket – cuts middle circle | -0.250" |
| circle frame – cuts outer 1.830 diameter circle | -0.250" |
| circle frame – cuts material from corners remaining on Euclid block | -0.250" |
| roughs material in upper right-hand corner | -0.500" |
| cuts triangle on Euclid block | -0.500" |
| rectangular frame – cuts outer 2.750" rectangle position to 1.318 on X and Y | -0.750" |
| | +10.000" |

9. After the program run, the program will locate to the following position.

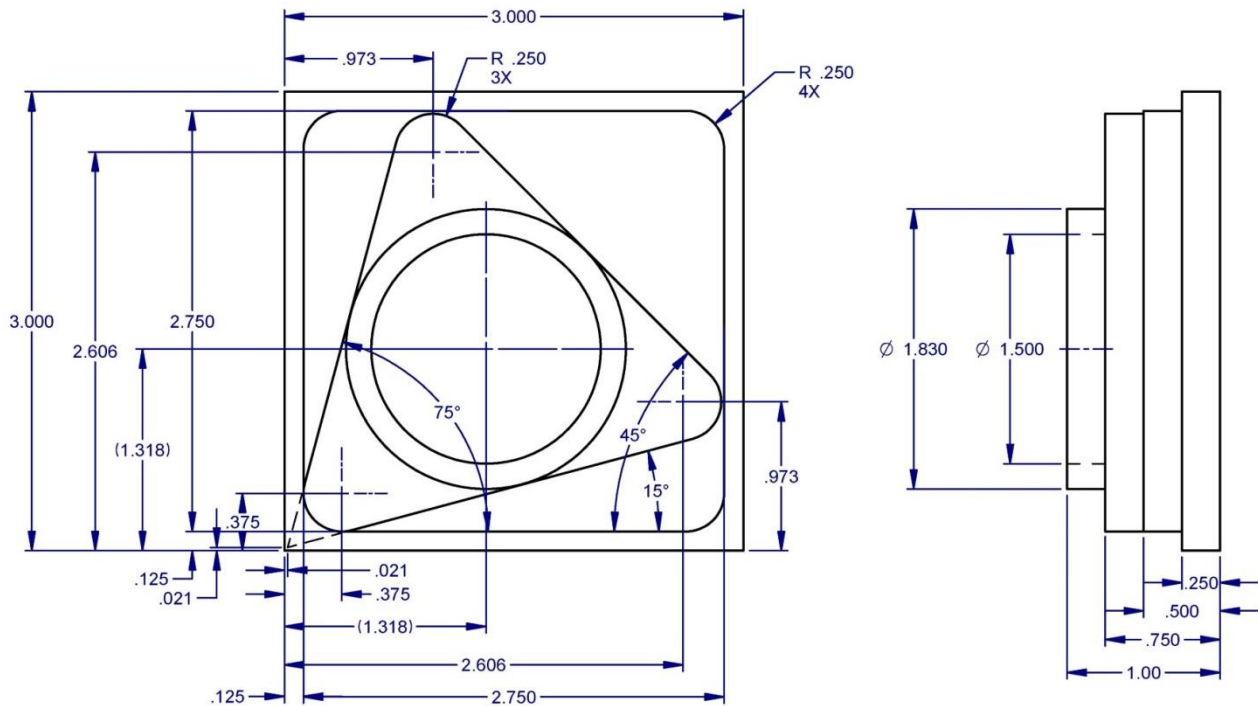
X = 1.318

Y = 1.318

10. Mount a dial indicator in the quill and check the circles.

11. Check the runout of the sides of the square frame.

12. Inspect the machined surfaces for smoothness.



115537-1

Figure 3.11

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

| 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. |
| 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 3.9 |
| 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 | Visually check the condition of all the Linear Guide surfaces. For machines that may have excessively |

| | |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| vibration, or are excessively worn | 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. |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|

4.1.2 Circles Out of Round

Circles are not round within 0.002" 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

| Possible Cause | Check This |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Machine geometry | The geometry may be suspect if you find the circle is round if you move the X and/or Y axis to find the true center of the circle. The tram and/or XZ or YZ perpendicularity may be suspect. Adjust leveling feet if tram is found out of specification. A granite square would be needed to check XZ or YZ perpendicularity. |
| Backlash values set too high or low | Check code 128. Typically values for backlash should be less than 0.002". Reset values as necessary. |
| 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 |
| Torque values on X and Y-axis are too high. | Make sure torque is lower than 12 in-lbs. Normal values for a machine that is aligned and adjusted properly should be between 5 and 10 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:** 0.002" TIR over a 1.830" DIA (assumes cutting euclid block)
- **Positional Accuracy:** 0.0005"
- **Repeatability:** 0.0005"

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. |
| Configuration file that contains calibration file that has been erased or corrupted. | Recalibrate the system. |
| Backlash problem | Unusual high backlash values are causing slight variations in your part dimensions. Values for backlash should be less than 0.002". |

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 131** turn the X or Y axis ballscrew manually to make sure the motor encoder counts. Each axis should count 6mm (0.236") per revolution of motor. When using Code 131, first press the E stop, then go into this service code. It works only for X and Y axis.

| Possible Cause | Check This |
|-----------------------|---------------------------------------------------------------|
| Poor cable connection | Check the cable connections at the computer module and servos |
| 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 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 | Check the setting of service code 503. See service code diagnostics section 5.11 |

| | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| running that rapid speed | |
| 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. Exceeding blocks per second rate for control. | Use lower feedrates when programming or change the tool path so the change in direction is not as abrupt. For blocks per second problems, increase the move size or lower the feedrate. |
| 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 3.9 |
| 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
- Check the LED lights on the computer module as you turn the EHW. See section 5.3 for more information.

| 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. |
| 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 | Remove programming panel and check cable |

| | |
|---------------------------|---------------------------------------------------------------------------------------|
| | connections |
| Servo Motor/Drive failure | Especially, if only one axis will not jog; See motor/servo diagnostics section 5.5 |
| Computer module failed | See Computer module diagnostics Section 5.3 |

4.2.4 Vibration at Rest

While axis is holding position there is vibration or noise coming from the X, Y or Z-axis. The axis motor may be searching or jumping back and forth.

Do the following Service Codes and procedures:

- **Code 127** Measure's the backlash in the system.
- **Code 128** Enter backlash compensation
- Turn the EHW on the axis in question and see if the noise goes away.

| Possible Cause | Check This |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Too much backlash entered in Code 128 | Recheck the machines backlash. Values should be less than 0.002". |
| 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 |
| 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 |

4.3 Control Related Problems

4.3.1 Blank Screen – Black or Blue

The display is a 5" 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 black 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 |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 Panel Assy. See drawing 27604. |
| 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. |
| 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 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 12VDC green LED (D26) on the Overlay Interface Board is on. |
| Computer Module failure. | See Computer Module diagnostics, Section 5.3 |
| LCD Controller Board failure. | See Program Panel diagnostics, Section 5.4 |
| Overlay Interface Board failure. | |

The display shows a blue screen with a no signal on the screen.

| Possible Cause | Check This |
|--------------------------------------|----------------------------------------------------------------|
| VGA cable is not connected correctly | Verify connection at computer module and at programming panel. |
| Computer module failure | See computer module diagnostics, section 5.3 |
| LCD controller board failure | See programming panel 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 Program Panel 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)**

To check if the Programming 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 |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Software is in some indeterminate state. | Press the E stop, then servo on button and see if overlay not responds. |
| Overlay cables are loose or not seated | Check the 3 overlay cables to make sure they are seated properly to the overlay interface board. |
| 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. |
| Computer Module failure | See Computer Module diagnostics, Section 5.3 |
| Overlay Interface Board failure. | See Program Panel diagnostics, Section 5.4 |
| Programming Panel Failure | See Programming 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.

Do the following Service Codes and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.

For a constant fault, follow the list below.

For intermittent faults, we are going to need what fault message is on the drive when it faults. Under certain circumstances, this can be viewed on display on the servo driver in question. If the error message resets itself, then we will need to view a parameter on the servo drive itself. See section 5.5 for more information on how to do this.

| Possible Cause | Check This |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Connection problem with Motor Encoder cable. | Verify that the Motor Encoder cable is connected properly to the computer module |
| Connection problem with Motor Power cable. | Verify that the Motor Power cable is connected properly to the computer module |
| 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 |
| Motor/Servo Drive failure | See Axis Motors/Servos Section 5.5 |
| Computer Module failure | See Computer diagnostics, Section 5.3. To rule out the computer module, swap the cables that run to the servo at the computer module between a good axis to a bad axis. If the problem stays with the physical axis that faulted, then the computer module is most likely NOT the problem. |

4.3.5 Problems Reading or Saving to the USB Drives

The USB port is USB 2.0 version. Only USB Drives formatted with FAT16 or higher should be used.

| Possible Cause | Check This |
|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Make sure folder which programs are saved on the USB device is named properly. | The folder on the USB device should be called 2 OP PROGRAMS. This folder can be created automatically if you save a program. |
| 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. |
| 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 programming panel |
| Computer Module failure | See Computer diagnostics, Section 5.3 |

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 |
|-------------------------------------------|----------------------------------------------------------------------------|
| 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. |
| 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 computer module or transformer fuses are blown. | Remove fuse and check continuity |
| 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 Coolant Pump Not Working

The coolant pump is controlled by the AUX button in run mode. When pressed it will show the status of the auxiliary function in the status line. To test, you can go to DRO and press the AUX button to turn the pump on.

| Possible Cause | Check This |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The output from the computer module is not working | Check the F1 fuse coming out of the computer module. There is an LED that tells you if it is OK. Turn the coolant pump on and check for 115 VAC coming out of the computer module. If no voltage, then replace computer module |
| Pump has failed | Check voltage at pump and replace as required. |

4.3.10 E-Stop Error

The E-stop stops the spindle and axis motors when pressed.

| Possible Cause | Check This |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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. Verify the E stop input LED turns on at the computer module. |
| E-stop button failure | Check continuity with ohm meter across E stop terminals. It should be zero ohms when the E stop is in the out position. |
| Computer module failure | Verify the LED on the E-stop turns on. |

4.3.11 Homing Error

The homing function is a very critical function that locates and identifies the absolute machine zero position. This function is to be performed every time the system has been turned on or reset. The homing function will cause each axis to move in the most positive direction that it can.

WARNING407: HOMING ERROR

Servo cannot home to machine zero.

Check machine and try again. If the problem persists, call for service

If a homing error occurs these are some of the possible causes.

| Possible Cause | Check This |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Door is open. | If the Door is open the homing routine will not run. |
| Home Switch failure. | The system will move the axis to the home 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. Check the 3 home switch input lights on the computer module when the switch is activated. |
| Motor encoder failure | See Motor diagnostics, Section 5.5. Check if software sees index angle on motor and reset once motors rotates 360 degrees. |
| Computer Module failure | See Computer diagnostics, Section 5.3. |

4.4 Tool Changer Problems

When the tool changer has a problem, generally you will get an error messages describing what the problem might be. See section 5.8 for the list of error messages and what might be the cause in addition to what is written below.

4.4.1 Automatic Tool Changer (ATC) will not move

When a tool change is commanded, the ATC will not advance towards the front of the machine.

| Possible Cause | Check This |
|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Is the door open | Make sure the door is closed and there is no door open message on the screen. |
| The computer module is not outputting the command to move the ATC | Check the ATC front LED output on the computer module. |
| Compressed air not being supplied to the machine. | Is air connected to the machine? 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 90 PSI. The tool carrier should still move if the air pressure is low. |
| Something is obstructing the movement of the ATC sliding assembly. | Switch off the air. Open the ATC cover and try to slide the tool carrier. 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. |
| ATC in/out pneumatic cylinder is faulty | Check for air escaping from the ATC in/out pneumatic cylinder. |
| The solenoid labeled 2 on drawing 27563 has failed | If the solenoid is receiving a signal from the computer module, then press the red button to fire the solenoid to see if it works when commanded manually. Make sure the table and head are in the proper place prior to doing this. |
| The ATC door assist cylinder flow controls are closed too much, or the cylinder is jammed so it cannot move | Check if the cylinder is free to move and pivot. Check if the flow controls on the door lift are set per recommended settings as described in section 5.9 of this manual. |

4.4.2 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.

Do the following Service Codes and procedures:

- **Code 510 – Spindle Setup, set spindle orientation**

| Possible Cause | Check This |
|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The coupling that couples the motor to the spindle has come loose | 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 | Check the cable connection at the spindle motor |

| | |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| encoder, AC drive or computer module. | and AC drive. Also check the cable that runs from the AC drive to the computer module |
| Spindle Encoder Failure | Verify that all the encoder signals are being sent to the AC drive by verifying the LEDs for Channel A, B and Z are turning ON and OFF when the spindle is rotating. |
| Spindle drive failure | Replace drive |
| Computer module failure | Replace computer module. See section 5.3 |

4.4.3 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 4.5.5 as well.

| 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 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 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 |
| Belleville washers are damaged, worn or fatigued. | With a BT30 tension gage, check the pull strength of the draw bar, it should be approximately 1000 lbs. |
| The pull fingers inside the spindle have become loose | Check the fingers are tightened to the torque value of 20 ft lbs. |
| The pull fingers inside the spindle have been damaged | Remove the pull fingers and visually inspect for damage and replace as necessary |

4.4.4 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 27563-1. 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 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. |
| There is a blockage | Check that there are no kinked lines. |
| The solenoid labeled 1 on drawing 27563-1 has failed or is not receiving an electrical signal. | If the solenoid is receiving a signal from the computer module, then press the red button to fire the solenoid to see if it works when commanded manually. Make sure the table and head are in the proper place prior to doing this. |

4.5 Control Input or Output Problems

4.5.1 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 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 60 psi. Check that the computer module sees the air pressure input. A green LED should be on. |
| Computer module failed | See computer module diagnostics, section 5.3 |

4.5.2 Status Light is not functioning correctly

The status light is used to identify the state of the program in RUN mode. The Green beacon light indicates that the program is running. A flashing green light once per second indicates the machine is waiting for the operator to start the next program. If the light is blinking 3 times per second, there is a fault on the machine.

Do the following Service Code:

- **Code 521 – Input/Output Service Code**

| Possible Cause | Check This |
|------------------------|------------------------------------------------------------------------------------------------------|
| Status light failed | If the computer module output LED for the status light is on then the light or bulb may have failed. |
| Computer module failed | See computer module diagnostic, Section 5.3 |

4.5.3 Lube pump not working

The lube pump plays a key role in assuring the performance and durability of the 2 OP. 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 60 minutes of axial movement. The control monitors the lube pump for oil level and pressure and will produce an error when either are a problem.

Do the following Service Codes and procedures:

- **Code 300** Manual turn on pump

| Possible Cause | Check This |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lube pump fuse has blown | Check the fuse on the lube pump and manually turn on pump with service code 300 |
| Cable or connection problem | Check cable connection at pump and computer module. |
| Computer module failed | See computer module diagnostic, section 5.3. You can remove the lube pump connector from the computer module and measure for 115 VAC when you turn pump on with service code 300. |

4.5.4 Z Axis Motor Brake is not working

The 2 OP 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 due to gravity. 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.

When there is no power to the brake, the brake will be on (engaged).

| Possible Cause | Check This |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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. See computer module diagnostics, section 5.3 |
| Motor brake has failed | Replace motor brake. A 24 volt signal should turn the brake off, which means the head is allowed to move. |

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

The 2 OP 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 1000 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 wiring to the switch and where it plugs into the computer module as an input. It is called unclamp BT. |
| Air solenoid that supplies air to the tool change air cylinder is not working | Check the solenoid in question. Check pneumatic diagnostics, section 5.9. See drawing 27563. |
| Computer module failure | 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 0.0005" 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.

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 | 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 may be loose | Use a Dial Indicator and check for side-to-side movement between the Spindle 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 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 your 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 |
| Thermal expansion of the ballscrew | If the machine is run very hard at high feedrates then this may come into play. |
| Calibration has not been performed or is wrong | Go to service code 123 and recalibrate the machine |
| 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 131** turn the X or Y axis ballscrew manually to make sure the motor encoder counts. Each axis should count 6mm (0.236") per revolution of motor. When using Code 131, first press the E stop, then go into this service code. It works only for X and Y axis.

| 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 5.5 |
| 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. The wires are labeled as well as the terminals on the actual EHW device. |

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.

| Possible Cause | Check This |
|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The way covers are not properly aligned on the Y or Z axis | 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. |
| 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 of the drive train. | 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 |
| Z axis brake malfunctioning | The Z axis brake may be rattling or it is turned on when it should not be. |

4.7.2 Spindle Stalls or Turns-Off During Machining

During machining, the spindle turns off and loses power.

| 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 |
| Cut more than the machine is capable | Check width and depth of cut |
| 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. This machine can be wired for 220 or 440 volts. Make sure the voltage matches the AC spindle drive.

DANGER!
Take extreme caution when working with high voltage. There is possibility of death by electrocution!

| 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 6.9 for a wiring diagram for the spindle motor. |
| Spindle Drive may be in "Local Mode" and cannot 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. |

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 effect on direction.

DANGER!
Take extreme caution when working with high voltage. There is possibility of death by electrocution!

| 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. |
| Wiring to AC drive incorrect. | Verify that the wiring to the AC Drive is correct and that the correct command is given. See section 5.6 |

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 |

| | |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <p>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 than 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.</p> |
| Spindle bearings are worn out | <p>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 6.10.</p> |

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 4 feet See Leveling procedures | Parts incorrect Machine geometry off, i.e. tram. | New installation, after moving machine or heavy crash. |
| Head out of tram | Leaves uneven surfaces on bottom of pockets. Circles are not round when circularity is checked. | Machine not level or after a heavy crash. |
| Water in your air lines | Faulty solenoid valves Rust Problems with the pneumatics on the tool carrier 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 tool unclamp 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 2 OP 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. The ProtoTRAK will automatically lubricate the machine when it is turned on. At the beginning of the day, if the machine has been left on overnight, it is recommended to go to service code 300 to lubricate the guides and ballscrews.

Lack of lubrication using recommended type of lubricant 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 2 OP 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.

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.

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 Protecting the Axis from a Crash

The machine has a few means to help prevent crashes. The first line of defense is a soft limit that is built into the software. The values are set from the factory and can be found in service code 505. In addition to the software limits, each axis has rubber bumpers on either end to prevent a hard crash into a hard stop.

5.2.3 Z Axis Mechanical Brake

The Z axis contains an electro-mechanical safety brake that automatically engages when the electrical power is removed from the machine, or when the E-stop is pressed. This brake is required to support the head and keep it from falling when the servomotor is turned off or disabled. When 24 volts is applied to the brake, the brake disengages from the ballscrew, allowing the motor to move the Z axis up and down. When power is removed from the brake, the brake engages and stops the ballscrew from rotation.

5.2.4 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 2 OP with the way covers removed (except when service requires it). NEVER ALLOW ANY OBJECT TO FALL ONTO THE LINEAR GUIDEWAYS!

5.2.5 Lubrication

The automatic lubricating system is dedicated exclusively to the ballscrew and the linear guideways on this machine. The amount of oil and how often oil is applied is controlled by service code 300. See section 5.11.4.7 for more information. Also see drawing 27591-1. The ATC linear guide blocks that the ATC moves on, needs to be manually lubricated with grease. There is 1 grease fitting for each of the 2 guide blocks. The lubrication pump reservoir oil level must be checked daily and maintained in the indicated Min/Max range. If the lube pump level gets too low or the pressure is low, the control will create a flashing warning message on the screen. If the lubrication problem is not addressed, the machine will eventually create a critical error message and not allow the machine to run until the problem is resolved. The software will allow the current program to finish before creating a critical error.

5.2.6 Way Covers

The Z ballscrew cover is 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. The X axis and linear guides on the Z axis are protected with accordion style covers. The Y axis linear guideways are mostly unprotected, but are mounted upside-down underneath the Y-axis casting, therefore are not directly exposed to the normal hazards of the milling environment.

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 modules 2 fuses are located just below the power input connection.

The F2 fuse is a 4 amp slow blow that is used to protect the power supply in the computer. The F1 fuse is a 5 amp slow blow that is used to protect the coolant pump and lube pump. When the light is on the fuse is good.

These fuses will need to be checked with an ohmmeter.

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 APPS Board.
2. The APPS Board, contains the circuitry that provides the interface for the Apps board to control each axis and all the Digital I/O functions.
3. The IDE Flash, which contains the operating system and our software and is plugged into the motherboard.
4. The Power Supply, that provides 5, 12, -12 and 24 volts for all the boards inside the computer module.
5. Fan – the fan is used to cool the inside components.

The computer module contains a number of LED's that can be used for troubleshooting. The following summarizes the LED's and how they work. See figure 5.3b.

1. Input LED's – these LED's are turned on when an input is triggered. A small green LED light will come on next to each of the inputs. The inputs are E-stop, Door, X home, Y home, Z home, air pressure, tool clamp, tool unclamp, ATC front, ATC back, Unclamp button, Servo On, mill indexer and lube pump (may be called SPARE 2 on certain modules). There are also spares.
2. Output LED's – these LED's come on when the computer commands an output. The light is on for as long as the output is sent. The outputs are Z axis brake, NC ready, ATC front, ATC back, Tool Unclamp, status light, door lock and mill indexer. There are also 4 spares. The door lock feature is not part of USA sold machines. NC ready LED is on when servos are on. This controls the K1 relay which powers the servo drives.
3. LED's above the overlay power connector are used to monitor the pressing of the following 5 overlay buttons: AUX (D32), STOP key (D28), GO key (D29), ON key (D31), OFF key (D30). There is also one spare LED not used. See figure 5.3d for pin assignments. Please note, early computer modules may call the AUX the START key.
4. 24 VDC Connector – not used on USA machines. Can be used to power the Z axis brake when troubleshooting the Z axis. Plugging the brake into this port will cause the brake to be on. **NOTE** – this will cause the head to fall so be prepared to press E stop after head falls a few inches so the brake will stop the head from falling. This output is controlled by the E-stop. If the E-stop is out there will be 24VDC at this connector.
5. LED's to the right of the 24 VDC connector of which there are 33 + 12. See figure 5.3b. Most of the LEDs are used to monitor the signals for the axis motors. Each axis and the spindle have 6 LEDs. The A+,A-,B+, and B- are used for encoder counts, as the motor rotates one direction a particular sequence of LEDs are turned ON and OFF. Here is a summary of all LED's
 - a) XZ- X axis – the Z- refers to a LED light that should be on most of the time except when the index mark on the encoder is triggered. YZ-, SPZ- (spindle), ZZ- are all the same signal but for a different axis. The motor must be rotated slowly to see these lights update. HWZ- (handwheel) is not used.
 - b) XZ+ X axis – Z + LED comes on for a brief second once the index is seen by the computer module. YZ+, SPZ+ (spindle), ZZ+ are all the same signal but for a different axis. HWZ+ (handwheel) is not used.
 - c) XA- X axis, reads A- channel of encoder. Flickers on and off as motor rotates. YA-, SPA- (spindle), ZA-, HWA- (handwheel) are all the same signal but for a different axis.

- d) XA+ X axis, reads A+ channel of encoder. Flickers on and off as motor rotates. YA+, SPA+ (spindle), ZA+, HWA+ (handwheel) are all the same signal but for a different axis.
- e) XB- X axis, reads B- channel of encoder. Flickers on and off as motor rotates. YB-, SPB- (spindle), ZB-, HWB- (handwheel) are all the same signal but for a different axis.
- f) XB+ X axis, reads B+ channel of encoder. Flickers on and off as motor rotates. YB+, SPB+ (spindle), ZB+, HWB+ (handwheel) are all the same signal but for a different axis.
- g) WDT WDT stands for watchdog timer. This light should be off when the computer is behaving normally and the software is running. When this light goes on, our software is not communicating to the hardware or the Operating System is locked up.
- h) 5 VDC This LED is on all the time. If this is not on the VGA signal is most likely not working and the LCD screen will be black. If this is the case, unplug all cables but the power cable to the computer and see if it comes on. If it does, there may be a short somewhere. If it does not, the computer module is bad. Make sure F2 fuse is OK as well. This controls the 5 volts.
- i) TP1 this is a test port for internal use only
- j) OEN 1 and 2 – output enable. The software enables this if the Watchdog is OK and the E stop is out.
- k) PRG blinks if FPGA is programmed. If solid, computer module has a problem and needs replacing.
- l) EN X, Y and Z These LEDs are on once the servos are enabled. Pressing the Servo On button should turn these LEDs on. These LEDs come on a second or so after the OEN LEDs come on. The E stop must be out for both sets of lights to come on.
- m) The LEDs labeled SHZ- through SHA- are not used at this time.

On the side of the computer module, there are 15 cable connections. The spare port is used internally and not applicable to users. The following is a summary of the connections.

1. AC Input – this is the 115VAC input required to run the computer module.
2. Green connectors – there are 2 green connectors that control 2 more outputs. Coolant and lube are outputs to turn the coolant and lube pump on respectively. These outputs are 115 volts.
3. X, Y and Z axis port – these connectors are the feedback from the axis motor encoders.
4. Handwheel port – this is the connection that feeds the electronic handwheel signals back to the computer. See below for more details.
5. Spindle Port – this is the connector that sends and receives the signals from the spindle drive. See below for more details.
6. VGA port – this sends the signal for the LCD.
7. COM port – this is a serial port used to communicate to the Overlay Interface board. If the Programming panel keys are not operating correctly this cable may be at fault.
8. Machine ID port – this port is used by our software to identify the type of machine.
9. USB port – we have 2 USB ports. We use 2 cables that run up to the right side of the machine where the USB ports reside. The USB ports are USB 2.0 compatible.
10. Network Port – a network cable runs from this port to the top of the machine at the right side. This allows users to network the control.

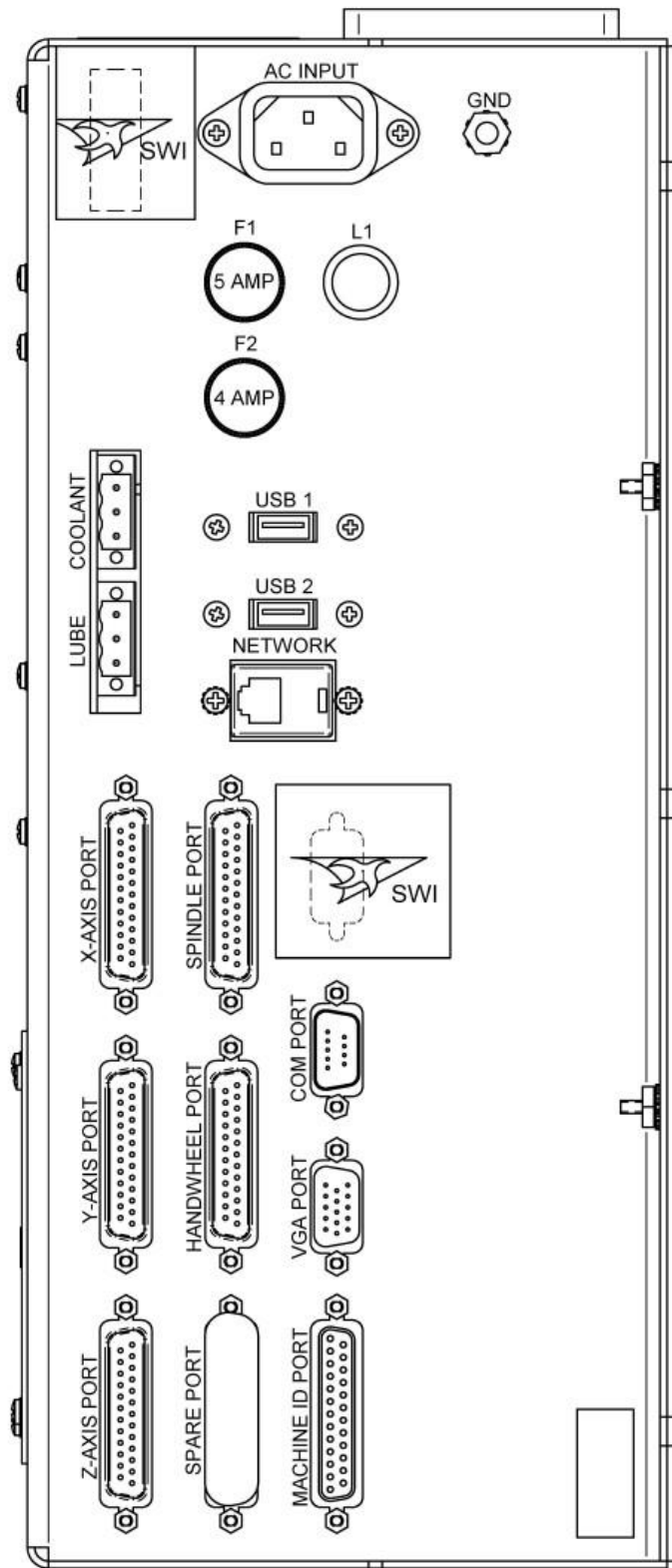


Figure 5.3a – Computer Module Right Side View

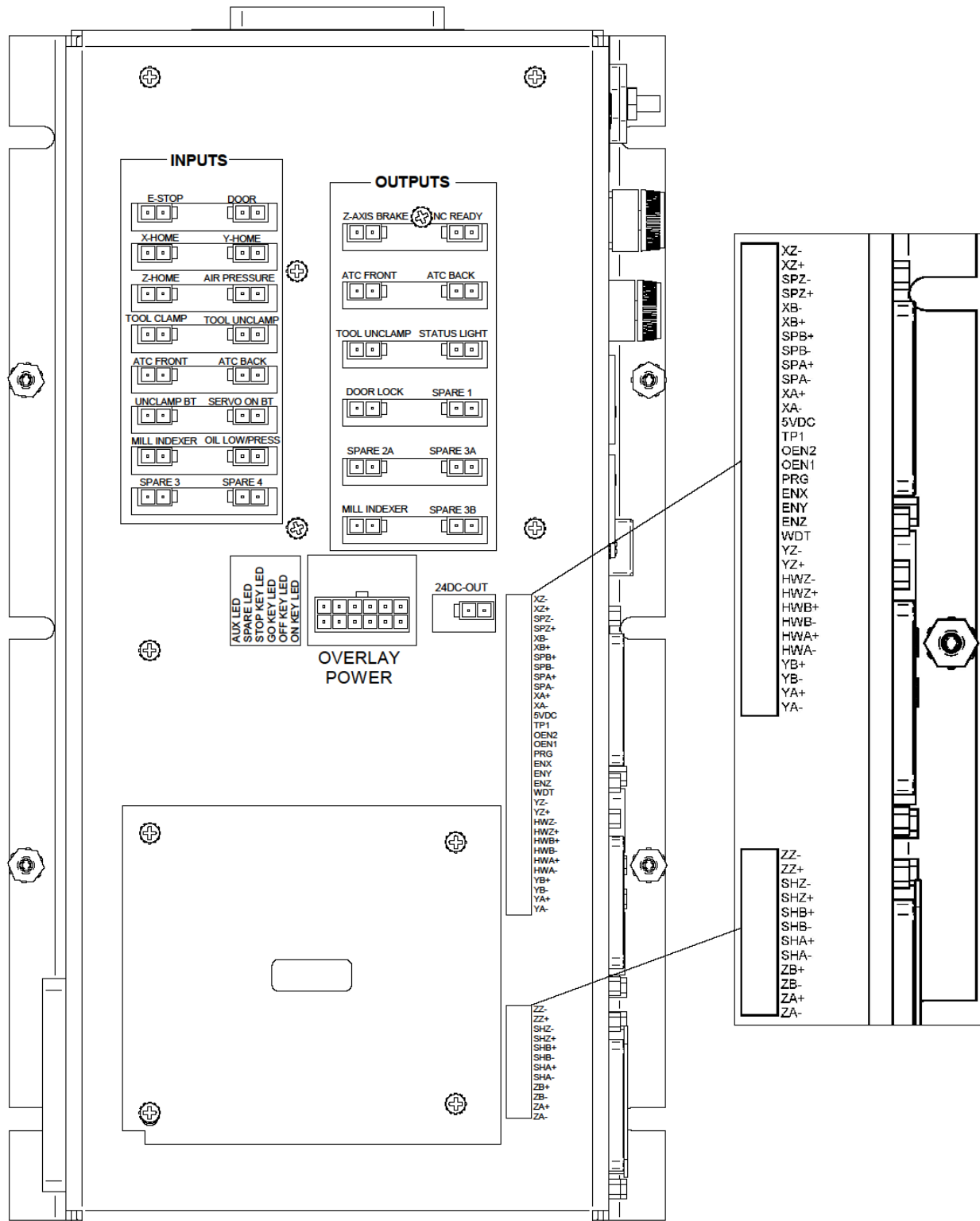
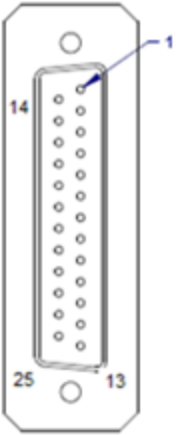


Figure 5.3b – Computer Module Front View

The Spindle Port contains the following signals.

1. DAC (digital to analog) signal is an analog 0 to 10 Volt signal that is used to control the speed of the spindle motor. This is the AVI terminal on the AC Drive. When measuring AVI voltage use ACM terminal for reference.
2. 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. This is the FWD terminal on the AC Drive.
3. 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. This is the REV terminal on the AC Drive. The ON spindle button normally only runs in the FWD direction. The software may allow for reverse operation in certain circumstances.
4. SPD_ORI 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. This is the MI3 terminal on the AC Drive. To orientate the spindle, the FWD and Orientate command is sent at once.
5. 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. This is the MI2 terminal on the AC Drive.
6. E-SPD signal to the AC Drive. This is the MI1 terminal on the AC Drive.
7. CHA, CHB, CHZ are 5 volt DC digital signals that are used for the motor encoder input. The CHZ signal is the index pulse of the motor that is activated once per revolution.
8. SPD_TAP signal is 24VDC volt digital signal from the AC Drive that is used to control the Acceleration and Deceleration time when tapping. This is the MI4 terminal on the AC Drive.



| PIN # | WIRE COLOR | FUNCTION | AC DRIVE TERMINAL / LABEL TEXT |
|-------|----------------|-------------|-----------------------------------------|
| 1 | BLACK | | - |
| 2 | BROWN | COU4+ | AVI |
| 3 | RED | | |
| 4 | ORANGE | | - |
| 5 | YELLOW | E-SPD_COM | M1 |
| 6 | GREEN | SPD_REV | REV |
| 7 | BLUE | SPD_RESET | M2 |
| 8 | PURPLE | FAULT_4 | RB |
| 9 | GRAY | 100% torque | MRA |
| 10 | WHITE | CHA4+ | AO |
| 11 | PINK | CHB4+ | BO |
| 12 | LIGHT GREEN | CHZ4+ | ZO |
| 13 | BLACK / WHITE | GND | GND |
| 14 | BROWN / WHITE | GND | ACM |
| 15 | RED / WHITE | | - |
| 16 | ORANGE / WHITE | | |
| 17 | GREEN / WHITE | SPD-TAP | M4 |
| 18 | BLUE / WHITE | SPD_FWD | FWD |
| 19 | PURPLE / WHITE | SPD_ORT | M3 |
| 20 | RED / BLACK | SPD_COM | DCM |
| 21 | ORANGE / BLACK | GND | RC |
| 22 | YELLOW / BLACK | GND | MRC |
| 23 | GREEN / BLACK | CHA4- | -AO |
| 24 | GRAY / BLACK | CHB4- | -BO |
| 25 | PINK / BLACK | CHZ4- | -ZO |

Figure 5.3c – Spindle Port Pin Assignments

The computer module contains one Handwheel port that is used to move each axes, it is also used for spindle override, feedrate override, scrolling on certain screens 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.



Figure 5.3c1 – EHW Port Pin Assignments

The Overlay Power Connector (see figure 5.3b) is used to provide power to the programming panel and it also carries some critical overlay key feedback to the computer module. The following are the signals that are carried inside the Overlay Power connector.

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. ON-KEY is a 24 Volt DC digital signal that is used to command the spindle motor to turn on.
5. OFF-KEY is a 24 Volt DC digital signal that is used to command the spindle motor to stop spinning.
6. 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.
7. 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.
8. AUX is a 24 Volt DC digital signal that is used to turn the coolant pump on.

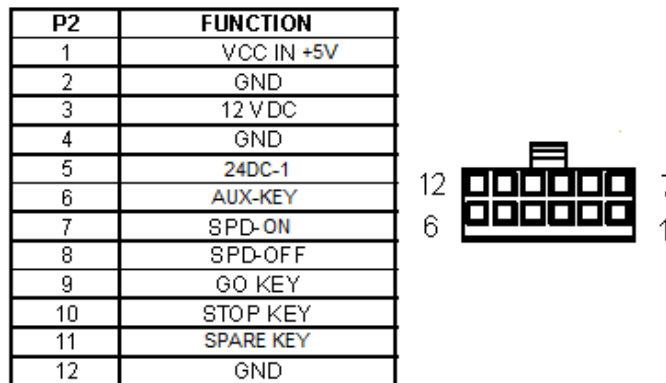


Figure 5.3d – Overlay Power Connector Pin Assignments

The IDE flash is a minimum of 1GB in size. The IDE 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 service codes 141 and 142 must be

used to transfer the configuration from the old compact flash to the new compact flash on the new computer module.

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.

| Symptoms | Diagnostics |
|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| As a general rule all symptoms should be checked for the following items. | <ul style="list-style-type: none"> • 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 ± 5 volts AC. • Utilize service code 521 to test the I/O of each port. |
| X, Y or Z-axis Faulting | <ul style="list-style-type: none"> • Swap the axis port cable and power cable with a different axis to see if the problem follows the motor/servo or the computer module. • Utilize service code 131 and LEDs on the computer module to test the encoder portion of the axis. |
| Spindle Faulting | <ul style="list-style-type: none"> • Utilize service code 521 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 | <ul style="list-style-type: none"> • Utilize service code 132 to test the encoder portion of the handwheel. |
| Digital Input Errors | <ul style="list-style-type: none"> • Make sure that the LEDs to the corresponding digital input that is in question turn OFF and ON. • Utilize service code 521 to test all the inputs to the computer module. |
| Digital Output Errors | <ul style="list-style-type: none"> • Make sure that the LED corresponding to the output function in question turns OFF and ON utilizing service code 521. Note outputs require the NC Ready function to be activated and E-stop to be in the out position. |
| E-stop error cannot be cleared. | <ul style="list-style-type: none"> • Service code 521 should be performed and verified that the E-stop signal is not being seen by the computer module. Verify E-stop LED turns ON. |
| Critical Keys (ON, OFF, GO, STOP & AUX) are not responding. | <ul style="list-style-type: none"> • Check LED's above overlay power connector when buttons are pressed. Light should only be on when the button is being held down. • Verify that the 24VDC is between 22-26 volts DC. • Service code 521 should be performed to identify what critical keys are working. |
| Blank Video or Distorted Video | <ul style="list-style-type: none"> • 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 sent out from the computer module. |
| Overlay Keys not responding | <ul style="list-style-type: none"> • 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 |

| | |
|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <p>module is functioning correctly.</p> <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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) | <ul style="list-style-type: none"> • When the system does not respond to an Overlay command, verify if the operating system is still operational by utilizing a USB keyboard. Press the cap lock button on the keyboard to see if the light comes on and off. • Identify if the WDT LED is ON. If the LED is ON the system has locked up. |
| System Will not boot up error | <ul style="list-style-type: none"> • Try disconnecting all cables one at a time until only the 115 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. |
| Watch Dog On | <ul style="list-style-type: none"> • 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, VGA cable and Overlay power cable, and seeing that the DC power LED is still off while our software is running. |
| Disk boot failure message | <p>Make sure there is no USB device inserted to the computer module. If problem continues refer to section 5.3 computer module diagnostics.</p> |
| Machine will not home | <p>Verify the index pulse is being recognized by the computer module by checking the LED's described above.</p> |

5.4 Programming Panel

The programming panel attaches to the front of the machine via 4 screws and also uses a gasket to prevent any coolant or debris from getting into the rear of the panel. The e-stop, EHW and servo on button is also part of this assembly. Please see figures 5.4a and 5.4b and drawing 28160 found in the rear of the manual.

In general, this 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.



Fig. 5.4a – Programming Panel

The programming panel has 6 cables that run from this panel back to the computer module. See figure 5.4b. They are as follows:

1. 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. The E stop is wired normally closed.
2. Servo On Cable – cable that run from an input port on the computer module to the servo on button. This button must be pressed upon boot up or after an e-stop condition is resolved. This switch is wired normally open.
3. VGA Cable – this cable carries the video signal from the computer module to the LCD controller board.
4. Com Port Cable – this cable is used to establish communication between the pendant and computer module. It carries the non-critical key signals on the overlay as well as the signal for the beeper. It connects to com port on the side of the computer module.
5. Overlay Power Cable – this cable provides power. The voltages are 12 VDC, 5 VDC and 24 VDC. This cable also carries the following critical keys: AUX, ON, OFF, GO and STOP.
6. 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.

The Program Panel consists of the following components.

1. LCD Controller board –It controls the video output to the LCD screen, which comes from the computer module.
2. LCD User interface board - sets the video input signal and adjusts 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. This light is green and indicates the board is on. If you see a red light, something is wrong and there most likely will be no video. This light should always be on when power (12 VDC) is available. Press power button to see if light comes back on. See figure 5.4b and 5.4c.
3. LCD User Interface Cable – used to communicate between the LCD controller board and LCD user interface board.
4. LCD LVDS Cable - used to communicate between the LCD controller board and the LCD screen. It is found between LCD and board.
5. LCD Backlight Power Cable – used to power the backlight on the LCD.
6. Overlay Interface Board - this board is responsible for sending and receiving signals to and from the programming panel and computer module. This board is responsible for the overlay buttons. The beeper is also found on this board. It also provides 12 VDC to the LCD module.
7. LCD Power Cable – It provides power to the LCD controller board, which is 12 VDC.
8. LED Lights – *The overlay interface board has a few LED lights that can be used for troubleshooting. See figure 5.4e for location of LED's on board.*

- a. D22 – each key press on overlay will cause this light to flash, except critical keys.
- b. D23 – LED should always be on and this means power is getting to critical keys
- c. D26 – LED should always be on and it shows we have 12 volts.
- d. D25 – Txd (transmit exchange data) LED should blink on and off when a non-critical key is pressed and relayed to computer module.
- e. D24 – Rxd (receive exchange data) LED should blink on and off as confirmation from computer module (acknowledgement or command from computer module) that a non-critical key was pressed

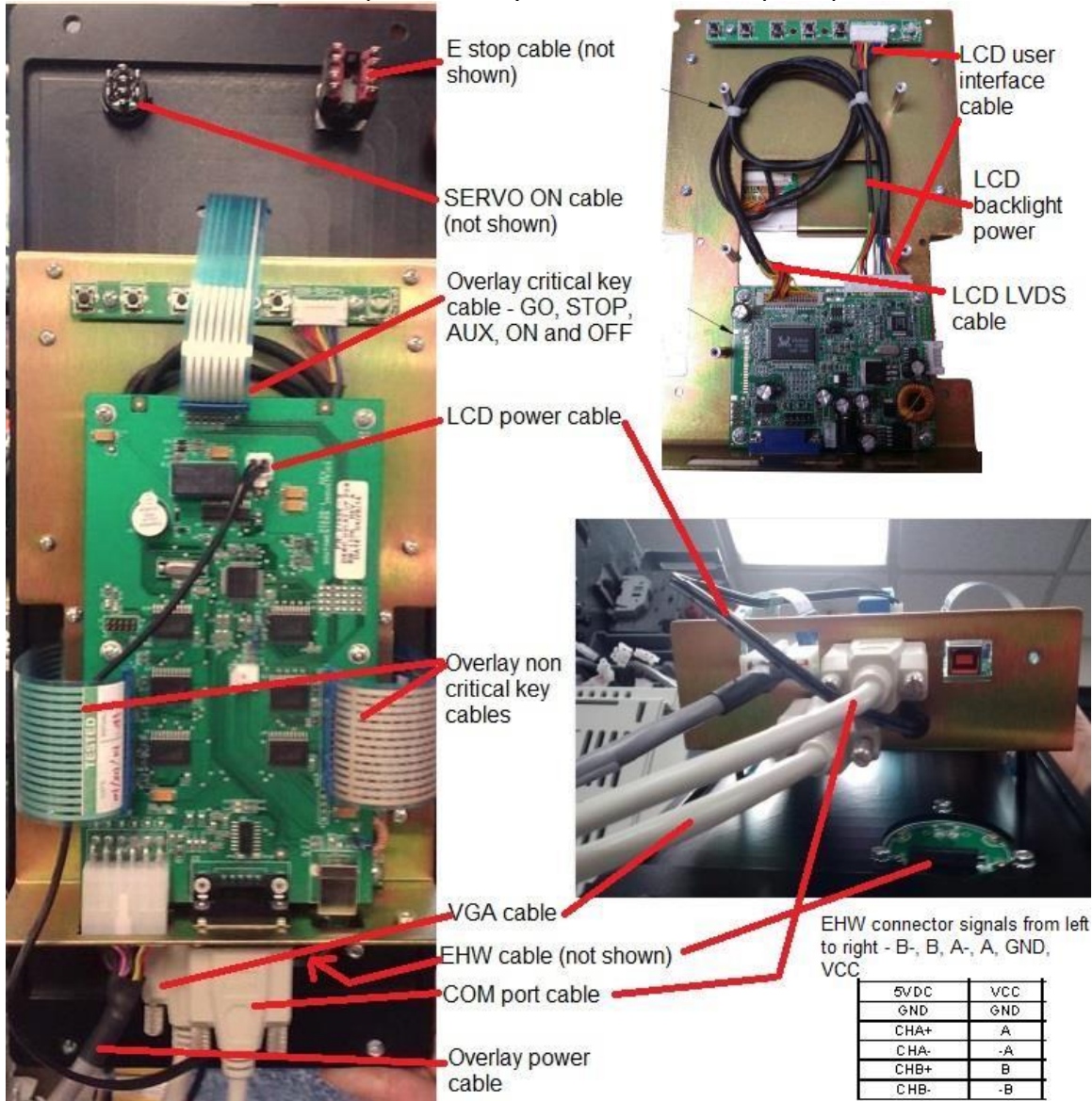


Figure 5.4b – Programming Panel Rear View

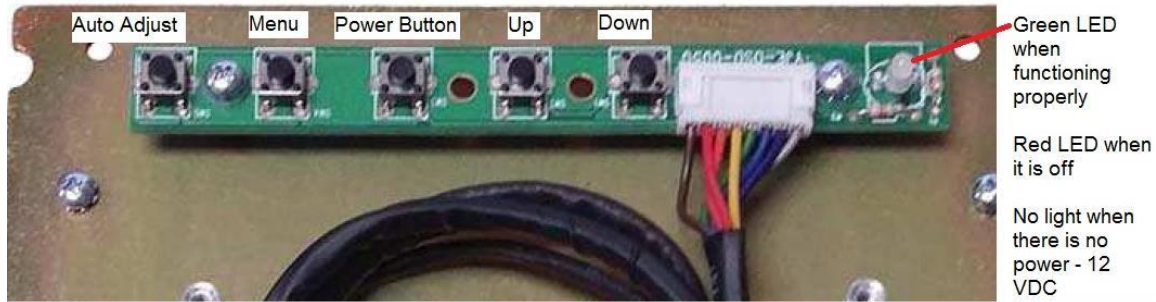


Figure 5.4c – LCD User Interface Board

| Possible problems | Can lead to |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Poor cable connections | Loss of backlight, video signal, overlay function, and/or LCD power. Check all cable connections. |
| Overlay Key failure | Keys on panel do not work. Check by using service code 81. The screen will display a picture of the overlay. 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 connections between the Program panel overlay and the overlay interface board. Also check the overlay power cable for the critical keys and COM port cable for all other keys. Refer to Fig. 5.4b. |
| LCD has no display | You will not have the ability to see the video signal. Make sure the user interface board is not turned off (figure 5.4c). 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. 5.4b. |
| Electronic Handwheel does not work | Unable to jog an axis. Make certain that the jog speed key you want is pressed and you have selected the axis you wish to move. 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. You can also verify the computer module is reading the EHW signals but looking at the LED lights on the front of the computer module. See section 5.3 for more info. |
| 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. The replacement part number for E stop switch is 26039. |

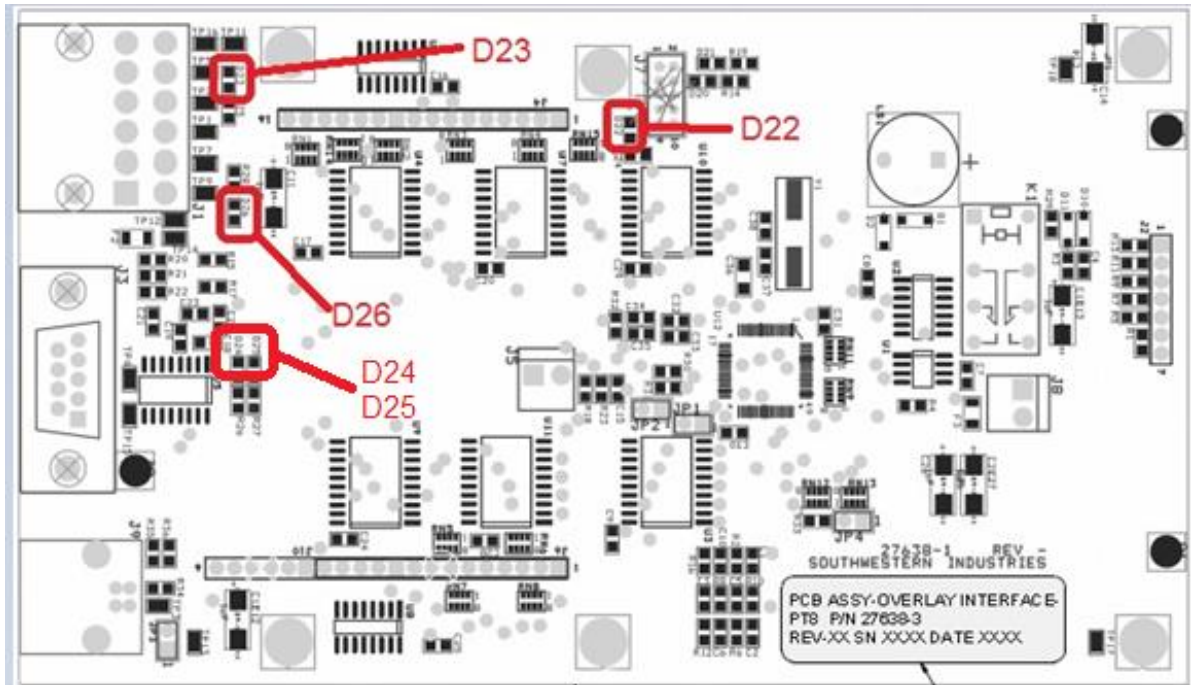


Figure 5.4e – Overlay Interface Board

5.5 Axis Motors/Servos

5.5.1 Axis Motors

The motor is a brushless motor that has a 220 volt single phase power input. The X and Y axis use the same motor and the Z axis uses a bigger motor. The X and Y axis motor is rated at 750 watts and the Z axis at 1000 watts. The X, Y and Z axis motor encoder produces 9,600 ppr (38,400 counts per revolution). The motor encoder also contains one index pulse per revolution which is used for homing.

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.

When troubleshooting only the X-axis and Y-axis motors are interchangeable. The Z-axis is not interchangeable with any other axis. The X and Y servo also cannot run the Z axis motor. If you try to do so, a fault will appear.

DANGER!

Do not work with the motors unless the power is disconnected from the machine. The motors are run by 220 VAC. There is possibility of death by electrocution!

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 home 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. The ATC tool positions may also need to be done with service code 520.

5.5.2 Servo Drivers

The servo drivers are used to control the motors. They are run on single phase 220 volt power. Figure 5.5.2a illustrates the main components that are in the servo electrical cabinet. The servo drivers are located in a box on top of the machine. The X and Y axis servos are identical and the Z axis is unique. The X and Y axis is rated at 750 watts and the Z axis at 1000 watts.

The servo has 2 separate 220 volt power sources. See figure 5.5.2b. The control circuit terminals power the LED display and the main terminals are used for the power circuit. When the machine is turned on, 220 volts is present to power the display hence you should always see lights on the display. If there is no display on one particular servo and the wiring is OK then the servo will need to be replaced. Pressing the servo on button allows power to flow to the main terminals of the servos via the K1 relay.

The computer module outputs a command to each servo drive that is between -10 and 10 volts. The + and - voltage dictates the direction the motor rotates. The higher the voltage command to the servo, the faster the motor will turn.

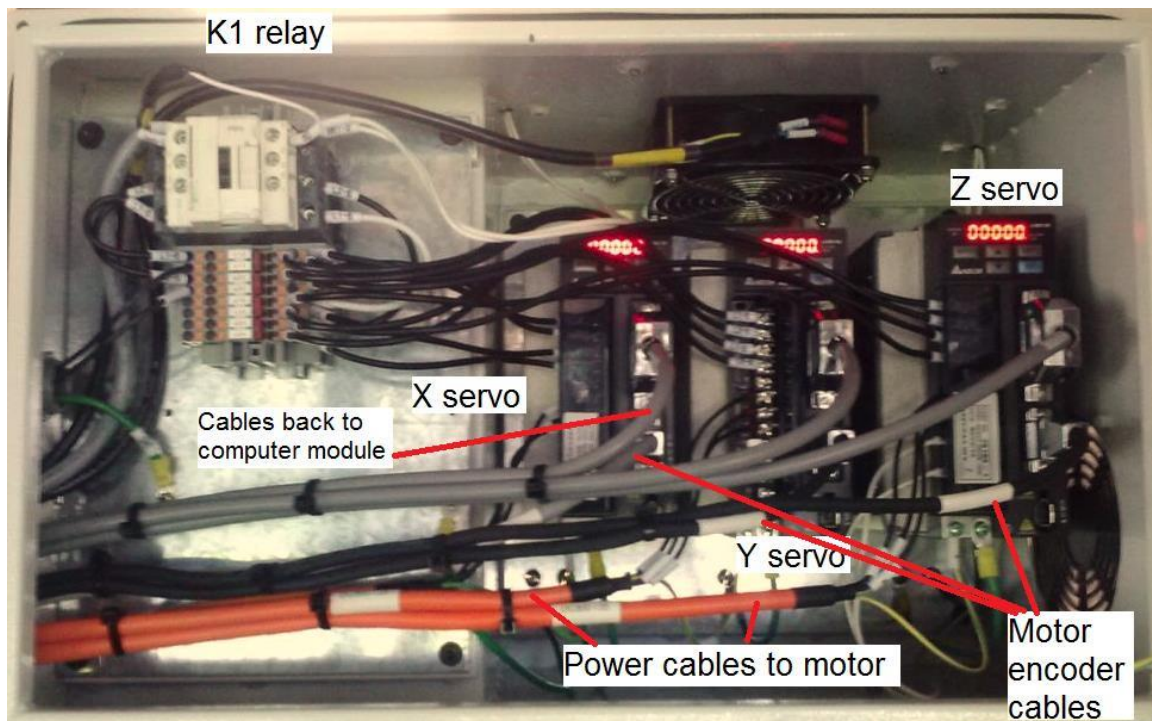


Figure 5.5.2a – Inside of Servo Electrical Cabinet

Part Names and Functions



Figure 5.5.2b – Servo Drive Nomenclature

Description of the Digital Keypad

The digital keypad includes the display panel and function keys. The Figure 4.1 shows all of the features of the digital keypad and an overview of their functions.



| Name | Function |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LCD Display | The LCD Display (5-digit, 7-step display panel) shows the monitor codes, parameter settings and operation values of the AC servo drive. |
| Charge LED | The Charge LED lights to indicate the power is applied to the circuit. |
| MODE Key | MODE Key. Pressing MODE key can enter or exit different parameter groups, and switch between Monitor mode and Parameter mode. |
| SHIFT Key | SHIFT Key. Pressing SHIFT key can scrolls through parameter groups. After a parameter is selected and its value displayed, pressing SHIFT key can move the cursor to the left and then change parameter settings (blinking digits) by using arrow keys. |
| UP and DOWN Key | UP and DOWN arrow Key. Pressing the UP and DOWN arrow key can scroll through and change monitor codes, parameter groups and various parameter settings. |
| SET Key | SET Key. Pressing the SET key can display and save the parameter groups, the various parameter settings. In monitor mode, pressing SET key can switch decimal or hexadecimal display. In parameter mode, pressing SET key can enter into parameter setting mode. During diagnosis operation, pressing SET key can execute the function in the last step. (The parameter settings changes are not effective until the SET key is pressed.) |

Figure 5.5.2c – Digital Keypad on Servo Drive

Fault Message Display


| Display Message | Description |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | When the AC servo drive has a fault, LCD display will display "ALnnn". "AL" indicates the alarm and "nnn" indicates the drive fault code. For the list of drive fault code, please refer to parameter P0-01 or refer to Chapter 11 (Troubleshooting). |

Figure 5.5.2d – Fault Message Display on Servo Drive

The following is the list of potential fault messages on the servo drives. It should be noted that faults 4, 11, 23 through 29, 31 and 35 can only be cleared by turning power off to the machine. For those below in the table that say "Turn ARST (DI signal) on to clear the fault", this means to press the servo on button and the fault should clear. It should also be noted that some errors may clear themselves after a few seconds so you may need to review a few parameters to get the fault codes. See figure 5.5.2f.

Servo Drive Fault Messages

| Fault Messages | | |
|----------------|--------------------------------|-----------------------------------------------------------------------------------------------------|
| Display | Fault Name | Fault Description |
| AL001 | Overcurrent | Main circuit current is higher than 1.5 multiple of motor's instantaneous maximum current value. |
| AL002 | Overvoltage | Main circuit voltage has exceeded its maximum allowable value. |
| AL003 | Undervoltage | Main circuit voltage is below its minimum specified value. |
| AL004 | Motor error | The motor does not match the drive. They are not correctly matched for size (power rating). |
| AL005 | Regeneration error | Regeneration control operation is in error. |
| AL006 | Overload | Servo motor and drive is overload. |
| AL007 | Overspeed | Motor's control speed exceeds the limit of normal speed. |
| AL008 | Abnormal pulse control command | Input frequency of pulse command exceeds the limit of its allowable setting value. |
| AL009 | Excessive deviation | Position control deviation value exceeds the limit of its allowable setting value. |
| AL010 | Reserve | Reserve |
| AL011 | Encoder error | Pulse signal is in error. |
| AL012 | Adjustment error | Adjusted value exceeds the limit of its allowable setting value when perform electrical adjustment. |
| AL013 | Emergency stop activated | Emergency stop switch is activated. |
| AL014 | Reverse limit switch error | Reverse limit switch is activated. |
| AL015 | Forward limit switch error | Forward limit switch is activated. |

| Fault Messages | | |
|----------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Display | Fault Name | Fault Description |
| AL016 | IGBT temperature error | The temperature of IGBT is over high. |
| AL017 | Memory error | EE-PROM write-in and read-out is in error. |
| AL018 | Encoder output error | The encoder output exceeds the rated output frequency. |
| AL019 | Serial communication error | RS232/485 communication is in error. |
| AL020 | Serial communication time out | RS232/485 communication time out. |
| AL021 | Reserve | Reserve |
| AL022 | Input power phase loss | One phase of the input power is loss. |
| AL023 | Pre-overload warning | To warn that the servo motor and drive is going to overload. This alarm will display before ALM06. When the servo motor reach the setting value of P1-56, the motor will send a warning to the drive. After the drive has detected the warning, the DO signal OLV will be activated and this fault message will display. |
| AL024 | Encoder initial magnetic field error | The magnetic field of the encoder U, V, W signal is in error. |
| AL025 | Encoder internal error | The internal memory of the encoder is in error. An internal counter error is detected. |
| AL026 | Encoder data error | An encoder data error is detected for three times. |
| AL027 | Motor internal error | The setting value of the encoder is in error. |
| AL028 | Motor internal error | The encoder U, V, W signals are in error. |
| AL029 | Motor internal error | The internal address of the encoder is in error. |
| AL030 | Motor protection error | In order to protect the motor, this alarm will be activated when the setting value of P1-57 is reached after a period of time set by P1-58. |
| AL031 | U, V, W, GND wiring error | The wiring connections of U, V, W (for servo motor output) and GND (for grounding) are in error. |
| AL035 | Motor temperature error | Motor is working under temperature over 105°C (221°F). |
| AL048 | Excessive encoder output error | The encoder output errors or output pulses exceed hardware tolerance. |
| AL067 | Motor temperature warning | The temperature of motor is over 85°C (185°F). |
| AL099 | DSP firmware upgrade | EE-PROM is not reset after the firmware version is upgraded. This fault can be cleared after setting P2-08 to 30 first, and then setting P2-08 to 28 next and restarting the servo drive. |

Figure 5.5.2e – Servo Fault Messages

The gain access to the P4 parameters below, please do the following:

1. Press MODE button on display.
2. Press SHIFT button until you get to P4.
3. Press arrow up or down button to get to P4-00, P4-01, etc.
4. Press SET button to see value.
5. Hit MODE to get out of each parameter.

Fault Code Display Operation

After entering the parameter mode P4-00 to P4-04 (Fault Record), press SET key to display the corresponding fault code history for the parameter.

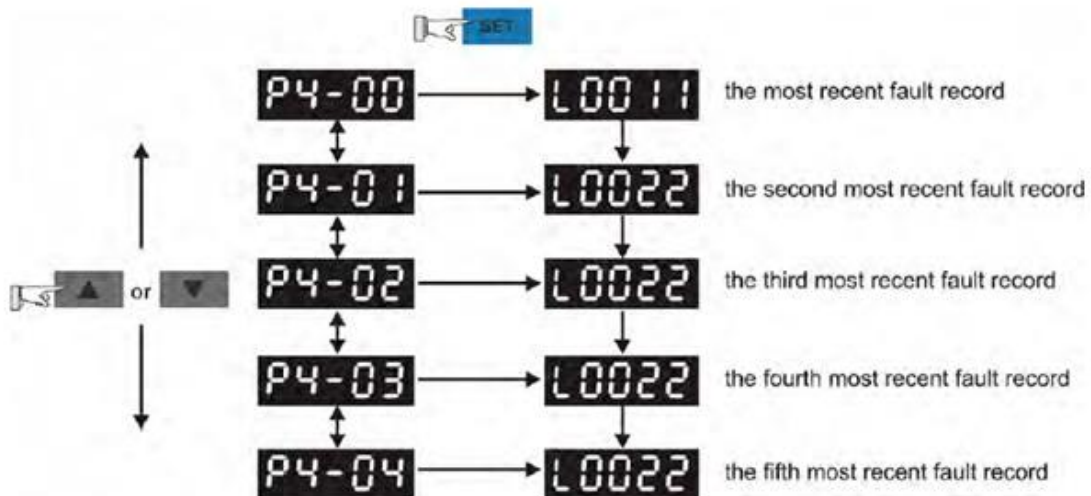


Figure 5.5.2f - Fault History Display

How to display load current on the drive display.

1. Press MODE button on display
2. Press SHIFT button until you get to P0.
3. Press arrow up or down button to get to P0-02.
4. Press SET button and use arrow keys to set to 12.
5. Press MODE.

| P0-02 Setting | Display Message | Description | Unit |
|---------------|-----------------|--------------|------|
| 12 | AUG-L | Average load | [%] |

Figure 5.5.2g - Display Load Current

Once the display is set to this value, the display will show the % load on the screen. When an axis accelerates, you will see a spike in the displayed numbers. This is one way we can check the mechanics by seeing how much current it takes to drive an axis.

Troubleshooting Axis Faults

The main goal of troubleshooting axis faults is to try and determine if the problem is caused by a mechanical problem (drive train), computer module, servo drive, axis motor or the following cables: cable from computer module to servo drive, encoder cable from servo to servo drive, motor power cable from servo drive to axis motor.

| Symptoms | Diagnostics |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Constant Axis Faults - a given axis will not run and axis or following error fault is on the screen | <ol style="list-style-type: none"> 1. Confirm the computer module is not the problem. For this scenario, let's assume you are seeing a X axis fault. Swap the X and Y cables at the computer module that run to the servo. This means the X axis port of the computer module is now going to move the Y axis servo and motor. If the Y axis motor now moves, this means the computer module is not part of the problem. This test can be done with the X and Z or Y and Z cables as well. Note – for the Z axis, you need to unplug the Z brake input from the computer module as we want the brake holding the head up otherwise the head will fall if the Z motor or servo is not working. Try to move the Z axis with the EHW very slowly just to see if the axis moves. This will drive the axis with the brake on. 2. Confirm the drives trains are not binding and causing the fault. If a fault is happening due to a mechanical problem, there is a good chance you will get an overcurrent fault 1 on the drive. 3. Check all the wiring connections to the servo drive and motor. 4. Swap the X and Y axis motor. If problem stays with the X axis, then replace the servo amp. 5. If the Z axis continues to fault, replace the servo or motor. We will send both parts, but try each part individually. Do not replace both parts if only one is bad. |
| Intermittent Axis Fault | <ol style="list-style-type: none"> 1. Identify the fault code on the axis that is intermittently faulting. Check parameters P4-01 through P4-04 for a history of the most recent faults. The nature of the axis fault will now dictate the direction you go from a troubleshooting standpoint. 2. It is always a good idea to rule out a mechanical drive train issue. |
| Servo error 11 – encoder error | Check cable connections, especially the encoder cable to the motor, both ends of cable. If the cable was loose or had a poor connection, fix problem and power off and back on the machine. |

| | |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Servo error 1 - Overcurrent | If mechanics check out OK, then remove axis belt and run motor with no load to see if problem still exists. If it does, then swap the X and Y axis motors and see if problem stays or goes. Based on the result, replace the motor or servo. For the Z axis, order a replacement motor and servo and replace only the part that turns out bad. |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

5.6 Spindle Motor & AC Drive

Danger!
The spindle motor and AC Drive uses 220 or 415 AC volts to operate, utilize care when working with these components. There is possibility of death by electrocution!

Warning!
The spindle inverter is able to store energy after power is removed. Please allow 20 seconds for the power to dissipate from these devices before servicing. The screen on the AC drive will go blank once power is dissipated from the unit.

5.6.1 Spindle Motor

The spindle motor is a 3HP induction motor rated for a max rpm of 6000 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 directly drives the spindle via a coupling. The spindle motor also contains a 110 VAC fan that is used to cool the motor. The fan blows air down over the motor. The motor can be wired for either 220 or 440 volts, make sure you wire the motor correctly if you replace the motor.

WARNING!
Whenever the spindle motor is replaced or removed, service code 510 must be performed to reset the spindle orientation angle

| Symptoms | Diagnostics |
|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Spindle goes to the wrong orientation angle when doing a tool change. | <ul style="list-style-type: none"> • 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 motor coupling being loose or slipping. • Redo the spindle orientation setup. |
| Spindle faults out immediately when trying to run the spindle. | <ul style="list-style-type: none"> • Verify that the spindle encoder is working properly. Use service code 510 to check. • Verify that the AC drive parameters have the correct values. • Verify that the spindle is able to turn freely. • Verify that the spindle power wiring is correct and properly fasten. |
| Spindle faults out when decelerating from high speed. | <ul style="list-style-type: none"> • Verify that the deceleration parameter on the AC Drive 01-13 is set correctly. |

| | |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <ul style="list-style-type: none"> • Verify that the spindle braking resistors are connected properly to the AC drive. • Verify that the braking resistance is equal to 100 ohms at the AC drive for a 220VAC system and 200 ohms for a 400 system |
| Spindle will not turn when a command is given. | <ul style="list-style-type: none"> • 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 are set correctly. • Verify that the E-stop command to AC Drive has not been activated (in other words, the button is not pressed). By measuring 0V from MI1 to DCM. When the E-stop message is present it will measure 24V (button is pressed). • Verify the parameters on the AC Drive are correct. |

5.6.2 Spindle AC Drive

The spindle AC Drive is a 3HP 3phase 220 VAC input drive or if the user orders the 400 volt option, it will be 440 VAC input. The AC drive is able to drive the spindle motor up to 6000 RPM, which is 200 HZ 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, the AC drive will automatically decelerate to a stop.

The spindle braking is done via a braking resistor that is found on the top of the machine. The resistor is rated at 500 watts and has 100 ohms of resistance for 220 volt power and 200 ohms for 440 volt power. If the spindle is not braking properly, check the resistance of the resistor with an ohmmeter.

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 press the AC drive will scroll through the following modes and 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. 0011 – Means that the Orientate and FWD command input has been activated.
This is necessary when performing a tool change.
 - h. 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. The following RPM’s should produce the noted current under a no load condition.
 - a. 100 RPM – 6 amps
 - b. 1000 RPM – 6 amps
 - c. 1800 RPM – 5.4 amps
 - d. 3000 RPM – 3.11 amps
 - e. 6000 RPM – 1.8 amps
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.

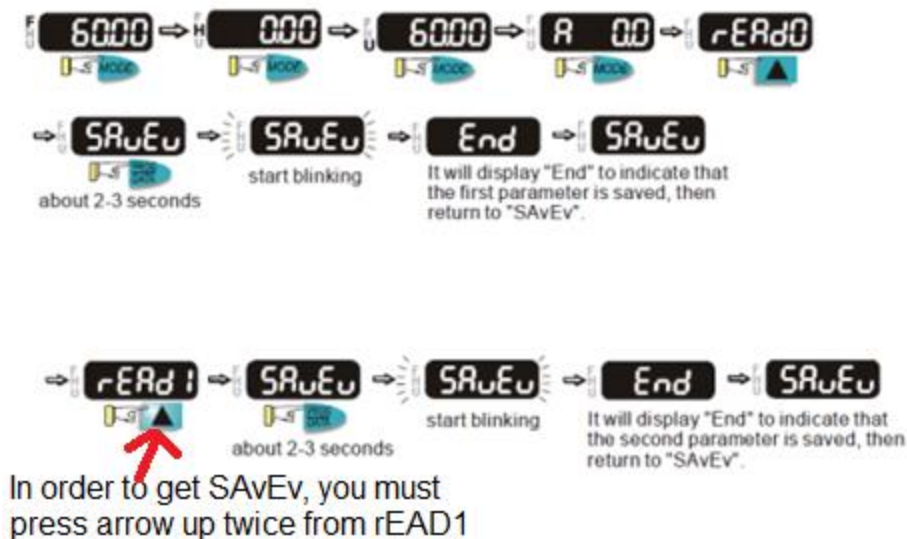
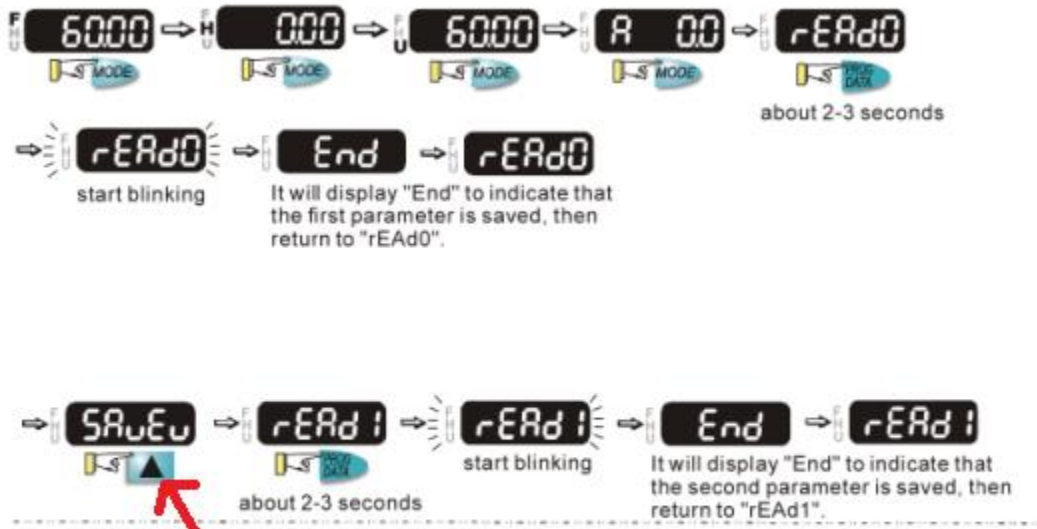


Figure 5.6.2A

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



In order to get rEA1, you must press up arrow twice from rEA0.

Figure 5.6.2B

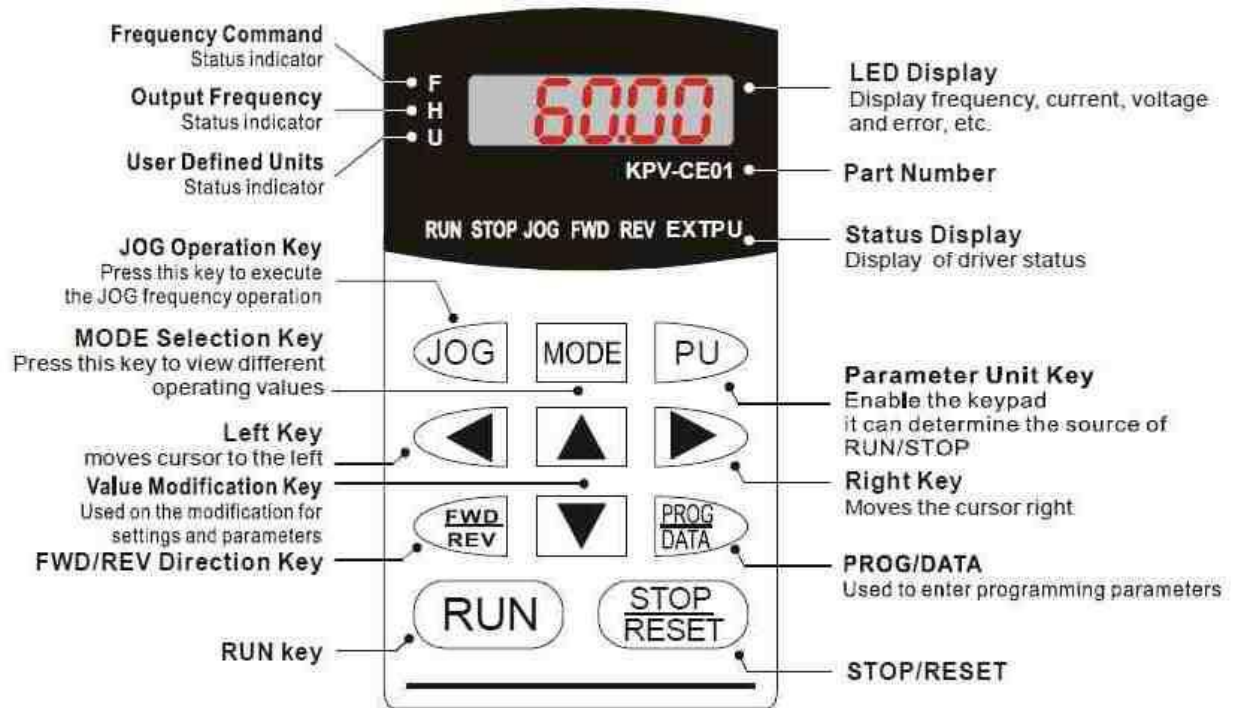


Figure 5.6.2C

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 viewing the motor from the top looking down. 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 viewing the motor from the top looking down. 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. Please note that the user can only run the spindle forward when pressing the ON button on the overlay. The ON button usually only runs in FWD. The software may allow for reverse commands to be sent to drive.
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. When the E stop button is pressed and the message is on the screen you should see 24 volts.
6. DAC (digital to analog) signal is an analog 0 to 10 Volt signal that is used to control the speed of the spindle motor. This is the AVI terminal on the AC Drive. When measuring AVI voltage use ACM terminal for reference.

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. 100% Torque Achieved (MRA and MRC terminals) output, is used to indicate when the actual spindle is equal to the 100% of the full torque of the motor. When the spindle torque output is 100% the voltage between the MRA and MRC terminals will be 0 volts and when it is not it will be 5 volts. ***This feature was not implemented upon product release.

| Symptoms | Diagnostics |
|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Spindle will not perform a spindle orientate command. | <ul style="list-style-type: none"> • 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. • Verify that the E-stop command to AC Drive has not been activated. By measuring 0V from MI1 to |

| | |
|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | DCM. When the E-stop command is present it will measure 24V. |
| The AC Drive will fault out immediately when starting the spindle. | <ul style="list-style-type: none"> • Verify that the spindle AC drive encoder PCB is properly seated. • Verify the spindle encoder on the motor works. • 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. | <ul style="list-style-type: none"> • 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

DANGER!

Take extreme caution when working with high voltage. There is possibility of death by electrocution!

There are 10 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, as seen in figure 5.7.1a. It powers the spindle and axis motors.
2. 415VAC (400 to 440 VAC), 3 phase – this is an optional voltage that can be ordered with this machine and replaces the standard 220 volts. This powers the spindle motor only.
3. 115VAC (115 to 125VAC), 1 phase – This voltage is produced by the transformer. It is used for power to the computer module, which then powers the power supply, lube and coolant Pumps.
4. 24VDC (22 to 26VDC) – This voltage is produced by the internal power supply of the computer module and is used for most of the inputs and outputs. The voltage can be measured between pin 1 of the 24VDC Port and the chassis ground on the computer module or on pin 5 of the overlay power cable, 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 Overlay Power Port 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 Voltage Fault 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. If this voltage is not correct the computer module will produce a DC Power Fault that will be identified by the Voltage Fault 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). This voltage varies depending on rpm of the motor.

8. -15VDC and 15VDC – this voltage is produced by the computer module and is used to control the input to the DAC chip that controls the axis motors. +10 volts commands the motors to run at rapid speed in 1 direction and -10 volts command the motors to run the opposite direction. This voltage is internal to the computer module and not easily measured.
9. -10VDC and 10VDC – this voltage is output by the DAC chip and is used to control the axis motors. +10 volts commands the motors to run at rapid speed in 1 direction and -10 volts command the motors to run the opposite direction.
10. 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 1 of the Overlay Power Port 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 Voltage Fault LED being turn ON, on the computer module.

