TRAK® DPM V3, V5, V7
PROTOTRAK® VM CNC

Safety, Installation, Maintenance, Service and Parts List

Document: P/N 24949
Version: 063008

Southwestern Industries, Inc.
2615 Homestead Place
Rancho Dominguez, CA 90220-5610 USA
T | 310.608.4422 | F | 310. 764.2668
Service Department: 800.367.3165
e-mail: sales@southwesternindustries.com | service@southwesternindustries.com | web: southwesternindustries.com

Southwestern Industries, Inc.
2615 Homestead Place
Rancho Dominguez, CA 90220
Phn 310/608-4422 ◆ Fax 310/764-2668
Service Department
Phn 800/367-3165 ◆ Fax 310/886-8029

Table of Contents

List of Figures

1.0 Safety

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

- Read and study this manual and the DPMV Safety, Operation & Programming Manual. Be certain every operator understands the operation and safety requirements of this machine before its use.
- 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 - Milling Machine.

1.1 Safety Publications

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

Safety Requirements for Manual Milling, Drilling and Boring Machines with or without Automatic Control (ANSI B11.8-2001). 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 20210.

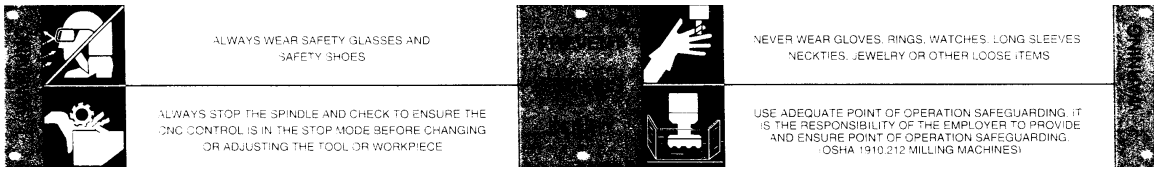
1.2 Danger, Warning, Caution, Note Labels & Notices as Used in this Manual

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 that could result in minor personal injury or equipment/product damage. Caution labels on the machine are yellow in color.

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



NOTICE: The manufacture is not liable (responsible) for any damages 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 component parts, or the use of this unit with any third party accessories or parts.

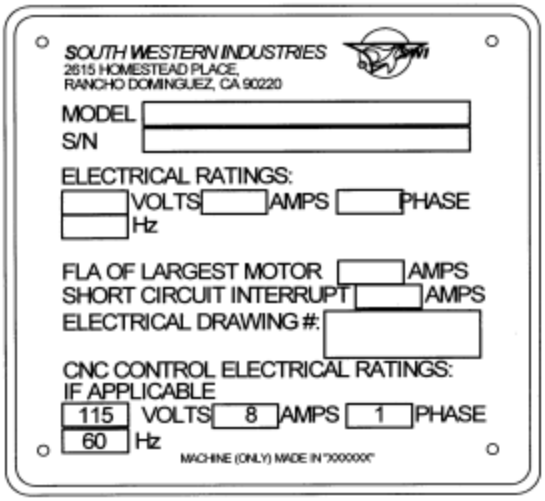
.i00775

115 Volts
208-240 Volts

Safety & Information Labels Used On The DPMV Bed Mill

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

Power Requirements at 220 Volts, 3-phase 60 HZ		
Model	**Full-load Amp of Machine**	**Full-load Amp of Largest Motor**
DPMV3	30	13.5
DPMV5	36.5	17.5
DPMV7	52	33



i00774

1.3 Safety Precautions

1. Do not operate this machine before the DPMV Safety, Operation, & Programming Manual has 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 (wrenches, check keys, etc.) 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
    - Before you make an adjustment to the part, fixture, coolant nozzle or take measurements

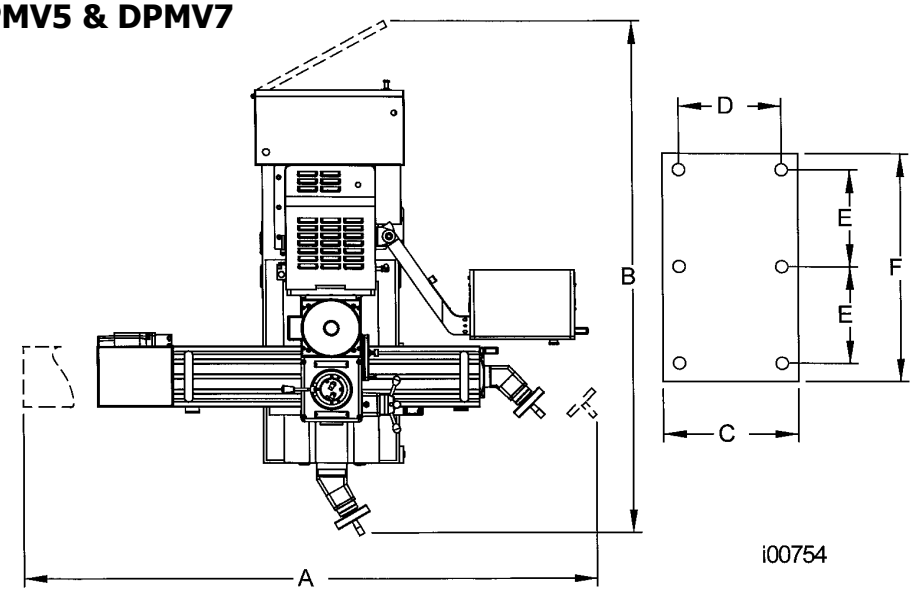
- Before you open safeguards (protective shields, etc.). Never reach for the part, tool, or fixture around a safeguard

11. Protect your eyes and the machine as well. Don't use a compressed air hose to remove the chips or clean the machine (oil, coolant, etc.).
12. Stop and disconnect the machine before you change belts or pulleys.
13. Keep work area 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 the 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.
19. Use proper cutting tools for the job. Pay attention to the rotation of the spindle: Left hand tool for counterclockwise rotation of spindle, and right hand tool for clockwise rotation of spindle.
20. 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 or power feed.
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. Large overhang on cutting tools when not required result in accidents and damaged parts.
24. Prevent fires. When machining certain materials (magnesium, etc.) the chips and dust are highly flammable. Obtain special instruction from you supervisor before machining these materials.
25. Prevent fires. Keep flammable materials and fluids away from the machine and hot, flying chips.
26. Interlocked table guards. Interlocked table guards may be purchased from Southwestern Industries, Inc. if deemed necessary by the user.

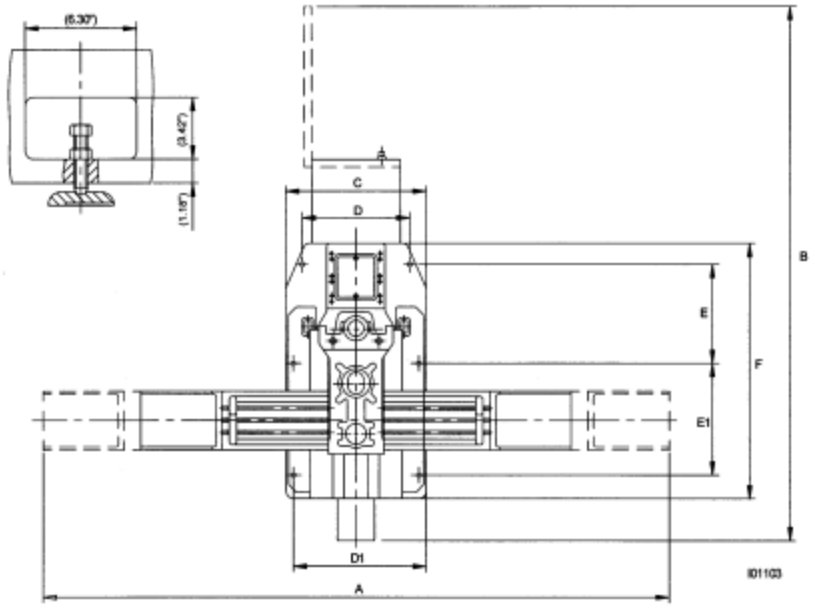
2.0 Installation

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

2.1 Floor Plan, Layout & Space Requirements – DPMV3, DPMV5 & DPMV7



DPMV3 & DPMV5



DPMV7

Figure 1
Machine Footprints

	DPMV3	DPMV5	DPMV7
Footprint of Machine	24″ x 44″	24″ x 48.4″	37″ x 62.2″
Weight (approximate) net	4100 lb.	4400 lbs.	7650 lbs.
Weight (approximate) shipping	4400 lb.	4700 lbs.	7975 lbs.
Pallet Size	6′ x 6′	6′ x 6′	90.5″ x 84″
A Overall width	104″	136″	171.65″
B Overall length	100″	103″	119.5″
C Bed width	24″	24″	37″
D Bed width between leveling screws	21.7″	21.7″	27.87″
D1 Bed width between leveling screws	N/A	N/A	34.25″
E Distance between leveling screws	18.1″	20.5″	24.21″
E1 Distance between leveling screws	N/A	N/A	24.01″
F Bed length	43.3″	48.4″	62.2"

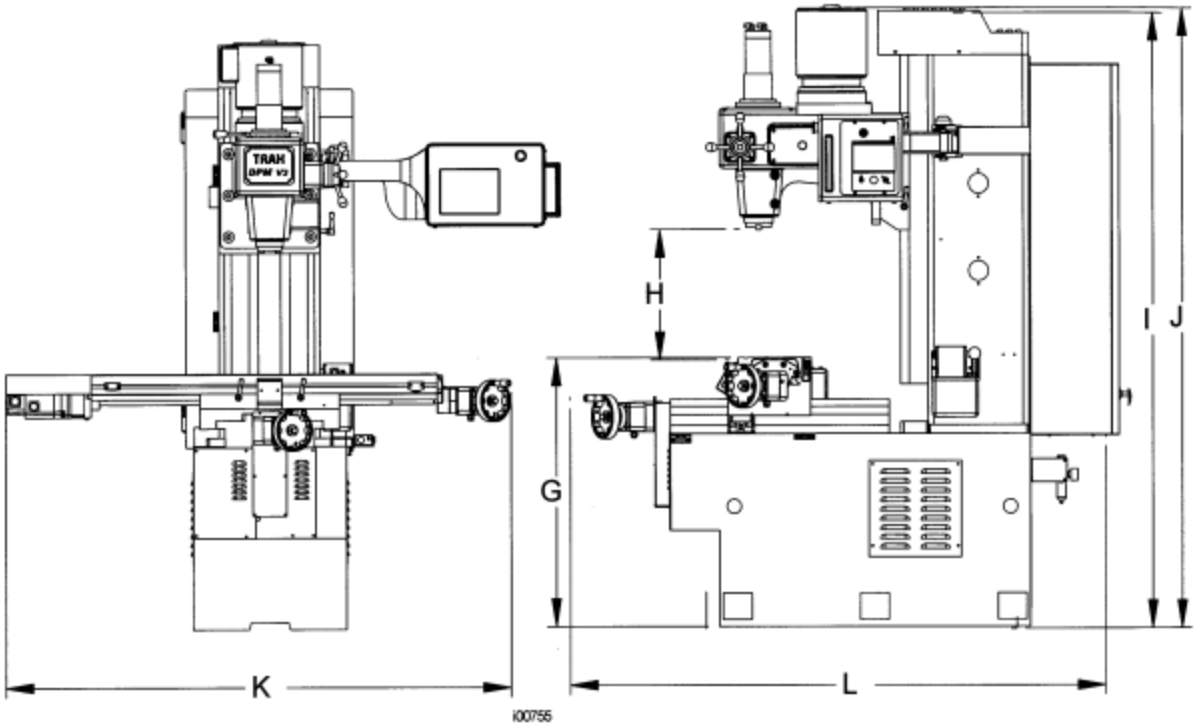


Figure 2
Overall Dimensions – DPMV3 & DPMV5

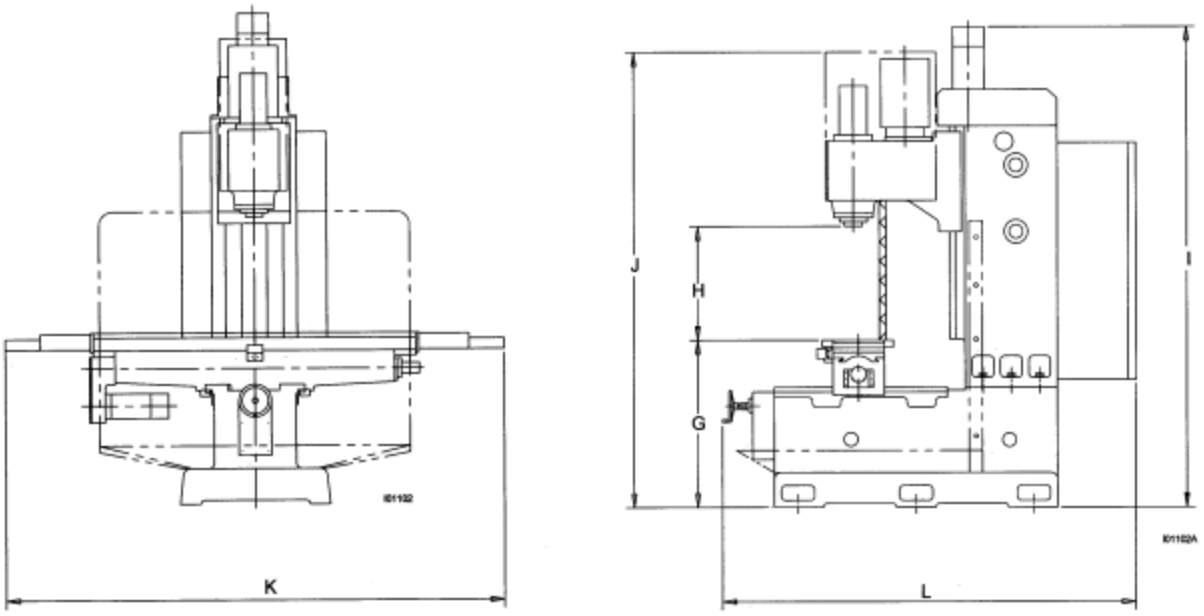


Figure 2A
Overall Dimensions – DPMV7

		DPMV3	DPMV5	DPMV7
G	Height of table from bottom of bed	38″	40″	38.25″
H	Maximum distance from spindle nose to table	21″	22.5″	21.5″
I	Height of machine from bottom of bed to top of column cover. NOTE: Top of Z-axis motor for DPMV7	85″	85.5″	91.75″
J	Height of machine from bottom of bed to top of spindle motor	98″	99″	92.5″
K	Width of machine including table	73″	94″	110.5″
L	Length of machine with electric box door closed	76″	81″	93.75″

2.2 Uncrating

Carefully remove the wood crate and protective packaging, paying attention not to scratch, damage, or mar any parts of the machine.

DPMV3 & DPMV5: Remove the cardboard boxes with the PENDANT DISPLAY (handle carefully), the box containing the TOOL BOX and Z crank. The leveling pads and screws for the machine can be found in the toolbox. The Y-axis way covers are shipped in a separate tube. The lower Z way cover can be found in a box as well.

Remove two steel bars - 1.0 inch in diameter. These items are necessary for lifting and moving the machine.

Loosen and remove 4 screws and nuts holding the machine to the wood pallet.

DPMV7 – Remove the cardboard boxes with PENDANT DISPLAY (handle carefully), the box containing the TOOL BOX. The leveling pads and the screw for the machine can be found in the toolbox. The table steel way covers, Y-axis front steel way cover, retractable rear saddle/ram bottom cover and top column covers are shipped separate with the machine.

See Section 2.8.1 for details on lifting /moving the machine.

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.

2.3 Shortages: Inventory Checklist

_____Machine (check model and serial number)

_____DPMV3 & DPMV5 - Manual drawbar (P/N 22115) with washer (P/N 22116)

_____DPMV7 - Manual drawbar (P/N 24538) with washer (P/N 24539)

_____Leveling pads (B239) and screws (B240) (6 each)

_____ Pendant Display with four 1/4-20 screws for mounting

_____ Pendant Arm assembled to the column, P/N 22328-1

_____ Toolbox with various tools (DPMV5 P/N 22358, DPMV7 P/N 24503)

_____ DPMV3 Safety, Operation & Programming Manual (P/N 22634)

_____ DPMV5 & V7 Safety, Operation & Programming Manual (P/N 24491)

_____ DPMV3, DPMV5 & V7 Safety, Installation, Maintenance, Service & Parts List Manual (P/N 24490)

_____ Table trays (DPMV5 only)

_____ Manual Z-axis crank (P/N 16526)

_____ Table way covers DPMV7 – (P/N 24505) (2 each)

_____ Way covers DPMV3 – front (B268) and rear (B267) of saddle

_____ Way covers DPMV5 – front (B268) and rear (B267-1) of saddle

_____ Way covers DPMV7 – front (P/N 24504) and rear (P/N 24506) of saddle

_____ Column covers DPMV3 & DPMV5 - bottom on column (B202), top on column (B201)

_____ Column covers DPMV7 - top on column (P/N 24522)

In case of shortages, contact the representative from whom you purchased the machine.

2.4 Installation Instructions & Checklist

Installer: Use this checklist to assure a complete set-up of the DPMV3, DPMV5 or DPMV7.

☐	1.	Shut off power to the machine.
☐	2.	Visually inspect the 220-wiring going into the electrical panel. Visually verify the wiring is correct per our wiring diagram. Make sure a strain relief is being used where the wiring enters the cabinet. Have the customer repair any wiring discrepancies.
☐	3.	Clean the machine if needed and remove any remaining grease.
☐	4.	Unlock the table, saddle, and ram gib locks.
☐	5.	Install the manual Z-axis hand crank. (DPMV3 & DPMV5 only)
☐	6.	Use a M8 Allen wrench on the Z-axis ball screw end at the top of the column to manually lower or raise the spindle head/ram. (DPMV7 only)
☐	7.	Release the counterweight support. See Section 2.9 for details.
☐	8.	Remove the manual Z-axis hand crank. (DPMV3 & DPMV5 only)
	9.	Remove the M8 Allen wrench on the Z-axis ball screw end.
☐	10.	Attach (2) wiper brushes to each table tray using (2) M5 X 10 button head cap screws (supplied) per brush. Install (1) table tray on each end of the table (DPMV5 only).
☐	11.	Install the table way covers to both ends of table. (DPMV7 only)
☐	12.	Mount the pendant to the pendant arm using (4) 1/4-20 x 3/4" socket head cap screws.
☐	13.	Make and check all the proper electrical connections from the pendant to the electric box. See the pendant and electric box wiring diagrams. Fasten servo drive cable bracket to pendant using the supplied (2) 6-32 x 3/8" screws and thumbscrew. **NOTE: Failure to secure the servo cable with the bracket may result to a fault message or improper operation of the control.**
☐	14.	If applicable, load TRAK sensors. (DPMV3 & DPMV5 only)
☐	15.	Turn on the power to the machine and to the pendant. Make sure that the 220V line is plugged in. Check the voltage coming out of the transformer across the 115V and 0V taps. The acceptable range is between 110V and 130V. Adjust taps as necessary. See section 4.8.6 for instructions.
☐	16.	Perform motor alignment routine. Press Check System key on boot up screen. It can also be accessed through Service Code 203 for DPMV3 & DPMV5 and 204 for DPMV7. This must be done initially before the machine can be jogged. Use the handwheels first to move the spindle away from any obstructions. Total movement will be approximately 1" in all directions. Make sure the gib locks are unlocked before running.
☐	17.	Lubricate all the way surfaces and the ball screws. Under service codes press the lubrication switch button to operate the lube pump.
☐	18.	Jog the table, saddle, and ram back and forth until the way surfaces are well lubricated. Oil should be visible on all the way surfaces.
☐	19.	Check the level of the machine. The machine should be level to within 0.0005" front to back and 0.0005" side to side. Even though it is the responsibility of the customer, make any adjustments if necessary.
☐	20.	Make sure all 3 electronic handwheels are functional. Use Service Code 132 to test.
☐	21.	Check to make sure that the E-Stop button is functioning correctly.
☐	22.	Perform Service Code 12, Feed Forward Constant.
☐	23.	Perform Service Code 123 to calibrate the X and Y-axis using a 150mm standard.
☐	24.	Perform Service Code 11 to automatically calculate the backlash for the X and Y-axis of a dual feedback machines (i.e. TRAK sensor or glass scale with a motor encoder).
☐	25.	Perform Service Code 127 and 128 to manually calculate the backlash for the X and Y-axis of single feedback machines (i.e. motor encoder only).
☐	26.	Check for positional accuracy and repeatability on the X and Y-axis using programs XREPEAT.PT4 and YREPEAT.PT4 respectively. Positioning and repeatability values should be less than or = to 0.0005". Programs can be found on hard drive under the PT4 folder followed

		by the SWI TEST PROGRAMS folder.
☐	27.	Perform Service Code 123 to calibrate the Z-axis ram using a 75mm standard.
☐	28.	Perform Service Code 127 and 128 to manually calculate the backlash for the Z-axis ram.
☐	29.	Check for positional accuracy and repeatability on the Z-axis using program ZREPEAT.PT4 Positioning and repeatability values should be less than or = to 0.0005”.
☐	30.	Perform Service Code 100 in both directions for the X, Y, and Z-axis to verify that the feed rate shown on the display is at least 300 ipm.
☐	31.	Run the spindle at 1000 rpm for 5 minutes and then at 5000 rpm for 5 minutes.
	32.	Install the Y-axis front and rear way covers. (DPMV3 & DPMV5 only)
☐	33.	Install the Y-axis front steel way cover. (DPMV7 only)
	34.	Install the retractable rear saddle/ram bottom cover. (DPMV7 only)
☐	35.	Install the Z-axis upper way cover and Z-axis lower cover and bracket. (DPMV3 & DPMV5 only)
	36.	Install the Z-axis upper column cover. (DPMV7 only)
☐	37.	Use accessory key on pendant and make sure solenoid fires. The accessory key should be in the ON position to test solenoid. Make sure air is hooked up to the machine during the test. Service Code 315 changes accessory key to work with either coolant pump or mister.
☐	38.	If the machine has a power drawbar option, check to make sure that the tools load and unload properly.
☐	39.	Cut a Euclid block. The total run out of the circle frame on the Euclid block must be within 0.002". Visually inspect the finish on the Euclid block and make any necessary adjustments to the machine. See the Euclid block instructions.
☐	40.	Wipe down the machine prior to leaving.

2.5 Machine Specifications

Specifications	**DPMV3**	**DPMV5**	**DPMV7**
Table Size	50” x 10”	50” x 12”	76” x 14”
T-Slots (number x width x pitch**)**	3 x 5/8” x 2.5”	3 x 5/8” x 2.5”	4 x 5/8” x 2.5”
Travel (X, Y, Z axis)	31 x 17 x 21"	40” x 20” x 20”	60” x 23” x 20.5”
Spindle Taper	#40 taper	#40 taper	#40 taper
Spindle Speed Range	200 – 5000 RPM	160 – 4000 RPM	200 – 5000 RPM
Spindle Nose to Table (max part height)	0 – 21”	0- 20.5”	0- 21.5”
Spindle Center to Column Face	19 ¼"	20 ½”	23 ¾”
Spindle Motor Power	3 HP/5 HP	5 HP	7.5 HP
Voltage	220 V	220 V	220 V
Phase/Cycle	3 phase/60 Hz	3 phase/60 Hz	3 phase/60 Hz
Current (Full load amps)	30 FLA	36.5 FLA	52 FLA
Machine Net Weight	4070 lbs	4400 lbs	7650 lbs
Maximum Weight of Workpiece	1320	1760 lbs	2200 lbs

2.6 Maximum Work Capacities

DPMV3 & DPMV5

Drilling Mild Steel	1" dia.
Tapping Mild Steel	5/8"
Milling (metal removal rate/mild steel)	5 $inch^3$/min

DPMV7

Drilling Mild Steel	1"
Tapping Mild Steel	5/8"
Milling (metal removal rate/mild steel)	7 $inch^3$/min

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. The numbers above assume all conditions are optimal and may be higher or lower depending on material composition.

2.7 ProtoTRAK VM Control Hardware

- 3-axis CNC, 3-axis DRO
- 266 PC-based processor
- 64 MB of RAM
- A.C. Servo Motors rated at 704 in-oz continuous torque for X, Y and Z-axes
- Precision ground ballscrews in the table, saddle and ram to ensure smooth accurate contours without backlash
- Feedrate override of programmed feedrate and rapid
- Programmable Spindle Speed
- Speed override of programmed spindle speed
- Polycarbonate sealed membrane and gasket sealed control enclosure to lock out contamination
- 10 ½" color LCD for clear presentation of prompts, status information and part graphics
- RS232 port for interface to computers
- Modular design simplifies service and maximizes uptime
- 2GB minimum hard drive
- Single floppy disk drive for additional part program storage
- Auxiliary function box for control of spray mist coolant, spindle off, a 110 AC outlet (coolant pump) and a programmable rotary table or indexer
- Limit switches for the X, Y and Z-axes that are installed on the table, saddle and ram to prevent crashes.
- Electronic handwheels on the X, Y and Z-axes.

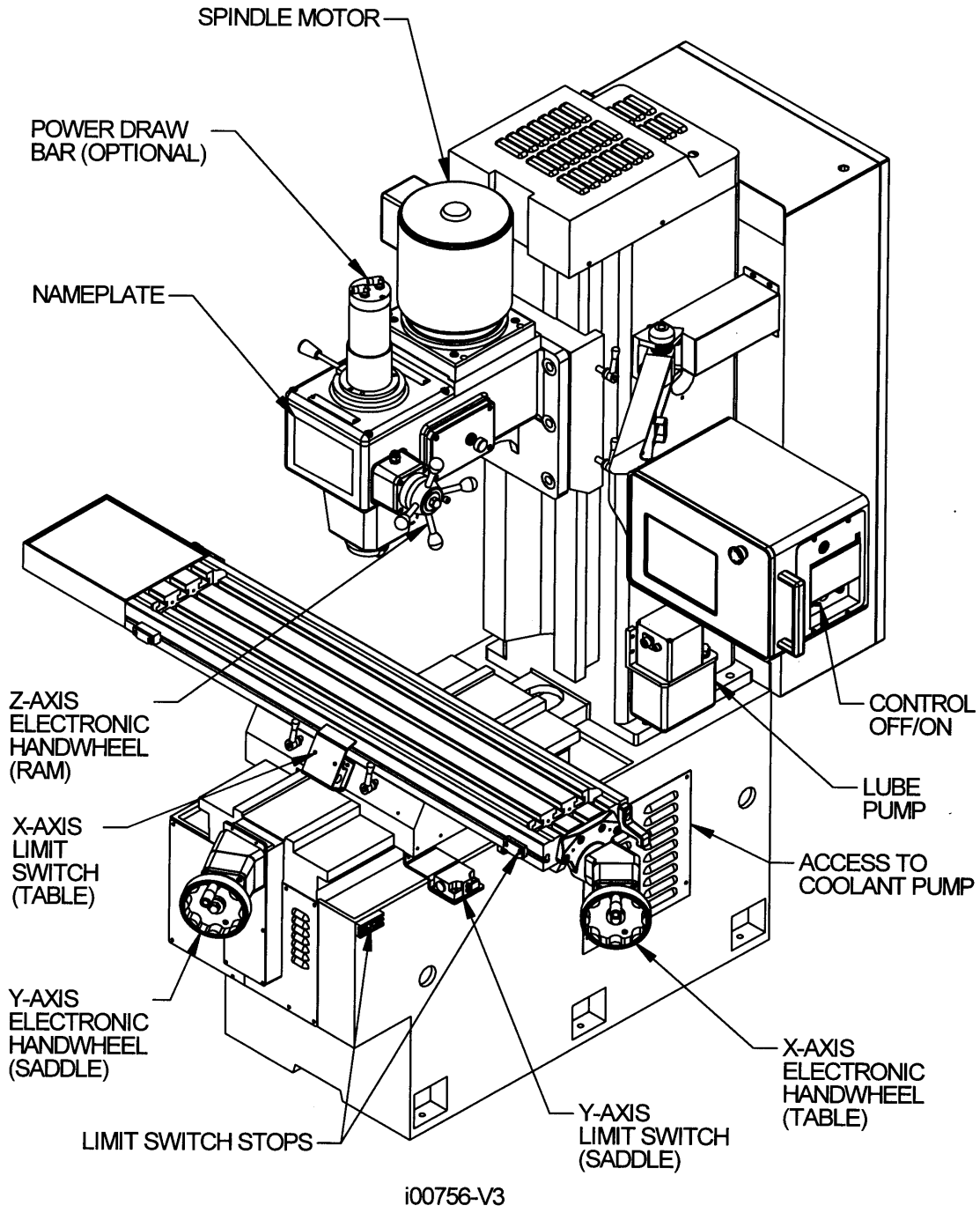


Figure 3
DPMV Component Identification

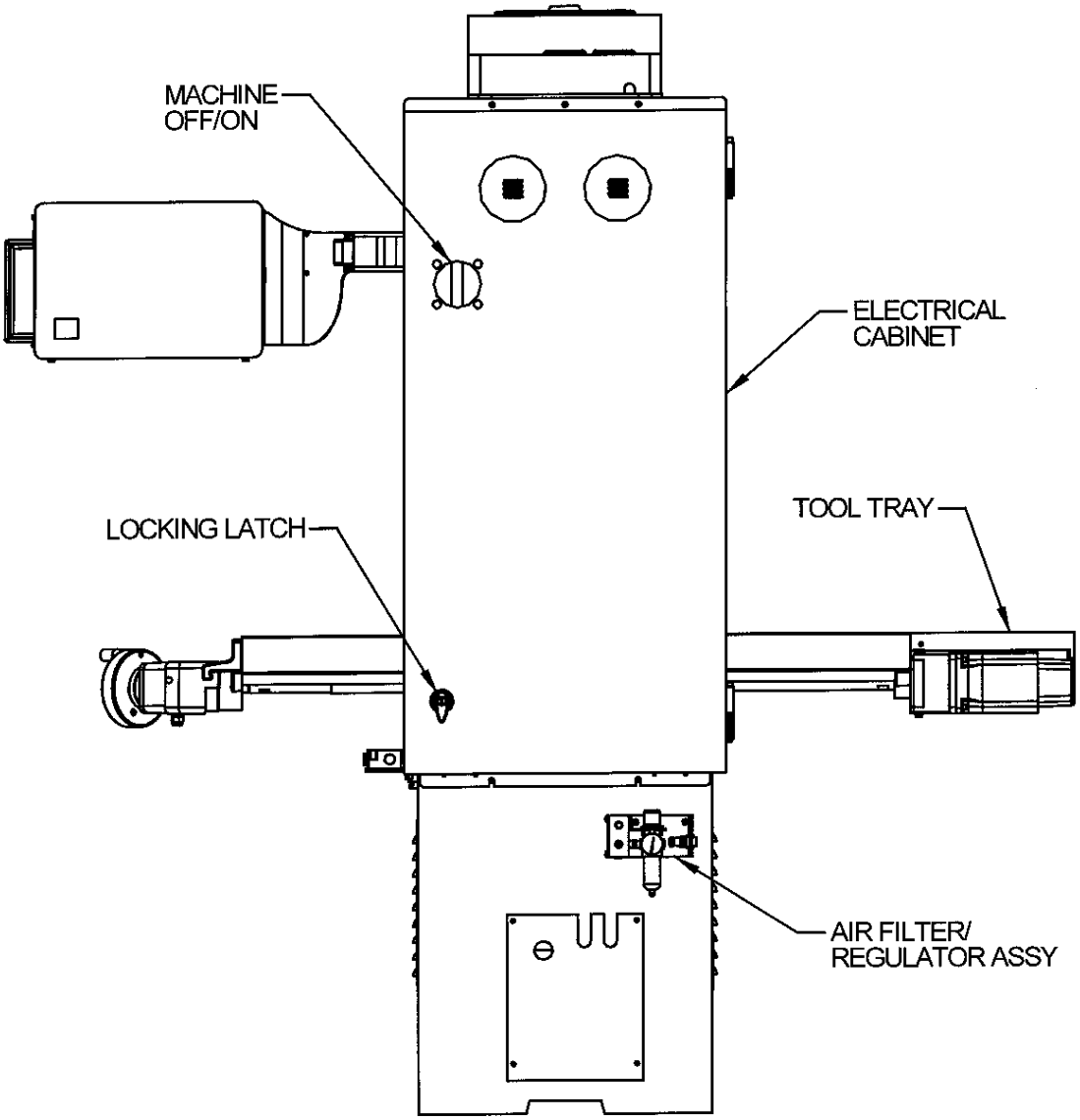


Figure 4
DPMV Rear View

2.8 Lifting and/or Moving the Machine

2.8.1 Lifting and/or Moving the Machine – DPMV3 & DPMV5

CAUTION!

The DPMV3 and DPMV5 machines weigh approximately 4100 and 4400 lbs. respectively. Proper equipment of sufficient capacity must be used when lifting and/or moving the machine.