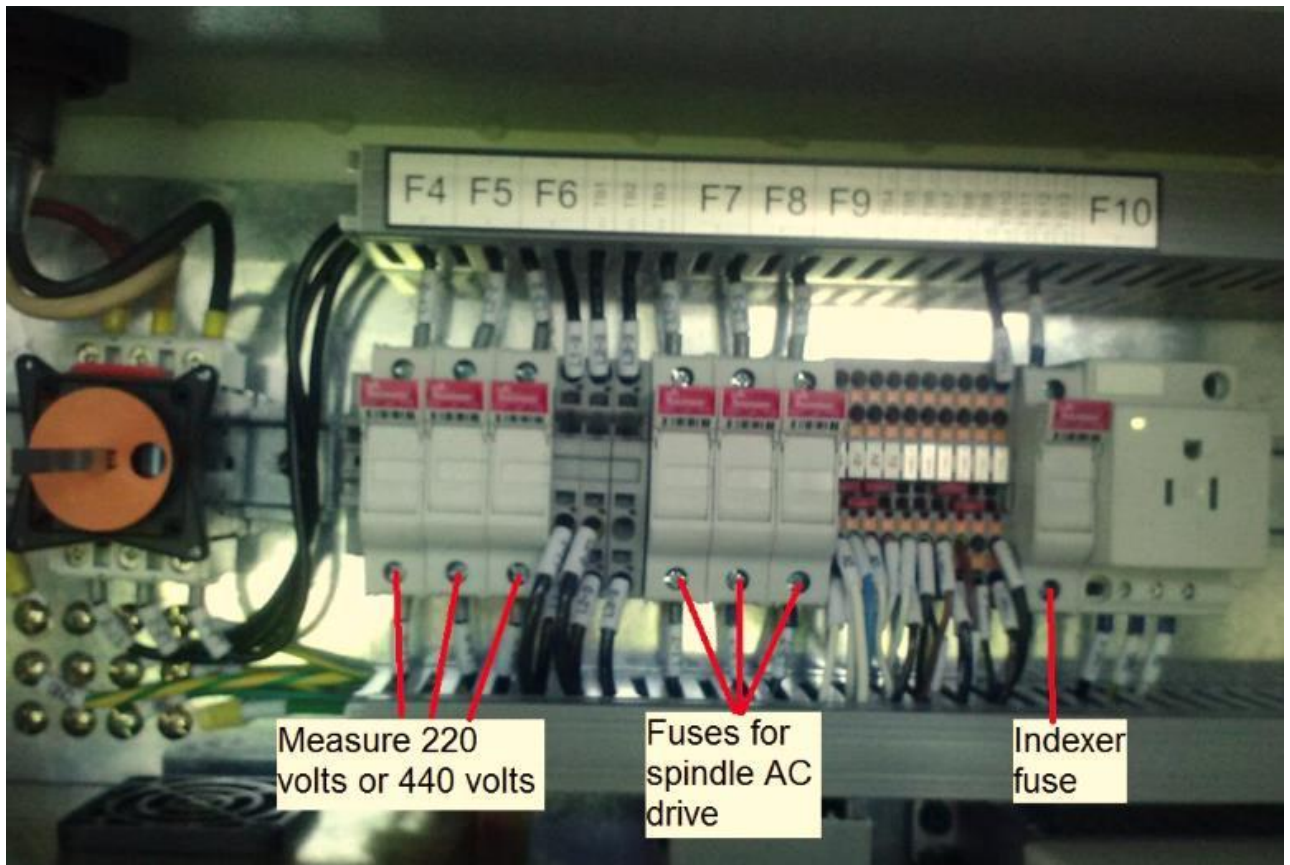


Figure 5.7.1a

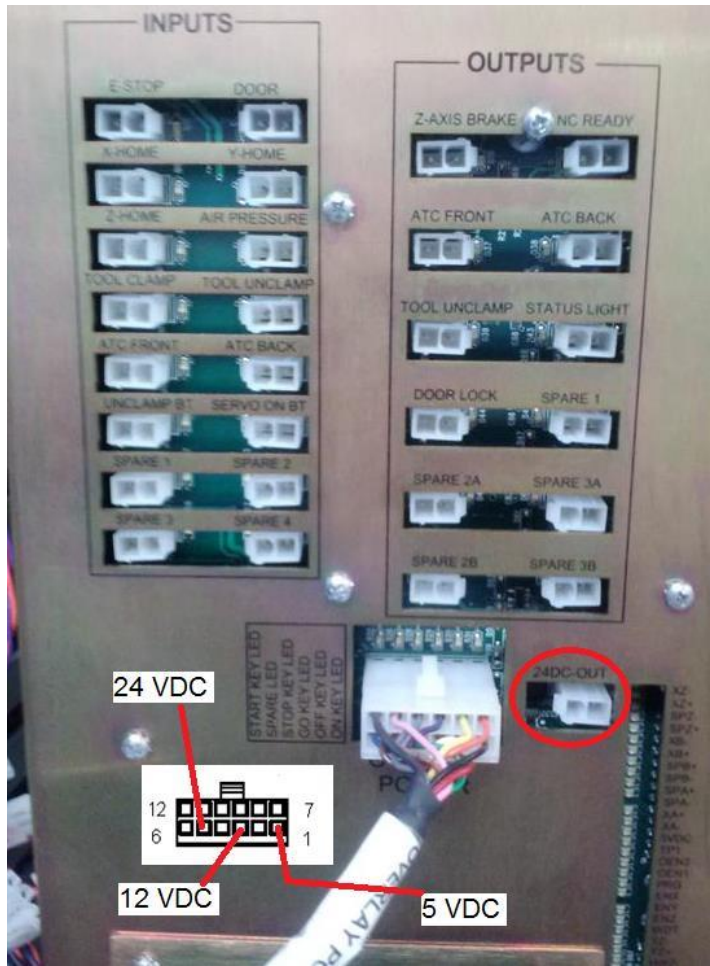


Figure 5.7.1b

5.7.2 Checking Fuses

There are 17 field replaceable fuses in the system for 220 volt machines and 440 volt machines. See figures 5.7.1a and 5.7.2a.

220 Volt Machines

- 2 on the computer module (see section 5.3).
 - F1 – coolant pump, lube pump – 5 amps (21824-5 Time Delay).

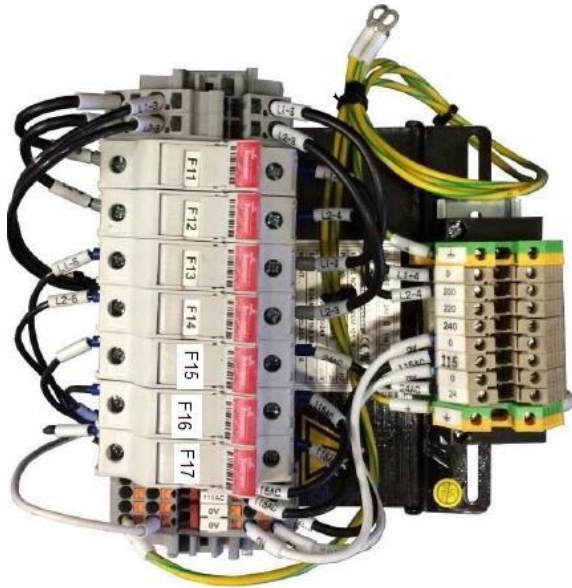
- Note changed to 5 amps from 4 amps on 7/2015.
 - F2 – computer module power supply – 4 amps (21824-4 Time Delay).
- 3 next to the on/off switch are for the 3 phase 220 volt power in (30 amps) and labeled F4, F5 and F6 (23153-30 Time Delay).
- 3 fuses (16 amps) for the spindle inverter labeled F7, F8 and F9 (23152-16 Time Delay).
Note changed fuse type on 7/2015 from 15 amps to 16 amps each.
- 2 fuses (16 amps) for the servo drives labeled F13 and F14 (23152-16 Time Delay).
Note changed fuse type on 7/2015 from 15 amps to 16 amps each.
- 2 fuses (8 amps) for the incoming power to transformer labeled F11 and F12 (23152-8 Time Delay).
- 1 fuse (10 amps) that controls power out of the transformer to the computer module labeled F17 (23152-10 Time Delay).
Note changed fuse size on 7/2015 from 8 amps to 10 amps. Use this value moving forward.
- 1 fuse (4 amps) that controls power of the worklight, electrical cabinet fans, spindle fan and labeled F16 (23152-4 Time Delay).
- 1 fuse (4 amps) that controls power to auxiliary 115 volt outlet labeled F10 (23152-4 Time Delay). This 115 volt auxiliary outlet should only be used to run an indexer or low current devices like a light or laptop.
- 1 fuse (1 amp) for the 24 volts that controls NC Ready labeled F15 (23152-1 1 amp Time Delay).
- 1 on the lube pump (5 amps Fast Acting).

440 Volt Machines

- 2 on the computer module (see section 5.3).
 - F1 – coolant pump, lube pump – 5 amps (21824-5 Time Delay).
Note changed to 5 amp from 4 amp on 7/2015.
 - F2 – computer module power supply – 4 amps (21824-4 Time Delay).
- 3 next to the on/off switch are for the 3 phase 440 volt power in (15 amp) and labeled F4, F5 and F6 (23152-16 Time Delay).
- 3 fuses (8 amps) for the spindle inverter labeled F7, F8 and F9 (23152-8 Time Delay).
- 2 fuses (16 amps) for the servo drives labeled F20 and F21 (23152-16 Time Delay).
Note changed fuse type on 7/2015 from 15 amps to 16 amps each.
- 2 fuses (12 amps) for the incoming power to transformer labeled F18 and F19 (23152-12 Time Delay).
- 1 fuse (10 amp) that controls power out of the transformer to the computer module labeled F24 (23152-10 Time Delay).
Note changed fuse size on 7/2015 from 8 amps to 10 amps (Time Delay). Use this value moving forward.
- 1 fuse (4 amps) that controls power of the work light, electrical cabinet fans, spindle fan and labeled F23 (23152-4 Time Delay).
- 1 fuse (4 amps) that controls power to auxiliary 115 volt outlet labeled F10 (23152-4 Time Delay). This 115 volt auxiliary outlet should only be used to run an indexer or low current devices like a light or laptop.
- 1 fuse (1 amp) for the 24 volts that controls NC Ready labeled F22 (23152-1 Time Delay).
- 1 on the lube pump (5 amps Fast Acting).

To check fuses:

- Use a Volt/Ohmmeter; select "OHM".
- Remove the fuse completely from the holder.
- 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.



220 Volt Transformer



440 Volt Transformer

Figure 5.7.2a

5.8 Tool Carrier Diagnostics

The Automatic Tool Carrier or the ATC, as it is referred to throughout this manual, consists of 8 tool spots that correspond to tools 1 through 8 in your program. See drawing 27587-1 at the rear of the manual. (Tool number arrangement label is located on the front door)

5.8.1 Spindle Orientation

An automatic tool change requires that many components of the 2 OP work in concert with one another. These components include the ATC positions (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 because the machine will crash as a result of an improper setting. Spindle

orientation aligns the spindle drive dogs for proper engagement with the 30 taper tool holders held in the ATC tool magazine. Service code 510 will safely walk you through this procedure. Make sure to follow the procedure precisely. See section 6.2.2 of this manual.

5.8.2 Tool Change Height

Service code 520 will take you through the procedure for setting the tool change height. It will set the position where the Z-axis will clamp or unclamp the tool. Like the spindle orientation, this setting is also very critical.

During this procedure you will hear the "air through spindle" hissing sound, this sound is actually a valuable tool for this procedure. As you near the proper tool change height while performing service code 520, you will hear the sound of the air slowly being blocked off, simply creep down at .002" jog feed rate until the sound of the air hissing just disappears, then back it off one click and a 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 30 taper tool holder a slight bump of ~0.020" during the "Unclamp" cycle, to help dislodge the tool holder from the spindle. Likewise, it will give the tool holder a slight tug at the "Clamp" cycle. 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 magazine.

5.8.3 Tool Change Positions

The ATC has 8 tool (X,Y) locations that need to be set correctly. Service code 520 is used to set these locations. See section 6.13 for a procedure.

All 8 locations should be set by using a dial indicator to sweep in the taper on a tool. The X and Y coordinate should be within 0.005" on your indicator. In other words, there is some room for error, but these tool locations cannot be set by eyesight. Once you have all tools set properly, press the "SAVE TABLE" button to save all tool locations. Note: the ideal and the fastest tool for setting the tool positions is a Coaxial indicator.

5.8.4 Tool Clamping Mechanism

There are two forces that are used in the tool clamping mechanism. The first being the force applied by a stack of Belleville spring washers that are set to apply ~1000 lbs of pull force on the 30 taper retention knob which clamps the tool holder into the spindle. The second being the force of the air/oil cylinder that compresses the Belleville washers and releases the tool holder from the spindle. See section 6.15 for how to bleed this hydraulic system if air gets into it.

The spindle pull force is set at the factory and should not be modified for any reason. Modifying this setting will change the effectiveness of the tool clamping mechanism, and/or shorten its life expectancy.

5.8.5 Tool Carrier Front and Back Cylinder Switches

An air cylinder is used to move the ATC to the front and back. There are two sensors mounted on the cylinder, one near each end. Each sensor has an LED light which illuminates to indicate

when the air cylinder has reached the fully retracted or extended position. When the ATC is back, the rear LED light should be on. When the ATC moves all the way forward, the front LED comes on for a brief second and then turns off, as soon as the ATC is pushed back by the worktable to the proper Y location.

There are also 2 switches to monitor if the spindle is clamped or unclamped.

ATC "FRONT" is a limit switch that turns ON when the ATC has advanced all the way forward toward the operator.

ATC "BACK" is a limit switch that turns ON when the ATC has retracted all the way back behind the access door.

Tool "Unclamp" is a limit switch that turns ON when the tool unclamp mechanism is in the unclamped state. If this limit switch is not set or functioning improperly, there is the potential that the drawbar gripper or the mechanism may become damaged. This switch is triggered only when the machine or the operator is loading a tool in and out of the spindle. Pressing the green push button on the head puts the machine in the unclamped state.

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

5.8.6 ATC Flow Control Valves

The speed at which the ATC can move front or back can be controlled by 2 flow control valves, identified on drawings 27563-1 and 27540-1 found in this manual. See section 5.9 for more information on these flow control valves and guidelines on how to adjust them.

One flow control valve controls the speed at which the ATC travels out toward the operator and other how fast it travels back to its retracted position. 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.

5.8.7 Error Messages Relating to the ATC

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

Error 105 - Check the Spindle Drive Module and related electronics. Repair as needed. The spindle drive may have faulted. This would happen due to an orientation issue or when the spindle is decelerating prior to a tool change.

124 - SPINDLE ERROR - The spindle did not orient correctly. - During Service Code 510, the control software remembers the desired encoder count for proper spindle orientation. Also, the spindle drive electronics is programmed with the same encoder value. When the spindle is commanded to orient, the logic waits for the spindle to stop and for the encoder position (index angle) to match the value that was entered in Service Code 510. If the commanded value (in the spindle electronics) doesn't match (with about .5 degrees or 6 encoder counts) the expected

value in the control, then orientation will fail. Also, the orientation must happen within 12 seconds and the spindle must come to a complete stop.

126 - TOOL CLAMP ERROR - The spindle is in the unclamped position and needs to be clamped to proceed. Check that air pressure is available and the limit switches are functioning properly. - The tool unclamp is either jammed or the limit switch is not functioning. Check the LED on the back of the control. Use the Hardware Tester application to confirm the proper inputs.

127 - TOOL UNCLAMP ERROR - The spindle is in the clamped position and needs to be unclamped to proceed. Check that air pressure is available and the limit switches are functioning properly. - The tool unclamp is either jammed or the limit switch is not functioning. Check the LED on the back of the control. Use the Hardware Tester application to confirm the proper inputs.

128 - ATC ERROR - The ATC was commanded to home but it's not in the back position. Manually move the ATC all the way back and then re-home the machine. - If the ATC is back, then the limit switch probably has moved or failed. Check the light on the switch and the LED on the back of the control. Use the Hardware Tester application to confirm the proper inputs. This message happens during homing.

129 - ATC ERROR - The ATC was commanded to move but its position is not known. Check that air pressure is available and ATC limit switches are functioning properly. - The ATC loses air pressure, 24 volts or is not on the limit switch when the machine is disabled, it needs to be pushed back and servos re-enabled. Even a very short loss air pressure may cause this condition. The ATC must be "homed" the first time after power-up when the axes are homed. The ATC must be on the back limit switch, air pressure and 24 volts must be available, then the door must be closed and the GO button pressed (to initiate homing).

131 - ATC ERROR - The ATC timed-out moving to the front. Check and make sure that there is no access of chips accumulated between the ATC and the back of the table, that air pressure is available, and that the ATC limit switches are functioning properly. - When moving forward, the ATC never detected the front limit switch. Check the light on the switch and the LED on the back of the control. Use the Hardware Tester application to confirm the proper inputs.

132 - ATC ERROR - The ATC was commanded to the back position, but the back limit switch is not active. Check the limit switches. - If the ATC is back then the limit switch probably has moved or failed. Check the light on the switch and the LED on the back of the control. This error message may occur during tool changes and tool loading/unloading.

139 - ATC ERROR - The ATC carrier is trying to move but the air pressure is too low. Check air pressure and make sure it is set to the correct amount. - If the ATC is commanded to move but pressure was not available (for even a short time) this message may occur. Often times, during a tool change, the Tool Unclamp (draw-bar) actuator is activate to release the tool. If the air pressure is set below 65 PSI, this large sudden use of air may cause this ATC problem. Check that the air pressure regulator lower limit is properly adjusted and that the shop air supply is sufficiently high and has enough volume to not cause a momentary drop in air pressure. Also, check and make sure that the air filter is not plugged up, if it looks dirty, it may require cleaning or replacement.

208 - ATC ERROR - ATC limit switch failure. Both the front and the back switches are active at the same time. The ATC location is unknown. Check that both limit switches are functioning properly. - During normal operation both switches should not be active. Check the lights on the switches and the LEDs on the back of the control. Use the Hardware Tester application to confirm the proper inputs.

216 - TOOL CLAMP ERROR - The tool clamp was actuated, but no air pressure is available. Check air pressure. - Check that the air pressure regulator is properly adjusted and that the shop air supply is sufficiently high and has enough air flow to not cause a momentary drop in air pressure. If the air supply pressure is Ok, check the air filter and make sure it is not excessively dirty.

217 - TOOL CLAMP ERROR - Both tool clamp and unclamp limit switches are active at the same time. Check that both limit switches are functioning properly. - During normal operation both switches should not be active. Check the LEDs on the back of the control. Use the Hardware Tester application to confirm the proper inputs.

218 - ATC ERROR - The ATC timed-out moving to the back location. Check that that air pressure is available and the ATC limit switches are functioning properly. - The ATC started to move but didn't make it back in 2 seconds. Use the Hardware Tester to time the ATC. Also make sure the ATC doesn't bounce off the back limit switch when actuated. The light should stay on and not blink when the ATC gets to the back location.

219 - SPINDLE ERROR - The spindle was commanded to turn on but the tool clamp is not in the clamped position. Check the tool clamp limit switches. - Check that the tool clamp limit switch is functioning correctly. Check the LED on the back of the control. Use the Hardware Tester application to confirm the proper inputs.

5.8.8 Diagnostics Table

The following is a list of symptoms for the ATC and possible causes and remedies.

| Symptom | Possible Cause | Remedy |
|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ATC will not move to the front or back positions | <ul style="list-style-type: none"> • The door is open • Compressed air is not being supplied to the machine. • Low air pressure, dirty air filter • The solenoid is not receiving an electrical signal. • The tube supplying air to | <ul style="list-style-type: none"> • Close the door. • Supply 90 psi air to the machine • Find the cause of the low air pressure. Pressure should be 90 psi at the machines regulator, clean or replace filter. • Check the LED light on the computer module to see if the output has been triggered to move ATC move out or in. • Replace and re-route |

| | | |
|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <p>advance the sliding mechanism toward the spindle became pinched or obstructed.</p> <ul style="list-style-type: none"> • A mechanical obstruction is preventing movement. • The ATC door lift assist cylinder is jammed, or its flow controls are closed too much and do not allow sufficient amount of air flow to lift the door up and assist the ATC cylinder. This causes too much resistance for the ATC cylinder and will prevent the ATC cylinder from moving forward. | <p>pinched tubing.</p> <ul style="list-style-type: none"> • Remove the obstruction • Adjust the ATC door assist lift cylinder flow controls as specified in section 5.9. |
| 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 Do not leave tool in the spindle for long periods of time or overnight. |
| Tool holder falls from the spindle during a tool change | <ul style="list-style-type: none"> • An incorrect retention knob is being used. • The pull fingers inside the spindle are damaged, jammed open or missing | <ul style="list-style-type: none"> • Locate and use the proper retention knob. • Visually inspect the pull fingers. |

5.9 Pneumatic Diagnostics

Air is a vital component to the operation of the 2 OP machine and is used to run many key components on the machine. Air is used to run the tool change carriage cylinder, clamp and unclamp tools in the spindle, and to clean the spindle taper during a tool change.

The following is a brief description of the pneumatic components used on the 2 OP machine. Please refer to drawing 27563-1 at the rear of the manual for a schematic of the pneumatic system.

1. Supply Air Line to Machine – in order to provide the proper pressure and volume of air necessary to run the 2 OP you must use an air supply line with a minimum ID diameter of 3/8", we recommend a 1/2" supply line. The main air line is connected to the machine in the back of the machine.
2. 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 and should not need to be adjusted. The air pressure can be adjusted by lifting up on the 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 160 psi. Liquid impurities, for instance water and compressor oils, and other solid particles in the compressed air that are above 40 microns in size, are filtered out and collected in the filter below the regulator. Solid particles are captured in the filter

element, and the liquid impurities collect on the bottom of the filter bowl. The liquid impurities will be released automatically once they reach a certain level.

3. Air regulator (door) – a 2nd air regulator is used to control the air pressure to the door open cylinder. This air regulator is to be set so the door requires around 8 to 10 lbs of force to lift. This regulator should be set to around 70 to 75 psi to accomplish this task.
4. Air regulator (spindle) – a 3rd air regulator is used to provide pressurize air to the spindle cartridge. This will help prevent debris from getting inside. It is set between 7 and 10 psi. In addition to this, a spindle ring is mounted to the dogs of the spindle as an extra measure to prevent coolant from getting inside of the spindle.
5. Air Pressure Switch – the 2 OP 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 60 psi. The low pressure setting on this switch is set on the "RANGE" scale at the factory to 60 psi (4 kg/cm²), and the differential pressure setting is set on the "DIFF" scale to ~22 psi (1.5 kg/cm²). These values should not need to be adjusted in the field. If necessary, the low pressure setting "Range" can be adjusted by turning the right screw on the top of the switch. The CW adjustment will reduce this setting and CCW will increase it. The differential pressure setting "DIFF" is adjusted by turning the left screw on the top of the switch. The CW adjustment will increase the value and CCW will reduce it.

Note - The "Range" is total pressure range that this switch can be adjusted or set to trip at. The "Diff" setting is for setting the maximum pressure difference between the input and output. If this difference is exceeded the switch will also trip.

6. Solenoids Valves – the 2 OP Mill has 2 solenoid valves as seen on the schematic drawing 27563-1. These valves are designed to control various functions of the pneumatic system.
 - a) Valve labeled "1" (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. It also provides air to blow down the center of the spindle when changing tools. This helps blow chips or debris off of the spindle taper and tool holder during a tool change.
 - b) Valve labeled "2" – this is a dual solenoid, 4 Way valve and designed to control the direction of flow of air to the ATC carriage cylinder and the ATC door lift cylinder. It moves the ATC front and back depending on which solenoid is energized. This valve also supplies air to the door lift cylinder, which assists in opening and closing the ATC door.
 - c) Valve Manual Override – each valve has a ¼" red button that protrudes 1/8" out of the valve near each solenoid that can be pushed in to manually shift/operate the valve. This feature should **not** be used to adjust the ATC cylinder, but it can be used to adjust the tool unclamp cylinder operation and thru spindle air. The electrical power does not have to be connected to use this feature.

Pressing the manual override button basically shifts the valve in the same direction as if it was operated via the adjacent solenoid during the normal machine operation. These buttons are normally spring loaded OUT. They have two basic functions:

1. Push button - when pushed in they shift the valve, and when released the valve shifts back.
2. Push and Twist to Lock - when pushed down and twisted clockwise, the button will stay down and stick out only about 1/16" in this state. The valve will shift and will stay shifted until the button is twisted counterclockwise to unlock it. Once unlocked, the button will return to its OUT position (stick out 1/8"), and act as a spring loaded push button.

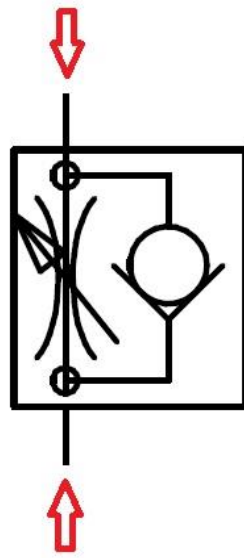
The locked down button is often forgotten after the machine troubleshooting/diagnostics are completed. It is often hard to notice that the button is down, and if left in the locked position, the machine will not function properly, which may lead to confusion and cause a more serious and complicated machine problem or malfunction.

Warning!

Do not activate the valve #2 manually if the Y-axis is not completely forward, (0.40 inches past the actual soft limit) or if the Z axis is not in its upper most position. Failure to do so may lead to a crash of the ATC into the table or head. Also, never activate the air tool change cylinder valve 1 when there is a tool still in the spindle.

7. Flow Control Valves – the 2 OP has 6 air flow control valves and are labeled 1 through 6 on drawing 27563-1. The tool carrier carriage cylinder has 2 of them (labeled 1 and 2), which control the speed at which the ATC moves front and back. The flow control labeled 2 controls the speed at which the ATC will move out. The flow control labeled 1 controls how fast it moves back. They are adjusted at the factory by opening them to make the ATC move as fast as possible but smooth and without a noticeable bounce at the end of the stroke. Note: The ATC flow controls must be adjusted in conjunction with the ATC cylinder's internal cushions for the optimum operation – see below for adjustment procedure. It should take approximately 1.2 to 1.4 seconds to move out and 1.2 to 1.4 seconds to move back in. Flow control valve labeled 3 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 it approximately 8 full turns. Flow controls 4 through 6 are used to control the speed of the tool change door lift assist cylinder (see procedure on the next page). These flow controls should also be adjusted to obtain a fast but smooth door operation. Flow control #6 controls how fast the door can open by regulating how fast the air can exhaust from the cylinder. Flow control #5 controls how fast the door is permitted to close. Flow control #4 works in conjunction with #5 when closing the door. See below for a guideline on how to adjust the flow controls.

Note – it is important to route the air lines properly when replacing a flow control valve. Failure to do so will cause the system to not behave properly when adjustments are made. Figure 5.9 explains how a flow control valve works.



Air flowing down through the flow control valve from the top is metered by adjusting the flow control screw. Air cannot flow down the parallel path where the ball is shown.

Air flowing up through the flow control valve is un-metered as it passes up through the path where the ball is shown.

Figure 5.9

ATC Cylinder initial Adjustments

Front Flow Control adjustment (labeled 2 on drawing 27563-1) – commonly known as “meter-out” type, it controls the air exhausting from the cylinder, it is used to adjust the speed of the ATC cylinder as it extends toward the work table.

Initial adjustment - close the flow control all the way**, mark the knob with a black marker to establish a reference starting point, and then open it 10 full turns.

Front Internal Cushion adjustment – this air cushion controls the deceleration of the cylinder when it is within the last 1.5 inches of its full extension. It causes the cylinder to slow down gradually near the end of the extend stroke. See figure 5.9a.

Initial adjustment – using a 3mm Allen wrench close the cushion all the way down, and open it 1/2 of a turn.

Rear Flow Control (mounted on the exhaust port of the quick exhaust valve, labeled 1 on drawing 27563-1) - this “metering-out” type flow control is used to control the speed of the ATC cylinder as it retracts back to its home position.

Initial adjustment - close the flow control all the way, mark the knob with a black marker to establish a reference starting point, and then open it 1 1/2 turns.

Rear Internal Cushion adjustment – this air cushion controls the deceleration of the cylinder when it is within the last 1.5 inches of the full retraction. It causes the cylinder to slow down gradually near the end of the retract stroke.

Initial adjustment – close the cushion all the way down, and open it 1/4 turn. Figure 5.9a shows both cushions on the ATC cylinder.

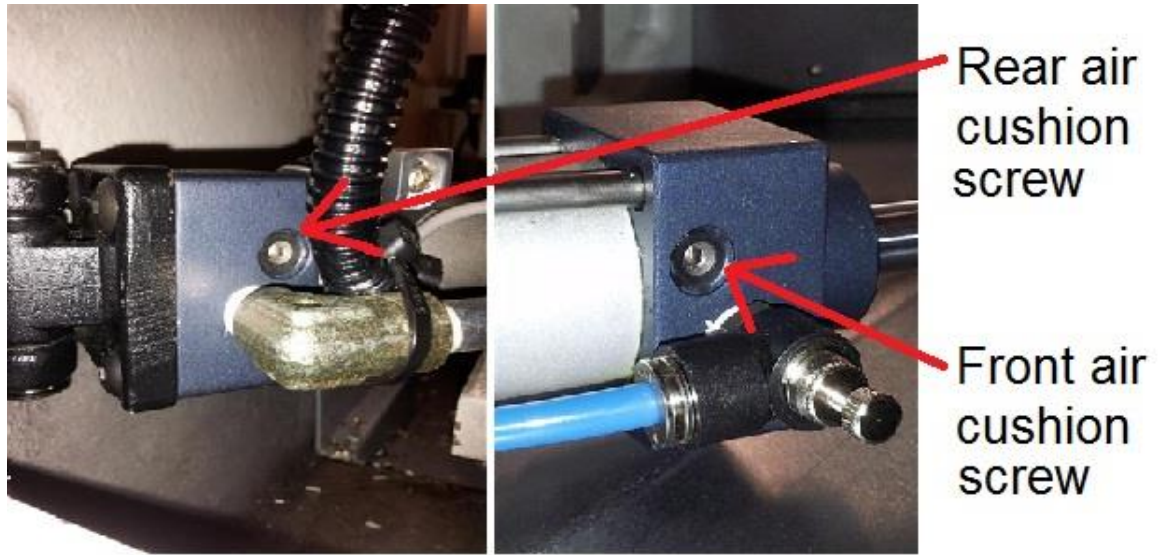


Figure 5.9a

ATC Door Assist Cylinder initial adjustments

Door opening

Front Flow Control - this flow control is a “metering-out” type (labeled 6 on drawing 27563), it controls the air exhausting from the front of the cylinder, it is used to adjust the speed of the door cylinder as it extends and lifts the door up.

Initial adjustment - close the flow control all the way**, mark the knob with a black marker to establish a reference starting point, and then open it 1 3/4 full turns.

Door closing

Rear Flow Control- this flow control is a “metering-out” type (labeled 4 on Sheet 2 of drawing 27563-1), it controls the air exhausting from the back of the cylinder, it is used to adjust the speed of the door cylinder as it retracts and closes the door.*

Initial adjustment – close the flow control all the way**, mark the knob with a black marker to establish a reference starting point, and then open it 1 1/2 full turns.

* In order to close the door in a relatively controlled manner, a second flow control for controlling the air going into the cylinder is used; this flow control is commonly known as a “metering –in” type (labeled 5 on drawing 27563-1).

Initial adjustment - close the flow control all the way**, mark the knob with a black marker to establish a reference starting point, then open it 1 1/2 full turns.

**Note: When closing flow controls used on this machine you will not feel a hard stop when the flow control is completely closed, but you will feel a noticeable change in tightening resistance as you approach the closed position, please use reasonable care and do not over tighten them.

8. Air/Oil Tool Change Cylinder – this is air-over-oil cylinder that is mounted near the top, behind the spindle. Its output line carries high-pressure oil to the hydraulic cylinder built into the spindle, for clamping and unclamping tools in the spindle. Please make sure to monitor a small oil reservoir cup that is mounted near this cylinder, just above the head

- sheet metal enclosure for easy visibility. The oil level inside this reservoir will only drop if there is a leak in the system. Please note that the solenoid valve #1 described in item 5a provides air to this cylinder and a 2nd air line provides the air that is directed down through the center of the spindle. See section 6.15 for how to bleed this hydraulic system if air gets into it.
9. ATC Air Cylinder – this is the cylinder that moves the ATC to the front and back when changing tools. This cylinder has two adjustable internal cushions designed to decelerate the carriage motion as smoothly as possible, as it approaches each end of its stroke. These adjustment screws are located in the front and back end cap of the cylinder next to the air line connections. They are factory set, and should not be tempered with. The cushions must be properly adjusted to take advantage of this feature. The basic adjustment of the cushion requires that the screw be turned almost all the way in at first, and as the cylinder is moved back and forth with full load, the screw is slowly unscrewed until the deceleration of the carriage is smooth and soft – see the initial setting procedure above.
 10. Quick Exhaust – the 2 OP has a quick exhaust valve that helps to exhaust air quickly. On the tool carrier carriage cylinder, the quick exhaust prevents the air cylinder from seeing too high of a pressure during the ATC shift from the first to the second row of tools. Once again, if you need to replace a quick exhaust valve, you must make sure to mount it properly, as shown on the pneumatic schematic, drawing 27563-1.
 11. Reservoir Tank – this tank is used to store extra volume of compressed air for the front door assist cylinder in the event the 90 psi compressed air supply line is disconnected from the machine. It also acts as an air pressure accumulator to help maintain the air pressure relatively constant during opening and closing of the front door. This tank will keep the door feeling light even if the air supply is suddenly disconnected or removed. Due to the check valve installed before the tank's pressure regulator, the pressure will stay in the front door reservoir tank overnight assuming you do not open and close the door many times with the air disconnected.
 12. Check Valve – there is one check valve found prior to the inlet of the door pressure regulator. It prevents air from exhausting from this line when air is removed from the machine.
 13. Tank Bleed Off Valve – this is used to remove air and drain any water or oil from the reservoir tank. This valve must remain closed during normal operation.

5.9.1 Air Quality

Air quality is very important in the pneumatic system of the 2 OP Mill. The most common problem with the compressed air quality is the presence of water. Water contamination has a negative impact on the longevity and performance 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 2 OP Mill.

The 2 OP does have a filter with water separation ability but it can only handle a small amount of water per day, and if a larger amount of water was to enter the air line at one time, water may move downstream of this device and cause problems with the pneumatic components.

Note: Valves and cylinders on this machine are internally pre-lubricated with grease from the manufacturer; therefore no external lubrication is needed nor recommended.

The following table is a quick reference guide for troubleshooting problems related to the pneumatic system.

| Problems with | Can contribute to |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Air Pressure Switch or low air pressure | <ul style="list-style-type: none"> • 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 521. |
| Air Flow Control Valves | <ul style="list-style-type: none"> • ATC will move in and out either too fast or too slow • Too little air is coming down through the spindle which can lead to chips sticking inside of the spindle taper • Make sure they are installed properly and air flows in the correct direction. |

5.10 Coolant Diagnostics

The coolant system consists of a 115 volt coolant pump, coolant tank and various hoses that supply coolant to various aspects of the machine. For an illustration of the coolant system, see drawing 27557 located in the rear of the manual.

The following summarizes various aspects of the coolant system.

1. Coolant pump – the coolant pump serves 2 purposes. It supplies coolant to the cutting tool and also washes chips away from the rear of the table so the ATC can move forward and backward smoothly. If the coolant wash is not working properly to clean chips away, it could lead to the ATC not moving forward enough which may lead to error messages or a possible machine crash when changing tools.
2. Coolant Wash Nozzles – the coolant wash supplies coolant to the rear of the table via 2 nozzles. The nozzles are flexible and should be directed as shown in the picture below. It is very important to make sure the lines are routed as shown so chips are washed away from the path that the ATC travels. Note: most M11 machines will have this set of nozzles mounted on the right side to provide room for indexer option.



Figure 5.10

1. Chip Coolant Screen – the coolant tank contains a screen to filter out any chips or debris from the coolant pumps. Please see drawing 27557, item 8 for an illustration of this item. Depending on the machine usage, and the material being machined, this screen may need to be cleaned at various intervals. If the coolant is not draining fast enough and causes low coolant flow, the screen needs to be cleaned. This screens simply rests on top of the coolant tank.
2. Coolant Hoses – there are 2 coolant hoses attached to the coolant pump. One hose delivers coolant to the nozzle on the head, and the second one to the nozzle used for washing chips from the back of the worktable.
3. Coolant Drain Plug – there is a drain plug near the bottom left corner on front of the machine intended for coolant draining from the tank.
4. Coolant level Sight Gauge - An external coolant level sight gauge is mounted on the front of the coolant tank. It gives the operator an easy way to visually check how much coolant is in the tank.
5. Coolant tank capacity – the capacity of the coolant tank on the 2 OP Mill is approximately 15 gal.

6. Rear Drain Plug – at the rear of the machine there is a drain plug in the floor of the machine that can be removed to drain any coolant that collects in the rear compartment of the machine. Over time as coolant splashes around, some coolant may accumulate in this area.

5.11 Service Codes

Service codes are broken down into the following categories: software, machine setup, diagnostics, user options/defaults.

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 CODE #, enter the number you want, then press SET.

Warning!

Certain service codes must be performed when servicing certain items on the 2 OP. Failure to do so can lead to machine crashes and expensive repair work. Do not work on the TRAK 2 OP 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 TMX 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. |
| 400 | Update Foreign Language MLS File | Used to update the software language table. Please contact your distributor for available languages and for more information. |

Machine Set-Up

| | | |
|-----|-------------------------------|--------------------------------------------------------------|
| 122 | Axis Calibration Using Offset | |
| 123 | Calibration Mode | Use to calibrate the TMX control |
| 128 | Backlash Calibration Constant | Use to load backlash compensation for each axis. |
| 500 | X, Y Ball Lock Offsets | Used to enter the offsets for ball lock |
| 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. |
| 520 | Set Tool Carrier Locations | Use to set the 8 ATC tool locations as well as the tool change height. |
| 530 | Set Machine & Computer Module Serial Numbers | Used to set the machines serial number, motherboard MAC address and computer module serial number. |

Diagnostic Codes

| | | |
|-----|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Program, File, Log Back up | The following service code captures all important data from the 2 OP machine. This includes the users program, configuration files, message log, fault log etc. This is meant to be used to help us solve problems that may pertain to our software. This file can then be emailed to our service department. |
| 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. |
| 131 | Manual DRO | Turns off servos so you can check encoders |
| 132 | Electronic Handwheel Test | Test the EHW signals |
| 319 | Message Log | Logs the machine as it runs. It captures all key presses, error messages and data as the machine runs. It is saved automatically with service code 1. |
| 320 | Fault Log | A log that captures all faults and error messages. |
| 326 | Error Message Display | Displays error messages on screen |
| 327 | Display Memory Check | Displays memory availability of various devices |
| 342 | Test Light Indicator | Turns on and off some test lights used for troubleshooting blocks per second problems. |
| 521 | Check Control IO (input/output) | Application used to check all machine input and outputs. |

Operator Defaults/Options

| | | |
|-----|---------------------------|---------------------------------------------------------------------------------|
| 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 |
| 203 | Initiate Homing Sequence | Homes machine when entered |
| 300 | Set Lube Pump | Allows user to manual run lube pump and adjust frequency and discharge times. |
| 345 | Set Part Program Location | Sets the location of part program storage between a USB device and to a network |
| 503 | Set Maximum Feedrate | Sets the rapid speed for the machine. Default is 600 ipm |

5.11.1 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.

5.11.1.1 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 software you have installed.
- **Operating System Version** – shows the version of the CE operating system. Hit the MORE button to see the OS version number

5.11.1.2 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, etc. 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 2 OP, you must have the following file structure. On your thumb drive you need to have a folder called PT8, with a subfolder called CONFIG.

5.11.1.3 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, etc. 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.

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

5.11.1.4 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. Follow the instructions on the screen.

5.11.2 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.

5.11.2.1 CODE 122: Calibration Using Offset

Measure your part and compare the actual measurement to the dimension desired. For example, say you squared a block using a 3" by 3" rectangular frame. When you measure the parts you find the actual measurements are the following:

X dimension = 3.003

Y dimension = 2.995

To calculate your offset, do the following:

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$$\begin{aligned} \text{X calibration offset} &= \text{programmed} \div \text{actual} = 3.000 \div 3.003 = 0.9990 \\ \text{Y calibration offset} &= \text{programmed} \div \text{actual} = 3.000 \div 2.995 = 1.0017 \end{aligned}$$

For your Z axis calibration, machine a reference plane and set your DRO Z readout to 0. Use the DRO to position the quill down some number, for example 1.00". Machine some material away from a corner so it will be easy to measure the difference between your reference plane and your new plane.

To calculate your offset with a 1.000" difference in position, measure the actual amount machined and compare it with 1.000".

For example, if your measurement showed the difference between the reference plane and the machined plane is 0.985", calculate the offset:

$$\text{Z calibration offset} = \text{DRO} \div \text{actual} = 1.000 \div 0.985 = 1.0152$$

Once you have calculated your values, use Service Code 122 to enter them.

5.11.2.2 CODE 123: Calibration

See Section 7.1 for a further explanation of this code.

5.11.2.3 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. See section 7.2 for more information on this service code.

5.11.2.4 Code 500: XY Ball Lock Offsets

This code defines the locations of the ball lock located on the machine's table, relative to 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 .0001" dial indicator and sweeping in the ball lock receiver. Major changes to the home switches or cams may also require this service code to be redone.

5.11.2.5 Code 505: Over Travel Limits

When entering this service code, the soft limits will be disabled so as to allow for setup or troubleshooting.

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 home 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 problems. See section 6.20 for a procedure.

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 brings up a table that shows the default soft limits. These values should not have to be changed by the user.

5.11.2.6 Code 510: 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. See section 6.2.2 for procedure.
 - a) ATC FRONT – brings the ATC in towards the user. Make sure the Z axis is high enough to clear the ATC before using.
 - b) ATC BACK – moves the ATC back out and away from the user.
 - 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.

5.11.2.7 Code 520: Set Tool Change Locations

Use this service code to set the 8 ATC locations. The locations are relative to the machines home position.

Follow the directions on the screen. All 8 locations should be set by using a dial indicator to sweep in the taper on a tool. The X and Y coordinate should be within 0.005" or so on your indicator. In other words, there is some room for error, but these tool locations cannot be set by eyesight.

The Z tool change height is defined as the location that Z axis must go to load a tool into the ATC. See section 5.8.2 above for more instructions.

Once you have all tools set properly and the Z height, press the "SAVE TABLE" button to save all tool locations.

5.11.2.7 Code 530: Set Machine and Computer Module Serial Numbers

In order for the machine to be fully functional, the system requires both the serial # from the machine and from the computer module to be entered. When you receive your new machine, the serial numbers should already be entered and ready to go. However, if you were to ever replace the computer module, then the serial numbers will need to be entered upon installation.

To enter the machine's serial #, press MACHINE SERIAL and then use the alpha matrix to enter your machine's serial #, which should be found on an outside sheet metal plate on the machine.

To enter the computer module's serial #, press COM MOD SERIAL and use the alpha matrix to enter the serial #. The computer module is found in the back of the machine, inside the electrical cabinet. It is the main component on the lower left corner, and should have a visible sticker with the serial # on it.

This information is used for logging into code 319 and code 1.

5.11.3 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.

5.11.3.0 Code 1: Program, File, Log Backup

This service code is meant for trying to backup everything currently in memory, for the sake of troubleshooting. Along with the logs from code 319, and the config files from code 142, this will also save the current program in memory, tool table, and various other files that may be useful for pinpointing a problem that may have occurred.

All the above files will be put saved into a ZIP file onto the destination USB flash drive, and will be named SWI_Service_Code_1.zip.

5.11.3.1 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.

5.11.3.2 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.

5.11.3.3 Code 131: Manual DRO

A manual diagnostic routine used to check the motors' encoders. The E stop must be pressed before entering this service code. This turns the servo's off and allows the X and Y axis ballscrew to be turned. 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. The Z axis cannot be checked with this service code.

5.11.3.4 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.

5.11.3.5 Code 319: Message Log

This service code captures data as the machine runs. It captures key presses, error messages, commands sent to the motion control system amongst other things. This is the key piece of information we request when dealing with a potential software problem. This file can be saved via service code 319 or when running service code 1. The preference is to run service code 1 as this captures these files along with others that we may want to review.

You can navigate the log via the PAGE FWD and PAGE BACK soft keys on the screen. Use the EHW 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. If you press MORE, you can turn the log on and off, the default is on. The log should not be turned off. The message log file will capture data up to a point and then the file is saved to a backup file and the original file is cleared and data is once again captured. There is also a clear log file, which is useful if you have a problem that you can duplicate. It is nice to clear the file and then run your program to capture just the information that pertains to the problem. From here the user can save the 2 files to a USB flash drive. Once this is done it prompts you to save the files individually. Again, it is better to run service code 1 to capture the logs.

Lastly, there is another MORE button on the 2nd page of the message log. This allows the user to change the logging capabilities. The log leaves the factory with the following settings. These should not be changes unless specifically requested by a SWI representative. Turning on the logging features that are off may have a negative impact on the motion control system.

| SERV | SERVO ON | INCH |
|-------------------------------------------|----------|------|
| Log Critical Messages to file: | YES | |
| Log Information Messages to file: | YES | |
| Log Debug Messages to file: | YES | |
| Log Realtime Messages to file: | NO | |
| Display Critical Messages in viewer: | YES | |
| Display Informational Messages in viewer: | YES | |
| Display Debug Messages in viewer: | YES | |
| Display Realtime Messages in viewer | NO | |

| | | | | |
|-------------|--------------|--|------------|--------|
| DATA FWD | DATA BACK | | YES/ NO | RETURN |
|-------------|--------------|--|------------|--------|

5.11.3.6 Code 326: Error Message Display

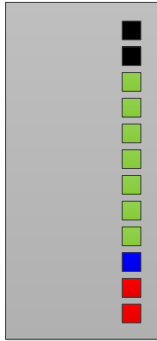
Useful for checking error messages if the error number is already known.

5.11.3.7 Code 327: Display Memory Check

This service code is used to check the amount of free memory available from system RAM or a USB device. 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.

5.11.3.8 Code 342: Test Light Indicator

When service code 342 is enabled, the following is displayed in the bottom right-hand corner of the screen. These test light will aid in understanding problems associated with running G code programs that may not be running smoothly. This will identify if the blocks per second rate for the machine has been exceeded.



The upper 9 squares will indicate how much of the buffer is loaded with moves, in 10 percent increments. When they are all green, the buffer is between 90 and 100% full. When the top one is black and the rest are green, the buffer is between 80 and 90% full. The example at the right shows the buffer is between 70 and 80% full. When it gets below 70% the lights turn yellow and below 40% they turn red.

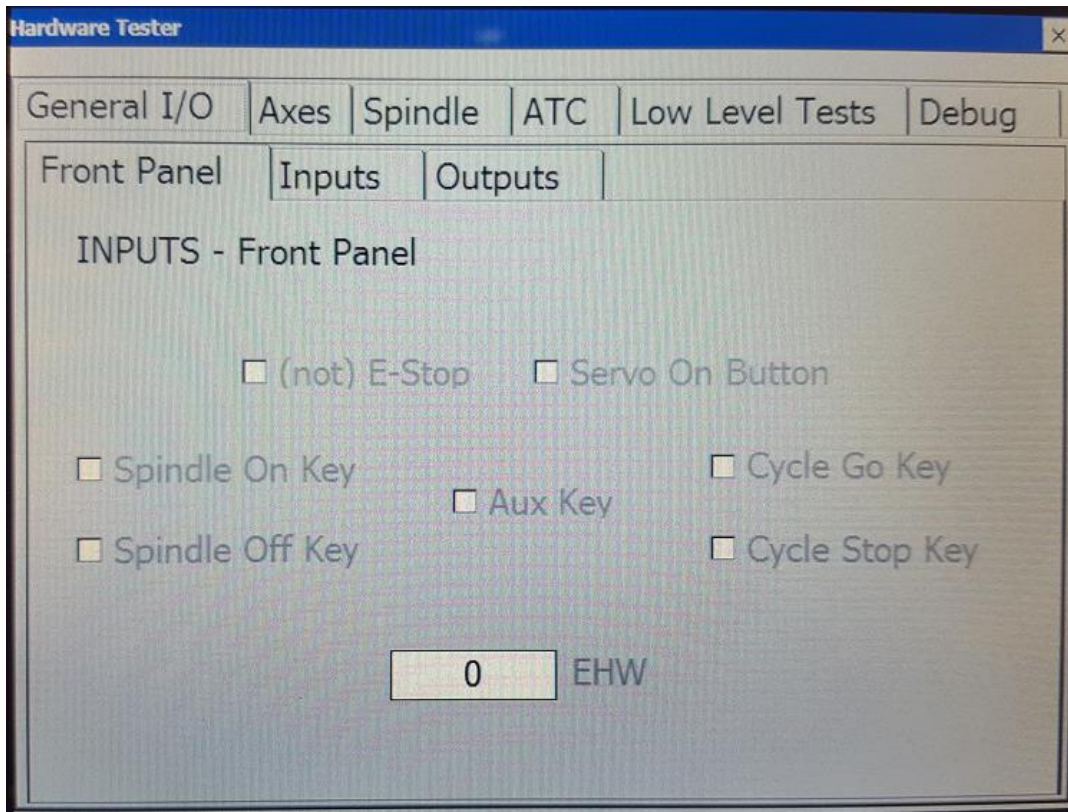
The blue light indicates that the binary file is still being processed. It will go to black when processing is done.

The red light, second from the bottom goes red when moves are being processed at or above our maximum BPS rate. The bottom light goes red if the slave ever takes longer than 1ms to execute. This only seems to happen if "real-time" logging is enable on the slave.

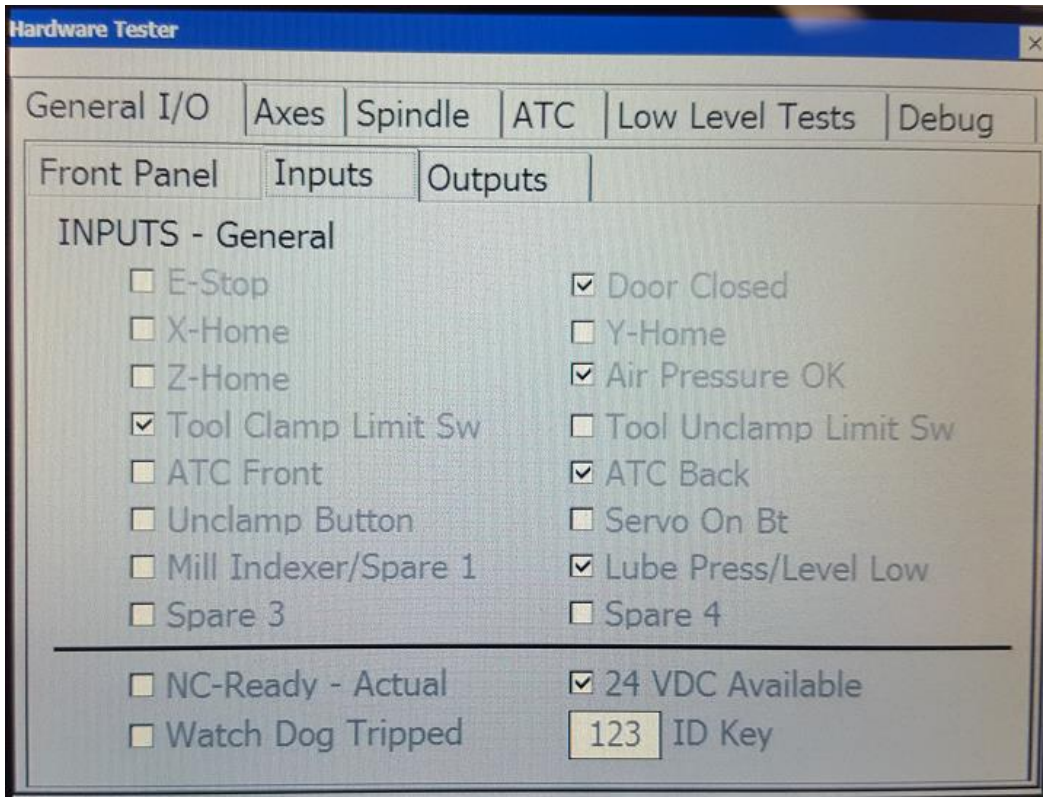
5.11.3.9 Code 521: Check Control I/O

This service launches a separate application which allows the user to check the various inputs and outputs on the machine. It is mainly used for troubleshooting purposes. The figures below depicts what some of the screens look like. Our software shuts down once this application is launched. This application is closed down when you press the X in the upper right hand corner. The machine must be turned off and back on to launch our TMX software.

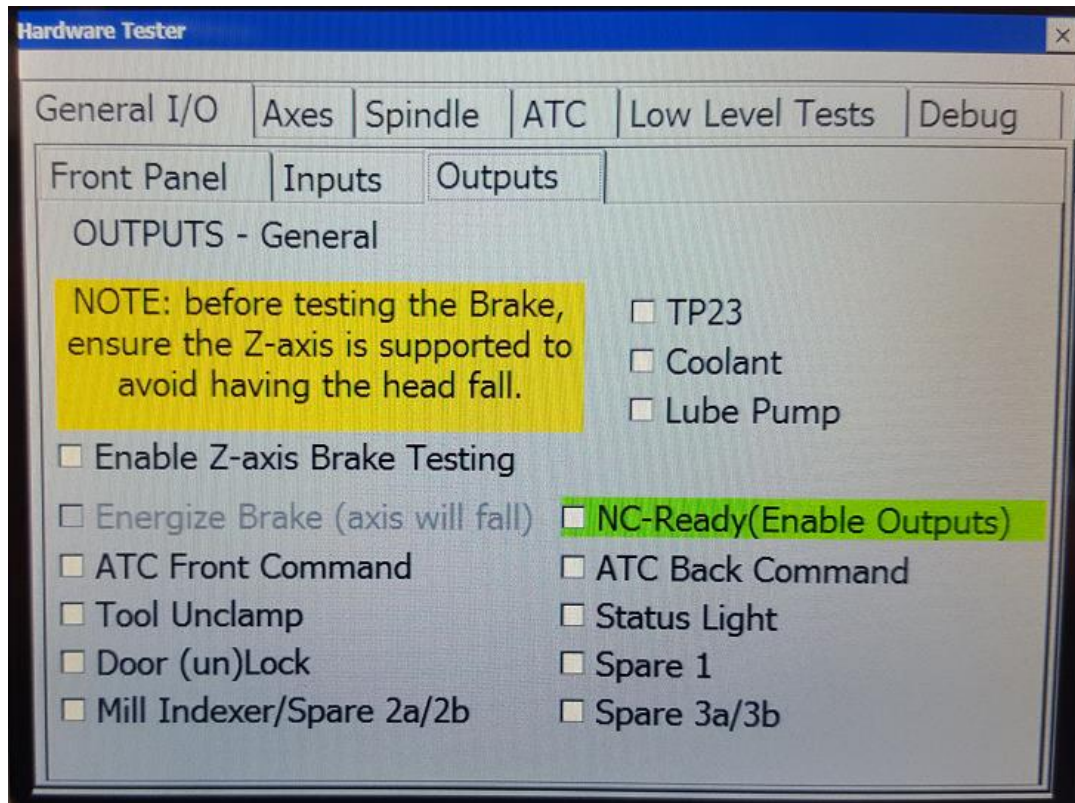
The following screen tests the following buttons on the front panel. Pressing the Cycle Go Key for example will highlight the white box.



The following INPUT screen allows you to check all the inputs on the control. Triggering an input, by pressing a switch for example, will highlight the corresponding white box.



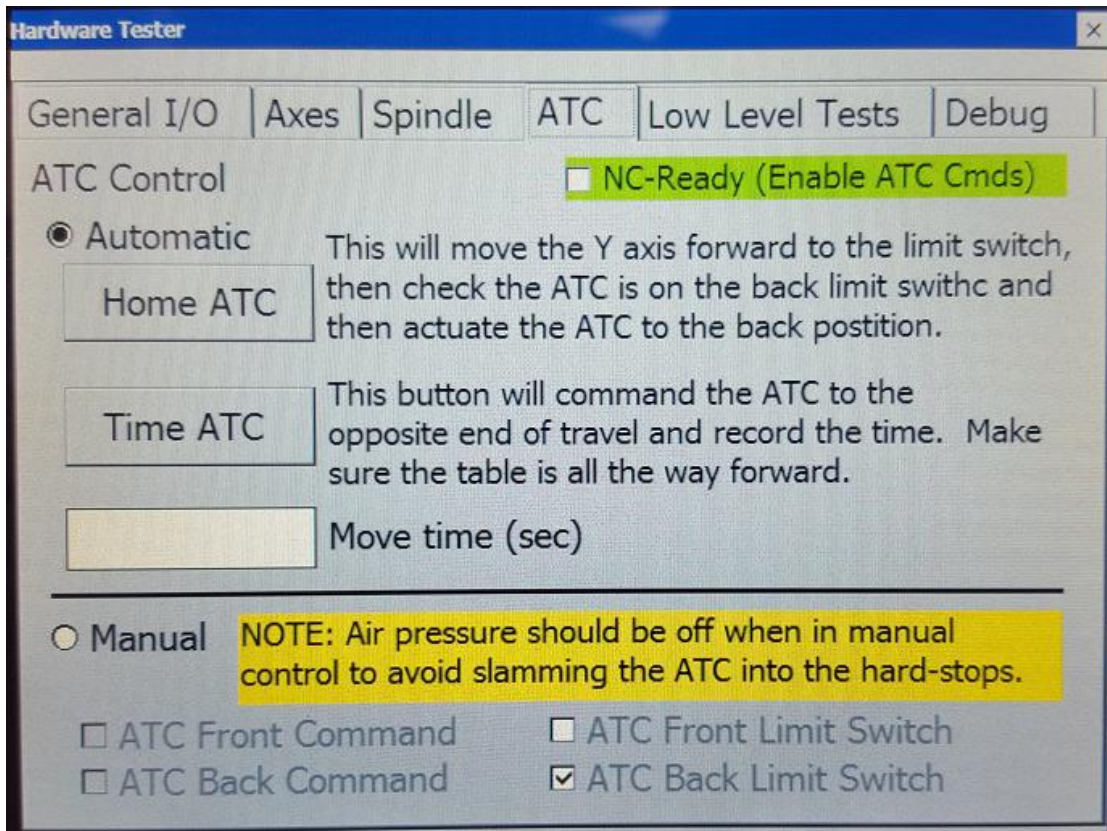
The following OUTPUT screen allows you to trigger various outputs on this machine. For example, if you click the white box for coolant, the pump will come on. Please note the NOTE about the brake. The NC Ready box also needs to be checked before any outputs can be triggered.



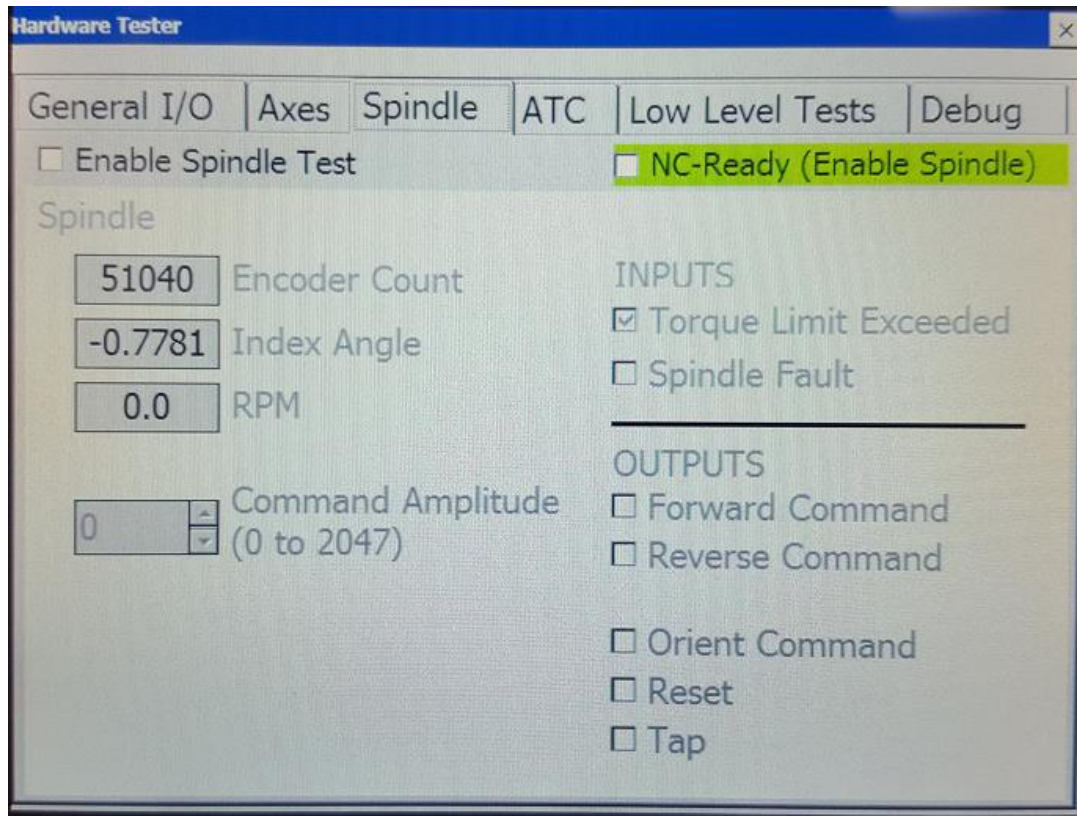
Warning

Be careful when commanding the ATC to move in this service code as it may cause the ATC to slam into the back of the table. There is a good chance the table is not in the correct position when in this mode.

The following ATC screen allows you to time the ATC movement in and out. We use this to set the flow controls for the ATC cylinder. The range of acceptability is 1 to 1.2 seconds. The Move Time box below will display how long it takes to move the ATC in and out.



The following SPINDLE screen allows you to test the spindle features. Most of these things can be done in service code 510. This is more of an advanced troubleshooting tools. The NC ready and enable spindle test buttons must be pressed before you can proceed.



5.11.4 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.

5.11.4.1 Code 66: Default Metric

This code causes the control to turn on in the metric mode.

5.11.4.2 Code 67: Default English

This code causes the control to turn on in the English mode.

5.11.4.3 Code 79: Beeper On

This turns on the beeper to the control keys.

5.11.4.4 Code 80: Beeper Off

This turns off the beeper to the control keys.

5.11.4.5 Code 203: Initiate Homing Sequence

This service code allows the user to home the machine. Normally this is done on the first screen when the control boots up, but if you exit this screen before homing the machine, you can also

home the machine via service code 203. You cannot run the machine until the machine is homed.

5.11.4.6 Code 300: Set Lube Pump

Allows user to manual run lube pump and adjust frequency and discharge times. These are factory set and should not need to be changed.

5.11.4.6 Code 345: Set Part Program Location

Allows the user to save programs to a USB device or to a network assuming the company has set up the machine for networking. See the 2 OP Programming and User Manual for more information on networking the ProtoTRAK TMX control.

5.11.4.7 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. The maximum feedrate is 600 ipm or 15240 mm/min

5.11.5 Section E - 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 | <ol style="list-style-type: none"> 1. Motor removed or replaced 2. Motor belt slips 3. Home switch replaced or a major mounting adjustment is made. 4. Home switch cam replaced or a major adjusted is made 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. | <ul style="list-style-type: none"> • The X and/or Y offsets saved with the users programs could now be off as much as 6 mm or 0.236”. • These items only apply when working on the X or Y axis |
| 4 | 505 – checking the motor index angle. Must be set to 180° +/- 45° | <ol style="list-style-type: none"> 1. Motor removed or replaced 2. Motor belt slips 3. Home switch replaced or a major mounting adjustment is made. 4. Home switch cam replaced or a major adjusted is made 5. Ballscrew replaced 6. Angular contact bearings on motor end replaced | <ul style="list-style-type: none"> • 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 | <ol style="list-style-type: none"> 1. Spindle motor has been removed, replaced or motor coupling has slipped during operation 2. AC spindle drive has been replaced (need to reset parameter 10-19, each machine has a unique value) 3. Computer module or compact flash has been | <ul style="list-style-type: none"> • The user will most likely break a finger on the ATC. More severe damage could also occur which could be |

| | | | |
|---|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | replaced and the configuration file was not loaded into the new computer. | costly to the user |
| 6 | 141 – Load configuration file | <ol style="list-style-type: none"> 1. Replace compact flash 2. Replace entire computer module along with compact flash | <ul style="list-style-type: none"> • Machine will crash if 1 or more service codes are not set correctly. • The following service code settings will be wrong: 123, 128, 134, 500, 505 and 510 |
| 7 | 520 – setting the ATC locations | <ol style="list-style-type: none"> 1. ATC replaced 2. ATC finger replaced 3. Motor removed or replaced 4. Motor belt slips 5. Home switch replaced or a major mounting adjustment is made. 6. Home switch cam replaced or a major adjusted is made 7. Ballscrew replaced 8. Angular contact bearings on motor end replaced | <ul style="list-style-type: none"> • This code applies to any work done to the X, Y and Z axis |

6.0 Replacement Procedures

6.1 Axis Motor Replacements

6.1.1 X Axis Motor replacement

Please refer to assembly drawing 27520-1 found at the back of this manual.

Warning!

Whenever the X or Y axes motors are removed, Service Code 520 must be performed **AFTER** index angles are set and machine has been homed. This re-establishes the precise location of the tool pockets of the ATC. Service Code 500 must also be reset for the ball locks.

Removal of the X Motor

1. Remove RH side enclosure sheet metal cover(s) to access X axis motor. Figure 6.1.1a



Figure 6.1.1a

2. If the machine can be jogged under power go to Service Code 505 and jog the X axis to the far right until the "POS X AXIS LIMIT SWITCH" flashing message warning appears on the screen. We are doing this to make it easier to reset the index angle on the motor once it is replaced.
3. If machine cannot be jogged under power it will be necessary to manually move the axis.
4. Using the I/O keyboard (inputs) in Service Code 521 manually turn the "X" axis ball screw to move the axis far to the right until the "X" Axis Home" box check mark appears.

5. Power down the machine.
6. Remove the 3 SHCS holding the X axis motor to the casting. Remove the belt.
7. Carefully maneuver the motor out from the machine casting exposing the cable connections. See figure 6.1.1b.

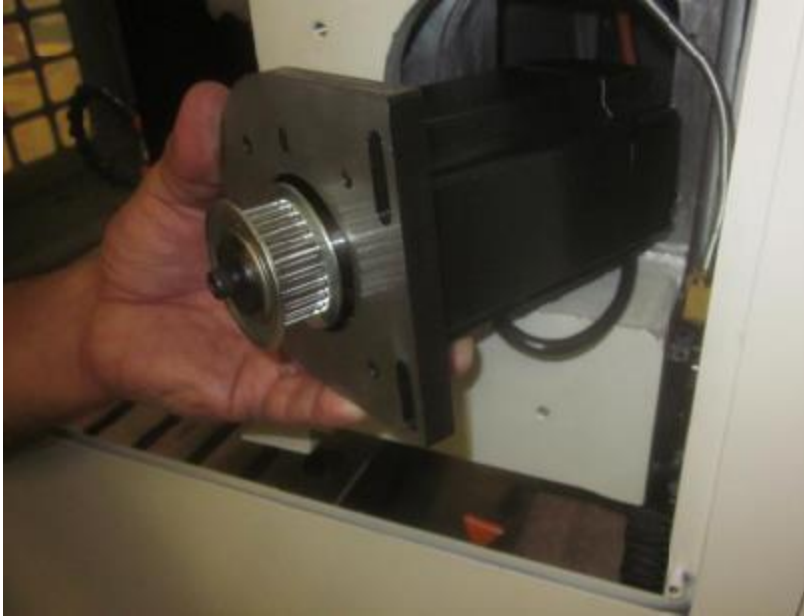


Figure 6.1.1b

8. Place the motor on the shelf area above the mounting cavity. Disconnect the encoder and power cables. See figure 6.1.1c.



Figure 6.1.1c

9. Remove the four SHCS with lock washers attaching the motor and separate the plate from the motor.
- 10.

Installation of the X Motor

11. Attach mounting plate to the new motor (if not previously performed). **Cables face down and the round end of the plate faces toward front of machine when installed.** Torque the M6 SHCS with lock washers and torque to 7 ft-lbs.
12. Place the motor on the shelf portion of the X motor casting above the motor cavity. Connect the encoder and power cables.
13. Maneuver the motor into the cavity using care to not damage the cables. Fasten the motor bracket with 3 SHCS with lock and flat washers.
14. Power up the machine. Note - The machine must be powered down when replacing the motor so the new motor and servo can sync themselves. Go to service code 505. **Note: The machine reads "0" for all axis.**
15. Press the "X" axis button (medium resolution) and rotate the hand wheel 2 or 3 revolutions and stop at 180 degrees to set the motor index angle.
16. Install the belt, set the tension (do not over tighten), re-assemble and torque the M6 motor bracket screws to 7 ft-lbs.
17. Home the machine.
18. Go to Service Code 505 and double check your index angle.
19. Check the Index Angle by jogging the X axis to the right until the "POS X AXIS LIMIT SWITCH" flashing warning on the screen appears. Jog using the finest EHW resolution to best measure the index angle. See figure 6.1.1d. Please note the index angle in this case is 179 for the X axis.

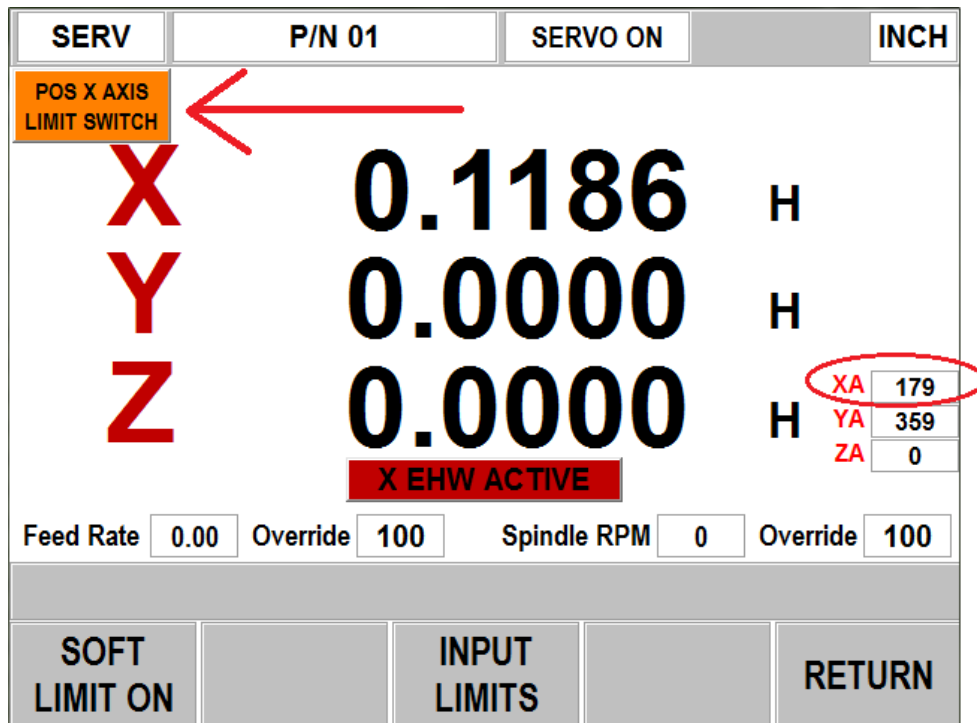


Figure 6.1.1d

- Note the Index Angle number and adjust as necessary. Remember to "Home" the machine if you re-adjust the index angle. Specification is 180 degrees +/- 45 degrees.
- Go to Service Code 520 and perform tool locations for all eight tools. Then go to Service Code 500 and set the "X" and "Y" locations.
- Reinstall all covers.

6.1.2 Y-axis servo motor replacement

Please refer to assembly drawing 27564-1 found at the back of this manual.

Removal of the Y Motor

- If the machine can be jogged under power go to Service Code 505 and jog the "Y" axis forward (use the finest resolution when you get near the limit switch) until the "POS Y AXIS LIMIT SWITCH" flashing warning message appears. Just like it shows in figure 6.1.1d, but for the Y axis.
- If the machine cannot be jogged under power it will be necessary to manually move the axis.
- Using the I/O keyboard (inputs) in Service Code 521 manually turn the ball screw moving the "Y" axis forward until the "Y Axis Home" box check mark appears.
- Power down the machine.
- Locate the Y-axis servo motor at the lower rear section of the 2 Op Mill. Disconnect the encoder and power cables from the machine. See figure 6.1.2.

6. Loosen the four SHCS that attach the motor to the machine. Note: The lower screws fit into "Slots" on the motor mount casting. Remove the upper screws and lift out the motor and belt.

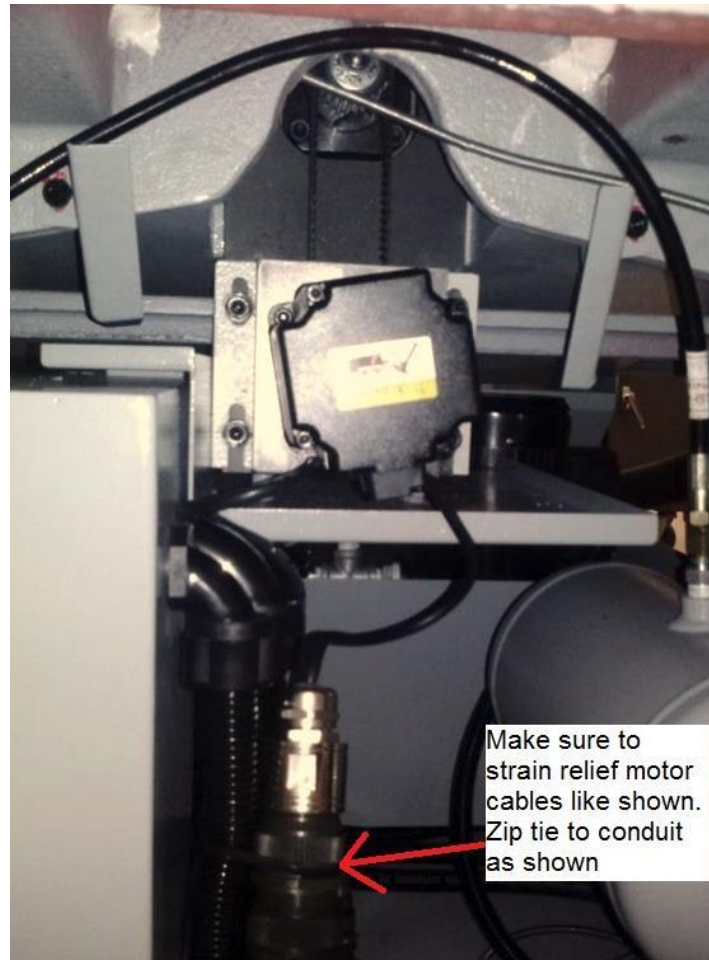


Figure 6.1.2

Installation of the Y Motor

7. Attached the new motor to the motor bracket with M6 SHCS's and tighten to 7 ft-lbs. Make sure cables are point down on motor when installed.
8. Attach the encoder and power cables to the motor. Turn on the machine and go to Service Code 505. **Note: The machine reads "0" for all axis.** Rotate the hand wheel 2 or 3 revolutions stopping at 180 degrees.
9. Install the motor. Set the belt tension (do not over tighten). Torque the M8 bolts to 18 ft-lbs for the motor bracket.
10. Restart the machine and "Home" the machine. The machine must be powered down when replacing the motor so the new motor and servo can sync themselves.
11. Go to Service Code 505.
12. Check the Index Angle by jogging the "Y" axis slowly forward until the "POS Y AXIS LIMIT SWITCH" flashing warning message appears. See figure 6.1.1d above.

13. Note the Index Angle and adjust if necessary. Remember to "Home" the machine if you adjust the Index Angle. Specification is 180 degrees +/- 45 degrees.
14. Go to Service Code 520 and perform tool locations for all eight tools. Go to Service Code 500 and set the "X" and "Y" locations.

Warning!

Whenever the X or Y axes motors are removed, service code 520 must be performed **AFTER** index angles are set and machine has been homed. This re-establishes the precise location of the tool pockets of the ATC. Service code 500 must also be reset.

6.1.3 Z-axis servo motor replacement

Please refer to assembly drawing 27540-1 found at the back of this manual.

Removal of the Z Motor

1. Locate the Z axis servo motor at the top of the column of the 2 Op Mill.
2. If the machine can be jogged under power lower the Z axis so the sheet metal clears access to the motor coupler.

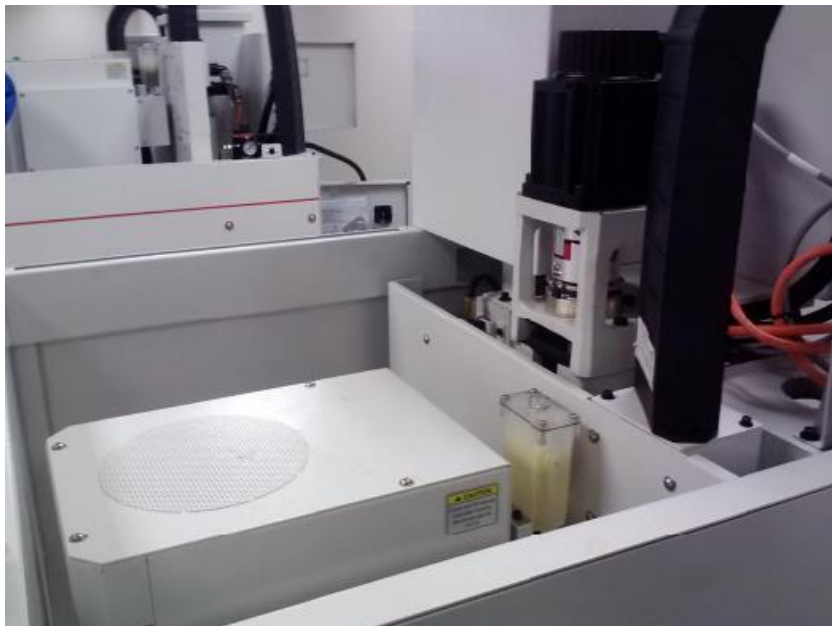


Figure 6.1.3a

3. If the machine cannot be jogged under power it will necessary to manually move the axis.
4. Power off machine.
5. To manually move the Z Axis:
6. Unplug the Z axis brake wire at the computer module found under outputs. This makes sure the brake is on. No power to brake means it is holding. Disconnect encoder and power cables.
7. Remove the four SHCS that mount the motor to the machine.
8. Lift the motor with half of the coupler attached to the motor's shaft off the machine.



Figure 6.1.3b

9. Remove the coupler half from the motor and install the special tool into the coupler.
10. Tighten the bolts securing the tool and assemble the coupler. Use a socket, extension & ratchet to move the ball screw. You will be moving the Z axis against the force of the brake so go slowly.

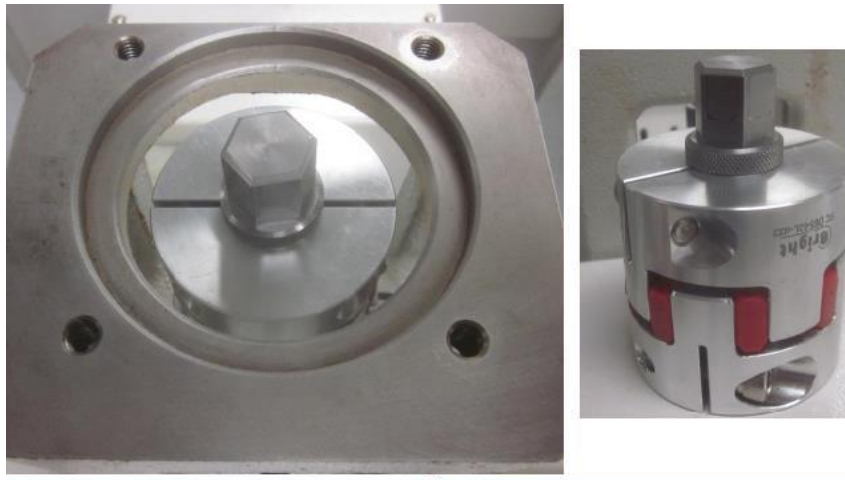


Figure 6.1.3c

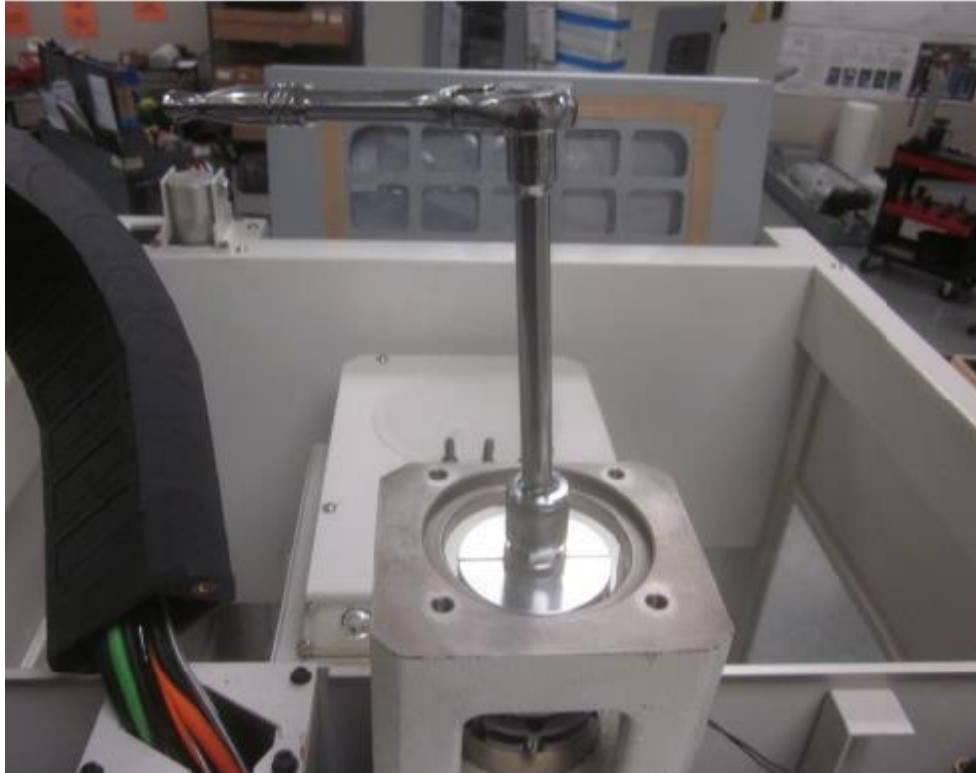


Figure 6.1.3d

11. Lower the Z axis until the motor coupler is accessible as shown in 6.1.3a. Remove the special tool. **Note: Leave the coupler in a position to access the attachment bolts.**
12. As an alternative and if you do not have the tools mentioned above. Do the following to lower the head. Power will need to be on to the control.

Warning!
Be very careful using this method.

13. Place something on the table to prevent the spindle from going too low and hitting something. The block we ship the machine with would be good to use.
14. Press the E stop to turn off power to the servos.
15. Undo the e-stop button but DO NOT turn on the servos. This allows 24 VDC to be output from the computer.
16. Plug the Z brake output cable into the 24 VDC connector on the back of the computer module. This will disengage the brake and allow the head to start moving down due to gravity. Once the head is far enough down, remove the brake cable from the 24 VDC connector and the brake will come back on and the head will stop moving.

Warning!
Whenever the Z-axis motor is removed, service code 520 must be performed to re-establish the precise tool change height

Installing the Z Axis Motor

17. Mount the new motor to the cast motor mount engaging the coupler and tighten the M8 motor SHCS screws to 18 ft-lbs. Tighten the coupler bolts but do not torque to a specific torque yet. Connect the encoder and power cables to the motor.
18. Power up the machine and press SERVO ON button. The machine must be powered down when replacing the motor so the new motor and servo can sync themselves.
19. Go to Service Code 505 to check the Z Index Angle. **Note: Machine reads "0" for all axis.**
20. Move the head all the way up to the Z axis home switch. A flashing message will show up on the screen that says "POS Z AXIS LIMIT SWITCH" once you reach the switch. Make sure to move into this switch at the finest resolution of the EHW.
21. If the motor index angle is off, then remove the Z axis brake cable from the computer module to hold the head in place.
22. First you may need to rotate the motor so the coupling bolts are in a position where you can get to them. Take into account how many degrees you need to move the motor and coupling from when the machine was on the Z axis home switch. For example, let's assume the index angle was reading 90° and you then needed to rotate the coupling 45° to gain access to the bolts, which now makes the index angle read 45°. Now rotate the motor 90 degrees from here so the display reads 135° (45 + 90).
23. Loosen the 2 bolts connecting the motor to the coupler and rotate the motor shaft inside of the coupling using the EHW and set the index angle as described above. Loosen the upper or lower bolts (not both) on the coupler and rotate the hand wheel to obtain the correct number.
24. Snug up the bolts connecting the motor to the coupler. Leave a gap between the aluminum coupler half and the spider of .100"/ 2.5 mm and tighten them to 18 ft-lbs.



Figure 6.1.3e

25. Connect the Z Axis Brake cable back to the output port on the computer module.
26. Turn servos on and go to Service Code 505 and recheck your index angle.
27. Raise the Z Axis until the "POS Z AXIS LIMIT SWITCH" flashing warning message appears. (Use the finest resolution when near the switch). Observe the accessibility of the coupler mounting bolts.
28. Note the Z Index angle. Spec is 180 degrees +/- 45 degrees.
29. Home the machine. Go to Service Code 505 and check Index Angle once more.

30. Enter service code 520 and press the "Input Table" tab to set Z tool change height.
 - a. Place a tool holder in any pocket. Jog the X and Y axes to the pockets coordinates that are displayed in the table.
 - b. Press the orient spindle tab.
 - c. Press the tool unclamp tab.
 - d. Using the EHW, highlight the Z Tool Change dialogue box.
 - e. Jog the Z-axis towards the tool holder, change to .002" resolution as you get close to the tool holder. As the spindle goes over the tool holder, listen for the air to stop escaping from around the tool holder, then back up one click. Enter the Z tool change offset that is displayed in the lower right hand gray box. Press ABS Set.

6.2 AC Spindle Drive Replacement

DANGER!
The AC Drive uses 220 or 440 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 spindle to orientate improperly and may lead to a 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 27648 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 be displayed in the lower left hand corner 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.

6.3 Computer Module Replacement

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

The following service codes **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 142** – Save the configuration file from old computer module to a USB device.
- **Service Code 141** – Load the configuration file back into the new computer from a USB device 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.

3. Remove all cables from the computer module.
4. Remove the 4 SHCS that hold the computer module in place.
5. Fasten the new computer module in place and connect all cables.
6. Turn power on to the machine.
7. Go to service code 141 to load in the saved configuration file.

6.4 Linear Guide Replacement

The linear guides that have come with the 2 OP 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.

6.5 Ballscrew Replacement, X Axis

Please refer to assembly drawing 27520-1 at the back of this manual.

1. Remove the sheet metal and covers
 - a. Remove the side enclosure covers, left and right.
 - b. Remove the X-axis accordion covers, left and right.
 - c. Remove the sheet metal covers that are adjacent to the accordion covers.
2. Remove the X-axis drive belt.
 - a. Loosen the 3 SHCS shown in figure 6.5a and remove the belt.



Figure 6.5a

3. While using a 6mm hex key to prevent the ballscrew from rotating, remove the hex nut, star washer, flat washer, pulley, ferrule and the clamp nut. See figures 6.5b and 6.5c.
- 4.



Figure 6.5b

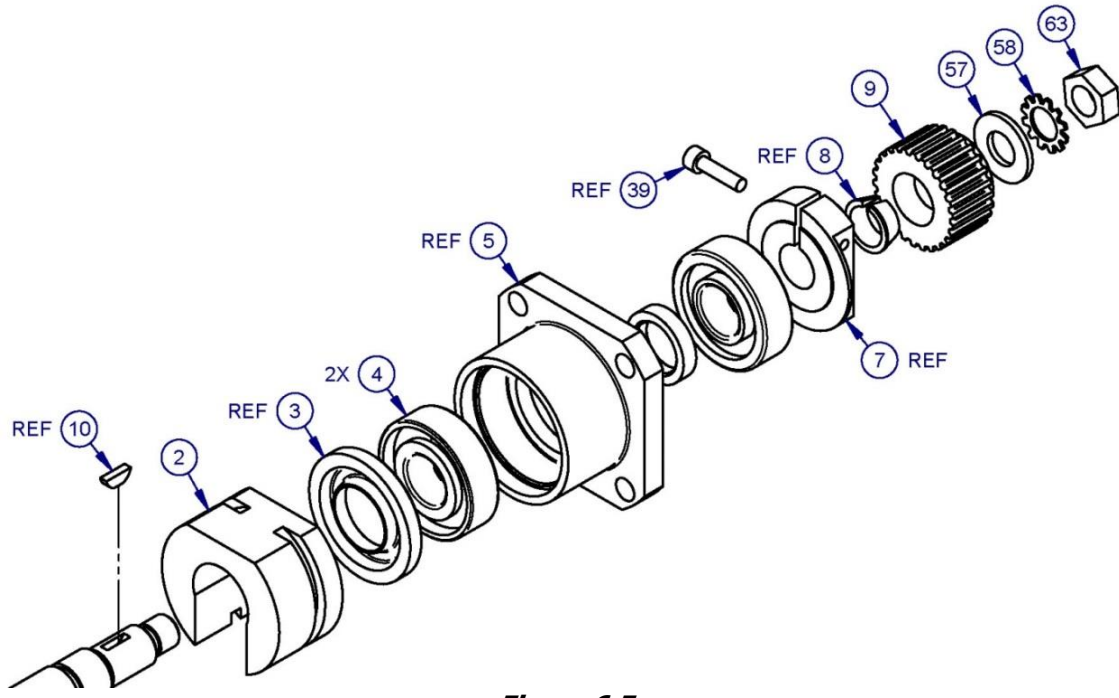


Figure 6.5c
See 27520 for Reference

Remove the oil line that is connected to the ball nut located on the left side of the head, as well as the cushion shown in figure 6.5d.

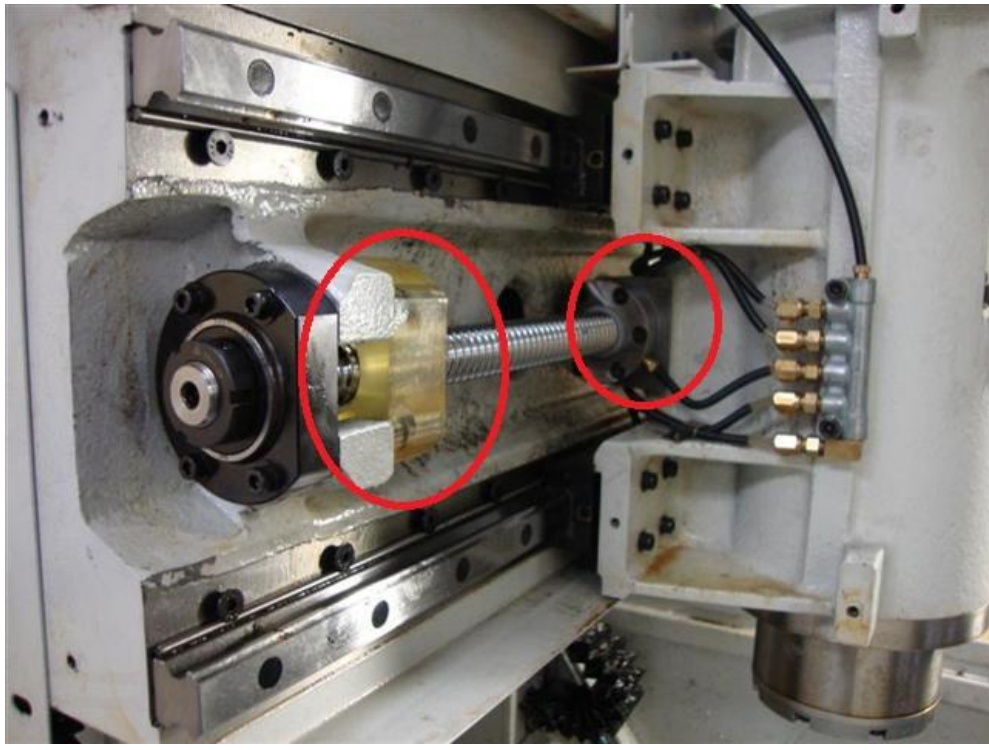


Figure 6.5d

5. Remove the five SHCS that secure the ballnut to the X-axis yoke.
6. Remove the four SHCS that secure the bearing cap found opposite to where the cushion seats, also shown in Figure 6.5c.
7. Slide the ballscrew out the left hand side window.
8. Remove the bearing housing from the right side of the X-axis casting, refer Figure 6.5c disassemble the seal, bearings and the inner spacer.

X-axis Ballscrew Installation

Note: Apply a thin film of oil on all screws to be torqued prior to installation

1. Thoroughly clean all parts before beginning the assembly process.
2. Install the angular contact bearings into the housing and seal. The bearings should be installed in the Back-to-Back arrangement as shown in figure 6.5e. Make sure that the inner spacer is between the two bearings. Install the housing assembly loosely into the right side of the X-axis casting.

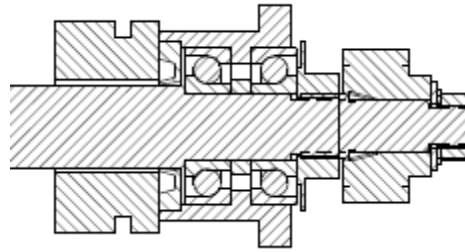


Figure 6.5e

3. Install bearing onto the left end of the ballscrew, lightly fasten with the bearing locknut.
4. Slide ballscrew assembly through the yoke at a slight angle, straighten it out as the ends of the ballscrew get closer to the ends.
5. Carefully guide end of the ballscrew into the set of angular contact bearings. Note: the inner spacer may not be lined up, so wiggle the shaft a bit until it does, but do not force it.
6. Slide the head back until the ballnut is inside of the yoke, and lightly secure it to the yoke with five SHCS.
7. Slide the bearing cap over the bearing, on the left side of the ballscrew, slide the ballscrew forward from the left hand side, and lightly secure the cap to the X-axis casting
8. Install the right side cushion and secure
9. Drive the head to near the full length of travel to the right, but not against the cushion. This will align the ballnut to the angular contact bearings.
10. Tighten the four SHCS that secure the bearing housing to the X-axis casting. Torque 11 ft-lbs
11. Tighten the five SHCS that secure the ballnut to the yoke. Torque to 7 ft-lbs and torque stripe
12. Install the cushion to the left side of the X-axis casting, and the lubrication line to the ball nut.
13. Drive the head to the full length of travel to the left, but not against the cushion.
14. Tighten the SHCS that secure the bearing cap to the X-axis casting. Torque to 11 ft-lbs

15. Install and tighten clamp nut and torque to 50 ft-lbs and lock in place with the SHCS.
Tighten lock screw and torque to 5 ft-lbs
16. Install the key into the key seat of the shaft.
17. Slide ferrule against the face of the clamp nut.
18. Fit pulley over the ferrule and key. Place the flat washer, the star washer and tighten down with the nut.
19. Loop the belt over both pulleys, then adjust the belt adjusting screw until the belt can be only twisted 45°
20. Tighten the four SHCS that secure the motor, tighten the jam nut of the belt adjusting screw.
21. Check X-Axis torque in 3 positions. Torque should be 10 in-lbs or less and within 3 in-lbs at all 3 locations

Service Codes to be Performed.

1. Service code 505 to check that the motor index angle is at 180° +/- 45°
2. Service code 520 to reset ATC tool positions.
3. Service code 500 to reset the ball lock location.

6.5 Ballscrew Replacement, Y Axis

Please refer to assembly drawing 27564-1 found at the back of this manual.

1. Remove the sheet metal and covers
 - a. Remove the rear cover for the Y-axis compartment.
 - b. Remove the drip pan that is secured to the motor mounting bracket.
 - c. Remove the front and rear sheet metal covers from the table.
 - d. Disconnect the ATC door from the door assist cylinder and remove the ATC door
 - e. Remove the ATC wiper cover.
 - f. Remove the six countersink screws that secure the Y-axis sheet metal cover to the Y-axis casting.
2. Remove the Y-axis motor, motor bracket and belt.
3. Remove the Y-axis motor plate bracket
4. Remove the hex nut, star washer, pulley, ferrule, key and clamp nut from the back end of the ballscrew.
5. Remove the four SHCS that secure the ATC magazine to the ATC slide, and remove the magazine.
6. Remove the eight SHCS that secure the table to the support brackets and remove the table.
7. Remove the Y-axis sheet metal cover
8. Drive out the two roll pins of the Y-axis casting, located in between the casting mounting holes at both ends.
9. Remove the seven SHCS that secure the Y-axis casting to the base.
10. Place a block of wood at the back of the Y-axis casting to prevent it from moving while hoisting, see figure 6.6a.
11. Place a sling around the Y-axis casting and the head as shown in figures 6.6b and 6.6c.



Figure 6.6a



Figure 6.6b

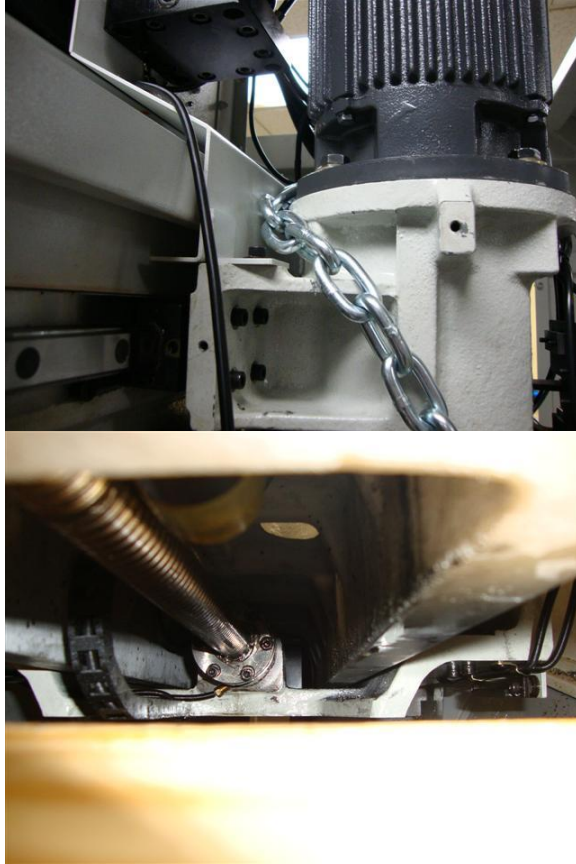


Figure 6.6c

Figure 6.6d

12. Using the electronic hand wheel, carefully jog the Z-axis upward to raise the Y-axis casting to expose the Y-axis ballscrew.
13. From the front of the machine, remove the five SHCS that secure the ball nut to the yoke and disconnect the oil line feeding the ball nut. (See figure 6.6d)
14. Remove the four SHCS that secure the bearing cap to the Y-axis casting on the front of the machine.
15. Slide the ballscrew out the front of the machine.
16. Remove the bearing housing from the bearing block.
17. Remove locknut and bearing from the forward end of the ballscrew.

Y-Axis Ballscrew Installation

1. When installing the ballscrew, it is recommended that new bearings be installed at both ends
2. Thoroughly clean all parts before beginning the assembly process.
3. Install the angular contact bearings into the housing and seal. The bearings should be installed in the Back-to-Back arrangement as shown in figure 6.5e. Make sure that the inner spacer is between the two bearings. Install the housing assembly loosely into the bearing block on the Y-

axis casting.

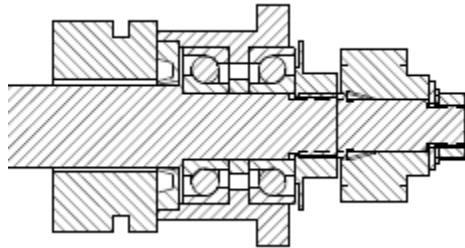


Figure 6.6e

4. Install bearing onto the front end of the ballscrew, lightly fasten with the bearing locknut.
5. Slide ballscrew assembly through the yoke at a slight angle, straighten it out as the ends of the ballscrew get closer to the ends.
6. Carefully guide end of the ballscrew into the set of angular contact bearings mounted in the rear bearing cap and block. Note: the inner spacer may not be lined up, so wiggle the shaft a bit until it does, but do not force it.
7. Rotate the ballscrew until the ballnut is even with the yoke, and lightly secure it to the yoke with five SHCS. Install the lubrication line to the ballnut.
8. Slide the bearing cap over the bearing, on the front of the ballscrew, and lightly secure the cap to the Y-axis casting
9. Install the front cushion and secure
10. Using the EHW carefully lower the Z-axis to lower the Y-Axis casting back into place.
11. Align the Y-Axis casting and install roll pins
12. Secure the Y-Axis casting to the bed of the machine.
13. Drive the saddle to near the full length of travel to the rear, but not against the cushion. This will align the ballnut to the angular contact bearings.
14. Tighten the four SHCS that secure the bearing housing to the Y-axis bearing block. Torque 11 ft-lbs
15. Tighten the five SHCS that secure the ballnut to the yoke. Torque to 7 ft-lbs and torque stripe
16. Drive the saddle the full length of travel to the front, but not against the cushion.
17. Tighten the SHCS that secure the bearing cap to the Y-axis casting. Torque to 11 ft-lbs.
18. Install and tighten clamp nut and torque to 50 ft-lbs and lock in place with the SHCS. Tighten lock screw and torque to 5 ft-lbs
19. Install the key into the key seat of the shaft.
20. Slide ferrule against the face of the clamp nut.
21. Fit pulley over the ferrule and key. Place the flat washer, the star washer and tighten down with the nut.
22. Install Y-axis motor plate bracket
23. Install Y-Axis motor, motor bracket and belt.

24. Loop the belt over both pulleys, then adjust the belt adjusting screw until the belt can be only twisted 45°
25. Tighten the four SHCS that secure the motor, tighten the jam nut of the belt adjusting screw.
26. Check Y-Axis rolling torque in 3 positions. Torque should be 10 in-lbs or less and within 3 in-lbs at all 3 locations.
27. Install Y-Axis sheetmetal cover
28. Secure the table to the support bracket
29. Secure the ATC magazine to the ATC slide
30. Re-attach sheetmetal covers and ATC door assist cylinder.

The following service codes **must** be performed in the following order, after the Y-axis motor is installed.

1. Service code 505 to check that the motor index angle is at 180° +/- 45°
2. Service code 520 to reset ATC tool positions.
3. Service code 500 to reset the ball lock location.

6.7 Ballscrew Replacement, Z Axis

Please refer to assembly drawing 27540-1 found at the back of this manual.

1. Remove the sheet metal. See figure 6.7a.
- 2.

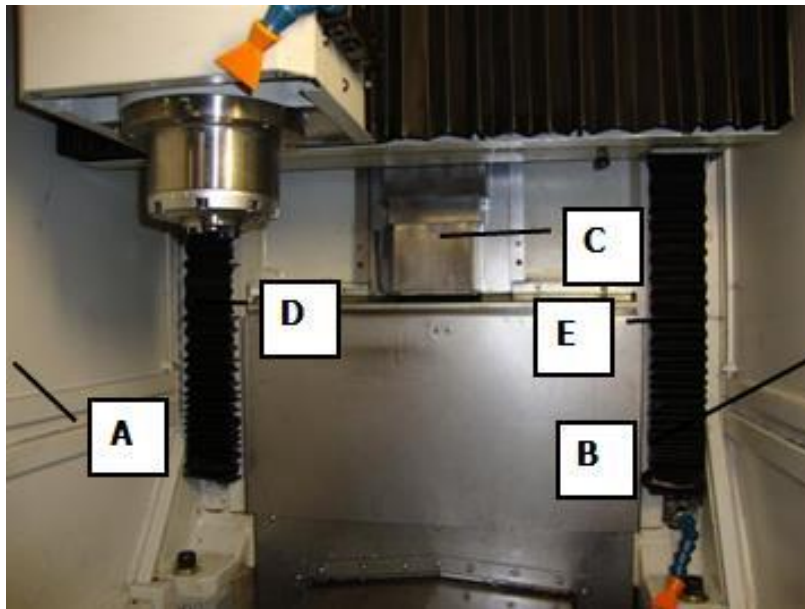


Figure 6.7a Ballscrew Replacement, Z Axis

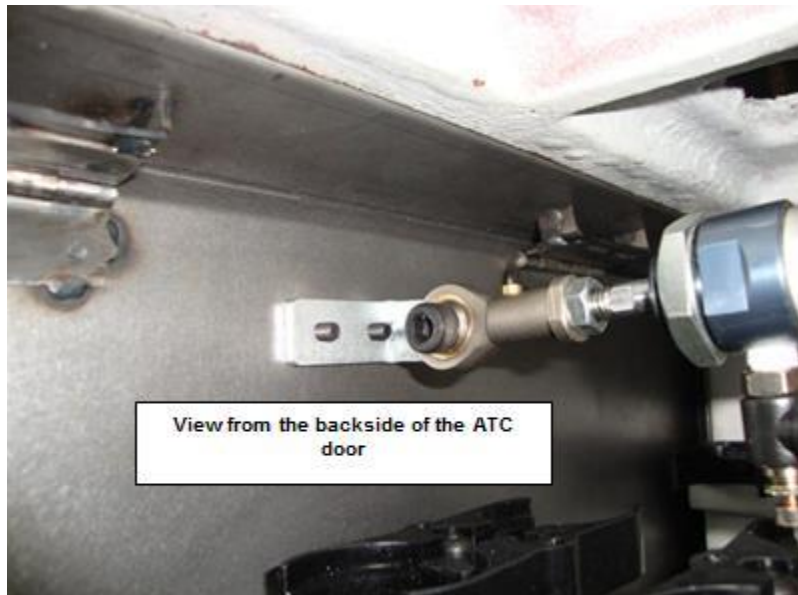


Figure 6.7b View from the backside of the ATC door

- a. Jog the Z-axis to its full upward position.
- b. Remove the ATC door by removing the four BHCS that secure the door flange to the column. Disconnect the door from the air cylinder at the pivot bolt. See figure 6.7b.
- c. Remove the side enclosure covers A & B from the machine enclosure.
- d. Remove the Z-axis ballscrew cover C.
 - i. Remove the four SHCS that the top bracket to the underside of the head, they can be found between the column and the back of the bridge.
 - ii. Remove the two SHCS that secure the bottom most segment to the Z-axis lower bearing housing.
 - iii. Lower the head, remove the upper sheet metal cover to access the upper (2) screws that secure the Z-axis ballscrew cover (frame) to the column.
 - iv. Raise the head and remove the four SHCS that secure the Z-axis ballscrew cover (frame) to the column and remove the cover.
 - v. Slide the way cover out as an assembly
3. Disconnect the oil line that feeds lubrication to the Z-axis ballnut.
4. Rotate the Z-axis ballscrew and loosen the three set screws that secure the lower bearing locknut. Remove the bearing locknut.
5. Remove the four SHCS that secure the lower bearing housing to the column, remove the housing and set aside.
6. Jog the Z-axis downward and rest the bridge on a suitable and stable brace.
7. Shut down the 2 Op mill and shut off the power at the disconnect switch
8. Disconnect the electrical connection to the Z-axis brake.
9. Remove the motor per section 6.1.3.
10. Remove the SHCS that secure the brake remove the brake.

Warning!

Make certain that the bridge is resting securely before removing the brake!

11. Remove motor bracket casting.

12. Remove the two screws that secure the cushion to the ballnut, and remove the cushion.
13. With a 36" extension and a hex bit socket, remove the five SHCS that secure the ballnut to the yoke.
14. Remove the four SHCS that fasten the bearing housing to the top of the column.
15. Remove the ballscrew by sliding it upward and towards the bridge allowing the ballnut to clear.

Disassembling the Z-axis Ballscrew

1. Remove item 32 (part of brake) as shown on drawing from the ballscrew
2. Remove the key.
3. Loosen the clamp nut.
4. Remove the bearing housing.
5. Remove the bearings.

Installing the Z-axis ballscrew

Note: Apply a thin film of oil on all screws to be torqued prior to installation

1. When installing the ballscrew, it is recommended that new bearings be installed at both ends.
2. Reassemble the upper end of the ballscrew.
 - a. Install the bearings in the bearing housing and seal.
 - b. Place the bearing housing on the ballscrew
 - c. Install the clamp nut and torque to 50 ft-lbs and tighten the clamp screw torque to 5 ft-lbs
 - d. Install the key for the brake.
3. Install a new bearing into the lower bearing housing and install the housing onto the column.
4. Slide the ballscrew into the machine from the top of the column.
5. Wind the ball nut up or down until the bearing cap is flush with the mating boss of the column, and ballnut flange is slightly (.100" or less) above the yoke of the bridge.
6. Install the four SHCS that secure the bearing cap to the column, torque to 18 ft-lbs
7. Install the five SHCS that secure the ballnut to the bridge and tighten 75%. The bridge will pull upward as the screws are tightened. Do not tighten the screws completely at this time.
8. Install the motor mounting casting.
9. Install the brake down over the square keyed block.
10. Reinstall the coupling and motor. See section 6.13.
11. Jog the Z-axis upward to near the end of travel, this will align the ballnut with the bearing housing.
12. Attach the oil line to the ballnut.
13. Torque the five SHCS that secure the ballnut to the yoke to 7 ft lbs.
14. Install the lower bearing locknut and tighten the three locking set screws.
15. Check Z-Axis torque. Move head down and place a support under head and press the E stop. Go to electrical cabinet and move Z axis brake connector to the 24 VDC out port to turn brake off. DANGER – HEAD WILL FALL IF NOT SUPPORTED. Check torque in upward direction and record. Values should be 31 in-lbs or less. Ideally you want to check the torque in 3 places along the length to make the ballscrew is aligned.
16. Install the Z-axis ballscrew cover. Perform step 1 in this procedure in reverse order.

- a. Place the cover against the column and secure with the two SHCS at the center of the frame.
 - b. Secure the underside of the frame to the lower bearing housing with two BHCS
 - c. Secure the top segment of the telescoping cover to the sheet metal bracket at the back of the bridge.
17. Make sure the motor index angle is set correctly. Check in service code 505. Adjust motor as required.
18. Enter service code 520 to set the tool change height.
- a. Place a tool holder in any pocket. Jog the X and Y axes to that pocket's coordinates that are displayed in the table.
 - b. Press the orient spindle tab.
 - c. Press the tool unclamp tab.
 - d. Using the EHW, highlight the Z Tool Change dialogue box.
 - e. Jog the Z-axis towards the tool holder, change to .002" federate as you get close to the tool holder. As the spindle goes over the tool holder, listen for the air to stop escaping from around the tool holder, then back up one click. Enter the Z tool change offset that is displayed in the lower right hand gray box.

6.8 Spindle Motor Replacement

Please refer to assembly drawing 27500-1 found at the back of this manual.

1. Remove the sheet metal covers
 - a. Remove the right and left side enclosure panels, the unclamp button panel, the vented top cover, the front cover, and the left side cover.
2. Jog the Z-axis downward to the end of travel.
3. Shut down the 2 Op mill and turn off the power.
4. Remove the junction box covers from the motor and disconnect the incoming power, spindle fan and encoder cables.
5. Secure a cable to the eye-hooks attached to the motor if you are using a hoist. The motor weighs approximately 65 lbs.
6. Remove the clamp/ unclamp bracket assembly
7. Loosen the 2 clamp screws on the driven side of the coupler
8. Remove the four hex head bolts that secure the motor to the head.
9. Hoist the motor upward until the motor shaft is clear of the head.
10. Using an extended hex socket, manually drive the X-axis to the right hand side of the bridge, allowing the motor to be lowered to the table.
11. Place a couple blocks of wood or other suitable support onto the table and lower the motor down.
12. Remove the hoisting cable
13. Manually drive the Y-axis toward the front of machine to ease lifting from the machine.
14. Install the new motor in reverse order.
15. Tighten the two clamp screws on the motor coupler.
16. Enter service code 510 to set spindle orientation and follow the on-screen instructions.

6.9 Spindle Motor Wiring

The following 3 pictures show the wiring of the spindle motor. It should be noted that the spindle motor can be wired for 220 volts or 440 volts. Make sure you wire the motor correctly depending the voltage supplied to the machine and the inverter voltage.

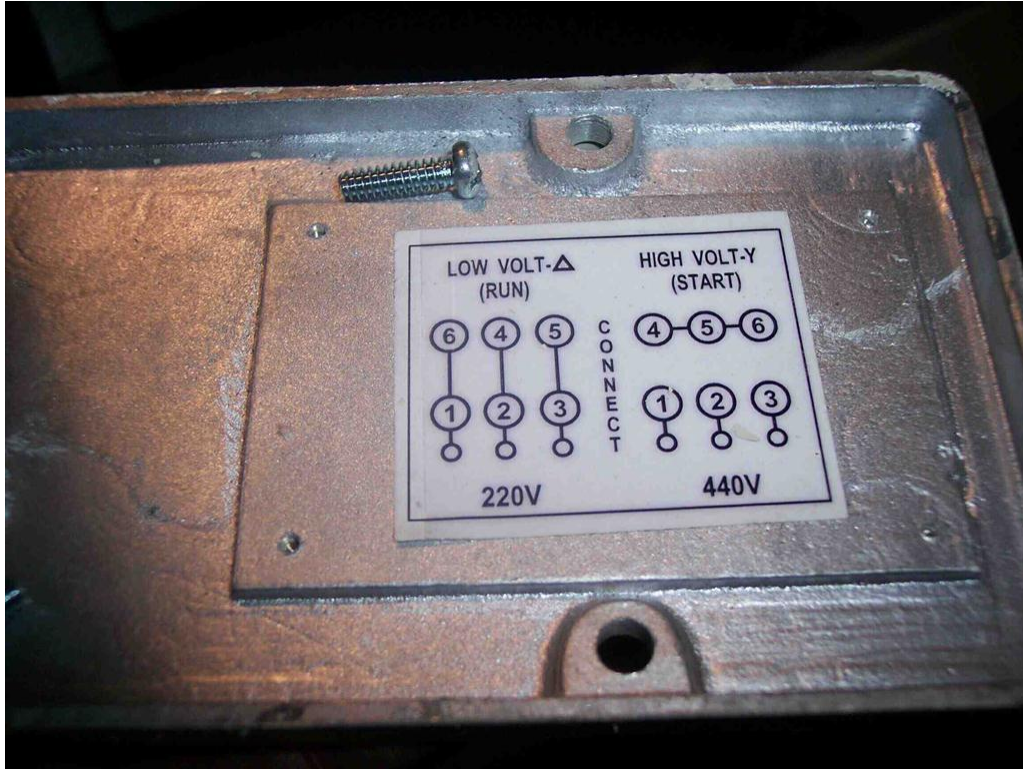


Figure 6.9a – Wiring Diagram for 220 and 440 volts

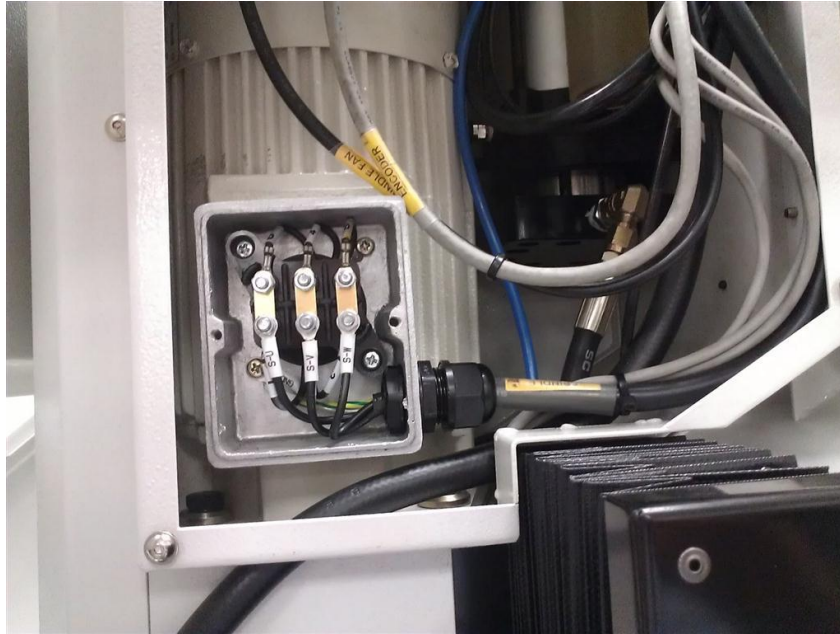


Figure 6.9b – Wiring into spindle motor – 220 volt wiring shown



Figure 6.9c – Wiring of motor fan and encoder

6.10 Spindle Cartridge Replacement

Please refer to assembly drawing 27500-1 found at the back of this manual.

1. Remove the left and right side sheet metal covers
2. Remove the unclamp button panel.
3. Jog the Z-axis downward toward the table so you have access to the unclamp panel and the 6 bolts that hold the spindle cartridge in place.
4. Press the E stop on the control.
5. Remove the clamp/unclamp bracket assembly (A), air line (B), oil line (C) and the actuator plate (D). Reference figure 6.10

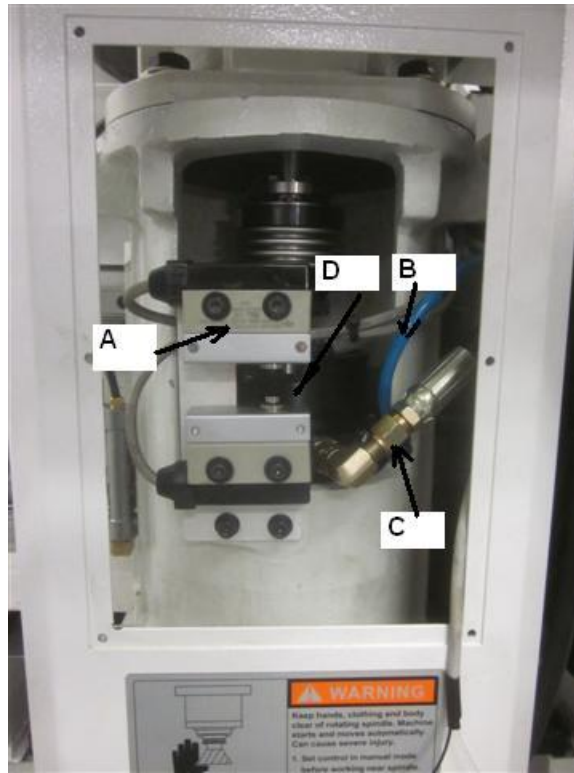


Figure 6.10

6. Loosen the 2 clamp screws on the motor coupler.
7. Remove 5 of the 6 bolts that holds the spindle cartridge up inside of the head. Loosen the 6 bolt as well.
8. Jog the Z-axis downward toward the table and place the spindle nose on top of a block of wood.
9. Remove the last bolt and now move the head up with the handwheel to expose the spindle cartridge.
10. Install the new spindle cartridge in reverse order. It is recommended to perform tightening of the screws crosswise in order to prevent any distortion of the hub. These bolts are to be tightened to 8 ft-lbs.

11. It is very important to set the clamp and unclamp switches correctly upon installation.
12. Enter service code 510 to set spindle orientation and follow the on-screen instructions.

6.11 Spindle/Motor Coupling Alignment

When a motor or spindle is replaced on the 2 OP mill, it is important that the coupling that attaches between the top of the spindle and the motor shaft is aligned and there is minimal runout axially and radially. The procedure below explains how to align and install the coupling.

1. Remove the front cover on the head to gain access to the spindle coupling.
2. Remove the bracket that holds the clamp and unclamp switches.
3. Slide one half of the coupling on the spindle motor shaft as far up as it will go and still be able to lightly tighten the clamp screw so it does not slide down on its own.
4. Slide the other half of the coupling with the urethane middle piece onto the spindle shaft and lightly tighten the clamp screw, like on the motor shaft.
5. Install the spindle in the spindle housing and snug the spindle mtg. screws slightly and then just break them loose.
6. Loosen the coupling half on the motor shaft and lower it down to engage with the half installed on the spindle shaft, and loosen the spindle half of the coupling so the coupling can be moved up and down as an assembly.
7. Align the spindle in the housing so the coupling assembly easily slides up the motor shaft and down the spindle shaft without noticeable resistance during the transition from shaft to shaft. Loosen the motor bolts if required to get more adjustment.
8. Once the coupling moves freely from shaft to shaft, the spindle is adequately aligned with the motor. Center the coupling so each half is roughly clamped on the same length of the corresponding shaft and tighten the clamp screws to the recommended torque setting of 18.5 ft-lbs.
9. Make sure the tighten the motor and spindle bolts.

6.12 Automatic Tool Changer (ATC) Replacement

Please see drawings 27600-2 and 27587-1 in the back of this manual.

1. Go to tool loading and bring the ATC out.
2. Press E stop once the ATC is out.
3. Remove the three BHCS that secure the ATC door lower wiper
4. Remove the 4 bolts that hold the ATC in place. It is also keyed to ensure you can remove it and place it back in the same place.
5. Remove the ATC casting from the machine and replace with the new one.
6. Align the ATC side to side by placing a tool in spot 1 and spot 6. Run an indicator across the taper on the holder on tool 1 and then across to spot 6. Alignment should be within 0.020".
7. To replace a finger, loosen the 2 screws that hold the finger in place. The fingers are pinned so you can place the new finger in the same exact spot.
8. After replacing the ATC or a finger, go to service code 520 and double check the ATC locations.

6.13 Setting ATC Tool Locations

1. Go to service code 520, bring tool magazine out and select Input Table

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2. Place a .0005" test indicator in the spindle.
3. Place a BT30 tool into the tool change spot or the locating tool shown below in figure 6.13.
4. Jog both X and Y axes until the spindle is in line with the bore of the locating tool as shown in figure 6.13.
5. Using the .0002" feed rate, jog both X and Y while rotating the spindle until the indicator reads less than .0050". The spindle centerline is now positioned over the center of the pocket.
6. Enter the X and Y values displayed in the DRO shown in the lower right into the input table.
7. Repeat this procedure for pockets 2 through 8. Press save table after each position is found.
8. For setting the Z height on the ATC, see section 5.8.2.



Figure 6.13

6.14 Coolant Pump Replacement

Please see drawings 27557 and 27542-1 in the back of this manual.

1. Remove the chip pan from the machine.

2. Drain the coolant from the coolant tank.
3. Slide the coolant tank out of the machine.
4. Remove the 4 screws that hold the pump in place.
5. Remove the power cable from the coolant pump.
6. Follow these instructions in reverse to install the new pump.

6.15 Bleeding Air from Tool Unclamp Cylinder Oil System

As described in section 5.8.4, oil is compressed by the tool unclamp cylinder which then presses down on the drawbar that holds the tools. If air gets into this system, the tool unclamping process will not work correctly. This is usually identified by seeing oil on the some of the fittings or seeing air bubbles in the oil reservoir. Figure 6.15 shows this oil reservoir.



Figure 6.15

Please also refer to drawing 27500-1 for a reference drawing.

To bleed air from the system, follow this procedure.

1. Make sure all connection points are tight and no air can get into the system. If the connection points are tight and not leaking but you notice oil leaking from the tool clamp cylinder, the cylinder will need to be replaced.

2. Make sure to fill the oil reservoir cap to the fill line. If the system has been leaking the oil level will have dropped.
3. Press the unclamp button on the front of the head a number of times over and over until you do not see any more oil bubbles in the oil reservoir. The air should escape from the top of the oil reservoir tank.

6.16 Programming Panel Replacement

See reference drawing 27648-2 for cable connections or section 5.4 of manual.

1. Turn power off to the machine.
2. Remove the 4 bolts that hold the programming panel in place.
3. Remove the following 4 connectors: E-stop cable, com port cable, VGA cable and overlay power cable. See section 5.4 for a diagram of these connections.
4. Reconnect cables to new panel.
5. Fasten panel with the 4 bolts you removed.

6.17 Home Switch Replacement

The 2 OP machine has 3 home switches which are used to home the machine.

1. Depending on which switch you need to replace or adjust, you may need to move the machine to gain clearance. For the X axis, it is best to move the head all the way to the left. For the Y axis, move the table towards the rear of the machine. For the Z axis, it may be easiest to move the head down toward the table.
2. Turn power off to the machine.
3. See drawing 27658-1 for an illustration of where each home switch is mounted.
4. Remove all sheet metal covers necessary to gain access to the switches.
5. The switches are held in place with a few screws.
6. It is very important to place the new switch in the same location as the old one so the home of the machine will stay the same.
7. Replace all covers and sheet metal as necessary.

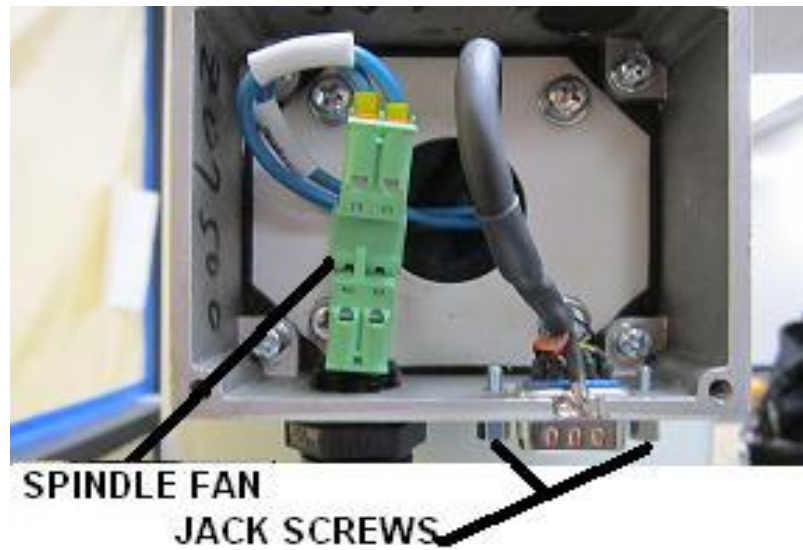
Caution!

If the home of the machine changes, various parameters will need to be reset. Important machine parameters such as ball lock locations (service code 500), tool change height, ATC locations (service code 520) will need to be reset if the home has changed.

6.18 Spindle Motor Encoder Replacement



1. Remove Encoder housing cover to gain access to internal connections.



2. Disconnect Spindle fan and remove jackscrews.



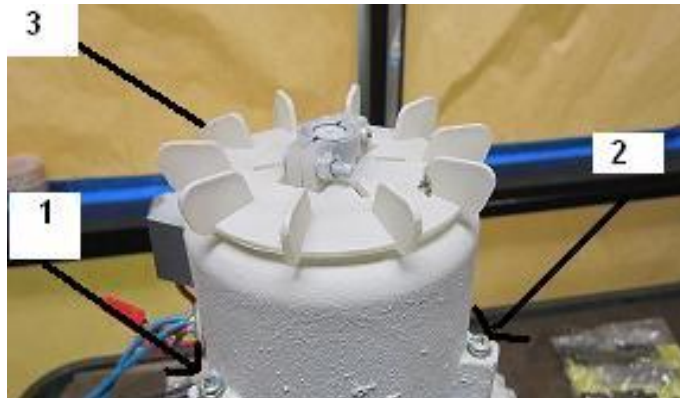
3. Push Spindle Fan cable through Encoder housing opening.



4. Push Encoder cable through Encoder housing opening.



5. Remove Spindle Fan shroud.



6. Remove Spindle Fan. Loosen and remove the 3 screws that secure it in place.



7. Remove the 2 screws on top and loosen the setscrews underneath to remove encoder.

INSTALL NEW ENCODER IN REVERSE ORDER

6.19 X, Y, Z Home Switch Adjustments

The following service codes may need to be performed when a major adjustment is made to a home switches. Failure to do may cause the ball lock locations to be off for the X and Y axis and the tool change X and Y locations as well as height may 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). Must be redone after any home switch is adjusted.
- Service Code 500 – reset the X and Y ball lock locations. May need to be performed after X or Y axis home switch work
- Service Code 520 – reset the X and Y tool position locations and tool change height.

The home switches that come on the 2 OP 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 home switches are set from the factory to be approximately 1 revolution of the ballscrew (6 mm) from the hard stop on the machine. From there the soft limits are set 0.030" past the home switches and 14.03", 18.40" and 17.03" inches from the home switch for the X, Y and Z respectively. When setting this 6 mm 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 turn (since the ballscrew has a 6 mm pitch) and then set the cam.

The home switch 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 home 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 home switch cam.

6.20 Adjusting the Drawbar Bump Out

To prevent tools from sticking in the spindle taper, the tool is bumped out by the drawbar assembly when the green button is pressed or when an automatic tool change is done. The bump out amount should be approximately 0.015" to 0.02". You can check this amount by loading a tool manually and taking note how much the tool is sucked up into the spindle once you release the green button. This amount would be what we consider the bump out amount. To adjust bump out, you will need a 4 and 5 mm allen wrench.

1. Turn off the air that flows down the spindle when you press the green button. To do so, you can close the air flow control valve found on top of the tool clamp/unclamp cylinder. See drawing 27563-1 (item 35) for this valve.
2. Loosen the set screw up inside the spindle with a 4 mm wrench. Figure 6.21 shows the drawbar assembly when removed from the machine so you can see how it is assembled.
3. Now use a 5 mm wrench to move the spanner down so it will bump the top of the retention knob on the tool holder. Please note, only very small adjustments are necessary to adjust the bump out.
4. Fasten the 4 mm set screw back down.
5. Load a tool manual in and out of the spindle to verify the bump is now within spec.
6. Turn the air flow valve that allows air down through the spindle.



Figure 6.21

6.21 Servo Driver Replacement

The servo drives are located in a box on the top of the machine. See drawings 28156 and 27648-2 at the end of the manual.

1. Turn power off to the machine and wait a minute or 2 to make sure power is not longer present in the cabinet. Power is stored for a brief period of time after power is removed.
2. Identify the servo that needs replacement. They are mounted as X, Y and Z from left to right.
3. Remove all cables and wires from the servo driver.
4. Remove 4 screws holding servo in place.
5. Mount new servo.
6. Connect all wires back where they were removed.
7. The z axis servo has some extra wires for a resistor that is used to dissipate energy on the Z axis during deceleration.

6.22 Setting Spindle Orientation – Service Code 510

1. In service code 520 select ATC FRONT, to move the ATC to the front of the machine. Then select INPUT TABLE. Using the handwheel and the DRO display on the lower right side of the screen, move the X and Y Axis to tool #4's location. The location of tool #4 can be found in the table. Without moving the tool carrier or the Axis, mode out and enter service code 510 and select ORIENT SPINDLE.
2. Rotate the spindle at least 1 revolution before proceeding.
3. Using a BT30 tool holder with the retention knob removed, lower the spindle over the tool holder and align the drive dogs to fit tool holder.
4. Move spindle dogs back and forth inside fingers and record lowest and highest value on screen. Take the difference between the 2 and add $\frac{1}{2}$ to the lowest value. For example, low = 330 high = 352, difference = 22. Add 11 to 330 = 341. Enter this value in the service code.
5. Go to Delta drive and enter this value under parameter 10-19.
 - 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 from step 3 and press Program/Data
 - e. Press Mode button to return to frequency reading.

- f. Upload the new parameters to the operator
6. Raise spindle above tool holder and press ORIENT ON. Lower the spindle over tool holder to verify proper orientation. Repeat this step 5 times to verify repeatability within \pm 5 counts.
7. Raise the Z Axis and press ATC BACK.
8. Press RETURN to exit service code and turn off orientation.

7.0 Maintenance

7.1 Calibration

Calibration & Backlash Constants

Calibration and backlash constants were set as part of the installation and set-up of your system. They should be re-set when indicated in the Troubleshooting section or after the replacement of the Computer module, or any parts of the drive train.

X, Y, Z Calibration

Calibration is used to teach the machine a known distance. We typically calibrate our machines over a 150 mm distance. There is no limit to how far you can calibrate the machine.

1. Set-up a gauge block or standard and indicate it parallel to the axis you are calibrating.

Note: Put the display in Inch or mm to match your gage block. Recommended gage blocks are:

- X, Y and Z -- 150mm or 6"

3. Set a 0.0001" indicator in the spindle and move it up to one side of the gage block or standard.
4. Go to setup mode, go to section "B" and press CODE 123.
5. Select the axis you want to calibrate X, Y or Z.
6. Follow the instructions on the screen to complete calibration.

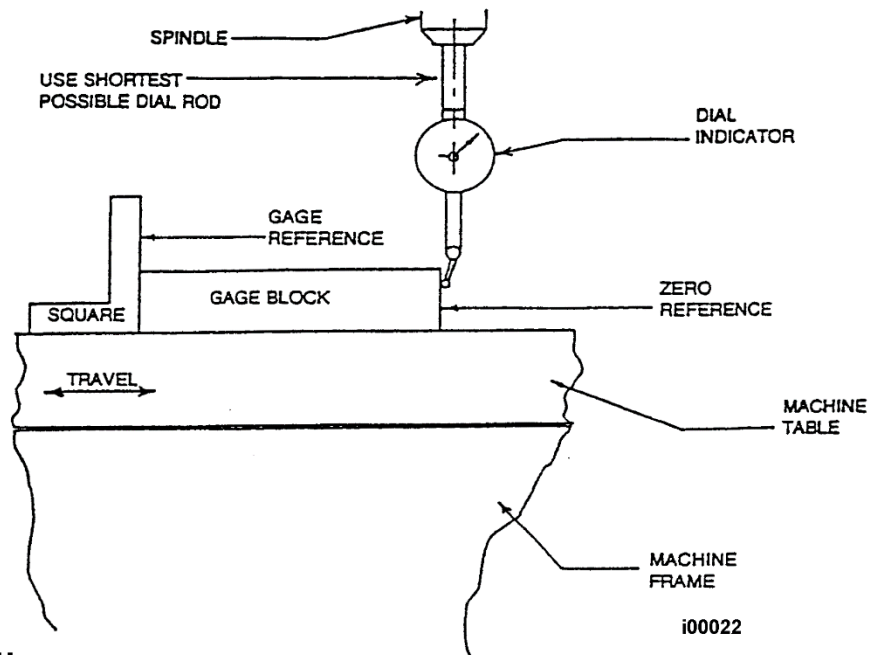


Figure 7.1
Calibration Set-Up

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 0.0001" indicator with the following method.
3. Load the indicator to zero from one direction and zero out the DRO.
4. Move the indicator to 0.002" 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 0.002" or less. Most new machines will exhibit a 0.001" or less. Larger values could mean the machine has a mechanical problem.

7.3 Periodic Maintenance

The following table lists the periodic maintenance that must be done on a daily, month(s) and yearly basis.

| Maintenance Time Period | Items |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Daily | <ol style="list-style-type: none"> 1. Remove majority of chips from around the axis slide ways, work table and ways covers, especially between table and ATC. 2. Empty chip tray. 3. Visually check lubrication pump oil level, make sure it is always above the minimum line. 4. Visual check the coolant level, add if needed. 5. Visually check the air supply filter. |
| Month(s) | <ol style="list-style-type: none"> 1. Remove back ATC and Y axis motor compartment access covers and clean chips and any other debris. Cleanup any oil or coolant accumulated on the bottom panel of the machine base. There is a drain plug at the rear of the machine to drain any fluids. 2. Visually inspect the condition of way and ballscrew covers, clean if showing chip build up. 3. Check and if needed replace the air regulator filter element. 4. Remove all air filters in the electrical cabinet and transformer enclosure every 2 months and clean. 5. Every 2 months, drain and remove the coolant tank and clean inside, including the pump screen. Fill with new coolant. |

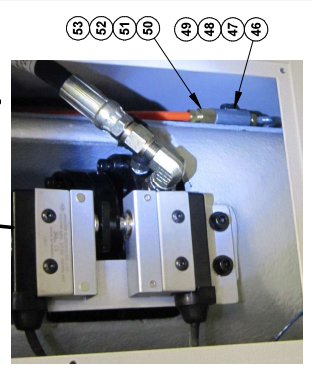
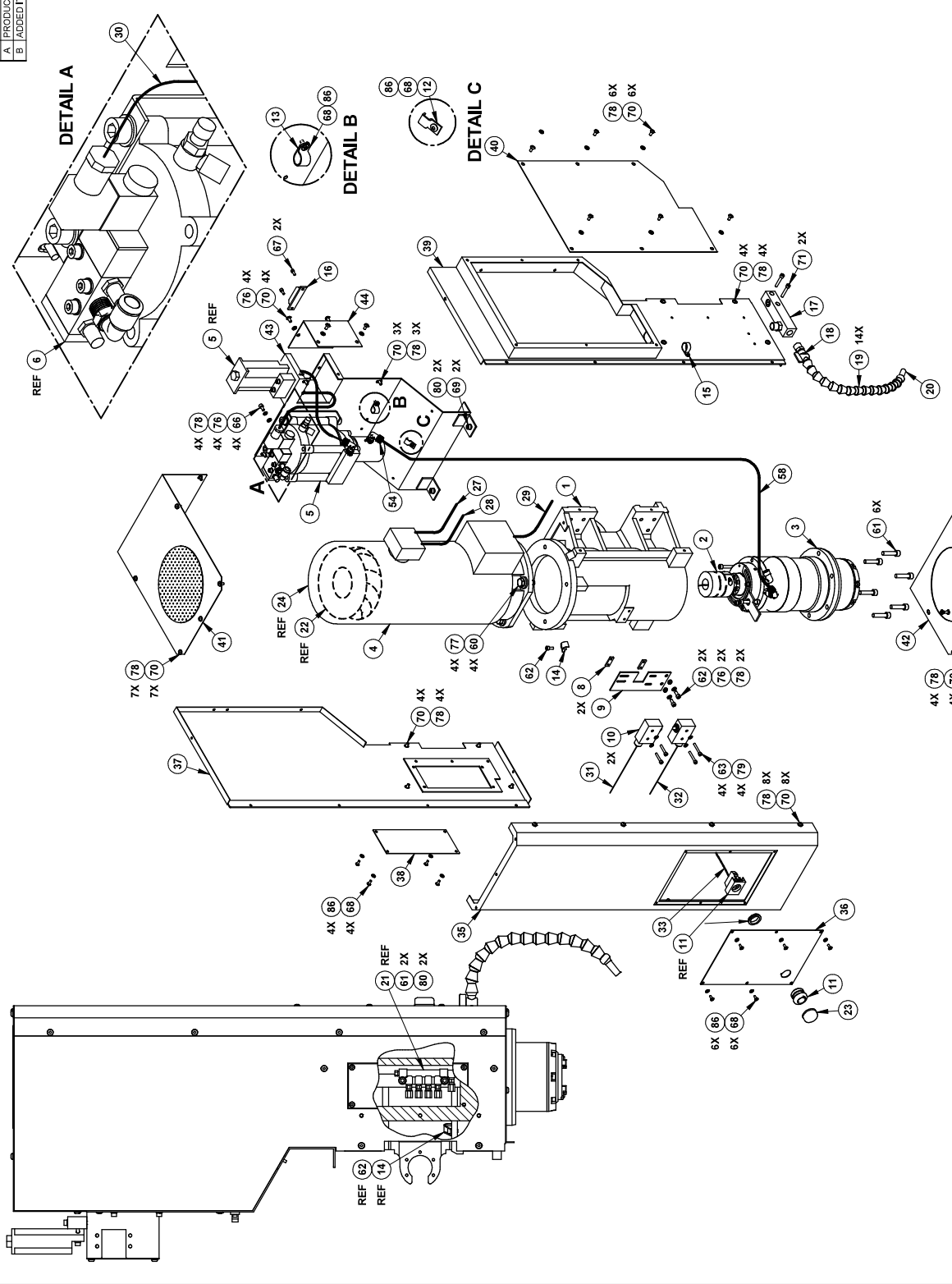
| | |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | 6. Visually check the tool unclamp oil reservoir level. |
| Yearly | <ol style="list-style-type: none"> 1. Check backlash on each axis and adjust as necessary. 2. Remove all covers and clean chips and debris that may have built up. 3. Inspect the tool change air cylinder and grease the ATC linear rail bearing blocks. 4. Inspect machine for any unusual wear and play, check cables and pneumatic lines for any excessive abrasions or cuts. |

1 2 3 4 5 6 7 8

D C B A

A B C D

| REV. | DESCRIPTION | DATE | BY | APPV. |
|------|--------------------------------------|----------------|----|-------|
| A | PRODUCTION RELEASE | 14218 10/24/14 | TO | |
| B | ADDED ITEMS 48-53, DELETED DETAIL E. | 14405 8-5-15 | TO | |



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| APPROVALS | DATE | BY | FOR |
|-----------|---------|----|-----|
| Bob | 2/28/14 | TO | |
| Sal | | | |

ENGINEER TO

DESIGNER TO

DATE 2/28/14

BY Bob

APPV. TO

FOR

SCALE

THIRD ANGLE PROJECTION

REV. B

27500-1

06238

SHEET 1 OF 1

NOTES: (UNLESS OTHERWISE SPECIFIED).

FOR PART LIST SEE SEPARATE 'A' SIZE SHEET

SOUTHWESTERN INDUSTRIES, INC.
MANUFACTURING DIVISION OF ANALOGWORKS

TITLE
SPINDLE HEAD ASSY.
20P M11

Parts List for Assembly P/N: 27500-1

Printed 8/7/2015

27500-1

SPINDLE HEAD ASSY-2OP M11

| | | | |
|----------|-----------|--------------|-----|
| Type | PL | Dwg Size | D |
| Revision | B | Product | 2OP |
| Status | R | Engineer | TO |
| Date | 2/26/2014 | Planner Code | |
| By | Bob | Comm Code | |

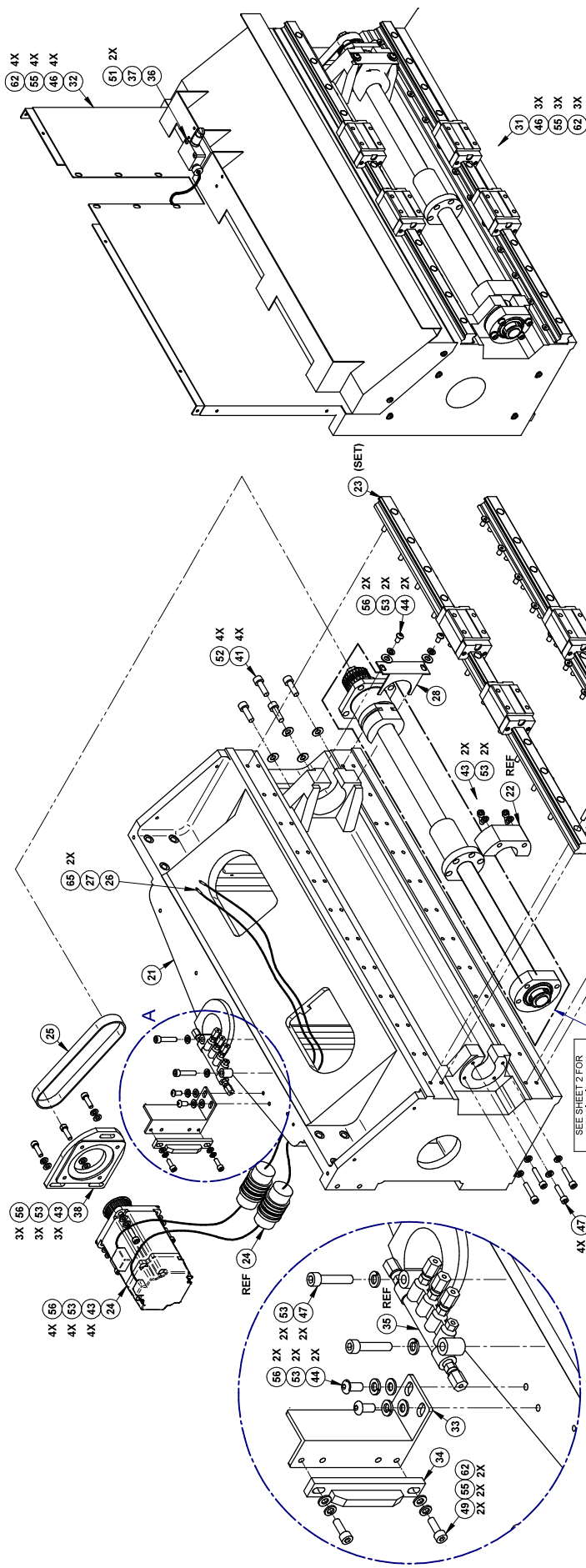
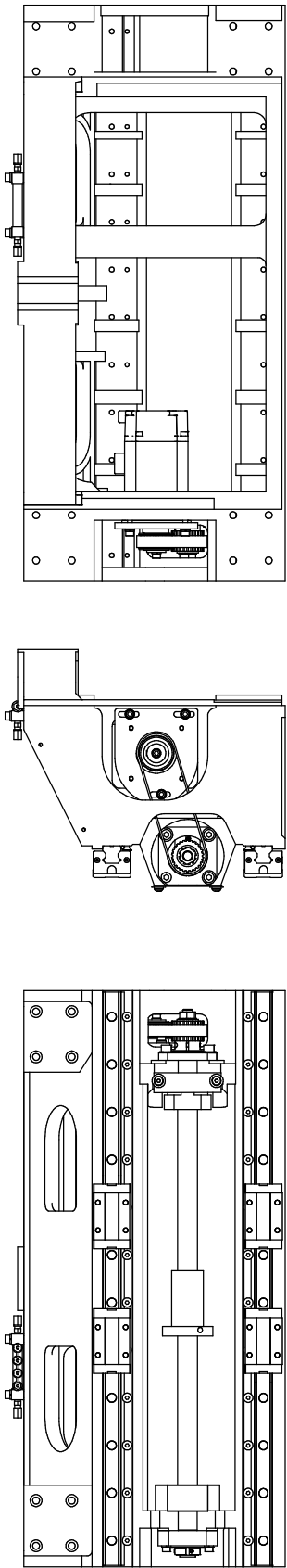
| Item | P/N | Title | Qty | UseA | Rev | Stat | Type | Mfr |
|------|---------|--------------------------------------------|-----|------|-----|------|------|-----------|
| 1 | 27505 | HOUSING-SPINDLE-30 TAPER | 1 | EA | - | R | DWG | |
| 2 | 27857 | COUPLING-SPINDLE-2OP | 1 | EA | - | R | PS | KING RICH |
| 3 | 27830-1 | SPINDLE ASSY-2OP M11 MILL | 1 | EA | B | R | PL | |
| 4 | 26849-4 | MOTOR-SPINDLE-INDUCTION-3HP-WITH ENCODER | 1 | EA | A | R | DWG | |
| 5 | 27502-3 | CYLINDER ASSY-TOOL UNCLAMP | 1 | EA | A | R | PL | |
| 6 | 26938-6 | VALVE-AIR-SOLENOID-SINGLE-4WAY-2POS- 24VDC | (1) | EA | A | R | DWG | |
| 8 | 27506 | PLATE-NUT-LIM SW | 2 | EA | - | R | PS | KING RICH |
| 9 | 27507 | PLATE-MOUNTING-LIM SW | 1 | EA | - | R | DWG | |
| 10 | 22680-4 | SWITCH-LIMIT-PLUNGER | 2 | EA | - | R | PS | |
| 11 | 22874-1 | PUSH BUTTON-RESET-N.O. CONTACT | 1 | EA | B | R | DWG | |
| 12 | 22637-2 | CLAMP-CABLE-HALF | 1 | EA | - | R | PS | |
| 13 | 22599 | CLAMP-CABLE-NYLON-1/2" | 1 | EA | - | R | DWG | |
| 14 | 22637 | CLAMP-HALF | 1 | EA | - | R | DWG | |
| 15 | 22636-2 | CLAMP-CABLE- Ø 7mm | 1 | EA | - | R | PS | KING RICH |
| 16 | 27634 | TRIGGER-HOME SWITCH-2 OP | 1 | EA | - | R | PS | KING RICH |
| 17 | 22378-1 | MANIFOLD-COOLANT | 1 | EA | - | R | PS | KING RICH |
| 18 | 27177 | VALVE-MALE-COOLANT WASH | 1 | EA | - | R | PS | LOC LINE |
| 19 | 27177-1 | ADAPTER-LINK-COOLANT | 14 | EA | - | R | PS | KING RICH |
| 20 | 27177-5 | NOZZLE-COOLANT-1/4" ROUND | 1 | EA | A | R | PS | KING RICH |
| 21 | 28042-2 | MANIFOLD-TUBE FITTING-6 OUTLETS | (1) | EA | - | R | PS | KING RICH |
| 22 | 26348-1 | FAN-SPINDLE MOTOR | (1) | EA | - | R | PS | |

| Item | P/N | Title | Detail | Qty | UseA | Rev | Stat | Type | Mfr |
|------|----------|-------------------------------------------|------------------------|-----|------|-----|------|--------------|-----|
| 23 | 28039 | COVER-PUSHBUTTON | | 1 | EA | A | R | DWG | |
| 24 | 27553 | ENCODER ASSY-MOTOR-SPINDLE-2OP | ENCODER REPL KIT 27581 | (1) | EA | A | R | PL | |
| 27 | 26514-1 | CABLE ASSY-SPINDLE MOTOR FAN | DC300-103A | 1 | EA | A | R | PL | |
| 28 | 26940-1 | CABLE ASSY-SPINDLE MOTOR ENCODER | DC300-102A | 1 | EA | D | R | PL | |
| 29 | 26671-4 | CABLE ASSY-SPINDLE MOTOR POWER | | 1 | EA | B | R | PL | |
| 30 | 27635-10 | CABLE ASSY-SOLENOID-TOOL UNCLAMP | DC300-104A | 1 | EA | A | R | PL | |
| 31 | 27635-8 | CABLE ASSY-LIMIT SW-TOOL CLAMP | DC300-105A | 1 | EA | A | R | PL | |
| 32 | 27635-7 | CABLE ASSY-LIMIT SW-TOOL UNCLAMP | DC300-106A | 1 | EA | A | R | PL | |
| 33 | 27635-6 | CABLE ASSY-BUTTON-TOOL UNCLAMP INPUT | DC300-107A | 1 | EA | A | R | PL | |
| 35 | 27495-1 | SHEET METAL-FRONT COVER-SPINDLE ASSY | SEE 27500 OR 27500-1 | 1 | EA | - | R | PS KING RICH | |
| 36 | 27495-2 | SHEET METAL-FRONT PANEL-SPINDLE ASSY | SEE 27500 OR 27500-1 | 1 | EA | - | R | PS KING RICH | |
| 37 | 27495-3 | SHEET METAL-LEFT COVER-SPINDLE ASSY | SEE 27500 OR 27500-1 | 1 | EA | - | R | PS KING RICH | |
| 38 | 27495-4 | SHEET METAL-LEFT PANEL-SPINDLE ASSY | SEE 27500 OR 27500-1 | 1 | EA | - | R | PS KING RICH | |
| 39 | 27495-5 | SHEET METAL-RIGHT COVER-SPINDLE ASSY | SEE 27500 OR 27500-1 | 1 | EA | - | R | PS KING RICH | |
| 40 | 27495-6 | SHEET METAL-RIGHT PANEL-SPINDLE ASSY | SEE 27500 OR 27500-1 | 1 | EA | - | R | PS KING RICH | |
| 41 | 27495-7 | SHEET METAL-TOP COVER-SPINDLE ASSY | SEE 27500 OR 27500-1 | 1 | EA | - | R | PS KING RICH | |
| 42 | 27495-8 | SHEET METAL-BOTTOM COVER-SPINDLE ASSY | SEE 27500 OR 27500-1 | 1 | EA | - | R | PS KING RICH | |
| 43 | 27495-9 | SHEET METAL-CYLINDER BRACKET-SPINDLE ASSY | SEE 27500 OR 27500-1 | 1 | EA | - | R | PS KING RICH | |
| 44 | 27495-10 | SHEET METAL-CYLINDER COVER-SPINDLE ASSY | SEE 27500 OR 27500-1 | 1 | EA | - | R | PS KING RICH | |
| 46 | 27745-3 | COUPLING-1/4 BSPT | SEE 27563-1 | 1 | EA | A | R | PS KING RICH | |
| 47 | 28046 | NUT-COMPRESSION-4mm-MANIFOLD | | 1 | EA | - | R | PS KING RICH | |
| 48 | 28047 | SLEEVE-COMPRESSION-OUTER-4mm-MANIFOLD | | 1 | EA | - | R | PS KING RICH | |
| 49 | 28047-1 | SLEEVE-COMPRESSION-INNER-4mm-MANIFOLD | | 1 | EA | - | R | PS KING RICH | |
| 50 | 28046-2 | NUT-COMPRESSION-6mm-MANIFOLD | | 1 | EA | A | R | PS KING RICH | |

| Item | P/N | Title | Detail | Qty | UseA | Rev | Stat | Type | Mfr |
|------|----------------|-------------------------------------------|---------------|-----|------|-----|------|------|-----------|
| 51 | 28047-2 | SLEEVE-COMPRESSION-OUTER-6mm-MANIFOLD | | 1 | EA | A | R | PS | KING RICH |
| 52 | 28047-3 | SLEEVE-COMPRESSION-INNER-6mm-MANIFOLD | | 1 | EA | A | R | PS | KING RICH |
| 53 | 27531 | TUBING-POLYURETHANE-6mm OD | | 1 | IN | - | R | PS | KING RICH |
| 54 | 27076-2 | FITTING-90°-1/4 HYDR SWVL TO 1/4 HYDR F/M | | 1 | EA | - | R | PS | KING RICH |
| 58 | 28127-1 | LINE-HYDRAULIC-1/4 X 450mm | | 1 | EA | A | R | DWG | |
| 60 | M10-1.5X30 24B | SCREW-HEX HD-STL-BO | NON STOCKABLE | 4 | EA | - | R | PS | |
| 61 | M6-1.0X35 25B | SCREW-SHCS-STL-BO | | 8 | EA | - | R | PS | |
| 62 | M5-0.8X12 25B | SCREW-SHCS-STL-BO | | 3 | EA | - | R | PS | |
| 63 | M4-0.7X20 25B | SCREW-SHCS-STL-BO | | 4 | EA | | R | PS | |
| 66 | M5-0.8X10 25B | SCREW-SHCS-STL-BO | | 4 | EA | - | R | PS | |
| 67 | M4-0.7X10 25B | SCREW-SHCS-STL-BO | | 2 | EA | | R | PS | |
| 68 | M4-0.7X10 27B | SCREW-BHCS-STL-BO | | 12 | EA | - | R | PS | |
| 69 | M6-1.0X12 25B | SCREW-SHCS-STL-BO | | 2 | EA | | R | PS | |
| 70 | M5-0.8X12 27B | SCREW-BHCS-STL-BO | | 40 | EA | | R | PS | |
| 71 | M5-0.8X30 25B | SCREW-SHCS-STL-BO | NON STOCKABLE | 2 | EA | - | R | PS | |
| 76 | M5 78B | WASHER-FLAT-DIN 125-BO | NON-STOCKABLE | 10 | EA | | R | PS | |
| 77 | M10 WASHER | WASHER-FINISH-BRASS | NON STOCKABLE | 4 | EA | - | R | PS | |
| 78 | M5 73B | WASHER-SPLIT LOCK-STL-BO | | 42 | EA | - | R | PS | |
| 79 | M4 78Z | WASHER-FLAT-DIN 125-ZINC | NON-STOCKABLE | 4 | EA | | R | PS | |
| 80 | M6 73B | WASHER-SPLIT LOCK-STL-BO | | 4 | EA | - | R | PS | |
| 86 | M4 73B | WASHER-SPLIT LOCK-STL-BO | | 12 | EA | | R | PS | |

1 2 3 4 5 6 7 8

| REV. | DESCRIPTION | DATE | BY | APPV. |
|------|-----------------------------|-------|---------|-------|
| A | PRODUCTION RELEASE | 14216 | 7/7/14 | TO |
| B | ITEM 58 1/2 BEZ WAS 1/2 71Z | 14335 | 12/5/14 | LG |



SEE SHEET 2 FOR
DETAIL VIEW OF
BALLSCREW

DETAIL A

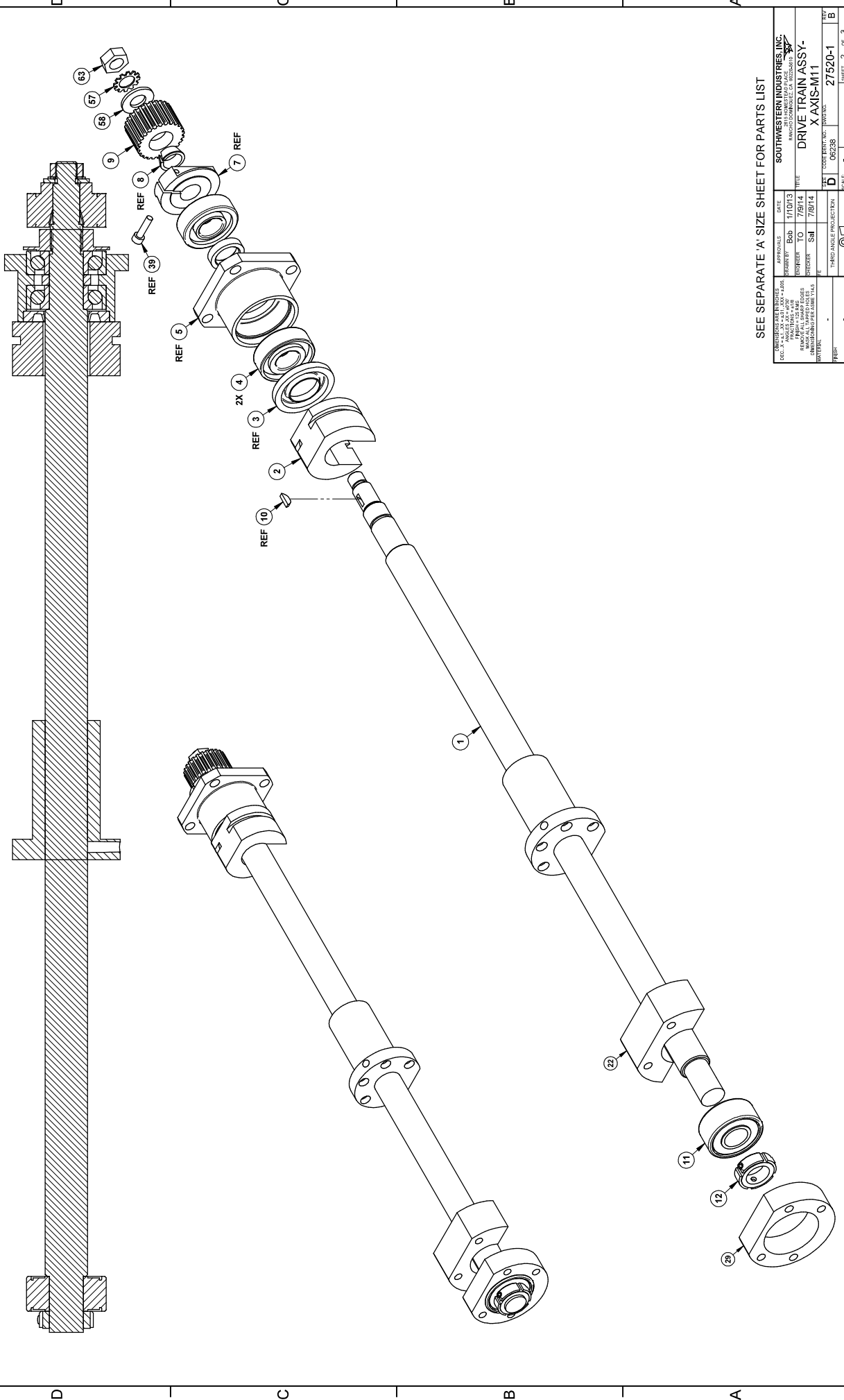
SEE SEPARATE 'A' SIZE SHEET FOR PARTS LIST

| APPROVALS | | DATE | BY | APPV. |
|-------------------------------|------|-------------------------------------------|-------|-------|
| DESIGNED BY | Bob | 1/10/13 | | |
| ENGINEER | TO | 7/9/14 | | |
| DRAWN BY | Sal | 7/9/14 | | |
| THIRD ANGLE PROJECTION | | | | |
| SOUTHWESTERN INDUSTRIES, INC. | | MANUFACTURED IN THE U.S.A. | | |
| DRIVE TRAIN ASSY - X AXIS-M11 | | PART CODE: BERT, INC. DRAWING NO. 27520-1 | | |
| REV | DATE | BY | APPV. | |
| B | | | | |

NOTES: (UNLESS OTHERWISE SPECIFIED).