Method 1 (see Figure 5):

1. Insert a steel bar 1.0" dia x 36" long through the rear side holes of the bed (under column).
2. Use a steel cable (with protective sleeving) min. 3/4" dia. or a 3 ton sling.
3. Use cardboard pieces or other suitable protective sheets on both sides of the machine to prevent scratching.
4. Remove the 4 nuts and screws holding the machine to the wood skid.
5. Lift the machine (the front side of the machine should be lower than the back side).
6. Insert the 6 screws for leveling pads in their place in the bed.
7. Place the machine in its location (see floor plan and bed footprint drawing) carefully positioning each leveling pad under each leveling screw.
8. Remove the lifting cable or sling, the steel bar and all protective cardboard.

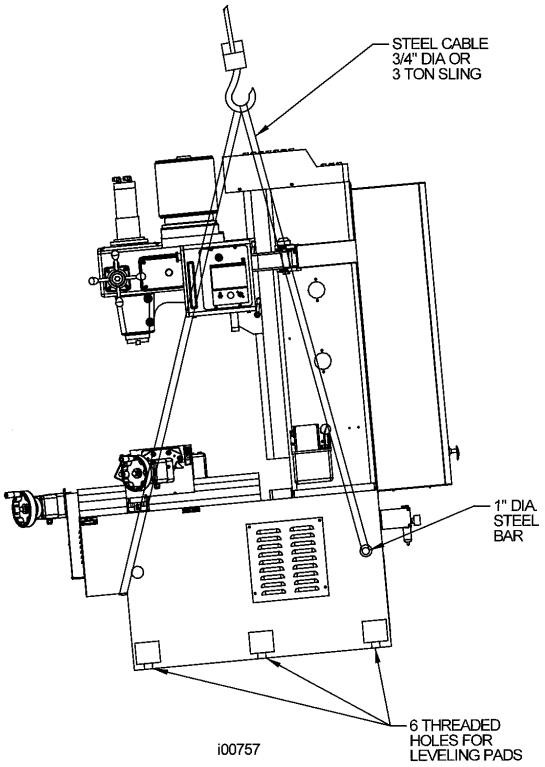


Figure 5
Lifting the Machine
Method 1

Method 2 (see Figure 6):

1. Insert 2 steel bars 1" dia x 36" long through both sides in the existing holes in the machine base (front and back).
2. Position 4 (two each side) wood vee blocks under the steel bars and over a suitable lift truck.
3. Lift the machine up (somewhat tilted towards the front) 4-6" from the ground and move it to its floor plan position.

WARNING!
The lift truck must have sufficient lifting capacity (5 tons) and be equipped with suitably long forks. When lifting the machine on the pallet, the center of gravity of the machine while on the pallet is 36" from the edge of the pallet

4. Insert the 6 screws for the leveling pads in their place in the bed.
5. Place the machine in its location (see floor plan bed/footprint) carefully positioning each leveling pad under each leveling screw.

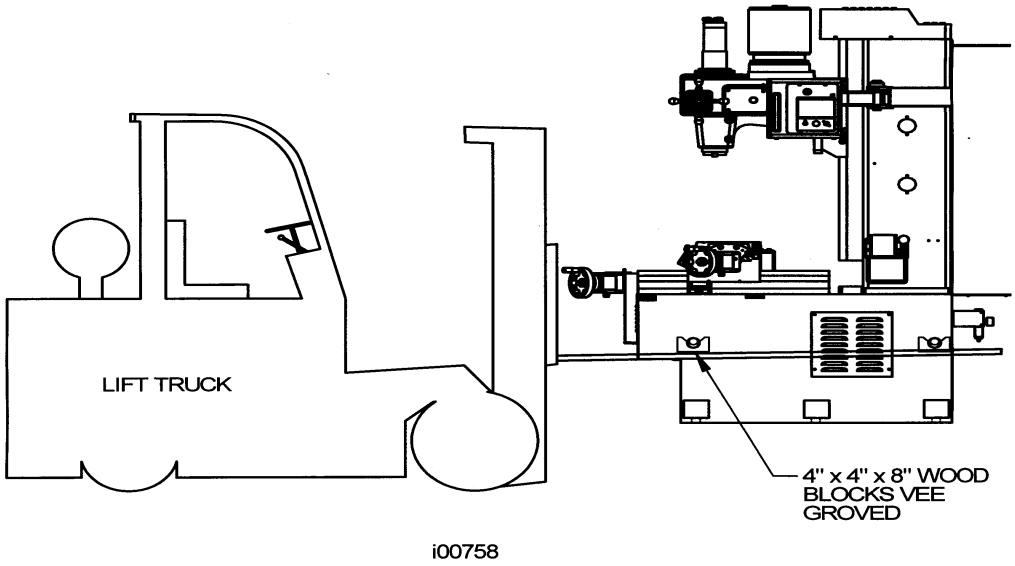


Figure 6
Lifting the Machine
Method 2

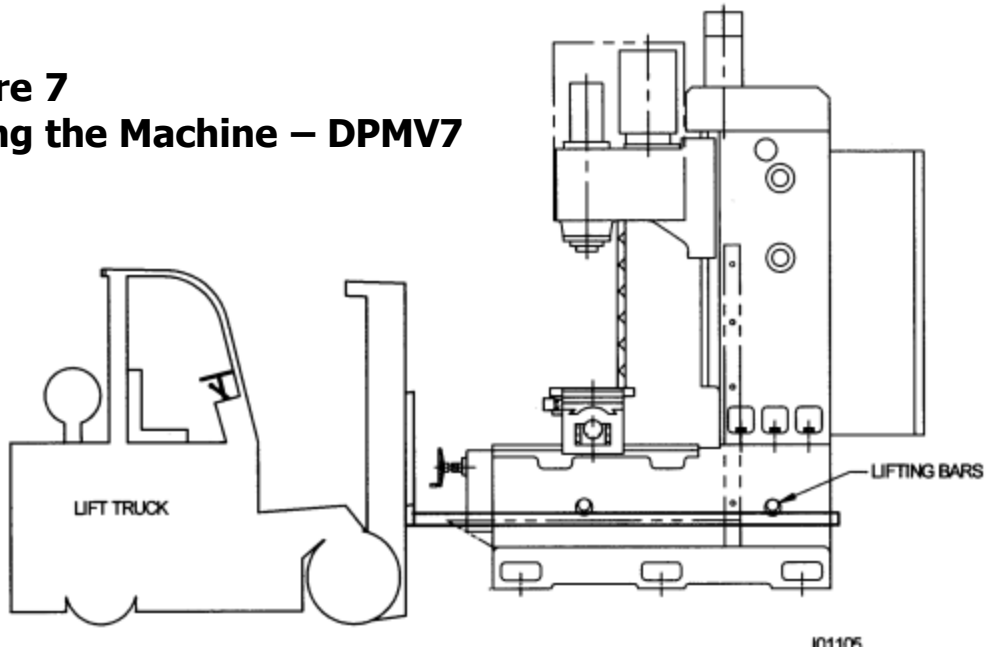
2.8.2 Lifting the machine - DPMV7 (See Figure 7)

CAUTION!
The DPMV7 machines weigh approximately 7650 lbs. Proper equipment of sufficient capacity must be used when lifting and/or moving the machine.

1. Using the recommended size forklift, lift the pallet with the machine on thru the fork pocket. (Note: The center of gravity (CG) of the machine while on the pallet is 42" from the edge of the pallet.)
2. Using (4) pieces of 4" x 4" x 6" high steel block. Equally, position the steel blocks to the front, back and side of the machine base.
3. Gradually lower the lift and let the machine base rest on the (4) steel blocks. (Note: Machine weight must be equally distributed and well supported by the (4) steel blocks also make sure that the position of the blocks does not obstruct the skid.
4. Remove forklift from steel pallet.
5. Remove the (4) bolts securing the machine base to the pallet and let the steel pallet rest on the floor.
6. Carefully lift the machine thru the fork access cut out on the side of the machine.
7. Remove steel pallet under the machine.
8. Insert the (6) leveling screws into place.
9. Position and lower the machine to its location (see floor plan bed/footprint). (Note: Make sure to position each leveling pads under each leveling screws.)

WARNING!
The lift truck must have sufficient lifting capacity (15000 lbs.) with a 24" load center or equivalent, and be equipped with 6 ft. extension forks.

Figure 7
Lifting the Machine – DPMV7



2.9 Releasing the Head Counterweight Supports

2.9.1 Releasing the Head Counterweight Supports – DPMV3 & DPMV5

In order to move (raise or lower) the spindle head/ram it is first necessary to remove the 2 steel rods (with flanges) inserted through the holes in the column. These rods support the counterweight during shipping to prevent damage to the counterweight chains and sprockets.

1. Release the spindle head/ram gib locks.
2. Using the ram crank, slowly raise the spindle head/ram and remove the wood block that supports the spindle head/ram during shipping.
3. Lower the head slowly with the ram crank until the chain between the ram and counterweight is tight.
4. Lower a little further until the 2 support steel rods are loose. Remove the 2 steel rods and store them for future machine moves or transportation.
5. Remove the panel on the bottom rear of the bed. . Verify that the lower end of the counterbalance rod guide at the bottom of the column is attached using the (2) socket-head cap screws supplied. Replace the panel.
6. Do not continue to move the head/ram until all ways have been cleaned.

CAUTION!
Do not remove the steel rods unless they are loose.

2.9.2 Releasing the Head Counterweight Supports – DPMV7

In order to move (raise or lower) the spindle head/ram, it is first necessary to remove the retaining plug that supports the counterweight located on the right side of the machine. The retaining plug support the counterweight during shipping to prevent damage to the counterweights chains and sprocket.

1. Release the spindle head/ram gib lock.
2. Using an M8 Allen wrench, turn the Z-axis ballscrew at the top of the column to slowly raise the spindle head/ram. Remove the wood block that supports the spindle head/ram during shipment.
3. Remove the (3) socket head cap screws that secure the counterweight retaining plug to the column.
4. Using an M14 Allen wrench, remove the bolt that secures the retaining plug to the counterweight.
5. Lower the spindle head/ram slowly until the chain between the ram and the counterweight is tight.
6. Lower the spindle head/ram a little further until the retaining plug is loose. Remove retaining plug and store them for future use.
7. Do not continue to move the spindle head/ram until all ways have been cleaned.

2.10 Cleaning

1. Remove rust protective coating from the machine before moving any slideways (table, saddle, ram/spindle head, etc.).
2. The coating is best removed with clean, dry rags. Do not use a cleaning solution that may damage the rubber way scrapers, plastic parts, or paint.

WARNING!
Do not use gasoline or other flammable cleaning agents for cleaning the machine**.**

3. It may be necessary to move back and forward, left and right, and up and down the table, saddle and the ram. Always release the clamp levers (two in front of the table, one underneath the saddle on each side, and two on the ram on the right side of the column) before attempting to move the above parts.

CAUTION!
Never move any of the above parts over ways that were not previously cleaned. Serious damage to the TURCITE surface of slideways can occur.

4. Be certain the table, saddle, head/ram, and spindle move freely and smoothly over their entire length.

2.11 Leveling: Leveling Tolerance for DPMV is .0005”/10”

1. Set the machine on its 6 leveling pads on a solid, level floor prepared in accordance with the state and local rules for machine tool installation.
2. Put one or two precision Spirit Levels or Electronic Levels in the center of the table in the positions illustrated in A1 and B1.
3. Adjust the 4 corner leveling screws on their pads until the machine is level to .0005 in/10 in. Snug the 2 middle leveling screws being careful to not affect the level.
4. If the machine must be anchored to the floor, follow the general instruction for installing machine tools and use for leveling any well-known methods: shims, etc.).
5. If the machine must be installed on vibration mounts/pads (rubber, commercially available leveling and vibration mounts, etc.) follow the instructions delivered with the mounts/pads, ordering them to satisfy the load of the machine and the maximum weight of the workpiece.
6. When machine is correctly level, lock the adjusting screws in place with their hex nuts.

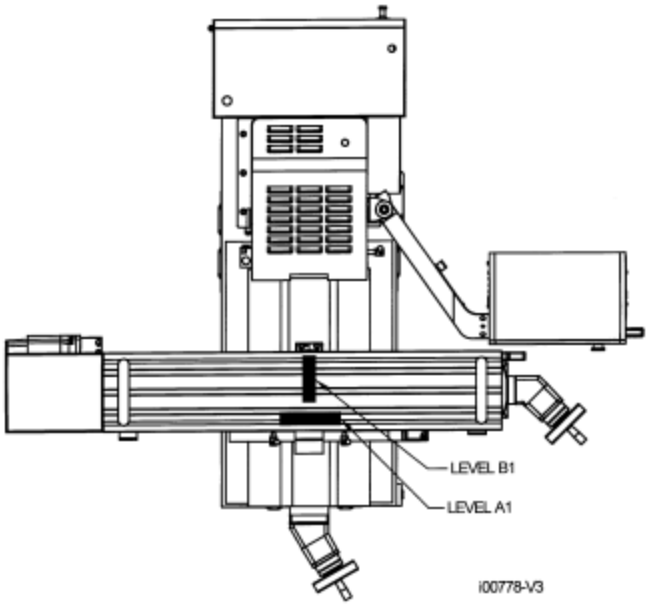


Figure 8
Placement of Levels

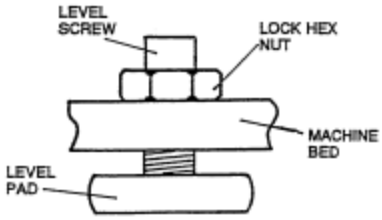


Figure 9
Leveling Screws

2.12 Electrical Connection

The DPMV3, DPMV5 & DPMV7 Bed Mills can only be configured for 208-240 volt 3 phase electricity. To run at 440V, you will need a step down transformer from 440V to 220V.

DANGER!
Be certain that 200-volt electricity (typical range 208 – 240V) is used only with a machine labeled 220 volts at the motor and at the electrics box on the back of the column.

WARNING!
440 Volts will damage expensive electrical components if machine is wired by mistake as 440 volts. These components are not covered under warranty. The circuit breaker for the machine should be a minimum of 30 amps (DPMV3 & DPMV5) and 52 amps (DPMV7).

DANGER!
The 208-240 volt line must originate from a dedicated and independent fused box with a manual shut-off lever. It is the responsibility of the purchaser to supply a wired box that meets all local codes and regulations.

The 208-240 volts wired to the machine through the electrical box located on the back of the column. The wire enters the main on/off switch through a hole on the top of the box on the left side.

DANGER!
Only a qualified electrician should wire the 208-240 volt 3-phase electricity.

Southwestern Industries recommends the machine be earth grounded by driving a copper rod into the ground. It is the responsibility of the customer to install this rod.

2.12.1 Phase Converters

For those machines that will be run with a phase converter it must be a CNC rated rotary type rather than a static phase converters. Rotary phase converters allow for varying loads in the system. The electrical load on the machine will vary based on the type of cut taken and the speed of the motor.

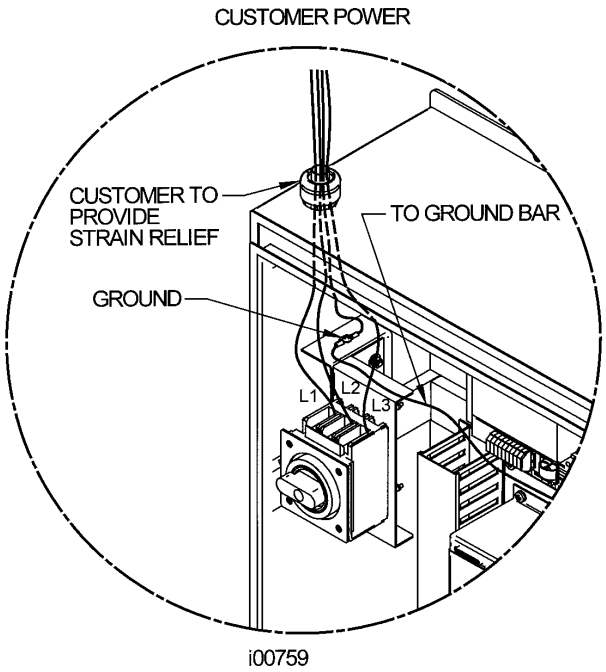
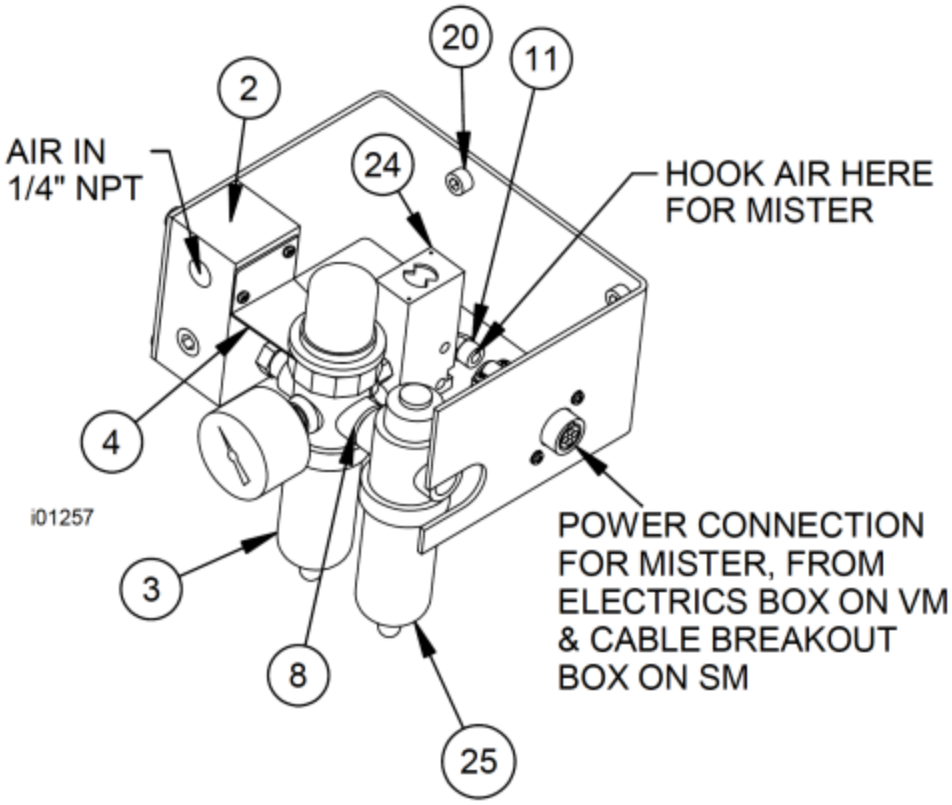


Figure 10
Wiring the DPMV3, DPMV5 & DPMV7

2.13 Air Connection

The DPMV machines have an air hookup in the rear of the machine. It includes an air regulator, air manifold, air solenoid and an oiler for a power drawbar, if the machine was ordered with this option. The air fitting is ¼ NPT. Within the manifold there is an additional airline port in case the user wants to hook up an air line to clean chips. Remove the plug to gain access to this port.

The air regulator is set to 90 psi at the factory for the power drawbar unit. See Section 5 for more information on the power drawbar unit. The air comes in through the manifold, and then into the air regulator that tees off into an oiler for the power drawbar unit and into an air solenoid. The solenoid is used for a misting system the user may install later on this machine. There is a ¼" quick disconnect air fitting on the solenoid where the mister air hose can be plugged into. See the figure below for an illustration.



2.14 Mounting the Display Pendant

The ProtoTRAK VM display pendant mounts to the pendant arm with four 1/4-20 x ¾ SHCS that are shipped screwed into the left side of the display. There is a locating screw on the pendant arm to help align the pendant with the mounting holes.

CAUTION!
The locating screw in the arm is used for positioning. Keep a hold of the pendant until the screws are fastened.

If the pendant arm rotates too freely, remove the painted cap on the bracket attached to the column and tighten the hex nut to adjust it. Replace the cap.

2.15 Cable Interconnections

All cable interconnections are made at the factory except for those connecting to the pendant display. There are a total of 9 cables that need to be connected to the pendant. See Section 6 for a complete illustration of cable interconnections for all components.

With the main power to the machine turned off plug in the connectors that are bundled on the pendant arm. Each cable mates to only one connector on the pendant display back panel. Each cable is labeled with a sticker. Use the key on the pendant to match up the connectors with the correct port. The parallel port will have a key plugged into this port. The monitor port, RS232 and network ports will be left empty during installation.

Make sure there is sufficient slack in the cables for when the pendant is rotated about the pendant arm. The worst case is when the pendant is all the way forward toward the operator. The following drawing describes all of the cable connections to the pendant.

Make sure there is a hardware (option) key plugged into the parallel port of the pendant. This key activates any converters or options ordered. The part # for this key is 22648. The key must be programmed according to the type of machine it is on and the options ordered.

CAUTION!

Make sure the main power switch is turned off on the back of the electrical cabinet before plugging in the cables.

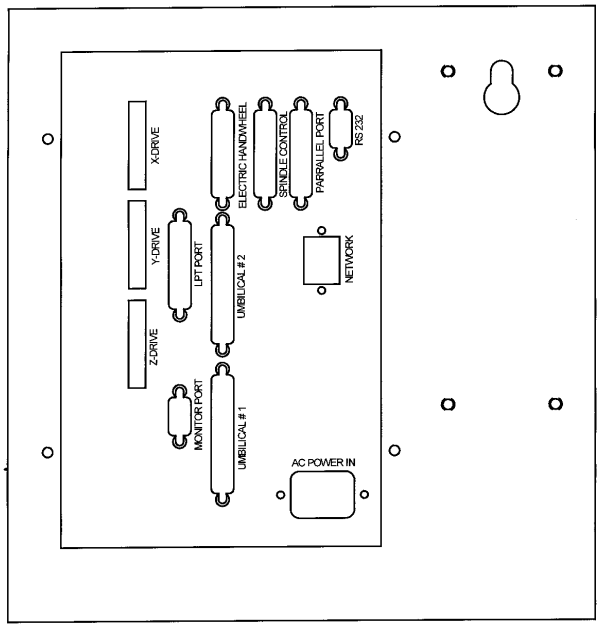


Figure 12
Pendant Cable Connections
Left Side

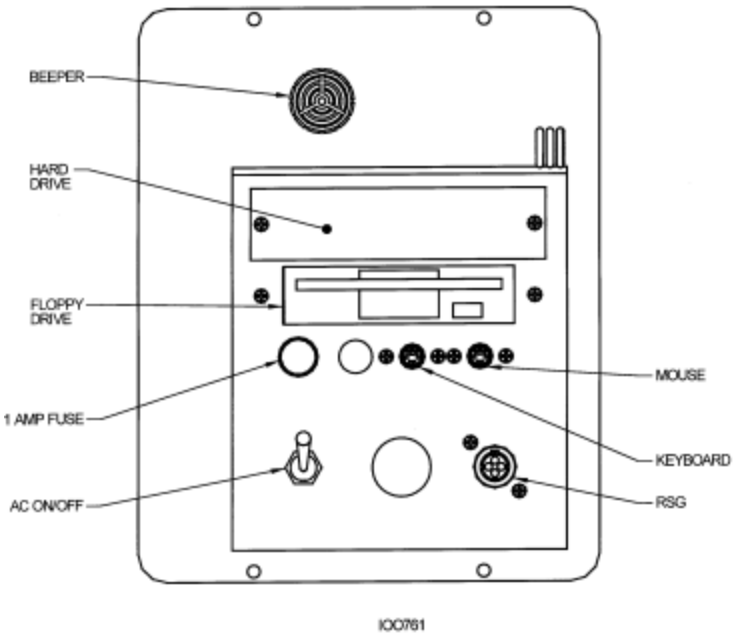


Figure 13
Pendant Cable Connections
Right Side

2.16 Lubrication

The DPMV3, DPMV5 and DPMV7 auto lube system provides centralized automatic lubrication for the table, saddle and ballscrews. The lube pump has a 2-liter reservoir filled with Mobil Vactra Oil No. 2. If Mobil Vactra No 2 is not available, use S.A.E. 30-weight oil.

CAUTION!

Oil that is too heavy and viscous such as 50W or 90W oil can clog oil line tubing. Do not mix detergent type automotive or multi-purpose oils with the Mobil Vactra Oil No. 2 used in this application.

The lube pump has electronic memory, which acts as an internal clock to keep track of the running time of the axis motors. Even when the spindle is turned off, the lube pumps internal clock will not reset. The interval between pump cycles is based on axis movement motor time.

2.16.1 Lube Pump Operation

The pumping output can be regulated electronically to control the Interval Time between pumping cycles, and the Discharge Time of each pumping cycle. The pump can also be run manually through a key found under service codes. The following describes the steps used to program the lube pumps Interval and Discharge times.

- Setting Interval time: Service Code 301
  Press "Mode", "Set up", "Service Codes", "C" (Machine Setup), Code 301, and then enter the desired Interval time in minutes.
- Setting Discharge time: Service Code 302
  Press "Mode", "Set up", "Service Codes", "C" (Machine Setup), Code 302, and then enter the desired Discharge time in seconds.
- To manually pump oil: Service Code 300
  Press "Mode", "Set up", "Service Codes", press "E", and then press Code 300 (Lubrication Pump Switch). The pump will pump oil for the amount of time programmed in Code 302. The spindle does not need to be turned on.

2.16.2 Factory Default Values

Interval Time - 60 min.
Discharge Time - 15 sec
Discharge Pressure - Approximately 100 - 150psi

To adjust the amount of Discharge Pressure displayed on the lube pump gauge, loosen the jam nut and turn the adjustment screw located on the top right side of the lube pump while the lube pump is activated. To activate the lube pump use Service Code 300.

CAUTION!
Failure to properly lubricate the mill will result in the premature failure of ball screws and sliding surfaces.

CAUTION!
Failure to manually activate the pump at the beginning of each day, or allowing the Auto Lube to run dry may cause severe damage to the DPMV3, DPMV5 or DPMV7 mill way surfaces and ball screws.

The settings for the lube pump can be viewed by doing the following: press Service Codes, press "A" (software), press Code 313. This screen lists the values programmed for the cycle time and discharge time.

See Section 6 for diagrams of how the oil lines are routed on the DPMV.

2.17 ProtoTRAK VM Euclid Block Procedure

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

The material for the Euclid block test part is found in the tool box.

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

1. Mount vise and indicate the back jaw parallel to the table within .0005".
2. Clamp material in vice with a minimum of .800" above the vise jaws.

3. Load in the Euclid block program from the ProtoTRAK VM hard drive, it is part number euclid.PT4. It is found under the PT4 folder followed by the SWI TEST PROGRAMS folder.
4. Use an edge finder to set Absolute 0 on X and Y. Absolute zero is the front left corner of the block as viewed from in front of the machine.
5. Load the .750 end mill and set Z Absolute 0 at the top of the part, and set Z reference positions in the SET UP mode. Set Z-retract a few inches above the part.
6. Begin to run the program. The part will be machined in the following sequence:

Event(s) #	Description	Depth of Cut
1	circle pocket – cuts middle circle	-0.250″
2	circle frame – cuts outer 1.830 diameter circle	-0.250″
3	circle frame – cuts material from corners remaining on Euclid block	-0.250″
4 - 12	cuts triangle on Euclid block	-0.500
13	rectangular frame – cuts outer 2.750″ rectangle	-0.750″
14 – 21	finish cut for triangle section – tool #2	-0.500″

7. After the program run, the program will locate to the following position.
   - X = 1.318
   - Y = 1.318
8. Mount a dial indicator in the quill and check the circles.
9. Check the runout of the sides of the square frame.
10. Inspect the machined surfaces for smoothness.

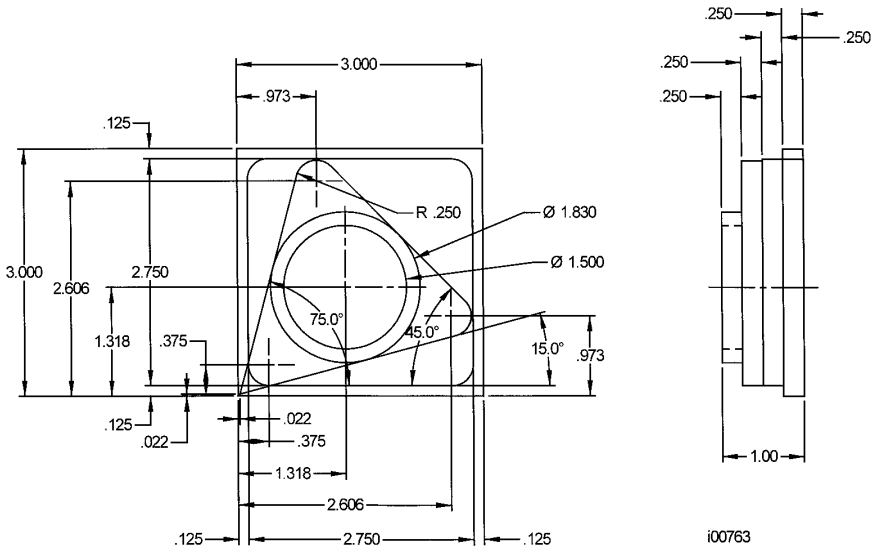


Figure 14
Euclid Block

3.0 Troubleshooting by Symptom

Use this section to begin the process of resolving a service problem. Each problem 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.

3.1 Problems Relating to Machining Results

3.1.1 Poor Finish

The part finish is marred with scallops or is very rough. It should be determined whether the cut is straight along the X or Y-axis, or at a diagonal.

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 11** Measures backlash in the system (Only used on Dual Feedback systems)
- **Code 12** Feed Forward Constant
- **Code 127** Measures backlash in the system (not used on Dual Feedback systems)
- **Code 128** Enter backlash compensation

Possible Cause	Check This
Too much backlash entered for code 128 or calculated with code 11.	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 4.1
Table, Saddle, or Ram Locks are locked	Make sure the Table, Saddle, and Ram Locks are unlocked. Never use gib locks with a CNC machine.
Inadequate or no Lubrication to Ballscrews and Way surfaces	Make sure all the Way 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 4.1.3
X, Y, and Z-axis Gibs are not adjusted properly	Check the adjustment of the X, Y, and Z-axis Gibs. See X, Y, and Z-axis Gib Adjustments in Section 5.2.1.
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 4.2
Way surfaces are pocked, scarred, or excessively worn	Visually check the condition of all the Way surfaces. For machines that may have excessively worn Way surfaces you may need to adjust the Gibs in this area. This will affect performance when using the machine outside of this area. Check lubrication to affected areas.

3.1.2 Circles Out of Round

Circles are not round within 0.002" TIR over 3.0" DIA. This is best measured by placing a dial indicator in the quill and sweeping around the part.

Note: The typical slideway-milling machine is not capable of achieving more precise results. Although careful adjustments to a new milling machine have produced better results, you should not expect the same level of accuracy from a machine of this class. If more precise circles are required, then it is recommended to use a precision boring head/boring bar.

Do the following Service Code:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 11** Measures backlash in the system (Only used on Dual Feedback systems)
- **Code 12** Feed Forward Constant
- **Code 127** Measures backlash in the system (not used on Dual Feedback systems)
- **Code 128** Enter backlash compensation

Possible Cause	Check This
Torque values on X and Y-axis are too high.	Make sure torque is lower than 20 in-lbs. Normal values for a machine that is aligned and adjusted properly should be between 10 and 15 in-lbs. Make sure torque is consistent across axis travel.
Machine Tool and Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). See Machine Tool & Setup - Section 4.1
Machine not level	Verify that the machine is level to specification.
Head is not Trammed	Verify that the Head is Trammed to specification. See Tramming the Head
X, Y, and Z-axis Gibs are not adjusted properly	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures. Section 5.2.1
Calibration or Backlash problem	Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy. See Calibration & Backlash Constants Section 5.2.2
TRAK Sensor or Glass Scale problem	Make sure that the Sensor or Glass Scale is installed correctly according to the Sensor or Glass Scale Installation procedures. Check for any loose brackets or misalignment etc. Also, check to make sure the Sensor or Glass Scale assemblies are functioning correctly. See TRAK Sensors or Glass Scales Sections 4.6 & 4.7.
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 4.2
Spindle Shaft is loose	Verify using a dial indicator whether or not the Spindle Shaft is loose. If so, it could possibly be either bad spindle bearings or loose quill etc.

3.1.3 Taper Cut on a Programmed Straight Line Move

An unwanted tapered cut occurs, when the machine is programmed to move in a straight line along either the X or Y-axis. The DRO shows motion of a few thousandths of an inch in the axis that is not supposed to be moving.

Explanation: For straight line cuts along the X or Y-axis, the control is designed to lock the motor of the axis that is not moving. A taper is created when there is play in the system. The force of the tool shoves the table or saddle out of position.
The system will respond to being pushed out of position by making an adjustment at the end of the move.

An unwanted tapered cut is the result of looseness in the system.

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 11** Measure's the backlash in the system. Only used on machines with Dual Feedback systems.
- **Code 12** Feed Forward Constant
- **Code 127** Measure's the backlash in the system. Only used on machines with no Dual Feedback
- **Code 128** Enter backlash compensation

Possible Cause	Check This
Machine Tool & Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). See Machine Tool & Setup Section 4.1
X, Y, and Z-axis Gibs are loose	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures. See Section 5.2.1
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 4.2

3.1.4 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 3.00" DIA
- **Positional Accuracy:** 0.0005"
- **Repeatability:** 0.0005"

Note: The typical slideway-milling machine is not capable of achieving more precise results. Although careful adjustments to a new milling machine have produced better results, you should not expect the same level of accuracy from a machine of this class

Furthermore, the system should be expected to repeat within the resolution of the displayed DRO numbers of 0.0005".

Do the following Service Code:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 123** Calibration
- **Code 11** Measure's the backlash in the system. Only used on machines with Dual Feedback systems.
- **Code 12** Feed Forward Constant
- **Code 127** Measure's the backlash in the system. Only used on machines with no Dual Feedback
- **Code 128** Enter backlash compensation

3.1.4.1 Every Part Has the Same Error

Possible Cause	Check This
Machine Tool & Setup problem	See Machine Tool & Setup Section 4.1
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 and backlash constants has been erased or corrupted.	Verify configuration file (Code 313) does not read default values. Load save configuration file from floppy disk in electrics cabinet with Code 141.
Calibration or Backlash problem	Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy. See Calibration & Backlash Constants – Section 5.2.2

3.1.4.2 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 4.1
TRAK Sensor or Glass Scale problem	Make sure that the Sensor or Glass Scale is installed correctly according to the Sensor or Glass Scale Installation procedures. Check for any loose brackets or misalignment etc. Also, check to make sure the Sensor or Glass Scale assemblies are functioning correctly. See TRAK Sensors or Glass Scales Sections 4.6 & 4.7
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 4.2

3.2 Problems Regarding the Motion of the Machine

3.2.1 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.

Do the following Service Codes:

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

Possible Cause	Check This
The home positions or tools are not set correctly	See the Controls Programming, Operations and Care manual.
The Sensor or Glass Scale is not reading.	See TRAK Sensors or Glass Scales diagnostic Section 4.6 or 4.7
Bad Motor Encoder	See Motor diagnostics Section 4.4

3.2.2 Slow Down Axis

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

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting.
- **Code 129** Set's the maximum allowable arc accuracy error. This applies to arcs only.

Possible Cause	Check This
The maximum allowable Arc Accuracy is set too low.	This value will only slow down the machine during arc moves. The factory default is set at 0.001". Perform Code 129 to check or change this value. See Service Codes section
Incoming AC voltage is inadequate	Perform Code 100. See Service Codes - Section 4.9 and Electrical Section 4.8
Table, Saddle, or Ram Locks are locked	Make sure the Table, Saddle, and Ram Locks are unlocked.
Inadequate or no Lubrication to Ballscrews and Way surfaces	Make sure all the Way 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 4.1.3
X, Y, and Z-axis Gibs are not adjusted properly	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures. - Section 5.2.1
Binding in the Drive Train	Check Repeatability using the Repeatability and Positional Accuracy procedure. 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 4.2
Servo Drive failure	See Servo Drive Section 4.5
Motor failure	See Motor Section 4.4

3.2.3 Axis Will Not Jog

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

Do the following Service Codes and procedures:

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

Possible Cause	Check This
Improper Boot-up	Shut down the system and wait 10 seconds before rebooting
E-Stop is pressed in	Check E-Stop. Especially if both axes will not jog
Servo Drive failure	Especially, if only one axis will not jog; See Servo Driver Section 4.5
Shorted motor	See Motor Section 4.4
Poor cable or wiring connections	See Electrical Connection Section 2.12
Computer/Pendant failed	See Computer/Pendant diagnostics Section 4.3

3.2.4 Axis Motor Motion Is Not Smooth

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

Do the following Service Codes and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 11** Measure's the backlash in the system. Only used on machines with Dual Feedback systems.
- **Code 12** Feed Forward Constant
- **Code 127** Measure's the backlash in the system. Only used on machines with no Dual Feedback
- **Code 128** Enter backlash compensation
- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting.

Possible Cause	Check This
X, Y, and Z-axis Gibs are not adjusted properly	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures. Section 5.2.1
TRAK Sensor or Glass Scale problem	Make sure that the Sensor or Glass Scale is installed correctly according to the Sensor or Glass Scale Installation procedures. Check for any loose brackets or misalignment etc. Also, check to make sure the Sensor or Glass Scale assemblies are functioning correctly. See TRAK Sensors or Glass Scales Section 4.6 & 4.7
Calibration or Backlash problem	Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy. See Calibration & Backlash Constants Section 5.2.2
Binding in the Drive Train	Check Repeatability using the Repeatability and Positional Accuracy procedure. 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 4.2

3.2.5 Vibration in Motion

While axis is moving there is vibration or noise coming from the X or Y-axis.

Do the following Service Codes and procedures:

- **Code 11** Measure's the backlash in the system. Only used on machines with Dual Feedback systems.
- **Code 12** Feed Forward Constant
- **Code 127** Measure's the backlash in the system. Only used on machines with no Dual Feedback
- **Code 128** Enter backlash compensation

Possible Cause	Check This
Too much backlash entered in Code 128 or Code 11.	Recheck the machines backlash.
Inadequate or no Lubrication to Ballscrews and Way surfaces	Make sure all the Way 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
X, Y, and Z-axis Gibs are not adjusted properly	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures. - - Section 5.2.1
Gibs not making good contact.	Pull gibs out and mark with a blue die to check where the gibs are making contact. It is recommended that the gibs uniformly contact at least 80% of the surface.
Binding or looseness in the Drive Train	Check Repeatability using the Repeatability and Positional Accuracy procedure. 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 4.2
Axis Motor belt too tight.	Loosen belt.
Misalignment of ball screw	See Mechanical Drive Train (X, Y) Section 4.2

3.3 Problems Relating to the Operation of the Control

3.3.1 Display Blanks

The display is completely blank.

Possible Cause	Check This
Screen saver has been activated	Press any key to turn back on. All LED keys on pendant will blink when the screen saver is on. Press any key to deactivate. Hitting this key will not activate any feature on the control.
The system has shut down	Turn off the power switch; check the computer/pendant fuses and cable connections. See Electrical Section 4.8
Poor cable connection from Computer Module to LCD (Liquid Crystal Display)	Double-check the connection from the computer module to the LCD.
Fuse blown in pendant	Remove fuse and check continuity
Computer/Pendant failed	See Computer/Pendant Section 4.3

3.3.2 Bad Picture on the Display

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

Possible Cause	Check This
Poor cable connection from Computer Module to LCD (Liquid Crystal Display)	Check connections on computer module.
Computer/Pendant failed	See Computer/Pendant Section 4.3

3.3.3 Keyboard Lockup

The screen display is normal, but the system will not respond to key presses.

Do the following Service Codes and procedures:

- **Code 81** press each key on the pendant. The screen will display a keypad that signifies if a key is working. The pendant will also beep.

Possible Cause	Check This
Voltage drop/spike has occurred	Shut down the system and wait 10 seconds to reboot the system.
Remote Stop-Go (RSG) switch has a short (if connected)	Remove the RSG. Turn the system off and then on again. If the problem goes away and then re-appears when the RSG is plugged-in, replace the RSG.
Poor cable connections from the Computer Module to the Distribution Board and from the Distribution Board to the Keyboard	Re-seat cable connectors by pulling out and pushing back in.
Computer/Pendant failed	See Computer/Pendant Section 4.3
Electromagnetic interference has entered through the RS232 cable (if connected); especially if intermittent	Especially suspected if the RS232 cable is run near any electrical conduit. If the problem is chronic, remove the cable for a while to see if there is a difference.

3.3.4 Fault X, Y or Z

The program run or jogging operation is interrupted with a 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.
- **Code 11** Measure's the backlash in the system. Only used on machines with Dual Feedback systems.
- **Code 12** Feed Forward Constant
- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting.

Possible Cause	Check This
Servo cables at pendant switched around.	Make sure during an installation the X, Y and Z servo cables at the pendant are in the correct ports.

Possible Cause	Check This
Table, Saddle, or Ram Locks are locked	Make sure the Table, Saddle, and Ram Locks are unlocked. High torque on any axis may cause faulting problems during alignment routine.
X, Y, and Z-axis Gibs are adjusted extremely tight	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures. See X, Y, and Z-axis Gib Adjustments Section 5.2.1
Excessive friction in the slideways	See Machine Tool & Setup Section 4.1
Binding or looseness in the Drive Train	See Mechanical Drive Train (X, Y) Section 4.2
Incoming electrical power	Incoming voltage. See Electrical Section 4.8
Measurement system not functioning properly	See Section 4.6 or 4.7
Servo Drive failure	See Servo Driver - Section 4.5
Motor failure	See Motor diagnostics, Section 4.4
Computer/Pendant failure	See Computer/Pendant diagnostics, Section 4.3

3.3.5 Problems Reading the Floppy Disk; Programs Not Saved Properly

The floppy drive will not read or write programs from a disk.

Possible Cause	Check This
Improper Boot-up	Shut down the system and wait 10 seconds before rebooting
Floppy Disk failure	The Floppy Disk may be bad. See if the Floppy Disk can be read by a Personal Computer. Does the green light on the floppy drive come on when you access the disk? If so, power is getting to the floppy drive. If not check connections of floppy drive inside the computer module. See Computer/Pendant Section 4.3 for more information.
Floppy Disk full	Put the Floppy Disk into a Personal Computer to see how many bytes remain.

3.3.6 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
Main Disconnect switch is off	Check the Main Disconnect switch.
Pendant On/Off switch is Off.	Check the Pendant On/Off switch
Fuse blown in pendant or the 2 transformer fuses.	Remove fuse and check continuity. Is the power strip light on?
Incoming 220VAC is too high, too low or not present	Using a Voltmeter, check the incoming 220VAC to the machine. See Electrical Section 4.8
Bad Fuses in electrics box	Check the 2-Transformer fuses, 1-Power Strip fuse. See Electrical Section 4.8
Out coming 110VAC from Transformer is too high, too low or not present	Using a Voltmeter, check the out coming 110VAC from the Transformer. See Electrical Section 4.8
Out coming 110VAC from Power Strip is too high, too low or not present	Using a Voltmeter, check the out coming 110VAC from the Power Strip. See Electrical Section 4.8

Possible Cause	Check This
Poor wiring and cable connections	Check for any loose wiring. Also, check the 110VAC Power Cable connection from the 110VAC Power Strip to the Pendant. See Electrical Section 4.8
Bad cable from the 110VAC Power Strip to the Pendant.	Using a Voltmeter, check the out coming voltage from the 110VAC Power Cable to the Pendant. See Electrical Section 4.8
Hard Drive failure	When the Computer Module starts the boot-up process, look at the 8th line on the Display Screen. If the Mother Board of the Computer Module is communicating with the Hard Drive you will see "Detecting IDE Primary Master … Toshiba MK6014MAP". If the Mother Board of the Computer Module is not communicating with the Hard Drive you will see "Detecting IDE Primary Master … None". Also, check the wiring connection between the Hard Drive and the Mother Board. See Computer/Pendant diagnostics Section 4.3
Computer/Pendant has failed	See Computer/Pendant diagnostics Section 4.3

3.3.7 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
Incoming 220VAC is too high, too low or not present	Using a Voltmeter, check the incoming 220VAC to the machine. See Electrical Section 4.8
Out coming 110VAC from Transformer is too high, too low or not present	Using a Voltmeter, check the out coming 110VAC from the Transformer. See Electrical Section 4.8
Out coming 110VAC from Power Strip is too high, too low or not present	Using a Voltmeter, check the out coming 110VAC from the Power Strip. See Electrical Section 4.8
Bad cable from the 110VAC Power Strip to the Pendant.	Using a Voltmeter, check the out coming voltage from the 110VAC Power Cable to the Pendant. See Electrical Section 4.8
Poor wiring and cable connections	Check for any loose wiring. Also, check the 110VAC Power Cable connection from the 110VAC Power Strip to the Pendant. See Electrical Section 4.8
Computer/Pendant failed	See Computer/Pendant diagnostics Section 4.3

3.3.8 System Shuts Off

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

Possible Cause	Check This
Fuse blown in pendant	Remove fuse and check continuity
Incoming 220VAC is too high, too low or not present	Using a Voltmeter, check the incoming 220VAC to the machine. See Electrical Section 4.8
Bad fuses in electrics box	Check the 2-Transformer fuses, 1-Power Strip fuse. See Electrical Section 4.8
Out coming 110VAC from Transformer is too high, too low or not present	Using a Voltmeter, check the out coming 110VAC from the Transformer. See Electrical Section 4.8

Possible Cause	Check This
Out coming 110VAC from Power Strip is too high, too low or not present	Using a Voltmeter, check the out coming 110VAC from the Power Strip. See Electrical Section 4.8
Poor wiring and cable connections	Check for any loose wiring. Also, check the 110VAC Power Cable connection from the 110VAC Power Strip to the Pendant. See Electrical Section 4.8
Bad cable from the 110VAC Power Strip to the Pendant.	Using a Voltmeter, check the out coming voltage from the 110VAC Power Cable to the Pendant. See Electrical Section 4.8
Hard drive failure	Check the hard drive connections in the computer module.
Computer/Pendant has failed	See Computer/Pendant diagnostics Section 4.3

3.3.9 Will Not Hold Calibration

The control will not hold calibration. Go to the "Configuration Values" screen and write down the calibration values for the motor encoders (Encoder) and the position feedback encoders (Scales). The calibration values are written in Hexadecimal. Recalibrate the system and see if the values change. Turn the system off and on and see if the values are held.

Do the following service codes and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 313** Configuration Values
- **Code 123** Calibration Mode

Possible Cause	Check This
Not saving Calibration values	Replace Computer/Pendant module. See Computer/Pendant

If calibration factors are being saved, but the measurements are not repeating or are not accurate:

- See Measurements Are Not Repeating
- See Measurements Are Not Accurate

3.3.10 Auxiliary Functions Not Working

The Auxiliary Functions will not turn on or off at the programmed times. There are 4 Auxiliary Functions:

1. Activates or deactivates a "110VAC Receptacle" typically used for a coolant pump.
2. Activates or deactivates an "Air Solenoid" typically used for a mister.
3. Sends an electrical signal to rotate the turret on a "Haas Indexer".
4. Turns the "Spindle Off" at the end of a programmed event.

In order to run the 4 above auxiliary functions in run mode the accessory key on the front of the pendant must be in the AUTO mode.

Do the following service code and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 315** allows mister or coolant pump to be run with accessories key on pendant. Toggles one or the other on and off.

Possible Cause	Check This
Bad 110VAC "Coolant" receptacle fuse or bad 110VAC "Mister" receptacle fuse	Check if the fuse light indicator next to the plug is lit. Verify that the fuses are good or bad by checking the resistance of the fuses using an Ohmmeter.
Poor cable connections	Check all the cable connections on the Auxiliary Module, Coolant Pump, and Air Solenoid (Located on the Air Regulator)
Faulty 110VAC "Coolant" receptacle	Activate the 110VAC "Coolant" receptacle (Located on the Auxiliary Module) by pressing the Accessory Button (Located on the Pendant) until the LED designated "On" is illuminated. The "Light" next to the 110VAC "Coolant" receptacle should illuminate when the receptacle is activated. Check the 110VAC "Coolant" receptacle with a Voltmeter.
Faulty 110VAC "Mister" receptacle	Activate the 110VAC "Mister" receptacle (Located on the Auxiliary Module) by pressing the Accessory Button (Located on the Pendant) until the LED designated "On" is illuminated. The "Light" next to the 110VAC "Mister" receptacle should illuminate when the receptacle is activated. Check the 110VAC "Mister" receptacle with a Voltmeter.
Faulty "Haas Indexer" connector	Check for continuity between pins 3 and 4, when the output of the Haas Indexer connector is activated.
"Spindle Off" does not work	Turn the Spindle on or off using the Spindle Switch.
Bad cables	Check the functionality of the cables on the Auxiliary Module, Coolant Pump, and Air Solenoid (Located on the Air Regulator) using a Voltmeter. Check for continuity, short circuit, and open circuit conditions.

3.3.11 E-Stop Error

The E-Stop cuts power to the Coolant pump, Mister, and Lube pump by de-energizing a relay, which is internally hard-wired inside the Auxiliary Module. The signal that is responsible for de-energizing the relay comes down from the Computer Module to the Auxiliary Module through the Spindle Control cable. Furthermore, the Auxiliary Module sends a signal to the Spindle Drive causing the Spindle Drive to command a "Servo to Stop", which cuts power to the Spindle Motor. This signal is sent from the Auxiliary Module to the Spindle Drive through the Spindle Drive cable.

In Addition, when the E-Stop is activated, the Computer Module sends a "Servo to Stop" command to each of the X, Y, and Z-Drive Modules. This cuts the power to the X, Y, and Z-axis Servomotors. These signals are fed down from the Computer Module to the X, Y, and Z-Drive Modules through the X, Y, and Z-Drive Module cables. Check the X, Y, and Z-axis Drive Modules for fault messages.

If the E-Stop button is depressed, and no message is displayed on the screen, then either the E-Stop button or the Computer Module is at fault. Check the E-Stop button and the cable connection from the E-Stop button to the Computer Module.

Possible Cause	Check This
Faulty E-Stop switch	Check the cable connections from the computer module to the E-Stop switch. Check the E-Stop switch for functionality.
Bad Computer Module	Assuming that the E-Stop Switch and cable to the Computer Module are good, if the E-Stop button is depressed, and no message is displayed on the screen, then replace the pendant.
Bad spindle auxiliary module	Replace module
Bad spindle control cable	This cable runs from the computer module to the auxiliary module.

3.3.12 Motor Alignment Routine does not Work Properly

The Motor Alignment Routine calculates the relative position between the motor poles on the stator and the magnets on the rotor through the use of the motor encoder. Once the stator and rotor are aligned, the encoder's absolute zero is set. The routine also distinguishes which type of motor is being used on the machine. The routine can last up to 30 seconds. After 30 seconds, the routine will under go a Time-out. If the motor alignment routine fails to work properly, a message should appear on the display prompting the user that the motor alignment routine has failed.

Possible Cause	Check This
Gib locks are on or mechanically one axis has very high torque.	Unlock gib locks and measure the torque on each axis. It should be less than 20 in-lbs.
Servo driver failure	See servo driver diagnostics Section 4.5
Motor failure.	See motor diagnostics Section 4.4

3.3.13 Limit Switch Error

Limit switches are installed on the table, saddle, and ram to prevent serious damage to the machine in the event of a crash. Each individual limit switch has two separate plungers. One plunger is responsible for triggering in the positive direction, while the other plunger is responsible for triggering in the negative direction. The limit switch will trigger when the table, saddle, or ram moves past the available travel. In the event a limit switch is triggered, the following error message will be displayed.

Critical Error 5252: Limit Switch Active
The Y-axis Limit Switch is activated.
Use the Handwheels to Move off the Switch.

When this happens, the control will not allow the operator to continue to jog or manually move the table, saddle, or ram in the same direction. Also, under these conditions the jog button will be disabled.

To return the machine to its normal state of operation, perform the following procedure:

1. Use the electronic hand wheel to move the table, saddle, or ram off the limit switch.

2. Press the "Mode" or "Return" key to reset the control.
3. Press the "DRO" key to enable the machine to once again jog.

Do the following service code and procedures:

- **Code 312** Toggles limit switches on/off – this will turn the limit switches on or off. This is a temporary fix for the problem and allows the user to run the machine until a replacement part can be installed. If the limit switches are turned off and a problem occurs because of a crash, this will not be covered under warranty.

Possible Cause	Check This
Limit Switches are triggered	Reset the Limit Switches using the procedures described above.
Poor Limit Switch Cable connection	Check for any pins that are loose, pushed in, or bent. Verify that there is a good connection between the cable and the Auxiliary Module.
Limit Switch failure Try this Switch 2 limit switch cables on the auxiliary module in the electrics box.	Turn off all power to the machine. For the positive direction, check for continuity between pins 1 and 6 on the Limit Switch cable connector. You should hear a continuous beep from your Multi-meter. By hand, manually depress the plunger on the limit switch responsible for when the table, saddle, or ram is moving in the positive direction. The beep from your Multi-meter should stop beeping. This means the Limit Switch is triggering properly for the positive direction. For the negative direction, repeat the same procedure as described above using pins 5 and 9 on the Limit Switch cable connector. Does the limit switch problem move to the other axis? If it does then the switch is most likely the problem. If it stays with the original axis then it could be the auxiliary module or computer module. See below.
Auxiliary or Computer Module failure	Turn off all power to the machine. Use two paper clips to jumper connector pins 1 & 6 together and 5 & 9 together on the Auxiliary module for the limit switch port in question. Next, turn on all power to the machine. This will verify whether or not the Auxiliary Module and the Computer Module are working properly. If there is still a failure, look at the "Product # " listed under "Configuration Values" (Mode, Setup, Service Codes, A-Software Version, More). This "Product # " represents the type of configuration for the machine type. The "Product # " should read "1" for DPMV3, "2" for DPMV5 and "35" for DPMV7. The Machine I.D. Key (located on the Auxiliary Module) configures the system according to machine type. If the Computer Module reads the correct "Product # ", then the Computer Module is good and the Auxiliary Module is bad. However, if the Computer Module reads the incorrect "Product # ", then the Computer Module is bad and the Auxiliary Module is good. Of course this is all under the assumption that the Auxiliary Module has the correct Machine I.D. Key.

3.4 Problem with the Measurements

3.4.1 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. 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 so, it may be caused by a misaligned sensor or scale. If the error abruptly changes by a large amount, it may be caused by a bad encoder.

Expected repeatability numbers should be 0.0005" or less.

Do the following service codes and procedures:

- **Code 304** Toggle X sensor/glass scale on/off
- **Code 305** Toggle Y sensor/glass scale on/off

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 4.1
X, Y, and Z-axis Gibs are loose	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures. – Section 5.2.1
TRAK Sensor or Glass Scale problem	Make sure that the Sensor or Glass Scale is installed correctly according to the Sensor or Glass Scale Installation procedures. Check for any loose brackets or misalignment etc. Also, check to make sure the Sensor or Glass Scale assemblies are functioning correctly. Use service codes 304 for X and 305 for Y to turn off the suspect encoder. Does problem still exist after turning it off? – Section 4.6 & 4.7
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 4.2
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.

Possible Cause	Check This
Spindle and/or Quill are loose	Use a Dial Indicator and check for side-to-side movement between the Spindle and the Head. Next, check for side-to-side movement between the Quill and the Head. There should be no more than 0.0003" of side-to-side movement. Make sure that there is a few thousandths gap between the Spindle Collar and the Quill after tightening.
Ram bolts are loose	Tighten Ram bolts

3.4.2 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.

Note: If your part has incorrect dimensions, see Parts Have Incorrect Dimensions, Section 3.1.4.

Note: First check for repeatability of the DRO: With a dial indicator mounted to the bottom of the spindle, touch off a fixed surface either in the X, Y, or Z-axis direction and set the DRO equal to 0. Crank away several inches and touch off again at the same place. If the reading has not returned to 0 on the DRO, zero the display and repeat the procedure. If the measurement does not repeat, you have a repeatability problem that must be resolved before the accuracy problem can be resolved. See Measurements That Do Not Repeat, Section 3.4.1.

Possible Cause	Do This
The Calibration is incorrect	Recalibrate the machine. See Calibration & Backlash Constants Section 5.2.2
Incorrect backlash values	If the machine does not repeat bi-directionally check the backlash on the axis in question. See Section 5.2.2.

3.4.3 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 section on faulting.

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting.
- **Code 132** Electronic handwheel test
- **Code 304 & 305** Turns off X and Y sensor or scale.

Possible Cause	Check This
Electronic handwheel failure	Each handwheel should count 0.200” per revolution in both directions in fine mode and 0.800” per revolution in course mode.

Possible Cause	Check This
Servo driver failure	Check the LED status on the axis in question. See Servo driver Section 4.5
Motor Encoder not counting	See Motor diagnostics (not applicable with Glass Scale option) Section 4.4
Glass Scale or Sensor Failure	Does axis now count? If so, replace scale.
Computer/Pendant failure	See Computer/Pendant diagnostics

3.4.4 X, Y, and Z-axis DRO Counting in Wrong Direction

The DRO is counting in the wrong direction.

The positive directions for each axis are:

- **X-axis** – Table moves to the left
- **Y-axis** – Saddle moves toward the front of the machine
- **Z-axis** – Ram moves up

Do the following service code and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 313** Check the line that specifies the product.
  Product = 1 for DPMV3
  Product = 2 for DPMV5
  Product = 35 for DPMV7

If the product does not match the machine then the machine ID key will need to be replaced.

3.4.5 X, Y, and Z-axis Electric Handwheels Turn in Wrong Direction

The Electric Handwheels turn in the wrong direction.

The positive directions for each Electric Handwheel are:

- **X-axis** - Electric Handwheel turns clockwise
- **Y-axis** - Electric Handwheel turns counterclockwise
- **Z-axis** - Electric Handwheel turns clockwise

Do the following service code and procedures:

- **Code 308** Reverse X-axis Handwheel Direction
- **Code 309** Reverse Y-axis Handwheel Direction
- **Code 310** Reverse Z-axis Handwheel Direction

3.5 Problems with the Machine Tool

3.5.1 Z-axis Noisy

While jogging or cutting in the Z-axis direction, the axis makes unusual noises. See below for head noise.

Possible Cause	Check This
Machine Tool and Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). See Machine Tool & Setup Section 4.1
Ram Locks are locked	Make sure the Ram Locks are unlocked.
Inadequate or no Lubrication to the Ballscrew and Way surfaces	Make sure all the Way 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 4.1.3
Z-axis Gibs are not adjusted properly	Check the adjustment of the Z-axis Gibs using the Z-axis Gib adjustment procedure. See Z-axis Gib Adjustments Section 5.2.1
Mechanical Drive Train	Misalign ballscrew, or top and lower bearing failure.
Z-axis motor failure	Replace Z-axis motor See Motor Diagnostics Section 4.4

3.5.2 Spindle Stalls or Turns-Off during Machining

During machining, the spindle turns off and loses power. First check incoming voltage and connections.

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 4.1
Drive Belt in the head is slipping	Check the alignment, condition, and tension of the Drive Belt.
Cut more than the machine is capable	Check width and depth of cut
Auxiliary Function "Spindle Off" is being used in the program	Check how the program is written. Also, check the program for any programming errors regarding the Auxiliary Functions. See the Controls Programming, Operations and Care manual.
Spindle Drive Thermal Overload Relay has tripped	IOUT - Current Out (located on the Spindle Drive). The current has exceeded the limit of the drive. When the Overload Relay is enabled, an "oL1" error occurs shutting off the Spindle Drive. The harder the Spindle Motor works trying to make heavy cuts, the more current the Spindle Motor utilizes. This can be caused by a cut so large that it exceeds the machine capability, or a problem with the spindle motor or AC drive.
Spindle Drive parameters are not correct	May need to re-download the Spindle Drive parameters. Contact Customer Service for assistance.

3.5.3 Spindle Motor Hums or Will Not Run

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

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

Possible Cause	Check This
Wrong voltage	Check the voltage to the machine before and after the Spindle Drive Fuse Block (F2) with a Voltmeter. Also, check the voltage to the Spindle Drive (L1, L2, and L3).
1 of the 3 fuses for the Spindle Drive is blown	Check each of the 3 fuses in the Spindle Drive Fuse Block (F2) for continuity with Ohmmeter. See Electrical Connection 2.12
Poor wiring connections	Check all the wiring connections to the Main Disconnect Switch, Spindle Drive Fuse Block, Spindle Drive, and Spindle Motor. See Electrical Connection
Defective cables or poor cable connections	Check the Spindle Control cable and cable connection between the Auxiliary Module and the Spindle Drive. Check the Spindle Control cable and cable connection between the Pendant and the Auxiliary Module. See Electrical Connection
Improper wiring/jumper configuration on the Spindle Motor	Check to make sure that the Spindle Motor has the correct wiring/jumper configuration for 220VAC. See Electrical wiring section.
Spindle Drive may be in "Local Mode" and can not be run from the Pendant	On the Spindle Drive, push the "DSPL" button until "LO/RE" lights up. Use the "Up" and "Down" arrow keys to choose between "Lo"- Local (Run Spindle Motor from Spindle Drive) or "rE" - Remote (Run Spindle Motor from the Pendant).
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.

3.5.4 Spindle Runs Backwards

The spindle motor runs in the opposite direction. The spindle should always spin in the clockwise direction when the forward key on the pendant is pressed.

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

3.5.5 Head Noise

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

Possible Cause	Check This
Machine setup or tooling problem	If the noise is most evident under load (cutting situations) then it is important to look at setup and tooling being used. Ask the following questions. Is the cutter dull? Is the tool loose in the holder? Am I taking a bigger cut then is possible on the machine? Is the part moving in the vice? Am I using realistic speeds and feeds? Any one of these can have a significant impact.
Motor coupling misalignment DPMV3 & DPMV5: 2-pc head only	This may be evident after the motor has been replaced or removed for some other reason. The noise will be emanating from the rear portion of the head. This is cause by the coupling on the motor and the coupling on the motor pulley shaft not being aligned with one another. Loosen the 4 bolts that hold the motor down and turn on the spindle. Realign the motor couplings by pushing or pulling on the motor. Tighten down the bolts once the noise quiets.
Belt is loose	Check to make sure the tensioning device is properly fastened. Make sure the lock nut is tight that holds this device in place.
The belt is not lined up with the grooves on the pulleys.	Make sure the 8-grooves on the belt are lined up with the 8-grooves on the 2-pulleys. Remove the upper spindle cover to verify. If the belt is frayed then replace the belt.
Idler bearings are worn out. DPMV3 & DPMV5: 2-pc head only	The belt-tensioning device uses 2-idler bearings to tension the belt. The noise should be more evident as the RPM increases. Loosen the belt tension as the spindle is running, and see if the noise fluctuates. If it gets quieter as you loosen the belt tension and louder as you tension the belt, then check the idler bearings.
Bearings on motor pulley shaft. This shaft is below the motor and not part of the motor. DPMV3 & DPMV5: 2-pc head only	Try to isolate these bearings by loosening the belt from the spindle pulley. Loosen the belt-tensioning device completely. Turn the spindle on and run only the motor and this shaft. If the noise is gone then it probably is a problem with the spindle bearings. If it persists then check the bearings on this shaft. Be careful the belt does not catch when only running the motor shaft! If this happens turn the spindle off immediately.
Quill clamps and quill bolt are loose. DPMV3 & DPMV5: 2-pc head only	Make sure the quill clamps that hold the quill are tight. Torque these bolts to no more than 10 ft-lbs. Make sure the 3/8 bolt on the left side of the head is tight.

Possible Cause	Check This
Upper spindle bearing is worn out. DPMV3 & DPMV5: 2-pc head only	Remove the upper bearing plate above the spindle. This will unload the bearing. If the noise goes away then this bearing should be replaced.
Verify nosepiece is tight on bottom of spindle.	To check if the nosepiece is bottomed out try to insert a piece of paper in between the nosepiece and the quill. If a piece of paper does fit then this may be the problem. Before tightening or loosening the nosepiece make sure to loosen the setscrew that holds it in place.
Spindle bearings are worn out	This is categorized by a high pitch sound and is most evident at high RPM's. It should also cause chatter under load. Replace the spindle if this is the case. See spindle replacement in Section 5.

4.0 Diagnostics

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

4.1 The Machine Tool & Set-Up

4.1.1 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 Replacement	Noisy head; Parts incorrect; Circles out of round	Older machines, machines that are pushed hard
Lubrication system	Premature wear of ball screws, wear surfaces, poor finish	New installations (may not be hooked up or line sheared)
Inadequate lubrication habits	Premature wear of ball screws, wear surfaces Poor finish	New installations (more motion than the machinist is used to with a manual mill) Lubricate machine every morning before use.
Gib locks - on X and Y axis	If locked can lead to axis faults. Unlock locks and run CODE 203 for V5; 204 for V7	Note: when using the CNC to machine, never tighten the gib locks!
X and Y gibs loose See Gib Adjustment - Section 5.2.1	Taper on straight Y moves Poor finish Circle out of round	When machine hasn't been serviced in a long while.
Gibs too tight	Not getting to position, does not repeat, axis faults Poor finish	N/A
Gibs floating	Not getting to position, does not repeat, axis faults Poor finish	Contact area of gibs. May need to be scraped. Very old machines may not have any more adjustments on gib. A new gib will need to be fit on the machine.
Gibs defective - bowed, scarred	Excess play when gib is checked side to side	Inadequate gib contact
Way surfaces pocked, scarred, or excessively worn	Poor finish Out of round circles Faulting	Inadequate lubrication
Ram gibs loose	Parts incorrect dimensions Head out of tram in Y direction.	Vibration or jerky motion in Z axis
Machine not level Weight not distributed evenly on all 6 screws. See Leveling procedures	Parts incorrect Machine geometry off, i.e. tram.	New installation or heavy crash.
Head out of tram See Tramming Head – Section 5.2.3	Leaves uneven surfaces on bottom of pockets.	Machine not level, ram gibs loose.
Spindle belt loose	Machine stalls during a heavy cut	Make sure belt tensioning device in locked in place. Belt is worn after many years of use.

4.1.2 A Special Word About X/Y/Z Gibs

The slideway surfaces are vital to the performance of the bed mill.

Gibs should be:

- flat
- free of twist
- free of burrs
- free of blockages in the oil passages and channels

Defective or scarred gibs must be replaced. Shimming of gibs will not yield acceptable results.

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 sliding way surfaces and compromising the performance of the machine.

Gibs that are not adjusted correctly will affect the performance of the machine. It will lead to positioning and repeatability problems. The gibs should be adjusted at least twice a year.

See Gib Adjustments Section 5.2.1.