1 2 3 4 5 6 7 8

| REV. | DESCRIPTION | DATE | BY | APPV. |
|------|------------------------------|-------|---------|-------|
| A | PRODUCTION RELEASE | 14216 | 7/18/14 | TG |
| B | ITEM 58 1/2 BEZ WAS 1/2 71.Z | 14335 | 12/5/14 | LG |

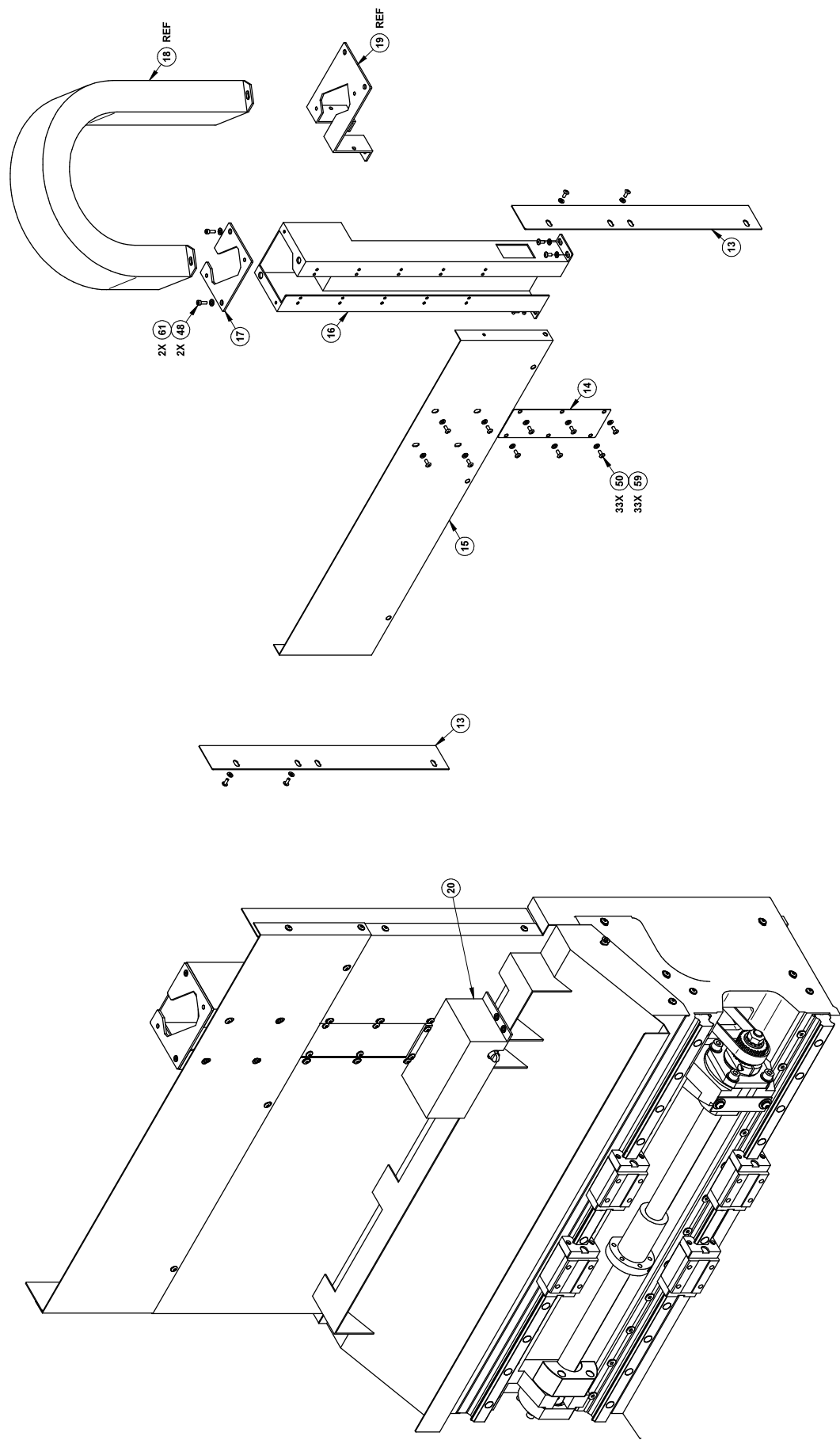


SEE SEPARATE 'A' SIZE SHEET FOR PARTS LIST

| SOUTHWESTERN INDUSTRIES, INC. | | APPROVALS | |
|-------------------------------|-----------|-----------|---------|
| DESIGNER | DATE | BY | TO |
| MANUFACTURER | 1/1/01/13 | Bob | Bob |
| ENGINEER | TO | 7/5/14 | 7/5/14 |
| DRAWN | BY | Sal | Sal |
| CHECKED | DATE | 7/5/14 | 7/5/14 |
| THIRD ANGLE PROJECTION | SCALE | | |
| TITLE | ITEM CODE | ITEM NO. | REV |
| DRIVE TRAIN ASSY - X AXIS-M11 | D | 06238 | 27520-1 |
| SHEET | | | 2 OF 3 |

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|------|------------------------------|-------|---------|
| A | PRODUCTION RELEASE | 14216 | 7/18/14 |
| B | ITEM 58 1/2 BEZ WAS 1/2 71 Z | 14335 | 12/5/14 |
| | | | LG |



| REV. | DESCRIPTION | DATE | BY |
|------|------------------------------|-------|---------|
| A | PRODUCTION RELEASE | 14216 | 7/18/14 |
| B | ITEM 58 1/2 BEZ WAS 1/2 71 Z | 14335 | 12/5/14 |
| | | | LG |

| REV. | DESCRIPTION | DATE | BY |
|------|------------------------------|-------|---------|
| A | PRODUCTION RELEASE | 14216 | 7/18/14 |
| B | ITEM 58 1/2 BEZ WAS 1/2 71 Z | 14335 | 12/5/14 |
| | | | LG |

| REV. | DESCRIPTION | DATE | BY |
|------|------------------------------|-------|---------|
| A | PRODUCTION RELEASE | 14216 | 7/18/14 |
| B | ITEM 58 1/2 BEZ WAS 1/2 71 Z | 14335 | 12/5/14 |
| | | | LG |

| REV. | DESCRIPTION | DATE | BY |
|------|------------------------------|-------|---------|
| A | PRODUCTION RELEASE | 14216 | 7/18/14 |
| B | ITEM 58 1/2 BEZ WAS 1/2 71 Z | 14335 | 12/5/14 |
| | | | LG |

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SOUTHWESTERN INDUSTRIES, INC.
 MANUFACTURING DIVISION
 DRIVE TRAIN ASSY -
 X AXIS-M11
 PART CODE: BERT, INC. PART NO.: 27520-1
 THIRD ANGLE PROJECTION
 SCALE: 1:1
 SHEET 3 OF 3

Parts List for Assembly P/N: 27520-1

Printed 12/5/2014

27520-1

DRIVE TRAIN ASSY-X AXIS-M11

Type PL
 Revision B
 Status R
 Date 1/10/2014
 By Bob

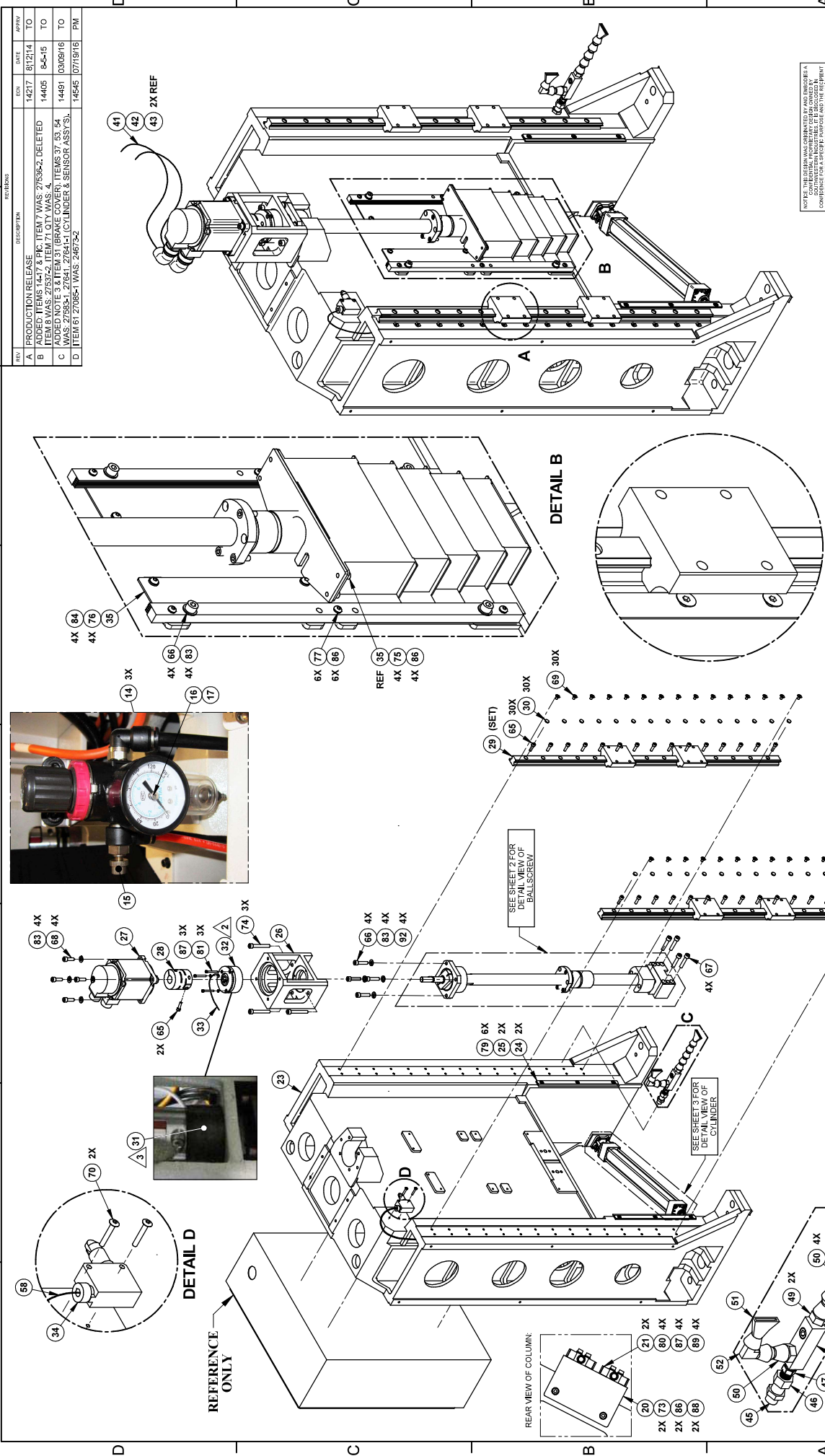
Dwg Size D
 Product 2 OP M11 MILL
 Engineer TO
 Planner Code
 Comm Code

| Item | P/N | Title | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|-----------|--------------------------------------|-----|-------|-----|------|------|-----------|----------|
| 1 | 27522 | BALLSCREW-X AXIS | 1 | EA | - | R | DWG | | |
| 2 | 27521 | BUMPER-X AXIS-RIGHT SIDE | 1 | EA | - | R | DWG | | |
| 3 | 15626 | SEAL-BEARING HOUSING | (1) | EA | A | R | DWG | | |
| 4 | 20373 | BEARING-ANGULAR CONTACT-7204 | 2 | EA | D | R | DWG | | |
| 5 | 27515 | BEARING HOUSING ASSY | (1) | EA | - | R | PL | | |
| 7 | 16452 | NUT CLAMP-X, Y, Z AXIS | (1) | EA | D | R | DWG | | |
| 8 | 16350 | FERRULE-SPROCKET-DRIVE | (1) | EA | - | R | DWG | | |
| 9 | 27513 | SPROCKET-26 TEETH W/O GUIDES | 1 | EA | A | R | DWG | | |
| 10 | 98481A090 | KEY WOODRUFF #404-1/8 X 1/2 | (1) | EA | | R | PS | | |
| 11 | 22008 | BEARING-204KTT | 1 | EA | C | R | DWG | | |
| 12 | 27951-4 | LOCKNUT-M20 X 1.0 | 1 | EA | - | R | PS | KING RICH | |
| 13 | 27603-9 | SUPPORT-LEFT & RIGHT-UPPER STRUCTURE | 2 | EA | - | R | PS | KING RICH | |
| 14 | 27603-10 | COVER-CONDUIT-MINOR-UPPER STRUCTURE | 1 | EA | - | R | PS | KING RICH | OP420420 |
| 15 | 27603-11 | COVER-CONDUIT-MAJOR-UPPER STRUCTURE | 1 | EA | - | R | PS | KING RICH | OP420410 |
| 16 | 27603-12 | CONDUIT-UPPER STRUCTURE | 1 | EA | - | R | PS | KING RICH | OP420430 |
| 17 | 27603-13 | COVER-CONDUIT-UPPER STRUCTURE | 1 | EA | - | R | PS | KING RICH | OP420460 |
| 18 | 26891-5 | CARRIER-CABLE-Z AXIS | (1) | EA | - | R | PS | KING RICH | A-85-184 |
| 19 | 27603-14 | BRACKET-MTG-CABLE CARRIER-UPR STRUCT | (1) | EA | - | R | PS | KING RICH | OP420520 |
| 20 | 27690-1 | COVER-HOME SWITCH-X AXIS | 1 | EA | - | R | PS | | |
| 21 | 27523-1 | CASTING-X AXIS-M11 | 1 | EA | A | R | PS | KING RICH | OP050102 |
| 22 | 27572 | BUMPER-X AXIS-LEFT SIDE | 1 | EA | - | R | DWG | | |

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|------------------|------------------------------------------|-----------------------|-----|-------|-----|------|------|-----------|----------|
| 23 | 26740-3 | GUIDE-LINEAR-SET (2) -X AXIS | 720mm | 1 | EA | - | R | DWG | | |
| 24 | 28153 | MOTOR ASSY-DELTA-750W | | 1 | EA | A | R | PL | | |
| 25 | 400-5M-15 | BELT - TIMING 5MM POWERGRIP | | 1 | EA | | R | PS | | |
| 26 | 26844-4 | CABLE ASSY-HI-FLEX-MTR EN-DELTA-X AXIS | DC300-132 | 1 | EA | A | R | PL | | |
| 27 | 26840-4 | CABLE ASSY-HI-FLEX-MTR PWR-DELTA-X AXIS | DC300-131 | 1 | EA | B | R | PL | | |
| 28 | 27683 | CLIP-BUMPER RETAINING | | 1 | EA | - | R | DWG | | |
| 29 | 27517 | BEARING HOUSING | | 1 | EA | - | R | DWG | | |
| 30 | 27541-1 | CAP-GUIDE-LINEAR | SEE X, Y, Z DRV TRAIN | 24 | EA | - | R | PS | | |
| 31 | 27603-17 | COVER-LOWER-X AXIS | SEE 27520 | 1 | EA | - | R | PS | | |
| 32 | 27603-18 | COVER-X AXIS ASSY | SEE 27520 | 1 | EA | - | R | PS | | |
| 33 | 27603-21 | BRACE-RIGHT-X AXIS ASSY | SEE 27520 | 1 | EA | - | R | PS | | |
| 34 | 27634 | TRIGGER-HOME SWITCH-2 OP | | 1 | EA | - | R | PS | KING RICH | OP360011 |
| 35 | 28042-2 | MANIFOLD-TUBE FITTING-6 OUTLETS | | (1) | EA | - | R | PS | KING RICH | |
| 36 | 22680-3 | SWITCH-LIMIT-ROLLER PLUNGER | | 1 | EA | - | R | DWG | | |
| 37 | 27635-1 | CABLE ASSY-X AXIS HOME SW | DC300-111 | 1 | EA | - | R | PL | | |
| 38 | 28155 | PLATE-ADAPTER-X AXIS MOTOR-2 OP M11 MILL | | 1 | EA | A | R | DWG | | |
| 39 | 10-32X3/4 25B | SCREW-SHCS-STL-BO | | (1) | EA | | R | PS | | |
| 40 | 1/4-20X1 1/4 25B | SCREW-SHCS-STL-BO | | (4) | EA | | R | PS | | |
| 41 | M8-1.25X25 25B | SCREW-SHCS-STL-BO | | 4 | EA | | R | PS | | |
| 43 | M6-1.0X20 25B | SCREW-SHCS-STL-BO | | 9 | EA | | R | PS | | |
| 44 | M6-1.0X10 27B | SCREW-BHCS-STL-BO | | 4 | EA | - | R | PS | | |
| 45 | M6-1.0X12 26B | SCREW-FHCS-STL-BO | NON STOCKABLE | 24 | EA | - | R | PS | | |
| 46 | M5-0.8X8 27B | SCREW-BHCS-STL-BO | | 7 | EA | - | R | PS | | |
| 47 | M6-1.0X30 25B | SCREW-SHCS-STL-BO | | 30 | EA | | R | PS | | |

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------------|---------------------------------|---------------|-----|-------|-----|------|------|-----|---------|
| 48 | M4-0.7X12 25B | SCREW-SHCS-STL-BO | | 2 | EA | | R | PS | | |
| 49 | M5-0.8X15 25B | SCREW-SHCS-STL-BO | NON STOCKABLE | 2 | EA | - | R | PS | | |
| 50 | M4-0.7X10 27B | SCREW-BHCS-STL-BO | | 33 | EA | - | R | PS | | |
| 51 | M4-0.7X25 27B | SCREW-BHCS-STL-BO | NON STOCKABLE | 2 | EA | - | R | PS | | |
| 52 | M8 73B | WASHER-SPLIT LOCK-STL-BO | | 4 | EA | | R | PS | | |
| 53 | M6 73B | WASHER-SPLIT LOCK-STL-BO | | 19 | EA | - | R | PS | | |
| 54 | 1/4 70B | WASHER-FLAT USS-STL-BO | | (4) | EA | | R | PS | | |
| 55 | M5 70B | WASHER-FLAT USS-STL-BO | | 9 | EA | | R | PS | | |
| 56 | M6 70B | WASHER-FLAT USS-STL-BO | | 11 | EA | - | R | PS | | |
| 57 | 1/2 75Z | WASHER-EXT TOOTH-STL-ZINC | | 1 | EA | | R | PS | | |
| 58 | 1/2 66Z | WASHER-FLAT-NARROW-ANSI TYPE B | | 1 | EA | - | R | PS | | |
| 59 | M4 70Z | WASHER-FLAT-STL-ZINC | | 33 | EA | - | R | PS | | |
| 60 | 1/4 73B | WASHER-SPLIT LOCK-STL-BO | | (4) | EA | | R | PS | | |
| 61 | M4 70B | WASHER-FLAT-STL-BO | | 2 | EA | - | R | PS | | |
| 62 | M5 73B | WASHER-SPLIT LOCK-STL-BO | | 9 | EA | - | R | PS | | |
| 63 | 1/2-20 51Z | NUT-HEX JAM-STL-ZINC | | 1 | EA | | R | PS | | |
| 65 | 22768-32 | LABEL-TEXT-WHITE-1.00W x 1.437H | X MOTOR | 2 | EA | AC | R | DWG | | |

| REV. | DESCRIPTION | DATE | BY | APPV. |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------|-------|
| A | PRODUCTION RELEASE | 14217 | 8/12/14 | TO |
| B | ADDED ITEMS 14-17 & PIC. ITEM 7 WAS 27636-2, DELETED ITEM 8 WAS 27637-2, ITEM 71 QTY WAS 4. | 14405 | 8-5-15 | TO |
| C | ADDED ITEM 23. ITEM 33 QTY WAS 37, ITEM 35 QTY WAS 64. ADDED ITEM 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000. | 14481 | 09/06/16 | TO |
| C | WAS 27634-1, 27641, 27641U (CYLINDER & SENSOR ASS'YS). | 14545 | 07/15/16 | PM |
| D | ITEM 61 27065-1 WAS 24672-2. | | | |



NOTE: THIS DESIGN WAS ORIGINATED BY AND PROVIDED TO CONTRACTOR, PROPRIETARY TO THE COMPANY BY SOUTH WESTERN INDUSTRIES, INC. COMPANY AGREES TO MAKE ANY AND ALL NECESSARY CHANGES TO THIS DESIGN TO ACCOMMODATE ANY OTHER COMPANY'S DESIGN OR DESIGN REQUIREMENTS. THE LIMITATION OF LIABILITY SHALL APPLY TO THE COMPANY'S DESIGN OR DESIGN REQUIREMENTS.

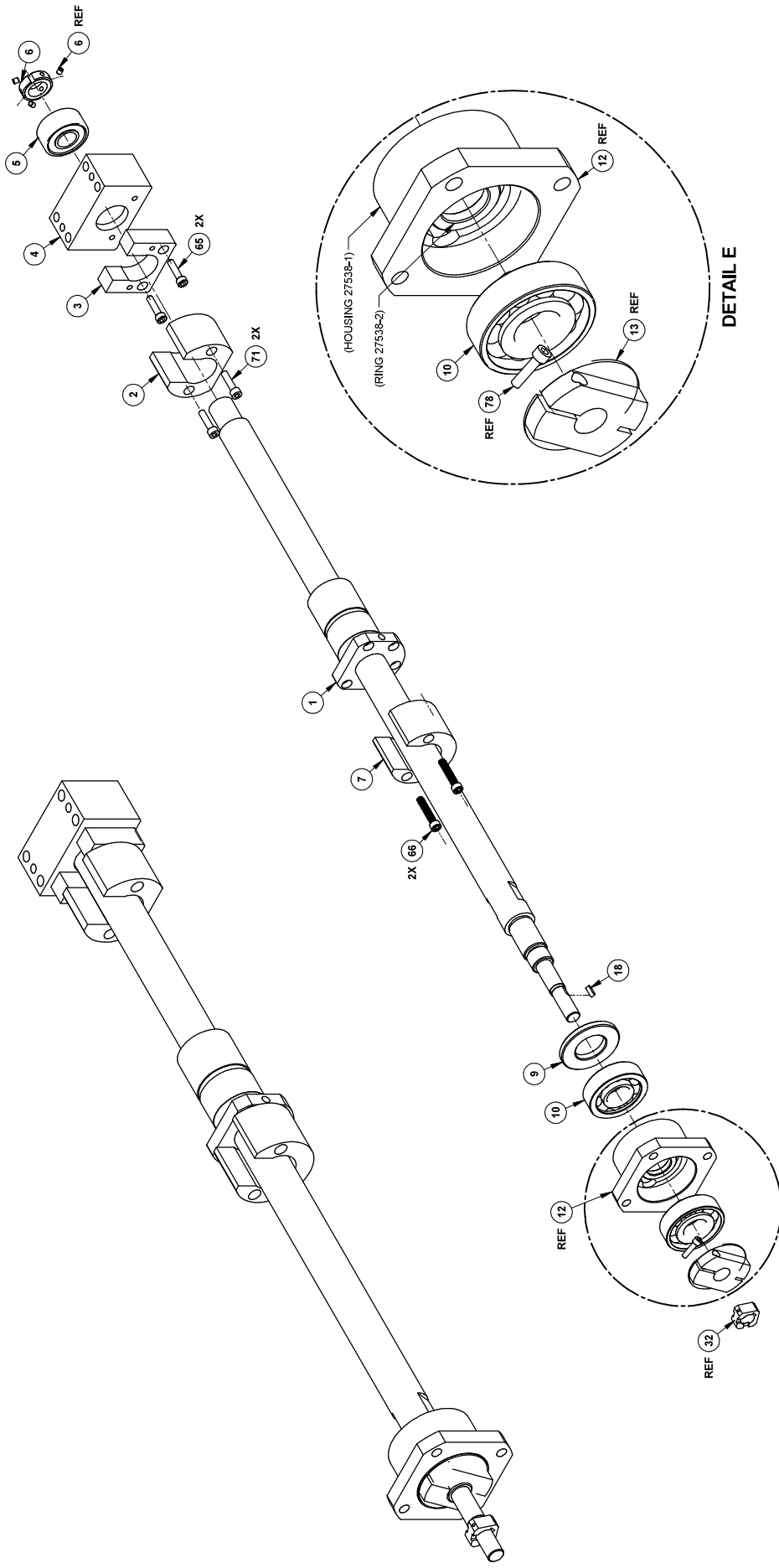
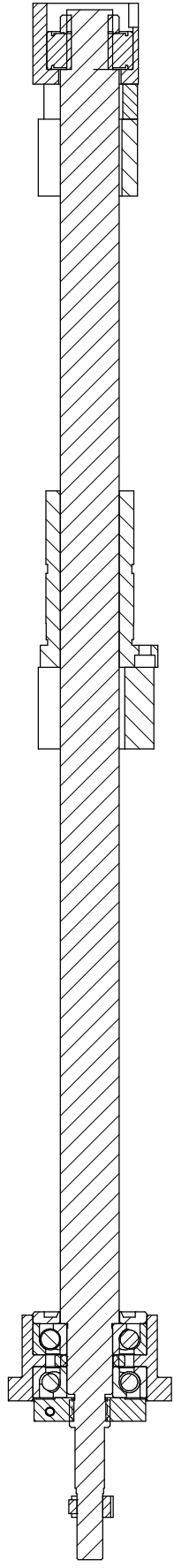
FOR PARTS LIST SEE SEPARATE 'A' SIZE SHEET

| | |
|------------------------|---------|
| APPROVALS: | DATE: |
| DESIGNED BY: Bob | 6/9/14 |
| ENGINEER: TO | 8/7/14 |
| DRAWN BY: Sal | 7/31/14 |
| THIRD ANGLE PROJECTION | |

COMPANY: SOUTH WESTERN INDUSTRIES, INC.
 MANUFACTURED IN: USA
 TITLE: COLUMN ASSY - Z AXIS-M11
 PART CODE: BERT, INC. TORRONS: 27540-1
 REV: D
 DATE: 06/23/8
 SHEET 1 OF 3

NOTES: (UNLESS OTHERWISE SPECIFIED),
 1. FOR CLARITY NOT ALL HARDWARE (FLAT & LOCK WASHERS) SHOWN, APPLY LOCITITE 222 TO HARDWARE.
 2. ORIENT BRAKE SUCH THAT LEAD WIRES EXIT REAR OF MOTOR BRACKET. (1D6)
 3. CURRENT CONFIGURATION SHOWN: BEGAN USING IN 1st QUARTER 2016. SEE ES-508 FOR INSTALLATION & TEST PROCEDURE. (1D7)

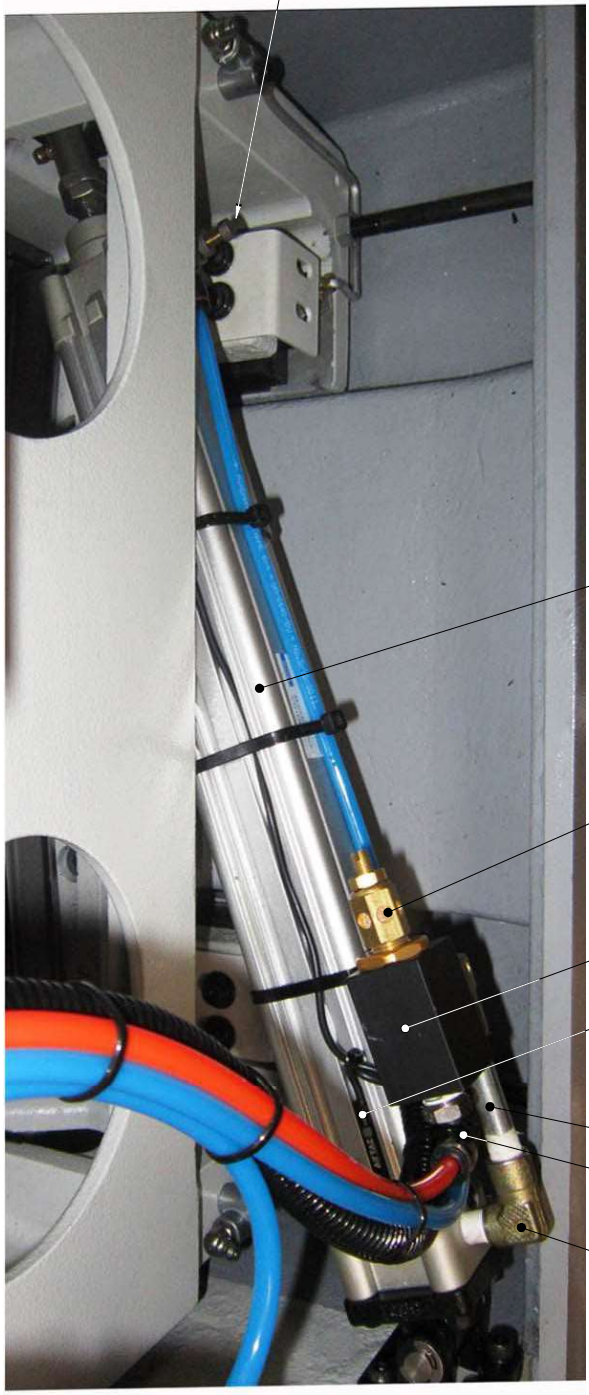
1 2 3 4 5 6 7 8



DETAIL E

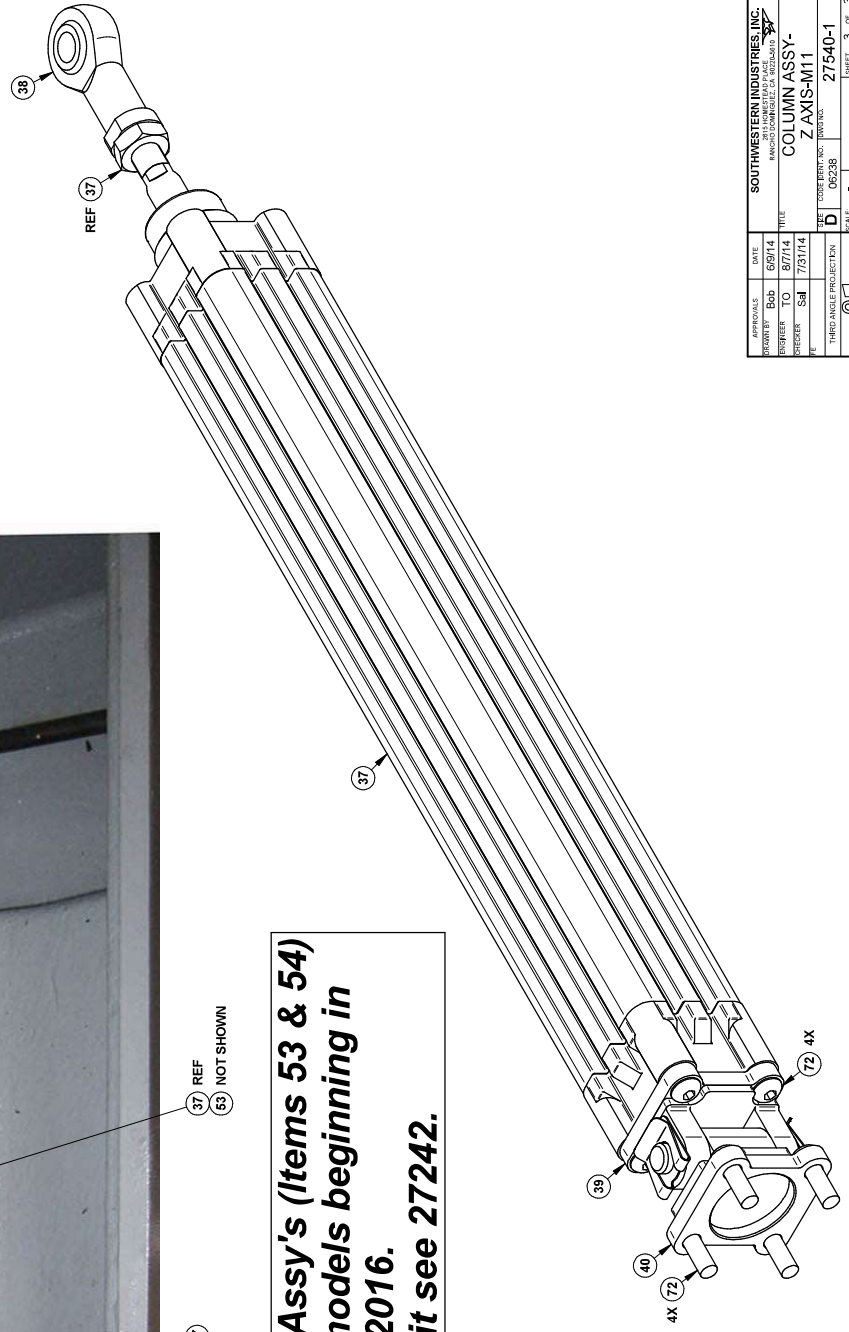
| | | |
|------------------------|-----------|-------------------------------|
| APPROVALS | DATE | SOUTHWESTERN INDUSTRIES, INC. |
| DESIGNED BY | 6/5/14 | MANUFACTURED BY |
| ENGINEER | TO 5/7/14 | TITLE |
| DRAWN BY | 5/11/14 | PROJECT |
| THIRD ANGLE PROJECTION | D | DRAWING NO. |
| | | 27540-1 |
| | | SCALE |
| | | SHEET 2 OF 3 |

1 2 3 4 5 6 7 8



- 2X (60)
- (61)
- (62)
- (54)
- (59)
- (57)
- (37) REF
- (53) NOT SHOWN

Cylinder (Item 37) & Sensor Assy's (Items 53 & 54) were changed to current models beginning in 1st quarter 2016. For Replacement Kit see 27242.



| | | | | |
|------------------------|-------------|----------|-------------------------------|----|
| APPROVALS | | DATE | SOUTHWESTERN INDUSTRIES, INC. | |
| DESIGNED BY | TO | 6/5/14 | MANUFACTURED BY | |
| ENGINEER | TO | 5/7/14 | COLUMBIA ASSY- | |
| DRAWN BY | TO | 7/31/14 | Z AXIS-M11 | |
| DATE | DESCRIPTION | 06/23/14 | REV | BY |
| 27540-1 | | | D | D |
| THIRD ANGLE PROJECTION | | SCALE | SHEET 3 OF 3 | |

D C B A

Parts List for Assembly P/N: 27540-1

Printed 7/19/2016

27540-1

COLUMN ASSY-Z AXIS-M11

| | | | |
|----------|-----------|--------------|---------------|
| Type | PL | Dwg Size | D |
| Revision | D | Product | 2 OP M11 MILL |
| Status | R | Engineer | TO |
| Date | 11/6/2013 | Planner Code | |
| By | Bob | Comm Code | |

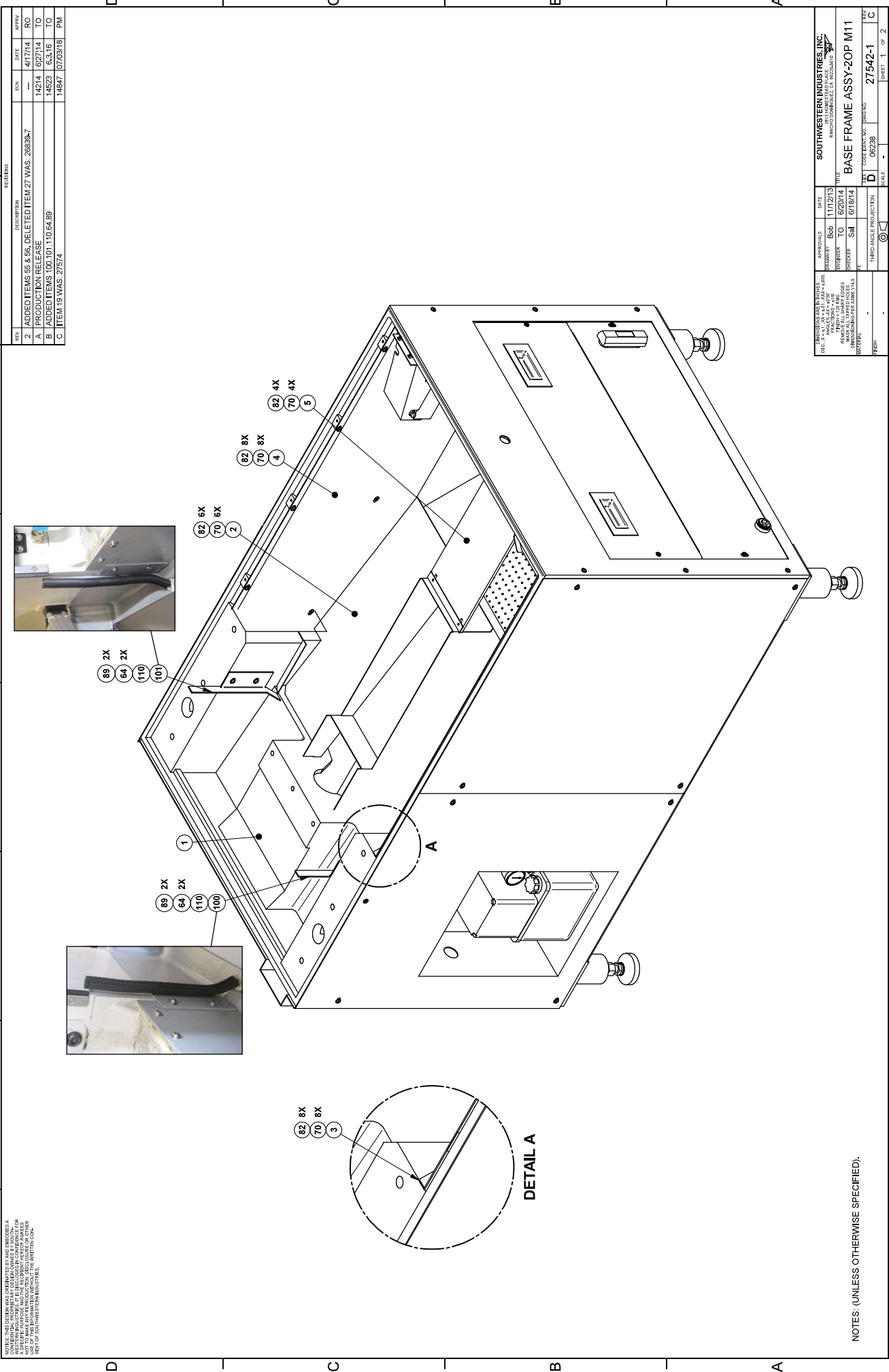
| Item | P/N | Title | Detail | Qty | UseA | Rev | Stat | Type | Mfr | Mfr P/N |
|------|----------|----------------------------------------------|---------------------------------------|-----|------|-----|------|------|-----------|-----------|
| 1 | 27533-1 | BALLSCREW-Z AXIS-M11 | | 1 | EA | A | R | DWG | | |
| 2 | 27537-1 | BUMPER-Z AXIS-BOTTOM | | 1 | EA | - | R | DWG | | |
| 3 | 27536-1 | SPACER-BUMPER-Z AXIS-BOTTOM | SEE 27540 OR 27540-1 | 1 | EA | - | R | PS | KING RICH | |
| 4 | 27535 | BEARING BLOCK-FLOATING END Z AXIS | | 1 | EA | - | R | DWG | | |
| 5 | 22008 | BEARING-204KTT | | 1 | EA | C | R | DWG | | |
| 6 | 27951-4 | LOCKNUT-M20 X 1.0 | | 1 | EA | - | R | PS | KING RICH | |
| 7 | 28184 | BUMPER-Z AXIS BALLSCREW | Replaces 27536-2 & 27537-2 | 1 | EA | A | R | PS | | |
| 9 | 27674 | SEAL-NILOS RING-7305-AVH | | 1 | EA | - | R | DWG | | |
| 10 | 20373-1 | BEARING-ANGULAR CONTACT-7305 BECBP | | 2 | EA | - | R | DWG | | |
| 12 | 27538 | BEARING HOUSING ASSY- Z AXIS DRIVE | | (1) | EA | - | R | PL | | |
| 13 | 27756 | NUT-CLAMP-Z AXIS | | (1) | EA | C | R | DWG | | |
| 14 | 27085-2 | FITTING-AIR-90°-10mm-PUSH TO CONN-1/4 BSPT M | SEE 27542 OR 27563 | 3 | EA | - | R | PS | KING RICH | A-316-381 |
| 15 | 28071-2 | VALVE-FLOW CONTROL-AIR | 1/4 BSPT TO 6mm PUSH TO CONNECT | 1 | EA | - | R | PS | KING RICH | JSC0603 |
| 16 | 22607-5 | FILTER/REGULATOR-W/ 5µm FILTER,0-140 PSI | FOR FILTER REPL SEE 24607-6 | 1 | EA | B | R | DWG | | |
| 17 | 22607-6 | FILTER ELEMENT-REPLACEMENT | SEE 22607-5 | (1) | EA | A | R | DWG | | |
| 18 | 28135-2 | KEY-ROUNDED ENDS-5x4x12 | SEE 27540-1 | 1 | EA | A | R | PS | KING RICH | |
| 20 | 27603-25 | BRACKET-MTG-FLOW CONTROL-ATC DOOR CYL | | 1 | EA | - | R | DWG | KING RICH | |
| 21 | 28071-3 | VALVE-FLOW CONTROL-INLINE-AIR | Ø6mm PUSH TO CONNECT | 2 | EA | - | R | PS | KING RICH | A-260-070 |
| 23 | 27528-1 | COLUMN-Z AXIS-2OP M11 | | 1 | EA | A | R | PS | KING RICH | OP030011 |
| 24 | 27682-12 | RETAINER-SEAL-TOOL-Z AXIS | SEE 27540 OR 27540-1 | 2 | EA | - | R | PS | KING RICH | |

| Item | P/N | Title | Detail | Qty | UseA | Rev | Stat | Type | Mfr | Mfr P/N |
|------|----------|---------------------------------------|------------------------------------------------|-----|------|-----|------|------|-----------|------------------------------|
| 25 | 27682-13 | SEAL-TOOL-Z-AXIS | SEE 27540 OR 27540-1 | 2 | EA | - | R | PS | KING RICH | |
| 26 | 27539-1 | BRACKET-MOTOR-Z AXIS-M11 | | 1 | EA | A | R | PS | KING RICH | OP130071 |
| 27 | 28164-1 | MOTOR-BRUSHLESS-DELTA-1KW | ECMA-C21010RS | 1 | EA | B | R | DWG | | |
| 28 | 27857-1 | COUPLING-Z AXIS-2OP | | 1 | EA | A | R | PS | KING RICH | |
| 29 | 26740-5 | GUIDE-LINEAR-SET (2) -Z AXIS | 920mm | 1 | EA | - | R | DWG | | |
| 30 | 27541-1 | CAP-GUIDE-LINEAR | SEE X, Y, Z DRV TRAIN | 30 | EA | - | R | PS | | |
| 31 | 27243 | COVER-BRAKE-M11 | | 1 | EA | A | R | DWG | | |
| 32 | 27640-1 | BRAKE ASSY-Z AXIS-24VDC-M11 | | 1 | EA | A | R | PL | | |
| 33 | 27635-13 | CABLE ASSY-Z AXIS BRAKE | DC300-118 | 1 | EA | - | R | PL | | |
| 34 | 22680-3 | SWITCH-LIMIT-ROLLER PLUNGER | | 1 | EA | - | R | DWG | | |
| 35 | 27545 | TELESCOPIC COVER ASSY-LF & RT | SEE 27540 OR 27540-1 | 1 | EA | - | R | PL | | |
| 37 | 27583-8 | CYLINDER-AIR-32 BORE 300 STROKE | USED WITH SENSORS ASSY 27641-2 & 27641-3 | 1 | EA | A | R | DWG | | |
| 38 | 27583-2 | ROD END-BALL JOINT-10MM ID | SEE 27540 OR 27540-1 | 1 | EA | - | R | PS | | |
| 39 | 27583-3 | SWIVEL FLANGE-REAR PIVOT | SEE 27540 OR 27540-1 | 1 | EA | - | R | PS | AIR TAC | CA-174404 SNCL 32 L |
| 40 | 27583-4 | SWIVEL FLANGE-MTG BRKT | SEE 27540 OR 27540-1 | 1 | EA | - | R | PS | AIR TAC | CB-174390 SNCB 32 SF 0 |
| 41 | 26840-6 | CABLE ASSY-MOTOR POWER-DELTA-Z AXIS | DC300-135_1MP | 1 | EA | D | R | PL | | |
| 42 | 26844-6 | CABLE ASSY-MOTOR ENCODER-DELTA-Z AXIS | DC300-136_1MP | 1 | EA | C | R | PL | | |
| 43 | 22768-33 | LABEL-TEXT-WHITE-1.00W x 1.437H | Y MOTOR | (2) | EA | AD | R | DWG | | |
| 45 | 28020-1 | FITTING-HOSE- HYDRAULIC | SEE 27540 OR 27540-1 | 1 | EA | - | R | PS | KING RICH | |
| 46 | 28020-2 | FITTING-COLUMN/MANIFOLD | SEE 27540 OR 27540-1 | 1 | EA | - | R | PS | KING RICH | |
| 47 | 28020-3 | FITTING-COLUMN | SEE 27540 OR 27540-1 | 1 | EA | - | R | PS | KING RICH | |
| 48 | 26893-1 | MANIFOLD-AIR/COOLANT | SEE 27540 OR 27540-1 | 1 | EA | - | R | PS | KING RICH | |

| Item | P/N | Title | Detail | Qty | UseA | Rev | Stat | Type | Mfr | Mfr P/N |
|------|----------------|-------------------------------------|-------------------------|-----|------|-----|------|------|-----------|-------------|
| 49 | 27177-3 | NUT-FLARE-ADAPTER | SEE 27540 OR 27540-1 | 2 | EA | - | R | PS | KING RICH | |
| 50 | 27177-1 | ADAPTER-LINK-COOLANT | | 5 | EA | - | R | PS | KING RICH | A-084-25 |
| 51 | 27177-2 | NOZZLE-COOLANT WASH-1" FLARE | SHORT | 2 | EA | - | R | PS | KING RICH | |
| 52 | 27177-4 | CONNECTOR-LOC LINE-COOLANT NPT | SEE 27540 OR 27540-1 | 1 | EA | - | R | PS | LOC LINE | |
| 53 | 27641-2 | SENSOR ASSY-ATC FRONT INPUT | | 1 | EA | A | R | PL | | |
| 54 | 27641-3 | SENSOR ASSY-ATC BACK INPUT | | 1 | EA | A | R | PL | | |
| 56 | 28071 | VALVE-FLOW CONTROL-AIR | | 1 | EA | - | R | PS | KING RICH | A-572-001 |
| 57 | 28071-1 | VALVE-FLOW CONTROL W MUFFLER-AIR | SEE 27563 | 1 | EA | - | R | PS | KING RICH | A-260-007-3 |
| 58 | 27635-3 | CABLE ASSY-Z AXIS HOME SW | DC300-113 | 1 | EA | - | R | PL | | |
| 59 | 28074 | VALVE-QUICK EXHAUST | SEE 27563 | 1 | EA | - | R | PS | KING RICH | A-201-001 |
| 60 | 24673-1 | ELBOW-STREET - 1/8 BSPT | SEE 27540 OR 27540-1 | 2 | EA | - | R | PS | | |
| 61 | 27085-1 | FITTING-AIR-90°-6mm-PUSH TO CONNECT | 1/4 BSPT MALE THD | 1 | EA | - | R | PS | KING RICH | A-316-408 |
| 62 | 28076 | NIPPLE-ROUND- 1/8 BSPT X 2 LG | SEE 27540 OR 27540-1 | 1 | EA | - | R | PS | | |
| 65 | M6-1.0X20 25B | SCREW-SHCS-STL-BO | | 34 | EA | | R | PS | | |
| 66 | M8-1.25X35 25B | SCREW-SHCS-STL-BO | | 10 | EA | | R | PS | | |
| 67 | M8-1.25X40 25B | SCREW-SHCS-STL-BO | | 4 | EA | | R | PS | | |
| 68 | M8-1.25X25 25B | SCREW-SHCS-STL-BO | | 4 | EA | | R | PS | | |
| 69 | M6-1.0X10 26B | SCREW-FHCS-STL-BO | NON STOCKABLE | 30 | EA | - | R | PS | | |
| 70 | M4-0.7X25 27B | SCREW-BHCS-STL-BO | NON STOCKABLE | 2 | EA | - | R | PS | | |
| 71 | M6-1.0X25 25B | SCREW-SHCS-STL-BO | | 2 | EA | | R | PS | | |
| 72 | M6-1.0X20 27B | SCREW-BHCS-STL-BO | | 8 | EA | | R | PS | | |
| 73 | M5-0.8X20 25B | SCREW-SHCS-STL-BO | NON STOCKABLE | 2 | EA | - | R | PS | | |
| 74 | M8-1.25X60 25B | SCREW-SHCS-STL-BO | | 3 | EA | | R | PS | | |
| 75 | M5-0.8X10 25B | SCREW-SHCS-STL-BO | | 4 | EA | - | R | PS | | |
| 76 | M6-1.0X10 27B | SCREW-BHCS-STL-BO | | 4 | EA | - | R | PS | | |

| Item | P/N | Title | Detail | Qty | UseA | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------------|--------------------------|---------------|-----|------|-----|------|------|-----|---------|
| 77 | M5-0.8X10 27B | SCREW-BHCS-STL-BO | | 6 | EA | - | R | PS | | |
| 78 | 10-32X3/4 25B | SCREW-SHCS-STL-BO | | (1) | EA | | R | PS | | |
| 79 | M5-0.7X10 26Z | SCREW-FHCS-STL-ZINC | NON STOCKABLE | 6 | EA | - | R | PS | | |
| 80 | M4-0.7X25 25B | SCREW-BHCS-STL-BO | NON STOCKABLE | 4 | EA | - | R | PS | | |
| 81 | M4-0.7X35 25B | SCREW-SHCS-STL-BO | NON STOCKABLE | 3 | EA | - | R | PS | | |
| 83 | M8 73B | WASHER-SPLIT LOCK-STL-BO | | 12 | EA | | R | PS | | |
| 84 | M6 73B | WASHER-SPLIT LOCK-STL-BO | | 4 | EA | - | R | PS | | |
| 86 | M5 73B | WASHER-SPLIT LOCK-STL-BO | | 12 | EA | - | R | PS | | |
| 87 | M4 73B | WASHER-SPLIT LOCK-STL-BO | | 7 | EA | | R | PS | | |
| 88 | M5 70B | WASHER-FLAT USS-STL-BO | | 2 | EA | - | R | PS | | |
| 89 | M4 70B | WASHER-FLAT-STL-BO | | 4 | EA | - | R | PS | | |
| 92 | M8 70B | WASHER-FLAT USS-STL-BO | | 4 | EA | | R | PS | | |

1 2 3 4 5 6 7 8



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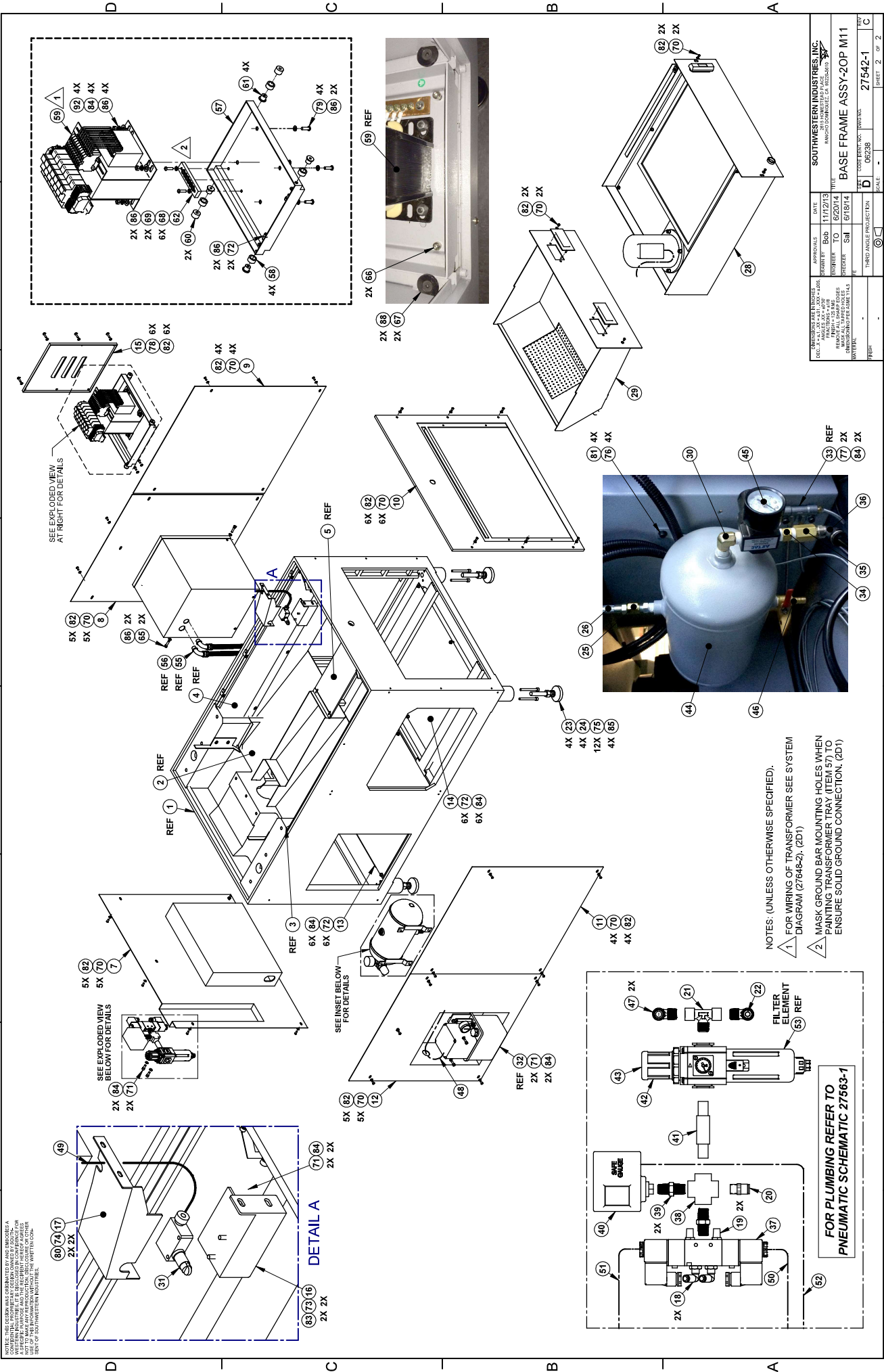
| REV | DESCRIPTION | DATE | APPROV |
|-----|---------------------------------------------------|----------|--------|
| 2 | ADDED ITEMS 55 & 56, DELETED ITEM 27 WAS: 26835-7 | 4/17/14 | RC |
| A | PRODUCTION RELEASE | 6/27/14 | TC |
| B | ADDED ITEMS 100, 101, 110, 64, 89 | 6.3.16 | TC |
| C | ITEM 19 WAS: 27574 | 07/03/18 | PM |

| APPROVALS | DATE | APPROV |
|-----------|----------|--------|
| Bob | 11/12/13 | |
| TO | 6/20/14 | |
| Sal | 6/18/14 | |

SOUTHWESTERN INDUSTRIES, INC.
 MANUFACTURING DIVISION
 27542-1
 BASE FRAME ASSEMBLY
 SHEET CODE: 27542-1
 SCALE: 1:1
 SHEET 1 OF 2

NOTES: (UNLESS OTHERWISE SPECIFIED).

NOTE: THIS DESIGN WAS CHARACTERIZED BY AND EMPLOYED BY SOUTHWESTERN INDUSTRIES, INC. ANY REPRODUCTION OF THIS DESIGN WITHOUT THE WRITTEN PERMISSION OF SOUTHWESTERN INDUSTRIES, INC. IS PROHIBITED. ANY REPRODUCTION OF THIS DESIGN WITHOUT THE WRITTEN PERMISSION OF SOUTHWESTERN INDUSTRIES, INC. IS PROHIBITED.



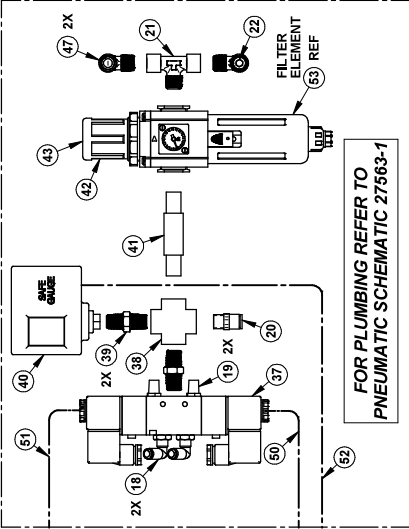
SEE EXPLODED VIEW AT RIGHT FOR DETAILS

SEE EXPLODED VIEW BELOW FOR DETAILS

SEE INSET BELOW FOR DETAILS

DETAIL A

NOTES: (UNLESS OTHERWISE SPECIFIED),
 1 FOR WIRING OF TRANSFORMER SEE SYSTEM DIAGRAM (27648-2), (2D1)
 2 MASK GROUND BAR MOUNTING HOLES WHEN PAINTING TRANSFORMER TRAY (ITEM 57) TO ENSURE SOLID GROUND CONNECTION. (2D1)



| | | | |
|-------------------------------|--|------------------------|----------|
| SOUTHWESTERN INDUSTRIES, INC. | | DATE | 11/17/13 |
| MANUFACTURED IN THE USA | | APPROVALS | Bob TO |
| PART NO. 27542-1 | | ENGINEER | TO |
| REV. 1 | | DESIGNER | Sal |
| REV. 2 | | DATE | 6/18/14 |
| REV. 3 | | THIRD ANGLE PROJECTION | D |
| REV. 4 | | SCALE | 1:1 |
| REV. 5 | | SHEET | 2 OF 2 |
| REV. 6 | | | |
| REV. 7 | | | |
| REV. 8 | | | |
| REV. 9 | | | |
| REV. 10 | | | |
| REV. 11 | | | |
| REV. 12 | | | |
| REV. 13 | | | |
| REV. 14 | | | |
| REV. 15 | | | |
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| REV. 87 | | | |
| REV. 88 | | | |
| REV. 89 | | | |
| REV. 90 | | | |
| REV. 91 | | | |
| REV. 92 | | | |

Parts List for Assembly P/N: 27542-1

Printed 7/3/2018

27542-1

BASE FRAME ASSY-2OP M11

Type PL
Revision C
Status R
Date 11/12/2013
By Bob

Dwg Size D
Product 2 OP MILL
Engineer TO
Planner Code
Comm Code

| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|-----------|-------------------------------------------|----------------------|--------------|-----|-------|-----|------|------|-----------|------------|
| 1 | 27529-1 | BASE CASTING-M11 | | | 1 | EA | A | R | PS | KING RICH | OP040010 |
| 2 | 27530-1 | DRAIN PAN | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420220 |
| 3 | 27530-2 | BRACE-DRAIN PAN-LEFT | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420200 |
| 4 | 27530-3 | BRACE-DRAIN PAN-RIGHT | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420210 |
| 5 | 27530-4 | COVER-Y AXIS BALLSCREW | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420680 |
| 7 | 27530-5-1 | COVER-REAR-FRAME ASSY | SEE 27542-1 | | 1 | EA | A | R | PS | KING RICH | OP420271 |
| 8 | 27530-6-1 | COVER-REAR/RIGHT-TRANSFORMER-M11 | SEE 27542-1 | | 1 | EA | A | R | PS | KING RICH | OP420251 |
| 9 | 27530-7 | COVER-FRONT/RIGHT-FRAME ASSY | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420260 |
| 10 | 27530-8 | COVER-CHIP & COOLANT TANK-FRAME ASSY | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420290 |
| 11 | 27530-9 | COVER-FRONT/LEFT-FRAME ASSY | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420260 |
| 12 | 27530-10 | COVER-REAR/LEFT-LUBE PUMP | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420240 |
| 13 | 27530-11 | COVER-BOTTOM/REAR-FRAME ASSY | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420631 |
| 14 | 27530-12 | COVER-BOTTOM/FRONT-FRAME ASSY | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420621 |
| 15 | 28112 | COVER-TRANSFORMER-2OP M11 | | | 1 | EA | A | R | PS | KING RICH | OP420251-C |
| 16 | 27546-1 | BRACKET-LOWER-SWITCH-Y AXIS | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420700 |
| 17 | 27546-2 | BRACKET-UPPER-SWITCH-Y AXIS | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420711 |
| 18 | 27085-1 | FITTING-AIR-90°-6mm-PUSH TO CONNECT | 1/4 BSPT MALE THD | | 2 | EA | - | R | PS | KING RICH | A-316-408 |
| 19 | 27574-1 | MUFFLER-1/8 BSPT | | | 2 | EA | A | R | PS | KING RICH | A-316-136 |
| 20 | 27091-2 | FITTING-AIR-STRAIGHT-10mm-PUSH TO CONNECT | 1/4 BSPT MALE THD | | 1 | EA | - | R | PS | KING RICH | |

| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------|--------------------------------------------------|------------------------------|--------------|-----|-------|-----|------|------|-----------|-----------|
| 21 | 22169-4 | FITTING-PIPE-TEE-F/M/F-1/4 BSPT | SEE 27542 OR 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 22 | 28042-3 | PLUG-1/4 BSPT | SEE 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 23 | 27555-1 | LEVELING MOUNT-FRAME ASSY | | | 4 | EA | - | R | DWG | | |
| 24 | 27555-2 | LEVELING PAD-FRAME ASSY | SEE 27542 | | 4 | EA | - | R | PS | KING RICH | A-446-003 |
| 25 | 27091-3 | FITTING-STRAIGHT-1/4 BSPT X 1/4 HYDR M/M | SEE 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 26 | 28127-3 | LINE-HYDRAULIC-1/8 X2850mm | | | 1 | EA | A | R | DWG | | |
| 28 | 27557 | COOLANT SYSTEM ASSY-2OP MILL | | | 1 | EA | B | R | PL | | |
| 29 | 27562 | CHIP TRAY ASSY | | | 1 | EA | - | R | PL | | |
| 30 | 26952-4 | FITTING-AIR-90°-1/4 BSPT M/M | SEE 27542 OR 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 31 | 22680-3 | SWITCH-LIMIT-ROLLER PLUNGER | | | 1 | EA | - | R | DWG | | |
| 32 | 22291-3 | LUBRICATION PUMP-WITH CABLE-110 VAC-M10 | | | (1) | EA | A | R | PL | | |
| 33 | 28042-1 | MANIFOLD-TUBE FITTING-4 OUTLETS | SEE 27591 | | (1) | EA | - | R | PS | KING RICH | |
| 34 | 27725 | CHECK VALVE-STRAIGHT-1/4 BSPT | SEE 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 35 | 27745 | COUPLING-1/4 BSPT | SEE 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 36 | 27085-2 | FITTING-AIR-90°-10mm-PUSH TO CONN-1/4 BSPT M | SEE 27542 OR 27563 | | 1 | EA | - | R | PS | KING RICH | A-316-381 |
| 37 | 26938-5 | VALVE-AIR-SOLENOID-DOUBLE-4WAY -3POS-NO-24VDC | | | 1 | EA | - | R | DWG | | |
| 38 | 22169-2 | FITTING-PIPE-CROSS-1/4-BSPT BRASS | SEE 27542 | | 1 | EA | - | R | PS | | |
| 39 | 24151-1 | HEX NIPPLE BSPT 1/4 M | | | 2 | EA | - | R | PS | KING RICH | |
| 40 | 26931-1 | SWITCH-AIR PRESSURE | | | 1 | EA | - | R | PS | KING RICH | |
| 41 | 22647-6 | NIPPLE-MALE-BRASS PIPE | 3/8 NPT-FULLY THREADED | | 1 | EA | B | R | DWG | KING RICH | |
| 42 | 22607-3 | BRACKET-MOUNTING KIT | MATE W/ 22607-2 | | 1 | EA | - | R | PS | | |

| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------------|-----------------------------------------------|-----------------------------------|--------------|-----|-------|-----|------|------|-----------|------------|
| 43 | 22607-2 | FILTER/REGULATOR-W/ 40µm FILTER, 0-160 PSI | FOR FILTER REPL SEE 24607-4 | | 1 | EA | C | R | DWG | | |
| 44 | 28033 | AIR TANK | | | 1 | EA | - | R | DWG | | |
| 45 | 28034 | AIR REGULATOR | SEE 27563 | | 1 | EA | - | R | PS | | |
| 46 | 28035 | DRAIN VALVE - AIR TANK | SEE 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 47 | 26952-2 | ELBOW-STREET-1/4 BSPT | SEE 27563 | | 2 | EA | - | R | PS | KING RICH | |
| 48 | 27176 | CABLE ASSY-LUBE PUMP | DC300-120 | | 1 | EA | A | R | PL | | |
| 49 | 27635-2 | CABLE ASSY-Y AXIS HOME SW | DC300-112C | | 1 | EA | A | R | PL | | |
| 50 | 27635-11 | CABLE ASSY-SOLENOID ATC BACK | DC300-108 | | 1 | EA | A | R | PL | | |
| 51 | 27635-12 | CABLE ASSY-SOLENOID ATC FRONT | DC300-109 | | 1 | EA | A | R | PL | | |
| 52 | 27635-5 | CABLE ASSY-LIMIT SW-AIR PRESSURE | DC300-110 | | 1 | EA | - | R | PL | | |
| 53 | 22607-4 | FILTER ELEMENT-REPLACEMENT | SEE 22607-2 | | (1) | EA | - | R | PS | KING RICH | A-260-051 |
| 55 | 27547-1 | WIRE HARNESS ASSY-7 COND-ELEC CAB TO TRX | | | (1) | EA | C | R | PL | | |
| 56 | 27547-2 | WIRE HARNESS ASSY-3 COND-TRX TO DRIVE | DC300-309C | | (1) | EA | C | R | PL | | |
| 57 | 28112-1 | TRAY-TRANSFORMER-2OP M11 | | | 1 | EA | A | R | PS | KING RICH | OP420251-B |
| 58 | 28111 | BEARING-DRAWN CUP-NEEDLE ROLLER-HK1308 | | | 1 | EA | A | R | PS | KING RICH | A-575-007 |
| 59 | 28152-1 | TRANSFORMER ASSY - 1.1KVA | | | 1 | EA | C | R | PL | | |
| 60 | 28166 | SPACER-13 ID x 19 OD x 12 THK | SEE 27542-1 | | 2 | EA | A | R | PS | KING RICH | OP420260 |
| 61 | 27593-2 | BUSHING-TRANSFORMER TRAY-2OP | | | 4 | EA | A | R | PS | KING RICH | OP420270 |
| 62 | 21753-5 | GROUND BAR- 6 HOLE-100 X 22 | | | 1 | EA | B | R | DWG | KING RICH | |
| 64 | M5-0.8X8 2Z | SCREW-BHCS-STL-ZINC | | | 4 | EA | - | R | PS | | |
| 65 | M6-1.0X25 25B | SCREW-SHCS-STL-BO | | | 2 | EA | A | R | PS | | |
| 66 | M5-0.8X25 25Z | SCREW-SHCS-STL-ZINC | NON STOCKABLE | | 2 | EA | - | R | PS | | |

| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|----------------|-----------------------------------|----------------|--------------|-----|-------|-----|------|------|-----|-----------|
| 67 | M5-0.8X15 26B | SCREW-FHCS-STL-BO | NON STOCKABLE | | 2 | EA | - | R | PS | | |
| 68 | M5-0.8X10 31Z | SCREW-PH-PHIL-EXT SEMS-STL-ZINC | | | 6 | EA | - | R | PS | | |
| 69 | M5-0.8X20 27Z | SCREW-BHCS-STL-ZINC | | | 2 | EA | - | R | PS | | |
| 70 | M5-0.8X12 27J | SCREW-BHCS-SS | NON-STOCKA BLE | | 59 | EA | - | R | PS | | |
| 71 | M6-1.0X16 25B | SCREW-SHCS-STL-BO | | | 6 | EA | - | R | PS | | |
| 72 | M6-1.0X12 25B | SCREW-SHCS-STL-BO | | | 14 | EA | | R | PS | | |
| 73 | M5-0.8X10 25B | SCREW-SHCS-STL-BO | | | 2 | EA | - | R | PS | | |
| 74 | M4-0.7X10 25B | SCREW-SHCS-STL-BO | | | 2 | EA | | R | PS | | |
| 75 | M8-1.25X80 25B | SCREW-SHCS-STL-BO | | | 12 | EA | - | R | PS | | |
| 76 | M5-0.8X12 25B | SCREW-SHCS-STL-BO | | | 4 | EA | - | R | PS | | |
| 77 | M6-1.0X35 25B | SCREW-SHCS-STL-BO | | | 2 | EA | - | R | PS | | |
| 78 | M5-0.8X20 27B | SCREW-BHCS-STL-BO | NON STOCKABLE | | 6 | EA | - | R | PS | | |
| 79 | M6-1.0X20 27B | SCREW-BHCS-STL-BO | | | 4 | EA | | R | PS | | |
| 80 | M4 73B | WASHER-SPLIT LOCK-STL-BO | | | 2 | EA | | R | PS | | |
| 81 | M5 70B | WASHER-FLAT USS-STL-BO | | | 12 | EA | - | R | PS | | |
| 82 | M5 70J | WASHER-FLAT-SS | NON-STOCKA BLE | | 65 | EA | - | R | PS | | |
| 83 | M5 73B | WASHER-SPLIT LOCK-STL-BO | | | 2 | EA | - | R | PS | | |
| 84 | M6 73B | WASHER-SPLIT LOCK-STL-BO | | | 24 | EA | - | R | PS | | |
| 85 | M8 73B | WASHER-SPLIT LOCK-STL-BO | | | 4 | EA | | R | PS | | |
| 86 | M6 70B | WASHER-FLAT USS-STL-BO | | | 4 | EA | - | R | PS | | |
| 87 | M5 75Z | WASHER-EXT TOOTH-STL-ZINC | NON-STOCKA BLE | | 2 | EA | - | R | PS | | |
| 88 | 28173 | WASHER-RETAINING-TRANSFORMER TRAY | | | 2 | EA | A | R | PS | | KING RICH |

| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|------------|--------------------------|---------------|--------------|-----|-------|-----|------|------|-----|---------|
| 89 | M5 71Z | WASHER-FLAT-STL-ZINC | NON STOCKABLE | | 4 | EA | - | R | PS | | |
| 92 | M6-1.0 50P | NUT-HEX-STL-PLAIN | | | 4 | EA | - | R | PS | | |
| 100 | 27262-1 | BRACKET-L-LEFT SIDE-ATC | | | 1 | EA | A | R | DWG | | |
| 101 | 27262-2 | BRACKET-L-RIGHT SIDE-ATC | | | 1 | EA | A | R | DWG | | |
| 110 | 27263 | SEAL-RUBBER | | | 2 | EA | A | R | PS | | |

Parts List for Assembly P/N: 27542-1

Printed 7/3/2018

27542-1

BASE FRAME ASSY-2OP M11

Type PL Dwg Size D
 Revision C Product 2 OP MILL
 Status R Engineer TO
 Date 11/12/2013 Planner Code
 By Bob Comm Code

| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|-----------|-------------------------------------------|----------------------|--------------|-----|-------|-----|------|------|-----------|------------|
| 1 | 27529-1 | BASE CASTING-M11 | | | 1 | EA | A | R | PS | KING RICH | OP040010 |
| 2 | 27530-1 | DRAIN PAN | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420220 |
| 3 | 27530-2 | BRACE-DRAIN PAN-LEFT | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420200 |
| 4 | 27530-3 | BRACE-DRAIN PAN-RIGHT | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420210 |
| 5 | 27530-4 | COVER-Y AXIS BALLSCREW | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420680 |
| 7 | 27530-5-1 | COVER-REAR-FRAME ASSY | SEE 27542-1 | | 1 | EA | A | R | PS | KING RICH | OP420271 |
| 8 | 27530-6-1 | COVER-REAR/RIGHT-TRANSFORMER-M11 | SEE 27542-1 | | 1 | EA | A | R | PS | KING RICH | OP420251 |
| 9 | 27530-7 | COVER-FRONT/RIGHT-FRAME ASSY | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420260 |
| 10 | 27530-8 | COVER-CHIP & COOLANT TANK-FRAME ASSY | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420290 |
| 11 | 27530-9 | COVER-FRONT/LEFT-FRAME ASSY | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420260 |
| 12 | 27530-10 | COVER-REAR/LEFT-LUBE PUMP | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420240 |
| 13 | 27530-11 | COVER-BOTTOM/REAR-FRAME ASSY | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420631 |
| 14 | 27530-12 | COVER-BOTTOM/FRONT-FRAME ASSY | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420621 |
| 15 | 28112 | COVER-TRANSFORMER-2OP M11 | | | 1 | EA | A | R | PS | KING RICH | OP420251-C |
| 16 | 27546-1 | BRACKET-LOWER-SWITCH-Y AXIS | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420700 |
| 17 | 27546-2 | BRACKET-UPPER-SWITCH-Y AXIS | SEE 27542 | | 1 | EA | - | R | PS | KING RICH | OP420711 |
| 18 | 27085-1 | FITTING-AIR-90°-6mm-PUSH TO CONNECT | 1/4 BSPT MALE THD | | 2 | EA | - | R | PS | KING RICH | A-316-408 |
| 19 | 27574-1 | MUFFLER-1/8 BSPT | | | 2 | EA | A | R | PS | KING RICH | A-316-136 |
| 20 | 27091-2 | FITTING-AIR-STRAIGHT-10mm-PUSH TO CONNECT | 1/4 BSPT MALE THD | | 1 | EA | - | R | PS | KING RICH | |

| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------|--------------------------------------------------|------------------------------|--------------|-----|-------|-----|------|------|-----------|-----------|
| 21 | 22169-4 | FITTING-PIPE-TEE-F/M/F-1/4 BSPT | SEE 27542 OR 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 22 | 28042-3 | PLUG-1/4 BSPT | SEE 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 23 | 27555-1 | LEVELING MOUNT-FRAME ASSY | | | 4 | EA | - | R | DWG | | |
| 24 | 27555-2 | LEVELING PAD-FRAME ASSY | SEE 27542 | | 4 | EA | - | R | PS | KING RICH | A-446-003 |
| 25 | 27091-3 | FITTING-STRAIGHT-1/4 BSPT X 1/4 HYDR M/M | SEE 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 26 | 28127-3 | LINE-HYDRAULIC-1/8 X2850mm | | | 1 | EA | A | R | DWG | | |
| 28 | 27557 | COOLANT SYSTEM ASSY-2OP MILL | | | 1 | EA | B | R | PL | | |
| 29 | 27562 | CHIP TRAY ASSY | | | 1 | EA | - | R | PL | | |
| 30 | 26952-4 | FITTING-AIR-90°-1/4 BSPT M/M | SEE 27542 OR 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 31 | 22680-3 | SWITCH-LIMIT-ROLLER PLUNGER | | | 1 | EA | - | R | DWG | | |
| 32 | 22291-3 | LUBRICATION PUMP-WITH CABLE-110 VAC-M10 | | | (1) | EA | A | R | PL | | |
| 33 | 28042-1 | MANIFOLD-TUBE FITTING-4 OUTLETS | SEE 27591 | | (1) | EA | - | R | PS | KING RICH | |
| 34 | 27725 | CHECK VALVE-STRAIGHT-1/4 BSPT | SEE 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 35 | 27745 | COUPLING-1/4 BSPT | SEE 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 36 | 27085-2 | FITTING-AIR-90°-10mm-PUSH TO CONN-1/4 BSPT M | SEE 27542 OR 27563 | | 1 | EA | - | R | PS | KING RICH | A-316-381 |
| 37 | 26938-5 | VALVE-AIR-SOLENOID-DOUBLE-4WAY -3POS-NO-24VDC | | | 1 | EA | - | R | DWG | | |
| 38 | 22169-2 | FITTING-PIPE-CROSS-1/4-BSPT BRASS | SEE 27542 | | 1 | EA | - | R | PS | | |
| 39 | 24151-1 | HEX NIPPLE BSPT 1/4 M | | | 2 | EA | - | R | PS | KING RICH | |
| 40 | 26931-1 | SWITCH-AIR PRESSURE | | | 1 | EA | - | R | PS | KING RICH | |
| 41 | 22647-6 | NIPPLE-MALE-BRASS PIPE | 3/8 NPT-FULLY THREADED | | 1 | EA | B | R | DWG | KING RICH | |
| 42 | 22607-3 | BRACKET-MOUNTING KIT | MATE W/ 22607-2 | | 1 | EA | - | R | PS | | |