4.1.3 Lubrication

Lubrication is one of the single, most important maintenance issues and plays a key role in assuring the performance and durability of the bed mill. At the beginning of each day manually supply oil to the way surfaces by doing Service Code 300.

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

4.1.4 Machining Set-Up

The machining set-up itself is always something that can greatly influence the performance of the your mill. The following are some things to keep in mind.

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.
Tooling Using the wrong cutter for an application Entering the wrong size diameter and programming with tool compensation.	Poor finish 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

4.1.4.1 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.

4.1.4.2 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.

4.2 The Mechanical Drive Train (X, Y)

Indications:

- Troubleshooting instructions indicate that the drive train is potentially the problem and other (more easily checked variables) have been exhausted.
- Roughness, looseness, tightness or jamming movement in the table or saddle.

1. Check for machine considerations, especially gib locks and gib adjustments. See Gib Adjustments section
2. Check the torque of the axis in three places (both ends and center of ball screw) along the length of the ball screw. The torque should be within 2 or 3 in-lbs across the length of the ball screw. If it is not, chances are the ball screw is misaligned. A misaligned ball screw can lead to parts being out of round and servo problems at low feedrates. A bad ball screw can also cause high torque, although this is highly unlikely. See Sections 4.2.1 and 4.2.2 for more information.

The following steps take you in logical sequence through the assemblies for the DPMV3, DPMV5 and DPMV7. For drawings of these assemblies see Figures 26, 27, 28 and 29 in Section 5. These instructions break the machine down from fully assembled and point out the areas to look at specifically.

3. Check that the belt is properly tightened. A loose belt can lead to excessive backlash compensation values on motor encoder only machines. To adjust belt tension, loosen the (4) screws that secure the motor to the bracket. Adjust motor for proper belt tension as necessary. See the drawings for illustrations.
4. Check that the nut that tightens up against the ball screw pulley is tight. If this is loose the pulley may not run true on the ball screw.
5. DPMV3 & DPMV5 X-axis only - Check that the tapered sleeve that seats the pulley has not clamped to the ball screw prematurely. It should be seated firmly against the pulley. Tightening the nut may not have ensured this. Also make sure the pulley is keyed to the ball screw.
6. DPMV3 X-axis only - Ensure that the screws that hold the bearing housing in place to the bracket are not loose.
7. DPMV5 X-axis & Y-axis bearing housings - Ensure that the bearing housing is clamped in place by the bracket. This design uses the bracket to secure the bearing housing in place. It should not allow the bearing housing to float between the bracket and machine. For the DPMV7, verify the bearing housing cover is properly fastened.
8. DPMV3 & DPMV5 X-axis & y-axis - Ensure that the Clamp Nut is secured. The following applies to the clamp nut:
    - When loosening, make sure to back out the 10-32 screw from the clamp nut.
    - When tightening, snug the 10-32 screw so the clamp goes onto the ball screw thread with some drag. Thread it onto the ball screw and torque the clamp nut to 50 ft/lbs and then tighten the screw down.

    For the DPMV7, verify the nut on the X-axis, and double nut on the Y-axis is tight.
9. Take out the angular contact bearings and inspect them. They should roll smoothly and be lightly greased. If not, replace them. When putting the bearings back into the housing make sure to put them in correctly. Failure to do this will cause problems. The thin race of each bearing should be facing inward toward the spacer ring.
   Note: DPMV3 & DPMV5 - the bearing housing and spacer ring are matched sets - keep them together.
10. Check the ball screw mounting to the yoke. Make sure the SHCS are tight.
11. Inspect the ball screw, ball nut and yoke for the potential problems shown in the chart on the next page.

CAUTION!
Unlike a lead screw, do not unscrew the ball screw from its nut. This will destroy the ball screw!

Potential Problem:	Check By:
Bad ball screw	• Visually inspecting the ball nut - if the nylon seal is broken or deformed, if contamination has visibly entered the ball nut or if balls are out of the ball nut, replace the ball screw. • Cranking the ball screw through a significant part of its travel. If it jams, feel loose or has rough spots, replace the ball screw. • Using the dial indicator on a vertical flat of the ball screw to check for backlash between the ball screw and ball nut.

Potential Problem:	Check By:
Ball nut not tightened to the yoke	• Inspection for space between the head of the bolt and the ball nut i.e. the retaining bolt has bottomed out in its thread and is not securing the ball nut to the yoke properly.
Yoke loose in the saddle	• Inspection for any motion of the yoke or looseness in the Yoke mounting screws.
Oil lines sheared	• Visual inspection.
Oil line blockage	• Pump the oil and ensure that it flows evenly to the ways and ball screw.
Ball screws not aligned properly	• Measure from the ball screw to the back of the saddle on both sides of the yoke (the table must be removed). The measurements must be within ±.005" end-to-end. See above explanations.

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.

4.2.1 Keys to Ball Screw Alignment

- X-axis – there are 3 components that can cause misalignment: the yoke, the left side bearing housing bracket, and the right side bearing housing. This machine has 2 separate yokes for the X and Y-axis. The yoke is bolted to the table on the X-axis.
- DPMV3 & DPMV5 - X Axis Yoke – the yoke is aligned at the factory. If you suspect the yoke is misaligned, the bolts for the yoke can be accessed from an opening on the bottom left side of the saddle. Break these bolts free and move the table back and forth along its travel and then retighten the bolts.
- Left side table bearing housing – To align the bracket, move the yoke (table left) as close to the bracket as possible. Loosen the bracket bolts and then retighten. This should allow the bearing housing to align itself up with the yoke.
- Right side table bearing housing – once again move the yoke as close to the bearing housing as possible (table right). Loosen the bearing housing and retighten. This should allow the bracket to align itself. If you do not move the table toward the yoke the ball screw will tend to bend down slightly and cause misalignment.
- Y-axis – the only component that can cause a misalignment problem is the motor mounting bracket. To align this bracket, move the saddle as far to the front of the machine as possible. Loosen the bracket and then retighten it. Once again moving the saddle forward allows the yoke to be as close to the bearing housing as possible. The yoke is pinned at SWI should not become misaligned unless the machine has been repeatedly crashed.

4.3 Computer/Pendant Diagnostics

The pendant consists of 3 separate modules: the computer module, the hard drive module and the sheet metal and LCD screen.

In general, the pendant/computer module is best diagnosed by eliminating all other possible alternatives. The following table lists some problems and what these problems can lead to.

Possible problems	Can lead to
Poor cable connections	There are 9 cable connections to the left side of the pendant. Make sure all cables are properly fastened.
Pendant locks up	Press the E-stop button and see if lock up clears if not then do the following: Turn the pendant off, wait at least 30 seconds, and turn it back on and check to see if the malfunction has been reset.
No voltage to RSG port	RSG will not work – should be 5 volts present Check with a voltmeter.
Low voltage to hard drive or slave board.	Can cause the system to lock up and the hard drive to act abnormally. Check voltage to power cable at hard drive module with voltmeter. It should be 4.8 volts and above. Lower values than this can cause problems.
Hard drive failure	If the hard drive fails, the system will not boot up or operate. It will need to be replaced. All programs and machine configurations will be lost. Make sure to back up your hard drive from time to time. Only the hard drive module will need to be replaced.
Floppy disk failure	Will not allow user to save or pull up programs from a floppy disk. Can the floppy drive format a disk? See instructions below.
LCD backlight burns out	Check all cable connections to LCD, distribution board and computer module. Make sure the power is turned off before doing so.
Faulty E-stop switch	It can be stuck open or closed (pressed). If it is stuck closed the pendant will need to be replaced because the user will have no way to get rid of the message. If it is open it will allow the machine to still operate but it will be unsafe for the user. The pendant will still need to be replaced.
Axis faults on screen	Servo driver cables at pendant are loose. Make sure cable connection bracket is fastened down. Make sure cable clips into female portion on the top and bottom. Sometimes the clips tend to stick.
Overlay failure (keys on pendant)	Certain buttons on overlay do not work. Do code 81 to verify each key beeps.
Low voltage to pendant or current spikes	1 amp fuse in pendant blows. Pendant will not turn on.
Slave board not functioning	Machine will not run. If under Code 33 it says "Firmware Edge," it means the slave board is not functioning.

4.3.1 Checking Floppy Drive by Formatting a Disk

1. Find a new disk and install in floppy drive.
2. Install keyboard into middle port.
3. Press CTRL ESC to get to start menu.
4. Press R for run.
5. Type Format a: - press enter.
6. If the format works your disk drive is working. If format does not work, reboot control and see if it now works. If it does not work replace the computer module.
7. Press ALT ESC to get back to PT4 software.

4.4 Motor Diagnostics

The Motor subsystem is comprised of 2 parts: The Motor Encoder and the Motor. The motors are powered by 3-phase AC voltage. The servo driver is also an integral part of servo system, which is discussed in detail in the next section.

WARNING!

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!

Rarely do both the X and Y motor/servo systems fail at the same time and in the same way. So, if your problem is occurring on both axes, its source is probably somewhere else.

4.4.1 Motor Alignment Routine – Code 203 DPMV3 & DPMV5; Code 204 DPMV7

This service code needs to be performed each time the ProtoTRAK is turned on, new software is installed or motors have been replaced. The control will boot up automatically to this screen. Press the Check System key and follow instructions on screen.

WARNING!

It is important that there are no obstructions on any axis before running this code. If there is an obstruction, then use the electronic handwheels to slowly move the machine away from the obstruction.

Each axis will move approximately 1" during this routine. The handwheels will not move at the normal feedrates during this routine. Failure to move each axis away from an obstruction will cause a crash.

Code 203 calculates the relative position between the motor poles on the stator and the magnets on the rotor through the use of the motor encoder.

4.4.2 Cable Connections

Check the motor cable connections on the motor side as well as the servo side. Make sure the threaded connectors on the motor side are fully threaded in place. The connectors should thread down about 7 to 8 turns for both the motor power cable and motor encoder cable. On the servo side make sure the 3 phase wires are plugged properly into the servo driver. The wires should be placed into the servo driver from left to right with the red wire on the left and the black wire on the right. Failure to put the correct color wire into the correct port may cause the motor to run in the wrong direction. Make sure none of the wires are crimped on the insulation instead of the fork connector. Also verify each motor cable ground wire is fastened to the side of the aluminum heat sink which the servos are mounted on. Check the connection of the motor encoder cable on the encoder module.

4.4.3 To Check the Motor Encoders

If the motor encoder inside the motor has failed or is not reading the machine will fault out on that axis. Do the following to verify this problem:

Motor encoder only machines – run Service Codes 100, 101 or 102. This will display on the DRO if the motor encoder is counting. If this number does not move then the encoder is not counting. This means either the encoder or the cable is the problem. Visually check the cable for any problems. If the encoder has failed the motor must be replaced.

Motor encoder and secondary feedback machines – run Service Codes 100, 101 or 102. Both the motor encoder and sensor or glass scale encoder should count on the DRO screen.

The motor value should be displayed under the Z-axis and the sensor or glass scale under the X or Y-axis depending on what axis you are doing.

4.4.4 Encoder Counts to Pendant

Before replacing the motor due to a bad motor encoder it is a good idea to check the cables that take those signals back to the pendant. If these signals are not getting back to the pendant then the axis will fault. Check the following cable connections.

- Umbilical #1 and #2 at the encoder module
- Umbilical #1 and #2 at the pendant
- Check the servo driver connections at the pendant and also at the servo driver

4.4.5 Moving Problem from One Axis to Another

Another way to troubleshoot a problem with a particular axis is to swap parts from 1 axis to another to see if the problem moves. If the problem moves then that component is faulty. See the example below.

Symptom – X Axis will not move and faults

This particular problem can happen because of any of following reasons: bad motor, servo driver, power cable, or computer module. In some cases it is not always obvious which component is causing the problem. This example will help us pinpoint the problem through a trial and error process.

Let's assume we have narrowed it down to the servo or electrical systems and the Y-axis has no problems. Lets also assume it is not an obvious problem like a loose connection. This particular example was done on a machine with motor encoders only.

Swap these components	Results
Physically switch the X and Y motors	Has problem moved to Y-axis? If yes, replace motor. If no, the motor is not the problem.
Switch X and Y encoder cables on encoder module and X and Y servo driver cables at the computer module. This runs the Y motor with the X port on the computer. Jog the X and the Y-axis should move.	Has the problem moved to the Y-axis? If yes, the X port on the computer is the problem, replace the pendant. The signal is not getting from the computer to the servo driver and on to the motor. If no, the X servo driver is most likely the problem. It could also be a problem with the servo driver cable that runs from the pendant to the servo driver or the power cable from the servo driver to the X motor.
Switch X and Y motor power cables at the servo driver, switch X and Y motor encoder cables on encoder module. Jog the Y-axis key and the X-axis will move. Jog the X-axis key and the Y will move.	This allows the X motor to be run with the Y servo driver and Y port on the computer module and the Y motor to be run with the X servo driver and X port on the computer. Has the problem moved to the Y-axis? If yes, then it is the X servo driver, replace this component. This also proves that there are no problems with any of the cables.

4.5 Servo Drivers

The servo drivers are located in the electrics box on the lower right side. They are positioned from top to bottom as X, Y and Z.

Indications:

- Problems moving just one axis. The axis faults out on the screen.

Servo Types:

- X, Y and Z servos are identical.

Objective:

- Isolate the problem to the particular Servo Driver

The input signal to each servo driver is 220 VAC 3 phase power. Inside the servo driver this input signal is transformed into a direct current output signal and reconfigured to simulate a 220 VAC signal with varying frequency. The servo driver takes the commands from the computer module and varies the frequency of the 220 VAC output signal, thus the speed of the motor.

SWI uses two different brands of servo drive modules. One servo drive module is manufactured by SemiPower Systems and the other is manufactured by MTS Systems. Although both brands of servo modules are almost identical, there are some subtle differences with the LED codes that are displayed.

4.5.1 Cap Block

Above the Y axis servo driver is a component called a cap block. The cap block serves 2 purposes: it filters the input signal voltages to the servo drivers and it is a current reserve for the servos. In other words it acts like a battery and stores energy for the servo system. When the motors are commanded to move, initially they will draw power from the cap block. If this component fails the servo system will not work. Most likely the fuses labeled

under F3 (T1, T2 and T3) will be blown or there will be visible damage to the cap block itself.

If one suspects a CapBlok failure, use a voltmeter (DC mode) to verify that the voltage between the terminals, "+B" and "-B" is approximately 300VDC. Terminals "+B" and "-B" are located at the top left corner of each of servo drive module. Next check for any loose wiring connections to the servo drive modules and to the CapBlok.

WARNING!

Make sure to first turn the power off and unplug the machine. Wait about 10 minutes or so for the CapBlok to discharge. Use a voltmeter to verify the voltage between terminals, "+B" and "-B" are safe before handling.

4.5.2 Servo Driver Cooling Fan

The PowerBlok drive modules in the electric box are temperature dependent (See Fault Code 5 - Substrate over-temperature). Therefore, SWI has mounted the servo drive modules to a heat sink to help transfer heat away by means of convection. On the bottom of the aluminum extrusion that the servos mount to sits a 12 VDC fan that cools the servo system. The temperature of the system must be above 131° F for the fan to turn on. The fan will turn off when the temperature reaches 122° F. If you see a Code 5 on one of the servos check to see that this fan is operational. The Z servo driver powers the fan. If the fan is not working check to see that 12 VDC is coming out of the Z servo driver by checking across the 2 pins on the servo driver. If there is 12 volts, then the fan is bad, otherwise the servo driver is bad. An alternative solution may be to swap the X and Z servo drivers. Check if 12 VDC is available on the X servo before switching.

WARNING!

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

4.5.3 Servo Driver Fault Codes

Each servo driver has an LED display that indicates fault and status conditions. On power up, before communication with the servo drivers is established, any fault code may be present. Once communication is established the LED should read 0. In addition, cycling the power clears the fault if the condition is no longer true.

The "decimal point" of the Seven-Segment LED display for the Semipower and MTS servo drive modules will turn on when the servomotor is active. Also, the Seven-Segment LED display for both the Semipower and MTS servo drive modules will display a "0" when the servomotor is active providing there are no errors. Therefore, when the Seven-Segment LED display shows a zero, the decimal point is on, no error conditions exist, the servo drive module is enabled, then the motor will be energized and servicing.

However, when the servomotors are not active, the Semipower servo drive module will display a "0" with no "decimal point" and the MTS servo drive module will display a "2" with no "decimal point". When the servomotors are not active, the "2" displayed on the MTS servo drive module does not mean that there is a "Watchdog timer timeout" fault.
This is just the way SWI has configured the MTS servo drive module for this particular application. It is completely normal to see a "2" with no "decimal point" displayed on the MTS servo drive module when the servomotors are not active.

Note: always check for errors when the servo drivers are active. This takes place in DRO and RUN mode.

The codes are as follows:

Code 0 - No Fault

Code 1 - Over-current: This over-current error is due to current conditions that exceed the thermal rating of the internal components inside the power drive module. This feature does not protect the motor. Sudden faults are high feedrates may cause this condition.

Code 2 - Watchdog timer timeout: This timeout error can primarily be attributed to electrical noise or mechanical disconnection, which interrupts the timing of the motor current data which is sent back to the controller every 4-times per PWM cycle. Check all cable connections from pendant to servo driver.

Code 3 - Motor Short/Ground Short: The power drive module is protected from short circuit and ground fault conditions by automatically shutting down without damage to any internal components. The power drive module shall stop operating when either the ground or phase current reaches approximately 5-times the current rating of the inverter or brake IGBT. However, an over-current fault may be reported instead of a short circuit / ground fault in the case that the short circuit trip point is not reached within a certain time frame. A shorted motor may cause this. Install a known good motor on this servo drive and see if the problem still exists.

Code 4 - IGBT Saturation Fault: Normally a fault code of 4 is a symptom of poor system grounding. If the fault can not be cleared by turning the power off and then back on to the power drive module, the fault may indicate a hardware failure with the power drive module. This means the power drive module will need to be replaced providing that the system grounding checks out to be good.

Code 5 - Substrate over-temperature: The substrate temperature is monitored by the hardware of the power drive module. If the temperature exceeds 92 degrees Celsius or 197.6 degrees Fahrenheit, the power drive module will stop operating and report fault condition "5". The power of the 12VDC fan is controlled internally by the power drive module. The power to the fan is cycled on and off automatically based on the measurement of the substrate temperature.

Code 6 - PWM frequency fault: If the PWM frequency exceeds 10.5kHz, the power drive module will display an error code of "6". This means that the parameter associated with the power output of the power drive module may have to be set correctly within the servo control. In addition, a "6" fault can also be a symptom of poor grounding or PWM command signal shielding. Make sure that the motor and the AC power ground are both tied to the Power drive module heat sink. Also check the routing and shielding of the servo driver cable that runs from the pendant to the servo driver. This problem should never be evident on the machine.

Code 7 - Substrate temp sensor fault: If the substrate temperature sensor fails, the power drive module will display an error code of "7". This is a hardware failure. The servo drive module must be replaced.

Code 8 - Control Mode fault: If the servo controller is not properly configured to control a power drive module in PWM mode, or there is a cabling error, the module will display an error code of "8". This problem should never be evident on the machine.

Code 9 - DC link under voltage: The power drive module will report under voltage conditions. If an under voltage condition exists, the power drive module will shut down the output and report fault condition "9". The under voltage trip point is 170VDC for 230VAC power drive modules. These voltages are set in the hardware. Check the DC voltage across the terminals labeled B- and B+. At 230 volts the DC voltage should be approximately 300 VDC.

Code A - DC link over voltage: The power drive module will report over voltage conditions. If an over voltage condition exists, the power drive module will shut down the output and report fault condition "A". The over voltage trip point is 450VDC for 230VAC power drive modules. These voltages are set in the hardware. This code may only be present if the machine was mistakenly wired for 440 volts.

Code B - DC logic power supply fault: This error code "b" can be attributed to poor grounding practices. Assuming that there is not a hardware failure in the power drive module, look at the ground connection between the motor frame and the power drive module. A poor connection here can generate enough noise to cause this power supply to drop.

Codes C, D, E and F – not used

As stated above in the motor section, one way to troubleshoot a faulty servo driver is to swap components with a problem free axis and see if the problem moves. Switching the power cable and encoder cable for the faulty axis with a good axis can do this. If the problem moves to the other axis and clears up from the original axis, replace the Servo Driver. In order to do this you will need to turn off the secondary feedback for both the X and Y-axis. This applies to dual feedback machines only. Turn the X-axis scale off with code 304 and the Y-axis with Code 305. See Service Codes Section for information on how to do this.

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

4.6 Glass Scales

Glass scales are used on the X and Y-axis for secondary feedback. They are optional on the DPMV machines.

4.6.1 Alignment of scales

- **X Axis** - The X-axis scale must be aligned within 0.005" in the up and down direction over the length of the scale for proper operation. Misalignment can cause the scale to not read in the certain areas of the scale that are not aligned with the reader head. If this happens, the axis will mostly likely fault out in this area. Also make sure the mounting hardware for the reader head is tight. Loose hardware can cause excess backlash when reversing direction.

  To align the scale, place a 0.001" indicator on the bed ways and on top of the scale extrusion. Move the table along its full travel from one end to another to verify it is aligned. If the scale is misaligned loosen the 2 screws at either end to shift the scale up or down as needed. You will also need to loosen the center support bracket to allow the scale to pivot.

- **Y Axis** - The Y-axis must be aligned in the up and down direction and must be parallel to the Y-axis way surface. Both surfaces must be aligned to within 0.005". Failure to

align the scale properly could cause the same problems as mentioned above. Mount your 0.001" indicator on the saddle and move the Y-axis back and forth along its travel.

Note: In order to run the machine with the electronic handwheels and align the scale you will need to turn the scale system off with a service code. See service code section.

See Figure 23 in Section 5 for an illustration of how to align the glass scales.

4.6.2 Measurements Do Not repeat

1. Determine if the error in repeatability is random or accumulating:
   - Mount a dial indicator in the quill.
   - Touch off a fixed point on the table and set the DRO to 0.
   - Traverse away approximately 6 inches.
   - Return the touch off again.
   - Write down the reading on the DRO.
   - Do not Re-zero the DRO, traverse away and return several times.
   - Write down the DRO readings

   Random error will be unpredictable and give scattered readings, adding and/or subtracting the error after each traverse with no pattern. See Step 2.

   Accumulating error will add roughly the same amount to the reading after each traverse. See Step 3.
2. For random error, look for problems in the set-up of the glass scale that have resulted in a loss of rigidity. Common sources of random error include:
   - Loose scale mounting hardware.
   - Loose reader head.
   - Very loose motion of the table or saddle.
3. Accumulating error is commonly the result of:
   - Scale out of parallel to the axis travel.
   - Dirt or chip on the glass scale.
   - Broken glass.

4.7 TRAK Sensors (DPMV3 & DPMV5 only)

TRAK Sensors are used on the X and Y-axis for secondary feedback. They are optional on the DPMV machines. The following section talks about some of the common symptoms associated with a problem sensor and how to isolate or fix the problem.

Common symptoms

- Faulting Axis
- The DRO measurements do not repeat
- The DRO measurements are not accurate

Objectives:

- To determine if the TRAK Sensor is bad and needs to be replaced.
- To determine if there is a problem with the sensor set-up

4.7.1 Faulting Axis

If a sensor has stop reading and you try to move an axis, the axis will run away and fault. Our control uses the counts from the sensor and motor when reading position. If either one of these signals is not working our system will fault.

1. The first thing that can be done to see if it is the sensor is to turn off the sensor on the axis in question. This will allow the system to run only on the motor encoders. If the fault continues then the sensor was not the problem. Turn the sensor back on. See the service code section for a codes needed to turn the sensors on and off.
2. The next thing to do is to visually inspect the sensor and base to determine if there has been a crash. A damaged base will usually have crinkles in the small, triangular plates on the front and back.
3. Next make sure the sensor is preloaded correctly against the running surface. There is a setscrew on the base that allows for adjustment.
4. If no outward signs of damage are present, remove the sensor from its base, and inspect the wheel for damage and wear.

   If the wheel is worn smooth in the center, replace the sensor.

Note: Sensors should not wear smooth for many years of normal operation.

5. If the sensor looks normal, it is probably OK and there is a mechanical obstruction somewhere in the set-up. Look for the following possible problems:
   - Broken sensor base
   - Broken bracket
   - Sensor tilted too much (so that the wheel is not engaging the running surface)
   - Sensor chip scraper has doubled back and is pushing the wheel away from the running surface
   - Sensor chip scraper is defective or has worn and is pushing the sensor unevenly

4.7.2 Measurements Do Not Repeat

1. Determine if the error in repeatability is random or accumulating:
   - Mount a dial indicator in the quill
   - Touch off a fixed point on the table and set the DRO to 0.
   - Traverse away approximately 6 inches
   - Return and touch off again
   - Write down the reading on the DRO.
   - Do not re-zero the DRO, traverse away and return several times
   - Write down the DRO readings

   Random error will be unpredictable and give scattered readings, adding and/or subtracting the error after each traverse with no pattern. See Step 2.

Accumulating error will add roughly the same amount to the reading after each traverse. See Step 3.

2. For random error, look for problems in the set-up of the TRAK Sensor that have resulted in a loss of rigidity. Common sources of random error include:
   - broken base
   - broken bracket
   - loose puller screws
   - loose run bar
   - very loose motion of the table or saddle
   - loose clamp screw
3. Accumulating error is almost always the result of the wheel not traveling in a path parallel to the motion of the axis. This causes the wheel to skip at certain regular points in its travel.
   - Inspect the base to determine if it has been damaged. A damaged base will usually have crinkles in the small, triangle-shaped plates on the front and back.
   - Use a bubble level or an indicator to adjust the puller screws so that the base is parallel to the running surface.
   - Inspect that the sensor is not cocked so that the case contacts the running surface.
   - Inspect the wheel for chips that are adhered or for gouges.

4.8 Electrical

The electrical box is divided into 4 different modules: power module, drive module, auxiliary module and encoder module. See Figure 15 for an illustration of the box layout.

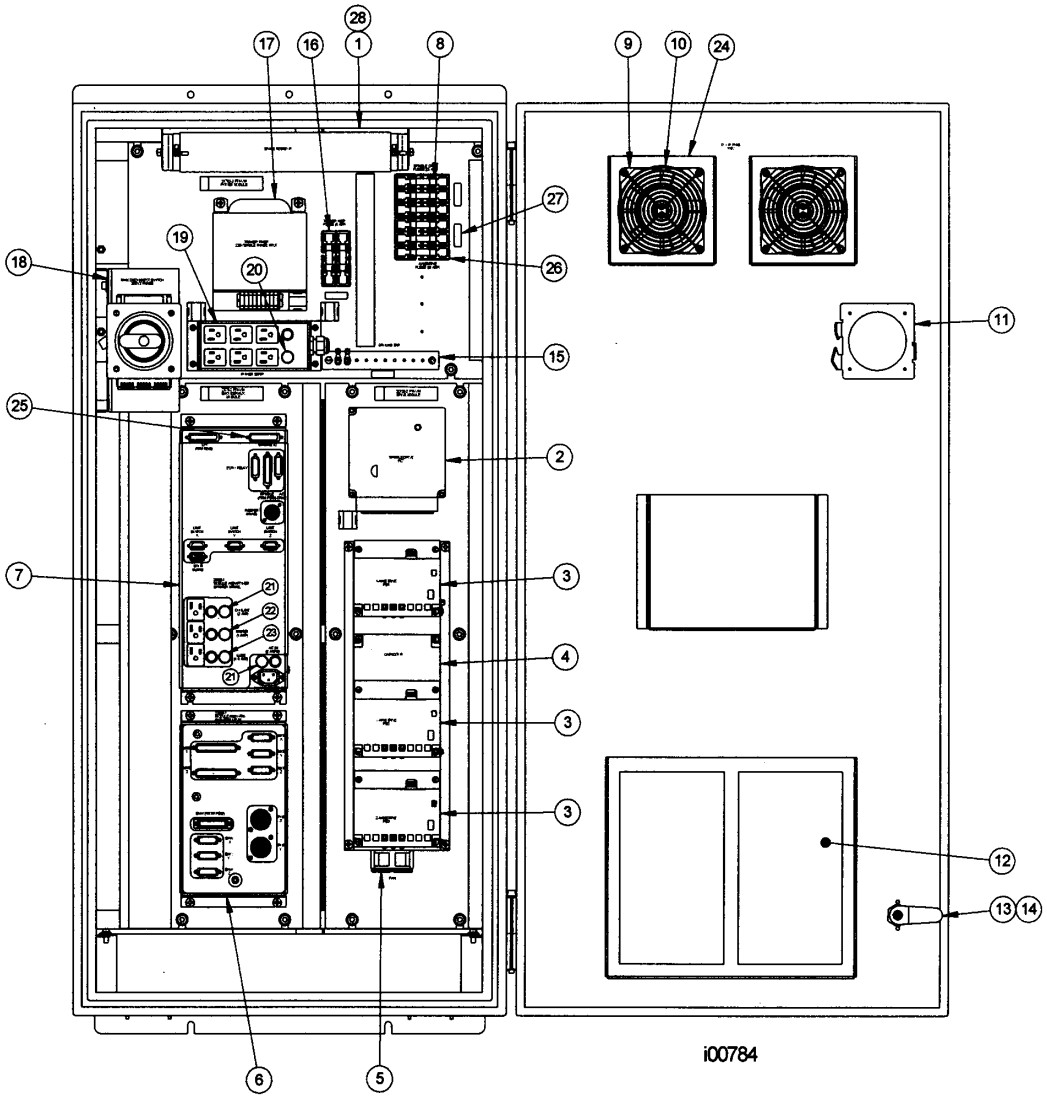


Figure 15
Electrical Cabinet
DPMV5 & DPMV7

DPMV3 & DPMV5 – Electrical Cabinet, Parts List

Item	P/N	DESCRIPTION	Qty
1	22157-32	32 OHMS RESISTOR- 750 WATTS	2
2	22128-DPMV3/V5	AC DRIVE PROGRAMMED - 5 HP, 220V W/CABLE	1
3	22027-220	SERVO- POWERBLOK - 220V	2
4	22028-220	CAPBLOK MODULE-PT4 220V	1
5	22149	FAN-PT4-12V-DRIVE MODULE	1
6	22068-1	MODULE ASSY-VM - ENCODER INTERFACE	1
7	22065-1	MODULE ASSY-PT4-EB-SPIN/AUX I/F-MILL	1
8	21893-25	FUSE- 500 VOLT- SLO-BLO TYPE	3
9	22164	FAN-PT4-ENCLOSURE	1
10	22656	GUARD - FAN	1
11	22653	HANDLE OPERATING MECHANISM	1
12	22552	FILTER-PT4 ELECTRICS BOX	1
13	22553	HANDLE-PT4-ELECTRICS BOX	1
14	22554	WASHER- SEALING	1
15	21753	GROUND BAR-PT4	1
16	21893-10	FUSE- 500 VOLT- SLO-BLO TYPE	2
17	21258	TRANSFORMER-1840 1000VA EI	1
18	22654	BREAKER-220 VOLT- 60 AMP	1
19	22288	MODULE ASSY- PT4- POWER PANEL POWER STRIP	1
20	21824-8	FUSE-3AG-SLOW BLOW	1
21	21824-3	FUSE-3AG-SLOW BLOW	1
22	21824-1	FUSE-3AG-SLOW BLOW	1
23	21824-1.6	FUSE-3AG-SLOW BLOW	1
24	22552-1	FILTER-PT4 COOLING FAN	2
25	22758-V3	KEY-PT4-MACHINE ID (DPMV3)	1
26	22758-V5	KEY-PT4-MACHINE ID (DPMV5)	1
27	21893-25	FUSE- 500 VOLT- SLO-BLO TYPE	3

i00784-V5-PL

DPMV7 – Electrical Cabinet, Parts List

Item	P/N	DESCRIPTION	Qty
1	22890-500-30	32 OHMS RESISTOR- 750 WATTS (DPMV7)	1
2	22287-DPMV7	AC DRIVE PROGRAMMED - 5 HP, 220V W/CABLE (DPMV7)	1
3	22027-220	SERVO- POWERBLOK- 220V	3
4	22028-220	CAPBLOK MODULE-PT4 220V	1
5	22149	FAN-PT4-12V-DRIVE MODULE	1
6	22068-1	MODULE ASSY-VM- ENCODER INTERFACE	1
7	22065-1	MODULE ASSY-PT4-EB-SPIN/AUX I/F-MILL	1
8	21893-25	FUSE- 500 VOLT- SLO-BLO TYPE	3
9	22164	FAN-PT4-ENCLOSURE	1
10	22656	GUARD- FAN	1
12	22552	FILTER-PT4 ELECTRICS BOX	1
15	21753	GROUND BAR-PT4	1
16	21893-10	FUSE- 500 VOLT- SLO-BLO TYPE	1
17	21258	TRANSFORMER-1840 1000VA EI	1
19	22288	MODULE ASSY- PT4- POWER PANEL POWER STRIP	1
20	21824-8	FUSE-3AG-SLOW BLOW	1
21	21824-3	FUSE-3AG-SLOW BLOW	1
22	21824-1	FUSE-3AG-SLOW BLOW	1
23	21824-1.6	FUSE-3AG-SLOW BLOW	1
24	22552-1	FILTER-PT4 COOLING FAN	2
25	22758-V7	KEY-PT4-MACHINE ID	1
26	22026-40	FUSE- CLASS J TIME DELAY-AJT 40 AMP	3

i00784-V7-PL

4.8.1 Power Module

The purpose of the power module is to fuse and distribute 220 V 3 phase power to the drive module assembly. Also, 220 V single-phase power is input into the transformer to produce 110 V single-phase power to the power strip. The power strip has (6) 110 V outlets that supply power to the pendant, spindle auxiliary module, spindle motor fan, electrical box fans and a work light option. One outlet is used as a spare. There is a LED light on the power strip that indicates it is getting 110V power. If this is out check its fuse followed by the fuses for the transformer.

The power module has (3) 25-amp fuses for DPMV3 & DPMV5 and (3) 40-amp fuses for DPMV7 to protect the spindle AC drive. The module has (3) 25 amp fuses to protect the X, Y and Z servo drivers for all models. It also has (2) 10 amp fuses for the transformer. The power module also has a ground bar where all of the panels are grounded.

4.8.2 Drive Module

The drive module consists of 3 servo drivers for X, Y and Z, an AC drive to control the spindle, and a fan to cool the servo drivers. An explanation for the servo drivers can be found in the servo driver section.

4.8.2.1 AC Spindle Motor Drive

The AC drive varies the frequency of the power to change the speed of the motor. The lower the frequency the lower the spindle RPM and the higher the frequency the higher the RPM. The frequency range for the DPMV machines is from 8 Hz to 200 Hz. The corresponding RPM's for each machine are listed in the table below.

Frequency	DPMV3 – Spindle RPM	DPMV5 – Spindle RPM	DPMV7 – Spindle RPM
8 Hz	200	160	200
200 Hz	5000	4000	5000

4.8.2.2 Braking Resistors

The braking mechanism for the spindle motor is non-mechanical. The braking effect is caused by the AC drive sending a current that produces a set magnetic field. This set field will oppose the motion of the motor and bring the motor to a stop. The energy generated through braking is dissipated by the brake resistor mounted to the top of the electrical cabinet. The motor is set to brake in 2.5 seconds from 4000 or 5000 RPM.

CAUTION!
Do not use the brake handle on the head to brake the spindle.

WARNING!
The resistor becomes very hot during braking. Before working around this area, be sure braking has not occurred in the last 10 minutes.

The brake resistors and AC drive programming play a critical role in the tapping function. The resistors play a role in reversing the spindle at the bottom of a tapping routine. Once again the energy is dissipated through the resistor. The drive is also calibrated with parameters to assure the output rpm at the spindle and the RPM programmed are very close. The actual RPM value and programmed value should be around 5% of each other. If these values are outside this range you will have problems with the tapping cycle.

Note: the values in the AC drive are programmed at the factory and should never be adjusted in the field. Adjustments of these values will void the warranty of the machine.

If there is a problem with the braking of the system, the resistor can be checked with an ohmmeter. Remove the cover of the AC spindle drive and locate terminals B1 and B2. The reading across these terminals should be approximately 32 ohms for the DPMV3 & DPMV5 and 10 ohms for the DPMV7. If the ohmmeter displays an overload then the resistor is bad or there is a bad connection. The DPMV7 has 3 resistors wired in parallel.

4.8.3 Spindle Auxiliary Module

This module is located on the lower left side of the electrical cabinet above the encoder module. See Figure 15. This list below describes what takes place through each connection.

- **LPT Parallel Port (From Pendant)** - Controls the Auxiliary Module from the Pendant. Its primary function is to control the limit switches, Haas indexer, mister, coolant pump, lube pump, spindle and tap enable signals.

- **Machine I.D. Key Port** - Configures the slave software according to the machine type. This key tells the control what type of machine it is. If this key is not present the machine will not boot up correctly.

- **Spindle Control Port (From Pendant)** - Interfaces signals such as Run, Off, Stop, FWD/REV, and E-Stop from the Pendant to the spindle auxiliary module.

- **Spindle Control Port (To PC7 Spindle Drive)** - Interfaces signals such as Run, Stop, FWD/REV, Overload, and E-Stop from the spindle auxiliary module to the Spindle Drive.

- **Euro Relay Port** – not used on DPMVs

- **Indexer Port** - An auxiliary function that uses Logic signals to operate the indexer.

- **XYZ-Limit Switch Ports** - Logic signals from limit switches. These signals are also direction specific.

- **Door Guard Port –** not used on DPMVs

- **Coolant Pump Outlet** - An auxiliary function that uses a 110V signal to power the coolant pump. This outlet uses a 3A fuse for circuit protection and an Indicating Lamp, which signifies that the outlet is powered up. The fuse and the Indicating Lamp are located next to the outlet.

- **Mister Outlet** - An auxiliary function that uses a 110V signal to power the mister. This outlet uses a 1A fuse for circuit protection and an Indicating Lamp, which signifies that the outlet is powered up. The fuse and the Indicating Lamp are located next to the outlet.

- **Lube Pump Outlet** - An auxiliary function that uses a 110V signal to power the lube pump. This outlet uses a 1.6A fuse for circuit protection and an Indicating Lamp, which signifies that the outlet is powered up. The fuse and the Indicating Lamp are located next to the outlet.

- **Auxiliary Module Power In** -110V signal from the power strip to power the auxiliary module. This uses a 3A fuse for circuit protection and an Indicating Lamp, which signifies that the Auxiliary Module is powered up. The fuse and the Indicating Lamp are located next to the incoming power cord.

4.8.4 Encoder Module

This module is located on the lower left side of the electrical cabinet below the spindle auxiliary module. See Figure 15. This list below describes what takes place through each connection. There are 2 LED's that signify that power is reaching this module. Power reaches the encoder module through umbilical cables 1 and 2 and also the electronic hand wheel cable. If these lights are off and all the cables are plugged in then the computer module is probably the problem.

- **Umbilical #1 & Umbilical #2 Ports (To Pendant)** - The DPMVs have (3) motor encoder signals and (2) Position feed back signals, which are communicated between the Encoder module and the Pendant by use of (2) Umbilical cables. The X and Y signals are communicated through umbilical #1 and the Z motor signal is transferred through umbilical #2.

- **Electric Hand Wheel Port (To Pendant)** - Communication for XYZ-Hand Wheel logic signals between the Pendant and the Encoder module.
- **XYZ-Electric Hand Wheel Ports -** These ports are used to receive logic signals from each of the XYZ-Electric Hand Wheels.
- **XYZ-Motor Encoder Ports** - These ports are used to receive logic signals from each of the XYZ-Motor Encoders.
- **XYZ-Position Feed Back Ports** - These ports are used to receive logic signals from each of the XYZ-Position Feed Back devices.

4.8.5 Cable Connections

The DPMV machines use 20+ cables to communicate between systems. It is often the case that what appears to be the failure of an electrical component is actually attributable to a poor connection.

Indications:

- Control problems, chronic or intermittent.
- Motor problems
- Measurement problems

Explanation:

1. Turn off and unplug the system from the wall.

WARNING!
Do not plug and unplug connectors with the system power on. This may cause damage to the connector board and harm to the technician.

2. Visually inspect the connections for excessive debris, moisture, or obvious damage.
3. Carefully clean any chips away from the connectors.
4. One-by-one, take out each connector and then plug them back in. Do the same at the computer/display.
5. Make sure to tighten up the screws on each of the connectors.

4.8.6 Checking A/C Voltage

This procedure tests for the 115V power for the control.

- Use a Voltmeter, reading A/C volts.
- Acceptable range is 110V to 130V

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

Our system is shipped out assuming the customers shop has 220 V power. The transformer secondary tap is set on 115 volts. Measure the voltage coming out of the transformer by placing the voltmeter across the 115 V and 0 V taps. If this measurement is above 120 volts then move the tap from 115 V to 110 V. If the reading is low, 110 V or below, then change the tap from 115 V to 124 V. Input power to the machine that is 230 V

or above will cause the 110 voltage to be high and voltage that is 208 V or below typically causes 110 voltage to be low.

WARNING!
Turn the main power off before changing the taps on the transformer. Failure to do this can possibly cause death by electrocution!

4.8.6.1 Checking Fuses

There are 15 fuses that make up the system. There is (1) 1-amp fuse in the pendant, 13 fuses in the electrical cabinet and 1 fuse in the lube pump.

To check fuses:

1. Use a Volt/Ohmmeter; select "OHM" or "Ω".
2. Remove the fuse completely from the pendant display or computer module.
3. 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 or OL (overload).

4.8.6.2 Fuse Indicator lights

The power strip and spindle auxiliary module have LED lights on them to signify that 110 V power is reaching the components. If these lights are off, check up stream to see if some other fuses are blown.

Within the spindle auxiliary module there are also 3 LED's that come on when the lube pump, mister solenoid and coolant pump outlets are activated. Remember these lights will only come on when those devices are in operation. If they do not come on when they should check the fuse next to the light.

4.9 Service Codes

Service codes are broken down into the 5 following categories: software, machine setup, diagnostics, user options/defaults and lubrication pump control.

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

4.9.1 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 or code 313. These values will be valuable for troubleshooting.

4.9.1.1 CODE 33: Software ID

The Code 33 is the software identification procedure. The two types of software in the control include:

- **Software Version** - the version of the system you have installed
- **Firmware Version** - the version of firmware software that is responsible for control to servo interface.
- **Converter Version** – the version of software that is responsible for converters and options.

4.9.1.2 CODE 37: RS232 Baud Rate

This code sets the baud rate for RS232 applications. The recommended baud rate is 9600. The following baud rates can be chosen: 4800, 9600, 19200, 38400, 57600, 115200.

4.9.1.3 CODE 141: Load Configuration file from floppy "A" drive

This code allows you to load your configuration file from the floppy disk to your hard drive. The configuration file consists of items such as calibration and backlash constants. This code is used when a computer module or hard drive has been replaced.

4.9.1.4 CODE 142: Save Configuration file to floppy "A" drive

This code allows you to save your configuration file to a floppy disk. The configuration file consists of items such as calibration and backlash constants. This code is used when a computer module or hard drive needs to be replaced. This stores the configuration file from the hard drive to the floppy disk. 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 hard drive 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 hard drive is replaced.

Note: All machines will have a copy of the configuration file in the back of the electric's cabinet.

4.9.1.5 CODE 313: Display Configuration File

This code displays the configuration file. This file contains pertinent information about the machine. The file will look similar to the following. If the file becomes corrupt you can load default values by pressing the F4 softkey.

Product = DPMV (displays machine ID key of machine)
Lube pump cycle time – 60 minutes
Lube pump discharge time – 15 seconds

Motor encoder calibration constants	X242.0462	X242.0267	Z242.0312
Secondary feedback calibration constants	X3302.6107	Y3302.5345	Z3302.6433

(These numbers above are typical numbers for the calibration constants, the numbers for secondary feedback are default numbers, which means no calibration has been done, or the machine does not have secondary feedback)

Arc accuracy – 0.001"
Secondary feedback – 0, 1, 2 or 3
(0 = off, 1 = X on only, 2 = Y on only, 3 = XY both on)
Limit switches – on or off
Spindle on or off during run – On or Off

Code 11 values	X = 0.002	Y = 0.001"	
Code 128	X=0.001"	Y=0.0014"	Z=0.0016"
Code 12 (+)	X=000005	Y=000006	Z=000006
(-)	X=000005	Y=000005	Z=000006
Accessory Key = Mist or Coolant			
Code 100 (+)	X=352.7	Y=367.2	Z=325.2
(-)	X=350.1	Y=356.7	Z=333.1

4.9.1.6 CODE 316: Update Master Software

Load upgrade disk in floppy drive and press this service code. New software will automatically download and control will reboot. Please perform alignment routine afterwards.

4.9.1.7 CODE 317: Update Slave Software

Load upgrade disk in floppy drive and press this service code. New software will automatically download and control will reboot. Please perform alignment routine afterwards.

4.9.1.8 CODE 318: Activate Converters or Options

See programming and operating manual.

4.9.2 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.

4.9.2.1 CODE 11: Hysteresis

Note: This code is use only for systems with Sensors or Glass Scales on the table and saddle.

The Code 11 service routine checks the readings of the motor encoder against the sensor encoder. It is a measurement of how much motor motion is necessary to create table or saddle motion. This test helps us to look at two things:

- Play: How much backlash must be taken up when motion is reversed.
- Friction: How much the mechanical components must be "torqued up" in order to break the friction and create motion.

The Code 11 procedure is very useful and will help in diagnosing all types of motion and performance problems.

1. Position the table and saddle in the center of travel. Note: You will lose your DRO position reference.

2. Go into the Service Codes and input Code 11.
3. The system will run the checking routine automatically and then display the values in the position readout.

Explanation:
As an overall measure of the system hysteresis, we are looking for the X and Y values to be less than .004". A value greater than this indicates a problem with either excessive friction or play that may affect the finish or accuracy of machined parts.

4.9.2.2 CODE 12: Feed Forward Constant

The Code 12 procedure helps the control "learn" the friction characteristics of the machine by sending a graduated series of motor signals and observing the results. The process takes less than 30 seconds to run. It is both a diagnostic routine that displays values, and a routine that sets the parameters of the control for the particular machine.

The Code 12 is used for diagnosing and resolving:

- Problems with machine motion.
- Machined parts come out bad – especially poor finish.

Note: Code 12 routine will set the parameters for the particular machine and its particular situation. If the machine changes its friction characteristic, the Feed Forward Constant should change too, or the system will not servo properly. Whenever gibs are adjusted or a heavy workpiece has been added to the table, you should run a Code 12. When the heavy workpiece is removed, Code 12 should be run again.

Steps
1. Position the table and addle in the center of travel. Note: You will lose your DRO position reference.
2. Go into the Service Codes and input the Code 12.
3. Press Auto
4. The system will run the routine automatically and then display values on the position readout.

Explanation
Typical values should be between 2.02 and 8.08 are considered normal for each axis. Higher values indicate excessive friction in the system. Lower values indicate a loose system and may mean a gib adjustment is necessary. The value 2.02 means the friction is a factor of 2 in one direction, and 2 in the other direction. The values should be within 3 of each other in both directions. A value of 6.08 would still be considered normal.

Machines with axis torques from 8 to 12 in-lbs can expect values in the 4 to 6 range. Machines with torques from 13 to 17 in-lbs can expect values from 5 to 7 and machines with a torque range from 18 to 22 in-lbs can expect values from 7 to 9. Typical torque values on machines that have the ball screw aligned and the gibs adjusted to specification should be between 10 to 15 in-lbs.

The feed forward gain can be adjusted manually by pressing the manual button. Choose the axis you would like to change and then enter values in the positive and negative direction to adjust. Adjusting the gain can help solve circularity problems. Default values can be set by pressing the Reset button. The manual feature should only be used in

extreme cases where the AUTO routine did not solve the problem. Manual adjusts above 9 may lead to servo related problems.

4.9.2.3 CODE 100: Axis Open Loop Test

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

IMPORTANT -- SAFETY NOTICE

During this procedure the designated axis will be given a command to move at maximum speed for 1 second in the direction you choose. Avoid crashes by making sure the quill is out of the way and by starting with the table and saddle centered. MAKE SURE THAT NO ONE IS STANDING IN THE WAY OF THE TABLE OR SADDLE!

Note: You will lose the DRO reference position.

This procedure is to be run for each axis that is servo-driven, and for both the plus and minus direction for each axis.

1. Center the table and saddle and raise the head. Make sure the gib locks are released.
2. On the Pendant display, go into the Service Codes and input the Code 100.
3. The conversation line will say: "SELECT AXIS". Input the axis. Either X, Y or Z.
4. In the conversation line it will say "WHICH DIRECTION? PLUS".
   - If you want to run in the plus direction, press INC SET.
   - If you want to run in the minus direction, press +/-, then INC SET
5. In the conversation line it will say "PRESS GO". Press Go after you are sure that the machine will not crash in the direction and axis that you have specified.
6. Afterward the screen will display values next to the DRO position axes. The table below assumes machine has secondary feedback. Machines with motor encoders only will display the reading next to the axis in question.

Your input	Display	Data displayed.
X +	X	table encoder reading
	Y	nothing (should be 0)
	Z	Motor encoder reading
	Feedrate	the maximum feedrate attained

Your input		
X -	X	table encoder reading
	Y	nothing (should be 0)
	Z	Motor encoder reading
	Feedrate	the maximum feedrate attained

Your input Y +		
	X	nothing (should be 0)
	Y	table encoder reading
	Z	Motor encoder reading
	Feedrate	the maximum feedrate attained

Your input Y -		
	X	nothing (should be 0)
	Y	table encoder reading
	Z	Motor encoder reading
	Feedrate	the maximum feedrate attained

Your input Z +		
	X	nothing (should be 0)
	Y	nothing (should be 0)
	Z	motor encoder reading
	Feedrate	the maximum feedrate attained

Your input Z -		
	X	nothing (should be 0)
	Y	nothing (should be 0)
	Z	motor encoder reading
	Feedrate	the maximum feedrate attained

Interpretation of the resulting values displayed:

The values for the encoder displays should be in the range of 4.0000" to 6.5000".

- If the motor encoder and sensor or glass scale reading is not within this value, then the one that is out of specification may be the problem. If one of the encoders is not reading then it will need to be replaced.

The feedrate should be a minimum of 300 ipm. Shops with higher voltages will see higher values. Values for voltages in the 208 V range will see values somewhere around 325 to 350 ipm. Shops with voltages around 240 V may see values in the 400+ ipm range.

- If the feedrate is very different on the same axis for + and -, then the torque on the axis that is tested is may be higher than 15 in-lbs. Typical torque values on machines that have the ball screw aligned and the gibs adjusted to specification should be between 10 to 15 in-lbs. This will produce code 100 values within 50 ipm in the positive and negative directions. Machines that have an axis torque of 20 in-lbs may see a deviation of 75 ipm. If the code 100 values exceed this deviation then the axis torque is too high. Align the ball screw or adjust the gibs.
- If the feedrate is less than 300 ipm and consistent in both directions, check the incoming AC voltage.

4.9.2.4 CODE 123: Calibration

See Section 5.22 for a further explanation of this code.

4.9.2.5 CODE 127 - Set X or Y Backlash Constant

See Section 5.22 for a further explanation of this code.

4.9.2.6 CODE 128: Input Backlash Constant

Code 128 allows you to enter the backlash values for each axis. It displays the value after it enters. This code is only used on machines with motor encoders only.

4.9.2.7 CODE 203: Brushless Motor Alignment

This service code needs to be performed each time the ProtoTRAK is turned on, new software is installed or axis motors have been replaced. The control will boot up automatically to this screen. Press the Check System key and follow instructions on screen.

WARNING!

It is important that there are no obstructions on any axis before running this code. If there is an obstruction, then use the electronic handwheels to slowly move the machine away from the obstruction.

Each axis will move approximately 1" during this routine. The handwheels will not move at the normal feedrates during this routine. Failure to move each axis away from an obstruction will cause a crash.

The Motor Alignment Routine Code 203 calculates the relative position between the motor poles on the stator and the magnets on the rotor through the use of the motor encoder. Once the stator and rotor are aligned the encoder's absolute zero is set. The routine also distinguishes which type of motor is being used on the machine. The routine can last up to 30 seconds. After 30 seconds, the routine will under go a Time-out. If the motor alignment routine fails to work properly, a message should appear on the display prompting the user that the motor alignment routine has failed.

4.9.2.8 Code 304: Toggles X sensor or glass scale on/off

This service code toggles the X sensor or glass scale on or off. It is used to configure the machine and also is a useful tool for troubleshooting. Code 313 (configuration file) displays whether the sensors have been turned on or off. The line labeled secondary feedback explains which sensors or glass scales are turned on. This line can read any one of the following:

0 = sensors or glass scales turned off

1 = X sensor or glass scale turned on only

2 = Y sensor or glass scale turned on only

3 = both X and Y sensor or glass scale turned on

4.9.2.9 Code 305: Toggles Y sensor or glass scale on/off

This service code toggles the Y sensor or glass scale on or off. See Code 304 for further explanation

4.9.2.10 Code 308: Reverse X hand wheel direction

This service code reverses the direction of the X hand wheel.

4.9.2.11 Code 309: Reverse Y hand wheel direction

This service code reverses the direction of the Y hand wheel.

4.9.2.12 Code 310: Reverse Z hand wheel direction

This service code reverses the direction of the Z hand wheel.

4.9.2.13 Code 311: Set no move if spindle off – on/off

This service code toggles this function on or off. It defaults to on from the factory, which means the spindle must be on for a program to run. If it is on and you forget to turn the spindle on, the tool will move to Z rapid and wait for the spindle to come on. This function will be needed if you are running a repeatability program with an indicator in the spindle. Make sure this feature is on when cutting parts.

4.9.2.14 Code 312: Toggle limit switches on/off

This service code toggles the limit switches on or off. Code 313 also displays which state the limit switches are in.

4.9.2.15 Code 321: Reverse Y position sensor direction

This service code reverses the direction of the encoder. It may be needed if sensors or glass scales are mounted on different sides of the machine.

4.9.2.16 Code 322: Reverse X position sensor direction

This service code reverses the direction of the encoder. It may be needed if sensors or glass scales are mounted on different sides of the machine.

4.9.3 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.

4.9.3.1 Code 54: Program Continuous Run

This Code runs a program continuously without stopping for SET Z or CHECK Z commands. It is helpful in running a long period to identify an intermittent problem.

1. Prepare a program as you normally would.
2. Press **MODE**, **SET UP**, **"C"**, **Code 54**, **INC SET**. The program run will start automatically.
3. Press **STOP** to stop, and **GO** to continue.

4.9.3.2 Code 81: Keyboard Test

This code is used to check if the keyboard is functioning correctly. It allows you to test each key on the pendant 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 pendant assembly may need to be replaced. If none of the keys are working chances are that the computer module will need to be replaced.

4.9.3.3 Code 131: Manual DRO

A manual diagnostic routine to check the motor encoder and table encoders. Turn the X hand wheel to display the encoder readings. This code will display the actual DRO counts and the raw encoder counts before the calibration and backlash factors have been factors into the counts.

4.9.3.4 Code 132 - Electronic Hand wheel Test

Turn the X, Y or Z-axis electronic hand wheel. The display should show movement as the hand wheel is being turned. There should be no skipping and it should count smoothly while the hand wheel is being turned. One revolution of hand wheel should read 0.2000".

4.9.3.5 Code 314: Toggle test lights 'on' in status line

This code toggles on and off 2 test lights that appear in status line. The top light signifies if the master software is working. If functioning it should flash a green light. The bottom light signifies if the slave firmware is functioning. It will appear orange in run mode when it is processing information. Pressing the mode key will change this orange box to black. The orange box will also change to black when the program you are running reaches the 3rd event from the end of the program. If the firmware is locked up no keys will work. This code is useful for diagnosing intermittent problems with the control locking up.

4.9.3.6 Code 319: Error Log

This code when turned on captures the commands that were sent to the servo system. It includes items such as positioning commands, errors, stop and go commands, etc. It may be helpful for identifying problems between programmed commands and executed commands. To turn on the error log press the F6 softkey. The page forward and backward keys allow you to scroll through the file one page at a time. The data forward and data backward keys allow you to scroll through the file one line at a time. The data bottom key takes you to the bottom of the file and then changes to data top which will take you back to the top. The file will capture data until the file reaches a size of approximately 600 Kb. At this time the file is saved to a backup file and the original file is cleared and data is once again captured. Once again as the file reaches a size of 600 Kb it copies over the previous backup file. From here the user can save the file to the floppy drive by pressing the F8 softkey. Once this in done it prompts you for which file you want to save to disk. The F1 key saves the current file to disk and the F2 key saves the backup file to disk. To clear the files press the F7 softkey.

4.9.3.7 Code 324: Toggle Simulation Mode

Simulation Mode allows the control to run a program without actually moving the table. It is helpful in diagnosing Computer/display problems.

4.9.4 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.

4.9.4.1 Code 66: Default Metric

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

4.9.4.2 Code 67: Default English

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

4.9.4.3 Code 79: Beeper On

This turns on the beeper to the control keys.

4.9.4.4 Code 80: Beeper Off

This turns off the beeper to the control keys.

4.9.4.5 Code 129: Arc Accuracy

When the VM control operates at high feedrates it may create small part machining errors as it goes around sharp corners. This exists on all CNC's and is commonly called a "following error." The control is factory preset to allow a maximum following error of 0.001 inch. The feedrate will automatically be adjusted around sharp corners so as to not violate this limit. This code only applies to arcs that are programmed and ones that are created in the tool path to generate the shape you want. This code will not make a difference on mill moves.

You may adjust the maximum following error to a value as small as .0001 inch. However, the smaller the value, the slower the feedrate around corners.

To input a new Following Error use the following procedure:

Follow the instructions on the screen and input the Following Error value (from .0001 to .0100) and press **INC SET**.

4.9.4.6 Code 315: Toggle Accessory key between coolant pump and air (mister)

This allows the accessory key on the front of the pendant to be set up to either run the coolant pump or the air solenoid that is used on a mister system. It will read C for coolant or M for mister.

4.9.4.7 Code 323: RS232 Com Port

This code switches between COM ports for RS232 applications.

4.9.5 Lube Pump Codes

The following codes are used for programming and operating the lube pump. To get to any of these codes go to Service Codes, press "E" and press the code you wish to view.

4.9.5.1 Code 300: Lube Pump Switch

This code acts as a switch to turn the lube pump on for the programmed time set in Code 302.

4.9.5.2 Code 301: Set Lube Pump cycle time

This code sets the interval time between lube cycles.

4.9.5.3 Code 302: Set Lube Pump discharge time

This code sets the lube pumps discharge time.

5.0 Procedures for Replacements & Maintenance

5.1 Replacements

5.1.1 Servo Motor Replacement

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

1. Turn off power to the machine.
2. Remove the necessary sheet metal covers to get access to the motor.
3. Remove the power and encoder cable from the motor.
4. The motor is bolted in place with (4) M6 SHCS.
5. On the X and Y axis the motor is bolted to an adapter plate. Remove the motor from the adapter plate before sending back to SWI. Use the adapter plate on the replacement motor.

CAUTION!
Replacement motors will not come with adapter plates.

6. The Z-axis motor is bolted directly to the bracket on top of the column. Make sure to mount the connectors on the new Z motor in the same place as the old one, otherwise there may be some interference between the motor and counterweight.

See Figure 16 for an illustration of the motor and adapter plate.

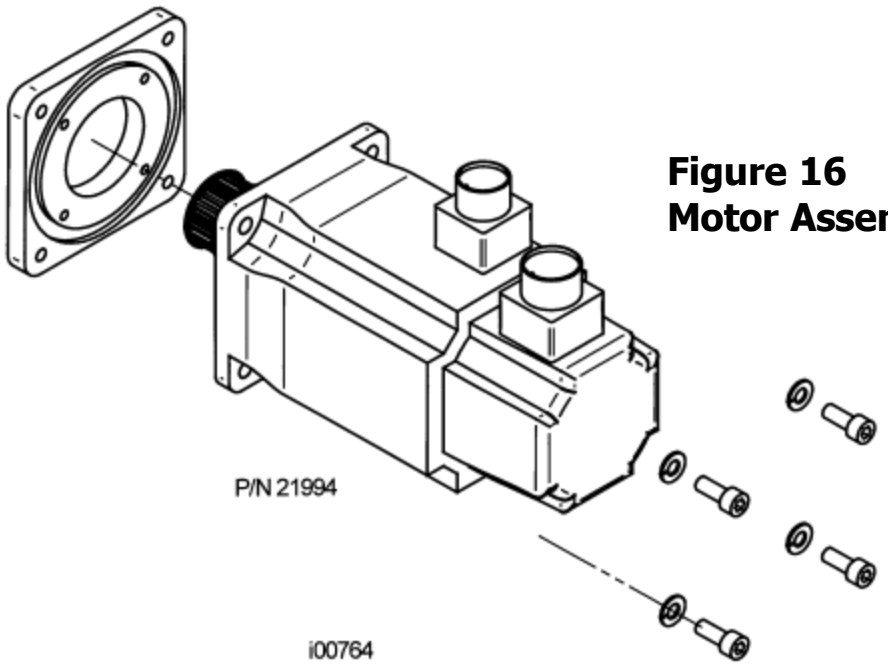


Figure 16
Motor Assembly

5.1.2 Servo Driver Replacement

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

1. Turn off power to the machine.
2. Open up the electrical cabinet.
3. Remove the bracket that holds the cable in place. Remove the servo driver cable from the front of the servo driver.
4. Remove the power cable that runs to the servomotor. This includes the (3) 3 phase wires and a ground wire on the side of the aluminum extrusion. In order for the servomotor to move in the same direction as it did before you replaced it you must put the wires back in the same terminals. T1 uses the red wire, T2 uses the white wire and T3 uses the black wire.
5. Remove the black wires from servo driver labeled L1, L2 and L3. These wires feed power into the servo drivers.
6. Remove the wires that run between each servo driver. They are labeled B-, B+ and IR. Once again, make sure to put them back into their proper terminals.
7. On the Z drive remove the small red cable that runs to the fan at the bottom of the extrusion. This cable provides power to the fan.
8. On the Y servo drive make sure to unplug the capacitor from the servo drive. The capacitor mounts to the top of the drive. Use this capacitor with the replacement servo driver.
9. The servo driver then mounts to the aluminum extrusion with 4 screws.

CRITICAL!
After replacing a servo driver, make sure to secure the bottom right hand screw of the drive that includes a ground cable to the heat sink, and the ground cable to the side of the heat sink. Also make sure that the heat sink is grounded to the ground bar on the power panel. Failure to do this may cause a good servo driver to not work properly.

See Figure 17 for an illustration of the wiring of the servo drive.

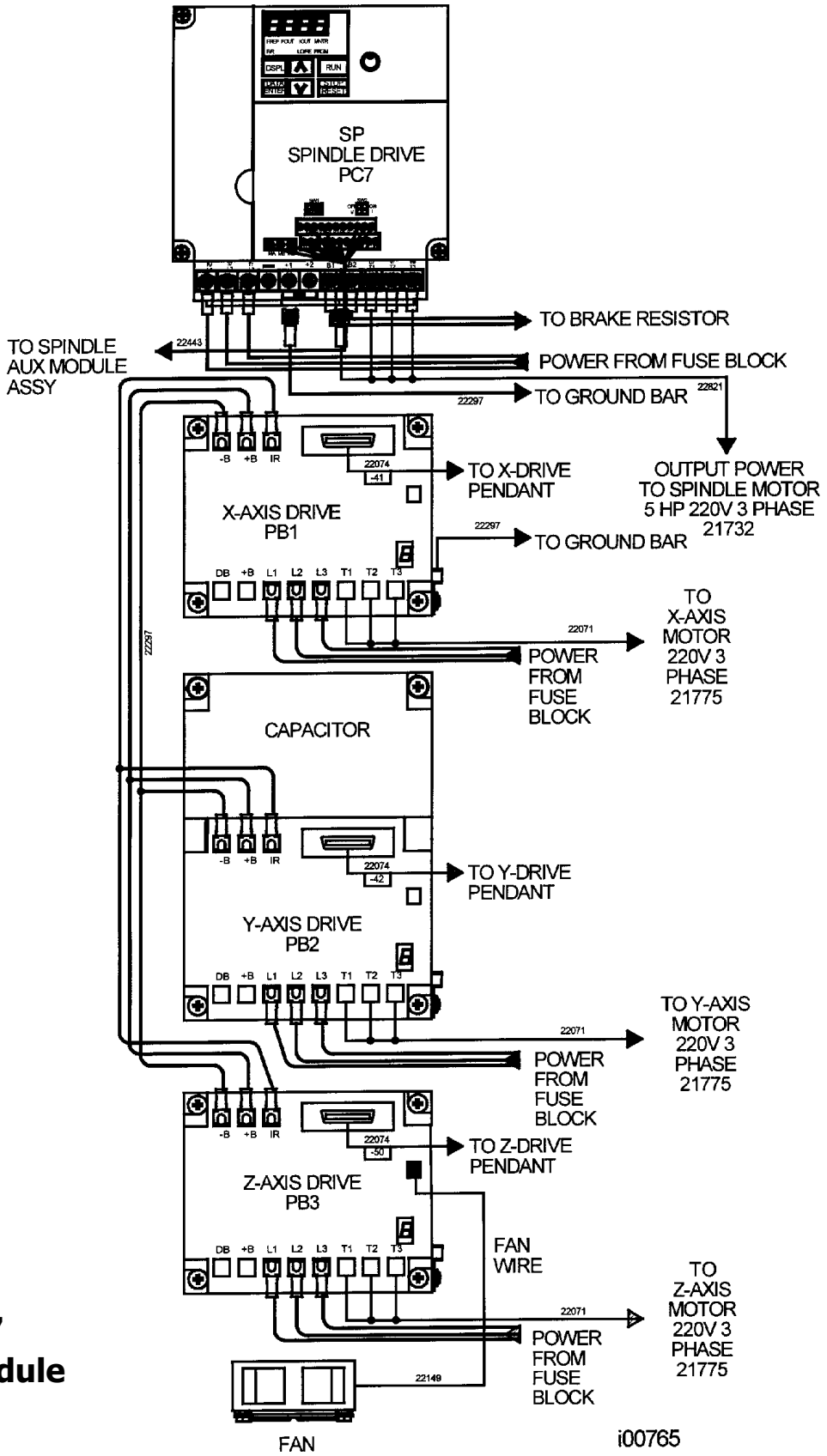


Figure 17
Drive Module

5.1.3 AC Drive Replacement

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

1. Turn power off to the machine.
2. Before working on this unit make sure all lights on the display are off. These units have a capacitor internally that keep them powered up for a minute or so after the power is turned off.
3. Remove the display unit on the front face of the unit. Also remove the lower cover on the unit to gain access to the wires.
4. Disconnect the 3 wires on the lower left side of the unit. These wires bring power into the unit.
5. Remove the 2 wires labeled B1 and B2. These wires run up to the resistor.
6. Remove the 3 wires labeled T1, T2 and T3. These wires take power to the spindle motor. Make sure to put these wires in the same position on the new unit. T1 uses the red wire, T2 uses the white wire and T3 uses the black wire.
7. Remove the ground wires from the bottom of the unit.
8. The unit bolts in place with 4 screws.
9. Follow the instructions in reverse order when reinstalling.