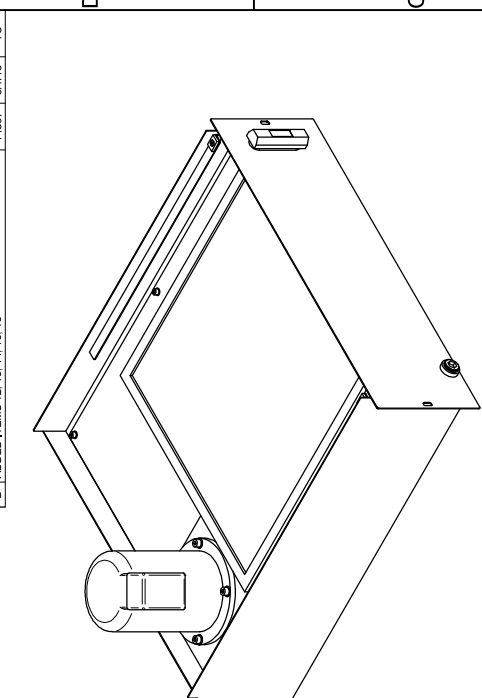
| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------------|-----------------------------------------------|-----------------------------------|--------------|-----|-------|-----|------|------|-----------|------------|
| 43 | 22607-2 | FILTER/REGULATOR-W/ 40µm FILTER, 0-160 PSI | FOR FILTER REPL SEE 24607-4 | | 1 | EA | C | R | DWG | | |
| 44 | 28033 | AIR TANK | | | 1 | EA | - | R | DWG | | |
| 45 | 28034 | AIR REGULATOR | SEE 27563 | | 1 | EA | - | R | PS | | |
| 46 | 28035 | DRAIN VALVE - AIR TANK | SEE 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 47 | 26952-2 | ELBOW-STREET-1/4 BSPT | SEE 27563 | | 2 | EA | - | R | PS | KING RICH | |
| 48 | 27176 | CABLE ASSY-LUBE PUMP | DC300-120 | | 1 | EA | A | R | PL | | |
| 49 | 27635-2 | CABLE ASSY-Y AXIS HOME SW | DC300-112C | | 1 | EA | A | R | PL | | |
| 50 | 27635-11 | CABLE ASSY-SOLENOID ATC BACK | DC300-108 | | 1 | EA | A | R | PL | | |
| 51 | 27635-12 | CABLE ASSY-SOLENOID ATC FRONT | DC300-109 | | 1 | EA | A | R | PL | | |
| 52 | 27635-5 | CABLE ASSY-LIMIT SW-AIR PRESSURE | DC300-110 | | 1 | EA | - | R | PL | | |
| 53 | 22607-4 | FILTER ELEMENT-REPLACEMENT | SEE 22607-2 | | (1) | EA | - | R | PS | KING RICH | A-260-051 |
| 55 | 27547-1 | WIRE HARNESS ASSY-7 COND-ELEC CAB TO TRX | | | (1) | EA | C | R | PL | | |
| 56 | 27547-2 | WIRE HARNESS ASSY-3 COND-TRX TO DRIVE | DC300-309C | | (1) | EA | C | R | PL | | |
| 57 | 28112-1 | TRAY-TRANSFORMER-2OP M11 | | | 1 | EA | A | R | PS | KING RICH | OP420251-B |
| 58 | 28111 | BEARING-DRAWN CUP-NEEDLE ROLLER-HK1308 | | | 1 | EA | A | R | PS | KING RICH | A-575-007 |
| 59 | 28152-1 | TRANSFORMER ASSY - 1.1KVA | | | 1 | EA | C | R | PL | | |
| 60 | 28166 | SPACER-13 ID x 19 OD x 12 THK | SEE 27542-1 | | 2 | EA | A | R | PS | KING RICH | OP420260 |
| 61 | 27593-2 | BUSHING-TRANSFORMER TRAY-2OP | | | 4 | EA | A | R | PS | KING RICH | OP420270 |
| 62 | 21753-5 | GROUND BAR- 6 HOLE-100 X 22 | | | 1 | EA | B | R | DWG | KING RICH | |
| 64 | M5-0.8X8 2Z | SCREW-BHCS-STL-ZINC | | | 4 | EA | - | R | PS | | |
| 65 | M6-1.0X25 25B | SCREW-SHCS-STL-BO | | | 2 | EA | A | R | PS | | |
| 66 | M5-0.8X25 25Z | SCREW-SHCS-STL-ZINC | NON STOCKABLE | | 2 | EA | - | R | PS | | |

| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------------|-----------------------------------------------|-----------------------------------|--------------|-----|-------|-----|------|------|-----------|------------|
| 43 | 22607-2 | FILTER/REGULATOR-W/ 40µm FILTER, 0-160 PSI | FOR FILTER REPL SEE 24607-4 | | 1 | EA | C | R | DWG | | |
| 44 | 28033 | AIR TANK | | | 1 | EA | - | R | DWG | | |
| 45 | 28034 | AIR REGULATOR | SEE 27563 | | 1 | EA | - | R | PS | | |
| 46 | 28035 | DRAIN VALVE - AIR TANK | SEE 27563 | | 1 | EA | - | R | PS | KING RICH | |
| 47 | 26952-2 | ELBOW-STREET-1/4 BSPT | SEE 27563 | | 2 | EA | - | R | PS | KING RICH | |
| 48 | 27176 | CABLE ASSY-LUBE PUMP | DC300-120 | | 1 | EA | A | R | PL | | |
| 49 | 27635-2 | CABLE ASSY-Y AXIS HOME SW | DC300-112C | | 1 | EA | A | R | PL | | |
| 50 | 27635-11 | CABLE ASSY-SOLENOID ATC BACK | DC300-108 | | 1 | EA | A | R | PL | | |
| 51 | 27635-12 | CABLE ASSY-SOLENOID ATC FRONT | DC300-109 | | 1 | EA | A | R | PL | | |
| 52 | 27635-5 | CABLE ASSY-LIMIT SW-AIR PRESSURE | DC300-110 | | 1 | EA | - | R | PL | | |
| 53 | 22607-4 | FILTER ELEMENT-REPLACEMENT | SEE 22607-2 | | (1) | EA | - | R | PS | KING RICH | A-260-051 |
| 55 | 27547-1 | WIRE HARNESS ASSY-7 COND-ELEC CAB TO TRX | | | (1) | EA | C | R | PL | | |
| 56 | 27547-2 | WIRE HARNESS ASSY-3 COND-TRX TO DRIVE | DC300-309C | | (1) | EA | C | R | PL | | |
| 57 | 28112-1 | TRAY-TRANSFORMER-2OP M11 | | | 1 | EA | A | R | PS | KING RICH | OP420251-B |
| 58 | 28111 | BEARING-DRAWN CUP-NEEDLE ROLLER-HK1308 | | | 1 | EA | A | R | PS | KING RICH | A-575-007 |
| 59 | 28152-1 | TRANSFORMER ASSY - 1.1KVA | | | 1 | EA | C | R | PL | | |
| 60 | 28166 | SPACER-13 ID x 19 OD x 12 THK | SEE 27542-1 | | 2 | EA | A | R | PS | KING RICH | OP420260 |
| 61 | 27593-2 | BUSHING-TRANSFORMER TRAY-2OP | | | 4 | EA | A | R | PS | KING RICH | OP420270 |
| 62 | 21753-5 | GROUND BAR- 6 HOLE-100 X 22 | | | 1 | EA | B | R | DWG | KING RICH | |
| 64 | M5-0.8X8 2Z | SCREW-BHCS-STL-ZINC | | | 4 | EA | - | R | PS | | |
| 65 | M6-1.0X25 25B | SCREW-SHCS-STL-BO | | | 2 | EA | A | R | PS | | |
| 66 | M5-0.8X25 25Z | SCREW-SHCS-STL-ZINC | NON STOCKABLE | | 2 | EA | - | R | PS | | |

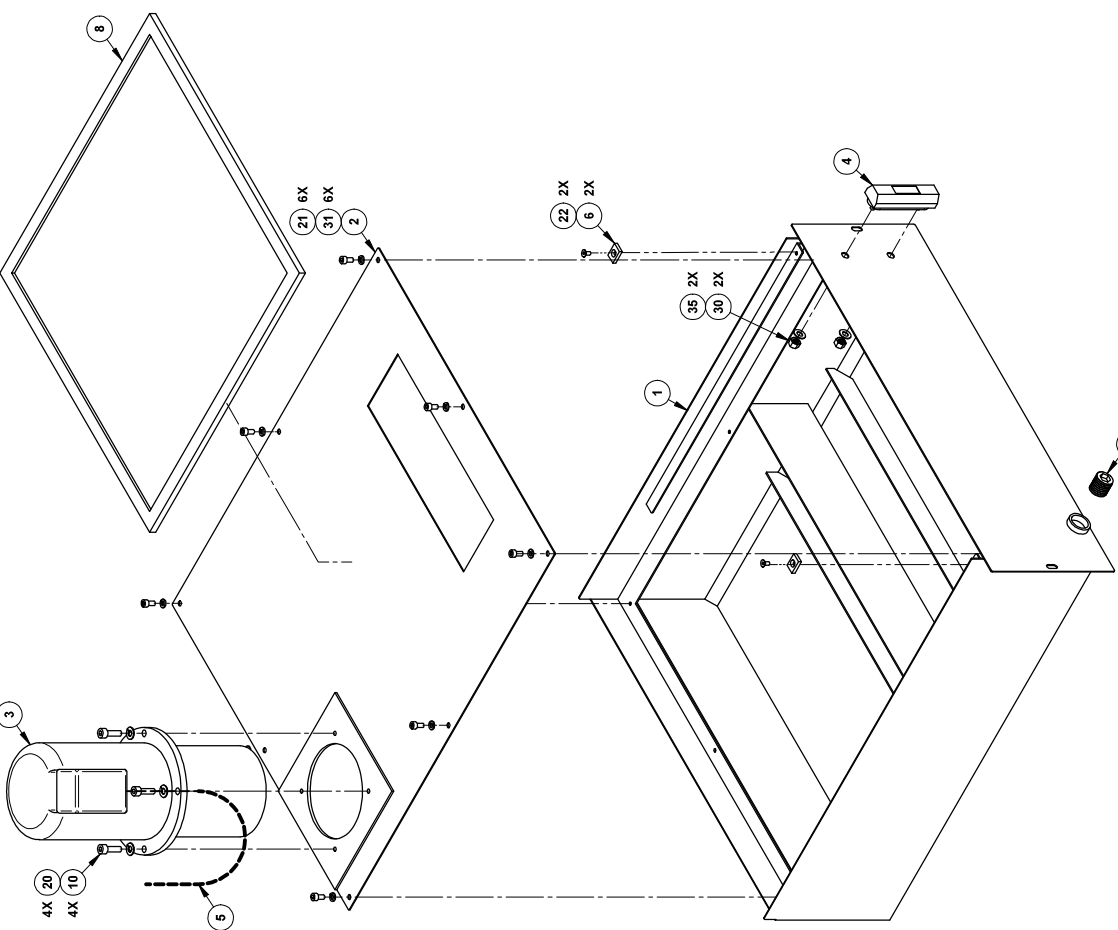
| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|----------------|-----------------------------------|----------------|--------------|-----|-------|-----|------|------|-----------|---------|
| 67 | M5-0.8X15 26B | SCREW-FHCS-STL-BO | NON STOCKABLE | | 2 | EA | - | R | PS | | |
| 68 | M5-0.8X10 31Z | SCREW-PH-PHIL-EXT SEMS-STL-ZINC | | | 6 | EA | - | R | PS | | |
| 69 | M5-0.8X20 27Z | SCREW-BHCS-STL-ZINC | | | 2 | EA | - | R | PS | | |
| 70 | M5-0.8X12 27J | SCREW-BHCS-SS | NON-STOCKA BLE | | 59 | EA | - | R | PS | | |
| 71 | M6-1.0X16 25B | SCREW-SHCS-STL-BO | | | 6 | EA | - | R | PS | | |
| 72 | M6-1.0X12 25B | SCREW-SHCS-STL-BO | | | 14 | EA | | R | PS | | |
| 73 | M5-0.8X10 25B | SCREW-SHCS-STL-BO | | | 2 | EA | - | R | PS | | |
| 74 | M4-0.7X10 25B | SCREW-SHCS-STL-BO | | | 2 | EA | | R | PS | | |
| 75 | M8-1.25X80 25B | SCREW-SHCS-STL-BO | | | 12 | EA | - | R | PS | | |
| 76 | M5-0.8X12 25B | SCREW-SHCS-STL-BO | | | 4 | EA | - | R | PS | | |
| 77 | M6-1.0X35 25B | SCREW-SHCS-STL-BO | | | 2 | EA | - | R | PS | | |
| 78 | M5-0.8X20 27B | SCREW-BHCS-STL-BO | NON STOCKABLE | | 6 | EA | - | R | PS | | |
| 79 | M6-1.0X20 27B | SCREW-BHCS-STL-BO | | | 4 | EA | | R | PS | | |
| 80 | M4 73B | WASHER-SPLIT LOCK-STL-BO | | | 2 | EA | | R | PS | | |
| 81 | M5 70B | WASHER-FLAT USS-STL-BO | | | 12 | EA | - | R | PS | | |
| 82 | M5 70J | WASHER-FLAT-SS | NON-STOCKA BLE | | 65 | EA | - | R | PS | | |
| 83 | M5 73B | WASHER-SPLIT LOCK-STL-BO | | | 2 | EA | - | R | PS | | |
| 84 | M6 73B | WASHER-SPLIT LOCK-STL-BO | | | 24 | EA | - | R | PS | | |
| 85 | M8 73B | WASHER-SPLIT LOCK-STL-BO | | | 4 | EA | | R | PS | | |
| 86 | M6 70B | WASHER-FLAT USS-STL-BO | | | 4 | EA | - | R | PS | | |
| 87 | M5 75Z | WASHER-EXT TOOTH-STL-ZINC | NON-STOCKA BLE | | 2 | EA | - | R | PS | | |
| 88 | 28173 | WASHER-RETAINING-TRANSFORMER TRAY | | | 2 | EA | A | R | PS | KING RICH | |

| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|------------|--------------------------|---------------|--------------|-----|-------|-----|------|------|-----|---------|
| 89 | M5 71Z | WASHER-FLAT-STL-ZINC | NON STOCKABLE | | 4 | EA | - | R | PS | | |
| 92 | M6-1.0 50P | NUT-HEX-STL-PLAIN | | | 4 | EA | - | R | PS | | |
| 100 | 27262-1 | BRACKET-L-LEFT SIDE-ATC | | | 1 | EA | A | R | DWG | | |
| 101 | 27262-2 | BRACKET-L-RIGHT SIDE-ATC | | | 1 | EA | A | R | DWG | | |
| 110 | 27263 | SEAL-RUBBER | | | 2 | EA | A | R | PS | | |

| REV | DESCRIPTION | DATE | APPV |
|-----|--------------------------------|-------|----------|
| - | ORIGINAL RELEASE | 13015 | 04/25/12 |
| A | ADDED ITEM 8 | 14196 | 2/18/14 |
| B | ADDED ITEMS 12, 13, 14, 16, 18 | 14397 | 6/1/15 |



RIGHT VIEW



NOTE: THIS DESIGN WAS CHARACTERIZED BY AND EMPLOYEE OF SOUTHWESTERN INDUSTRIES, INC. ANY REPRODUCTION OF THIS DESIGN OR ANY PART THEREOF WITHOUT THE WRITTEN PERMISSION OF SOUTHWESTERN INDUSTRIES, INC. IS PROHIBITED. ANY REPRODUCTION OF THIS DESIGN OR ANY PART THEREOF WITHOUT THE WRITTEN PERMISSION OF SOUTHWESTERN INDUSTRIES, INC. IS PROHIBITED.

| APPROVALS | DATE | DATE | APPV |
|------------------------|----------|------|------|
| DESIGNED BY: SBJ | 05/01/09 | | |
| ENGINEER TO: SBJ | 3/1/13 | | |
| PROFESSOR | | | |
| THIRD ANGLE PROJECTION | | | |
| SCALE | | | |
| DWG NO. | 06238 | | |
| REV | 27557 | | |
| B | | | |

SOUTHWESTERN INDUSTRIES, INC.
 MANUFACTURING DIVISION
 TITLE: COOLANT SYSTEM ASSY - 20P MILL
 PART CODE: 06238
 DRAWING NO.: 27557
 SHEET 1 OF 1

NOTES: (UNLESS OTHERWISE SPECIFIED).

Parts List for Assembly P/N: 27557

Printed 6/1/2015

27557

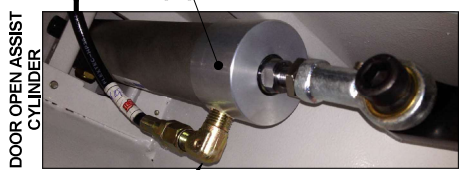
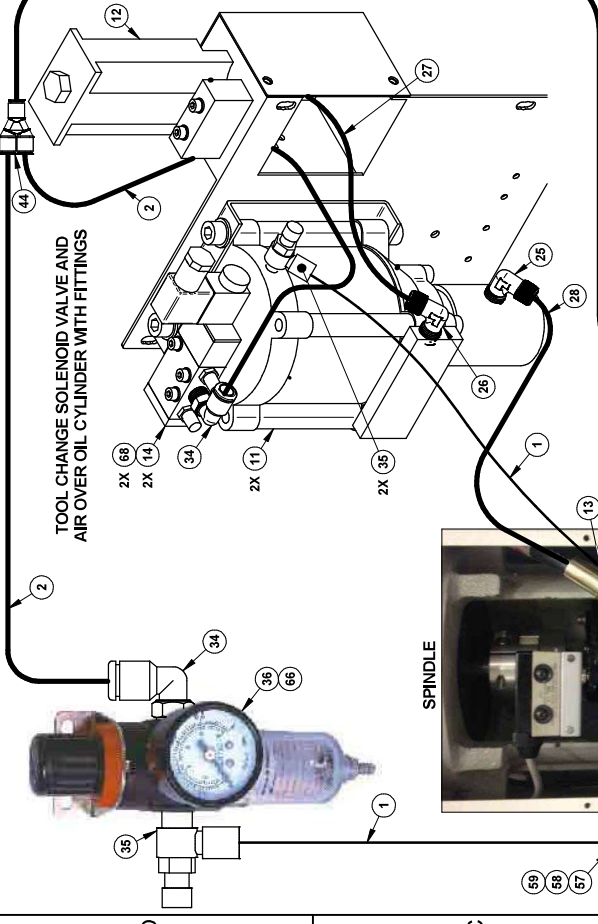
COOLANT SYSTEM ASSY-2OP MILL

| | | | |
|----------|----------|--------------|-----|
| Type | PL | Dwg Size | D |
| Revision | B | Product | 2OP |
| Status | R | Engineer | TO |
| Date | 5/1/2009 | Planner Code | |
| By | SAL | Comm Code | |

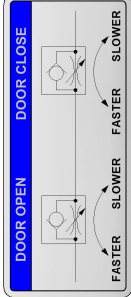
| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|----------------|---------------------------------------------------------------------|---------------|-----|-------|-----|------|------|-----------|---------------|
| 1 | 27714 | COOLANT TANK | SEE 27557 | 1 | EA | - | R | PS | KING RICH | OP420100_V1.1 |
| 2 | 27714-1 | COVER-COOLANT TANK | SEE 27557 | 1 | EA | - | R | PS | KING RICH | |
| 3 | 27713 | COOLANT PUMP | SEE 27557 | 1 | EA | - | R | PS | | |
| 4 | 27561 | INDICATOR-COOLANT LEVEL | SEE 27557 | 1 | EA | - | R | PS | KING RICH | |
| 5 | 27176-1 | CABLE ASSY-COOLANT PUMP | DC300-121C | 1 | EA | A | R | PL | | |
| 6 | 27615-1 | WEAR PLATE-CHIP TRAY-2OP | | 2 | EA | - | R | DWG | | |
| 7 | 28042 | PLUG-BSTP 3/4 14TPI | SEE 27557 | 1 | EA | - | R | PS | KING RICH | |
| 8 | 28133 | FILTER-FINE CHIP | | 1 | EA | - | R | DWG | | |
| 12 | 27016-4 | FITTING-90° BARB TO THD-3/8 TUBE ID x 3/8 MALE BSPT-STAINLESS STEEL | | 2 | EA | A | R | DWG | KING RICH | |
| 13 | 27016-5 | FITTING-3/4 BSPT-3/8 BSPT-STAINLESS STEEL | | 1 | EA | A | R | DWG | KING RICH | |
| 14 | 27016-6 | FITTING-TEE 3/8 BSPT-STAINLESS STEEL | | 1 | EA | A | R | DWG | KING RICH | |
| 16 | 26957-1 | CLAMP-HOSE & TUBE-WORM DRIVE 7/16 TO 25/32 | | 2 | EA | A | R | DWG | | |
| 18 | 26956-1 | HOSE-COOLANT-5/8 OD x 3/8 ID 200 PSI | | 24 | FT | A | R | DWG | | |
| 20 | M8-1.25X25 25B | SCREW-SHCS-STL-BO | | 4 | EA | | R | PS | | |
| 21 | M6-1.0X12 25B | SCREW-SHCS-STL-BO | | 6 | EA | | R | PS | | |
| 22 | M5-0.8X10 26B | SCREW-FHCS-STL-BO | NON STOCKABLE | 2 | EA | | R | PS | | |
| 30 | M8 73B | WASHER-SPLIT LOCK-STL-BO | | 8 | EA | | R | PS | | |
| 31 | M6 73B | WASHER-SPLIT LOCK-STL-BO | | 8 | EA | - | R | PS | | |
| 35 | M8-1.25 50B | NUT-HEX-BLK OX | NON-STOCKABLE | 2 | EA | - | R | PS | | |

Current configuration beginning in 1st quarter 2016.

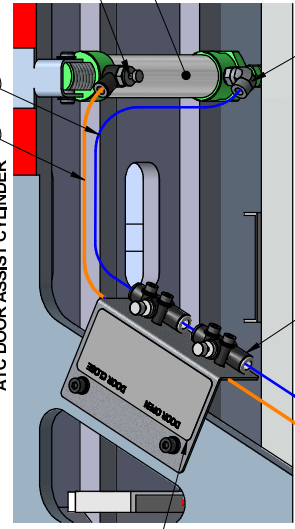
| REV | DESCRIPTION | DATE | BY | APPV |
|-----|----------------------------------------------------------------------------------------------------------|----------|----------|------|
| A | PRODUCTION RELEASE | 10/24/14 | TO | |
| B | ADDED ITEMS 56 & 66. | 14/05 | 8-5-15 | TO |
| C | SHI ADDED CURRENT CYLINDER CONFIGURATION. ITEMS 4 & 5 WAS ITEMS 3 & 4. ITEM 8 WAS 27583-1, ADDED ITEM 3. | 14/01 | 03/09/16 | TO |
| D | ITEM 33 QTY 3 WAS QTY 2. ITEM 41 QTY 1 WAS QTY 2. | 14/05 | 07/19/16 | PM |
| E | ITEM 30 QTY 1 WAS 5. ADDED ITEM 67, 68 | 14/04 | 07/03/16 | PM |



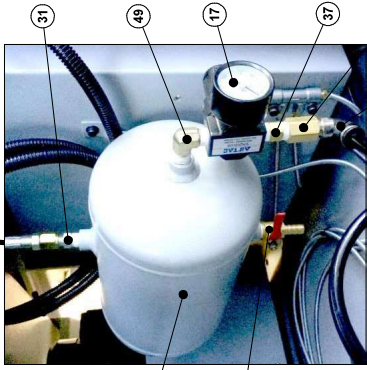
DOOR OPEN ASSIST CYLINDER



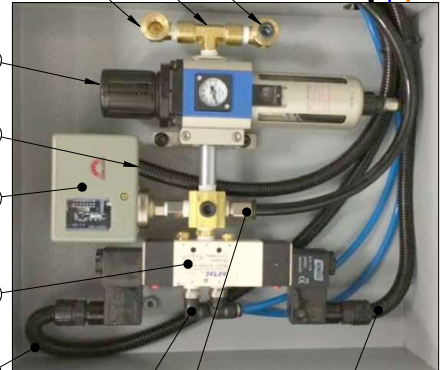
**Pneumatic Diagram-
All Items Shown are for Reference Only.**



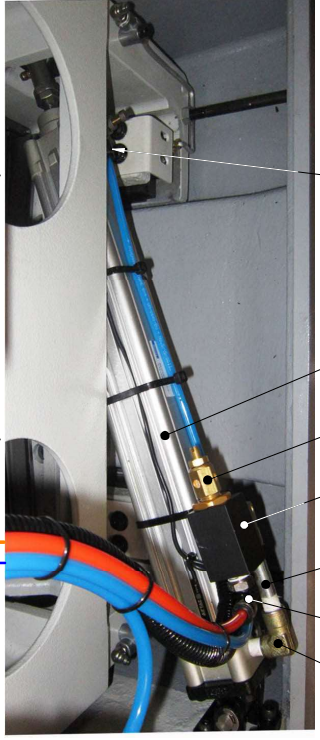
ATC DOOR ASSIST CYLINDER



AIR TANK



MAIN AIR PREPARATION UNIT AND ATC SOLENOID VALVE



ATC CYLINDER 27583-8 (WITH SENSORS 27641-2 & 27641-3)

| REV | DESCRIPTION | DATE | BY | APPV |
|-----|----------------------------------------------------------------------------------------------------------|----------|----------|------|
| A | PRODUCTION RELEASE | 10/24/14 | TO | |
| B | ADDED ITEMS 56 & 66. | 14/05 | 8-5-15 | TO |
| C | SHI ADDED CURRENT CYLINDER CONFIGURATION. ITEMS 4 & 5 WAS ITEMS 3 & 4. ITEM 8 WAS 27583-1, ADDED ITEM 3. | 14/01 | 03/09/16 | TO |
| D | ITEM 33 QTY 3 WAS QTY 2. ITEM 41 QTY 1 WAS QTY 2. | 14/05 | 07/19/16 | PM |
| E | ITEM 30 QTY 1 WAS 5. ADDED ITEM 67, 68 | 14/04 | 07/03/16 | PM |

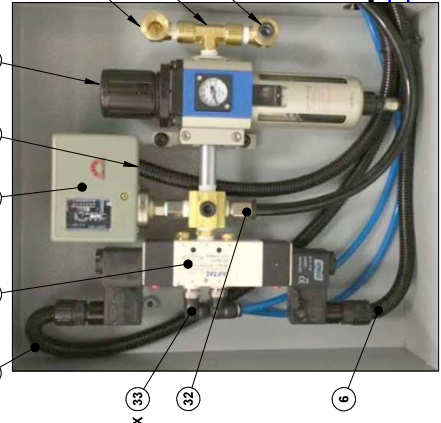
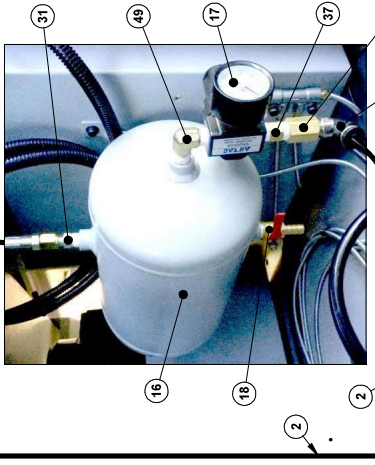
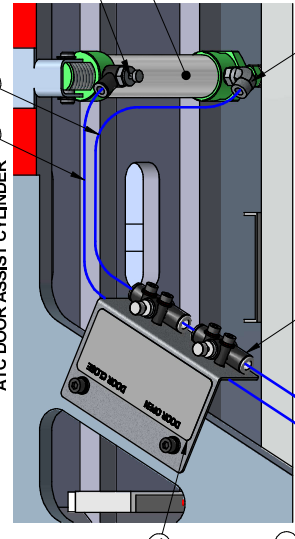
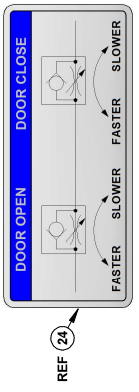
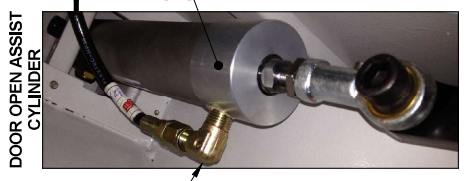
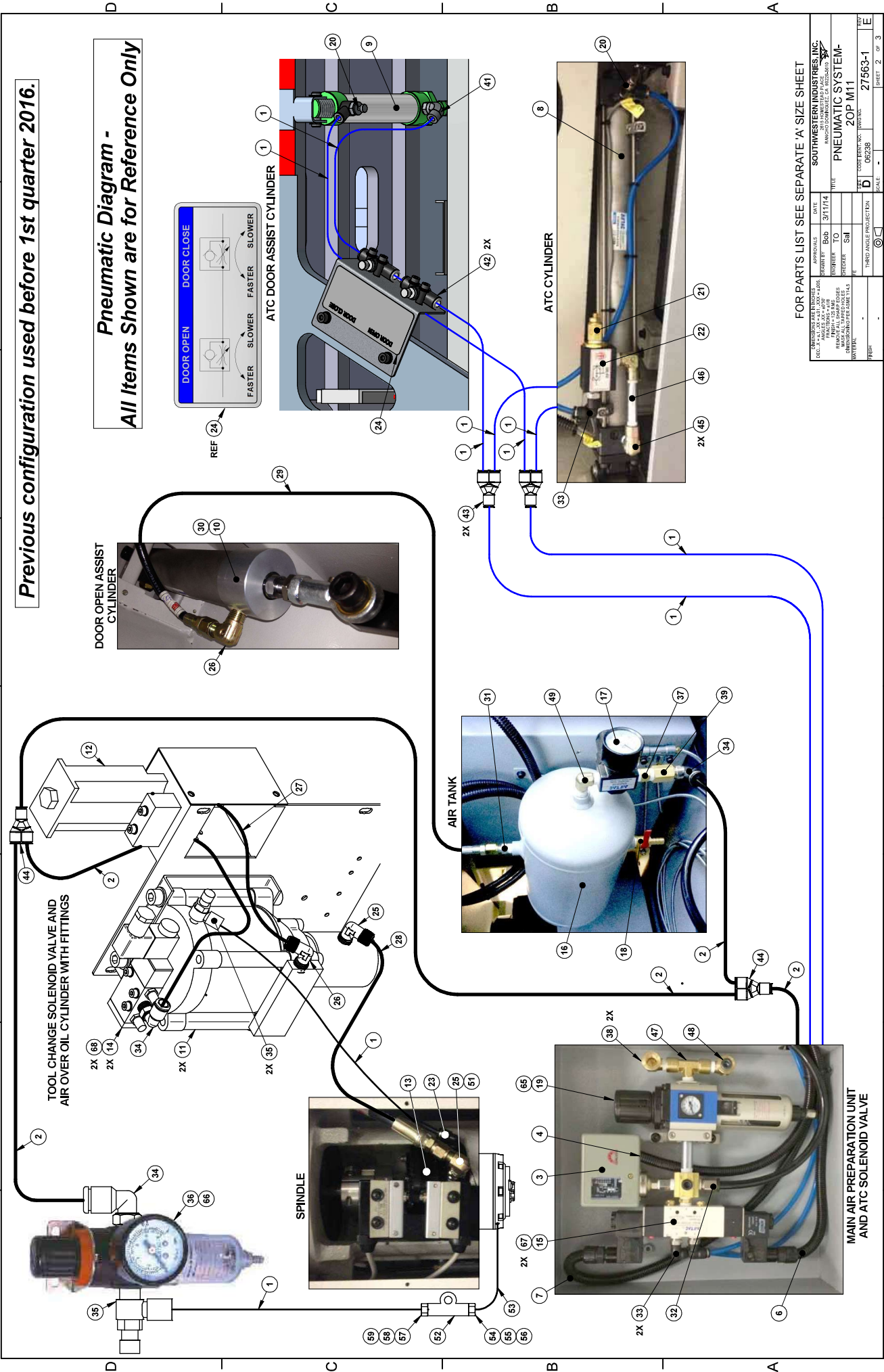
SOUTHWESTERN INDUSTRIES, INC.
**PNEUMATIC SYSTEM-
 ZOP M11**
 PART CODE: 27563-1
 DRAWING: 06238
 THIRD ANGLE PROJECTION
 SCALE: 1:1
 SHEET 1 OF 3

APPROVALS: DATE: 3/11/14
 DRAWN BY: Bob
 ENGINEER: TO
 CHECKED: Sal
 THIRD ANGLE PROJECTION
 SCALE: 1:1
 SHEET 1 OF 3

NOTES:
 1. THIS DRAWING IS THE PROPERTY OF SOUTHWESTERN INDUSTRIES, INC. AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES, INC.

Previous configuration used before 1st quarter 2016.

**Pneumatic Diagram -
All Items Shown are for Reference Only**



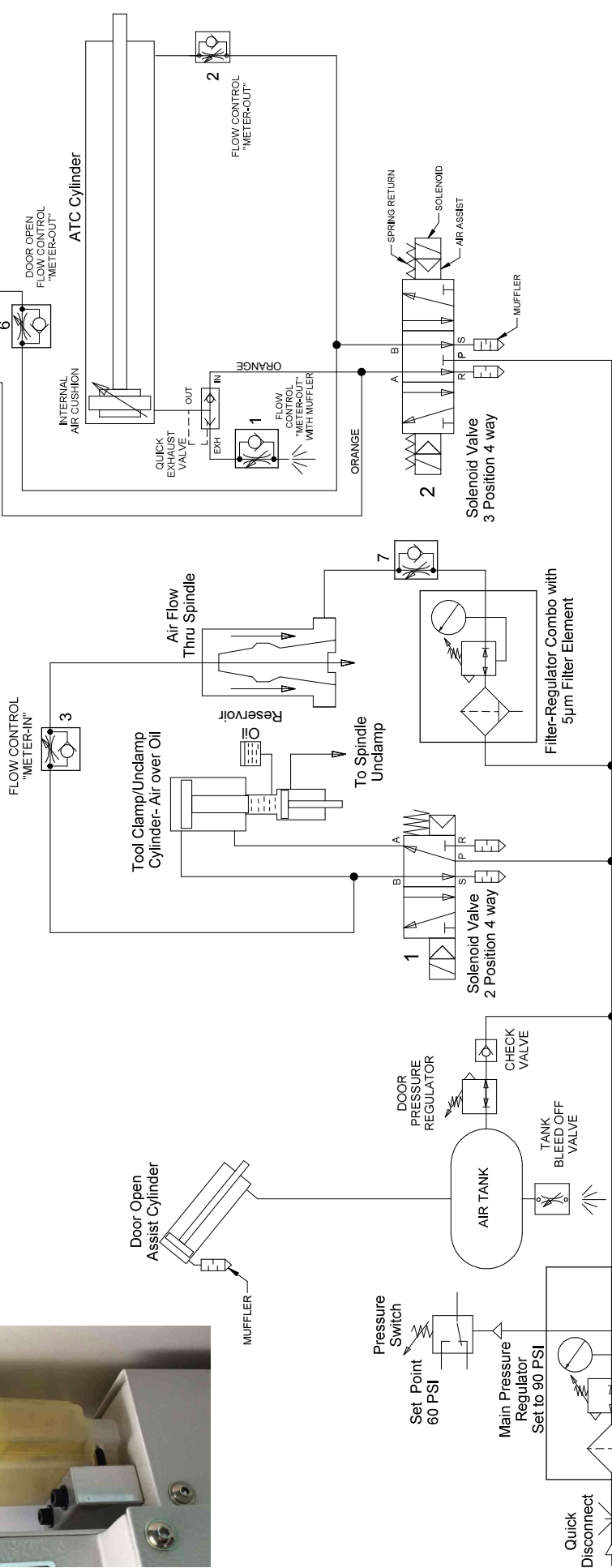
FOR PARTS LIST SEE SEPARATE 'A' SIZE SHEET

| | | | |
|------------------------|---------|-------------------------------|--|
| APPROVALS | DATE | SOUTHWESTERN INDUSTRIES, INC. | |
| DESIGNED BY: Bob | 3/11/14 | MANUFACTURED BY: HILLBARD | |
| ENGINEER: TO | | PNEUMATIC SYSTEM- | |
| DRAWN: Sal | | ZOP M11 | |
| MATERIAL: | | 20P M11 | |
| THIRD ANGLE PROJECTION | | DRAWING: 27563-1 | |
| SCALE: | | SHEET 2 OF 3 | |

Pneumatic Schematic



OIL MUST BE MAINTAINED AT APPROXIMATELY 3/4 LEVEL



EXTRA CONNECTION PORT FOR CUSTOMER AUXILIARY CONNECTION. THIS PORT SHOULD BE PLUGGED BEFORE SHIPPING.

| | | | |
|-------------------------------|--|------------------------|---------|
| SOUTHWESTERN INDUSTRIES, INC. | | DATE | 3/11/14 |
| MANUFACTURING DEPARTMENT | | APPROVALS | Bob TO |
| PNEUMATIC SYSTEM- | | ENGINEER | TO |
| 20P M11 | | DRAWN | Sal |
| PART CODE BERT, INC. | | THIRD ANGLE PROJECTION | |
| DRAWING NO. 27563-1 | | SCALE | |
| REV | | SHEET 3 of 3 | |

Parts List for Assembly P/N: 27563-1

Printed 7/3/2018

27563-1

PNEUMATIC SYSTEM-2OP M11

| | | | |
|----------|-----------|--------------|-----|
| Type | PL | Dwg Size | D |
| Revision | E | Product | PT8 |
| Status | R | Engineer | TO |
| Date | 2/27/2014 | Planner Code | |
| By | Bob | Comm Code | |

| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|----------|-----------------------------------------------|------------------------------------------|--------------|-----|-------|-----|------|------|-----------|-----------|
| 1 | 27531 | TUBING-POLYURETHANE-6mm OD-BLUE | | | A/R | IN | - | R | PS | KING RICH | |
| 2 | 27531-1 | TUBING-POLYURETHANE-10mm OD | | | A/R | IN | - | R | PS | KING RICH | |
| 3 | 27531-2 | TUBING-POLYURETHANE-6mm OD-ORANGE | | | A/R | IN | A | R | PS | KING RICH | |
| 4 | 26931-1 | SWITCH-AIR PRESSURE | | | (1) | EA | - | R | PS | KING RICH | |
| 5 | 27635-5 | CABLE ASSY-LIMIT SW-AIR PRESSURE | DC300-110 | | (1) | EA | - | R | PL | | |
| 6 | 27635-11 | CABLE ASSY-SOLENOID ATC BACK | DC300-108 | | (1) | EA | A | R | PL | | |
| 7 | 27635-12 | CABLE ASSY-SOLENOID ATC FRONT | DC300-109 | | (1) | EA | A | R | PL | | |
| 8 | 27583-8 | CYLINDER-AIR-32 BORE 300 STROKE | USED WITH SENSORS ASSY 27641-2 & 27641-3 | | (1) | EA | A | R | DWG | | |
| 9 | 27583-5 | CYLINDER-AIR-20mm BORE X 60mm STROKE | | | (1) | EA | A | R | DWG | | |
| 10 | 27583-6 | CYLINDER-AIR-40mm BORE 125mm STROKE | | | (1) | EA | - | R | DWG | | |
| 11 | 27670-1 | CYLINDER-TOOL UNCLAMP | SEE 27502-3 | | (1) | EA | A | R | DWG | | |
| 12 | 27502-2 | RESERVOIR-OIL MAKEUP-TOOL UNCLAMP CYLINDER | SEE 27563-1 | | (1) | EA | A | R | PS | KING RICH | A-222-007 |
| 13 | 27830 | SPINDLE ASSY-2OP M10 MILL | | | (1) | EA | D | R | PL | | |
| 14 | 26938-6 | VALVE-AIR-SOLENOID-SINGLE-4WAY-2POS - 24VDC | | | (1) | EA | A | R | DWG | | |
| 15 | 26938-5 | VALVE-AIR-SOLENOID-DOUBLE-4WAY -3POS-NO-24VDC | | | (1) | EA | - | R | DWG | | |
| 16 | 28033 | AIR TANK | | | (1) | EA | - | R | DWG | | |
| 17 | 28034 | AIR REGULATOR | SEE 27563 | | (1) | EA | - | R | PS | | |

| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|----------|-------------------------------------------------|---------------------------------------|--------------|-----|-------|-----|------|------|-----------|-------------|
| 18 | 28035 | DRAIN VALVE - AIR TANK | SEE 27563 | | (1) | EA | - | R | PS | KING RICH | |
| 19 | 22607-2 | FILTER/REGULATOR-W/ 40µm FILTER, 0-160 PSI | FOR FILTER REPL SEE 24607-4 | | (1) | EA | C | R | DWG | | |
| 20 | 28071 | VALVE-FLOW CONTROL-AIR | | | (2) | EA | - | R | PS | KING RICH | A-572-001 |
| 21 | 28071-1 | VALVE-FLOW CONTROL W MUFLER-AIR | SEE 27563 | | (1) | EA | - | R | PS | KING RICH | A-260-007-3 |
| 22 | 28074 | VALVE-QUICK EXHAUST | SEE 27563 | | (1) | EA | - | R | PS | KING RICH | A-201-001 |
| 23 | 27016-1 | FITTING-QUICK CONNECT 6MM TO 1/8 BSPT | | | (1) | EA | A | R | DWG | | |
| 24 | 27694-21 | LABEL-FLOW CONTROL VALVES | (S-S1260) | | (1) | EA | A | R | DWG | | |
| 25 | 27076-2 | FITTING-90°-1/4 HYDR SWVL TO 1/4 HYDR F/M | | | (2) | EA | - | R | PS | KING RICH | A-316-012 |
| 26 | 26952-3 | FITTING-AIR-90°-1/4 BSPTX1/4 HYDR M/M | SEE 27563 | | (2) | EA | - | R | PS | KING RICH | A-316-012 |
| 27 | 28127-4 | LINE-HYDRAULIC-1/4 X 220mm | | | (1) | EA | A | R | DWG | KING RICH | A-316-611-1 |
| 28 | 28127-1 | LINE-HYDRAULIC-1/4 X 450mm | | | (1) | EA | A | R | DWG | | |
| 29 | 28127-3 | LINE-HYDRAULIC-1/8 X2850mm | | | (1) | EA | A | R | DWG | | |
| 30 | 27574 | MUFFLER-1/4 BSPT | | | (1) | EA | - | R | PS | KING RICH | A-316-136 |
| 31 | 27091-3 | FITTING-STRAIGHT-1/4 BSPT X 1/4 HYDR M/M | SEE 27563 | | (1) | EA | - | R | PS | KING RICH | |
| 32 | 27091-2 | FITTING-AIR-STRAIGHT-10mm-PUSH TO CONNECT | 1/4 BSPT MALE THD | | (1) | EA | - | R | PS | KING RICH | |
| 33 | 27085-1 | FITTING-AIR-90°-6mm-PUSH TO CONNECT | 1/4 BSPT MALE THD | | (3) | EA | - | R | PS | KING RICH | A-316-408 |
| 34 | 27085-2 | FITTING-AIR-90°-10mm-PUSH TO CONN-1/4 BSPT M | SEE 27542 OR 27563 | | (3) | EA | - | R | PS | KING RICH | A-316-381 |
| 35 | 28071-2 | VALVE-FLOW CONTROL-AIR | 1/4 BSPT TO 6mm PUSH TO CONNECT | | (1) | EA | - | R | PS | KING RICH | JSC0603 |
| 36 | 22607-5 | FILTER/REGULATOR-W/ 5µm FILTER,0-140 PSI | FOR FILTER REPL SEE 24607-6 | | (1) | EA | B | R | DWG | | |
| 37 | 27725 | CHECK VALVE-STRAIGHT-1/4 BSPT | SEE 27563 | | (1) | EA | - | R | PS | KING RICH | |

| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------|-------------------------------------------|----------------------|--------------|-----|-------|-----|------|------|-----------|-----------|
| 38 | 26952-2 | ELBOW-STREET-1/4 BSPT | SEE 27563 | | (2) | EA | - | R | PS | KING RICH | |
| 39 | 27745 | COUPLING-1/4 BSPT | SEE 27563 | | (1) | EA | - | R | PS | KING RICH | |
| 41 | 24673-2 | ELBOW-1/8 BSPT TO 6mm QUICK CONNECT | | | (1) | EA | - | R | PS | | |
| 42 | 28071-3 | VALVE-FLOW CONTROL-INLINE-AIR | Ø6mm PUSH TO CONNECT | | (2) | EA | - | R | PS | KING RICH | A-260-070 |
| 43 | 27745-1 | COUPLING-Y-6mm PUSH TO CONNECT | SEE 27563 | | (2) | EA | - | R | PS | KING RICH | |
| 44 | 27745-2 | COUPLING-Y-10mm PUSH TO CONNECT | SEE 27563 | | (2) | EA | - | R | PS | KING RICH | |
| 45 | 24673-1 | ELBOW-STREET - 1/8 BSPT | SEE 27540 OR 27540-1 | | (2) | EA | - | R | PS | | |
| 46 | 28076 | NIPPLE-ROUND- 1/8 BSPT X 2 LG | SEE 27540 OR 27540-1 | | (1) | EA | - | R | PS | | |
| 47 | 22169-4 | FITTING-PIPE-TEE-F/M/F-1/4 BSPT | SEE 27542 OR 27563 | | (1) | EA | - | R | PS | KING RICH | |
| 48 | 28042-3 | PLUG-1/4 BSPT | SEE 27563 | | (1) | EA | - | R | PS | KING RICH | |
| 49 | 26952-4 | FITTING-AIR-90°-1/4 BSPT M/M | SEE 27542 OR 27563 | | (1) | EA | - | R | PS | KING RICH | |
| 51 | 27076-1 | FITTING-STRAIGHT-1/8 BSPT TO 1/4 HYDR M/M | SEE 27563 | | (1) | EA | - | R | PS | KING RICH | |
| 52 | 27745-3 | COUPLING-1/4 BSPT | SEE 27563-1 | | (1) | EA | A | R | PS | KING RICH | |
| 53 | A4 | TUBING-4MM ALUM | | | A/R | IN | - | R | PS | CHIBA | |
| 54 | 28046 | NUT-COMPRESSION-4mm-MANIFOLD | | | (1) | EA | - | R | PS | KING RICH | |
| 55 | 28047 | SLEEVE-COMPRESSION-OUTER-4mm-MANIFOLD | | | (1) | EA | - | R | PS | KING RICH | |
| 56 | 28047-1 | SLEEVE-COMPRESSION-INNER-4mm-MANIFOLD | | | (1) | EA | - | R | PS | KING RICH | |
| 57 | 28046-2 | NUT-COMPRESSION-6mm-MANIFOLD | | | (1) | EA | A | R | PS | KING RICH | |
| 58 | 28047-2 | SLEEVE-COMPRESSION-OUTER-6mm-MANIFOLD | | | (1) | EA | A | R | PS | KING RICH | |
| 59 | 28047-3 | SLEEVE-COMPRESSION-INNER-6mm-MANIFOLD | | | (1) | EA | A | R | PS | KING RICH | |
| 65 | 22607-4 | FILTER ELEMENT-REPLACEMENT | SEE 22607-2 | | (1) | EA | - | R | PS | KING RICH | A-260-051 |

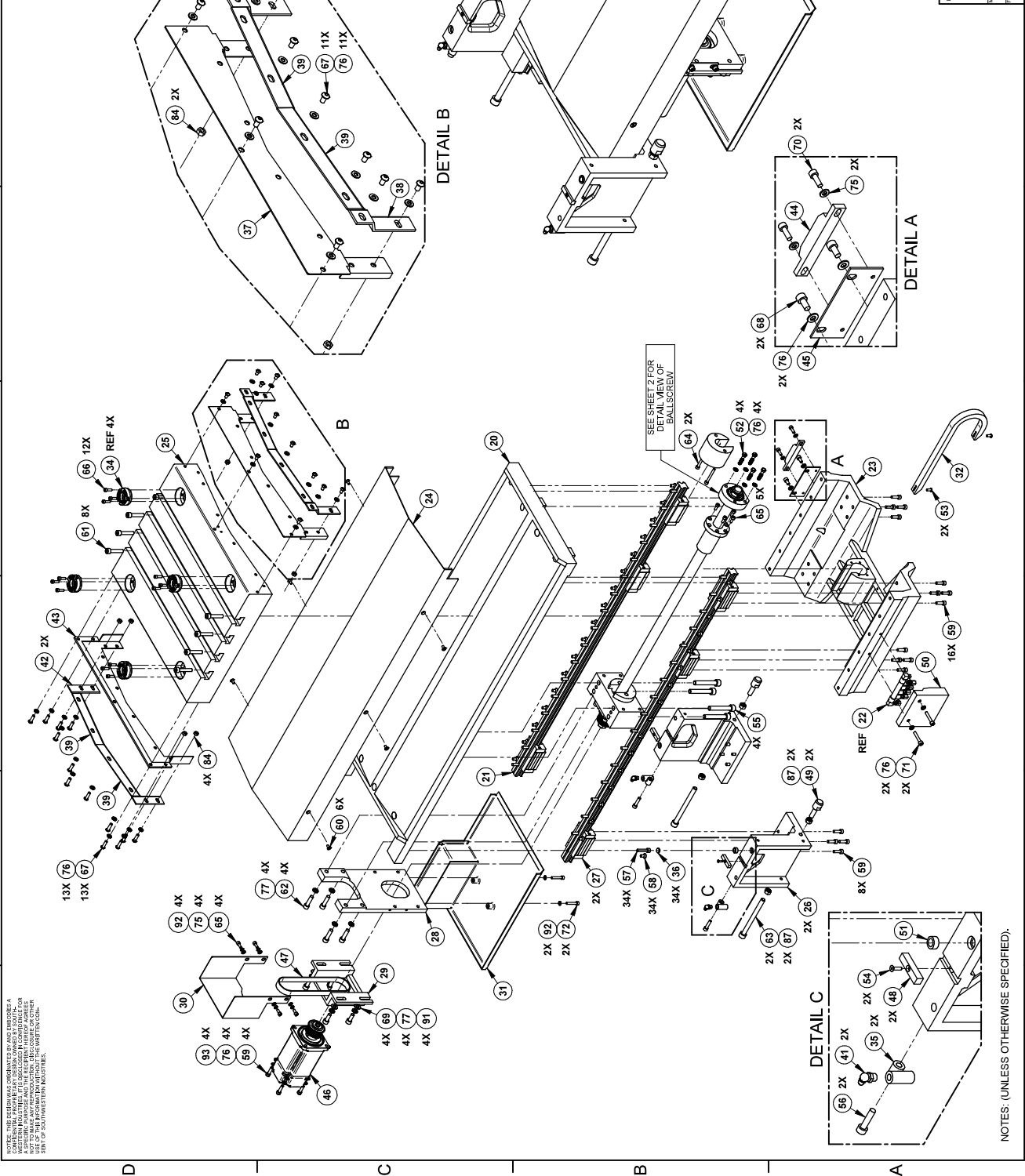
Parts List for Assembly P/N: 27563-1
 PNEUMATIC SYSTEM-2OP M11

27563-1
 Rev E
 Printed 7/3/2018

| Item | P/N | Title | Detail | Reference(t) | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------|----------------------------|-------------|--------------|-----|-------|-----|------|------|-----------|-----------|
| 66 | 22607-6 | FILTER ELEMENT-REPLACEMENT | SEE 22607-5 | | (1) | EA | A | R | DWG | | |
| 67 | 27574-1 | MUFFLER-1/8 BSPT | | | (2) | EA | A | R | PS | KING RICH | A-316-136 |
| 68 | 27574-2 | MUFFLER-3/8 BSPT | | | (2) | EA | A | R | PS | KING RICH | A-316-136 |

1 2 3 4 5 6 7 8

| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------------------|----------|----|------|
| D | ADDED ITEMS 32 & 53 | 2/13/15 | PM | |
| E | ADDED ITEM 41. | 8/13/15 | PM | |
| F | ITEM 13 2752-1 WAS: 27527 | 4.3.17 | TO | |
| G | ADDED ITEM 52, ITEMS 56 & 73 QTY WAS: 6 & 32. | 06/06/18 | PM | |

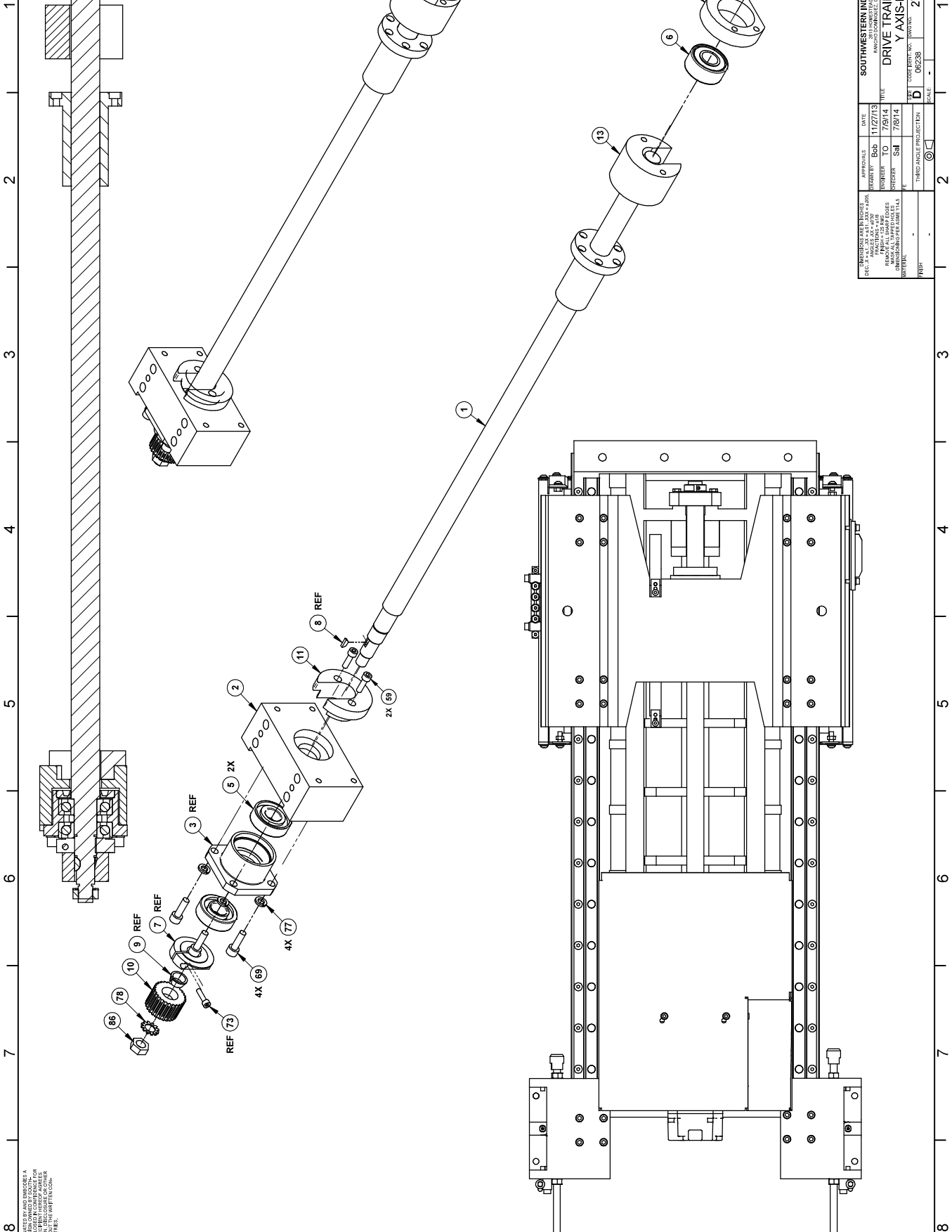


SEE SEPARATE 'A' SIZE SHEET FOR PART LIST

| APPROVALS | | DATE | SOUTHWESTERN INDUSTRIES, INC. | |
|------------------------|---------|----------|-------------------------------|------|
| DESIGNED BY | SAUL | 11/27/13 | MANUFACTURING | SAUL |
| ENGINEER | BOB | 7/5/14 | QUALITY CONTROL | BOB |
| DRIVER | SAUL | 7/5/14 | SALES | SAUL |
| THIRD ANGLE PROJECTION | | | | |
| PART CODE | 27564-1 | | | |
| REV | D | | | |
| SHEET | 1 | | | |
| OF | 2 | | | |

NOTES: (UNLESS OTHERWISE SPECIFIED).

1 2 3 4 5 6 7 8



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| | | | |
|-----------------------------------------------------------|-------------------------------|-------|----------|
| SOUTHWESTERN INDUSTRIES, INC. MANUFACTURING DEPARTMENT | | DATE | 11/27/13 |
| APPROVALS | Bob | TO | 7/5/14 |
| ENGINEER | Sal | TO | 7/5/14 |
| DRAWN | Sal | TO | 7/5/14 |
| DESIGNED | Sal | TO | 7/5/14 |
| THIRD ANGLE PROJECTION | D | SCALE | 1:1 |
| TITLE | DRIVE TRAIN ASSY - Y AXIS-M11 | | |
| REV | 27564-1 | | |
| SHEET | 2 | | OF 2 |

Parts List for Assembly P/N: 27564-1

Printed 6/6/2018

27564-1

DRIVE TRAIN ASSY-Y AXIS-M11

| | | | |
|----------|------------|--------------|---------------|
| Type | PL | Dwg Size | D |
| Revision | G | Product | 2 OP M11 MILL |
| Status | R | Engineer | TO |
| Date | 11/27/2013 | Planner Code | |
| By | Bob | Comm Code | |

| Item | P/N | Title | Detail | Reference(t) | Qty | UseA | Rev | Stat | Type |
|------|-----------|-----------------------------------------|-----------|--------------|-----|------|-----|------|------|
| 1 | 27579 | BALLSCREW-Y AXIS | | | 1 | EA | - | R | DWG |
| 2 | 27516 | BEARING BLOCK-FIXED END | | | 1 | EA | - | R | DWG |
| 3 | 27515 | BEARING HOUSING ASSY | | | (1) | EA | A | R | PL |
| 4 | 27517 | BEARING HOUSING | | | 1 | EA | - | R | DWG |
| 5 | 20373 | BEARING-ANGULAR CONTACT-7204 | | | 2 | EA | D | R | DWG |
| 6 | 22008 | BEARING-204KTT | | | 1 | EA | C | R | DWG |
| 7 | 16452 | NUT CLAMP-X, Y, & Z AXIS | | | (1) | EA | E | R | DWG |
| 8 | 98481A090 | KEY WOODRUFF #404-1/8 X 1/2 | | | (1) | EA | - | R | PS |
| 9 | 16350 | FERRULE-SPROCKET-DRIVE KIT | | | (1) | EA | - | R | DWG |
| 10 | 27513 | SPROCKET-26 TEETH W/O GUIDES | | | 1 | EA | A | R | DWG |
| 11 | 27526 | BUMPER-Y AXIS FIXED END | | | 1 | EA | - | R | DWG |
| 12 | 27951-4 | LOCKNUT-M20 X 1.0 | | | 1 | EA | - | R | PS |
| 13 | 27527-1 | BUMPER-Y AXIS FLOATING END-Ø70mm x 47mm | | | 1 | EA | A | R | DWG |
| 20 | 27559 | CASTING-Y AXIS DRIVE TRAIN | | | 1 | EA | B | R | DWG |
| 21 | 26740-4 | GUIDE-LINEAR-SET (2) -Y AXIS | 1010mm | | 1 | EA | - | R | DWG |
| 22 | 28042-2 | MANIFOLD-TUBE FITTING-6 OUTLETS | | | (1) | EA | - | R | PS |
| 23 | 27566 | CASTING-WORKTABLE SUPPORT | | | 1 | EA | - | R | DWG |
| 24 | 27584 | COVER-Y AXIS CASTING | SEE 27564 | | 1 | EA | - | R | PS |
| 25 | 27582 | WORKTABLE-MODIFIED-2OP M10 MILL | | | 1 | EA | A | R | DWG |
| 26 | 27577-1 | CASTING-TOOL CHANGER | | | 2 | EA | - | R | DWG |
| 27 | 27518 | BEARING BLOCK-25mm RAIL EXTENDED | | | 2 | EA | - | R | DWG |
| 28 | 27675 | PLATE-CASTING-MTR BRK | | | 1 | EA | - | R | DWG |

SOUTHWESTERN INDUSTRIES, INC.
 2615 HOMESTEAD PLACE, RANCHO DOMINGUEZ, CA. 90220
 1-310-608-4422 Fax 1-310-764-2668

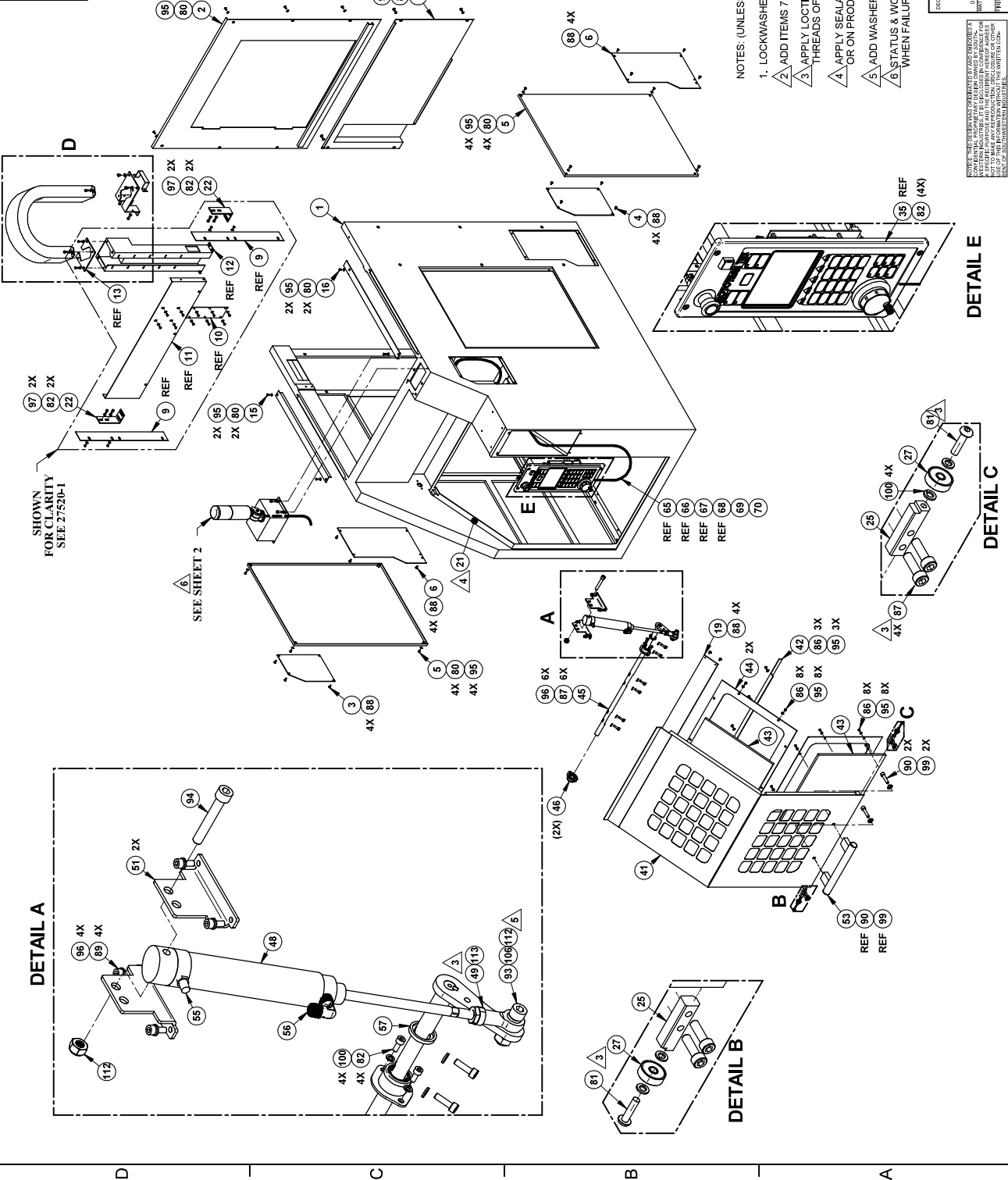
| Item | P/N | Title | Detail | Reference(t) | Qty | UseA | Rev | Stat | Type |
|------|---------------|------------------------------------------------|--------------------------|--------------|-----|------|-----|------|------|
| 29 | 27675-3 | BRACKET-MOUNTING-MOTOR-M11 | | | 1 | EA | A | R | DWG |
| 30 | 27603-23 | COVER-MOTOR-Y AXIS | SEE 27564 | | 1 | EA | - | R | PS |
| 31 | 27675-4 | DRAIN PAN-MOTOR-Y AXIS-M11 | | | 1 | EA | A | R | PS |
| 32 | 26891-6 | CARRIER-LUBE LINE-Y AXIS-20P | | | 1 | EA | A | R | DWG |
| 34 | 26711 | RECEIVER-BALL LOCK-FACE MOUNT | | | (4) | EA | - | R | DWG |
| 35 | 27676 | FITTING-LUBRICATION | SEE 27564 | | 2 | EA | - | R | PS |
| 36 | 27541-1 | CAP-GUIDE-LINEAR | SEE X, Y, Z DRV TRAIN | | 34 | EA | - | R | PS |
| 37 | 27679-1 | COVER-WIPER-FRONT-WORKTABLE | SEE 27564 | | 1 | EA | - | R | PL |
| 38 | 27998-1 | WIPER-FRONT/LEFT | SEE 27564 | | 1 | EA | - | R | PS |
| 39 | 27998-2 | WIPER-CENTER-FRONT & REAR | | | 4 | EA | A | R | DWG |
| 40 | 27998-3 | WIPER-FRONT/RIGHT | SEE 27564 | | 1 | EA | - | R | PS |
| 41 | 26969-1 | FITTING-GREASE-90°-M8-1 x MALE-18mm H-SS | | | 2 | EA | A | R | DWG |
| 42 | 27998-4 | WIPER-REAR-LEFT & RIGHT | | | 2 | EA | A | R | DWG |
| 43 | 27679-2 | COVER-WIPER-REAR-WORKTABLE | SEE 27564 | | 1 | EA | - | R | PS |
| 44 | 27634 | TRIGGER-HOME SWITCH-2 OP | | | 1 | EA | - | R | PS |
| 45 | 27691-1 | BRACKET-HOME SWITCH-Y AXIS | SEE 27564 | | 1 | EA | - | R | PS |
| 46 | 28153 | MOTOR ASSY-DELTA-750W | | | 1 | EA | A | R | PL |
| 47 | 450-5M-15 | BELT-TIMING 5MM POWERGRIP | | | 1 | EA | - | R | PS |
| 48 | 26220-2 | KEY-8mm x 8mm x 38.1L | SEE 27564 | | 2 | EA | - | R | PS |
| 49 | 22719-1 | STOP-ATC HOUSING | | | 2 | EA | - | R | DWG |
| 50 | 27584-1 | COVER-Y AXIS MANIFOLD | SEE 27564 | | 1 | EA | - | R | PS |
| 51 | 28043 | PIN-LOCATING-ØM13 x 6mm L | WITH M6 C' BORE | | 1 | EA | - | R | DWG |
| 52 | 27369-1 | SCREW-HEX HD-HI ST-10.9 CLASS-PART THD-BLU DYE | M6-1.0X30 | | 4 | EA | A | R | DWG |
| 53 | M5-0.8X12 27B | SCREW-BHCS-STL-BO | | | 2 | EA | | R | PS |

| Item | P/N | Title | Detail | Reference(t) | Qty | UseA | Rev | Stat | Type |
|------|-----------------|---------------------------|---------------|--------------|-----|------|-----|------|------|
| 54 | M3-0.5X10 26B | SCREW-FHCS-STL-BO | NON-STOCKABLE | | 2 | EA | - | R | PL |
| 55 | M10-1.5X45 25B | SCREW-SHCS-STL-BO | | | 4 | EA | - | R | PS |
| 56 | M5-0.8X20 27Z | SCREW-BHCS-STL-ZINC | | | 2 | EA | - | R | PS |
| 57 | M6-1.0X30 25B | SCREW-SHCS-STL-BO | | | 34 | EA | A | R | PS |
| 58 | M6-1.0X12 26B | SCREW-FHCS-STL-BO | NON STOCKABLE | | 34 | EA | - | R | PS |
| 59 | M6-1.0X20 25B | SCREW-SHCS-STL-BO | | | 30 | EA | - | R | PS |
| 60 | M5-0.8X10 26B | SCREW-FHCS-STL-BO | NON STOCKABLE | | 6 | EA | | R | PS |
| 61 | M8-1.25X40 25B | SCREW-SHCS-STL-BO | | | 8 | EA | | R | PS |
| 62 | M8-1.25X30 25B | SCREW-SHCS-STL-BO | | | 4 | EA | | R | PS |
| 63 | M10-1.5X110 25B | SCREW-SHCS-STL-BO | NON STOCKABLE | | 2 | EA | A | R | PS |
| 64 | M5-0.8X45 25B | SCREW-SHCS-STL-BO | | | 2 | EA | - | R | PS |
| 65 | M5-0.8X12 25B | SCREW-SHCS-STL-BO | | | 9 | EA | - | R | PS |
| 66 | 10-32X5/8 25B | SCREW-SHCS-STL-BO | | | 12 | EA | A | R | PS |
| 67 | M6-1.0X20 27B | SCREW-BHCS-STL-BO | | | 24 | EA | | R | PS |
| 68 | M6-1.0X12 25B | SCREW-SHCS-STL-BO | | | 2 | EA | | R | PS |
| 69 | M8-1.25X25 25B | SCREW-SHCS-STL-BO | | | 8 | EA | | R | PS |
| 70 | M5-0.8X15 25B | SCREW-SHCS-STL-BO | NON STOCKABLE | | 2 | EA | - | R | PS |
| 71 | M6-1.0X35 25B | SCREW-SHCS-STL-BO | | | 2 | EA | - | R | PS |
| 72 | M5-0.8X30 25B | SCREW-SHCS-STL-BO | NON STOCKABLE | | 2 | EA | - | R | PS |
| 73 | 10-32X3/4 25B | SCREW-SHCS-STL-BO | | | (1) | EA | | R | PS |
| 75 | M5 73B | WASHER-SPLIT LOCK-STL-BO | | | 6 | EA | - | R | PS |
| 76 | M6 73B | WASHER-SPLIT LOCK-STL-BO | | | 36 | EA | - | R | PS |
| 77 | M8 73B | WASHER-SPLIT LOCK-STL-BO | | | 12 | EA | | R | PS |
| 78 | 1/2 75Z | WASHER-EXT TOOTH-STL-ZINC | | | 1 | EA | | R | PS |
| 84 | M6-1.0 50B | NUT-HEX-STL-BO | | | 6 | EA | | R | PS |

| Item | P/N | Title | Detail | Reference(t) | Qty | UseA | Rev | Stat | Type |
|------|------------|------------------------|--------|--------------|-----|------|-----|------|------|
| 86 | 1/2-20 51Z | NUT-HEX JAM-STL-ZINC | | | 1 | EA | | R | PS |
| 87 | 28196 | HEX JAM NUT | | | 4 | EA | A | R | DWG |
| 91 | M8 70B | WASHER-FLAT USS-STL-BO | | | 4 | EA | | R | PS |
| 92 | M5 70B | WASHER-FLAT USS-STL-BO | | | 6 | EA | - | R | PS |
| 93 | M6 70B | WASHER-FLAT USS-STL-BO | | | 4 | EA | - | R | PS |

1 2 3 4 5 6 7 8

| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------------------------|-------|----------|-------|
| A | PRODUCTION RELEASE | 14209 | 9/12/14 | TO |
| B | ADDED ITEMS 19 & 57. ITEM 88 QTY 20 WAS: 16 | 14291 | 2/13/15 | TO/PM |
| C | ADDED ITEM 21. NOTE 4 & NOTE 5 | 14430 | 06/13/14 | TO/PM |
| D | ADDED NOTE 6 & SHIP. ITEMS 37, 38, 110 WAS: 2676&2. | 14496 | 3/16/16 | AW |
| E | DELETED ITEM 83. ITEM 97 QTY 10 WAS: QTY 6 | 14563 | 4.3.17 | TO |



NOTES: (UNLESS OTHERWISE SPECIFIED),

1. LOCKWASHERS TO BE ADDED AS REQUIRED.
2. ADD ITEMS 71 & 72 AS SHOWN TO HOLD HANDWHEEL CABLE (ITEM 67) IN PLACE. (2A2)
3. APPLY LOCTITE 242 (BLUE) TO EXTERNAL THREADS OF ROD (ITEMS 48) & EXTERNAL THREADS OF ITEMS 81 & 87. (1A5, 1A6, 1B6, 1C6)
4. APPLY SEALANT 3M-540 (WHT) POLYURETHANE PER INSTRUCTIONS FOUND ONLINE OR ON PRODUCT LABEL. (1C5)
5. ADD WASHER (ITEM 106) AS REQUIRED TO KEEP CYLINDER (ITEM 48) VERTICAL. (1B7)
6. STATUS & WORK LED LIGHTS (ITEMS 37 & 38) ARE TO BE REPLACED IN THEIR ENTIRETY WHEN FAILURE OCCURS. THERE ARE NO INDIVIDUAL PART REPLACEMENTS. (2A5, 2D7)

| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------------------------|-------|----------|-------|
| A | PRODUCTION RELEASE | 14209 | 9/12/14 | TO |
| B | ADDED ITEMS 19 & 57. ITEM 88 QTY 20 WAS: 16 | 14291 | 2/13/15 | TO/PM |
| C | ADDED ITEM 21. NOTE 4 & NOTE 5 | 14430 | 06/13/14 | TO/PM |
| D | ADDED NOTE 6 & SHIP. ITEMS 37, 38, 110 WAS: 2676&2. | 14496 | 3/16/16 | AW |
| E | DELETED ITEM 83. ITEM 97 QTY 10 WAS: QTY 6 | 14563 | 4.3.17 | TO |

| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------------------------|-------|----------|-------|
| A | PRODUCTION RELEASE | 14209 | 9/12/14 | TO |
| B | ADDED ITEMS 19 & 57. ITEM 88 QTY 20 WAS: 16 | 14291 | 2/13/15 | TO/PM |
| C | ADDED ITEM 21. NOTE 4 & NOTE 5 | 14430 | 06/13/14 | TO/PM |
| D | ADDED NOTE 6 & SHIP. ITEMS 37, 38, 110 WAS: 2676&2. | 14496 | 3/16/16 | AW |
| E | DELETED ITEM 83. ITEM 97 QTY 10 WAS: QTY 6 | 14563 | 4.3.17 | TO |

| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------------------------|-------|----------|-------|
| A | PRODUCTION RELEASE | 14209 | 9/12/14 | TO |
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| C | ADDED ITEM 21. NOTE 4 & NOTE 5 | 14430 | 06/13/14 | TO/PM |
| D | ADDED NOTE 6 & SHIP. ITEMS 37, 38, 110 WAS: 2676&2. | 14496 | 3/16/16 | AW |
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| B | ADDED ITEMS 19 & 57. ITEM 88 QTY 20 WAS: 16 | 14291 | 2/13/15 | TO/PM |
| C | ADDED ITEM 21. NOTE 4 & NOTE 5 | 14430 | 06/13/14 | TO/PM |
| D | ADDED NOTE 6 & SHIP. ITEMS 37, 38, 110 WAS: 2676&2. | 14496 | 3/16/16 | AW |
| E | DELETED ITEM 83. ITEM 97 QTY 10 WAS: QTY 6 | 14563 | 4.3.17 | TO |

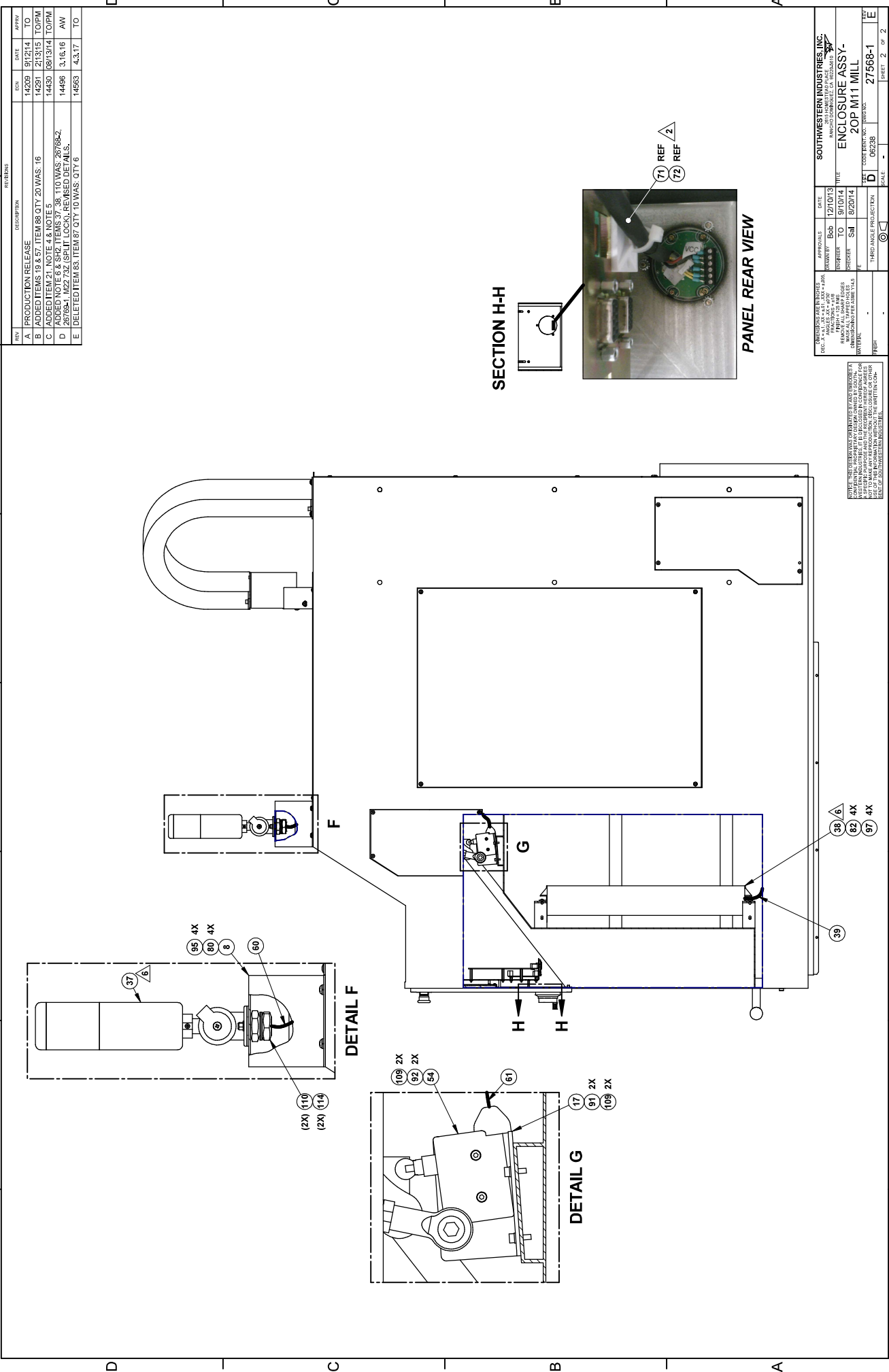
| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------------------------|-------|----------|-------|
| A | PRODUCTION RELEASE | 14209 | 9/12/14 | TO |
| B | ADDED ITEMS 19 & 57. ITEM 88 QTY 20 WAS: 16 | 14291 | 2/13/15 | TO/PM |
| C | ADDED ITEM 21. NOTE 4 & NOTE 5 | 14430 | 06/13/14 | TO/PM |
| D | ADDED NOTE 6 & SHIP. ITEMS 37, 38, 110 WAS: 2676&2. | 14496 | 3/16/16 | AW |
| E | DELETED ITEM 83. ITEM 97 QTY 10 WAS: QTY 6 | 14563 | 4.3.17 | TO |

| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------------------------|-------|----------|-------|
| A | PRODUCTION RELEASE | 14209 | 9/12/14 | TO |
| B | ADDED ITEMS 19 & 57. ITEM 88 QTY 20 WAS: 16 | 14291 | 2/13/15 | TO/PM |
| C | ADDED ITEM 21. NOTE 4 & NOTE 5 | 14430 | 06/13/14 | TO/PM |
| D | ADDED NOTE 6 & SHIP. ITEMS 37, 38, 110 WAS: 2676&2. | 14496 | 3/16/16 | AW |
| E | DELETED ITEM 83. ITEM 97 QTY 10 WAS: QTY 6 | 14563 | 4.3.17 | TO |

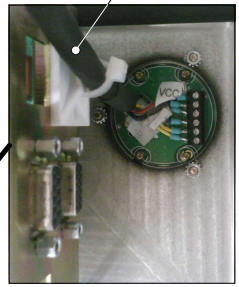
| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------------------------|-------|----------|-------|
| A | PRODUCTION RELEASE | 14209 | 9/12/14 | TO |
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| E | DELETED ITEM 83. ITEM 97 QTY 10 WAS: QTY 6 | 14563 | 4.3.17 | TO |

| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------------------------|-------|----------|-------|
| A | PRODUCTION RELEASE | 14209 | 9/12/14 | TO |
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| D | ADDED NOTE 6 & SHIP. ITEMS 37, 38, 110 WAS: 2676&2. | 14496 | 3/16/16 | AW |
| E | DELETED ITEM 83. ITEM 97 QTY 10 WAS: QTY 6 | 14563 | 4.3.17 | TO |

| REV | DESCRIPTION | DATE | BY | APPV |
|-----|----------------------------------------------------------------------------------------------------|----------|----|------|
| A | PRODUCTION RELEASE | 9/12/14 | | |
| B | ADDED ITEMS 19 & 57. ITEM 88 QTY 20 WAS: 16 | 2/13/15 | TO | TO |
| C | ADDED ITEM 21. NOTE 4 & NOTE 5 | 06/13/14 | TO | TO |
| D | ADDED NOTE 6 & SHZ. ITEMS 37, 38, 110 WAS: 26768-2, 26769-1, M27.3Z (SPLIT LOCK), REVISED DETAILS. | 3/16/16 | AW | AW |
| E | DELETED ITEM 83. ITEM 87 QTY 10 WAS: QTY 6 | 4.3.17 | TO | TO |



SECTION H-H



PANEL REAR VIEW

| APPROVALS | DATE | BY | APPV |
|--------------------------|----------|-----|------|
| DESIGNED BY: [Signature] | 12/10/13 | Bob | |
| DRAWN BY: [Signature] | 9/10/14 | TO | |
| CHECKED BY: [Signature] | 9/20/14 | Sal | |
| THIRD ANGLE PROJECTION | | | |

SOUTHWESTERN INDUSTRIES, INC.
 MANUFACTURING DIVISION
ENCLOSURE ASSY -
20P M11 MILL

FIG. CODE: 27581-1
 PART: 06238
 SCALE: 1:1
 SHEET 2 OF 2

CONSTRUCTION OF THIS DRAWING IS THE PROPERTY OF SOUTHWESTERN INDUSTRIES, INC. AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES, INC.