Note – the replacement AC drive will have the AC drive cable (#22443) already wired to the drive.

See Figure 18 for an illustration of the wiring of the AC drive.

WIRING CHART FOR CABLE 21732		
ITEM 17 PIN #	FUNCTION	SPINDLE PIN
1	SPD FWD	S1
2	SPD RFV	S2
3	SPD E-STOP	S3
4	TAP MODE	S5
5	SPD RESET	S4
6	SPD GND	SC
7	A GND	FC
8	DAC OUT	FR
9	GND	MC
10	GND	PC
11	FAULT FDB	MA
12	RUN FDB EN	P1
13	-	
14	-	
15	A GND	FC

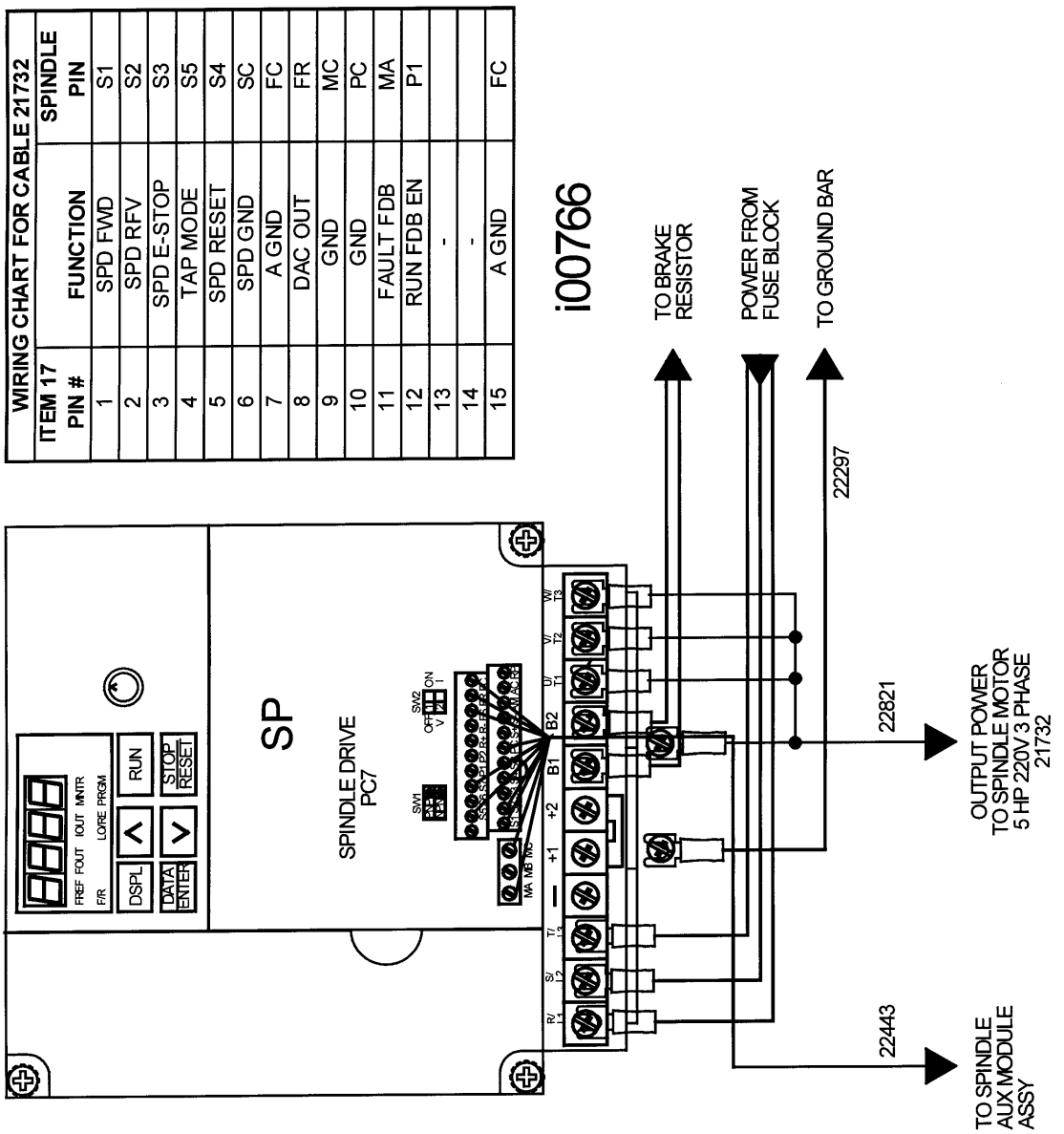
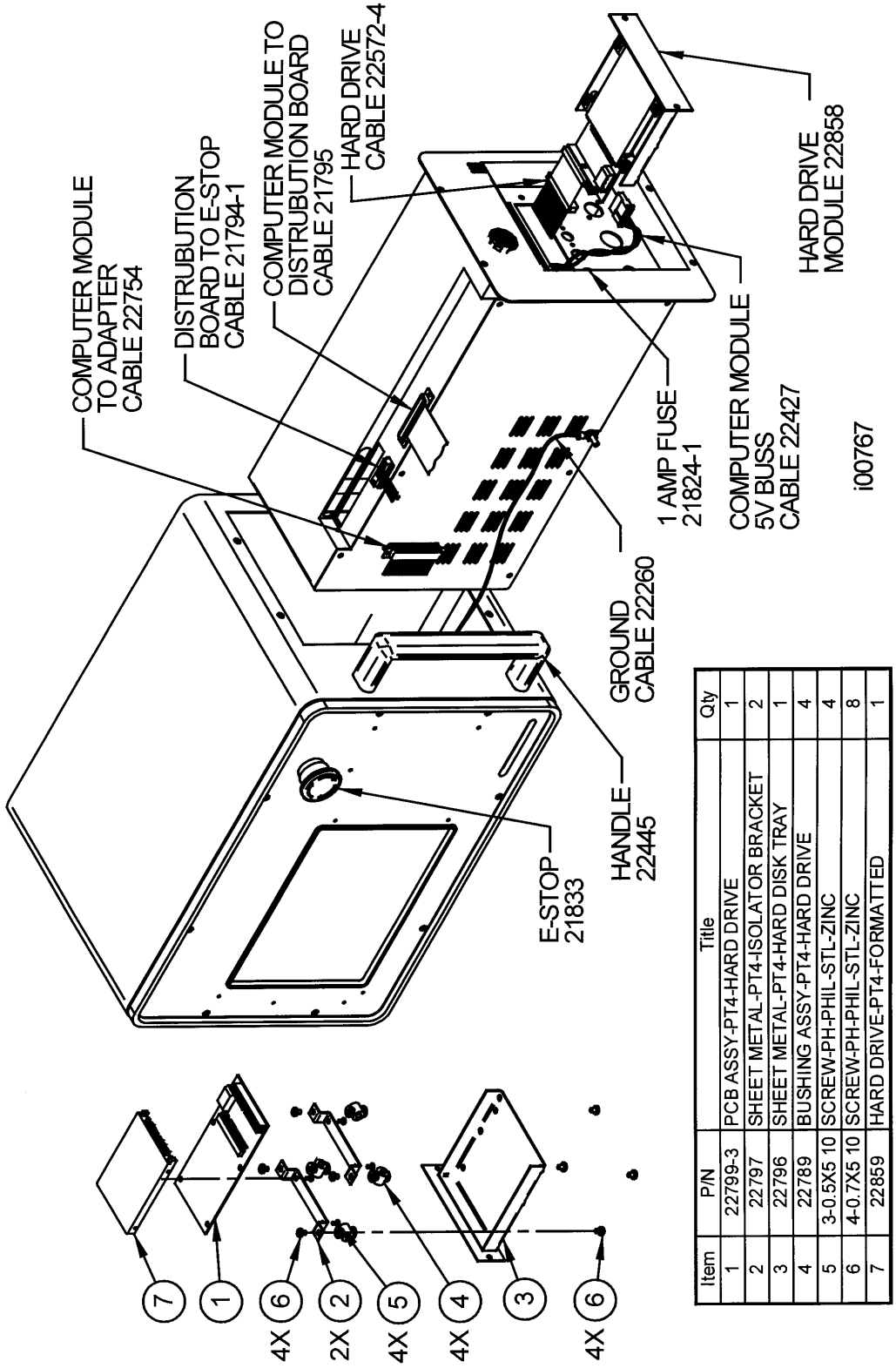


Figure 18
Spindle Drive

5.1.4 Computer Module Replacement

1. Turn power off to the machine and control.
2. Unplug all the connectors on the pendant arm side of the pendant.
3. Remove 4 screws on the right side of the unit and 2 screws on the left side of the unit. The module is now free to slide toward the right side of the pendant.
4. Slide the computer module a few inches and stop. Pulling the computer module too far will damage the LCD cable.
5. Now reach from the pendant arm side of the unit inside and remove the 37-pin LCD cable.
6. Now slide the module about ½ way out of the pendant sheet metal.
7. Remove the ground stud from the side of the computer module.
8. Next remove the 37 and 9 pin connectors from the top of the computer module.
9. Lastly slide the unit completely out of the sheet metal.
10. Follow the instructions in reverse order when reinstalling the new computer module.
11. Make sure the connectors are fully seated before bolting the unit back in place.

Note: if the hard drive is functional, you may want to remove the hard drive and install it in the new computer module. See the instructions in Section 5.1.5.



Item	P/N	Title	Qty
1	22799-3	PCB ASSY-PT4-HARD DRIVE	1
2	22797	SHEET METAL-PT4-ISOLATOR BRACKET	2
3	22796	SHEET METAL-PT4-HARD DISK TRAY	1
4	22789	BUSHING ASSY-PT4-HARD DRIVE	4
5	3-0.5X5 10	SCREW-PH-PHIL-STL-ZINC	4
6	4-0.7X5 10	SCREW-PH-PHIL-STL-ZINC	8
7	22859	HARD DRIVE-PT4-FORMATTED	1

Figure 19
Computer Module P/N 22442
& Hard Drive Replacement

5.1.5 Hard Drive Replacement

The hard drive is located inside of the computer module. It has been designed so it can be easily replaced in the field without replacing the entire computer module. Follow the instructions below.

1. Turn off power to the machine.
2. On the right side of the pendant above the floppy drive remove the 2 screws holding the hard drive in place.
3. Slide the unit toward you. Be careful not to pull it too far since a cable will restrict its travel.
4. Unplug the 40-pin hard drive cable and 4-pin power cable from the connector board. Lastly remove the hard drive assembly. The entire assembly will be replaced which includes the hard drive, connector board and associated sheet metal.
5. When reinstalling the 40-pin cable make sure you plug it in correctly. The tab on the cable should match the opening cut out in the male connector.
6. Slide the unit back into place and fasten the 2 screws.

Note: the new hard drive will have all of the necessary software installed already.

CAUTION!

It is a good idea to back up your hard drive from time to time via a network or floppy disk. If your hard drive needs to be replaced you will loose all of your programs. See your programming manual for instruction on how to do this.

5.1.6 Electronic Handwheels

There are 3 electronic handwheels on the DPMV machines. The X and Y hand wheel are interchangeable. All 3 handwheels are mounted on the machine by the use of 4 SHCS. The X and Y hand wheel have a hole in the hand wheel so the mounting bolts can be accessed easily with a 5 mm Allen wrench or ball end screwdriver. The handwheels are plugged into the encoder module located in the lower left side of the electrical cabinet. See the Section 6 for how to route the cables in the electrics box.

5.1.7 Cable Routing in Electrics Box

Each cable on this machine is labeled to help identify where it is used. The lower section of the electrics box has an area where the extra slack in the cables can be stored. There is a cover that covers up all of the cables. Whenever you replace a cable or reroute a cable it is very important to keep the power cables and logic cables separated from each other. The power cables consist of the (3) 220-volt servo motor cables and (7) 110-volt power cables for the pendant, spindle motor fan, work light option, coolant pump, lube pump, spindle auxiliary module and air solenoid. The logic cables are used to carry signals between modules, handwheels, encoders, etc. The power cables have been placed on the right side of the electrics box when facing from the back of the machine and the logic cables have been routed to the left side of the box. Mixing of the power and logic cables may cause noise from the power cables to interrupt the signals in the logic cables. This can lead to intermittent axis faults or repeatability problems.

5.1.8 TRAK Sensor (DPMV3 & DPMV5 only)

5.1.8.1 Replacing the M5 Base

See Figures 20 and 21.

1. Remove the sensor by removing the clamp screw and then backing the load screw out a few turns. The sensor should lift off the base easily.
2. Remove the old M5 Base by removing the two 1/4-20 hex head screws that are threaded into the base.
3. Assemble the new base as per Figure 20 .
4. Use a bubble level to align the raised bumps on the base with the table for X axis or saddle ways for Y-axis.
5. A dial indicator may be used to align the bumps on the base instead of a bubble level.

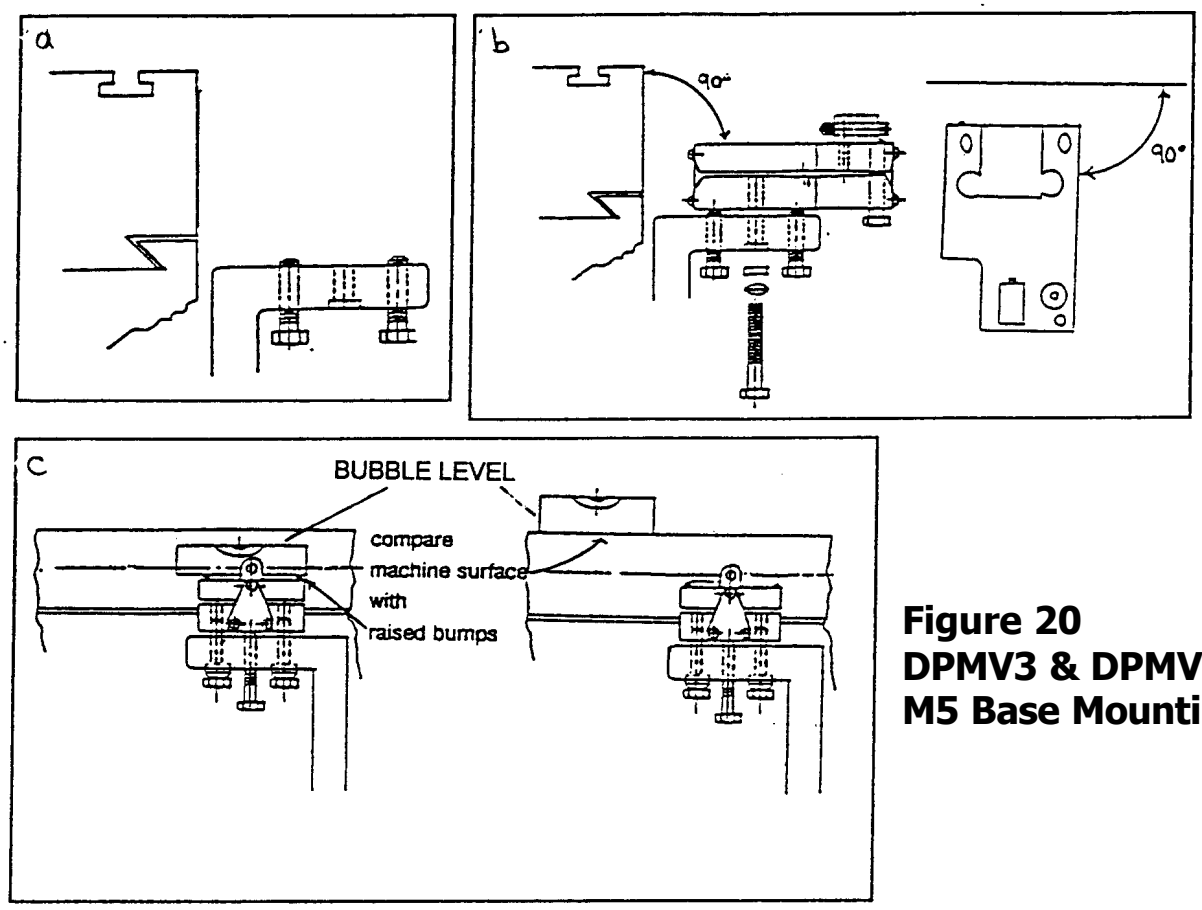


Figure 20
DPMV3 & DPMV5
M5 Base Mounting

5.1.8.2 Replacing the TRAK Sensor

1. Remove the old sensor by removing the clamp screw and then backing the load screw out a few turns. The sensor should lift off the base easily.
2. Install the new sensor on the M5 base using the clamp screw.
3. Load the sensor against the running surface (table or run bar) using the load screw. The white lines on the side of the M5 base tell you when it is loaded correctly.

Note: You want to load the gage wheel against the running surface using the flat spring of the M5 base. Do not tighten the clamp screw fully until after loading the sensor.

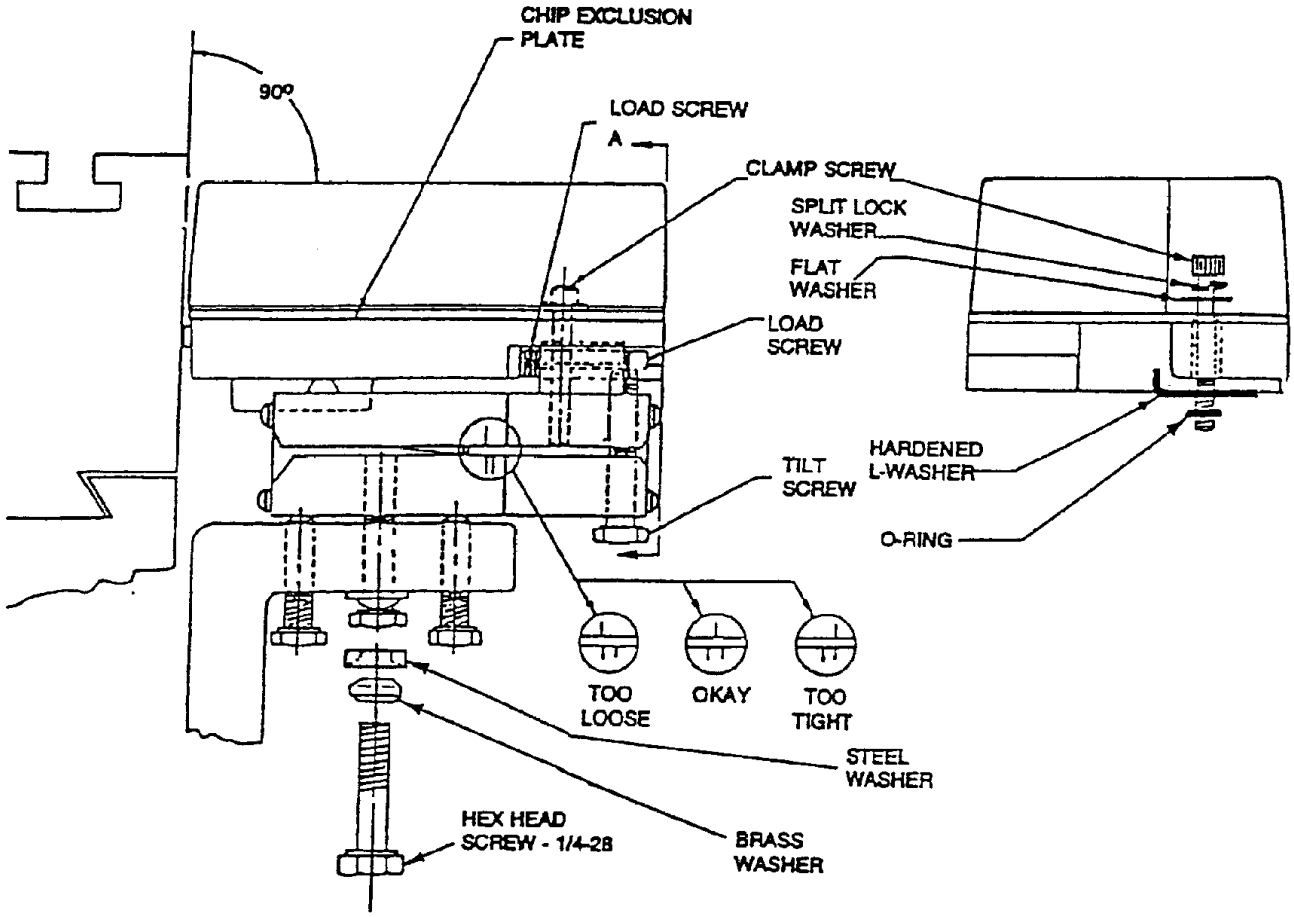


Figure 21
DPMV3 & DPMV5 - TRAK Sensor Mounting

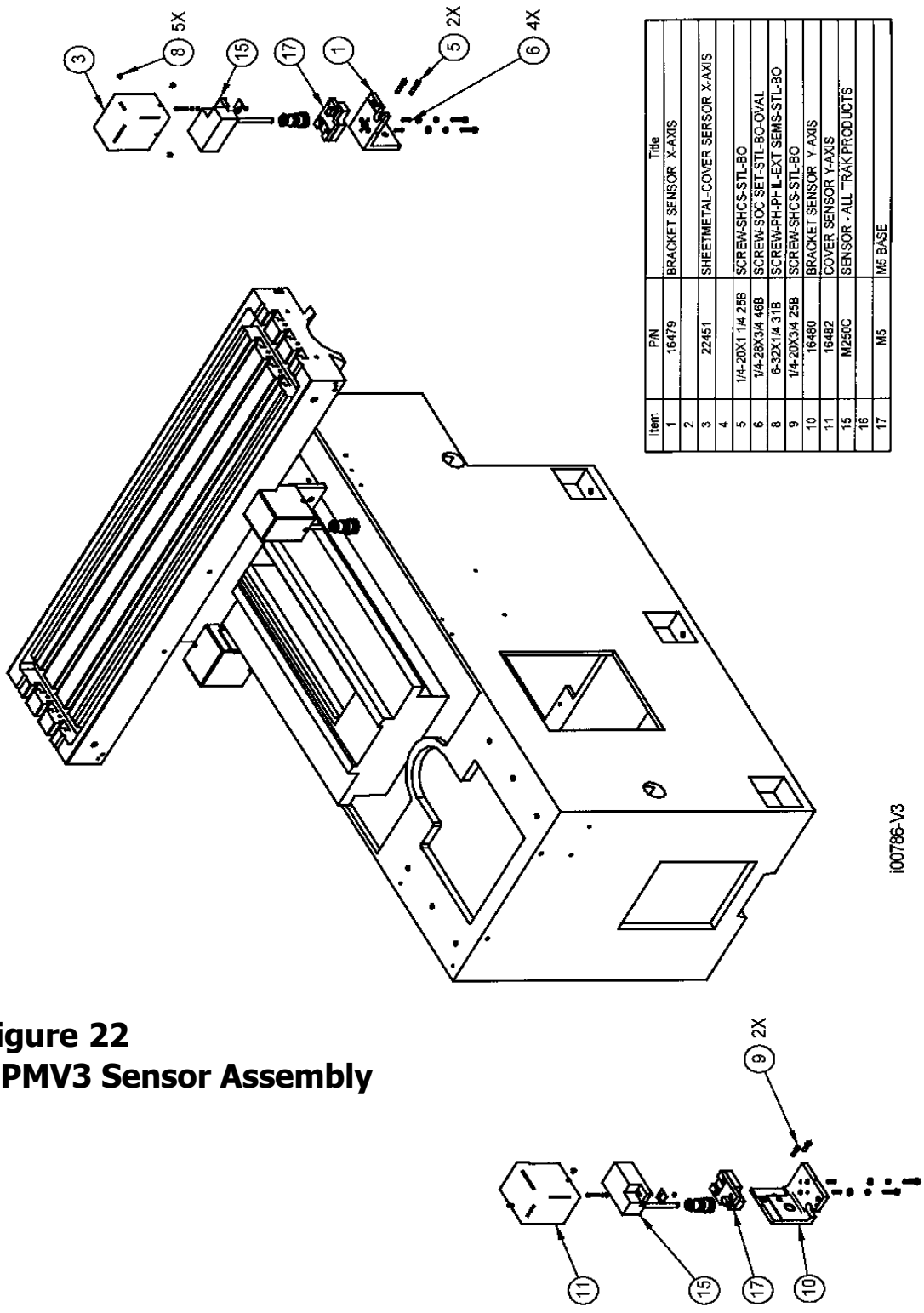
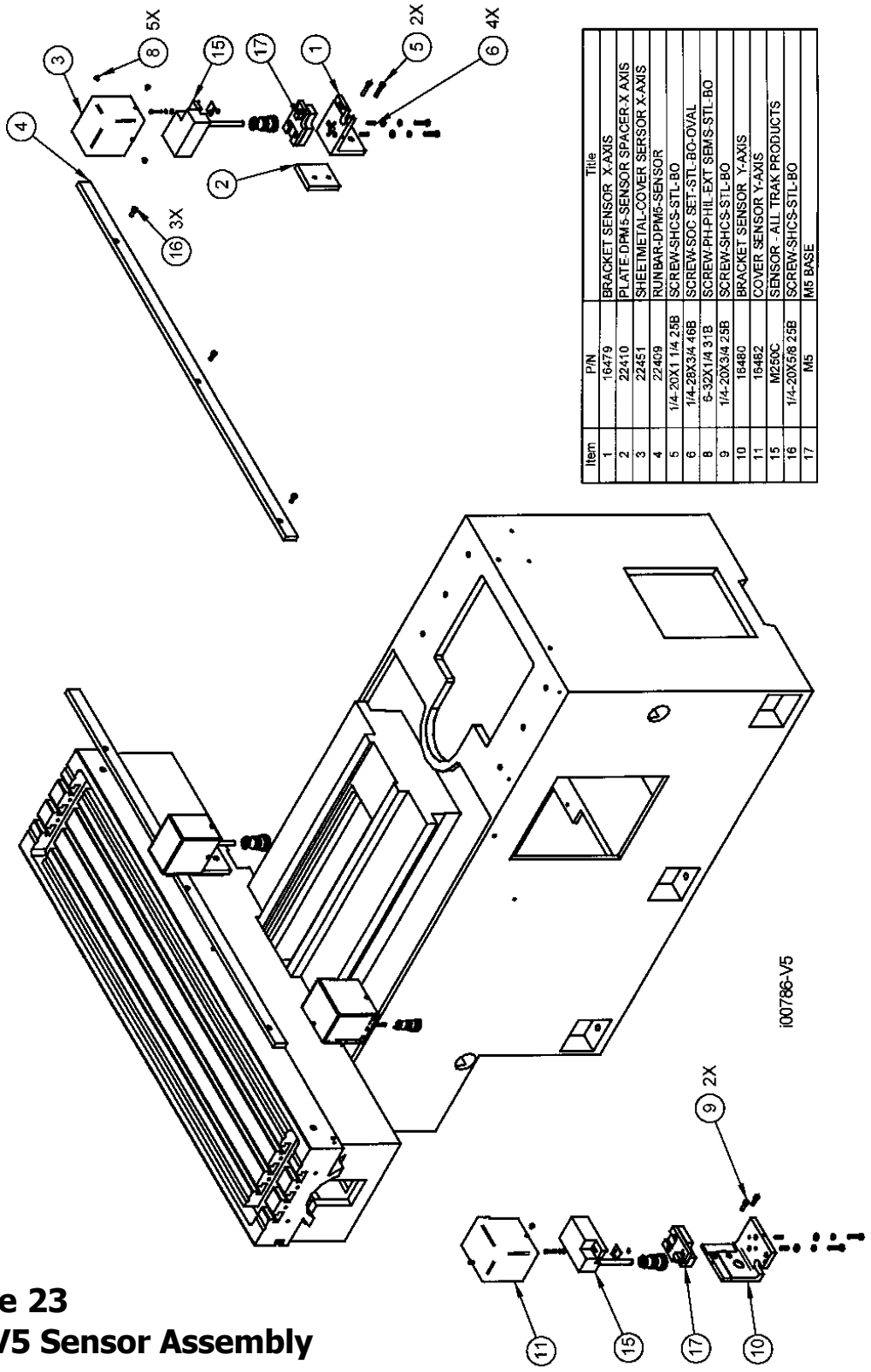


Figure 22
DPMV3 Sensor Assembly



Item	P/N	Title
1	16479	BRACKET SENSOR X-AXIS
2	22410	PLATE-DPM5-SENSOR SPACER-X AXIS
3	22451	SHEETMETAL-COVER SERSOR X-AXIS
4	22409	RUNBAR-DPM5-SENSOR
5	1/4-20X1 1/4 25B	SCREW-SHCS-STL-BO
6	1/4-28X3/4 46B	SCREW-SOC SET-STL-BO-OVAL
8	6-32X1/4 31B	SCREW-PH-PHIL-EXT SEMS-STL-BO
9	1/4-20X3/4 25B	SCREW-SHCS-STL-BO
10	16480	BRACKET SENSOR Y-AXIS
11	16482	COVER SENSOR Y-AXIS
15	M250C	SENSOR - ALL TRAK PRODUCTS
16	1/4-20X5/8 25B	SCREW-SHCS-STL-BO
17	M5	M5 BASE

Figure 23
DPMV5 Sensor Assembly

5.1.9 Glass Scale Replacement

5.1.9.1 Remove the Glass Scale

1. Unplug the glass scale connector from the encoder module inside the electrics box.
2. Unbolt the reader head of the glass scale from its mounting surface.
3. Unbolt the glass scale enclosure from the table on X or the mounting spar on Y.
4. Install the head alignment bracket that came with the replacement scale to this scale to secure it for shipping back to SWI. Failure to do this may cause the glass scale to get damaged during shipment. The head alignment bracket secures the reader head so it cannot move and damage the glass in the scale.

Note: 1st align the reader head on the new scale before removing it to fasten the old scale.

CAUTION!
Once the head alignment bracket is installed, do not traverse the axis or the reader head will break.

5.1.9.2 Install the Replacement Scale

CAUTION!
If the scale is not long enough for the table, it will break when the machine is traversed past the scale travel.

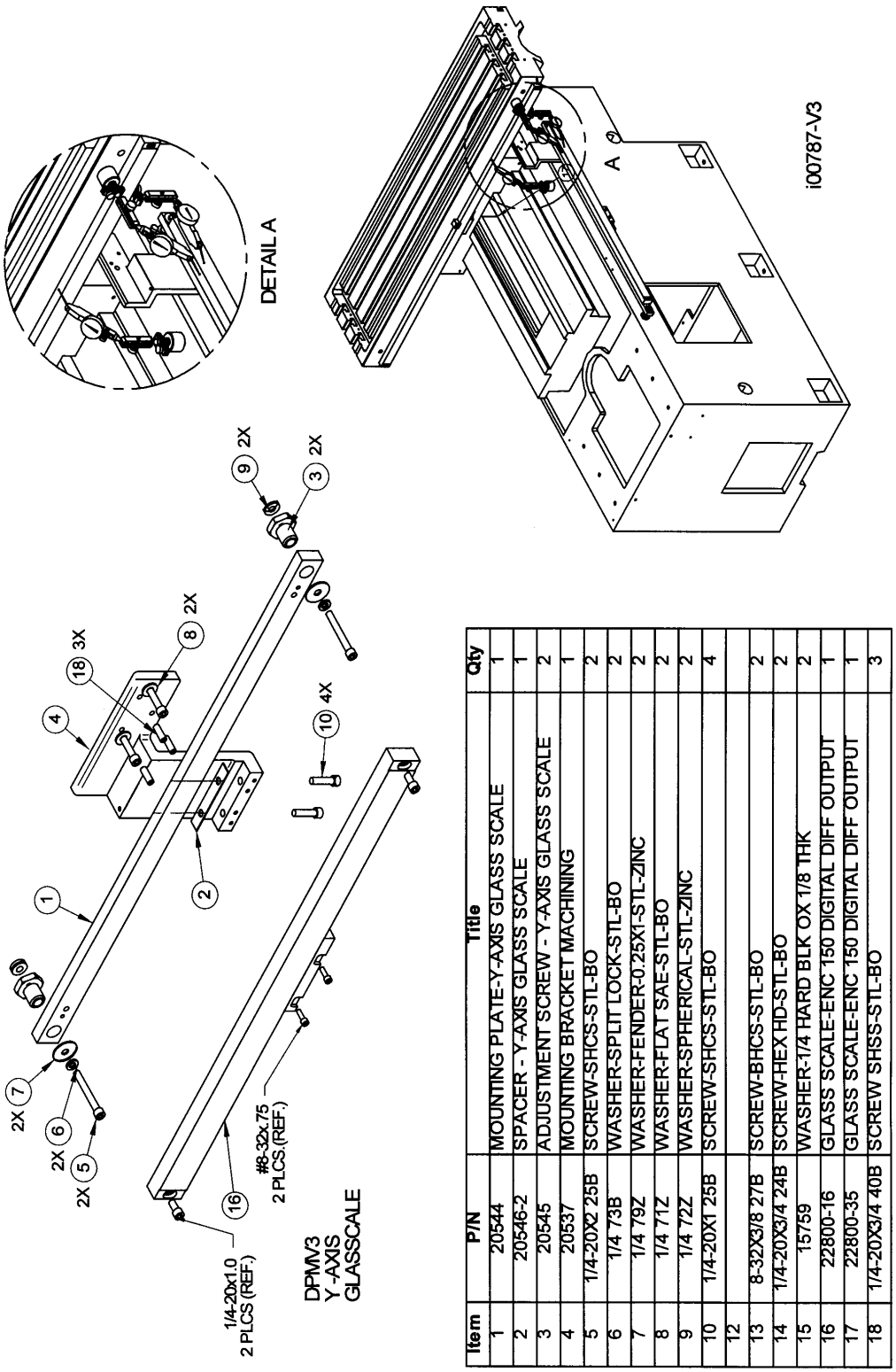
1. Mount the scale to the back of the table or Y-axis mounting spar.
2. Align the sale so that it is within +/- 0.005" end to end.

Notes: For the Y-axis, the mounting spar should already be aligned. It must be parallel to the Y-axis travel within +/-.005" end to end both horizontally and vertically. The mounting spar can be aligned in and out by the use of the adjustment screw.

3. Line the reader head up with the mounting holes on the back of the saddle for the X-axis or the bracket on the Y-axis.
4. Install the reader head bolts but leave them loose.
5. Use the jackscrews on the reader head to compensate for some gap between the reader head and the reader head mounting bracket. Leave the alignment brackets attached to the reader head. This bracket assures the reader head is aligned to the glass scale.
6. Tighten each jackscrew until it touches the bracket and then back it off 0.001” or 0.002”. Use a feeler gage to set the gap.
7. Tightening the reader head mounting screws. This ensures the reader head is aligned within a few thousandths.
8. Remove the shipping bracket that fixes the reader head to the scale for shipping.

WARNING!
After the reader head is attached to the reader head mounting bracket, do not move the machine axis until the shipping bracket is removed. This will break the reader head. This is not covered under warranty.

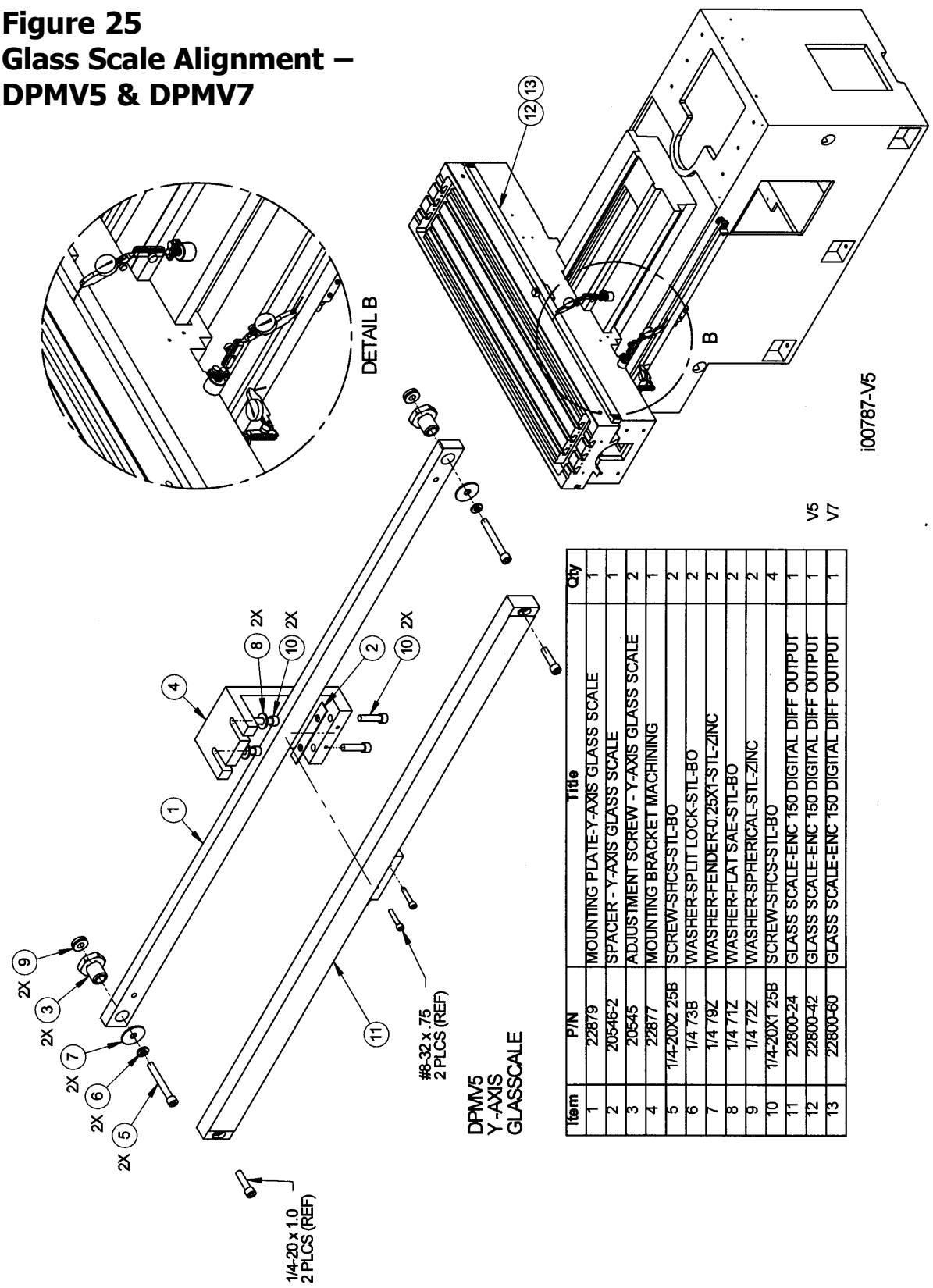
See Figure 24 for an illustration of how to align glass scales.



Item	P/N	Title	Qty
1	20544	MOUNTING PLATE-Y-AXIS GLASS SCALE	1
2	20546-2	SPACER - Y-AXIS GLASS SCALE	1
3	20545	ADJUSTMENT SCREW - Y-AXIS GLASS SCALE	2
4	20537	MOUNTING BRACKET MACHINING	1
5	1/4-20X2 25B	SCREW-SHCS-STL-BO	2
6	1/4 73B	WASHER-SPLIT LOCK-STL-BO	2
7	1/4 79Z	WASHER-FENDER-0.25X1-STL-ZINC	2
8	1/4 71Z	WASHER-FLAT SAE-STL-BO	2
9	1/4 72Z	WASHER-SPHERICAL-STL-ZINC	2
10	1/4-20X1 25B	SCREW-SHCS-STL-BO	4
12			
13	8-32X3/8 27B	SCREW-BHCS-STL-BO	2
14	1/4-20X3/4 24B	SCREW-HEX HD-STL-BO	2
15	15759	WASHER-1/4 HARD BLK OX 1/8 THK	2
16	22800-16	GLASS SCALE-ENC 150 DIGITAL DIFF OUTPUT	1
17	22800-35	GLASS SCALE-ENC 150 DIGITAL DIFF OUTPUT	1
18	1/4-20X3/4 40B	SCREW SHSS-STL-BO	3

Figure 24
Glass Scale Alignment – DPMV3

Figure 25
Glass Scale Alignment –
DPMV5 & DPMV7



Item	P/N	Title	Qty
1	22879	MOUNTING PLATE-Y-AXIS GLASS SCALE	1
2	20546-2	SPACER - Y-AXIS GLASS SCALE	1
3	20545	ADJUSTMENT SCREW - Y-AXIS GLASS SCALE	2
4	22877	MOUNTING BRACKET MACHINING	1
5	1/4-20X2 25B	SCREW-SHCS-STL-BO	2
6	1/4 73B	WASHER-SPLIT LOCK-STL-BO	2
7	1/4 79Z	WASHER-FENDER-0.25X1-STL-ZINC	2
8	1/4 71Z	WASHER-FLAT SAE-STL-BO	2
9	1/4 72Z	WASHER-SPHERICAL-STL-ZINC	2
10	1/4-20X1 25B	SCREW-SHCS-STL-BO	4
11	22800-24	GLASS SCALE-ENC 150 DIGITAL DIFF OUTPUT	1
12	22800-42	GLASS SCALE-ENC 150 DIGITAL DIFF OUTPUT	1
13	22800-60	GLASS SCALE-ENC 150 DIGITAL DIFF OUTPUT	1

5.1.10 Power Drawbar

A power drawbar is an optional item on the DPMV machine. It is bolted to the top of the head by the use of 3 SHCS. Some machines may require a washer to space the unit up to the proper height to allow the drawbar to engage properly.

Air Regulator and Oiler - This unit requires between 80 and 100 psi to operate properly. Some units work fine at 80 psi while others may need 90 or 100 psi. It is also important to make sure the oiler for this unit is kept filled with oil. Fill the reservoir about 2/3 full using AIR TOOL OIL ONLY. Failure to do this will not allow oil to lubricate the internal components of the unit and it may wear out prematurely. It is also important to make sure the oiler is set properly. To set the oiler, first close the adjustment screw (CW) on top of the oiler completely making sure to not over tighten. Then open the screw (CCW) between ½ to ¾ of a turn. Any more than this will cause too much oil to get into the unit and oil may come out of the exhaust port of the unit.

Tool Alignment Device - This unit also comes with a tool alignment device, which attaches to the bottom of the spindle. This device allows the tool to easily be aligned with the dogs when loading a tool.

CAUTION!

Some tools may not work with this device and the original spindle dogs will need to be used. The original spindle dogs are shipped with each machine in the toolbox. Some boring bar holders may not work with this device.

Item	P/N	Description
1	22581-1	AIR GUN ASSY ONLY-TORQUE RITE
2	23171-NMTB	DRAWBAR-NMTB (DPMV5)
	23171-CAT	DRAWBAR-CAT (DPMV5)
	23284	DRAWBAR-MANUAL (DPMV5)
3	21661	SPACER-POWER DRAWBAR (DPMV5)
	22116	SPACER-DRAWBAR-MANUAL (DPMV5)
	24166	SPACER-POWER DRAWBAR (DPMV7)
	24539	SPACER-DRAWBAR-MANUAL (DPMV7)
4	22773	OILER
5	24165-CAT	DRAWBAR-CAT (DPMV7)
	24165-NMTB	DRAWBAR-NMTB (DPMV7)
6	22581-2	SWITCH-CONTROL HEAD-TORQUE RITE
7	22581-4	NOSEPIECE FOR SPINDLE (DPMV5)
8		1/4" NPT AIR FITTING 90°
9		3/8 O.D. TUBING 132" LG.
10		3/8 O.D. TUBING 27" LG.

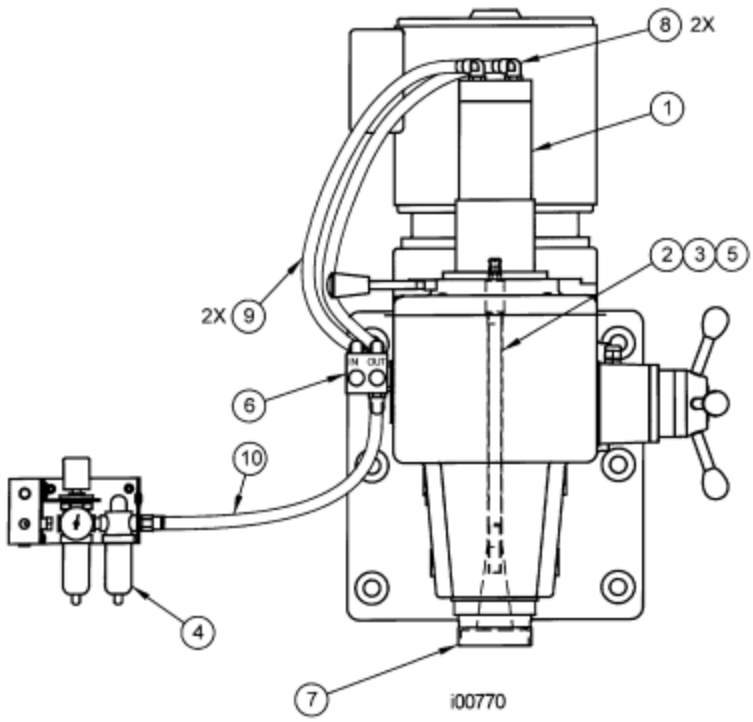


Figure 26
Power Drawbar Assembly

5.1.11 Ball Screw Replacement, X-Axis (Table) – DPMV3

CAUTION!
Never screw a ball screw partially or totally out of its nut. They cannot be reassembled.

1. Position the table in the center of travel
2. Remove the left side table tray by pulling it up, and remove the X motor.
3. Remove the motor mounting bracket and bearing housing.
4. Remove the right side electronic hand wheel and hand wheel mounting casting.
5. Loosen the table gibs. Slide the table to the right and on to a lift that will support the table's weight. Slide the table until the yoke is exposed.

CAUTION!
The weight of the table must be supported by the left to prevent damage or breakage to the dovetails.

6. Remove the (2) 5/16 x 1" screws holding the ball nut to the yoke and loosen the 4 screws that mount the yoke to the saddle. Remove the oil line.
7. Tilt the yoke (it is pinned) to remove the ball screw.
8. Remove the elbow and setscrew from the old ball screw flange and fit them similarly in the new ball screw.
9. Pump oil to be certain it flows through the oil line and then attach the oil line to the elbow.
10. Reassemble all assemblies.

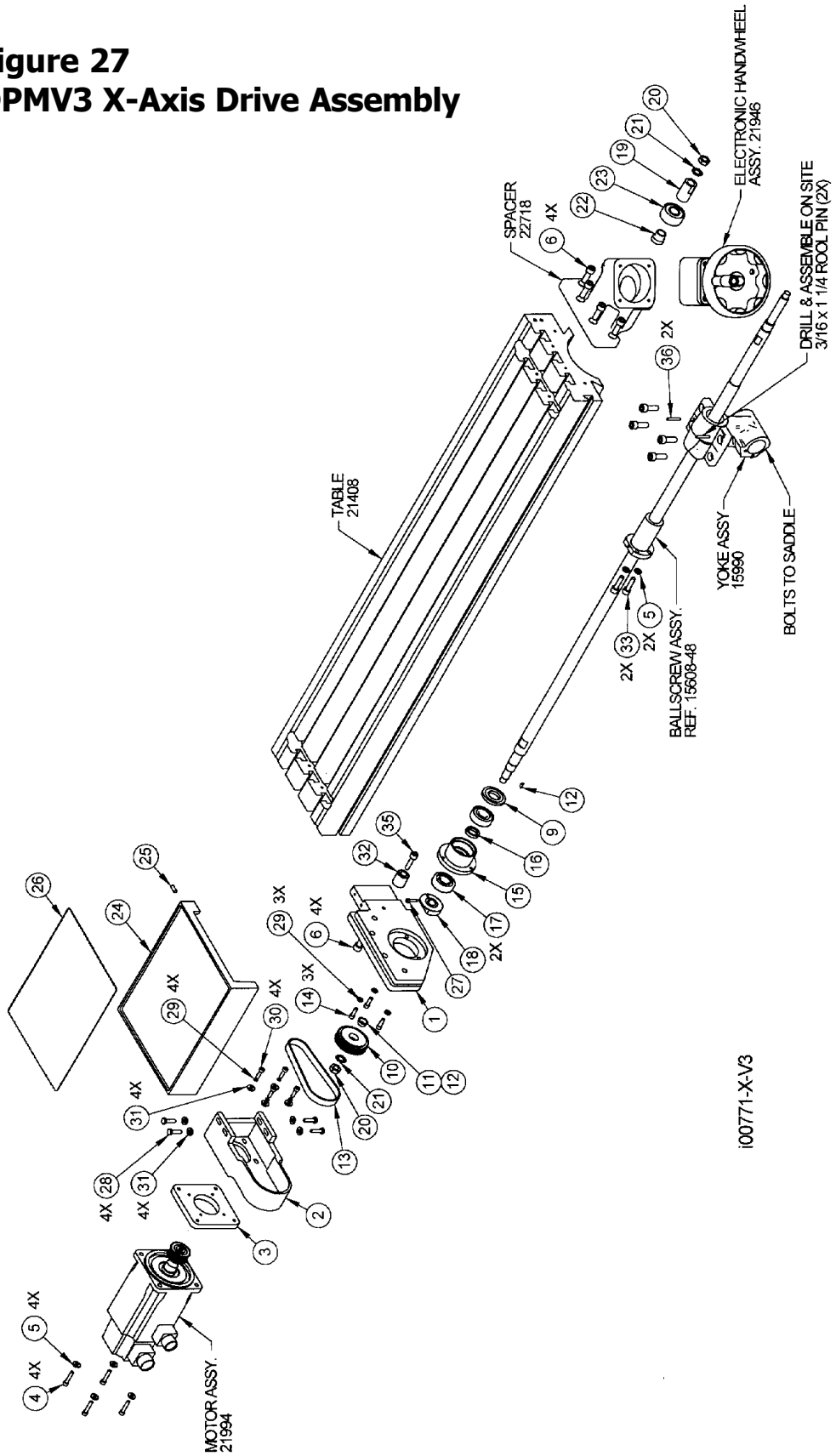
Important: The clamp nut must be reassembled as follows:

- Install rear bearing and seal into bearing housing and slide housing onto the ball screw. *(Note: Letters on bearings must face each other in the housing.)*
- Thread the split nut onto the ball screw and tighten the #10-32 clamp screw until you feel the split nut contact the ball screw threads. It should drag as you tighten the clamp nut.
- Torque the split nut to 50 ft. lb.
- Firmly tighten the #10-32 clamp screw to lock the clamp nut in place.

See the diagnostics section under Mechanical Drive Train for an explanation of how to align the ball screw.

See Figure 27 for an illustration of the X-axis drive train.

Figure 27
DPMV3 X-Axis Drive Assembly



DPMV3 X-Axis Drive Assembly Parts List

Item	P/N	Description	Qty
1	15974	END PLATE	1
2	15973	SERVO MOTOR ADAPTER	1
3	21988-1	SPACER - MOTOR X-AXIS	1
4	M8-1.25X20 25B	SCREW-SHCS-STL-BO	4
5	M8 73B	WASHER-SPLIT LOCK-STL-BO	6
6	M10-1.5X30 25B	SCREW-SHCS-STL-BO	8
7			
8			
9	15626	SEAL-BEARING HOUSING	1
10	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES	1
11	16350	FERRULE-SPROCKET	1
12	98481A090	KEY WOODRUFF #3-1/8 X 1/2	1
13	425-5M-15	BELT - TIMING 5 MM POWERGRIP	1
14	1/4-20X3/4 25B	SCREW-SHCS-STL-BO	3
15	15612	HOUSING - BEARING	1
16	15885	RING-BEARING HOUSING	1
17	20373	BEARING-ANGULAR CONTACT- 7204 BECBP	2
18	15613	CLAMP NUT-BEARING HOUSING	1
19	21992	BUSHING - BALL SCREW	1
20	1/2-20 51Z	NUT-HEX JAM-STL-ZINC	2
21	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	2
22	15058-.875	BUSHING	1
23	22008	BEARING-204KTT	1
24	22069	TRAY-DPMV3 MACHINE	1
25	1/4-28X3/4 42B	SCREW-SOC SET-STL-BO-CONE	1
26	15977	TRAY PAD	1
27	10-32X3/4 25B	SCREW-SHCS-STL-BO	1
28	1/4-20X1 24B	SCREW-HEX HD-STL-BO	4
29	1/4 73Z	WASHER-SPLIT LOCK-STL-BO	7
30	M6-1.0X20 25B	SCREW-SHCS-STL-BO	4
31	15759	WASHER-1/4 HARD BLK OX 1/8 THK	8
32	15638-3	STOP - X-AXIS	1
33	5/16-18X1 1/4 25B	SCREW-SHCS-STL-BO	2
35	5/16-18X3/4 25B	SCREW-SHCS-STL-BO	1
36	3/16 x 1 1/4 81P	PIN - ROLLED-STL-PLAIN	2

i00771-X-V3-PL.xls

5.1.12 Ball Screw Replacement, X-Axis (Table) – DPMV5

1. Remove table trays from each side of the table.
2. Remove bearing housing from right side of table.
3. Remove the sheet metal covers from the motor mounting brackets.
4. Remove the X-axis motor and belt from the left side of the table.
5. Remove the pulley and ferrule from the ball screw.
6. Remove the motor mounting bracket.
7. Loosen and remove the clamp nut. Loosen the setscrew on the clamp nut before loosening the clamp nut.
8. Push the table to the left so the bearing housing moves away from the saddle.
9. Remove the bearing housing. Note which way the bearings are in the bearing housing.
10. Slide the table to the right and remove the oil line and the 4 screws holding the ball nut to the yoke.
11. Pull the ball screw out.

Reassemble

12. Install the new ball screw into the yoke.
13. Slide table back to the left and assemble the left side of the X-axis.
14. Install rear bearing and seal into bearing housing and slide housing onto the ball screw. (Note: Letters on bearings must face each other in the housing.) Slide spacer onto ball screw. Slide top bearing onto ball screw and seat with clamp nut. Be sure to clamp nut to at least 50 ft-lbs. Don't forget to tighten setscrew after clamp nut is tight.
15. Install motor mounting bracket, motor spacer bracket, woodruff key, ferrule, pulley, star washer and nut. Before tightening down the motor mounting bracket move the table all the way to the left.
16. Move table to the right and assemble right side bearing housing.
17. Assemble motor to bracket. The servo should be facing toward the rear of the machine.
18. Install belt. Tighten lower 2 bolts followed by the top 2 bolts to properly tension belt.
19. Install electronic hand wheel.
20. Attach the sheet metal to the motor mounting bracket.
21. Install the table trays.

See the diagnostics section under Mechanical Drive Train for an explanation of how to align the ball screw.

See Figure 28 for an illustration of the X-axis drive train.

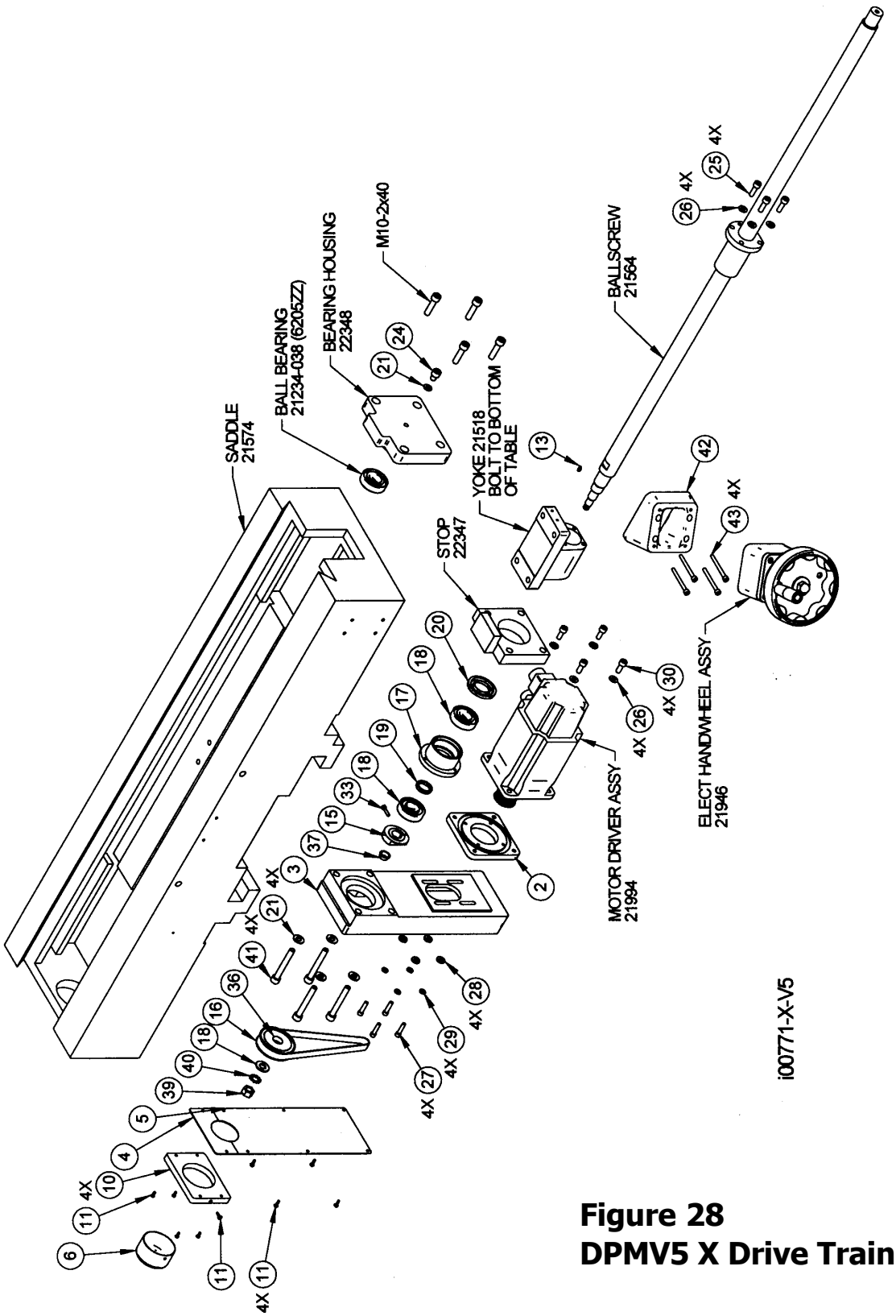


Figure 28
DPMV5 X Drive Train

DPMV5 X Drive Train Parts List

Item	P/N	Description
2	21988-2	SPACER - MOTOR X & Y-AXIS
3	15966	BRACKET-Y AXIS MOTOR MOUNT
4	15967	COVER-UPPER
5	15968	COVER-LOWER
6	21585-1	COVER-BALLSCREW END
10	21584-1	PLATE-END COVER
11	6-32X3/8 10B	SCREW-PH-PHIL-STL-BO
13	98481A090	KEY WOODRUFF #3-1/8 X 1/2
15	16066	NUT-CLAMP
16	565-5M-15	BELT-TIMING
17	21662	BEARING HOUSING-
18	21234-038	BALL BEARING – DEEP (6205ZZ)
19	16302	RING-BEARING HOUSING
20	16078	SEAL-BEARING HOUSING
21	M10 73B	WASHER-SPLIT LOCK-STL-BO
24	M10-1.5X12 25B	SCREW-SHCS-STL-BO
25	M8-1.25X25 25B	SCREW-SHCS-STL-BO
26	M8 73B	WASHER-SPLIT LOCK-STL-BO
27	M6-1.0X20 25B	SCREW-SHCS-STL-BO
28	15759	WASHER-1/4 HARD BLK OX 1/8 THK
29	1/4 73B	WASHER-SPLIT LOCK-STL-BO
30	M8-1.25X20 25B	SCREW-SHCS-STL-BO
33	10-32X3/4 25B	SCREW-SHCS-STL-BO
36	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES
37	16350	FERRULE-SPROCKET
38	1/2 70P	WASHER-FLAT USS-STL-PLAIN
39	1/2-20 51Z	NUT-HEX JAM-STL-ZINC
40	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC
41	M10-1.5X80 25B	SCREW-SHCS-STL-BO-FULLY THD
42	21985	SPACER - 30 DEGREE Y-AXIS DRIVE ASSY
43	M6-1.0X35 25B	SCREW-SHCS-STL-BO

5.1.13 Ball Screw Replacement, X-Axis (Table) – DPMV7

1. Remove table way covers from each side of the table.
2. Remove the left bearing housing cover by removing the (8) 10-24 truss head screw that secures it to the left bearing bracket.
3. Remove the motor cover/housing by removing the (4) 10-24 truss head screw secures it to the left bearing housing.
4. Remove the X-axis motor and belt from the left side of the table.
5. Using a #8 Allen hex key at the end of the ballscrew to hold it, remove the hex nut and lock washer securing the ballscrew pulley.
6. Remove pulley, key, and locking sleeve on the ballscrew.
7. Remove the (4) 3/8”-16 SHCS securing the left bearing housing to the saddle.

8. Remove left bearing housing and ballscrew bushing.
9. Remove the (3) ¼-20 SHCS securing the right bearing housing cover.
10. Remove the housing cover.
11. Disengage the lock washer tab from the two lock nuts.
12. Loosen and remove the (2) lock nut.
13. Remove the (4) 3/8-16 SHCS securing the right bearing housing
14. Remove the right bearing housing and bushing.
15. Slide the table to the right, remove the oil line and the (3) 5/16-18 SHCS that secures the ball nut to the yoke.
16. Pull the ball screw out.

Reassemble

17. Install the new ball screw into the yoke.
18. Reconnect oil line and fasten ball nut into yoke.
19. Slide table back to the center and assemble the left side of the X-axis.
20. Slide the left bearing housing bushing onto the ball screw.
21. Slide left bearing housing with bearing onto ball screw.
22. Mount bearing housing to saddle with the (4) 3/8-16 SHCS.
23. Slide locking sleeve onto ball screw with the short side out.
24. Install key and slide pulley onto ball screw.
25. Secure pulley with the lock washer and hex nut. (Note: Use a #8 Allen hex key to hold ball screw.)
26. Install motor, mounting bracket, motor spacer bracket, woodruff key, ferrule, pulley, star washer and nut. Before tightening down the motor mounting bracket move the table all the way to the left.
27. Move table to the right and assemble right side bearing housing.
28. Assemble motor to bracket. The servo should be facing toward the rear of the machine.
29. Install belt. Tighten lower 2 bolts followed by the top 2 bolts to properly tension belt.
30. Attach the sheet metal to the motor mounting bracket.
31. Install the table trays.

See the diagnostics section under Mechanical Drive Train for an explanation of how to align the ball screw.

See Figure 29 for an illustration of the X-axis drive train.