Parts List for Assembly P/N: 27568-1

Printed 4/3/2017

27568-1

ENCLOSURE ASSY-2OP M11 MILL

Type PL Dwg Size D
 Revision E Product 2OP M11 MILL
 Status R Engineer TO
 Date 12/6/2013 Planner Code
 By Bob Comm Code

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|-----------|--------------------------------------------|-------------|-----|-------|-----|------|------|-----------|------------|
| 1 | 27603-1-1 | ENCLOSURE-UPPER STRUCTURE-2OP M11 | SEE 27568-1 | 1 | EA | A | R | PS | KING RICH | OP420011 |
| 2 | 27603-2 | PANEL-REAR/TOP-UPPER STRUCTURE | SEE 27568 | 1 | EA | - | R | PS | KING RICH | OP420180 |
| 3 | 27603-3 | PANEL-TOP/LEFT-UPPER STRUCTURE | SEE 27568 | 1 | EA | - | R | PS | KING RICH | OP420860 |
| 4 | 27603-4 | PANEL-TOP/RIGHT-UPPER STRUCTURE | SEE 27568 | 1 | EA | 1 | R | DWG | KING RICH | OP420940 |
| 5 | 27603-5 | PANEL-CENTER-UPPER STRUCTURE | SEE 27568 | 2 | EA | - | R | PS | KING RICH | OP420070 |
| 6 | 27603-6 | PANEL-BOTTOM-UPPER STRUCTURE | SEE 27568 | 2 | EA | - | R | PS | KING RICH | OP420870 |
| 7 | 27603-7-1 | PANEL-REAR/BOTTOM-UPPER STRUCTURE-M11 | SEE 27568-1 | 1 | EA | A | R | PS | KING RICH | OP420191 |
| 8 | 27603-8 | COVER-CYLINDER-UPPER STRUCTURE | SEE 27568 | 1 | EA | - | R | PS | KING RICH | OP420841 |
| 9 | 27603-9 | SUPPORT-LEFT & RIGHT-UPPER STRUCTURE | SEE 27520 | (2) | EA | - | R | PS | KING RICH | OP420500 |
| 10 | 27603-10 | COVER-CONDUIT-MINOR-UPPER STRUCTURE | SEE 27520 | (1) | EA | - | R | PS | KING RICH | OP420420 |
| 11 | 27603-11 | COVER-CONDUIT-MAJOR-UPPER STRUCTURE | SEE 27520 | (1) | EA | - | R | PS | KING RICH | OP420410 |
| 12 | 27603-12 | CONDUIT-UPPER STRUCTURE | SEE 27520 | (1) | EA | - | R | PS | KING RICH | OP420430 |
| 13 | 27603-13 | COVER-CONDUIT-UPPER STRUCTURE | SEE 27520 | (1) | EA | - | R | PS | KING RICH | OP420460 |
| 14 | 27603-14 | BRACKET-MTG-CABLE CARRIER-UPR STRUCT | SEE 27520 | 1 | EA | - | R | PS | KING RICH | OP420520 |
| 15 | 27603-15 | COVER-TOP-LEFT-UPPER STRUCTURE | SEE 27568 | 1 | EA | - | R | PS | KING RICH | OP420141 |
| 16 | 27603-16 | COVER-TOP-RIGHT-UPPER STRUCTURE | SEE 27568 | 1 | EA | - | R | PS | KING RICH | OP420131 |
| 17 | 27603-24 | BRACKET-L-DOOR SWITCH | SEE 27568 | 1 | EA | - | R | PS | KING RICH | OP420700 |
| 18 | 27603-30 | BRACKET-MTG-SERVO CABLES-UPR STRUCT | SEE 27568-1 | 1 | EA | A | R | PS | KING RICH | OP420520-A |
| 19 | 27603-22 | BRACE-DOOR ASSY-UPPER REAR | SEE 27568-1 | 1 | EA | A | R | PS | KING RICH | |
| 21 | 27209 | WEAR STRIP SET-LEFT & RIGHT-DOOR GUIDE-M11 | | 1 | EA | A | R | PS | | |

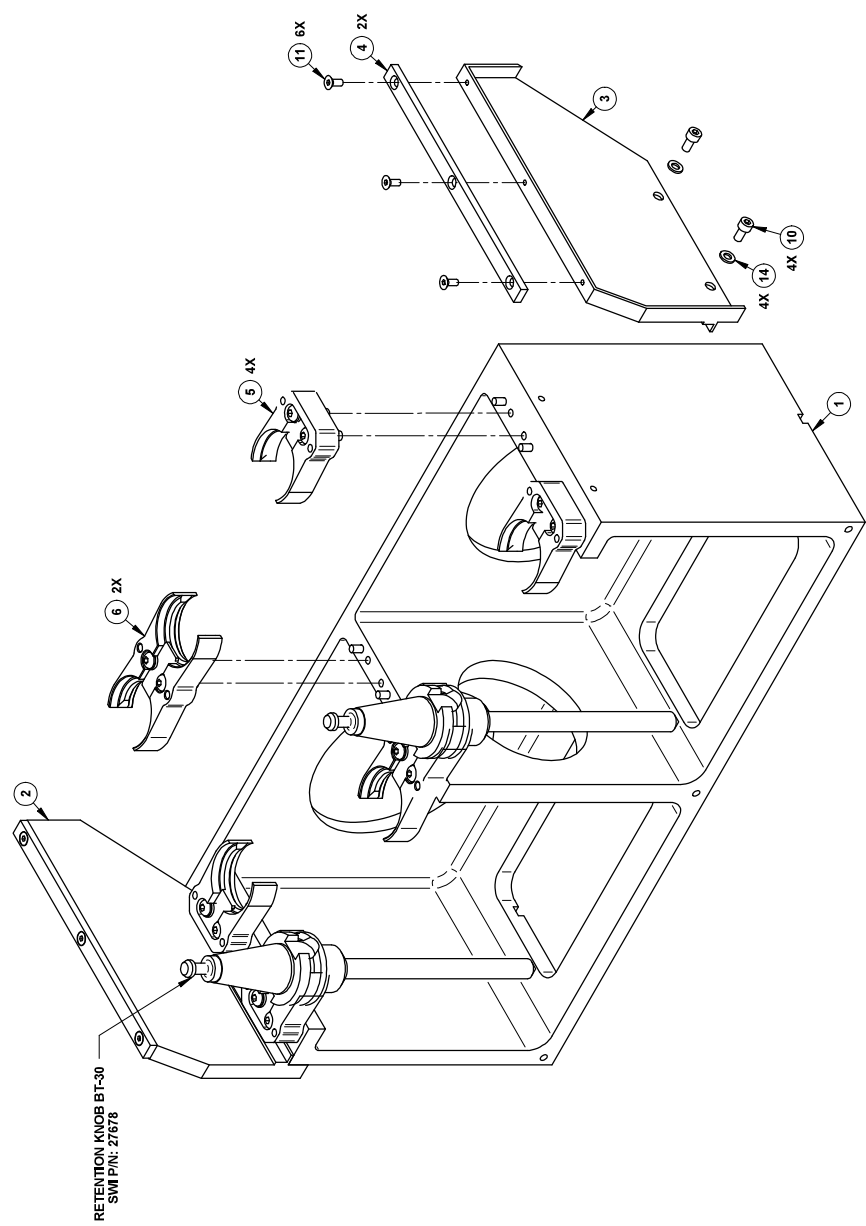
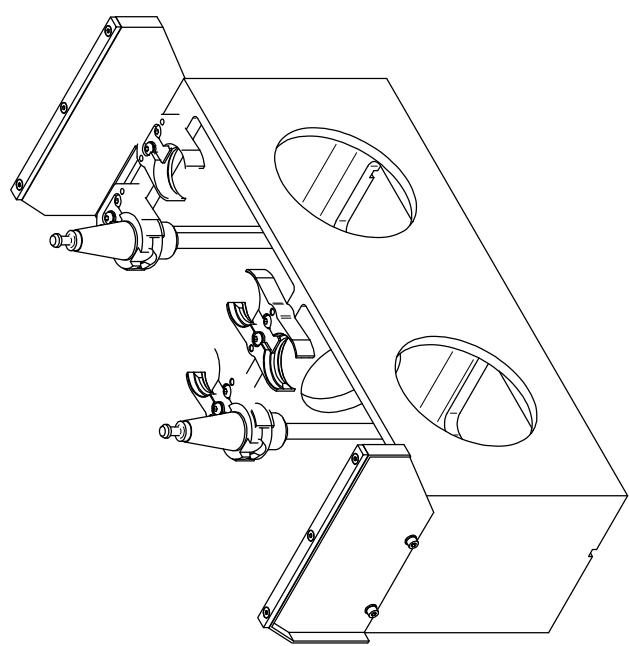
| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|----------|---------------------------------------|--------------------------------------------------------------------|-----|-------|-----|------|------|-----------|---------------------|
| 22 | 27682-8 | BRACKET-L-LEFT & RIGHT | | 2 | EA | - | R | PS | KING RICH | OP420161 |
| 25 | 28086 | BLOCK-MOUNTING-DOOR-2OP | | 2 | EA | A | R | DWG | | |
| 27 | 28131 | BEARING-DEEP GROOVE-635-2RS1 | | 2 | EA | - | R | DWG | | |
| 29 | 26891-5 | CARRIER-CABLE-Z AXIS | | 1 | EA | - | R | PS | KING RICH | A-85-184 |
| 35 | 28160 | PANEL ASSY-2 OP M11 MILL | | (1) | EA | C | R | PL | | |
| 37 | 26768-3 | STATUS LIGHT LED ASSY-2OP | THERE ARE NO REPLACEMENT PARTS IN CASE OF FAILURE REPL ENTIRE ASSY | 1 | EA | A | R | PL | KING RICH | A-141-082 |
| 38 | 26769-2 | WORK LIGHT-LED-115VAC | THERE ARE NO REPLACEMENT PARTS IN CASE OF FAILURE REPL ENTIRE ASSY | 1 | EA | A | R | DWG | KING RICH | A-141-081 |
| 39 | 27635-15 | CABLE ASSY-WORK LIGHT EXTENSION | DC300-116 | 1 | EA | - | R | PL | | |
| 41 | 27606 | DOOR-UPPER & LOWER | SEE 27568 | 1 | EA | - | R | PS | KING RICH | OP420050 & OP420060 |
| 42 | 27603-26 | COVER-SHEET METAL-DOOR-2OP | SEE 27568 | 1 | EA | - | R | PS | KING RICH | OP420990 |
| 43 | 24404-3 | LEXAN WINDOW-DOOR-2OP | | 2 | EA | - | R | PS | KING RICH | A-82-019 |
| 44 | 27560 | FRAME-LEXAN-WINDOW | | 2 | EA | - | R | PS | KING RICH | OP420120 |
| 45 | 27897 | WELDMENT-DOOR SHAFT AND LEVER ARM | | 1 | EA | A | R | PL | | |
| 46 | 27688 | BEARING-BRONZE-SELF ALIGNING-18mm | FLANGE-MOUNT | (2) | EA | - | R | PS | SPYRAFLO | BFM-18M-B |
| 48 | 27583-6 | CYLINDER-AIR-40mm BORE 125mm STROKE | | 1 | EA | - | R | DWG | | |
| 49 | 27583-2 | ROD END-BALL JOINT-10MM ID | SEE 27540 OR 27540-1 | 1 | EA | - | R | PS | | |
| 51 | 27682-9 | BRACKET-L-CYLINDER ASSY | | 2 | EA | - | R | PS | KING RICH | OP420010 |
| 53 | 27937-1 | HANDLE-DOOR-2OP | | 1 | EA | - | R | PS | KING RICH | A-141-018 |
| 54 | 22680-5 | SWITCH-LIMIT-ROLLER PLUNGER | | 1 | EA | - | R | PS | KING RICH | A-432-013 |
| 55 | 27574 | MUFFLER-1/4 BSPT | | 1 | EA | - | R | PS | KING RICH | A-316-136 |
| 56 | 26952-3 | FITTING-AIR-90°-1/4 BSPTx1/4 HYDR M/M | SEE 27563 | 1 | EA | - | R | PS | KING RICH | A-316-012 |

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|----------------|---------------------------------------------|---------------------|-----|-------|-----|------|------|-----|---------|
| 57 | 27897-1 | SPACER-DOOR SHAFT WELDMENT | | 1 | EA | A | R | DWG | | |
| 60 | 27635-14 | CABLE ASSY-STATUS LIGHT | DC300-115 | 1 | EA | - | R | PL | | |
| 61 | 27635-4 | CABLE ASSY-DOOR SWITCH | DC300-117 | 1 | EA | - | R | PL | | |
| 65 | 26511-120 | CABLE ASSY- VGA-10FT | | (1) | EA | - | R | DWG | | |
| 66 | 26513 | CABLE ASSY-OVERLAY POWER | | (1) | EA | B | R | PL | | |
| 67 | 26515-1 | CABLE ASSY-HANDWHEEL | | (1) | EA | A | R | PL | | |
| 68 | 25700-120 | CABLE ASSY-DB9 SHIELDED MALE/FEMALE 120" | | (1) | EA | - | R | DWG | | |
| 69 | 27635-9 | CABLE ASSY-E STOP | DC300-114 | 1 | EA | - | R | PL | | |
| 70 | 27635-16 | CABLE ASSY-SERVO ON BUTTON | DC300-124 | 1 | EA | A | R | PL | | |
| 71 | 23262-2 | CABLE TIE HOLDER | 0.75 x 0.75 x 0.188 | (1) | EA | A | R | DWG | | |
| 72 | 22475 | TIE WRAP-4 IN-PLASTIC | | (1) | EA | - | R | DWG | | |
| 80 | M5-0.8X10 27Z | SCREW-BHCS-STL-ZINC | NON STOCKABLE | 26 | EA | - | R | PS | | |
| 81 | M5-0.8X20 27B | SCREW-BHCS-STL-BO | NON STOCKABLE | 2 | EA | - | R | PS | | |
| 82 | M5-0.8X12 25B | SCREW-SHCS-STL-BO | | 22 | EA | - | R | PS | | |
| 84 | M6-1.0X10 27B | SCREW-BHCS-STL-BO | | 2 | EA | - | R | PS | | |
| 86 | M5-0.8X8 27B | SCREW-BHCS-STL-BO | | 19 | EA | - | R | PS | | |
| 87 | M6-1.0X20 25B | SCREW-SHCS-STL-BO | | 10 | EA | - | R | PS | | |
| 88 | M4-0.7X8 27Z | SCREW-BHCS-STL-ZINC | NON-STOCKABLE | 20 | EA | - | R | PS | | |
| 89 | M6-1.0X15 25B | SCREW-SHCS-STL-BO | | 4 | EA | | R | PS | | |
| 90 | M10-1.5X45 25B | SCREW-SHCS-STL-BO | | 2 | EA | - | R | PS | | |
| 91 | M3-0.5X10 25B | SCREW-SHCS-STL-BO | | 2 | EA | - | R | PS | | |
| 92 | M3-0.5X20 25B | SCREW-SHCS-STL-BO | | 2 | EA | - | R | PS | | |
| 93 | M10-1.5X40 25B | SCREW-SHCS-STL-BO | | 1 | EA | | R | PS | | |
| 94 | M10-1.5X65 25B | SCREW-SHCS-STL-BO | | 1 | EA | | R | PS | | |

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|-------------|--------------------------|---------------|-----|-------|-----|------|------|-----|---------|
| 95 | M5 71Z | WASHER-FLAT-STL-ZINC | NON STOCKABLE | 45 | EA | - | R | PS | | |
| 96 | M6 70B | WASHER-FLAT USS-STL-BO | | 12 | EA | - | R | PS | | |
| 97 | M5 70B | WASHER-FLAT USS-STL-BO | | 14 | EA | - | R | PS | | |
| 99 | M10 71B | WASHER-FLAT SAE-STL-BO | | 2 | EA | - | R | PS | | |
| 100 | M5 73B | WASHER-SPLIT LOCK-STL-BO | | 8 | EA | - | R | PS | | |
| 106 | M10 73B | WASHER-SPLIT LOCK-STL-BO | | 1 | EA | - | R | PS | | |
| 109 | M3 73B | WASHER-SPLIT LOCK-STL-BO | NON STOCKABLE | 4 | EA | - | R | PS | | |
| 110 | M22 71Z | WASHER-FLAT SAE-STL-ZINC | NON STOCKABLE | (2) | EA | A | R | PS | | |
| 112 | M10 56Z | NUT-NYLON LOCK-STL-ZINC | NON STOCKABLE | 2 | EA | - | R | PS | | |
| 113 | M10-1.5 51Z | NUT-HEX JAM-STL-ZINC | NON STOCKABLE | 1 | EA | - | R | PS | | |
| 114 | M22-2.5 51Z | NUT-HEX-STL-ZINC | NON STOCKABLE | (2) | EA | - | R | PS | | |

1 2 3 4 5 6 7 8

| | | | | |
|------|--------------------|-------|----------|---------|
| REV. | DESCRIPTION | ICN | DATE | APPROV. |
| A | PRODUCTION RELEASE | 14218 | 10/24/14 | TO |



RETENTION KNOB BT-30
SMP/P/N: Z7676

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| | | | |
|-----------------------------------------------------------|---------|------------------------|---------|
| DESIGNATION | DATE | APPROVALS | DATE |
| REVISION 1 | 8/18/14 | Bob TO | 8/18/14 |
| REVISION 2 | | Sal TO | |
| SOUTHWESTERN INDUSTRIES, INC. MANUFACTURING DEPARTMENT | | | |
| TITLE ATC ASSY - 2 OP M11 MILL | | | |
| DESIGNER | TO | ENGINEER | TO |
| DRAWN | TO | CHECKED | TO |
| MATERIAL | | THIRD ANGLE PROJECTION | |
| FIGURE | | SCALE | |
| REV | 27587-1 | REV | A |
| SHEET 1 OF 1 | | SHEET 1 OF 1 | |

NOTES: (UNLESS OTHERWISE SPECIFIED).

1 2 3 4 5 6 7 8

Parts List for Assembly P/N: 27587-1

Printed 10/22/2014

27587-1

ATC ASSY-2 OP M11 MILL

| | | | |
|----------|-----------|--------------|----------|
| Type | PL | Dwg Size | D |
| Revision | A | Product | 2 OP M11 |
| Status | R | Engineer | TO |
| Date | 8/18/2014 | Planner Code | |
| By | Bob | Comm Code | |

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------------|--------------------------------|---------------|-----|-------|-----|------|------|-----------|----------|
| 1 | 27576-3 | HOUSING ASSY-TOOL HOLDERS-M11 | | 1 | EA | A | R | PL | | |
| 2 | 27575 | BRACKET-DOOR ASSIST-LEFT | | 1 | EA | - | R | PS | KING RICH | OP520100 |
| 3 | 27575-1 | BRACKET-DOOR ASSIST-RIGHT | | 1 | EA | - | R | PS | KING RICH | OP520110 |
| 4 | 27615 | WEAR STRIP-DOOR ASSIST | | 2 | EA | - | R | PS | KING RICH | OP520210 |
| 5 | 27493 | GRIPPER ASSY-TOOL CHANGER | | 4 | EA | - | R | PL | | |
| 6 | 27494 | GRIPPER ASSY-DUAL-TOOL CHANGER | | 2 | EA | - | R | PL | | |
| 10 | M5-0.8X10 25B | SCREW-SHCS-STL-BO | | 4 | EA | - | R | PS | | |
| 11 | M4-0.7X10 26B | SCREW-FHCS-STL-BO | NON STOCKABLE | 6 | EA | - | R | PS | | |
| 14 | M5 71B | WASHER-FLAT SAE-STL-BO | NON STOCKABLE | 4 | EA | - | R | PS | | |

1 2 3 4 5 6 7 8

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| REV | DESCRIPTION | DATE | BY | APPV |
|-----|----------------------------------|----------|-------|------|
| A | PRODUCTION RELEASE | 10/24/14 | 14218 | TO |
| B | SHEET 4 FACTORIALY ADDED 2689145 | 2/13/15 | 14361 | PM |

MAIN DISTRIBUTION MANIFOLD MOUNTED BEHIND THE LUBRICATION PUMP. DISTRIBUTES LUBRICATION OIL TO THE 3 AXIS DISTRIBUTION MANIFOLDS.



LUBRICATION PUMP MOUNTED IN ELECTRICAL BOX. TO MAIN DISTRIBUTION MANIFOLD



FROM LUBE PUMP
TO Z AXIS MANIFOLD

- 2
- 10 4X
- 11 4X
- 12 4X
- 13 4X
- 14 2X REF
- 15 2X REF

5 36.0

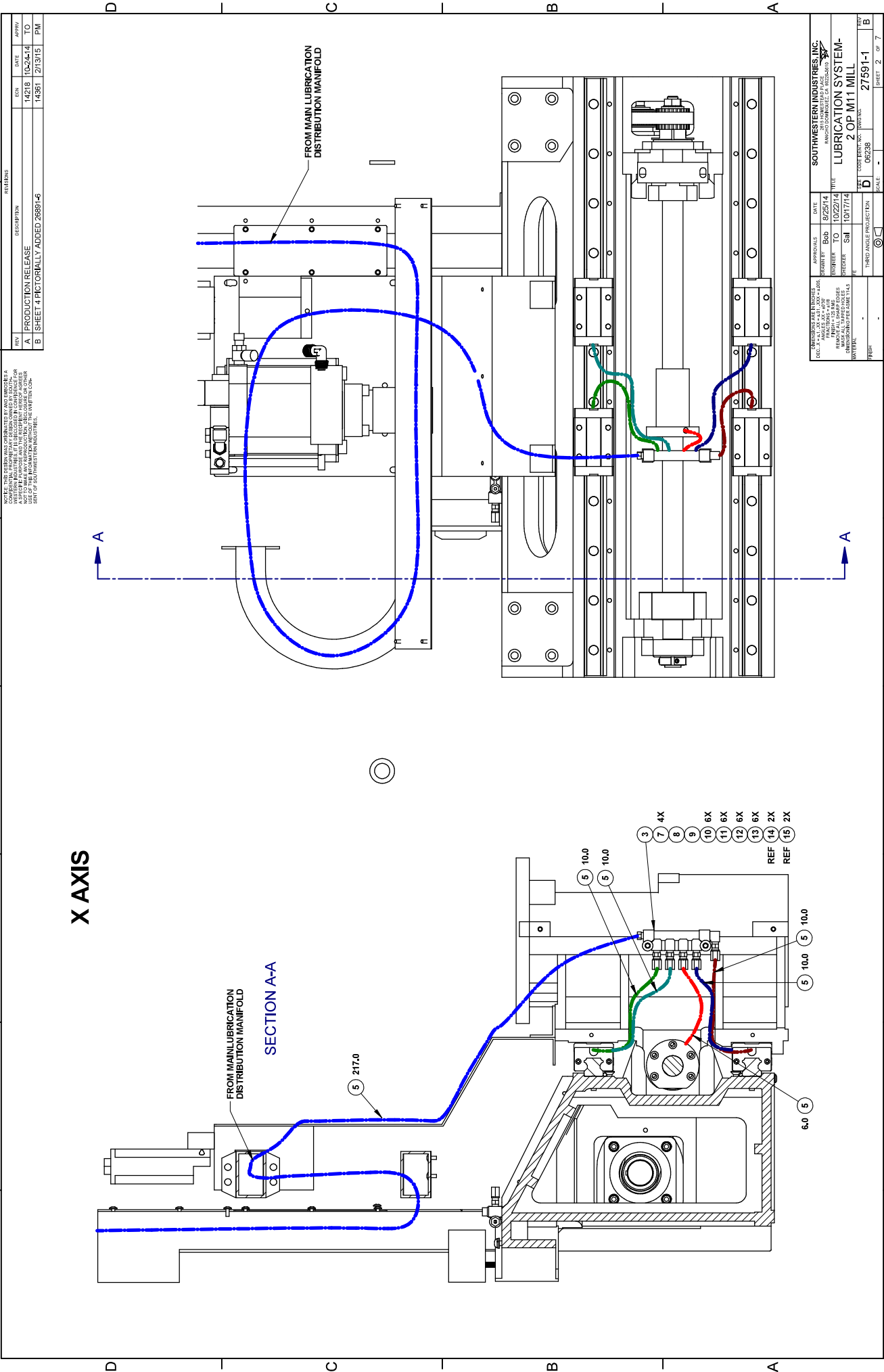
| REV | DESCRIPTION | DATE | BY | APPV |
|-----|----------------------------------|----------|-------|------|
| A | PRODUCTION RELEASE | 10/24/14 | 14218 | TO |
| B | SHEET 4 FACTORIALY ADDED 2689145 | 2/13/15 | 14361 | PM |

| DESIGNER | DATE | APPROVALS | DATE | SCALE |
|----------|----------|-----------|----------|-------|
| Bob | 8/25/14 | Bob | 8/25/14 | |
| Sal | 10/22/14 | Sal | 10/22/14 | |
| Sal | 10/17/14 | Sal | 10/17/14 | |

| PROJECT | TITLE | DATE | BY | APPV |
|---------------|---------------------|----------|-----|------|
| 2 OP M11 MILL | LUBRICATION SYSTEM- | 10/22/14 | Sal | Sal |
| 27591-1 | 2 OP M11 MILL | 10/17/14 | Sal | Sal |

| REV | DESCRIPTION | DATE | BY | APPV |
|-----|----------------------------------|----------|-------|------|
| A | PRODUCTION RELEASE | 10/24/14 | 14218 | TO |
| B | SHEET 4 FACTORIALY ADDED 2689145 | 2/13/15 | 14361 | PM |

1 2 3 4 5 6 7 8



| REV | DESCRIPTION | DATE | APPN |
|-----|-----------------------------------|----------|-----------|
| A | PRODUCTION RELEASE | 10/24/14 | TO |
| B | SHEET 4 PICTORIALY ADDED 26891-45 | 14/361 | 2/3/15 PM |

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| APPROVALS | DATE | APPROVALS | DATE |
|-----------|----------|-----------|----------|
| Bob | 8/25/14 | TO | 10/22/14 |
| Sal | 10/17/14 | DESIGNER | TO |
| Sal | 10/17/14 | ENGINEER | TO |
| Sal | 10/17/14 | DESIGNER | TO |
| Sal | 10/17/14 | ENGINEER | TO |

SOUTH WESTERN INDUSTRIES, INC.
 MANUFACTURING DIVISION
 LUBRICATION SYSTEMS
 2 OP M11 MILL
 PART CODE: 27591-1-1
 DRAWING NO.: 26891-45
 SCALE: 1:1
 SHEET 2 OF 7

X AXIS

SECTION A-A

FROM MAIN LUBRICATION DISTRIBUTION MANIFOLD

FROM MAIN LUBRICATION DISTRIBUTION MANIFOLD

5 217.0

5 10.0

5 10.0

3

7 4X

8

9

10 6X

11 6X

12 6X

13 6X

14 2X

15 2X

REF

REF

5 10.0

5 10.0

5 10.0

5 10.0

6.0 5

5

5

5

| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------|----------|----|------|
| A | PRODUCTION RELEASE | 10/22/14 | TO | |
| B | SHEET 4 PICTORIALY ADDED 26891-45 | 10/22/14 | TO | |

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X AXIS

X AXIS LUBRICATION LINE COMING FROM THE MAIN DISTRIBUTION MANIFOLD TO THE X AXIS DISTRIBUTION MANIFOLD VIEWED FROM THE RIGHT SIDE OF THE SPINDLE.



LUBRICATION LINE

LEFT SIDE VIEW OF THE X AXIS LUBRICATION DISTRIBUTION MANIFOLD AND THE LINES TO EACH OF THE RAIL GUIDE BLOCKS AND THE BALL NUT.



- FROM MAIN DISTRIBUTION MANIFOLD
- UPPER LEFT GUIDE LUBRICATION LINE SIZE: NO 2
- UPPER RIGHT GUIDE LUBRICATION LINE SIZE: NO 2
- TO BALL NUT SIZE: NO 8
- LOWER RIGHT GUIDE LUBRICATION LINE SIZE: NO 2
- LOWER LEFT GUIDE LUBRICATION LINE SIZE: NO 2

| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------|----------|----|------|
| A | PRODUCTION RELEASE | 10/22/14 | TO | |
| B | SHEET 4 PICTORIALY ADDED 26891-45 | 10/22/14 | TO | |

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| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------|----------|----|------|
| A | PRODUCTION RELEASE | 10/22/14 | TO | |
| B | SHEET 4 PICTORIALY ADDED 26891-45 | 10/22/14 | TO | |

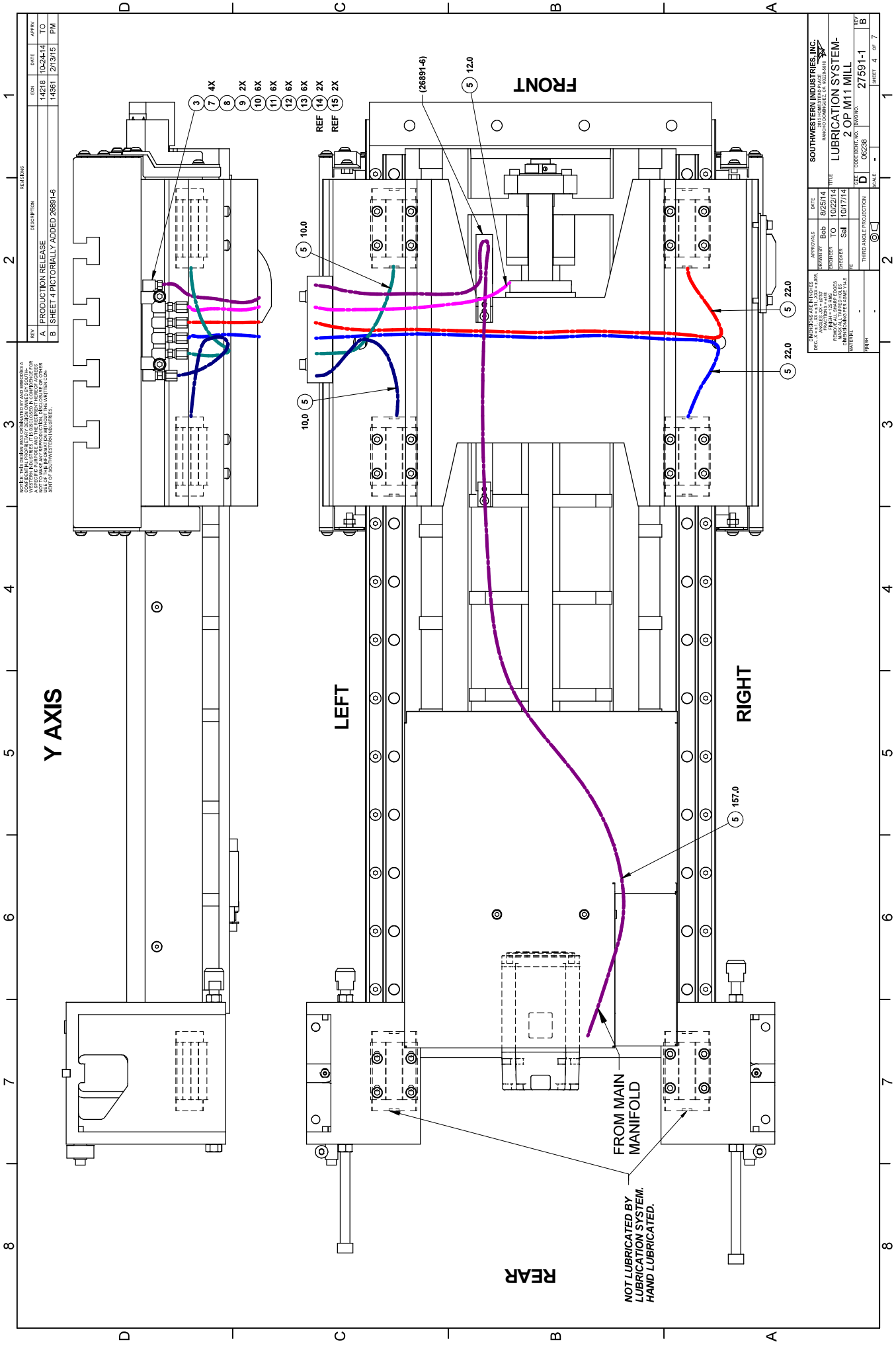
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| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------|----------|----|------|
| A | PRODUCTION RELEASE | 10/22/14 | TO | |
| B | SHEET 4 PICTORIALY ADDED 26891-45 | 10/22/14 | TO | |

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| REV | DESCRIPTION | DATE | BY | APPV |
|-----|-----------------------------------|----------|----|------|
| A | PRODUCTION RELEASE | 10/22/14 | TO | |
| B | SHEET 4 PICTORIALY ADDED 26891-45 | 10/22/14 | TO | |

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| REV | DESCRIPTION | DATE | APPROV |
|-----|----------------------------------|----------|--------|
| A | PRODUCTION RELEASE | 10/24/14 | TO |
| B | SHEET 4 PICTORIALY ADDED 26891-6 | 14/3/15 | PM |

| REV | DESCRIPTION | DATE | APPROV |
|-----|-------------|----------|--------|
| 1 | 14218 | 10/24/14 | TO |
| 2 | 14361 | 2/13/15 | PM |

- 3
- 7 4X
- 8
- 9 2X
- 10 8X
- 11 8X
- 12 8X
- 13 8X
- 14 2X
- 15 2X

REF (14) 2X
REF (15) 2X

10.0 (5)

12.0 (5)

22.0 (5)

22.0 (5)

157.0 (5)

26891-6

FROM MAIN MANIFOLD

NOT LUBRICATED BY LUBRICATION SYSTEM. HAND LUBRICATED.

FRONT

REAR

LEFT

RIGHT

Y AXIS

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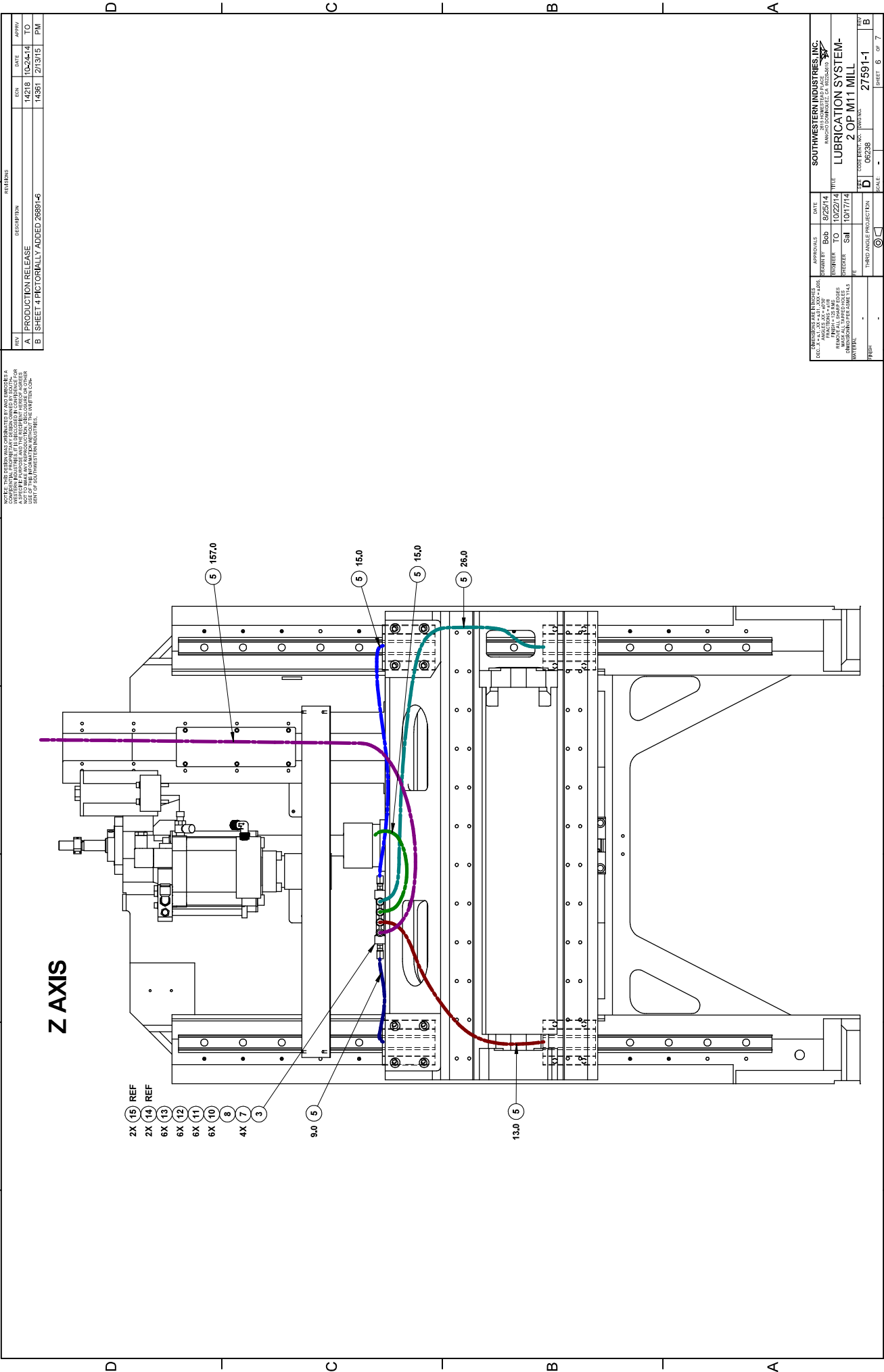
D

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</



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| REV | DESCRIPTION | DATE | APPN |
|-----|-----------------------------------|----------|------------|
| A | PRODUCTION RELEASE | 10/24/14 | TO |
| B | SHEET 4 FACTORIALY ADDED 26891-45 | 14361 | 2/13/15 PM |

| APPROVALS | DATE | DESIGNER | DATE | DRIVER | DATE | DRIVER | DATE | DRIVER | DATE |
|-----------|---------|----------|----------|--------|----------|--------|----------|--------|----------|
| Bob | 8/25/14 | Sal | 10/22/14 | Sal | 10/17/14 | Sal | 10/17/14 | Sal | 10/17/14 |

SOUTHWESTERN INDUSTRIES, INC.
 MANUFACTURING ASSISTANCE ACT
 LUBRICATION SYSTEM-
 2 OP M11 MILL
 PART CODE BERTV INC 27591-1
 PART CODE BERTV INC 06238
 THIRD ANGLE PROJECTION
 SCALE 1:1
 SHEET 6 OF 7

Z AXIS

VIEW OF CABLE CARRIER FROM RIGHT SIDE OF MACHINE.



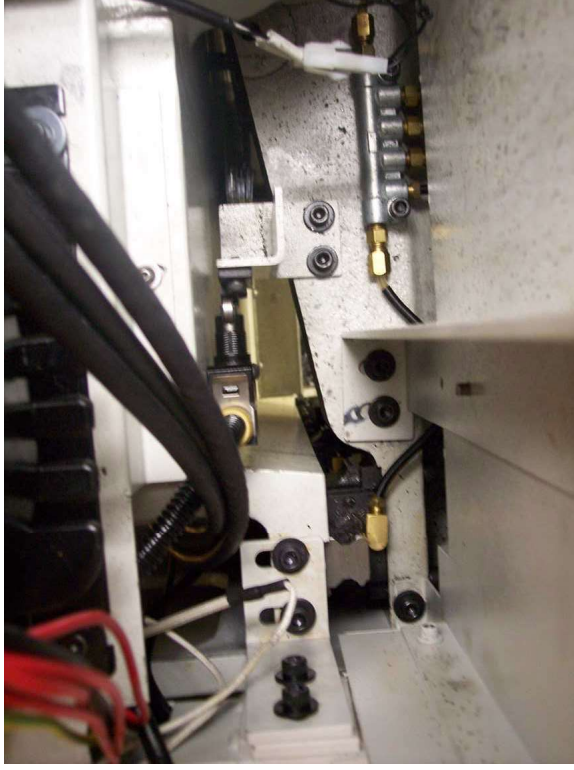
FROM MAIN MANIFOLD
TO Z-AXIS LUBRICATION
DISTRIBUTION MANIFOLD

TO BALL NUT,
SIZE: NO 5
(NOT SHOWN)

TO RIGHT BOTTOM
GUIDE BLOCK,
SIZE: NO 2

TO RIGHT TOP
GUIDE BLOCK,
SIZE: NO 2

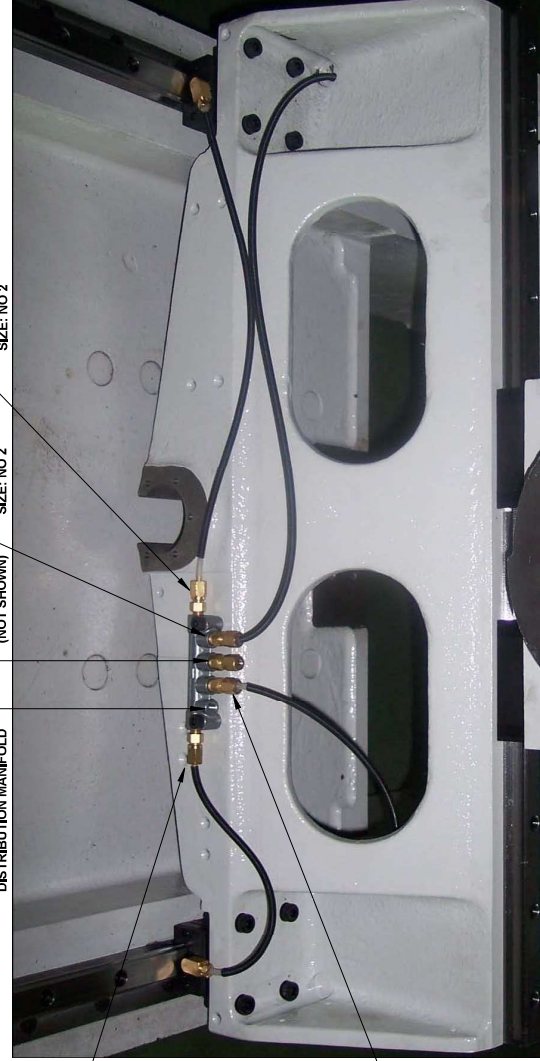
Z AXIS LUBRICATION DISTRIBUTION MANIFOLD FROM TOP OF MACHINE



FROM MAIN LUBRICATION
DISTRIBUTION MANIFOLD

TO LEFT TOP
GUIDE BLOCK,
SIZE: NO 2

TO LEFT BOTTOM
GUIDE BLOCK,
SIZE: NO 2



| REV | DESCRIPTION | DATE | BY | APPV |
|-----|----------------------------------|----------|---------|------|
| A | PRODUCTION RELEASE | 10/24/14 | TO | |
| B | SHEET 4 PICTORIALY ADDED 2689145 | 14361 | 2/13/15 | PM |

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| SOUTHWESTERN INDUSTRIES, INC. | | DATE | |
|-------------------------------|---------|----------|--|
| DESIGNER | Bob | 10/22/14 | |
| ENGINEER | TO | 10/22/14 | |
| DRAWN | Sal | 10/17/14 | |
| CHECKED | | | |
| APPROVED | | | |
| THIRD ANGLE PROJECTION | | | |
| SCALE | | | |
| PART CODE | 27591-1 | | |
| REV | B | | |

REVISIONS TO THIS DESIGN ARE TO BE INCLUDED IN THE RELEASE FOR THE NEXT REVISION. ANY REVISIONS TO THIS DESIGN ARE TO BE MADE BY A REPRESENTATIVE OF SOUTHWESTERN INDUSTRIES, INC. OR SOUTHWESTERN INDUSTRIES, INC. SOUTHWESTERN INDUSTRIES, INC. SOUTHWESTERN INDUSTRIES, INC.

SHEET 7 OF 7

27591-1

LUBRICATION SYSTEM-ZOP M11 MILL
 REFER TO 27591-KR XYZ

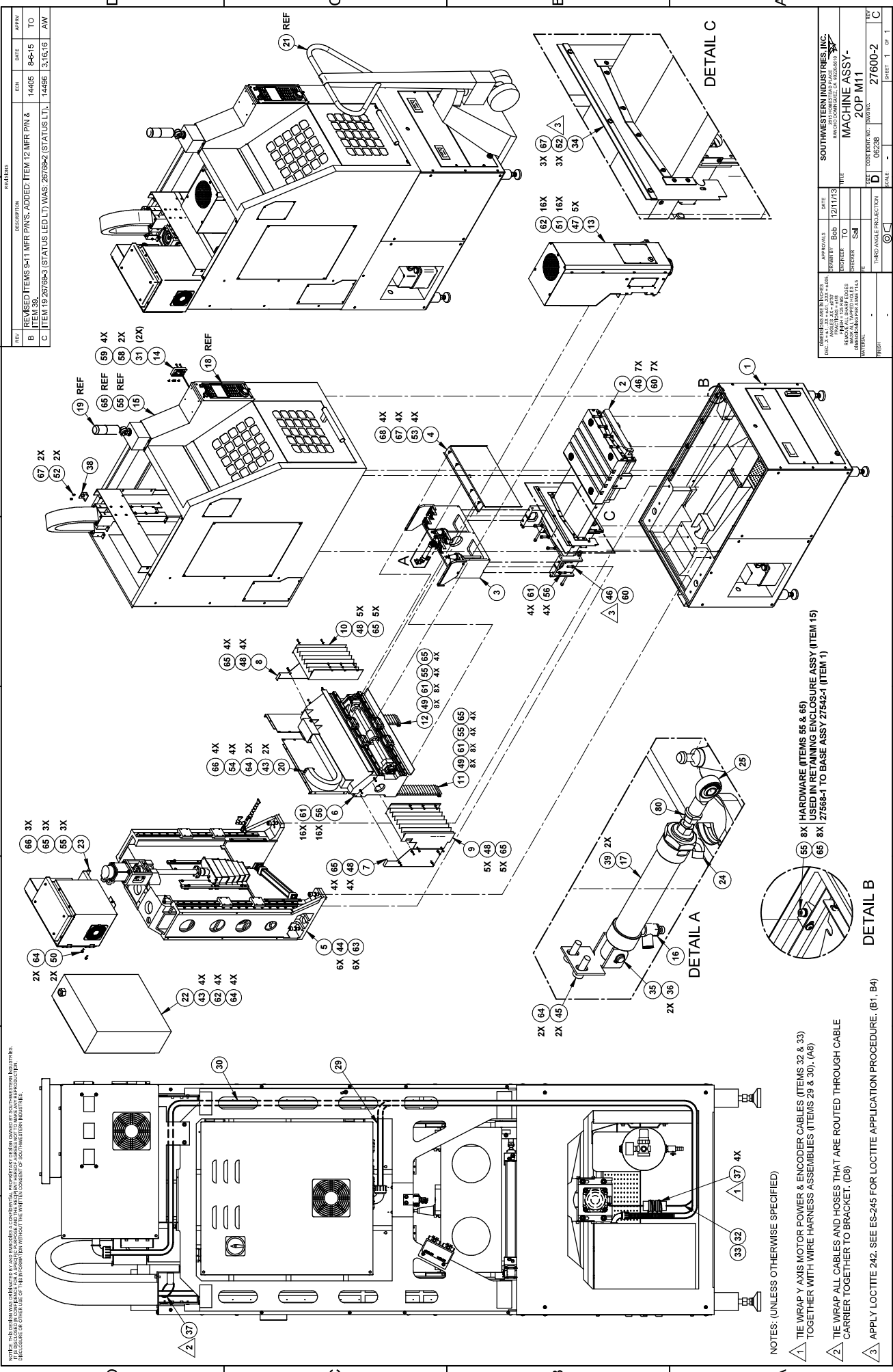
| | | | |
|----------|-----------|--------------|---------|
| Type | PL | Dwg Size | D |
| Revision | B | Product | 2OP M11 |
| Status | R | Engineer | TO |
| Date | 8/25/2014 | Planner Code | |
| By | Bob | Comm Code | |

| Item | P/N | Title | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------------|-------------------------------------------|-----|-------|-----|------|------|-----------|---------|
| 1 | 26718-1 | LUBE PUMP-115 VAC-W/ OIL LOW & OPRS SNSRS | 1 | EA | A | R | DWG | | |
| 2 | 28042-1 | MANIFOLD-TUBE FITTING-4 OUTLETS | 1 | EA | - | R | PS | KING RICH | |
| 3 | 28042-2 | MANIFOLD-TUBE FITTING-6 OUTLETS | 3 | EA | - | R | PS | KING RICH | |
| 4 | 27176-5 | CABLE ASSY-LUBE PUMP | (1) | EA | A | R | PL | | |
| 5 | 26979-2 | TUBING-PLASTIC-SOFT 2mm ID x 4mm OD | 767 | IN | - | R | PS | KING RICH | |
| 7 | 26972-2 | VALVE-CHECK/METER-SIZE 2 | 12 | EA | - | R | PS | KING RICH | |
| 8 | 26972-3 | VALVE-CHECK/METER-SIZE 5 | 3 | EA | - | R | PS | KING RICH | |
| 9 | 28048 | ELBOW-COMPRESSION FITTING | 3 | EA | - | R | PS | KING RICH | |
| 10 | 28046 | NUT-COMPRESSION-4mm-MANIFOLD | 22 | EA | - | R | PS | KING RICH | |
| 11 | 28046-1 | FITTING-COMPRESSION-4mm-MANIFOLD | 22 | EA | - | R | PS | KING RICH | |
| 12 | 28047 | SLEEVE-COMPRESSION-OUTER-4mm-MANIFOLD | 22 | EA | - | R | PS | KING RICH | |
| 13 | 28047-1 | SLEEVE-COMPRESSION-INNER-4mm-MANIFOLD | 22 | EA | - | R | PS | KING RICH | |
| 14 | M6-1.0X35 25B | SCREW-SHCS-STL-BO | (8) | EA | - | R | PS | | |
| 15 | M6 73B | WASHER-SPLIT LOCK-STL-BO | (8) | EA | - | R | PS | | |

| REV | DESCRIPTION | DATE | BY |
|-----|---------------------------------------------------------------|-------|---------|
| B | REVISED ITEMS 9-11 MFR PINS, ADDED ITEM 12 MFR PIN & ITEM 35. | 14/05 | 88-15 |
| C | ITEM 19 26768-3 (STATUS LED LIT) WAS 26768-2 (STATUS LIT). | 14/06 | 31.6.16 |

| REV | DESCRIPTION | DATE | BY |
|-----|---------------------------------------------------------------|-------|---------|
| B | REVISED ITEMS 9-11 MFR PINS, ADDED ITEM 12 MFR PIN & ITEM 35. | 14/05 | 88-15 |
| C | ITEM 19 26768-3 (STATUS LED LIT) WAS 26768-2 (STATUS LIT). | 14/06 | 31.6.16 |

NOTES: (UNLESS OTHERWISE SPECIFIED)
 1. TIE WRAP Y AXIS MOTOR POWER & ENCODER CABLES (ITEMS 32 & 33) TOGETHER WITH WIRE HARNESS ASSEMBLIES (ITEMS 29 & 30). (A8)
 2. TIE WRAP ALL CABLES AND HOSES THAT ARE ROUTED THROUGH CABLE CARRIER TOGETHER TO BRACKET. (D8)
 3. APPLY LOCITITE 242. SEE ES-245 FOR LOCITITE APPLICATION PROCEDURE. (61, B4)



| DATE | BY | TO |
|----------|-----|-----|
| 12/11/13 | Bob | Sal |

SOUTH WESTERN INDUSTRIES, INC.
 MANUFACTURING DEPARTMENT
 MACHINE ASSY -
 20P M11
 PART CODE BERT, INC. PART NO. 27600-2
 DEC 28 2013
 THIRD ANGLE PROJECTION
 SCALE 1 OF 1
 SHEET 1 OF 1

55 8X HARDWARE (ITEMS 55 & 65)
 USED IN RETAINING ENCLOSURE ASSY (ITEM 15)
 65 8X 27568-1 TO BASE ASSY 27542-1 (ITEM 1)

Parts List for Assembly P/N: 27600-2

Printed 4/20/2016

27600-2
MACHINE ASSY-2OP M11

| | | | |
|----------|------------|--------------|-----|
| Type | PL | Dwg Size | D |
| Revision | C | Product | 2OP |
| Status | R | Engineer | TO |
| Date | 11/19/2013 | Planner Code | |
| By | Bob | Comm Code | |

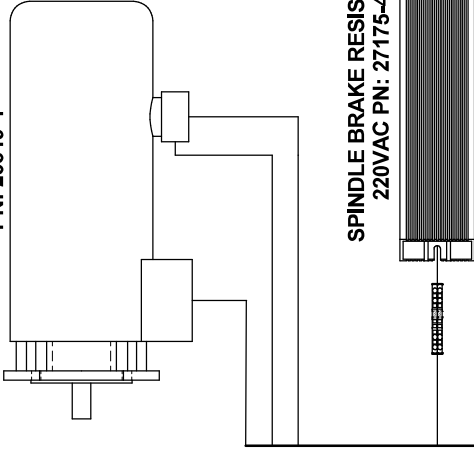
| Item | P/N | Title | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|----------|---------------------------------------|-----|-------|-----|------|------|-----------|-----------|
| 1 | 27542-1 | BASE FRAME ASSY-2OP M11 | 1 | EA | A | R | PL | | |
| 2 | 27564-1 | DRIVE TRAIN ASSY-Y AXIS-M11 | 1 | EA | E | R | PL | | |
| 3 | 27587-1 | ATC ASSY-2 OP M11 MILL | 1 | EA | A | R | PL | | |
| 4 | 27686 | DOOR ASSY-ATC CARRIAGE | 1 | EA | A | R | PL | | |
| 5 | 27540-1 | COLUMN ASSY-Z AXIS-M11 | 1 | EA | C | R | PL | | |
| 6 | 27520-1 | DRIVE TRAIN ASSY-X AXIS-M11 | 1 | EA | B | R | PL | | |
| 7 | 27603-19 | COVER-LEFT-X AXIS ASSY | 1 | EA | - | R | PS | KING RICH | |
| 8 | 27603-20 | COVER-RIGHT-X AXIS ASSY | 1 | EA | - | R | PS | KING RICH | |
| 9 | 27689-1 | BELLOW-LEFT-300mm H | 1 | EA | A | R | DWG | KING RICH | OP441010 |
| 10 | 27689-2 | BELLOW-RIGHT-300mm H | 1 | EA | A | R | DWG | KING RICH | OP441020 |
| 11 | 27689-3 | BELLOW-LEFT-70mm H | 1 | EA | A | R | DWG | KING RICH | OP443011 |
| 12 | 27689-4 | BELLOW-RIGHT-70mm H | 1 | EA | A | R | DWG | KING RICH | OP443021 |
| 13 | 27500-1 | SPINDLE HEAD ASSY-2OP M11 | 1 | EA | B | R | PL | | |
| 14 | 28031 | COVER-USB CONNECTOR-2 OP MILL & LATHE | 1 | EA | - | R | DWG | | |
| 15 | 27568-1 | ENCLOSURE ASSY-2OP M11 MILL | 1 | EA | D | R | PL | | |
| 16 | 28071 | VALVE-FLOW CONTROL-AIR | 1 | EA | - | R | PS | KING RICH | A-572-001 |
| 17 | 27583-5 | CYLINDER-AIR-20mm BORE X 60mm S | 1 | EA | - | R | DWG | | |
| 18 | 28160 | PANEL ASSY-2 OP M11 MILL | (1) | EA | B | R | PL | | |

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|------------------|--------------------------------------------|--------------------------------------------------------------------|-----|-------|-----|------|------|-----------|-----------|
| 19 | 26768-3 | STATUS LIGHT LED ASSY-2OP | THERE ARE NO REPLACEMENT PARTS IN CASE OF FAILURE REPL ENTIRE ASSY | (1) | EA | A | R | PL | KING RICH | A-141-082 |
| 20 | 26891-4 | CARRIER-CABLE-X AXIS | | 1 | EA | - | R | PS | KING RICH | A-85-183 |
| 21 | 27724 | PALLET JACK-2 OP MILL | | (1) | EA | A | R | DWG | | |
| 22 | 27621-2 | ENCLOSURE ASSY-ELEC-2OP M11 MILL | | 1 | EA | C | R | PL | | |
| 23 | 28156 | ENCL ASSY-SERVO DRIVES-2OP M11 MILL | | 1 | EA | A | R | PL | | |
| 24 | 24673-2 | ELBOW-1/8 BSPT TO 6mm QUICK CONNECT | | 1 | EA | - | R | PS | | |
| 25 | 27583-7 | ROD END-BALL JOINT-8MM ID | SEE 27600-2 OR 27600-5 | 1 | EA | A | R | PS | | |
| 29 | 27547-1 | WIRE HARNESS ASSY-7 COND-ELEC CAB TO TRX | | 1 | EA | C | R | PL | | |
| 30 | 27547-2 | WIRE HARNESS ASSY-3 COND-TRX TO DRIVE | DC300-309C | 1 | EA | C | R | PL | | |
| 31 | 27657-1 | CABLE ASSY-USB-MALE-A TO FEMALE-A-PANEL MT | 3 METER LENGTH | (2) | EA | A | R | PS | | |
| 32 | 26840-5 | CABLE ASSY-MOTOR POWER-DELTA-Y AXIS | DC300-133_3.2M | 1 | EA | C | R | PL | | |
| 33 | 26844-5 | CABLE ASSY-MOTOR ENCODER-DELTA-Y AXIS | | 1 | EA | B | R | PL | | |
| 34 | 27682 | COVER ASSY-TOOL -2OP | | 1 | EA | A | R | PL | | |
| 35 | 28087 | PIN-PIVOT-ATC DOOR ASSIST CYLINDER | | 1 | EA | - | R | DWG | | |
| 36 | 24768-1 | RETAINING RING-EXTERNAL-7mm | NON STOCKABLE | 2 | EA | - | R | PS | MCMASTE R | 98541A115 |
| 37 | 22475 | TIE WRAP-4 IN-PLASTIC | | 5 | EA | - | R | DWG | | |
| 38 | 28178 | BRACKET-MOUNTING-ETHERNET CABLE | | 1 | EA | A | R | DWG | | |
| 39 | 27745-1 | COUPLING-Y-6mm PUSH TO CONNECT | SEE 27563 | 2 | EA | - | R | PS | KING RICH | |
| 43 | M6-1.0X12 27B | SCREW-BHCS-STL-BO | | 6 | EA | | R | PS | | |
| 44 | M16-2.0 X 50 25B | SCREW-SHCS-STL-BO | NON STOCKABLE | 6 | EA | - | R | PS | | |
| 45 | M6-1.0X16 25B | SCREW-SHCS-STL-BO | | 2 | EA | - | R | PS | | |

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|----------------------|---------------------------------------|---------------|-----|-------|-----|------|------|-----|---------|
| 46 | M10-1.5X35 25B | SCREW-SHCS-STL-BO | | 8 | EA | | R | PS | | |
| 47 | M5-0.8X16 25B | SCREW-SHCS-STL-BO | | 5 | EA | A | R | PS | | |
| 48 | M5-0.8X8 27B | SCREW-BHCS-STL-BO | | 18 | EA | - | R | PS | | |
| 49 | M8-1.25X35 25B | SCREW-SHCS-STL-BO | | 16 | EA | | R | PS | | |
| 50 | M6-1.0X12 25B | SCREW-SHCS-STL-BO | | 2 | EA | | R | PS | | |
| 51 | M6-1.0X25 25B | SCREW-SHCS-STL-BO | | 16 | EA | | R | PS | | |
| 52 | M5-0.8X12 27Z | SCREW-BHCS-STL-ZINC | | 5 | EA | | R | PS | | |
| 53 | M5-0.8X12 25Z | SCREW-SHCS-STL-ZINC | NON-STOCKABLE | 4 | EA | - | R | PS | | |
| 54 | M5-0.8X10 25B | SCREW-SHCS-STL-BO | | 4 | EA | - | R | PS | | |
| 55 | M5-0.8X12 25B | SCREW-SHCS-STL-BO | | 19 | EA | - | R | PS | | |
| 56 | M8-1.25X25 25B | SCREW-SHCS-STL-BO | | 20 | EA | | R | PS | | |
| 58 | M4-0.7X20 25B | SCREW-SHCS-STL-BO | | 2 | EA | | R | PS | | |
| 59 | 4-40X3/8 31B | SCREW-PH-PHIL-EXT SEMS-STL-BO | | 4 | EA | | R | PS | | |
| 60 | M10 73B | WASHER-SPLIT LOCK-STL-BO | | 8 | EA | - | R | PS | | |
| 61 | M8 73B | WASHER-SPLIT LOCK-STL-BO | | 36 | EA | | R | PS | | |
| 62 | M6 73B | WASHER-SPLIT LOCK-STL-BO | | 20 | EA | - | R | PS | | |
| 63 | M16 WASHER FINISH | WASHER-FINISH-Ø35 OD x Ø17 ID x 6mm H | NON STOCKABLE | 6 | EA | - | R | PS | | |
| 64 | M6 78B | WASHER-FLAT-DIN 125-BO | NON-STOCKABLE | 13 | EA | | R | PS | | |
| 65 | M5 73B | WASHER-SPLIT LOCK-STL-BO | | 37 | EA | - | R | PS | | |
| 66 | M5 78B | WASHER-FLAT-DIN 125-BO | NON-STOCKABLE | 9 | EA | | R | PS | | |
| 67 | M5 78Z | WASHER-FLAT-DIN 125-ZINC | NON-STOCKABLE | 9 | EA | - | R | PS | | |
| 68 | M5 73Z | WASHER-SPLIT LOCK-STL-ZINC | NON-STOCKABLE | 4 | EA | - | R | PS | | |
| 80 | M8-1.25 51Z | NUT-JAM HEX-STL-ZINC | NON-STOCKABLE | 1 | EA | - | R | PS | | |

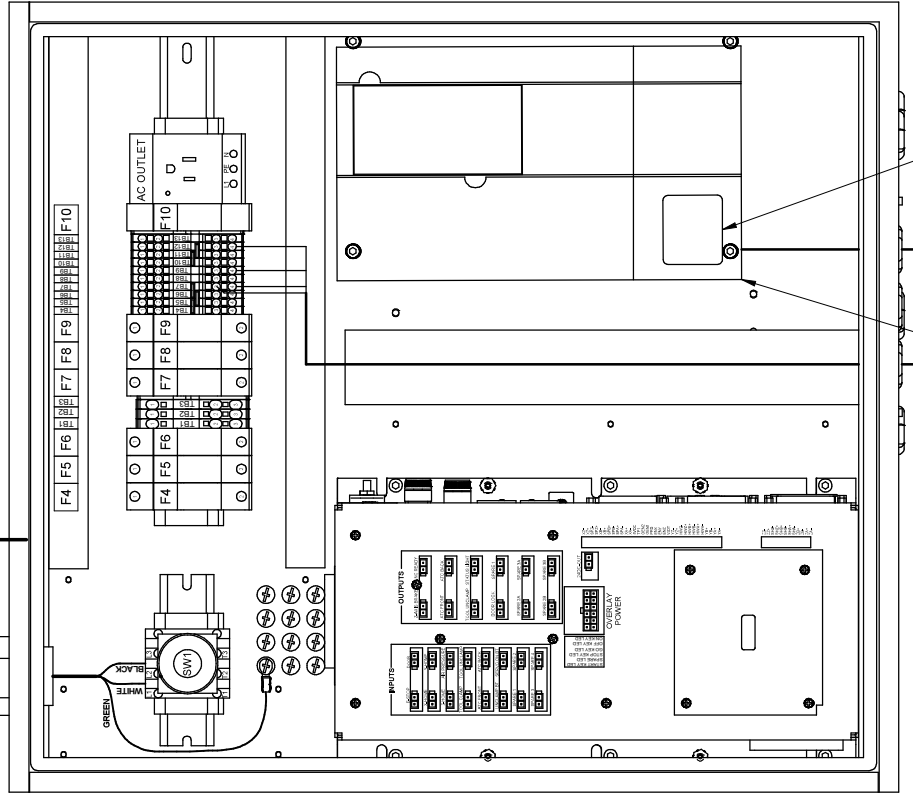
| REV | DESCRIPTION | DATE | BY | CHK | APP |
|-----|--------------------------------------|-------|----------|-----|-----|
| A | PRODUCTION RELEASE | 14283 | 10/24/14 | CL | RO |
| B | ADDED ITEM 14. ITEM 15 WAS: ITEM 11. | 14721 | 04/16/18 | SJ | RC |

SPINDLE MOTOR
PN: 26849-4



SPINDLE BRAKE RESISTOR
220VAC PN: 27175-4

| Parameter Difference Δ | |
|-------------------------------|-------------------------|
| Parameter | 3 Phase Single Phase |
| 06-03 | 220VAC PN: 28161 170 90 |
| 06-04 | 170 90 |
| 06-12 | 150 90 |
| 07-09 | 150 90 |



REF 3 Δ 4 / 1

NOTES: UNLESS OTHERWISE SPECIFIED.

Δ REMOVE EXISTING 220VAC 3 PHASE LABEL & APPLY 220VAC SINGLE PHASE LABEL (ITEM 4) AFTER MANUALLY CHANGING PARAMETERS DESCRIBED IN TABLE OR BY DOWNLOADING SINGLE PHASE PARAMETERS FROM LAPTOP (A5 & D1).

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| | | | |
|-------------------------------|--|------------------------|---------|
| SOUTHWESTERN INDUSTRIES, INC. | | DATE | 9/11/14 |
| MANUFACTURING DEPARTMENT | | APPROVALS | Chris |
| 10000 W. CENTRAL EXPRESSWAY | | DESIGNED BY | RO |
| MESA, AZ 85205 | | ENGINEER | Bob |
| TEL: 480.988.1234 | | DESIGNED BY | Bob |
| FAX: 480.988.1234 | | THIRD ANGLE PROJECTION | |
| WWW.SI.COM | | SCALE | 1:1 |
| SHEET NO. 27605-1 | | SHEET 1 OF 1 | |

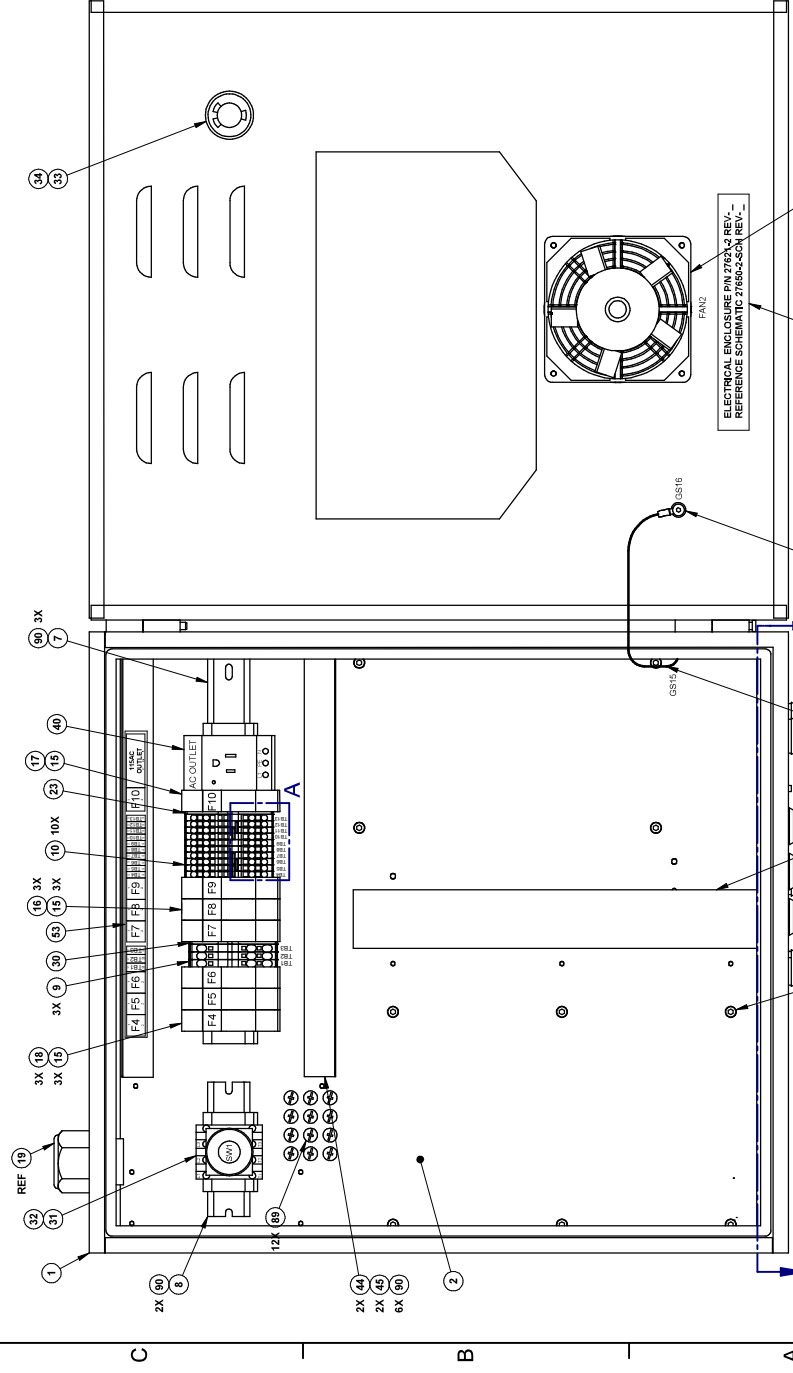
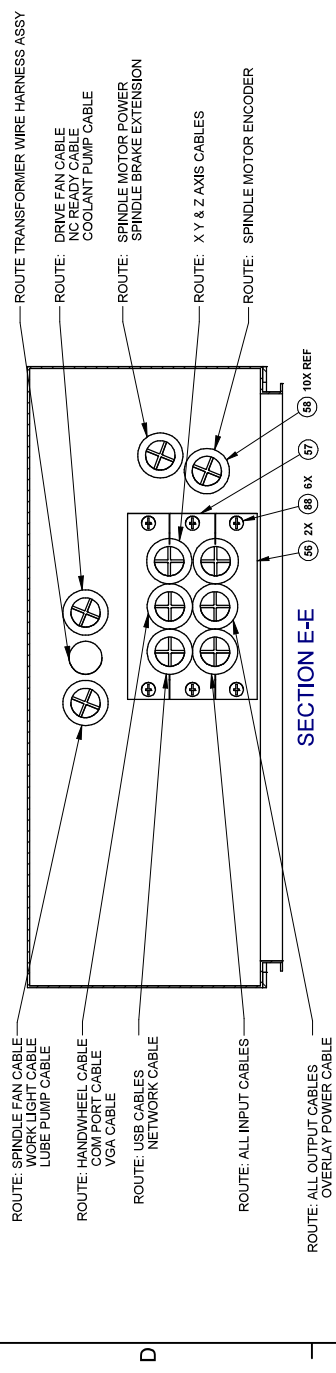
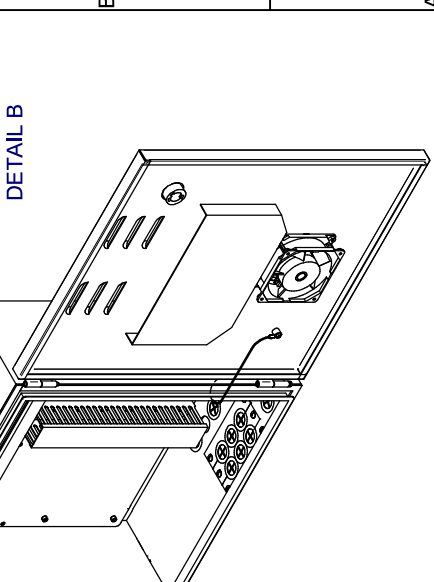
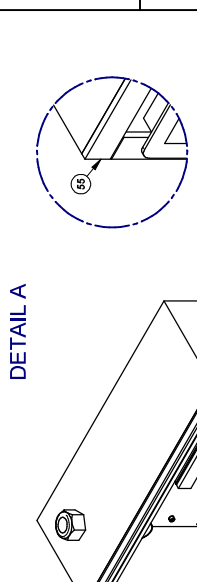
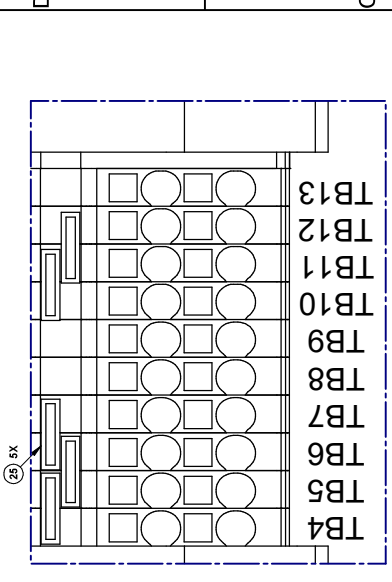
27605-1

KIT-CONVERSION-SINGLE PHASE
OPTION-220V-2OP M11

| | | | |
|----------|-----------|--------------|---------|
| Type | PL | Dwg Size | D |
| Revision | B | Product | 2OP M11 |
| Status | R | Engineer | RO |
| Date | 5/23/2014 | Planner Code | |
| By | | Comm Code | |

| Item | P/N | Title | Detail | Reference | Qty | UseA | Rev | Stat | Type | Mfr | Mfr P/N |
|------|-------------|-----------------------------------------------------------|---------------------------|-----------|------|------|-----|------|------|-----|---------|
| 1 | 21490-3 | POWER CORD-SINGLE PHASE-220V-2 OP | 126" | | 1 | EA | A | R | PL | | |
| 2 | 27648-2 | SYSTEM DIAGRAM-2 OP M11 MILL-USA | | | (1) | EA | D | R | DWG | | |
| 3 | 28161-2 | AC DRIVE ASSY-3HP-220 VAC-SINGLE PHASE PROGRAMMED-2OP M11 | | | (1) | EA | C | R | PL | | |
| 4 | 28161-2-LB1 | LABEL-AC DRIVE-3 HP-220VAC-SINGLE PHASE-PROGRAMMED | | | 1 | EA | A | R | DWG | | |
| 5 | 21490-4 | POWER CORD ASSY-SINGLE PHASE ADAPTER-220V | 12" | | 1 | EA | A | R | PL | | |
| 10 | 21490-1 | POWER CORD-3 PHASE-220V-2 OP | 126" | | (-1) | EA | - | R | PL | | |
| 14 | 21214-1 | NAMEPLATE-SERIAL NUMBER | | | 1 | EA | C | R | PL | | |
| 15 | 21214-56 | NAMEPLATE-S/N-2OP-M11-MILL-220V-SIN GLE PHASE | SEE 21214-1 WHEN UPDATING | | (1) | EA | C | R | DWG | | |

| REV. | DESCRIPTION | DATE | BY | APPV. |
|------|-------------------------------------------------------------|-------|----------|-------|
| B | REVISED ITEMS 16-18 WAS: 23152-16, 23152-4, 23152-25, (2C2) | 14/01 | 10/23/15 | RO |
| C | ITEMS 16, 17, 38 WAS: 23152-16, 23152-4, 26708, ITEM 53 | 14/08 | 8-2-15 | RO |
| D | REVISED TO REV. B. | 14/02 | 3-15-17 | RO |
| | ITEM 58 WAS: 26773-4. | | | |



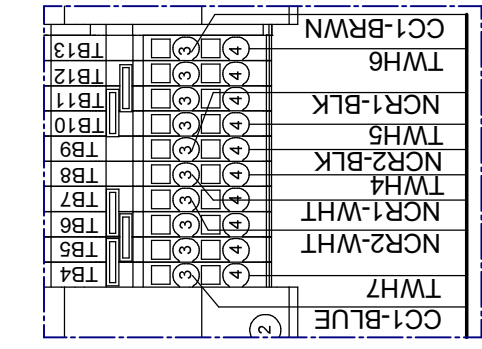
SEE SEPARATE "A" SIZE SHEET FOR PARTS LIST

| REV. | DATE | BY | APPV. |
|------|----------|-----|-------|
| D | 05/23/14 | Sal | RO |
| | 12/20/13 | Bob | RO |
| | 12/13/13 | Bob | RO |

SOUTHWESTERN INDUSTRIES, INC.
 MANUFACTURING DEPARTMENT
 ENCL-20P M11 MILL
 PART CODE REF. NO.: 27621-2
 DRAWING NO.: 06238
 SHEET 1 OF 3

NOTES: (UNLESS OTHERWISE SPECIFIED),
 LABEL TO HAVE CURRENT REVISIONS OF DRAWINGS INDICATED.
 APPLY A SLEEVE LABEL (ITEMS 73-85) TO BOTH ENDS OF EACH WIRE.
 USE WIRE CHART FOR REFERENCE. (2D3, 3C3)

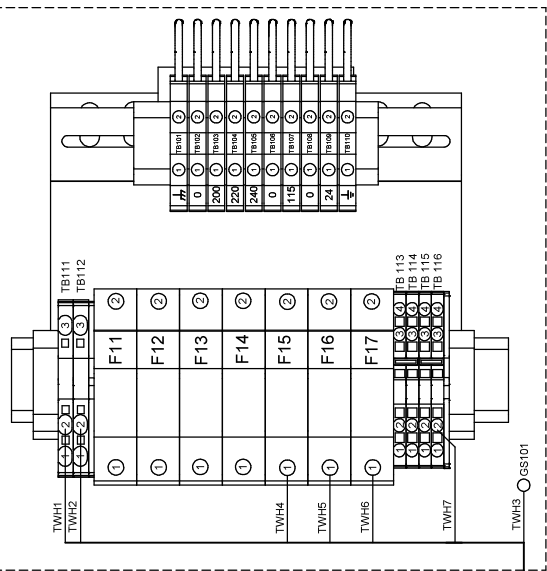
1 2 3 4 5 6 7 8



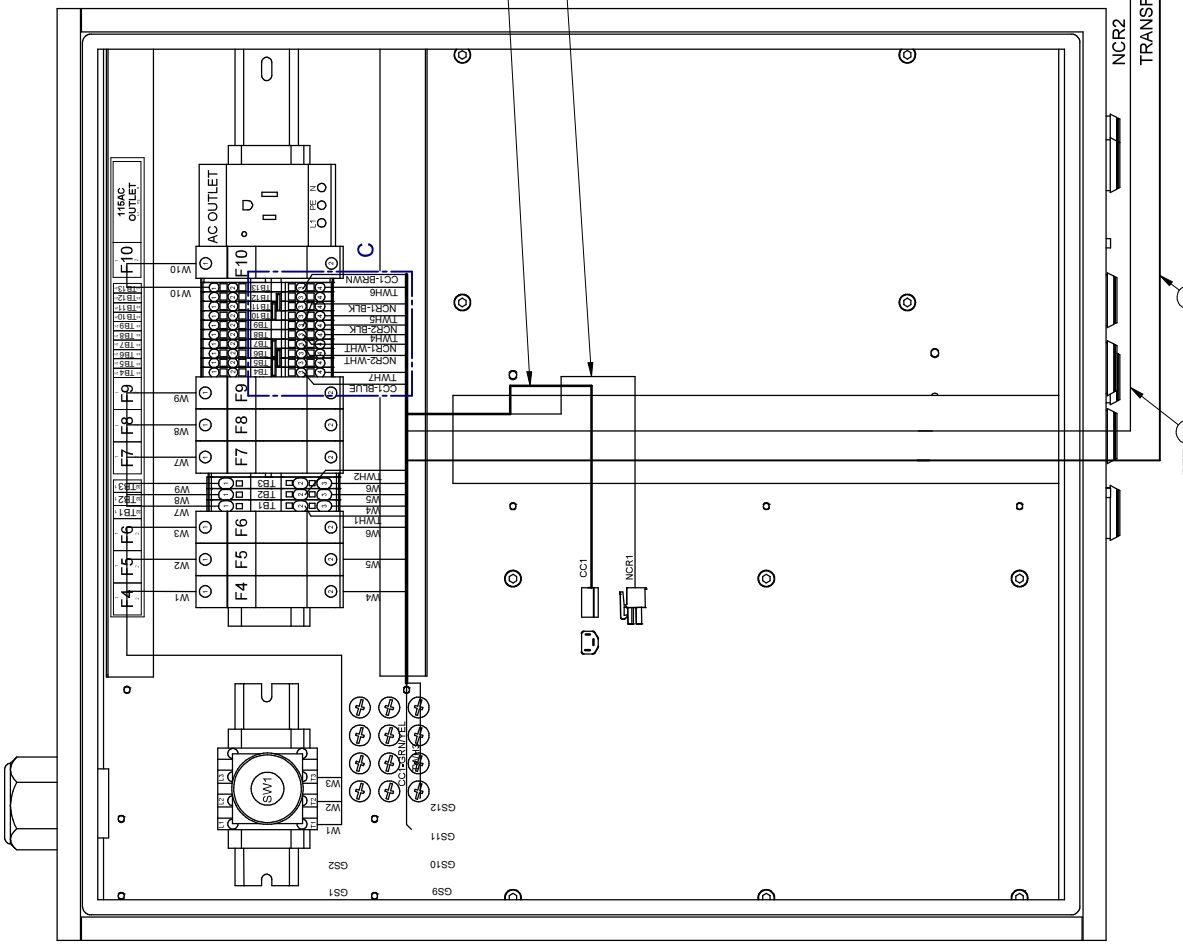
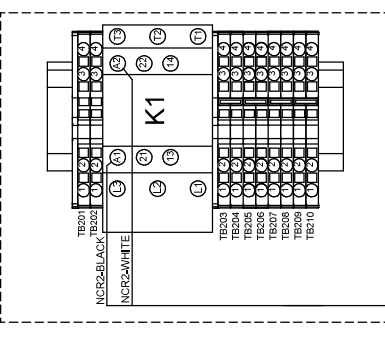
| WIRE CHART | | | | | |
|--------------------|-----------|-----------|--------------------|-------|---------|
| WIRE/ CABLE NUMBER | WIRE FROM | WIRE GAGE | LENGTH | COLOR | WIRE TO |
| W1 | SW1-T1 | L1-2 | 5.5mm ² | BLACK | F4-1 |
| W2 | SW1-T2 | L1-2 | 5.5mm ² | BLACK | F4-1 |
| W3 | SW1-T3 | L1-2 | 5.5mm ² | BLACK | F4-1 |
| W4 | SW1-T3 | L1-3 | 5.5mm ² | BLACK | TB1-3 |
| W5 | F4-2 | L1-3 | 5.5mm ² | BLACK | TB2-3 |
| W6 | F4-2 | L2-3 | 5.5mm ² | BLACK | TB3-3 |
| W7 | TB1-1 | L1-3 | 5.5mm ² | BLACK | F4-1 |
| W8 | TB2-1 | L1-3 | 5.5mm ² | BLACK | F4-1 |
| W9 | TB3-1 | L1-3 | 5.5mm ² | BLACK | F4-1 |
| W10 | TB13-1 | L15AC-1 | 2mm ² | BLACK | F23-1 |

| CABLE CHART | | | | | |
|--------------------------------|-----------|-----------|--------------------|----------------------------|--------|
| WIRE/ CABLE NUMBER | WIRE FROM | WIRE GAGE | COLOR | WIRE TO | |
| COMPUTER CABLE (CC1) | GS-11 | GND | GREEN/ YELLOW | COMPUTER MODULE | |
| NC READY TO COMPUTER (NCR1) | TB4-3 | 115AC-1 | BROWN | COMPUTER MODULE (NC READY) | |
| | TB8-3 | 24AC-1 | WHITE | COMPUTER MODULE (NC READY) | |
| | TB9-3 | 24AC-2 | BLACK | COMPUTER MODULE (NC READY) | |
| NC READY EXTENSION (NCR2) | TB7-3 | 0V | WHITE | K1-A2 | |
| | TB9-4 | 24AC-2 | BLACK | K1-A1 | |
| TRANSFORMER WIRE HARNESS (TWH) | TB11-2 | L1-3 | 5.5mm ² | BLACK | TB11-2 |
| | TB12-2 | L2-3 | 5.5mm ² | BLACK | TB12-2 |
| | TB13-2 | L3-3 | 5.5mm ² | GREEN | GS101 |
| | GS12 | 24AC1 | 2mm ² | BLACK | F18-1 |
| | GS13 | 24AC2 | 2mm ² | BLACK | F18-1 |
| | GS14 | 115AC-1 | 2mm ² | BLACK | F18-1 |
| TRANSFORMER WIRE HARNESS (TWH) | TB13-4 | 115AC-1 | 2mm ² | BLACK | F18-1 |
| | TB4-4 | 0V | 2mm ² | WHITE | TB11-2 |

TRANSFORMER ASSY
P/N 28152-1



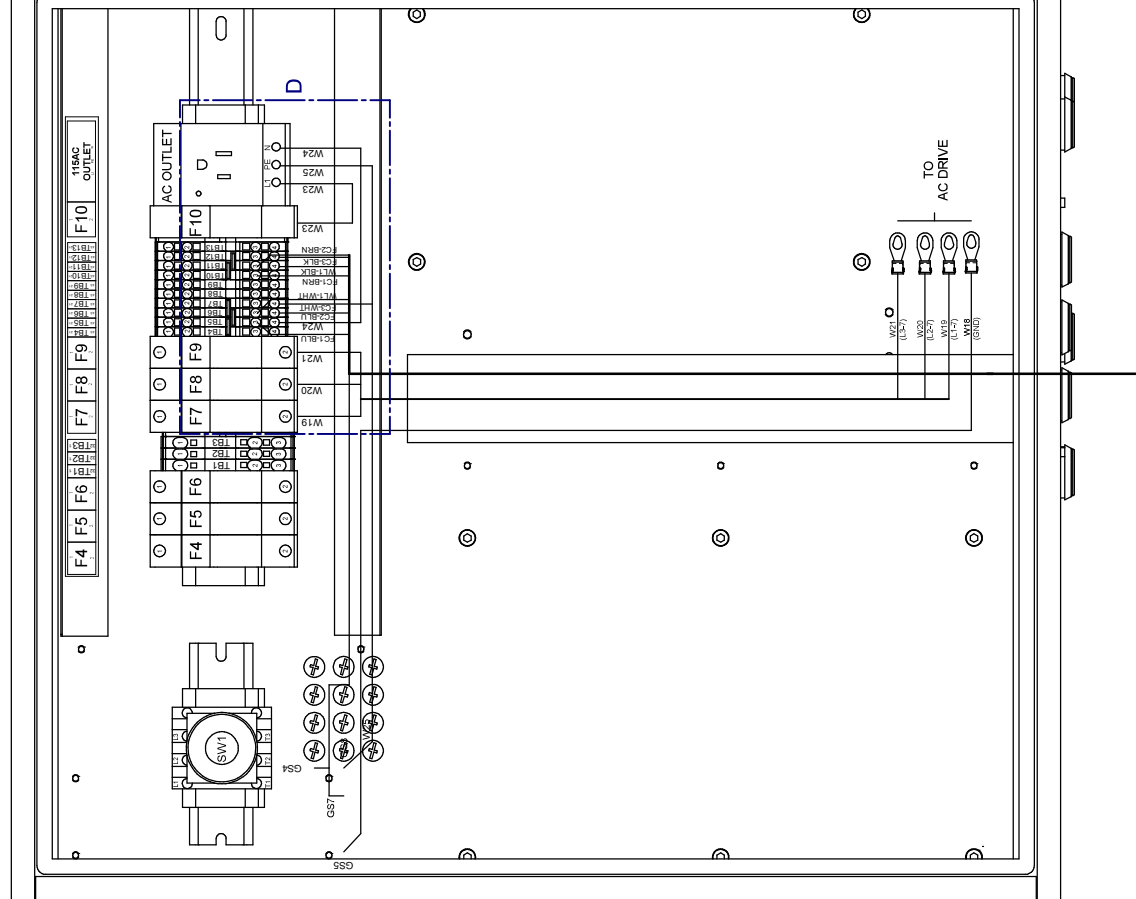
ENCLOSURE ASSY-SERVO
DRIVES P/N 28156



ENCLOSURE ASSY P/N 27568-1

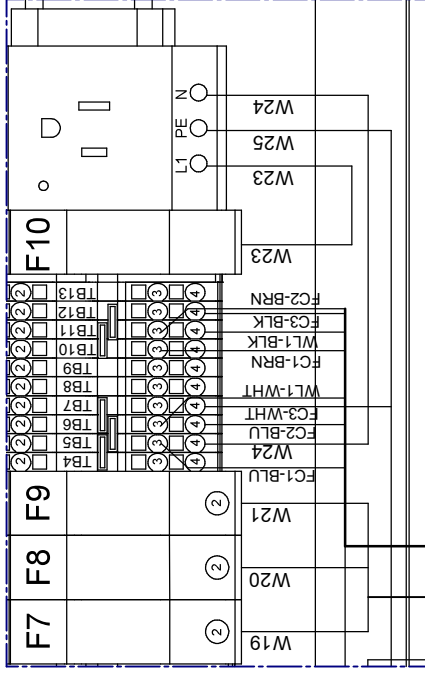
WORKLIGHT
26769-1

WLT-BLK (119AC-2)
WLT-WHT (BY)



64 REF

WORK LIGHT CABLE EXTENSION

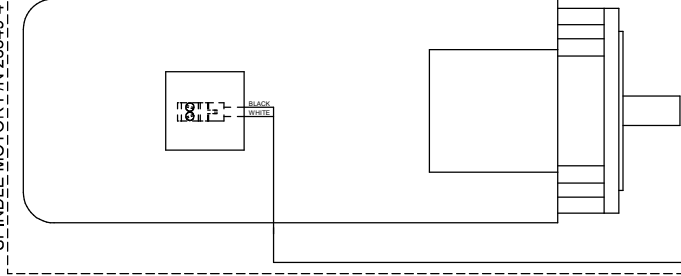


DETAIL D

| WIRE/ CABLE | ITEM NUMBER | WIRE FROM LABEL | WIRE TO LABEL | WIRE GAUGE | LENGTH | COLOR | WIRE TO |
|-------------|-------------|-----------------|--------------------|--------------------|---------|-------|--------------|
| W18 | 69 | GSS | L1-7 | 3.5mm ² | 760mm | GREEN | VFD-GND |
| W19 | 70 | FZ-2 | L1-7 | 3.5mm ² | 745mm | BLACK | VFD-L1 |
| W20 | 70 | FZ-2 | L3-7 | 3.5mm ² | 745mm | BLACK | VFD-L2 |
| W21 | 70 | FZ-2 | L3-7 | 3.5mm ² | 745mm | BLACK | VFD-L3 |
| W22 | 68 | FDC-2 | 2mm | 2mm | 130mm | BLACK | AC-OUTLET-L1 |
| W23 | 71 | GS2 | 2mm | 2mm | 230mm | WHITE | AC-OUTLET-R |
| W24 | 71 | GS2 | 2mm | 2mm | 230mm | WHITE | AC-OUTLET-R |
| W26 | 73 | GS1B | 3.5mm ² | 300mm | GRN/YEL | SS-1B | |

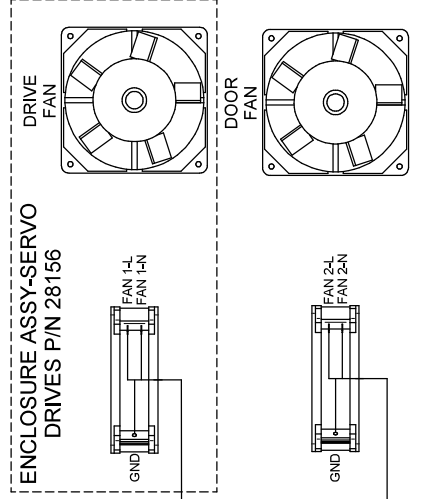
| WIRE/ CABLE | ITEM NUMBER | WIRE FROM LABEL | WIRE TO LABEL | WIRE GAUGE | COLOR | WIRE TO |
|-------------------------|-------------|-----------------|---------------|---------------------|---------|-------------|
| DRIVE FAN CABLE 1 (FC1) | 63 | TS-C3 | TS-C2 | 0.75mm ² | BLUE | FAN 1-N |
| | | GS7 | GND | 0.75mm ² | GRN/YEL | FAN 1-G |
| | | TS-B4 | 0V | 0.75mm ² | BLUE | FAN 2-N |
| DOOR FAN CABLE 2 (FC2) | 38 | TS-L3 | TS-L2 | 0.75mm ² | BROWN | FAN 2-L |
| | | GS4 | GND | 0.75mm ² | GRN/YEL | FAN 2-G |
| WORK LIGHT CABLE (WLT) | 64 | TS-L4 | 0V | 0.75mm ² | WHITE | LSHT-10V |
| SPINDLE FAN CABLE (FC3) | 65 | TS-L4 | TS-L2 | 0.75mm ² | BLACK | LSHT-15AC |
| | | TS-L4 | 0V | 0.75mm ² | WHITE | SPINDLE FAN |
| | | TS-L4 | TS-L2 | 0.75mm ² | BLACK | SPINDLE FAN |

SPINDLE MOTOR P/N 26849-4



65 REF

ENCLOSURE ASSY-SERVO
DRIVES P/N 28156



63 REF

38

27621-2

ENCLOSURE ASSY-ELEC-2OP M11 MILL

| | | | |
|----------|------------|--------------|----------|
| Type | PL | Dwg Size | D |
| Revision | D | Product | 2 OP M11 |
| Status | R | Engineer | RO |
| Date | 12/13/2013 | Planner Code | |
| By | Bob | Comm Code | |

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type |
|------|------------|--------------------------------------|---------|-----|-------|-----|------|------|
| 1 | 27620 | SHEET METAL-ELEC ENCLOSURE-2 OP MILL | | 1 | EA | B | R | DWG |
| 2 | 27620-1 | SHEET METAL-BACK PANEL | | 1 | EA | B | R | DWG |
| 7 | 26589-0320 | RAIL-DIN-SLOTTED | 320mm | 1 | EA | A | R | DWG |
| 8 | 26589-0110 | RAIL-DIN-SLOTTED | 110mm | 1 | EA | A | R | DWG |
| 9 | 22557-8 | TERMINAL BLOCK-DIN RAIL-3 POS | | 3 | EA | - | R | DWG |
| 10 | 22557-10 | TERMINAL BLOCK-DIN RAIL-4POS | | 10 | EA | - | R | DWG |
| 15 | 23036-1 | FUSE HOLDER-32 AMP-690V | | 7 | EA | B | R | DWG |
| 16 | 23152-16 | FUSE-TIME DELAY-500 V-10mm x 38mm L | 16 AMPS | 3 | EA | B | R | DWG |
| 17 | 23152-4 | FUSE-TIME DELAY-500 V-10mm x 38mm L | 4 AMPS | 1 | EA | B | R | DWG |
| 18 | 23153-30 | FUSE-TIME DELAY-600 VAC-CLASS CC | 30 AMPS | 3 | EA | B | R | DWG |
| 19 | 24211-1 | FITTING-LIQUID TIGHT-PG29 | | (1) | EA | - | R | DWG |
| 23 | 22557-9-C1 | TERMINAL BLOCK-COVER-4 POS | | 1 | EA | - | R | DWG |
| 25 | 22557-9-J1 | TERMINAL BLOCK- JUMPER | | 5 | EA | - | R | DWG |
| 26 | 23095-1 | TERMINAL BLOCK-RAIL END STOP | | 4 | EA | - | R | DWG |
| 30 | 22557-8-C1 | TERMINAL BLOCK-COVER-3 POS | | 1 | EA | - | R | DWG |
| 31 | 24182-2 | SWITCH-BODY-3 PHASE-25A | | 1 | EA | - | R | DWG |
| 32 | 24210-2 | SWITCH-ROD-SHAFT EXTENSION | | 1 | EA | - | R | DWG |
| 33 | 27549-2 | SWITCH-DOOR-INTERLOCK | | 1 | EA | - | R | DWG |
| 34 | 24183-2 | SWITCH-DISCONNECT-HANDLE-3 PHASE | | 1 | EA | - | R | DWG |
| 35 | 26564-1 | FAN-115 VAC | | 1 | EA | - | R | DWG |
| 36 | 26708-2 | FILTER GUARD-PLASTIC-120mm | | 1 | EA | A | R | DWG |

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type |
|------|-------------------|--------------------------------------------------------------|------------|------|-------|-----|------|------|
| 37 | 26708-1 | FAN GUARD-120 mm | | 1 | EA | - | R | DWG |
| 38 | 27176-2 | CABLE ASSY-DOOR FAN | DC300-122 | 1 | EA | A | R | PL |
| 39 | 26592-1 | CABLE ASSY-COMPUTER MODULE POWER-2OP | | 1 | EA | A | R | PL |
| 40 | 27548 | AC OUTLET-115VAC-WITHOUT FUSE | | 1 | EA | - | R | DWG |
| 44 | 27153-0362 | WIREWY-GRAY-5mm SLOT-45mm x 63mm | | 2 | EA | - | R | PS |
| 45 | 27154-0362 | WIREWY-COVER-GRAY-48mm x 330mm | | 2 | EA | - | R | PS |
| 48 | 27155-0330 | WIREWY-GRAY-5mm SLOT-22mm x 63mm | 330mm | 1 | EA | A | R | DWG |
| 49 | 27156-0330 | COVER-WIREWAY-GRAY-25mm x 8mm | 330mm | 1 | EA | A | R | DWG |
| 53 | 27621-2-LB1 | LABEL-TEXT-F4-F10, TB1-TB13 | | 1 | EA | B | R | PS |
| 54 | 27621-2-LB2 | LABEL-TEXT-ELEC ENCLOSURE-27621-2 | | 1 | EA | B | R | PS |
| 55 | 27669-1 | GASKET-BEZEL-ROLL | | 2104 | MM | - | R | DWG |
| 56 | 28157 | SHEET METAL-CABLE ENTRY-OUTSIDE | | 2 | EA | B | R | DWG |
| 57 | 28157-1 | SHEET METAL-CABLE ENTRY-INSIDE | | 1 | EA | B | R | DWG |
| 58 | 26779-5 | GROMMET-28mm HOLE | | (10) | EA | A | R | DWG |
| 60 | 27547-1 | WIRE HARNESS ASSY-7 COND-ELEC CAB TO TRX | | (1) | EA | C | R | PL |
| 61 | 27635-17 | CABLE ASSY-NC READY TO COMPUTER | DC300-206 | 1 | EA | B | R | PL |
| 62 | 27635-18 | CABLE ASSY-NC READY EXTENSION | DC300-207 | (1) | EA | B | R | PL |
| 63 | 27176-4 | CABLE ASSY-DRIVE FAN | DC300-211 | (1) | EA | B | R | PL |
| 64 | 27635-15 | CABLE ASSY-WORK LIGHT EXTENSION | DC300-116 | (1) | EA | - | R | PL |
| 65 | 26514-1 | CABLE ASSY-SPINDLE MOTOR FAN | DC300-103A | (1) | EA | A | R | PL |
| 66 | 26555-101414-0280 | WIRE ASSY-5.5mm ² -BLACK-FERRULE TO FERRULE-280mm | | 3 | EA | - | R | DWG |
| 67 | 26555-101414-0170 | WIRE ASSY-5.5mm ² -BLACK-FERRULE TO FERRULE-170mm | | 6 | EA | - | R | DWG |
| 68 | 26555-081313-0130 | WIRE ASSY-2mm ² -BLACK-FERRULE TO FERRULE-130mm | | 2 | EA | - | R | DWG |

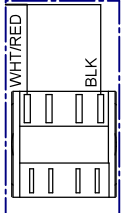
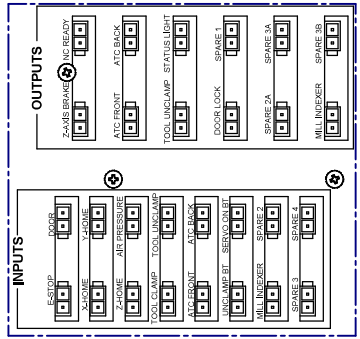
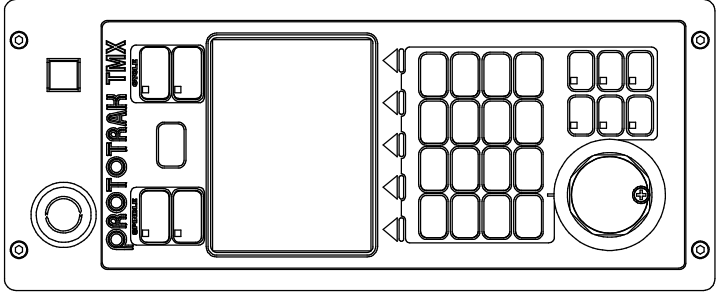
| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type |
|------|-------------------|----------------------------------------------------------------|---------------|-----|-------|-----|------|------|
| 69 | 26555-A12222-0760 | WIRE ASSY-5.5mm ² -GREEN/YELLOW-RING TO RING-760mm | | 1 | EA | - | R | DWG |
| 70 | 26555-091427-0745 | WIRE ASSY-3.5mm ² -BLACK-FERRULE TO RING-745mm | | 3 | EA | - | R | DWG |
| 71 | 26555-381313-0230 | WIRE ASSY-2mm ² -WHITE-FERRULE TO FERRULE-230mm | | 1 | EA | - | R | DWG |
| 72 | 26555-982113-0350 | WIRE ASSY-2mm ² -GREEN/YELLOW-RING TO FERRULE-350mm | | 1 | EA | - | R | DWG |
| 73 | 26555-992121-0300 | WIRE ASSY-3.5mm ² -GREEN/YELLOW-RING TO RING-300mm | | 1 | EA | - | R | DWG |
| 74 | 27734-L1-2 | LABEL-TEXT-WIRE SLEEVE | L1-2 | 2 | EA | C | R | DWG |
| 75 | 27734-L2-2 | LABEL-TEXT-WIRE SLEEVE | L2-2 | 2 | EA | C | R | DWG |
| 76 | 27734-L3-2 | LABEL-TEXT-WIRE SLEEVE | L3-2 | 2 | EA | C | R | DWG |
| 77 | 27734-L1-3 | LABEL-TEXT-WIRE SLEEVE | L1-3 | 6 | EA | C | R | DWG |
| 78 | 27734-L2-3 | LABEL-TEXT-WIRE SLEEVE | L2-3 | 6 | EA | C | R | DWG |
| 79 | 27734-L3-3 | LABEL-TEXT-WIRE SLEEVE | L3-3 | 4 | EA | C | R | DWG |
| 80 | 27734-GND | LABEL-TEXT-WIRE SLEEVE | GND | 4 | EA | C | R | DWG |
| 81 | 27734-L1-7 | LABEL-TEXT-WIRE SLEEVE | L1-7 | 2 | EA | C | R | DWG |
| 82 | 27734-L2-7 | LABEL-TEXT-WIRE SLEEVE | L2-7 | 2 | EA | C | R | DWG |
| 83 | 27734-L3-7 | LABEL-TEXT-WIRE SLEEVE | L3-7 | 2 | EA | C | R | DWG |
| 84 | 27734-115AC-3 | LABEL-TEXT-WIRE SLEEVE | 115AC-3 | 2 | EA | C | R | DWG |
| 85 | 27734-0DC | LABEL-TEXT-WIRE SLEEVE | 0DC | 2 | EA | C | R | DWG |
| 86 | 27734-115AC-1 | LABEL-TEXT-WIRE SLEEVE | 115AC-1 | 2 | EA | C | R | DWG |
| 88 | M5-0.8X6 2Z | SCREW-TH-PHIL-STL-ZINC | NON STOCKABLE | 6 | EA | - | R | PS |
| 89 | M5-0.8X12 2Z | SCREW-TH-PHIL-STL-ZINC | NON STOCKABLE | 12 | EA | - | R | PS |
| 90 | M4-0.7X6 2Z | SCREW-TH-PHIL-STL-ZINC | NON STOCKABLE | 14 | EA | - | R | PS |
| 91 | M5-0.8X12 25B | SCREW-SHCS-STL-BO | | 10 | EA | - | R | PS |
| 92 | M4-0.7X50 10Z | SCREW-PH-PHIL-STL-ZINC | NON STOCKABLE | 4 | EA | - | R | PS |

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type |
|------|---------------|--------------------------------------|-------------------------------------------|-----|-------|-----|------|------|
| 93 | M5-0.8X10 27Z | SCREW-BHCS-STL-ZINC | NON STOCKABLE | 2 | EA | - | R | PS |
| 95 | 24009-4 | WASHER-BELLEVILLE SPRING LK-SERRATED | .209 ID x .354 OD x .0212 THK-10 or M5 | 10 | EA | D | R | DWG |
| 97 | M4-0.7 50Z | NUT-HEX-STL-ZINC | | 4 | EA | - | R | PS |

REVISIONS

| REV | DESCRIPTION | DATE | BY |
|-----|----------------------------------------------------------------------------|-------|----------|
| A | PRODUCTION RELEASE | 14212 | 05/23/14 |
| B | (200) 28718-1 & 27176-5 WAS: 22291-3 & 27176; (204) DELETED | 14283 | 10-24-14 |
| C | 220VAC P/N: 26571-3 & 440VAC P/N: 26571-2 | 14491 | 03/09/16 |
| D | WIRING CHART REVISED. F15-1 WAS: F14-1. F16-1 WAS: F15-1. F17-1 WAS: F16-1 | 14762 | 01/02/16 |

PANEL ASSY (PROGRAMMING)
PN: 281160

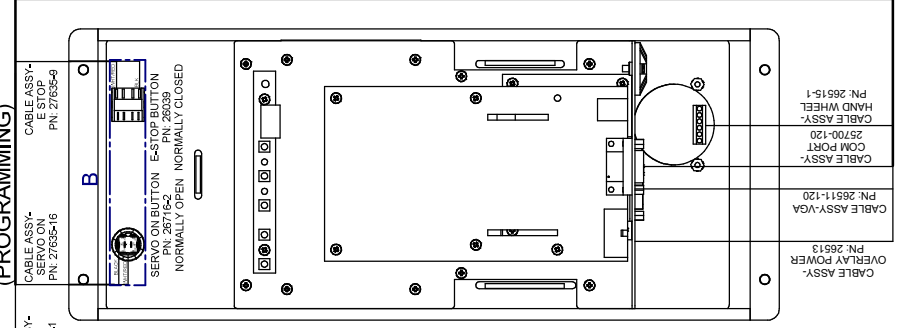


DETAIL B

INPUT POWER WIRING

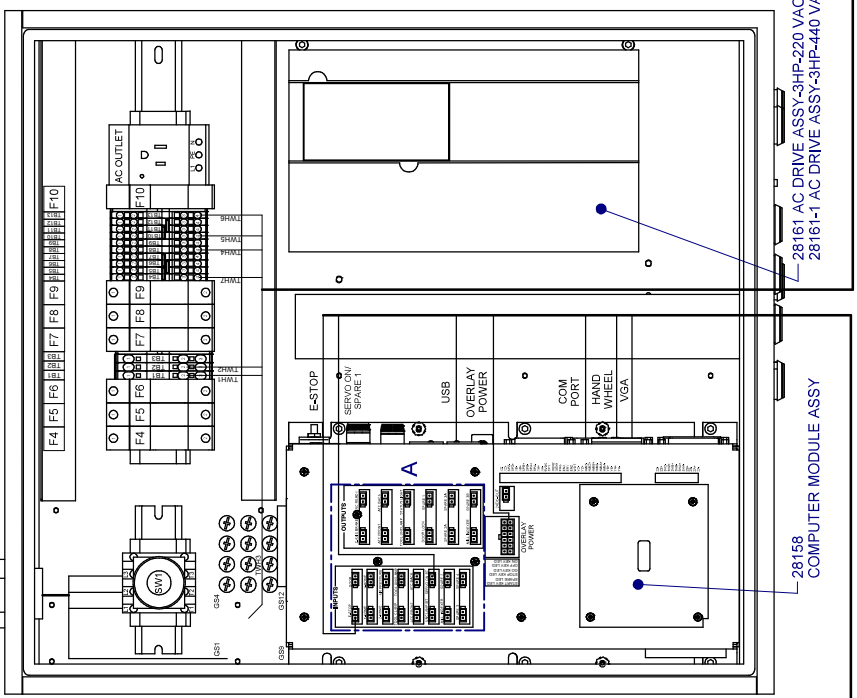
| SW1 | 220 OPTION | 440 OPTION | 220 SINGLE PHASE OPTION |
|-----|------------|------------|-------------------------|
| L1 | RED | RED | WHITE |
| L2 | WHITE | WHITE | BLACK |
| L3 | BLACK | BLACK | GREEN |
| GS1 | GREEN | GREEN | GREEN |

220/440 VAC INPUT
SEE INPUT POWER WIRING CHART



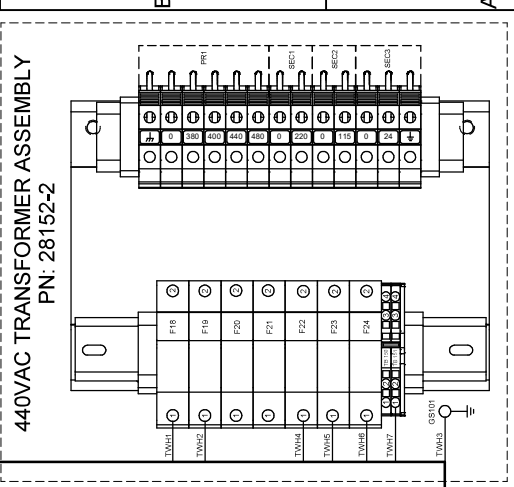
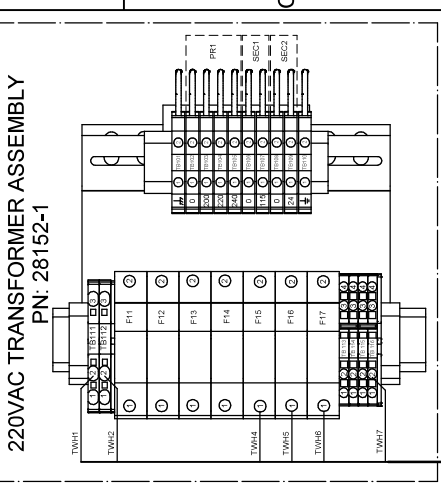
DETAIL A

NOTES: (UNLESS OTHERWISE SPECIFIED),
WIRING CHART SHOWS 220VAC AND 440VAC OPTIONS.



WIRE HARNESS ASSY-27547-1

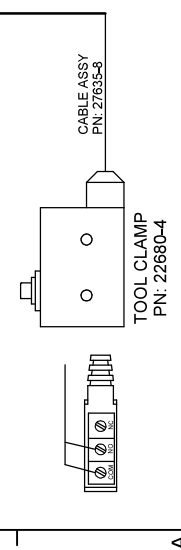
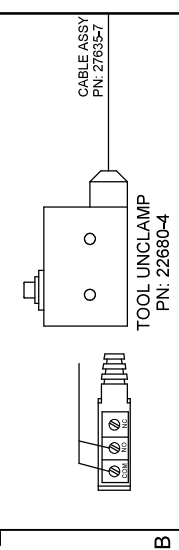
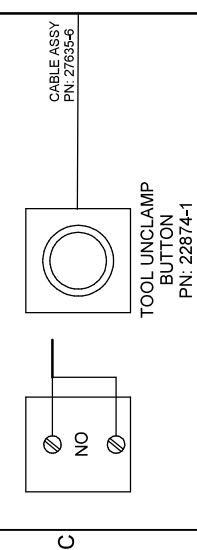
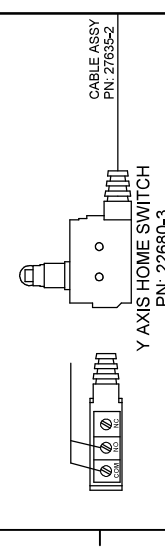
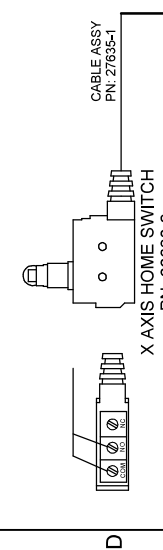
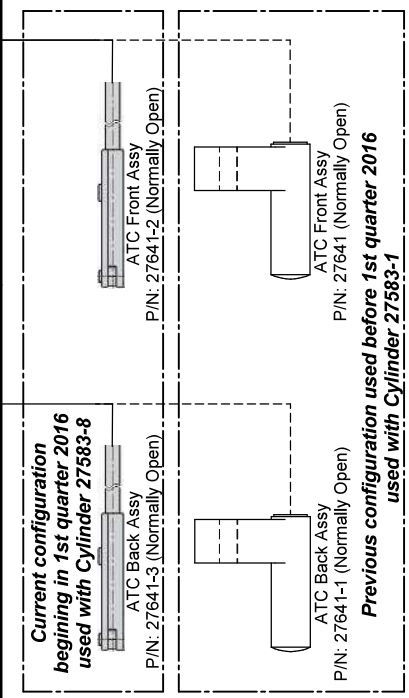
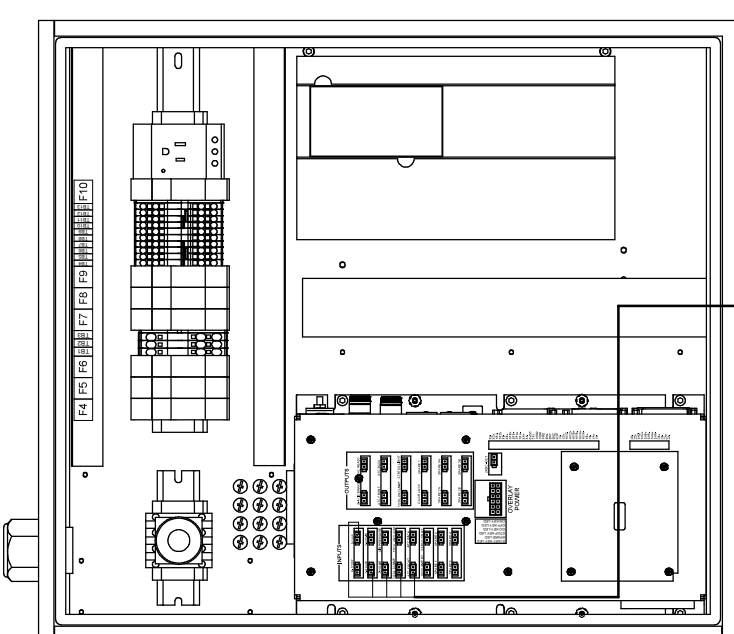
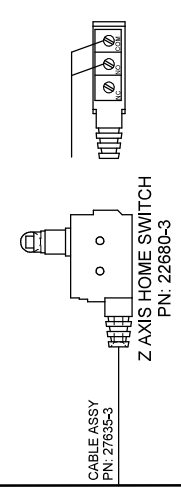
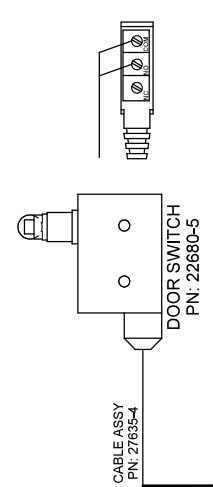
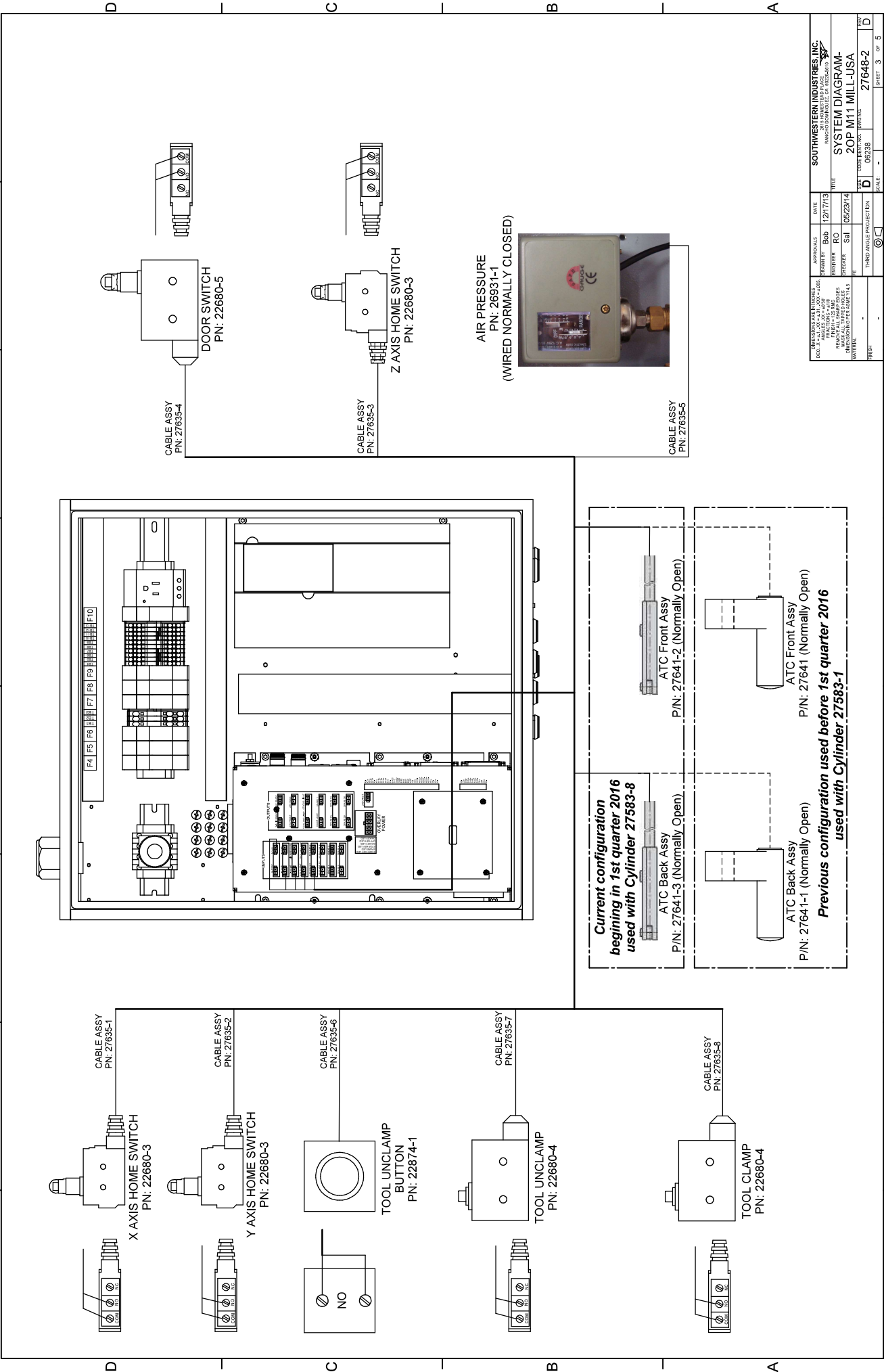
| WIRE FROM | WIRE TO | WIRE COLOR | 220VAC | 440VAC |
|-----------|---------|------------|--------|--------|
| GS7 | GS7 | GREEN | GREEN | GREEN |
| TMW1 | TMW1 | BLACK | BLACK | BLACK |
| TMW2 | TMW2 | BLACK | BLACK | BLACK |
| TMW3 | TMW3 | BLACK | BLACK | BLACK |
| TMW4 | TMW4 | BLACK | BLACK | BLACK |
| TMW5 | TMW5 | BLACK | BLACK | BLACK |
| TMW6 | TMW6 | BLACK | BLACK | BLACK |
| TMW7 | TMW7 | BLACK | BLACK | BLACK |
| TMW8 | TMW8 | BLACK | BLACK | BLACK |
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| TMW10 | TMW10 | BLACK | BLACK | BLACK |
| TMW11 | TMW11 | BLACK | BLACK | BLACK |
| TMW12 | TMW12 | BLACK | BLACK | BLACK |
| TMW13 | TMW13 | BLACK | BLACK | BLACK |
| TMW14 | TMW14 | BLACK | BLACK | BLACK |
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| TMW20 | TMW20 | BLACK | BLACK | BLACK |
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| TMW48 | TMW48 | BLACK | BLACK | BLACK |
| TMW49 | TMW49 | BLACK | BLACK | BLACK |
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| TMW93 | TMW93 | BLACK | BLACK | BLACK |
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WIRE HARNESS ASSY-27547-1

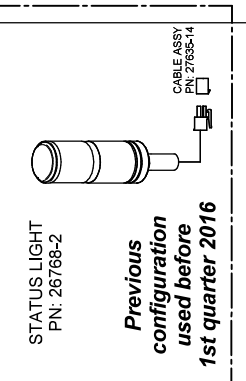
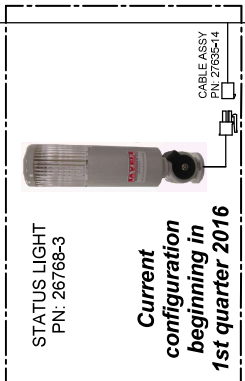
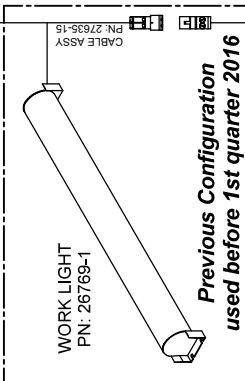
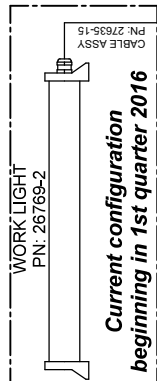
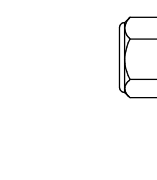
| WIRE FROM | WIRE TO | WIRE COLOR | 220VAC | 440VAC |
|-----------|---------|------------|--------|--------|
| GS7 | GS7 | GREEN | GREEN | GREEN |
| TMW1 | TMW1 | BLACK | BLACK | BLACK |
| TMW2 | TMW2 | BLACK | BLACK | BLACK |
| TMW3 | TMW3 | BLACK | BLACK | BLACK |
| TMW4 | TMW4 | BLACK | BLACK | BLACK |
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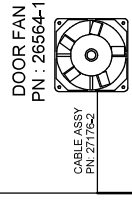
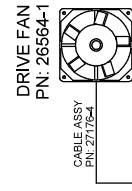
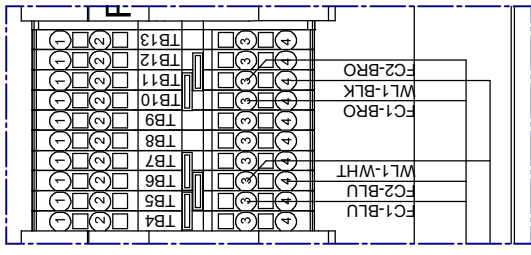


| | | | |
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| SOUTHWESTERN INDUSTRIES, INC. | | DATE | 12/17/13 |
| MANUFACTURING DIVISION | | APPROVALS | Bob |
| 20P M11 MILL-USA | | ENGINEER | RO |
| SYSTEM DIAGRAM | | DRAWN BY | Sal |
| TITLE | | DATE | 05/23/14 |
| 20P M11 MILL-USA | | DESIGNED BY | Sal |
| PART CODE REFERENCE | | THIRD ANGLE PROJECTION | D |
| PART NO. | | SCALE | 1 |
| 27648-2 | | | 3 of 5 |
| REV D | | | |

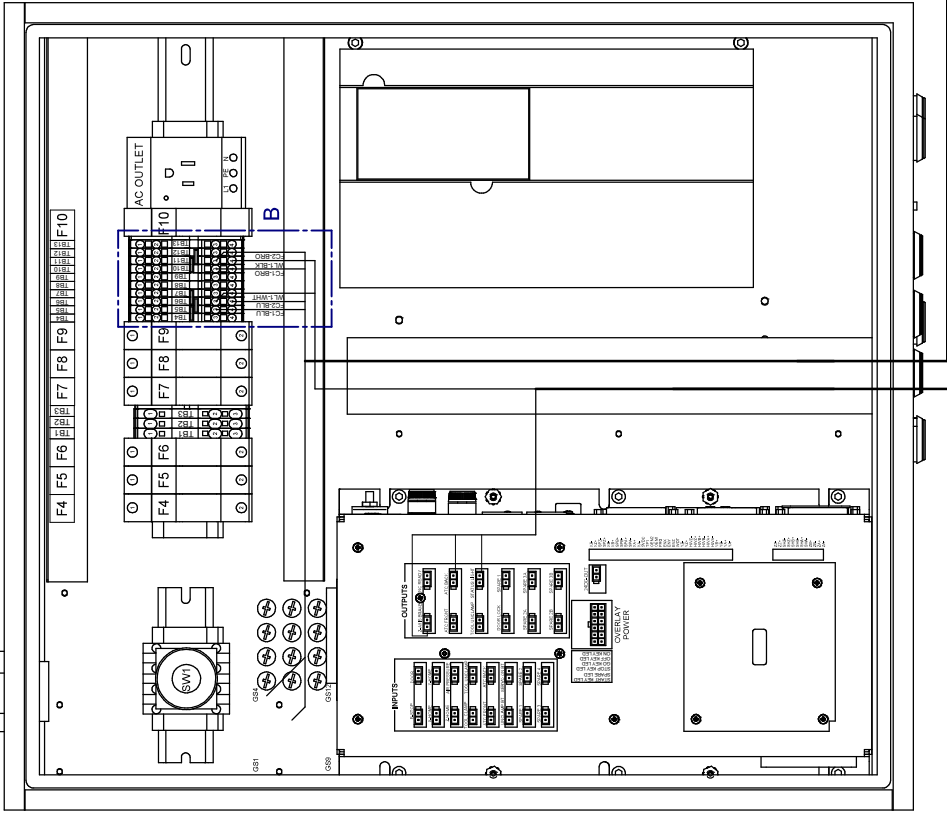
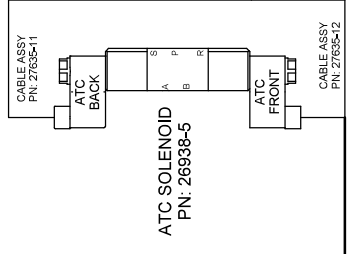
| WIRE CHART | | | | | |
|------------------|-----------|---------|---------------------|-------|-------------|
| WIRE CABLE LABEL | WIRE FROM | WIRE TO | WIRE TO LABEL | | |
| DRIVE FAN (FC1) | TS5-3 | 0V | 0.75mm ² | BLUE | FAN L-N |
| | TS10-3 | 115AC-2 | 0.75mm ² | BROWN | FAN L-L |
| DOOR FAN (FC2) | TS6-4 | 0V | 0.75mm ² | WHITE | FAN 2-N |
| | TS11-3 | 115AC-2 | 0.75mm ² | BROWN | FAN 2-L |
| WORK LIGHT (WL1) | TS4-3 | 0V | 0.75mm ² | WHITE | LIGHT-0V |
| | TS11-4 | 115AC-2 | 0.75mm ² | BLACK | LIGHT-115AC |



TOOL UNCLAMP SOLENOID
PN: 26938-4

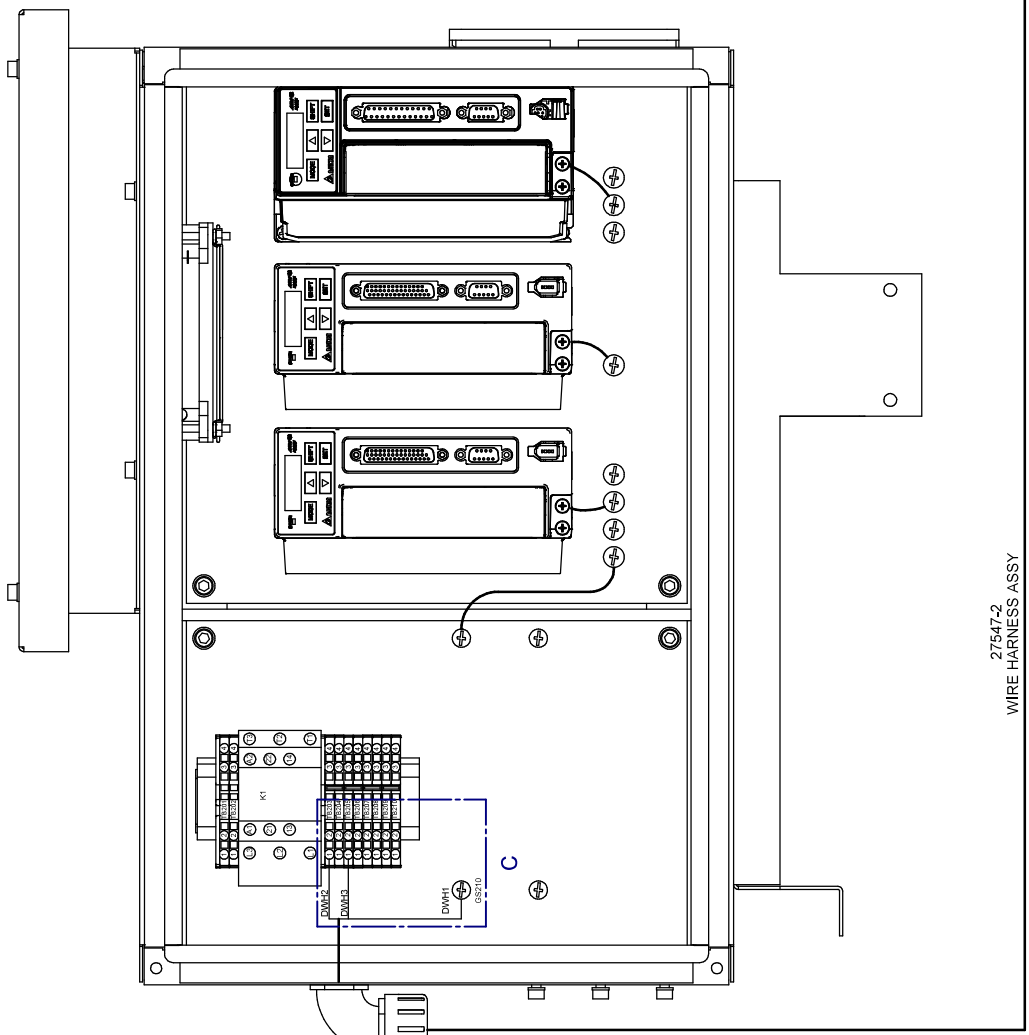
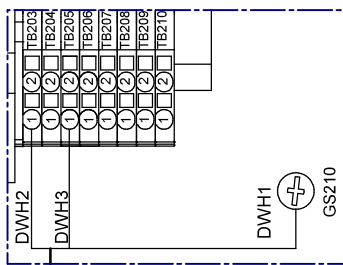


Z AXIS BRAKE ASSY
PN: 27640-1



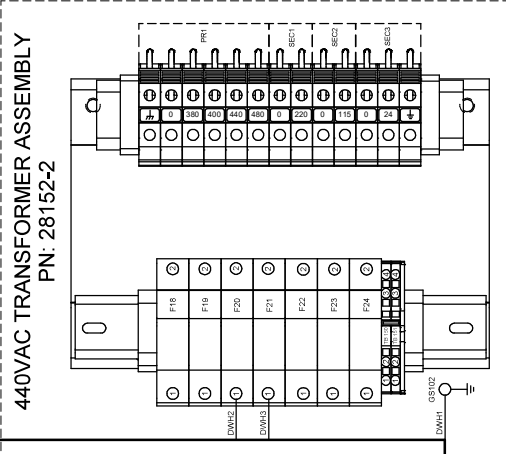
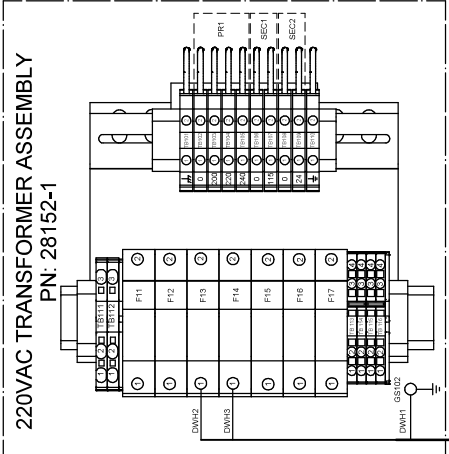
| | | | |
|------------------------|------------------|-----------|-------------------------------|
| DESIGN/REVISIONS | DATE | APPROVALS | SOUTHWESTERN INDUSTRIES, INC. |
| MANUFACTURING | 12/17/13 | Bob | MANUFACTURING |
| ENGINEERING | RO | Sal | ENGINEERING |
| DESIGN | 05/23/14 | Sal | DESIGN |
| WORK CENTER | D | 06238 | WORK CENTER |
| THIRD ANGLE PROJECTION | | | THIRD ANGLE PROJECTION |
| TITLE | SYSTEM DIAGRAM- | | |
| SIZE | 20P M11 MILL-USA | | |
| REV | 27648-2 | | |
| D | SHEET 4 OF 5 | | |

1 2 3 4 5 6 7 8



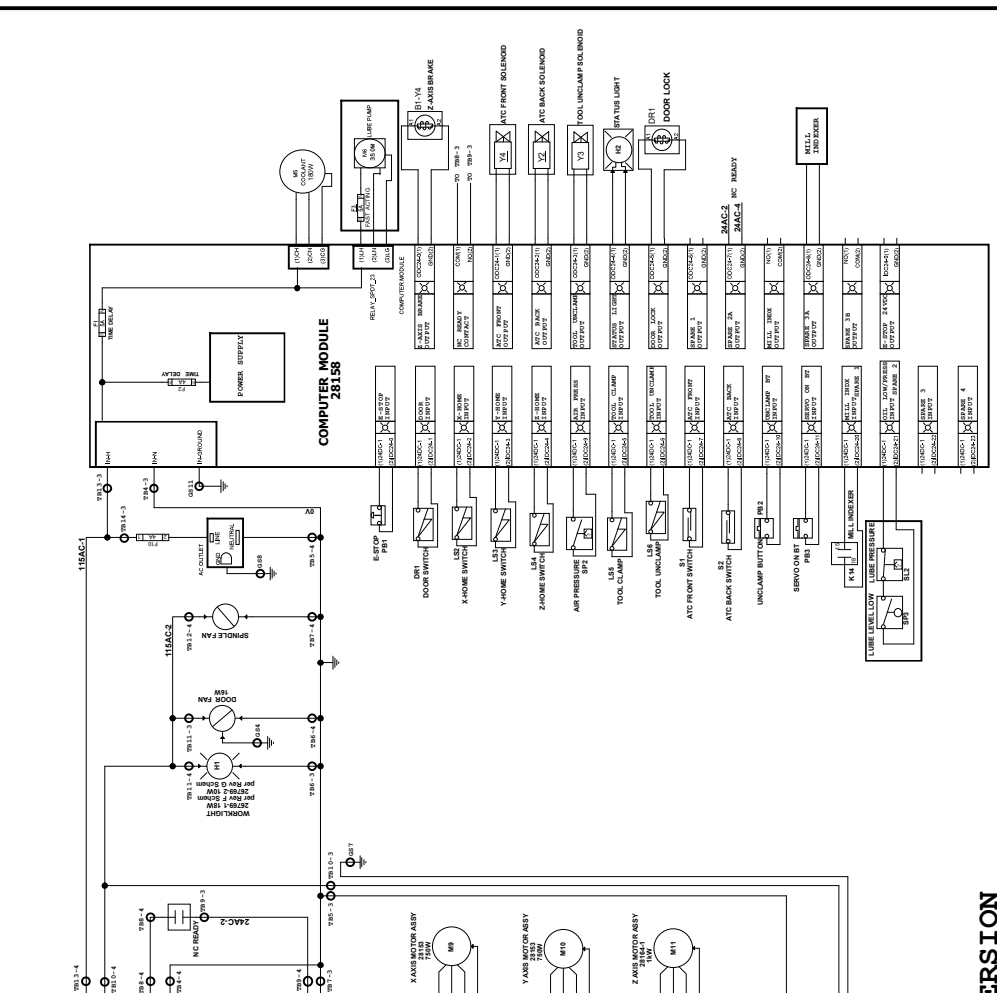
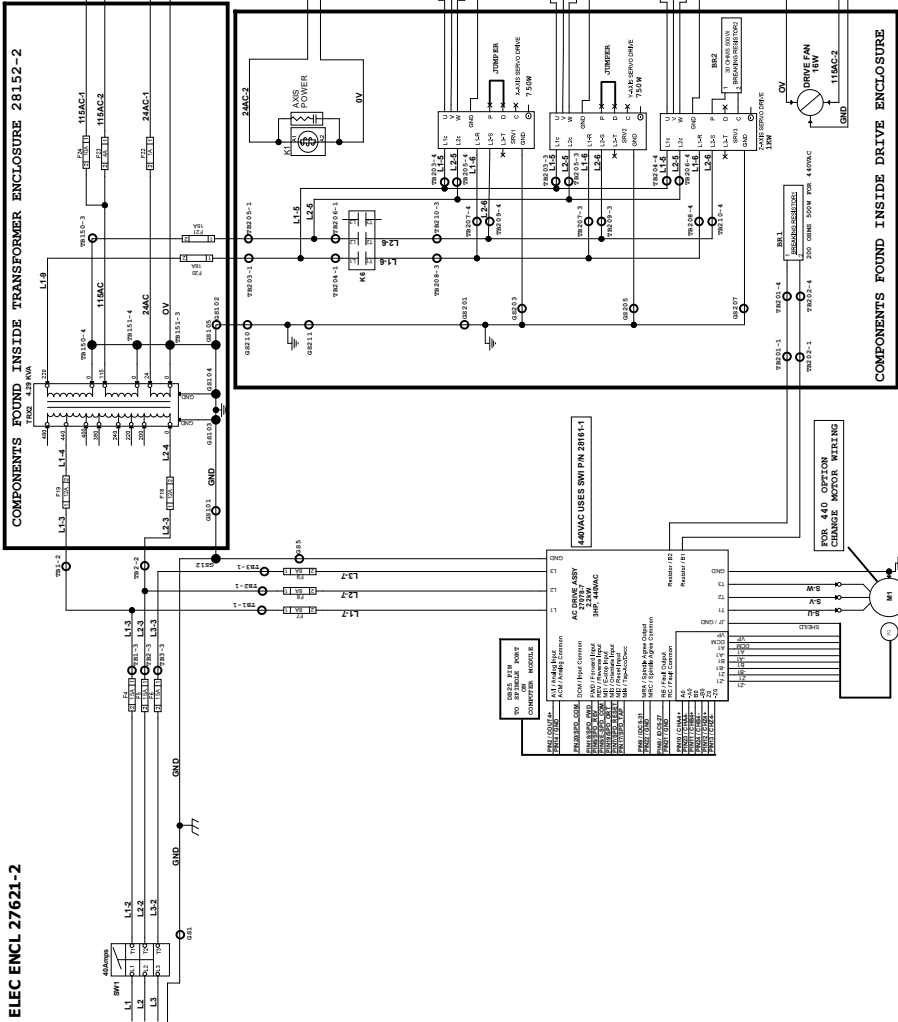
27647-2
WIRE HARNESS ASSY

| WIRE HARNESS ASSY-27647-2 | | | | |
|---------------------------|--------------|---------------|---------------|---------|
| WIRE/ CABLE | WIRE FROM | WIRE LABEL | WIRE COLOR | WIRE TO |
| DWH1 | GS210 | GND | GRN/YEL | GS102 |
| DWH2 | TB203-1 | L1-5 | BLACK | F13-1 |
| DWH3 | TB205-1 | L2-5 | BLACK | F14-1 |
| | | | | F20-1 |
| | | | | F21-1 |



| | | | |
|-------------------------------|--|--------------|----------|
| SOUTHWESTERN INDUSTRIES, INC. | | DATE | 12/17/13 |
| MANUFACTURED IN THE U.S.A. | | APPROVALS | Bob |
| DESIGNED BY: JACOB J. JOSE | | ENGINEER | RO |
| DRAWN BY: JACOB J. JOSE | | DRAWER | SAI |
| CHECKED BY: JACOB J. JOSE | | DATE | 05/23/14 |
| TITLE | | REV | D |
| SYSTEM DIAGRAM- | | REV | 5 |
| 20P M11 MILL-USA | | REV | 5 |
| PART CODE REFERENCE: 27648-2 | | REV | D |
| THIRD ANGLE PROJECTION | | SCALE | 1:1 |
| DRAWN BY: JACOB J. JOSE | | SHEET 5 OF 5 | |

ELEC ENCL 27621-2



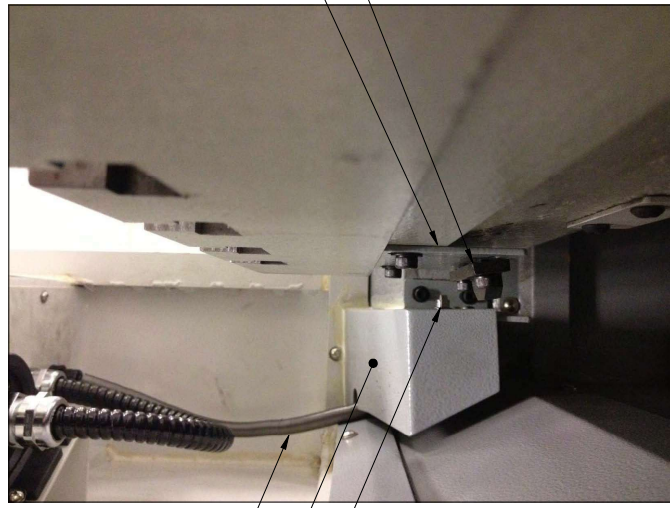
**NOTE: UNLESS OTHERWISE SPECIFIED,
ALL FUSES ARE TIME DELAY.**

440VAC SCHEMATIC VERSION

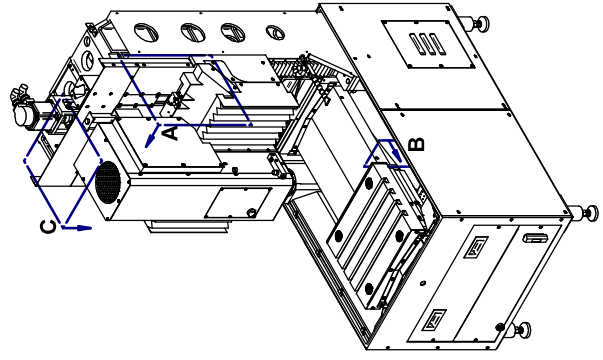
| | | |
|-----------|---------------|---------------------------------------------------------------------------------|
| APPROVALS | DATE | Southwestern Industries, Inc. 916 Westwood Boulevard Northridge, CA 91328 |
| DRAWN BY | R.O. 01/20/14 | TITLE |
| NUMBER | 01/20/14 | SCHEMATIC-ELECTRICAL |
| CHECKER | | M11-USA-220/440VAC |
| | | REV. DATE CON. FIG. NO. |
| | | D 27660-2-SCH H |
| | | REV. DATE CON. FIG. NO. |
| | | 27660-2-SCH H |
| | | REV. DATE CON. FIG. NO. |
| | | 27660-2-SCH H |

| REV | DESCRIPTION | DATE | BY | APPV |
|-----|--------------------|---------------|----|------|
| A | PRODUCTION RELEASE | 14209 9/12/14 | TO | TO |

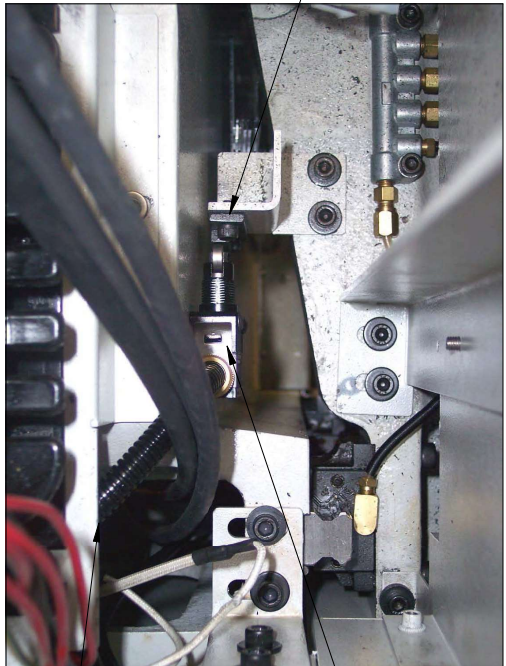
Y AXIS HOME SWITCH



**DETAIL B
INSIDE VIEW**

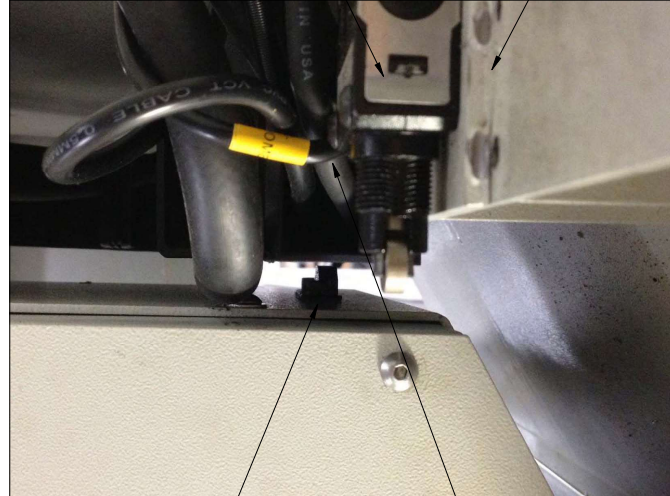


Z AXIS HOME SWITCH



**DETAIL C
TOP VIEW**

X AXIS HOME SWITCH



**DETAIL A
RIGHT SIDE VIEW**

REF (5) NOT SHOWN FOR CLARITY

NOTE: THIS DESIGN WAS CHARACTERIZED BY AND EMPLORES A SYSTEM OF DIMENSIONS AND TOLERANCES THAT IS THE PROPERTY OF SOUTHWESTERN INDUSTRIES, INC. IT IS TO BE USED ONLY FOR THE MANUFACTURE OF THIS PRODUCT AND NOT TO BE REPRODUCED, COPIED, OR OTHERWISE TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM. SOUTHWESTERN INDUSTRIES, INC. PART 754-008

| | | | |
|---------------------------------------------------------|-----------------------------------|------------------------|---------|
| SOUTHWESTERN INDUSTRIES, INC. MANUFACTURING DIVISION | | DATE | 3/18/14 |
| DESIGNED BY | BOB TO | APPROVED BY | BOB TO |
| ENGINEER | TO | DATE | 9/10/14 |
| PROJECT | HOME SWITCH ASSY- ZOP M11 MILL | DATE | 9/20/14 |
| REV | D | THIRD ANGLE PROJECTION | |
| REV | 27658-1 | SCALE | 1 OF 1 |

NOTES: (UNLESS OTHERWISE SPECIFIED).
1. FOR HOME AND SOFT LIMIT DEFINITION SEE DRAWING 25430-1.

27658-1

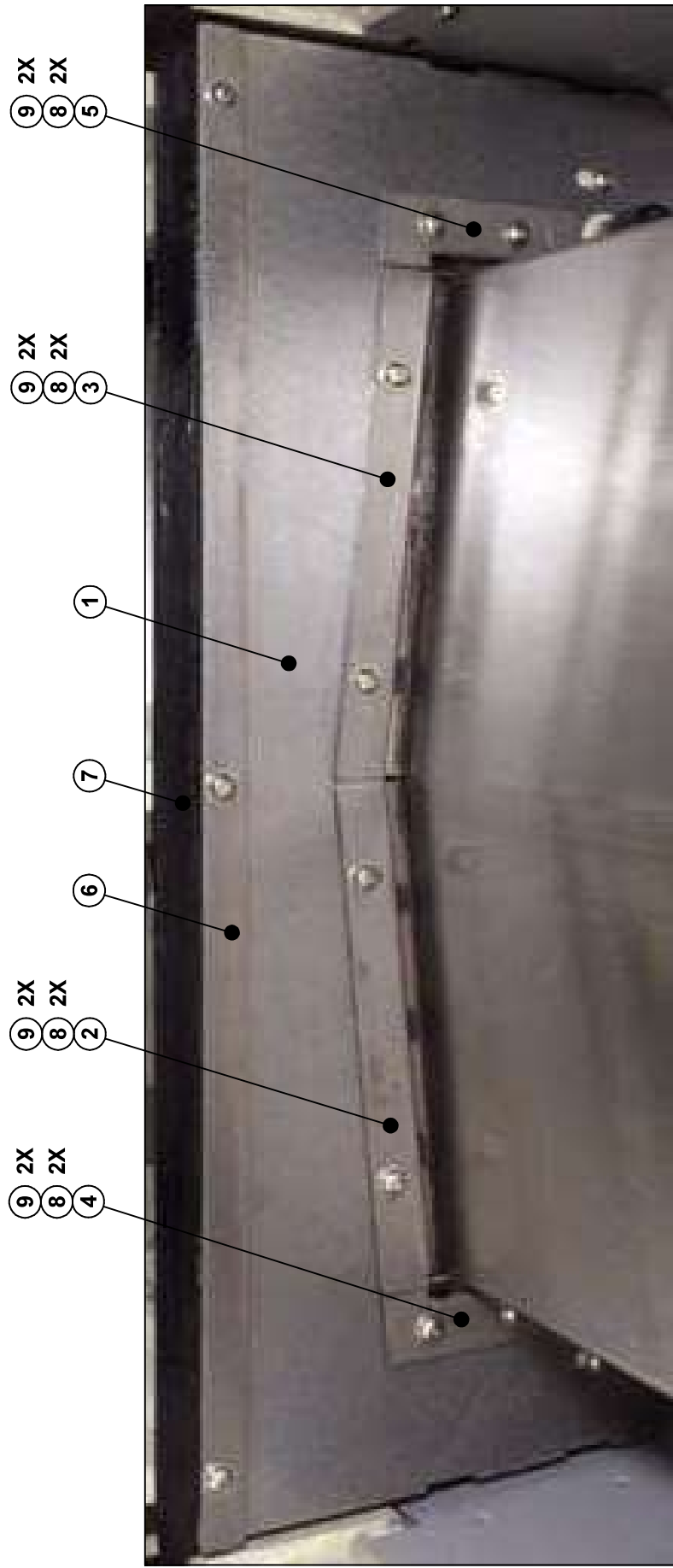
HOME SWITCH ASSY-2OP M11 MILL

| | | | |
|----------|-----------|--------------|----------|
| Type | PL | Dwg Size | D |
| Revision | A | Product | 2 OP M11 |
| Status | R | Engineer | TO |
| Date | 3/18/2014 | Planner Code | |
| By | Bob | Comm Code | |

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------------|-----------------------------|---------------|-----|-------|-----|------|------|-----------|---------|
| 1 | 22680-3 | SWITCH-LIMIT-ROLLER PLUNGER | | (3) | EA | - | R | DWG | | |
| 2 | 27635-1 | CABLE ASSY-X AXIS HOME SW | DC300-111 | (1) | EA | - | R | PL | | |
| 3 | 27635-2 | CABLE ASSY-Y AXIS HOME SW | DC300-112 | (1) | EA | - | R | PL | | |
| 4 | 27635-3 | CABLE ASSY-Z AXIS HOME SW | DC300-113 | (1) | EA | - | R | PL | | |
| 5 | 27690-1 | COVER-HOME SWITCH-X AXIS | SEE 27520 | (1) | EA | - | R | PS | | |
| 6 | 27690-2 | COVER-HOME SWITCH-Y AXIS | | (1) | EA | - | R | PS | | |
| 7 | 27691-1 | BRACKET-HOME SWITCH-Y AXIS | SEE 27564 | (1) | EA | - | R | PS | | |
| 9 | 27603-21 | BRACE-RIGHT-X AXIS ASSY | SEE 27520 | (1) | EA | - | R | PS | | |
| 10 | 27634 | TRIGGER-HOME SWITCH-2 OP | | (3) | EA | - | R | PS | KING RICH | |
| 15 | M4-0.7X25 27B | SCREW-BHCS-STL-BO | NON STOCKABLE | (6) | EA | - | R | PS | | |

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| REVISIONS | | | |
|-----------|-------------------|-------|----------|
| REV | DESCRIPTION | ECN | DATE |
| A | PICTORIAL RELEASE | 14196 | 2/18/14 |
| | | | APPRV TO |



| | | | |
|--------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| SOUTHWESTERN INDUSTRIES, INC. 2815 HOMESTEAD PLACE RANCHO DOMINGUEZ, CA. 90220-5610 | | APPROVALS DRAWN BY Bob ENGINEER TO MFE FE | DATE 1/16/14 2/13/14 |
| COVER ASSY-TOOL-20P | | DIMENSIONS ARE IN MILLIMETERS 1-4 ±0.020, 4-16 ±0.025, 16-63 ±0.050, 63-250 ±0.070, 250-1000 ±0.100, 1000-1500 ±0.200 REMOVE ALL SHARP EDGES MASK ALL TAPPED HOLES DIMENSIONS PER ASME Y14.5 | SIZE B |
| MATERIAL - | | CODE IDENT. NO. 06238 | DWG NO. 27682 |
| FINISH - | | THIRD ANGLE PROJECTION | REV A |
| SCALE - | | SHEET 1 OF 1 | |

NOTES: (UNLESS OTHERWISE SPECIFIED).

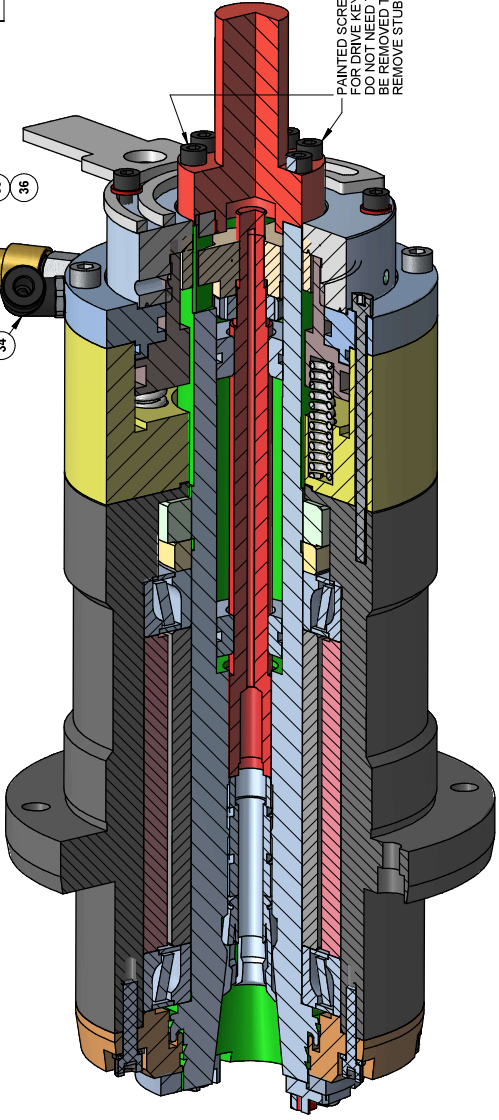
27682
COVER ASSY-TOOL -20P

| | | | |
|----------|----------|--------------|-----|
| Type | PL | Dwg Size | B |
| Revision | A | Product | 20P |
| Status | R | Engineer | TO |
| Date | 9/9/2011 | Planner Code | |
| By | Sal | Comm Code | |

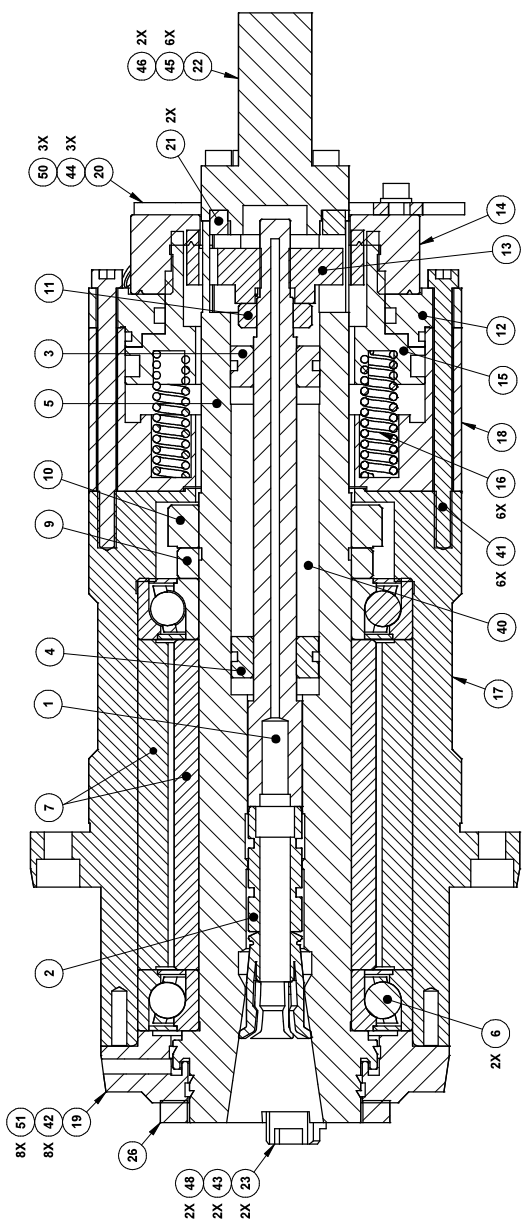
| Item | P/N | Title | Detail | Rev | Qty | UseAs | Stat | Type | Mfr | Mfr P/N |
|------|--------------|----------------------------------|--------|-----|-----|-------|------|------|-----|---------|
| 1 | 27682-1 | PLATE-WIPER HOLDER ASSY-TOOLS | | - | 1 | EA | R | PS | | |
| 2 | 27682-2 | WIPER-TOP/LEFT-COVER ASSY-TOOL | | - | 1 | EA | R | PS | | |
| 3 | 27682-3 | WIPER-TOP/RIGHT-COVER ASSY-TOOL | | - | 1 | EA | R | PS | | |
| 4 | 27682-4 | WIPER-LEFT SIDE-COVER ASSY-TOOL | | - | 1 | EA | R | PS | | |
| 5 | 27682-5 | WIPER-RIGHT SIDE-COVER ASSY-TOOL | | - | 1 | EA | R | PS | | |
| 6 | 27682-10 | RETAINER-SEAL-COVER ASSY-TOOL | | - | 1 | EA | R | PS | | |
| 7 | 27682-11 | SEAL-COVER ASSY-TOOL | | - | 1 | EA | R | PS | | |
| 8 | M5-0.8X8 27B | SCREW-BHCS-STL-BO | | - | 8 | EA | R | PS | | |
| 9 | M5 70B | WASHER-FLAT USS-STL-BO | | - | 8 | EA | R | PS | | |

1 2 3 4 5 6 7 8

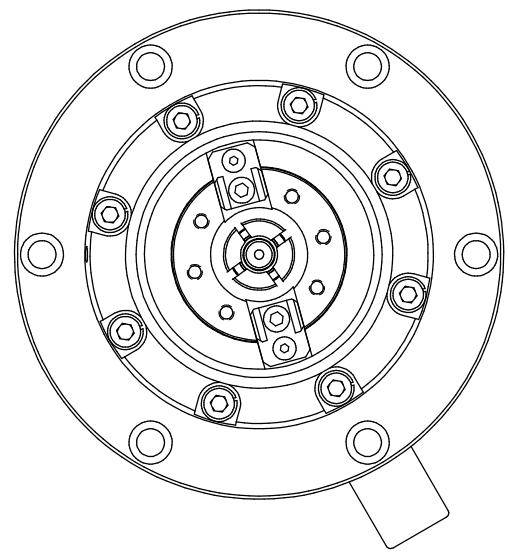
| REV. | DESCRIPTION | DATE | APPROV. |
|------|---------------------------------------------------------------------------------|---------|----------|
| A | PRODUCTION RELEASE | 14218 | 10/24/14 |
| B | DELETED ITEMS 8, 24, 25 & 47 WAS: 27834, 26884, 26885, 14333 | 12/4/14 | TO |
| C | ITEM 44 M5C-18X12-258 QTY 3 WAS: M5C-18X25-258 QTY 2, ITEM 50 QTY 3 WAS: QTY 2. | 14528 | 6/29/16 |
| D | | | PB |



PAINTED SCREWS FOR USE ONLY. DO NOT NEED TO BE REMOVED TO REMOVE STUB SHAFT.



NOTE BEARING ORIENTATION



| | | | |
|-----------------------|---------------|------------------------|-------------------------------|
| DESIGN/ISSUED BY: Bob | DATE: 8/11/14 | APPROVALS: | SOUTHWESTERN INDUSTRIES, INC. |
| ENGINEER: TO | TO: 12/11/14 | DRYER: Sal | MANUFACTURING: OF: RICHARD |
| DESIGNER: Sal | 11/21/14 | THIRD ANGLE PROJECTION | SPINDLE ASSY - |
| MATERIAL: | | | 2 OP M11 MILL |
| FIG. NO.: | | | 27830-1 |
| REV.: | | | DEC28 |
| | | | 1 OF 1 |

NOTES: (UNLESS OTHERWISE SPECIFIED).

1 2 3 4 5 6 7 8

Parts List for Assembly P/N: 27830-1

Printed 6/29/2016

27830-1

SPINDLE ASSY-2OP M11 MILL

Type PL
Revision C
Status R
Date 8/14/2014
By Bob

Dwg Size D
Product 2 OP M11 MILL
Engineer TO
Planner Code
Comm Code

| Item | P/N | Title | Qty | Detail | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------|--------------------------------------------------|-----|----------------|-------|-----|------|------|-----------|-----------|
| 1 | 27832 | DRAWBAR-SPINDLE 2 OP MILL | 1 | | EA | - | R | DWG | | |
| 2 | 27852 | GRIPPER-TOOL CLAMPING | 1 | SEE 27830 | EA | - | R | PS | KING RICH | A-197-003 |
| 3 | 27835 | GUIDE-DRAWBAR-UPPER | 1 | | EA | - | R | DWG | | |
| 4 | 27835-1 | GUIDE-DRAWBAR-LOWER | 1 | | EA | - | R | DWG | | |
| 5 | 27831 | SPINDLE | 1 | | EA | - | R | DWG | | |
| 6 | 27844 | BEARING-ANGULAR CONTACT-7210 P4-SET (2) | 1 | 7210A5TYNSUMP4 | SET | B | R | DWG | | |
| 7 | 28488 | SPACER KIT-INNER & OUTER SPINDLE BEARING (1 SET) | 1 | | EA | A | R | PL | | |
| 9 | 27836 | SPACER-TOP BEARING-SPINDLE | 1 | | EA | - | R | DWG | | |
| 10 | 27837 | NUT-SPANNER-M50 | 1 | | EA | - | R | DWG | | |
| 11 | 27839 | NUT-SPANNER M12 | 1 | | EA | - | R | DWG | | |
| 12 | 27848 | HOUSING-TOP-SPINDLE | 1 | | EA | - | R | DWG | | |
| 13 | 27841 | COLLAR-INNER | 1 | | EA | - | R | DWG | | |
| 14 | 27849 | ADJUSTMENT RING-PISTON STROKE-TOOL UNCLAMP | 1 | | EA | - | R | DWG | | |
| 15 | 27840 | PISTON-CYLINDER-TOOL RELEASE | 1 | | EA | - | R | DWG | | |
| 16 | 27843 | SPRING-CYLINDER RETURN-TOOL RELEASE | 6 | SEE 27830 | EA | - | R | PS | KING RICH | |
| 17 | 27846 | HOUSING-PRIMARY-SPINDLE | 1 | | EA | - | R | DWG | | |
| 18 | 27847 | BODY CYLINDER-TOOL RELEASE | 1 | | EA | - | R | DWG | | |
| 19 | 27845-1 | END CAP-SPINDLE-M11 | 1 | | EA | A | R | DWG | | |
| 20 | 27853 | ACTUATOR PLATE-TOOL UNCLAMP-SWITCHES | 1 | | EA | - | R | DWG | | |
| 21 | 27842 | DRIVE DOG-ADAPTOR SPINDLE | 2 | | EA | - | R | DWG | | |

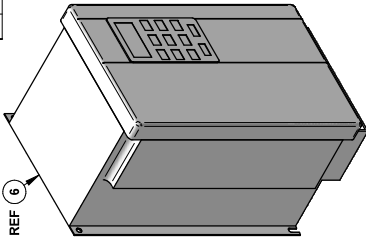
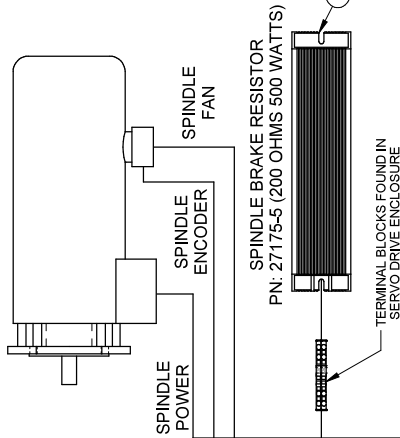
| Item | P/N | Title | Qty | Detail | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------------|-------------------------------------------|-----|---------------|-------|-----|------|------|-----------|-----------|
| 22 | 27850 | SHAFT-STUB COUPLING | 1 | | EA | - | R | DWG | | |
| 23 | 27838-1 | DRIVE DOG-FLANGED-SPINDLE | 2 | | EA | A | R | DWG | | |
| 26 | 27904 | SEAL-SPINDLE | 1 | | EA | A | R | DWG | | |
| 34 | 27016-1 | FITTING-QUICK CONNECT 6MM TO 1/8 BSPT | 1 | | EA | A | R | DWG | | |
| 35 | 27076-1 | FITTING-STRAIGHT-1/8 BSPT TO 1/4 HYDR M/M | 1 | SEE 27563 | EA | - | R | PS | KING RICH | |
| 36 | 27076-2 | FITTING-90°-1/4 HYDR SWVL TO 1/4 HYDR F/M | 1 | | EA | - | R | PS | KING RICH | A-316-012 |
| 40 | 27851 | WASHER-BELLEVILLE-SPINDLE | 28 | SEE 27830 | EA | - | R | PS | KING RICH | |
| 41 | M6-1.0X85 25B | SCREW-SHCS-STL-BO | 6 | NON STOCKABLE | EA | - | R | PS | | |
| 42 | M6-1.0X25 25B | SCREW-SHCS-STL-BO | 8 | | EA | | R | PS | | |
| 43 | M5-0.8X14 25B | SCREW-SHCS-STL-BO | 2 | NON STOCKABLE | EA | - | R | PS | | |
| 44 | M5-0.8X12 25B | SCREW-SHCS-STL-BO | 3 | | EA | - | R | PS | | |
| 45 | M5-0.8X30 25B | SCREW-SHCS-STL-BO | 6 | NON STOCKABLE | EA | - | R | PS | | |
| 46 | M5-0.8X20 25B | SCREW-SHCS-STL-BO | 2 | NON STOCKABLE | EA | - | R | PS | | |
| 48 | M4-0.7X8 27Z | SCREW-BHCS-STL-ZINC | 2 | NON-STOCKABLE | EA | - | R | PS | | |
| 50 | M5 70B | WASHER-FLAT USS-STL-BO | 3 | | EA | - | R | PS | | |
| 51 | M6 73B | WASHER-SPLIT LOCK-STL-BO | 8 | | EA | - | R | PS | | |

WARNING: POWER MUST BE TURNED OFF PRIOR TO MODIFYING

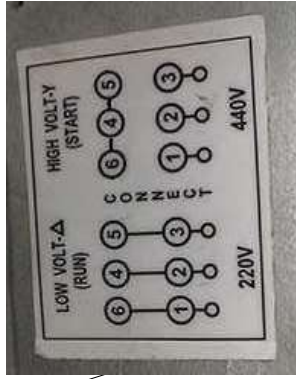
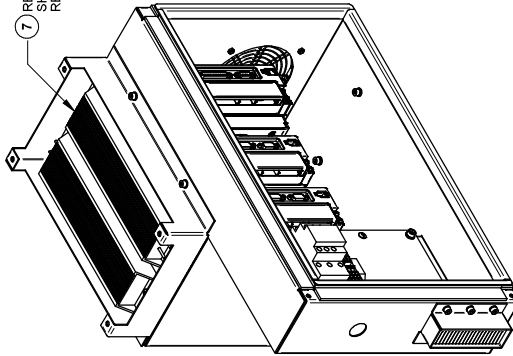
1. REMOVAL & REPLACEMENT CHART

| REMOVE ITEM | P/N REMOVED | QTY | REPLACE WITH | REF DES |
|---------------|-------------|-----|--------------|------------|
| AC DRIVE | 27078-6 | 1 | 28161-1 | --- |
| RESISTOR ASSY | 27175-4 | 1 | 27175-5 | --- |
| FUSES | 28182-30 | 3 | 23153-15 | F4, F5, F6 |
| POWER CORD | 21490-1 | 1 | 21490-2 | --- |
| TRANSFORMER | 28152-1 | 1 | 28152-2 | --- |
| FUSES | 23152-16 | 3 | 23153-8 | F7, F8, F9 |

SPINDLE MOTOR
P/N: 26849-4



RE-WIRE SPINDLE ASSEMBLY AS SHOWN BELOW FROM 220V TAPS TO 440V TAPS



| REV | DESCRIPTION | DATE | BY | CHK |
|-----|------------------------------------------------------|---------|----------|---------|
| D | SHEET 2: 2815-1, F1,3, F1,4, F1,7 WAS: 15A, 15A, BA; | 14/6/11 | 02/12/18 | Sai/ RO |
| E | ADDED ITEM 13. | 14/7/21 | 04/16/18 | Sai/ RC |

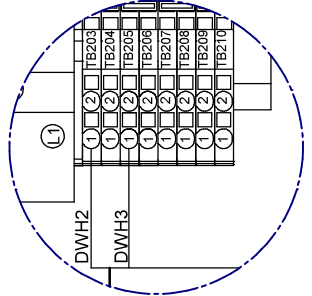
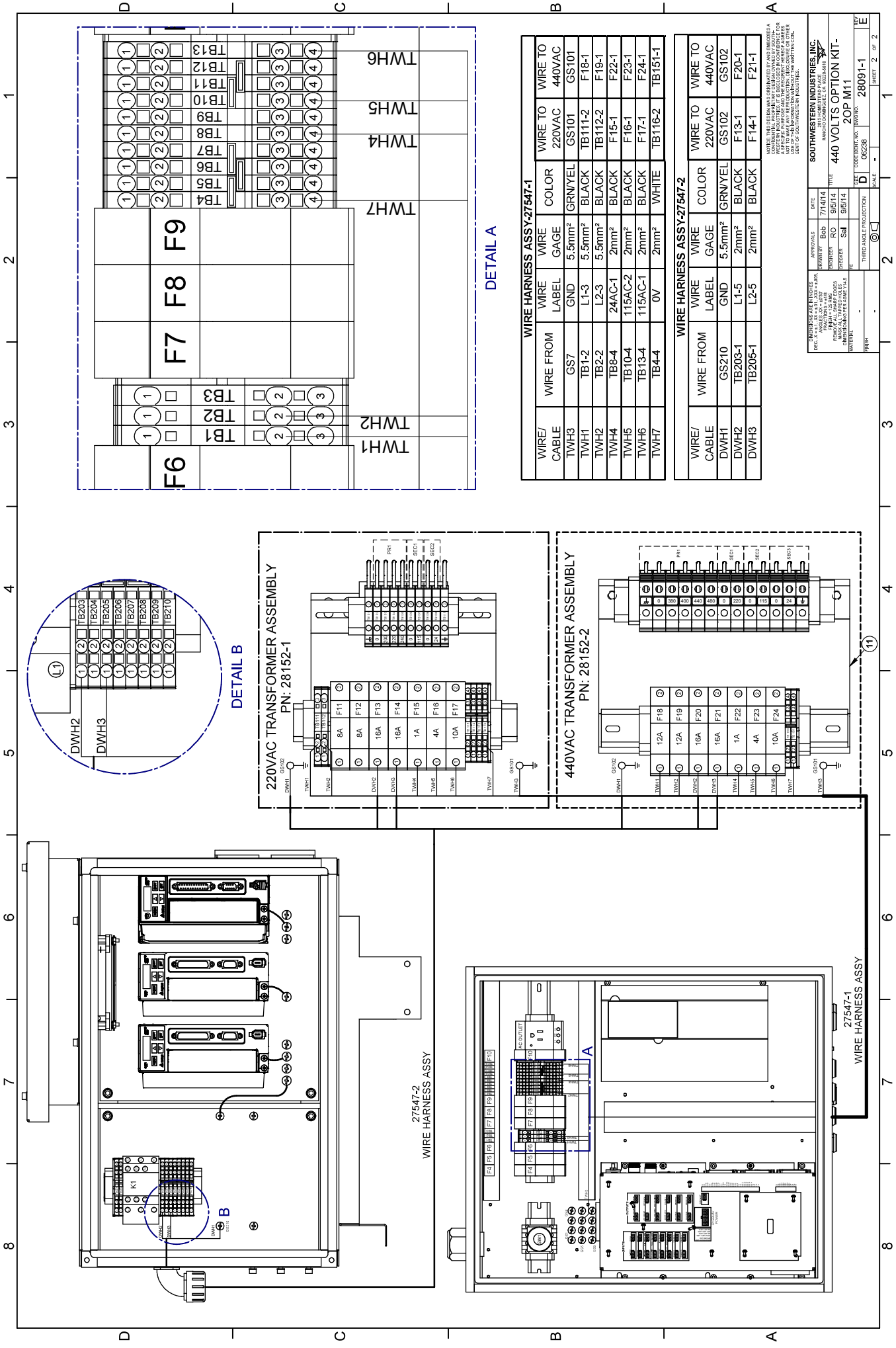
- NOTES: UNLESS OTHERWISE SPECIFIED.
1. REMOVE (ITEMS 1-5) & REPLACE WITH ITEMS 6-11. PER CHART. RETURN ALL REMOVED ASSEMBLIES TO STOCK. (1D6)
 2. AFTER INSTALLATION PERFORM ZOP-M11 440 VOLT OPTION INSPECTION.

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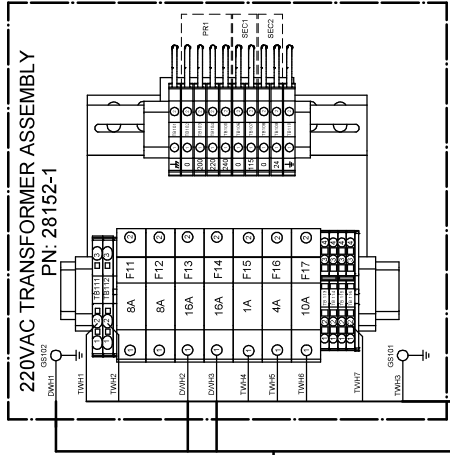
| REVISION | DATE | APPROVALS | DATE |
|----------|----------|-----------|---------|
| D | 06/23/8 | Bob | 7/14/14 |
| E | 09/05/14 | RO | 9/05/14 |
| F | 09/05/14 | Sai | 9/05/14 |

DRAWN BY: SAIB
 CHECKED BY: SAIB
 ENGINEER: RO
 PROJECT: Sai
 THIRD ANGLE PROJECTION
 SCALE: -
 SHEET: 1 of 2

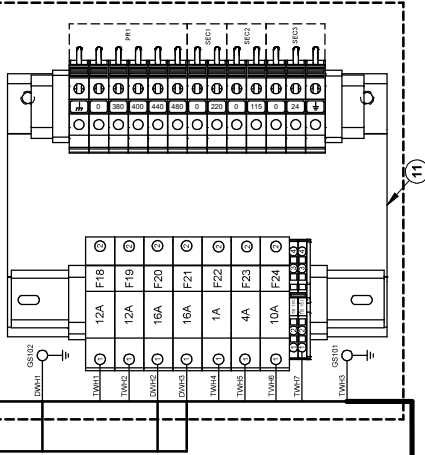
SOUTHWESTERN INDUSTRIES, INC.
 440 VOLT5 OPTION KIT
 ZOP M11
 28091-1
 DEC 2008



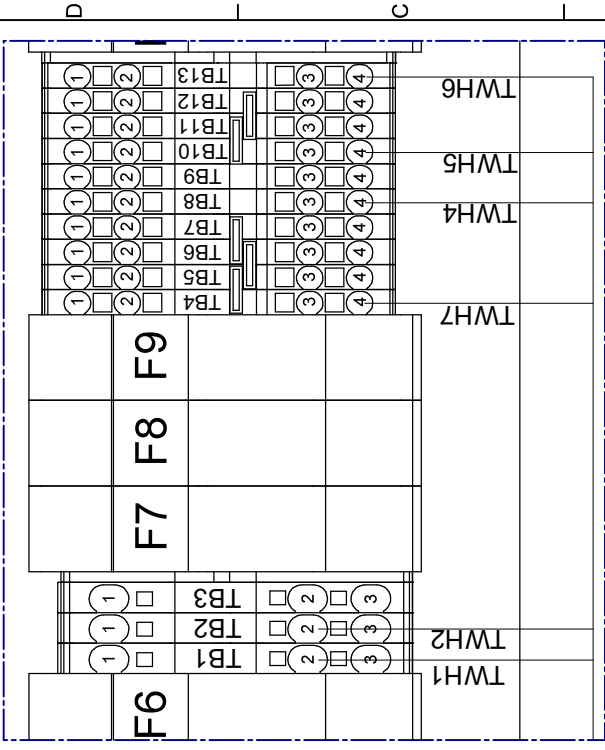
DETAIL B



220VAC TRANSFORMER ASSEMBLY
PN: 28152-1



440VAC TRANSFORMER ASSEMBLY
PN: 28152-2



DETAIL A

WIRE HARNESS ASSY-27547-1

| WIRE/CABLE | WIRE FROM | WIRE LABEL | WIRE GAGE | COLOR | WIRE TO |
|------------|-----------|------------|--------------------|---------|---------|
| TWH3 | GS7 | GND | 5.5mm ² | GRN/YEL | GS101 |
| TWH1 | TB1-2 | L1-3 | 5.5mm ² | BLACK | TB11-2 |
| TWH2 | TB2-2 | L2-3 | 5.5mm ² | BLACK | TB11-2 |
| TWH4 | TB8-4 | 24AC-1 | 2mm ² | BLACK | F15-1 |
| TWH5 | TB10-4 | 115AC-2 | 2mm ² | BLACK | F16-1 |
| TWH6 | TB13-4 | 115AC-1 | 2mm ² | BLACK | F17-1 |
| TWH7 | TB4-4 | 0V | 2mm ² | WHITE | TB116-2 |
| | | | | | TB151-1 |

WIRE HARNESS ASSY-27547-2

| WIRE/CABLE | WIRE FROM | WIRE LABEL | WIRE GAGE | COLOR | WIRE TO |
|------------|-----------|------------|--------------------|---------|---------|
| DWH1 | GS210 | GND | 5.5mm ² | GRN/YEL | GS102 |
| DWH2 | TB203-1 | L1-5 | 2mm ² | BLACK | F13-1 |
| DWH3 | TB205-1 | L2-5 | 2mm ² | BLACK | F14-1 |
| | | | | | F20-1 |
| | | | | | F21-1 |

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| | | |
|------------------------|------------------------------|---------|
| APPROVALS | DATE | 7/14/14 |
| DESIGNED BY: Bob | RO | 9/5/14 |
| ENGINEER: Sal | SA | 9/5/14 |
| THIRD ANGLE PROJECTION | | |
| SCALE | | |
| REV | DESCRIPTION | DATE |
| 1 | 440 VOLTS OPTION KIT-20P M11 | |
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27547-1 WIRE HARNESS ASSY

28091-1

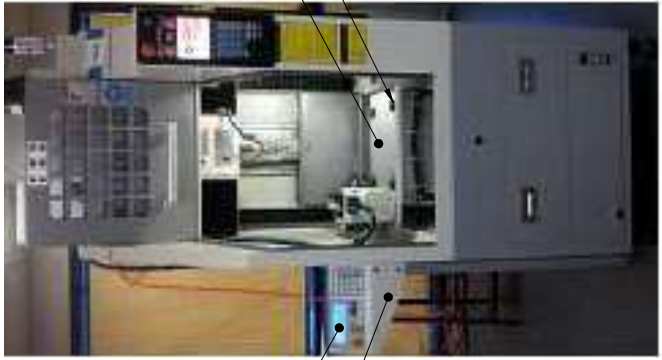
440V OPTION KIT-2OP M11

| | | | |
|----------|-----------|--------------|---------|
| Type | PL | Dwg Size | D |
| Revision | E | Product | 2OP M11 |
| Status | R | Engineer | RO |
| Date | 5/23/2014 | Planner Code | |
| By | Sal | Comm Code | |

| Item | P/N | Title | Detail | Reference | Qty | UseA | Rev | Stat | Type | Mfr | Mfr P/N |
|------|-------------|----------------------------------------------|---------------------------|-----------|------|------|-----|------|------|-----|---------|
| 1 | 27078-6 | AC DRIVE ASSY-3HP-220 VAC-NOT PROGRAMMED-2OP | | | (-1) | EA | B | R | PL | | |
| 2 | 27175-4 | RESISTOR ASSY-100 OHMS-500W-SPINDLE BRAKE | | | (-1) | EA | A | R | PL | | |
| 3 | 28182-30 | FUSE-FAST ACTING-CLASS CC-600 VAC 30 AMP | | | (-3) | EA | A | R | DWG | | |
| 4 | 21490-1 | POWER CORD-3 PHASE-220V-2 OP 126" | | | (-1) | EA | - | R | PL | | |
| 5 | 28152-1 | TRANSFORMER ASSY - 1.1KVA | | | (-1) | EA | C | R | PL | | |
| 6 | 28161-1 | AC DRIVE ASSY-3HP-440 VAC-PROGRAMMED-M11-USA | | | 1 | EA | D | R | PL | | |
| 7 | 27175-5 | RESISTOR ASSY-200 OHMS-500W-SPINDLE BRAKE | | | 1 | EA | A | R | PL | | |
| 8 | 23153-8 | FUSE-TIME DELAY-600 VAC-CLASS CC 8 AMPS | | F7,F8,F9 | 3 | EA | B | R | DWG | | |
| 9 | 23153-15 | FUSE-TIME DELAY-600 VAC-CLASS CC 15 AMPS | | F4,F5,F6 | 3 | EA | B | R | DWG | | |
| 10 | 21490-2 | POWER CORD-3 PHASE-440V-2 OP 126" | | | 1 | EA | - | R | PL | | |
| 11 | 28152-2 | TRANSFORMER ASSY-4290VA-JL/CE | | | 1 | EA | C | R | PL | | |
| 12 | 22537-440 | LABEL-440 VOLTS | | | 1 | EA | - | R | DWG | | |
| 13 | 21214-1 | NAMEPLATE-SERIAL NUMBER | | | 1 | EA | C | R | PL | | |
| 14 | 21214-55 | NAMEPLATE-S/N-2OP-M11 MILL-440V | SEE 21214-1 WHEN UPDATING | | (1) | EA | B | R | DWG | | |
| 15 | 28091-1-DOC | 440VOLTS OPTION KIT-2OP M11 | | | 1 | EA | A | R | DOC | | |
| 16 | 23152-16 | FUSE-TIME DELAY-500 V-10mm x 38mm L 16 AMPS | | | (-3) | EA | B1 | R | DWG | | |

1 2 3 4 5 6 7 8

| REV | DESCRIPTION | DATE | BY |
|-----|----------------------------------------------------------------------|----------|----|
| A | PRODUCTION RELEASE | 8/29/14 | TO |
| B | ITEM 16 26712 QTY 4 WAS: CLAMP-BALL LOCK QTY 1 | 1-7-15 | LG |
| C | ADDED ITEMS 14,17,18, 24, 35, 36, REVISED PICTURES & FIGURE NUMBERS. | 11-13-15 | PB |



NOTES: (UNLESS OTHERWISE SPECIFIED).

| REV | DESCRIPTION | DATE | BY |
|-----|----------------------------------------------------------------------|----------|----|
| A | PRODUCTION RELEASE | 8/29/14 | TO |
| B | ITEM 16 26712 QTY 4 WAS: CLAMP-BALL LOCK QTY 1 | 1-7-15 | LG |
| C | ADDED ITEMS 14,17,18, 24, 35, 36, REVISED PICTURES & FIGURE NUMBERS. | 11-13-15 | PB |

NOTES: THE DRAWING OR DRAWINGS ARE THE PROPERTY OF SOUTHWESTERN INDUSTRIES, INC. AND ARE UNCLASSIFIED. A SECURITY APPROVAL AND THE ISSUED PERIOD OF ADDRESS USE OF THIS INFORMATION WITHIN THE UNITED STATES IS FOR OFFICIAL USE ONLY.

REVISIONS: THE DRAWING OR DRAWINGS ARE THE PROPERTY OF SOUTHWESTERN INDUSTRIES, INC. AND ARE UNCLASSIFIED. A SECURITY APPROVAL AND THE ISSUED PERIOD OF ADDRESS USE OF THIS INFORMATION WITHIN THE UNITED STATES IS FOR OFFICIAL USE ONLY.

| APPROVALS | DATE | BY |
|--------------------------|---------|-------|
| DESIGNED BY: [Signature] | 7/14/14 | CHRIS |
| ENGINEER TO: [Signature] | 8/29/14 | TO |
| PROCESSOR: [Signature] | 8/29/14 | SAL |
| THIRD ANGLE PROJECTION | | |

SOUTHWESTERN INDUSTRIES, INC.
 INDEXER READY KIT
 HARDWARE
 PART CODE: 28137
 SCALE: 1 OF 3

1 2 3 4 5 6 7 8

| REV | DESCRIPTION | DATE | BY |
|-----|-----------------------------------------------------------------------|---------|-------------|
| A | PRODUCTION RELEASE | 8/29/14 | TO |
| B | ITEM 16 267/2 QTY 4 WAS: CLAMP-BALL LOCK QTY 1 | 14354 | 1-7-15 LG |
| C | ADDED ITEMS 14,17,18, 24, 35, 36, REVERSED PICTURES & FIGURE NUMBERS. | 14446 | 11-13-15 PB |

- 1 REF
- 1 REF (MOTOR ENCODER)
- 1 REF (AC POWER CABLE)
- 1 REF (MOTOR POWER CABLE)
- 6

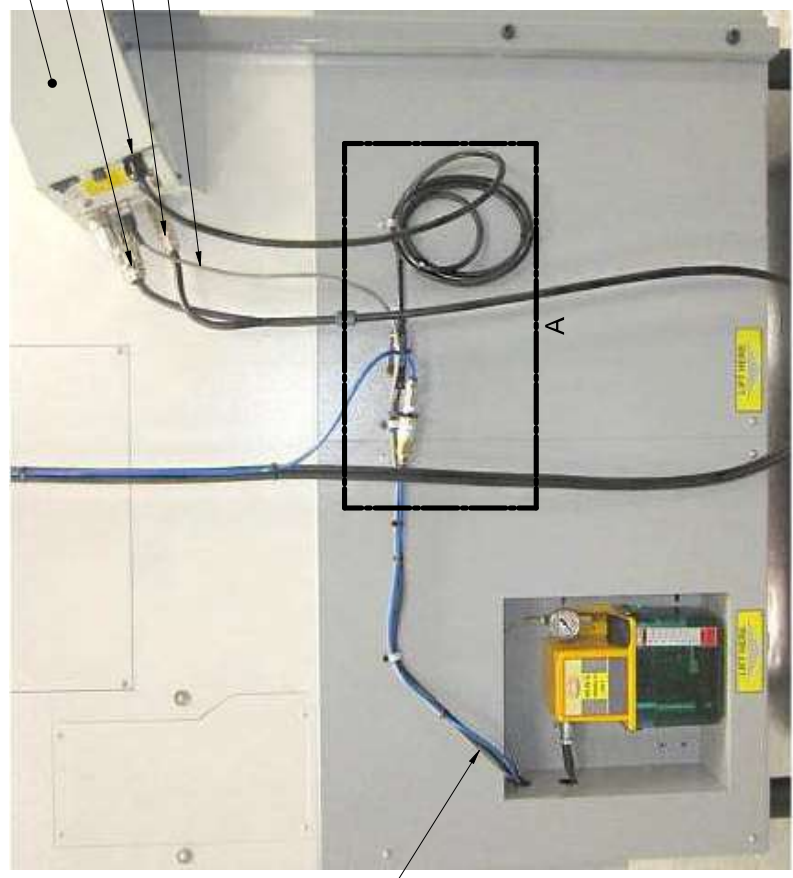


FIG 5



DETAIL A
FIG 5a

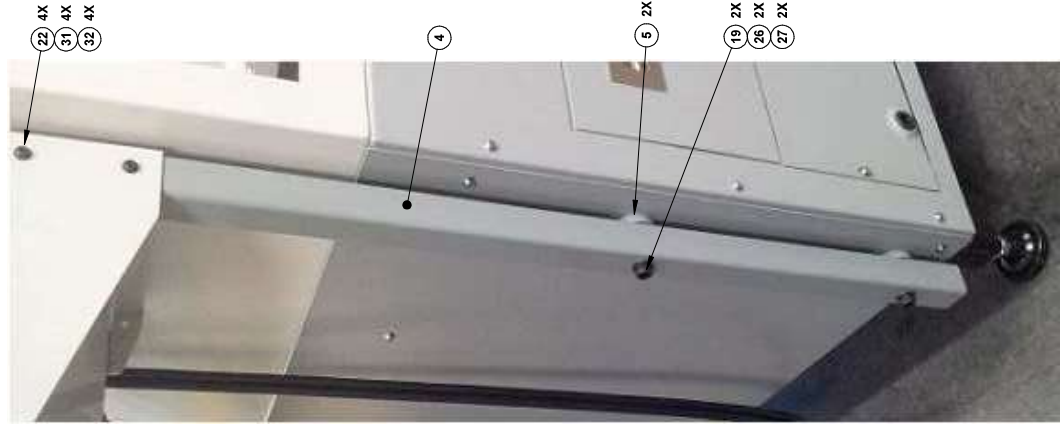


FIG 6

| REV | DESCRIPTION | DATE | BY |
|-----|-----------------------------------------------------------------------|---------|-------------|
| A | PRODUCTION RELEASE | 8/29/14 | TO |
| B | ITEM 16 267/2 QTY 4 WAS: CLAMP-BALL LOCK QTY 1 | 14354 | 1-7-15 LG |
| C | ADDED ITEMS 14,17,18, 24, 35, 36, REVERSED PICTURES & FIGURE NUMBERS. | 14446 | 11-13-15 PB |

NOTE: THE CUSTOMER REQUESTS AN ASSEMBLY AND TESTING PROCEDURE TO BE DEVELOPED FOR THE INDEXER READY KIT. A SECTION APPROVED AND THE TEST BEING PERFORMED. USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES, INC. IS PROHIBITED.

| REV | DESCRIPTION | DATE | BY |
|-----|-----------------------------------------------------------------------|---------|-------------|
| A | PRODUCTION RELEASE | 8/29/14 | TO |
| B | ITEM 16 267/2 QTY 4 WAS: CLAMP-BALL LOCK QTY 1 | 14354 | 1-7-15 LG |
| C | ADDED ITEMS 14,17,18, 24, 35, 36, REVERSED PICTURES & FIGURE NUMBERS. | 14446 | 11-13-15 PB |

NOTE: THE CUSTOMER REQUESTS AN ASSEMBLY AND TESTING PROCEDURE TO BE DEVELOPED FOR THE INDEXER READY KIT. A SECTION APPROVED AND THE TEST BEING PERFORMED. USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES, INC. IS PROHIBITED.

| REV | DESCRIPTION | DATE | BY |
|-----|-----------------------------------------------------------------------|---------|-------------|
| A | PRODUCTION RELEASE | 8/29/14 | TO |
| B | ITEM 16 267/2 QTY 4 WAS: CLAMP-BALL LOCK QTY 1 | 14354 | 1-7-15 LG |
| C | ADDED ITEMS 14,17,18, 24, 35, 36, REVERSED PICTURES & FIGURE NUMBERS. | 14446 | 11-13-15 PB |

NOTE: THE CUSTOMER REQUESTS AN ASSEMBLY AND TESTING PROCEDURE TO BE DEVELOPED FOR THE INDEXER READY KIT. A SECTION APPROVED AND THE TEST BEING PERFORMED. USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES, INC. IS PROHIBITED.

| REV | DESCRIPTION | DATE | BY |
|-----|-----------------------------------------------------------------------|---------|-------------|
| A | PRODUCTION RELEASE | 8/29/14 | TO |
| B | ITEM 16 267/2 QTY 4 WAS: CLAMP-BALL LOCK QTY 1 | 14354 | 1-7-15 LG |
| C | ADDED ITEMS 14,17,18, 24, 35, 36, REVERSED PICTURES & FIGURE NUMBERS. | 14446 | 11-13-15 PB |

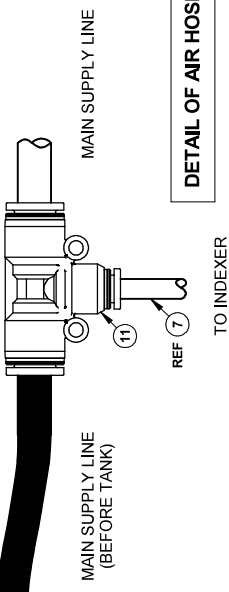
NOTE: THE CUSTOMER REQUESTS AN ASSEMBLY AND TESTING PROCEDURE TO BE DEVELOPED FOR THE INDEXER READY KIT. A SECTION APPROVED AND THE TEST BEING PERFORMED. USE OF THIS INFORMATION WITHOUT THE WRITTEN CONSENT OF SOUTHWESTERN INDUSTRIES, INC. IS PROHIBITED.

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

| REV | DESCRIPTION | ICN | DATE | APPROV |
|-----|----------------------------------------------------------------------|-------|----------|--------|
| A | PRODUCTION RELEASE | 14201 | 8/29/14 | TO |
| B | ITEM 16 267/2 QTY 4 WAS: CLAMP-BALL LOCK QTY 1 | 14354 | 1-7-15 | LG |
| C | ADDED ITEMS 14,17,18, 24, 35, 36, REVERSE PICTURES & FIGURE NUMBERS. | 14446 | 11-13-15 | PB |

FIG 7



ASSEMBLY PROCEDURE

- I. TURN MACHINE OFF AND DISCONNECT MAIN AIR SUPPLY. OPEN ELECTRICAL CABINET & REMOVE ALL 3 REAR PANELS.
- II. REMOVE RUBBER FEET FROM BOTTOM OF CONTROLLER (ITEM 1). REUSE SCREWS & ADD (4) FLAT & LOCK WASHERS (ITEMS 33 & 34) TO FASTEN CONTROLLER TO BRACKET (ITEM 3). (FIG 1)
- III. USE HARDWARE (ITEM 22, 31, 32) (4X) TO FASTEN BRACKET WITH CONTROLLER TO POST (ITEM 4). (FIG 6)
- IV. USE ITEMS 19, 26, 27 (2X) TO FASTEN POST (ITEM 4) TO MACHINE. USE SPACER (ITEM 5) BETWEEN MACHINE AND POST. (INSTALL TOP SCREW FIRST) (FIG 6)
- VI. FASTEN FIXTURE PLATE (ITEM 2) TO MACHINE WORKTABLE USING BALL LOCK CLAMPS (ITEM 16). (FIG 1)
- Va. USE HARDWARE (ITEMS 20, 28, 29) TO FASTEN FRONT OF INDEXER AND HARDWARE (ITEMS 21, 28, 29) TO FASTEN BACK OF INDEXER TO THE FIXTURE PLATE (ITEM 2). (FIG 2)
- Vb. SCREW ITEM 10 INTO ITEM 9. INSERT 6mm AIR TUBING (ITEM 7) INTO ITEM 10. THEN CONNECT ITEM 9 TO HIGH FORCE COLLET OPTION AIR INPUT ON INDEXER. (FIG 2)
- VII. ROUTE INDEXER MOTOR ENCODER AND POWER CABLES AND 6mm TUBING FROM INDEXER TO CONTROLLER. USE RUBBER STEEL LOOP (ITEM 15) TO SECURE BUNDLE IN 2 PLACES (FIG 3, 3a, 3b). DRILL & TAP #10-32 THRU VERTICAL ENCLOSURE BRACE WALL APPROXIMATELY 1" DOWN FROM CROSS BEAM & APPROXIMATELY IN THE MIDDLE OF THE BRACE AS SHOWN IN FIG 3a (DO NOT DRILL THRU OUTSIDE WALL). AT THE TOP OF THE ENCLOSURE (FIG 3b) REUSE EXISTING SCREW TO SECURE CLAMP.
- VIII. ROUTE AC POWER EXTENSION CABLE, INDEXER INTERFACE CABLE (ITEM 6) AND 6mm AIR HOSE THROUGH HOLE ON LEFT HAND SIDE OF MACHINE (FIG 5). ITEM 6 AND POWER CABLE WILL BE ROUTED UP TO CONTROL BOX THROUGH RIGHT/Front GROMMET (FIG 4a). PLUG 'INDEXER IN', 'INDEXER OUT' AND POWER CABLE TO RESPECTIVE AREAS (FIG 4, 4a, 4b). (FIG 5)
- IXa. THEN SPLICE 10mm MAIN AIR TUBING AS SHOWN IN (FIG 7).
- IXb. INSERT 10mm AIR TUBING INTO TEE ON BOTH ENDS AND 6mm AIR TUBING INTO TEE (ITEM 11). (FIG 7)
- IXc. ROUTE THE INDEXER CONTROL BOX AC POWER CORD ALONG THE SIDE OF THE MACHINE USING ITEM 14 AND PLUG INTO THE EXTENSION CORD. CUT 6MM AIR LINE AND ADD ITEM 10 AND 18 TO MACHINE SIDE OF AIR LINE AND ATTACH ITEM 9 AND 10 TO INDEXER SIDE OF AIR LINE AND CONNECT THE TWO AIR LINES.
- X. REINSTALL REAR PANELS & TURN MACHINE BACK ON.
- XI. TURN ON AIR.
- XII. TEST INDEXER FUNCTIONALITY.

| REV | DESCRIPTION | ICN | DATE | APPROV |
|-----|----------------------------------------------------------------------|-------|----------|--------|
| A | PRODUCTION RELEASE | 14201 | 8/29/14 | TO |
| B | ITEM 16 267/2 QTY 4 WAS: CLAMP-BALL LOCK QTY 1 | 14354 | 1-7-15 | LG |
| C | ADDED ITEMS 14,17,18, 24, 35, 36, REVERSE PICTURES & FIGURE NUMBERS. | 14446 | 11-13-15 | PB |

| REV | DESCRIPTION | ICN | DATE | APPROV |
|-----|----------------------------------------------------------------------|-------|----------|--------|
| A | PRODUCTION RELEASE | 14201 | 8/29/14 | TO |
| B | ITEM 16 267/2 QTY 4 WAS: CLAMP-BALL LOCK QTY 1 | 14354 | 1-7-15 | LG |
| C | ADDED ITEMS 14,17,18, 24, 35, 36, REVERSE PICTURES & FIGURE NUMBERS. | 14446 | 11-13-15 | PB |

| REV | DESCRIPTION | ICN | DATE | APPROV |
|-----|----------------------------------------------------------------------|-------|----------|--------|
| A | PRODUCTION RELEASE | 14201 | 8/29/14 | TO |
| B | ITEM 16 267/2 QTY 4 WAS: CLAMP-BALL LOCK QTY 1 | 14354 | 1-7-15 | LG |
| C | ADDED ITEMS 14,17,18, 24, 35, 36, REVERSE PICTURES & FIGURE NUMBERS. | 14446 | 11-13-15 | PB |

| REV | DESCRIPTION | ICN | DATE | APPROV |
|-----|----------------------------------------------------------------------|-------|----------|--------|
| A | PRODUCTION RELEASE | 14201 | 8/29/14 | TO |
| B | ITEM 16 267/2 QTY 4 WAS: CLAMP-BALL LOCK QTY 1 | 14354 | 1-7-15 | LG |
| C | ADDED ITEMS 14,17,18, 24, 35, 36, REVERSE PICTURES & FIGURE NUMBERS. | 14446 | 11-13-15 | PB |

Parts List for Assembly P/N: 28137

Printed 11/13/2015

28137

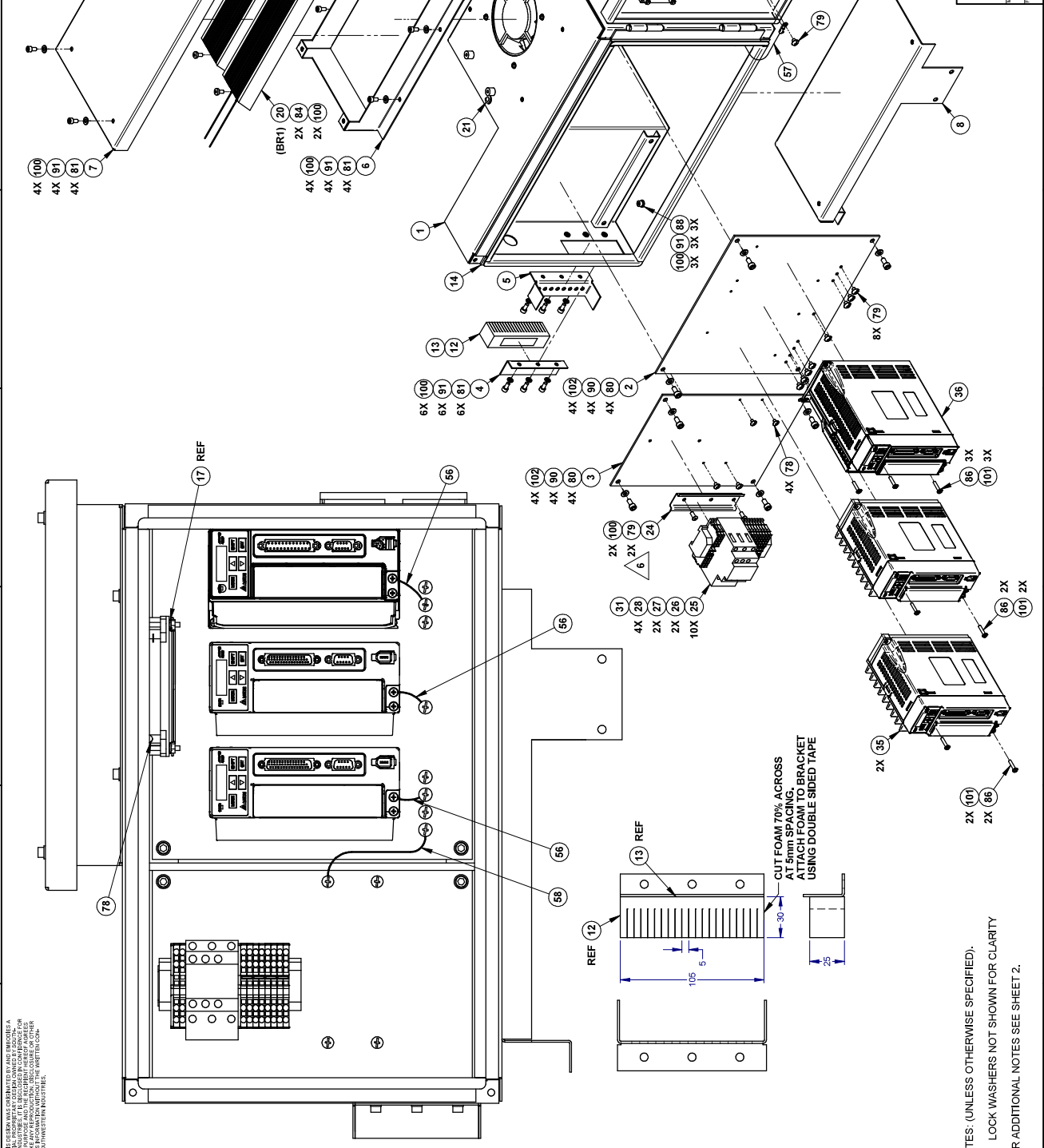
INDEXER READY KIT-HARDINGE

| | | | |
|----------|-----------|--------------|-----|
| Type | PL | Dwg Size | D |
| Revision | C | Product | 2OP |
| Status | R | Engineer | TO |
| Date | 1/21/2014 | Planner Code | |
| By | Bob | Comm Code | |

| Item | P/N | Title | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|------------------|---------------------------------------------------|-----|-------|-----|------|------|-----------|----------|
| 1 | 28179 | INDEXER 5C-W/ INDEXER CONT HI FORCE COLLET CLOSER | (1) | EA | B | R | DWG | | |
| 2 | 27693-3 | FIXTURE PLATE ASSY-HARDINGE INDEXER-2OP M11 | 1 | EA | A | R | PL | | |
| 3 | 27905 | BRACKET-SUPPORT INDEXER-2OP M11 | 1 | EA | A | R | PS | | |
| 4 | 27895 | POST-MTG INDEXER CONTROL BOX-2OP M11 | 1 | EA | A | R | DWG | | |
| 5 | 27896 | SPACER-INDEXER MOUNTING POST-2OP M11 | 2 | EA | A | R | DWG | | |
| 6 | 15361-2 | CABLE ASSY-COMP/MILL INDEXER | (1) | EA | A | R | PL | | |
| 7 | 27531 | TUBING-POLYURETHANE-6mm OD | 186 | IN | - | R | PS | KING RICH | |
| 9 | 27092-1 | COUPLING-QUICK DISCONNECT-1/4 NPTF-FEMALE | 2 | EA | A | R | DWG | | |
| 10 | 27016-3 | FITTING-PUSH TO CONNECT-6mm TO 1/4 NPT | 3 | EA | A | R | DWG | | |
| 11 | 22169-5 | FITTING-AIR-TEE-10mm & 6mm PUSH TO CONNECT | 1 | EA | A | R | DWG | | |
| 14 | 22599 | CLAMP-CABLE-NYLON-1/2" | 3 | EA | - | R | DWG | | |
| 15 | 22636-1 | CLAMP-CABLE-3/4 RUBBER STEEL LOOP | 2 | EA | - | R | DWG | | |
| 16 | 26712 | SHANK-CLAMPING-BALL LOCK | 4 | EA | - | R | DWG | | |
| 17 | 24930 | CABLE-POWER-EXTENSION | 1 | EA | - | R | DWG | PI MFG. | CORD-4-6 |
| 18 | 27092 | COUPLING-QUICK-DISCONNECT HOSE | 1 | EA | - | R | PS | | |
| 19 | M10-1.5X70 25B | SCREW-SHCS-STL-BO | 2 | EA | | R | PS | | |
| 20 | 1/2-13X1 1/4 24B | SCREW-HEX HD-STL-BO | 1 | EA | - | R | PS | | |
| 21 | 1/2-13X1 3/4 24B | SCREW-HEX HD-STL-BO | 1 | EA | - | R | PS | | |
| 22 | 1/4-20 X 1/2 27B | SCREW-BHCS-STL-BO | 4 | EA | - | R | PS | | |
| 23 | 10-32X3/8 25B | SCREW-SHCS-STL-BO | 1 | EA | | R | PS | | |

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type | Mfr | Mfr P/N |
|------|---------------|----------------------------|--------|-----|-------|-----|------|------|-----|---------|
| 24 | M5-0.8X12 25B | SCREW-SHCS-STL-BO | | 3 | EA | - | R | PS | | |
| 26 | M10 73B | WASHER-SPLIT LOCK-STL-BO | | 2 | EA | - | R | PS | | |
| 27 | M10 71B | WASHER-FLAT SAE-STL-BO | | 2 | EA | - | R | PS | | |
| 28 | 1/2 73B | WASHER-SPLIT LOCK-STL-BO | | 2 | EA | | R | PS | | |
| 29 | 1/2 70B | WASHER-FLAT USS-STL-BO | | 2 | EA | - | R | PS | | |
| 30 | 10 70B | WASHER-FLAT USS-STL-BO | | 1 | EA | | R | PS | | |
| 31 | 1/4 70B | WASHER-FLAT USS-STL-BO | | 4 | EA | | R | PS | | |
| 32 | 1/4 73B | WASHER-SPLIT LOCK-STL-BO | | 4 | EA | | R | PS | | |
| 33 | 8 71B | WASHER-FLAT SAE-STL-BO | | 4 | EA | - | R | PS | | |
| 34 | 8 73B | WASHER-SPLIT LOCK-STL-BO | | 4 | EA | | R | PS | | |
| 35 | M5 70B | WASHER-FLAT USS-STL-BO | | 3 | EA | | R | PS | | |
| 36 | M5 73B | WASHER-SPLIT LOCK-STL-BO | | 3 | EA | - | R | PS | | |
| 45 | 28137-DOC | INDEXER READY KIT-HARDINGE | | 1 | EA | A | R | DOC | | |

| REV | DESCRIPTION | DATE | APPV |
|-----|-------------------------------------------------------|----------------|------|
| 2 | ADDED ITEMS 17, 21, 56, 57, 64, 76, DETAIL B, ITEM 25 | 1/6/14 | RO |
| 1 | 2/25/10 WAS DELETED ITEM 65 WAS 1/6/08X12/27B | 4/15/14 | RO |
| 3 | 4.4 WAS 24, 28 & 7 | 4/15/14 | RO |
| A | PRODUCTION RELEASE | 14212 05/23/14 | RO |



| APPROVALS | DATE | DESCRIPTION |
|------------------------|----------|-------------|
| APPROVED BY: Bob | 11/19/13 | REVISION 1 |
| DESIGNED BY: [Blank] | | |
| ENGINEER TO: [Blank] | | |
| ENGINEER FROM: [Blank] | | |
| DRAWN BY: [Blank] | | |
| CHECKED BY: [Blank] | | |
| THIRD ANGLE PROJECTION | | |

SOUTHWESTERN INDUSTRIES, INC.
 1640 S. WILSON BLVD.
 TULSA, OK 74104
 TEL: 918.438.1111
 FAX: 918.438.1112
 WWW: SWI.COM
 ENCLOSURE ASSY-SERVO
 DRIVES-20P M11 MILL
 PART NUMBER: 28156
 REV: A
 SHEET 1 OF 2

NOTES: (UNLESS OTHERWISE SPECIFIED).
 1. LOCK WASHERS NOT SHOWN FOR CLARITY
 FOR ADDITIONAL NOTES SEE SHEET 2.

Parts List for Assembly P/N: 28156

Printed 5/22/2014

28156

ENCL ASSY-SERVO DRIVES-2OP M11 MILL

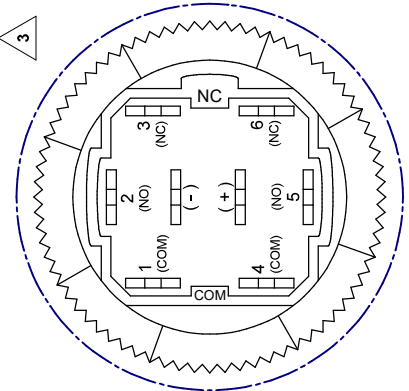
| | | | |
|----------|-----------|--------------|----------|
| Type | PL | Dwg Size | D |
| Revision | A | Product | 2 OP M11 |
| Status | R | Engineer | RO/TO |
| Date | 9/26/2013 | Planner Code | |
| By | Bob | Comm Code | |

| Item | P/N | Title | Detail | Stat | Qty | Rev | Type | UseAs | Mfr | Mfr P/N |
|------|------------|-------------------------------------------------|-----------|------|------|-----|------|-------|-----------|---------|
| 1 | 27620-4 | SHEET METAL-SERVO DRIVE ENCLOSURE-2 OP M11 MILL | | R | 1 | A | DWG | EA | | |
| 2 | 27620-5 | SHEET METAL-BACK PANEL-SERVO DRIVES-2OP M11 | | R | 1 | A | DWG | EA | | |
| 3 | 27620-6 | SHEET METAL-BACK PANEL-DIN RAIL-2OP M11 | | R | 1 | A | DWG | EA | | |
| 4 | 26691-3 | BRACKET-CABLE WAY-RIGHT-2OP M11 | | R | 1 | A | DWG | EA | | |
| 5 | 26691-4 | BRACKET-CABLE WAY-LEFT-2OP M11 | | R | 1 | A | DWG | EA | | |
| 6 | 27603-27 | SHEET METAL-COVER-LOWER-RESISTOR-2OP M11 | | R | 1 | A | DWG | EA | KING RICH | |
| 7 | 27603-28 | SHEET METAL-COVER-UPPER-RESISTOR-2OP M11 | | R | 1 | A | DWG | EA | KING RICH | |
| 8 | 27603-29 | BRACKET-MOUNTING-SERVO ENCLOSURE-2OP M11 | | R | 1 | A | DWG | EA | KING RICH | |
| 12 | 26687-2 | FOAM-CABLE WAY | | R | 1 | A | PS | EA | | |
| 13 | 28108-1 | TAPE-ADHESIVE-FOAM-36YD ROLL-DOUBLE SIDED | 12.7 WIDE | R | AR | A | PS | MM | MCMASTE | 7598A27 |
| 14 | 27669-1 | GASKET-BEZEL-ROLL | | R | 1500 | - | DWG | MM | | |
| 15 | 26708-2 | FILTER GUARD-PLASTIC-120mm | | R | 2 | A | DWG | EA | | |
| 16 | 26564-1 | FAN-115 VAC | | R | 1 | - | DWG | EA | | |
| 17 | 26708-1 | GUARD-FINGER-FAN | | R | 1 | - | DWG | EA | | |
| 19 | 27175-3 | RESISTOR ASSY-30 OHM-500W-BRAKE-Z AXIS | | R | 1 | A | PL | EA | | |
| 20 | 27175-4 | RESISTOR ASSY-100 OHMS-500W-SPINDLE BRAKE | | R | 1 | A | PL | EA | | |
| 21 | 26779-3 | GROMMET-6 X 3 | | R | 2 | A | DWG | EA | | |
| 24 | 26589-122 | RAIL-DIN-140mm | | R | 1 | - | DWG | EA | | |
| 25 | 22557-10 | TERMINAL BLOCK-DIN RAIL-4POS | | R | 10 | - | DWG | EA | | |
| 26 | 22557-9-C1 | TERMINAL BLOCK-COVER-4 POS | | R | 2 | - | DWG | EA | | |

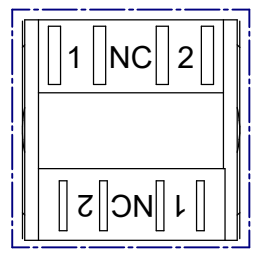
| Item | P/N | Title | Detail | Stat | Qty | Rev | Type | UseAs | Mfr | Mfr P/N |
|------|-------------------|---------------------------------------------------------------|-----------|------|-----|-----|------|-------|-----------|---------|
| 27 | 23095-1 | TERMINAL BLOCK-RAIL END STOP | | R | 2 | - | DWG | EA | | |
| 28 | 22557-9-J1 | TERMINAL BLOCK- JUMPER | | R | 4 | - | DWG | EA | | |
| 31 | 22892-4 | CONTACTOR-220VAC, 2.2KW-COIL 50/60 24VAC | | R | 1 | B | DWG | EA | | |
| 35 | 28163 | SERVO DRIVE-750W-PROGRAMMED | | R | 2 | A | PL | EA | | |
| 36 | 28163-1 | SERVO DRIVE-1KW-PROGRAMMED | | R | 1 | A | PL | EA | | |
| 39 | 24404-5 | LEXAN WINDOW-DOOR-SERVO ENCL-2OP M11 | | R | 1 | A | PS | EA | KING RICH | |
| 45 | 27176-4 | CABLE ASSY-DRIVE FAN | DC300-211 | R | (1) | A | PL | EA | | |
| 46 | 27635-19 | CABLE ASSY-2COND-SPINDLE BRAKE EXTENSION | DC300-308 | R | (1) | A | PL | EA | | |
| 47 | 27635-18 | CABLE ASSY-NC READY EXTENSION | DC300-207 | R | (1) | A | PL | EA | | |
| 50 | 27547-2 | WIRE HARNESS ASSY-3 CONN-TRX TO DRIVE | DC300-309 | R | (1) | A | PL | EA | | |
| 51 | 26555-081313-0200 | WIRE ASSY-2mm ² -BLACK-FERRULE TO FERRULE-200mm | | R | 4 | - | DWG | EA | | |
| 52 | 26555-081313-0350 | WIRE ASSY-2mm ² -BLACK-FERRULE TO FERRULE-350mm | | R | 4 | - | DWG | EA | | |
| 53 | 26555-081313-0400 | WIRE ASSY-2mm ² -BLACK-FERRULE TO FERRULE-400mm | | R | 4 | - | DWG | EA | | |
| 54 | 26555-081313-0150 | WIRE ASSY-2mm ² -BLACK-FERRULE TO FERRULE-150mm | | R | 2 | - | DWG | EA | | |
| 55 | 26555-081313-0110 | WIRE ASSY-2mm ² -BLACK-FERRULE TO FERRULE-110mm | | R | 2 | - | DWG | EA | | |
| 56 | 26555-982121-0250 | WIRE ASSY-2mm ² -GREEN/YELLOW-RING TO RING-250mm | | R | 3 | - | DWG | EA | | |
| 57 | 26555-982121-0410 | WIRE ASSY-2mm ² -GREEN/YELLOW-RING TO RING-410mm | | R | 1 | - | DWG | EA | | |
| 58 | 26555-A12222-0400 | WIRE ASSY-5.5mm ² -GREEN/YELLOW-RING TO RING-400mm | | R | 1 | - | DWG | EA | | |
| 60 | 27734-L2-6 | LABEL-TEXT-WIRE SLEEVE | L2-6 | R | 8 | A | DWG | EA | | |
| 61 | 27734-L1-6 | LABEL-TEXT-WIRE SLEEVE | L1-6 | R | 8 | A | DWG | EA | | |
| 62 | 27734-L1-5 | LABEL-TEXT-WIRE SLEEVE | L1-5 | R | 8 | A | DWG | EA | | |

| Item | P/N | Title | Detail | Stat | Qty | Rev | Type | UseAs | Mfr | Mfr P/N |
|------|---------------|-------------------------------|---------------|------|-----|-----|------|-------|-----|---------|
| 63 | 27734-L2-5 | LABEL-TEXT-WIRE SLEEVE | L2-5 | R | 8 | A | DWG | EA | | |
| 64 | 27734-GND | LABEL-TEXT-WIRE SLEEVE | GND | R | 8 | A | DWG | EA | | |
| 78 | M4-0.7X6 22Z | SCREW-TH-PHIL-STL-ZINC | NON STOCKABLE | R | 5 | - | PS | EA | | |
| 79 | M5-0.8X6 22Z | SCREW-TH-PHIL-STL-ZINC | NON STOCKABLE | R | 11 | - | PS | EA | | |
| 80 | M6-1.0X12 25B | SCREW-SHCS-STL-BO | | R | 8 | | PS | EA | | |
| 81 | M5-0.8X10 25B | SCREW-SHCS-STL-BO | | R | 14 | - | PS | EA | | |
| 82 | M4-0.7X50 10Z | SCREW-PH-PHIL-STL-ZINC | NON STOCKABLE | R | 4 | - | PS | EA | | |
| 83 | M4-0.7X12 26B | SCREW-FHCS-STL-BO | NON STOCKABLE | R | 8 | - | PS | EA | | |
| 84 | M5-0.8X10 10Z | SCREW-PH-PHIL-STL-ZINC | | R | 4 | - | PS | EA | | |
| 86 | M4-0.7X20 31B | SCREW-PH-PHIL-EXT SEMS-STL-BO | NON STOCKABLE | R | 7 | - | PS | EA | | |
| 87 | M5-0.8X16 27B | SCREW-BHCS-STL-BO | NON STOCKABLE | R | 4 | - | PS | EA | | |
| 88 | M5-0.8X14 25B | SCREW-SHCS-STL-BO | NON STOCKABLE | R | 3 | - | PS | EA | | |
| 90 | M6 70B | WASHER-FLAT USS-STL-BO | | R | 8 | - | PS | EA | | |
| 91 | M5 70B | WASHER-FLAT USS-STL-BO | | R | 21 | | PS | EA | | |
| 92 | M4 70Z | WASHER-FLAT-STL-ZINC | | R | 4 | - | PS | EA | | |
| 100 | M5 73B | WASHER-SPLIT LOCK-STL-BO | | R | 25 | - | PS | EA | | |
| 101 | M4 73B | WASHER-SPLIT LOCK-STL-BO | | R | 7 | | PS | EA | | |
| 102 | M6 73B | WASHER-SPLIT LOCK-STL-BO | | R | 8 | - | PS | EA | | |
| 105 | M4-0.7 50B | NUT-HEX-STL-BO | | R | 4 | | PS | EA | | |
| 106 | M5-0.8 50B | NUT-HEX-BLK OX | | R | 4 | - | PS | EA | | |

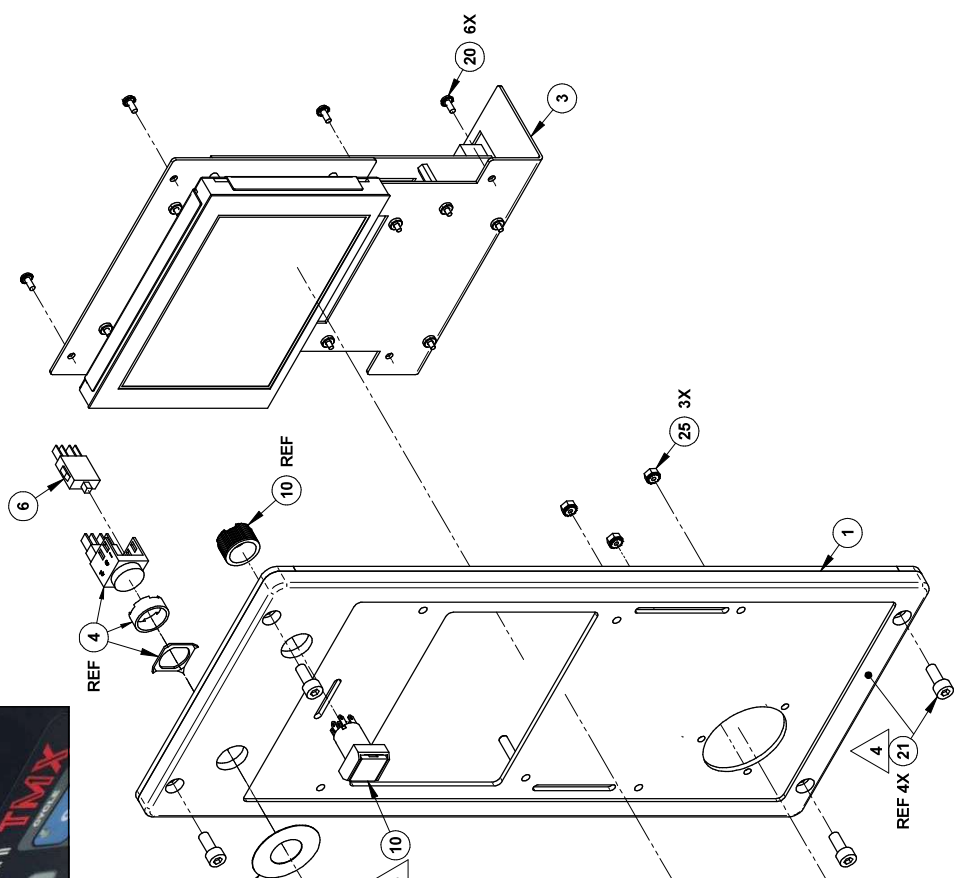
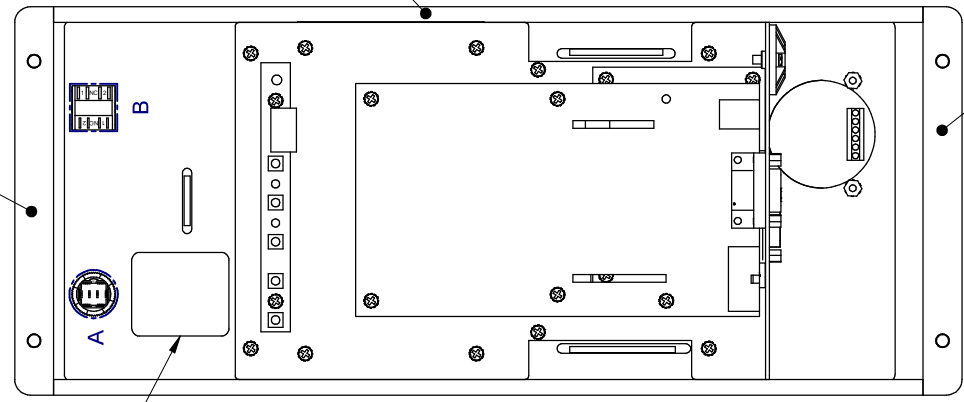
| REV | DESCRIPTION | DATE | BY | APPV |
|-----|---------------------------|---------|----|------|
| A | ADDED ITEM 15 | 7/9/14 | RO | |
| B | ADDED NOTE 4 | 12/8/14 | CH | |
| C | 23859 ITEM 12 WAS 22302-1 | 1/16/17 | DM | |



DETAIL A



DETAIL B



| REV | DESCRIPTION | DATE | BY | APPV |
|-----|---------------------------|---------|----|------|
| A | ADDED ITEM 15 | 7/9/14 | RO | |
| B | ADDED NOTE 4 | 12/8/14 | CH | |
| C | 23859 ITEM 12 WAS 22302-1 | 1/16/17 | DM | |

| | | | |
|------------------------------------|--|------------------------|---------|
| SOUTHWESTERN INDUSTRIES, INC. | | DATE | 12/8/13 |
| MANUFACTURING DIVISION OF HILLBARD | | APPROVALS | Bob |
| PANEL ASSY-2 OP M11 MILL | | ENGINEER | TO |
| 2 OP M11 MILL | | DRAWN | Sal |
| SHEET CODE: BERT, INC. | | DATE | 1/10/14 |
| PART NO: 28160 | | THIRD ANGLE PROJECTION | |
| SCALE | | | |
| SHEET 1 OF 1 | | | |

NOTES: (UNLESS OTHERWISE SPECIFIED)

- SEE ES-541 FOR TEST PROCEDURES.
- ITEM 21 USED TO MOUNT PENDANT TO MACHINE ON NEXT ASSEMBLY.
- ALIGN SERVO ON BUTTON (ITEM 10) AS SHOWN IN PHOTO & DETAIL A. (C4.D5).
- PLACE HARDWARE (ITEM 21) IN A PLASTIC BAG AND STAPLE CLOSE. TAPE BAG TO BEZEL SURFACE (A4, A7).

Parts List for Assembly P/N: 28160

Printed 1/16/2017

28160

PANEL ASSY-2 OP M11 MILL

| | | | |
|----------|------------|--------------|---------|
| Type | PL | Dwg Size | D |
| Revision | C | Product | 2OP M11 |
| Status | R | Engineer | TO |
| Date | 12/20/2010 | Planner Code | |
| By | Bob | Comm Code | |

| Item | P/N | Title | Detail | Qty | UseAs | Rev | Stat | Type | Mfr |
|------|---------------|-----------------------------------------------------------------------------|--------|-----|-------|-----|------|------|-----|
| 1 | 26364-1 | BEZEL-PANEL-5.7" LCD-M11 | | 1 | EA | - | R | DWG | |
| 2 | 27647-2 | OVERLAY-TMX-M11 | | 1 | EA | - | R | DWG | |
| 3 | 27652-2 | LCD MODULE ASSY-5.7" | | 1 | EA | A | R | PL | |
| 4 | 26039 | SWITCH-E-STOP-PUSH BUTTON | | 1 | EA | - | R | PS | |
| 5 | 26538-1 | HANDWHEEL-ELECTRONIC | | 1 | EA | A | R | PS | |
| 6 | 26040 | CONTACT BLOCK-E STOP | | 1 | EA | - | R | DWG | |
| 8 | 27669-3 | GASKET-BEZEL | | 2 | EA | - | R | DWG | |
| 9 | 27669-4 | GASKET-CLOSECELL 0.125 X 0.25 | | 2 | IN | A | R | DWG | |
| 10 | 26716-2 | SWITCH ASSY-PUSHBUTTON-SERVO ON-DBL POLE FOR REPL SEE 26716-1-1 & 26716-1-3 | | 1 | EA | - | R | PL | |
| 11 | 28160-LB1 | LABEL-TEXT-PANEL ASSY | | 1 | EA | - | R | DWG | |
| 12 | 29859 | LABEL-E STOP-YELLOW | | 1 | EA | B | R | DWG | |
| 15 | 28159 | PACKAGING-TX PANEL-5.7" LCD | | (1) | EA | A | R | PL | |
| 20 | 4-40X1/4 31Z | SCREW-PH-PHIL-EXT SEMS-STL-ZINC | | 6 | EA | - | R | PS | |
| 21 | M5-0.8X12 25B | SCREW-SHCS-STL-BO | | (4) | EA | - | R | PS | |
| 25 | M3 61Z | NUT-KEP-STL-ZINC | | 3 | EA | - | R | PS | |

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.

Disclaimers of Warranties

- 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.