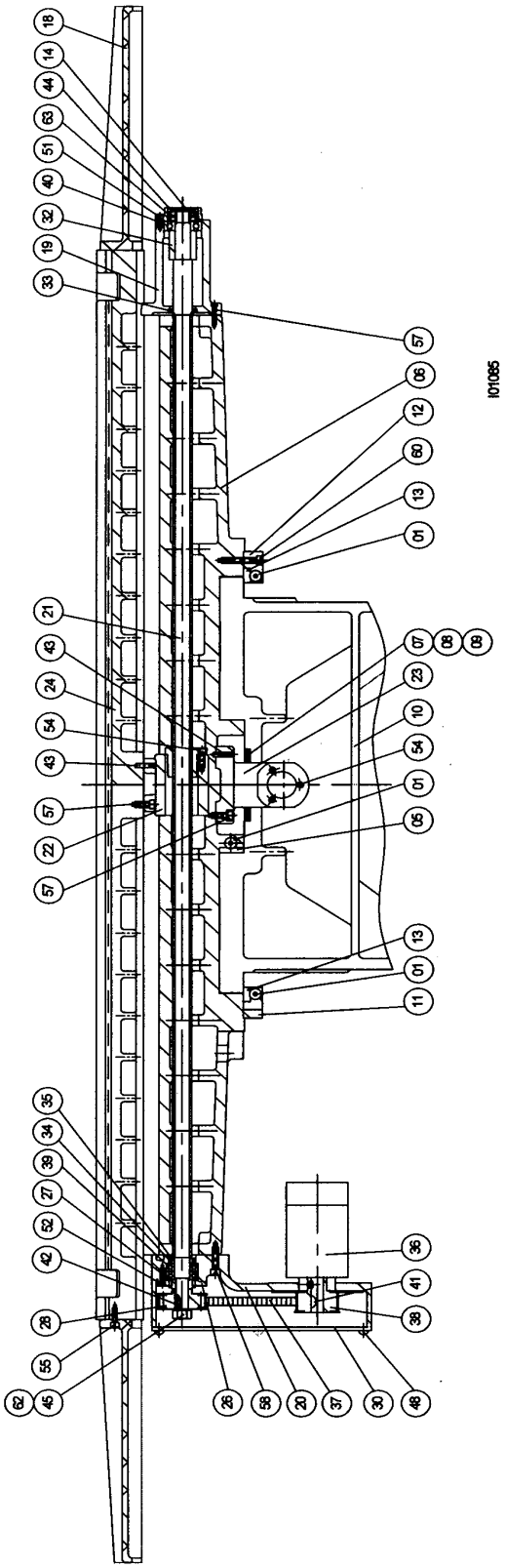


Figure 29
DPMV7 X Drive Train

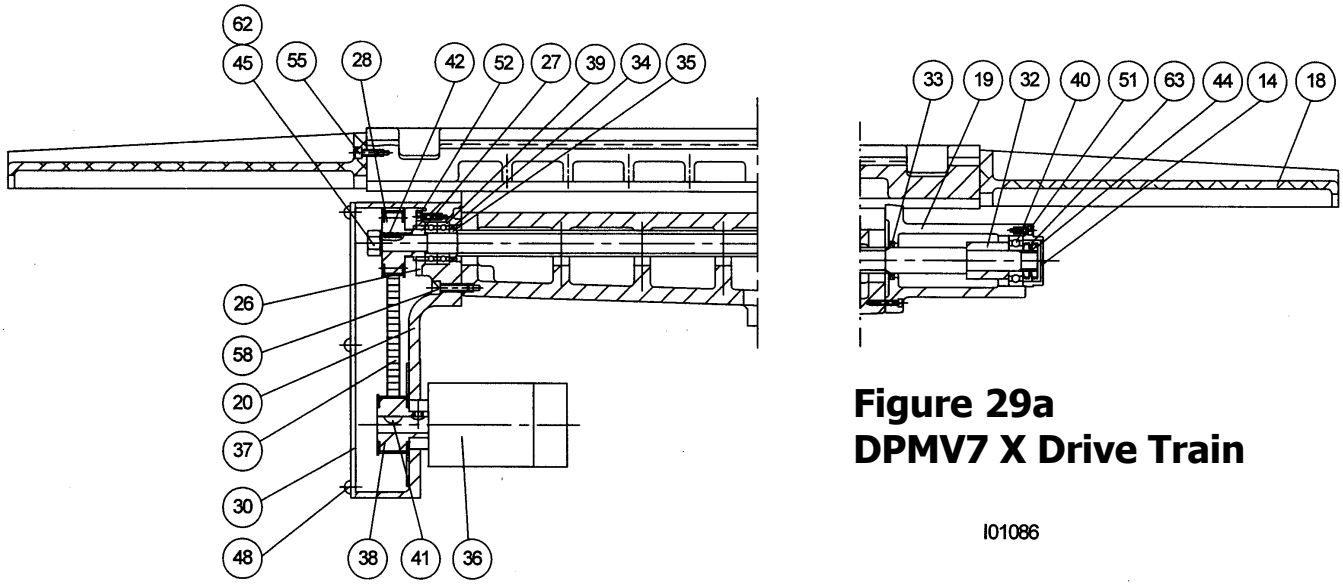


Figure 29a
DPMV7 X Drive Train

I01086

DPMV7 X-AXIS Drive Train Parts List

NO	PART NUMBER	DESCRIPTION	QTY
1	24518	SCREW - GIB ADJUSTING	3
2	24549	SCREW - GIB	2
3	24507	GIB – X AXIS	1
4	24521	WIPER – WAY	4
5	24508	GIB – Y AXIS SIDE	1
6	H-034-14B	SADDLE	1
7	H-042-8	COVER – PLATES (SMALL) - CHIP GUARD	1
8	H-043-8	COVER – PLATES (LARGE) - CHIP GUARD	1
9	H-044-8	COVER – PLATES (MIDDLE) - CHIP GUARD	1
10	H-067-9C	BASE – MACHINE	1
11	H-106-8	SEAT – GIB (LEFT)	1
12	H-107-8	SEAT – GIB (RIGHT)	1
13	24509	GIB – Y AXIS BOTTOM	2
14	H-120-6	COVER	1
15	H-122-6	STOP	2
16	24514	SWITCH – LIMIT	2
17	H-124-7A	COVER	1
18	24505	COVER – WAY -TABLE	2
19	HT-011-8B	BRACKET - RIGHT BEARING	1
20	HT-012-8B	BRACKET - LEFT BEARING	1
21	24500	BALLSCREW – X AXIS	1
22	HT-022-8	BRACKET – FEED NUT	1
23	HT-022-8B	BRACKET - CROSS SCREW	1
24	HT-029-14	TABLE	1
25	HT-032	PLUNGER –RUBBER	8

NO	PART NUMBER	DESCRIPTION	QTY
26	HT-040-7	COVER - BEARING	1
27	HT-041-6	SLEEVE – LOCKING	1
28	24545	PULLEY – X AXIS	1
29	HT-090-8B	COVER	1
30	HT-098-8	COVER	1
31	HT-157-8	BRACKET – HANDWHEEL	1
32	HT-166-8	BUSHING	1
33	HT-167	SEAL – OIL	1
34	HT-181	SEAL – OIL	1
35	HX-002	BUSHING	1
36	21994	MOTOR	1
37	635-5M-15	BELT	1
38			
39	24513	BEARING SET - ANGULAR CONTACT	1
40	24514	BEARING – BALL 6305ZZ	1
41			
42	24546	KEY:5x5x20	1
43	AKP205030	PIN:Ø5x30	6
44	24515	NUT - LOCKING:M25x1.5	2
45	ANI11858	NUT:5/8"-18NF	1
46	ANI118516	NUT:5/16"-18NC	2
47	ASM206010	SCREW:M6x1.0x15L	4
48	ASI231612	SCREW:3/16"-24NC-1/2"L	32
49	ASI231658	SCREW:3/16”-24NC-5/8”L	4
50	ASI61412	SCREW:1/4"-20NC-1/2"L	5
51	ASI61458	SCREW:1/4"-20NC-5/8"L	3
52	ASI61434	SCREW:1/4"-20NC-3/4"L	3
53	ASI61478	SCREW:1/4"-20NC-7/8"L	4
54	ASI651634	SCREW:5/16"-18NC-3/4"L	8
55	ASI65161	SCREW:5/16"-18NC-1"L	4
56	ASI6516134	SCREW:5/16"-18NC-1 3/4"L	2
57	ASI6381	SCREW:3/8"-16NC-1"L	12
58	ASI638178	SCREW:3/8"-16NC-1 7/8"L	4
59	ASI6121	SCREW:1/2"-12NC-1"L	2
60	ASI612112	SCREW:1/2"-12NC-1 1/2"L	8
61	AWIH01516	WASHER:5/16"-18NC	2
62	AWIH0158	WASHER:5/8"-18NF	1
63	24548	WASHER:M25x1.5	1

i01084

5.1.14 Ball Screw Replacement, Y-Axis (Saddle) – DPMV3

CAUTION!
Never screw a ball screw partially or totally out of its nut. They cannot be reassembled.

1. Position the saddle all the way forward.
2. Remove the electronic hand wheel assembly and bracket.
3. Remove the sheet metal covers on the front of the machine bed and on the motor mounting bracket.
4. Remove the motor, then remove the motor mounting bracket.
5. Remove the rest of the parts on the ball screw journal. Note the orientation of the bearings for reassembly.
6. Remove the (2) 5/16 x 1 inch screws that attach the ball nut to the yoke.
7. Remove the ball screw and oil line attached to the elbow fitting on the ball nut.
8. Remove the elbow and setscrew from the old ball screw flange and fit them similarly in the new ball screw.
9. Pump oil to be certain it flows through the oil line, and then attach the oil line to the elbow.
10. Reassemble all assemblies.

    Important: The clamp nut must be reassembled as follows:

    - Install rear bearing and seal into bearing housing and slide housing onto the ball screw. *(Note: Letters on bearings must face each other in the housing.)*
    - Thread the split nut onto the ball screw and tighten the #10-32 clamp screw until you feel the split nut contact the ball screw threads. It should drag as you tighten the clamp nut.
    - Torque the split nut to 50 ft. lb.
    - Firmly tighten the #10-32 clamp screw to lock the clamp nut in place.

    See the diagnostics section under Mechanical Drive Train for an explanation of how to align the ball screw.

See Figure 30 for an illustration of the Y-axis drive train.

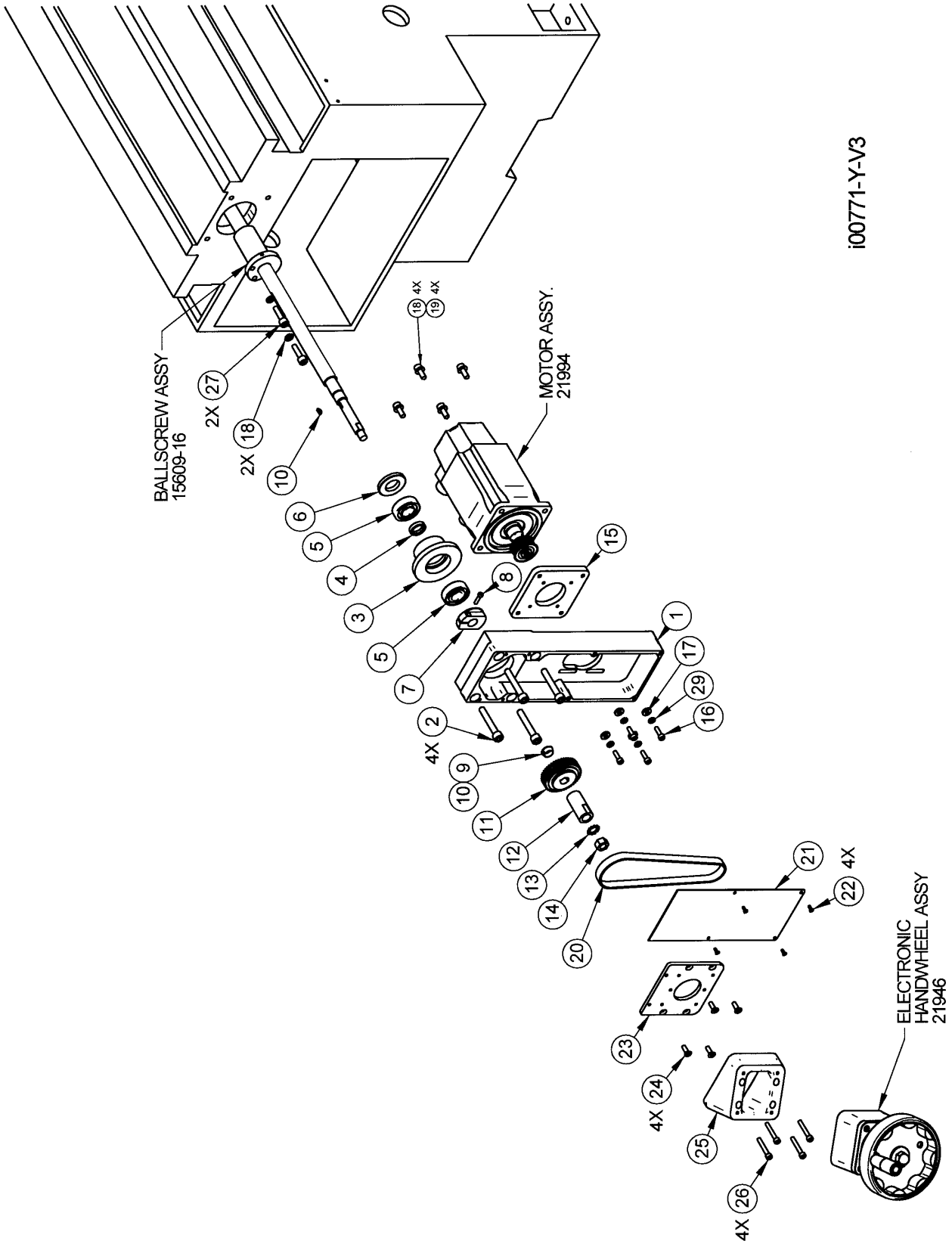


Figure 30 DPMV3 Y Drive Train

DPMV3 Y Drive Train Parts List

Item	P/N	DESCRIPTION	Qty
1	21986	BRACKET - MOTOR Y AXIS DRIVE (C15966)	1
2	M10-1.5X65 25B	SCREW-SHCS-STL-BO	4
3	15980	BEARING HOUSING	1
4	15885	RING-BEARING HOUSING	1
5	23930	BEARING (SET) -ANGULAR CONTACT- 7204 BECBP	1
6	15626	SEAL-BEARING HOUSING	1
7	15613	CLAMP NUT-BEARING HOUSING	1
8	10-32X3/4 25B	SCREW-SHCS-STL-BO	1
9	16350	FERRULE-SPROCKET	1
10	98481A090	KEY WOODRUFF #3-1/8 X 1/2	1
11	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES	1
12	21987	BUSHING - BALL SCREW	1
13	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	1
14	1/2-20 51Z	NUT-HEX JAM-STL-ZINC	1
15	21988-2	SPACER - MOTOR X & Y-AXIS	1
16	M6-1.0X20 25B	SCREW-SHCS-STL-BO	4
17	15759	WASHER-1/4 HARD BLK OX 1/8 THK	4
18	M8 73B	WASHER-SPLIT LOCK-STL-BO	6
19	M8-1.25X20 25B	SCREW-SHCS-STL-BO	4
20	565-5M-15	BELT-TIMING	1
21	21982	SHEET METAL-PT4-LOWER Y-AXIS DRIVE ASSY COVER	1
22	6-32X3/8 10B	SCREW-PH-PHIL-STL-BO	4
23	21984	BRACKET - WAY COVER FRONT Y-AXIS DRIVE	1
24	1/4-20X5/8 26B	SCREW-FHCS-STL-BO	4
25	21985	SPACER - 30 DEGREE Y-AXIS DRIVE ASSY	1
26	M6-1.0X35 25B	SCREW-SHCS-STL-BO	4
27	5/16-18X1 1/4 25B	SCREW-SHCS-STL-BO	2
29	1/4 73B	WASHER-SPLIT LOCK-STL-BO	4

i00771-Y-V3.xls

5.1.15 Ball Screw Replacement, Y-Axis (Saddle) – DPMV5

1. Remove the sheet metal from the front of the machine and from the motor mounting bracket.
2. Move the saddle toward the front of the machine and remove the electronic hand wheel.
3. Remove the Y-axis motor and belt.
4. Remove the pulley and ferrule from the ball screw.
5. Remove the motor mounting bracket.
6. Loosen and remove the clamp nut. Loosen the setscrew on the clamp nut before loosening the clamp nut.
7. Remove the bearing housing. Note which way the bearings are in the bearing housing.
8. Remove the oil line and the 4 screws holding the ball nut to the yoke.
9. Pull the ball screw out.

Reassemble

10. Install Y ball screw to yoke and install oil line to ball nut
11. Install rear bearing and seal into bearing housing and slide housing onto the ball screw. (Note: Letters on bearings must face each other in the housing.) Slide spacer onto ball screw. Slide top bearing onto ball screw and seat with clamp nut. Slide top bearing onto ball screw and seat with clamp nut. Be sure to clamp nut to at least 50 ft-lbs. Don't forget to tighten setscrew after clamp nut is tight.
12. Install motor mounting bracket, woodruff key, ferrule, pulley, star washer and nut. Before tightening down the motor mounting bracket move the saddle to the front of the machine.
13. Assemble motor to bracket. The servo should be facing the right of the machine.
14. Install belt. Tighten lower 2 bolts followed by the top 2 bolts to properly tension belt.
15. Install electronic hand wheel.
16. Install all sheet metal.

See the diagnostics section under Mechanical Drive Train for an explanation of how to align the ball screw.

See Figure 31 for an illustration of the Y-axis drive train.

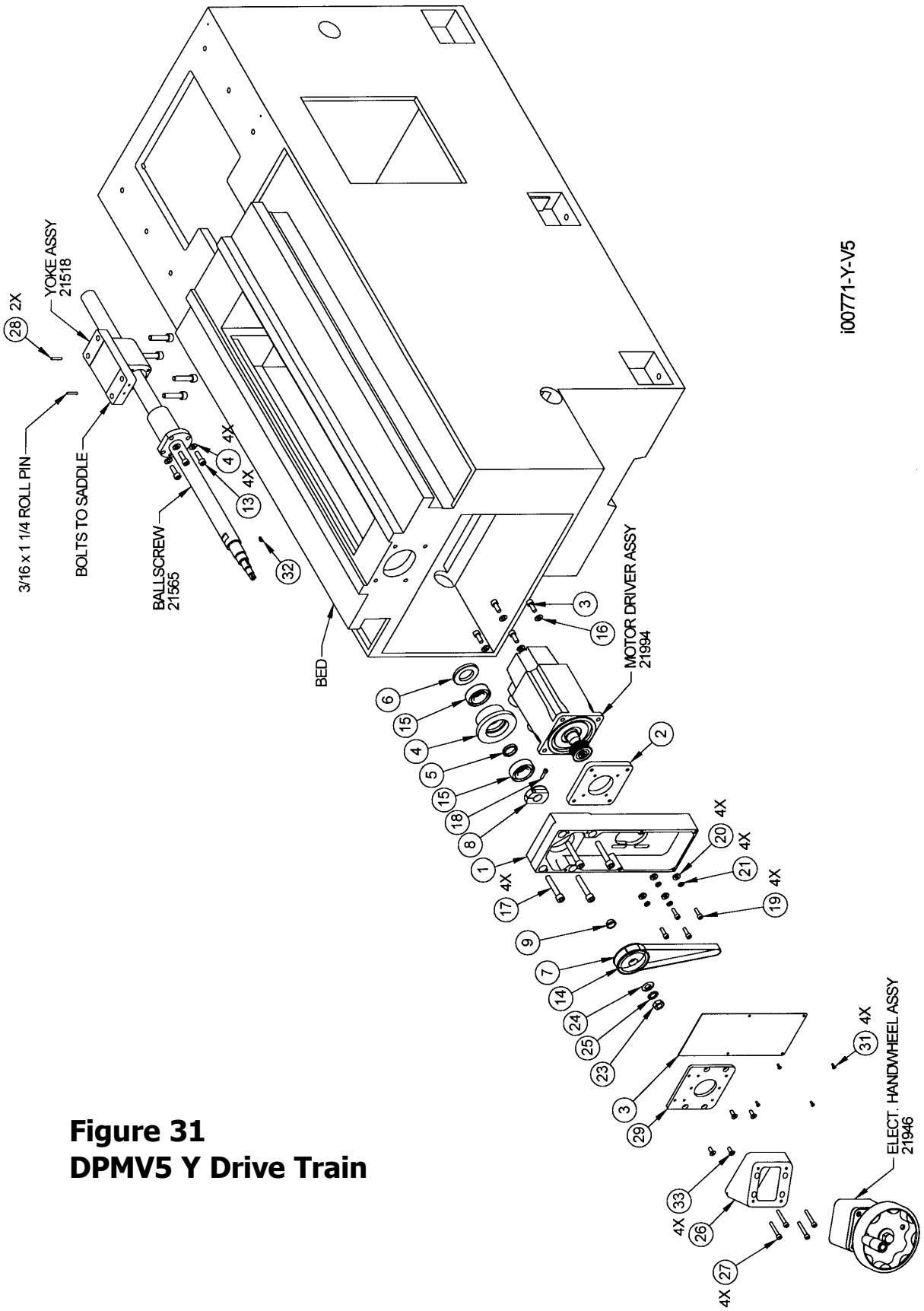


Figure 31
DPMV5 Y Drive Train

DPMV5 Y Drive Train Parts List

Item	P/N	Description
1	21986	BRACKET - MOTOR Y AXIS DRIVE (C15966)
2	21988-2	SPACER - MOTOR X & Y-AXIS
3	21982	SHEET METAL-PT4-LOWER Y-AXIS DRIVE ASSY COVER
4	21662	BEARING HOUSING-
5	16302	RING-BEARING HOUSING
6	16078	SEAL-BEARING HOUSING
7	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES
8	16066	NUT-CLAMP
9	16350	FERRULE-SPROCKET
13	M8-1.25X25 25B	SCREW-SHCS-STL-BO
14	565-5M-15	BELT-TIMING
15	20374	BEARING-ANGULAR CONTACT-7205 BECBP
16	M8 73B	WASHER-SPLIT LOCK-STL-BO
17	M10-1.5X65 25B	SCREW-SHCS-STL-BO
18	10-32X3/4 25B	SCREW-SHCS-STL-BO
19	M6-1.0X20 25B	SCREW-SHCS-STL-BO
20	15759	WASHER-1/4 HARD BLK OX 1/8 THK
21	1/4 73B	WASHER-SPLIT LOCK-STL-BO
23	1/2-20 51Z	NUT-HEX JAM-STL-ZINC
24	1/2 70Z	WASHER-FLAT USS-STL-ZINC
25	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC
26	21985	SPACER - 30 DEGREE Y-AXIS DRIVE ASSY
27	M6-1.0X35 25B	SCREW-SHCS-STL-BO
28	3/16X1 1/4 81P	PIN-ROLLED-STL-PLAIN
29	21984	BRACKET - WAY COVER FRONT Y-AXIS DRIVE
31	6-32X3/8 10B	SCREW-PH-PHIL-STL-BO
32	98481A090	KEY WOODRUFF #3-1/8 X 1/2
33	1/4-20X5/8 26B	SCREW-FHCS-STL-BO
35	M8-1.25X20 25B	SCREW-SHCS-STL-BO
42	21985	SPACER - 30 DEGREE Y-AXIS DRIVE ASSY
43	M6-1.0X35 25B	SCREW-SHCS-STL-BO

5.1.16 Ball Screw Replacement, Y-Axis – DPMV7

1. Move the Y-axis to the front of the machine.
2. Remove the electronic handwheel and axis motor cover.
3. Remove the front ballscrew bearing and housing.
4. Remove the Y-axis motor and belt.
5. Remove the double nut that holds the pulley and slide the ballscrew pulley from the ballscrew along with the key.
6. Remove the bearing cover, locking nut, axis bearings and bearing housing (block). When removing the bearings, take note to how they are mounted.
7. Now go to the bottom of the column and rear of bed and remove the access cover to the rear bearing on the Y-axis.

8. Remove the nut, bearing and bushing that is found at the end of the ballscrew.
9. Now go the front of the machine and remove the ballnut from the yoke. Slide the ballscrew toward you to remove. Make sure to disconnect the oil line.

Reassemble

10. Install the Y ballscrew to the yoke and install the oil line.
11. Install the axis bearings in the housing and into the ballscrew in the same manner as you removed them. Tighten the lock nut and install the bearing cover.
12. Install the ballscrew pulley and key. Lock the pulley with the double nut.
13. Install the axis motor and belt.
14. Install the front bearing and housing.
15. Install the motor bracket cover and electronic handwheel.

Note: See the diagnostic section under mechanical drive train for an explanation on how to align the ballscrew.

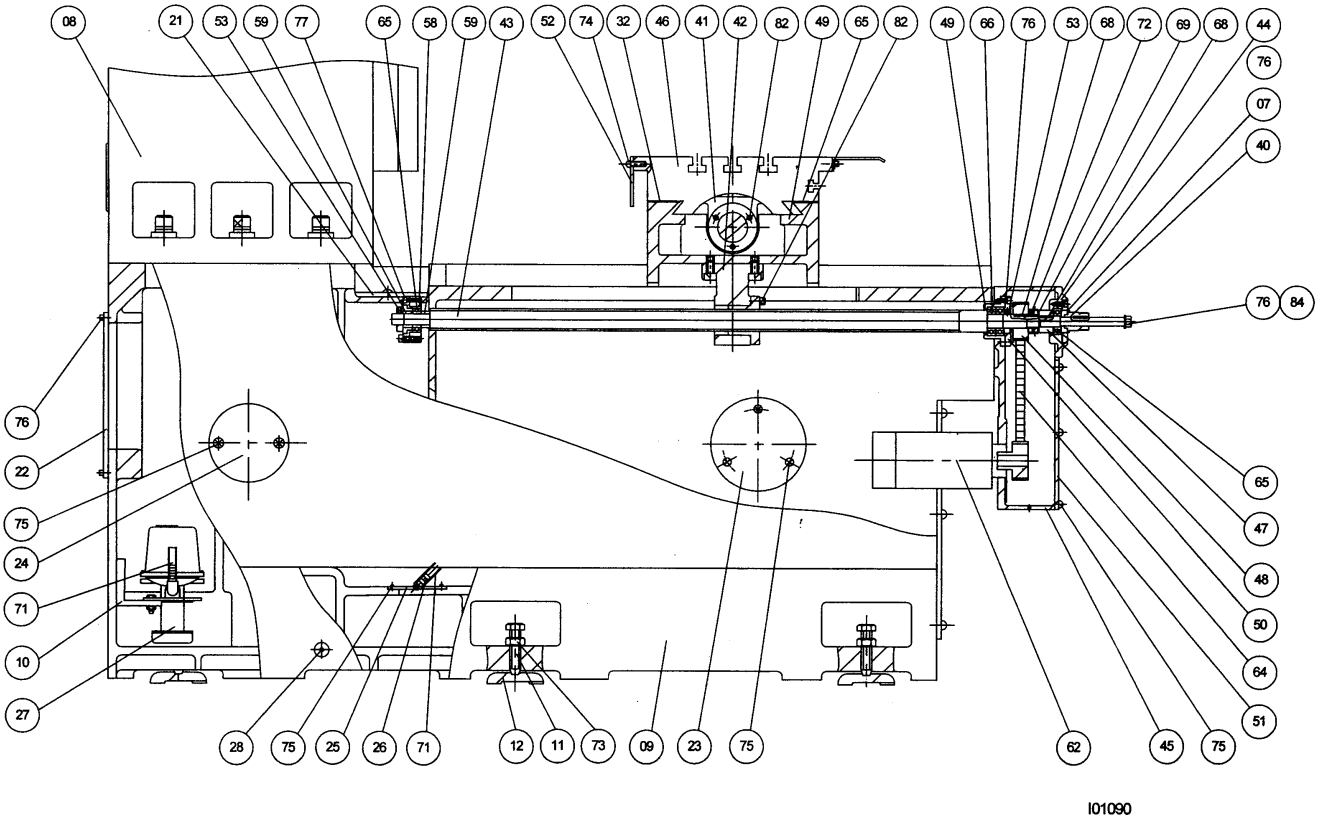


Figure 32
DPMV7 Y-Axis Drive Train

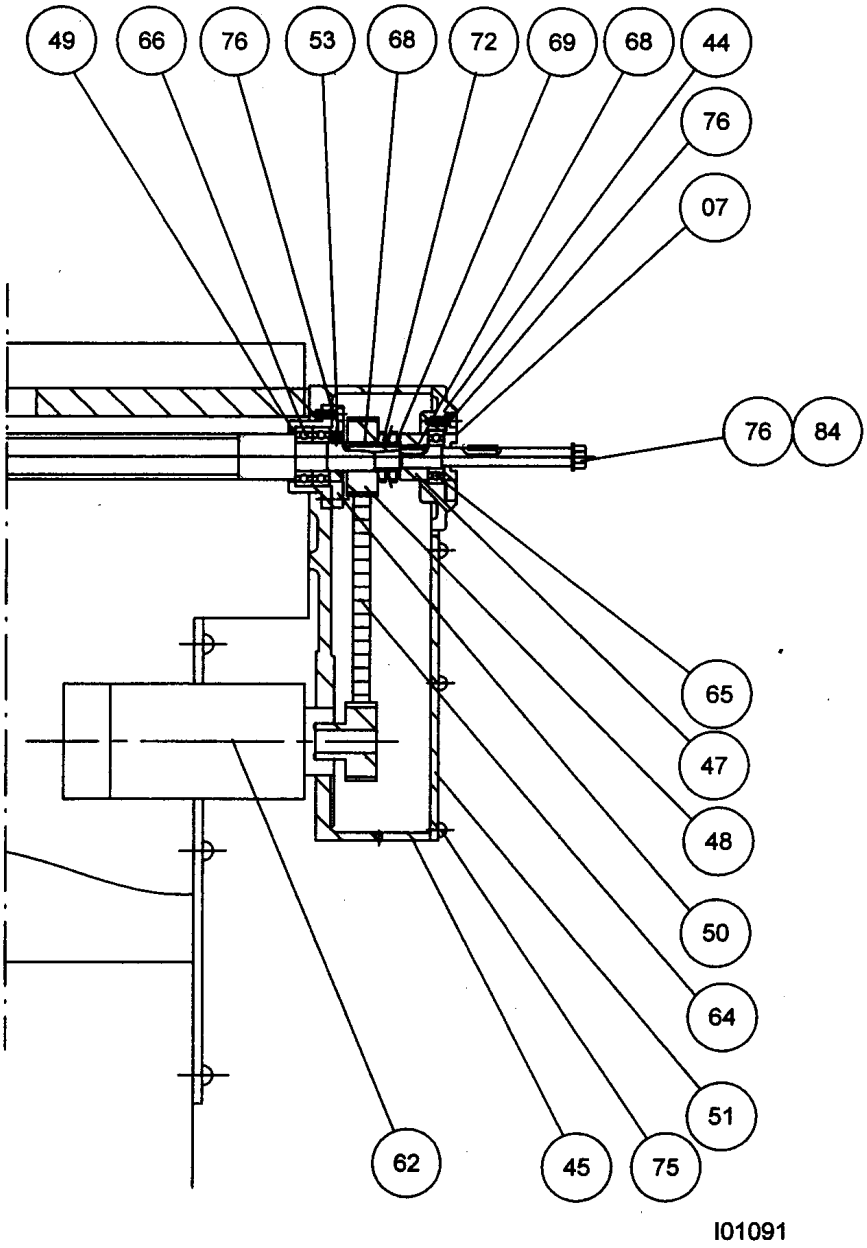


Figure 32

DPMV7 Y-Axis Drive Train

DPMV7 Y-Axis Drive Train Parts List

Item	P/N	**DESCRIPTION**	Qty
1			
2	H-026-B	SCREW	3
3	H-029-8A	PLATE - ALUMINUM	4
4			
5	H-034-14B	SADDLE	1
6			
7	H-060	COVER - BEARING	1
8	H-067-8	BODY - MACHINE	1
9	H-067-9C	BASE - MACHINE	1
10	H-075	HOLDER - COOLANT NOZZLE	1
11	24524	SCREW – LEVELING	6
12	H-103	BLOCK - ADJUSTING	6
13	H-106-8	SEAT – GIB (LEFT)	1
14	H-107-8	SEAT – GIB (RIGHT)	1
15	24509	GIB- Y BOTTOM	3
16	H-124-7B	BOX - LIMIT SWITCH	1
17	H-165-8	PIPE – CONNECTION	1
18	H-166-8C	COVER	2
19	H-166-14B	COVER - FRONT	1
20	H-170-8	WASHER	6
21	H-172-9	COVER	1
22	H-173-8B	COVER	1
23	H-237-8	COVER	1
24	H-237-9	COVER	1
25	H-239-10	NETWORK – OIL	2
26	H-254	NETWORK - OIL	5
27	23265	PUMP - COOLANT	1
28	H-259	PLUG - COOLANT	1
29	24506	COVER – WAY – Y AXIS REAR	1
30	H-263-10	BRACKET - UP-DOWN CHIP GUARD	1
31	22291-1	PUMP - LUBRICATION	1
32	H-267-10	TEFLON (L)	1
33	H-268-10	TEFLON (R)	1
34	H-279-8	GUARD	1
35	H-280-8	PLATE(L) – FIXED	1
36	H-281-8	PLATE(R) – FIXED	1
37			
38			
39			
40			
41	HT-022-8	BRACKET – FEED NUT	1
42	HT-022-8B	HOLDER - BALL SCREW	1
43	24501	BALLSCREW – Y-AXIS	1

44	HT-028-7A	BRACKET – BEARING – CROSS FEED	1
45	HT-028-8B	BRACKET – BEARING – CROSS FEED	1
46	HT-029-14	TABLE	1
47	HT-041-8	BUSHING	1
48	24544	PULLEY – Y AXIS	1
49	HT-077-7	BLOCK – BEARING	1
50	HT-078-7	COVER - BEARING	1
51	HT-096-8A	COVER	1
52	HT-142-8A	COVER	1
53	24519	NUT – LOCKING	2
54	HX-046	STOP - LIMIT SWITCH	2
55	24504	COVER – WAY – Y AXIS FRONT	1
56	HY-066-8	REST – FOOT	1
57	HY-066-8A	REST – FOOT	1
58	HY-073-8	BRACKET – BEARING BALL SCREW	1
59	HY-083-9	BUSHING	2
60			
61	24514	SWITCH - LIMIT	1
62	21994	MOTOR	1
63			
64	670-5M-15	BELT	1
65	6204ZZ	BEARING-BALL:6204ZZ	2
66	24513	BEARING SET - ANGULAR CONTACT	1
67			
68	24546	KEY:5x5x20	2
69	AK0505022	KEY:5x5x22	1
70	AKP138	PIPE:3/8"	2
71	AKP212	PIPE:1/2"	2
72	24515	NUT – LOCKING:M25x1.5	2
73	24547	NUT:3/4"-10NC	6
74	ASM105010	SCREW:M5x0.8x10L	5
75	ASI231638	SCREW:3/16"-24NC-3/8'L	26
76	ASI61458	SCREW:1/4"-20NC-5/8"L	29
77	ASI61434	SCREW:1/4"-20NC-3/4"L	10
78	ASI614158	SCREW:1/4"-20NC-1 5/8"L	2
79	ASI614134	SCREW:1/4"-20NC-1 3/4"L	2
80	ASI651612	SCREW:5/16"-18NC-1/2'L	4
81	ASI651634	SCREW:5/16"-18NC-3/4"L	14
82	ASI65161	SCREW:5/16"-18NC-1"L	6
83	ASI678312	SCREW:7/8"-9NC-3 1/2"L	6
84	AWIH0114	WASHER:1/4"	1
85	AWIH01516	WASHER: 5/16"	18

I01089.doc

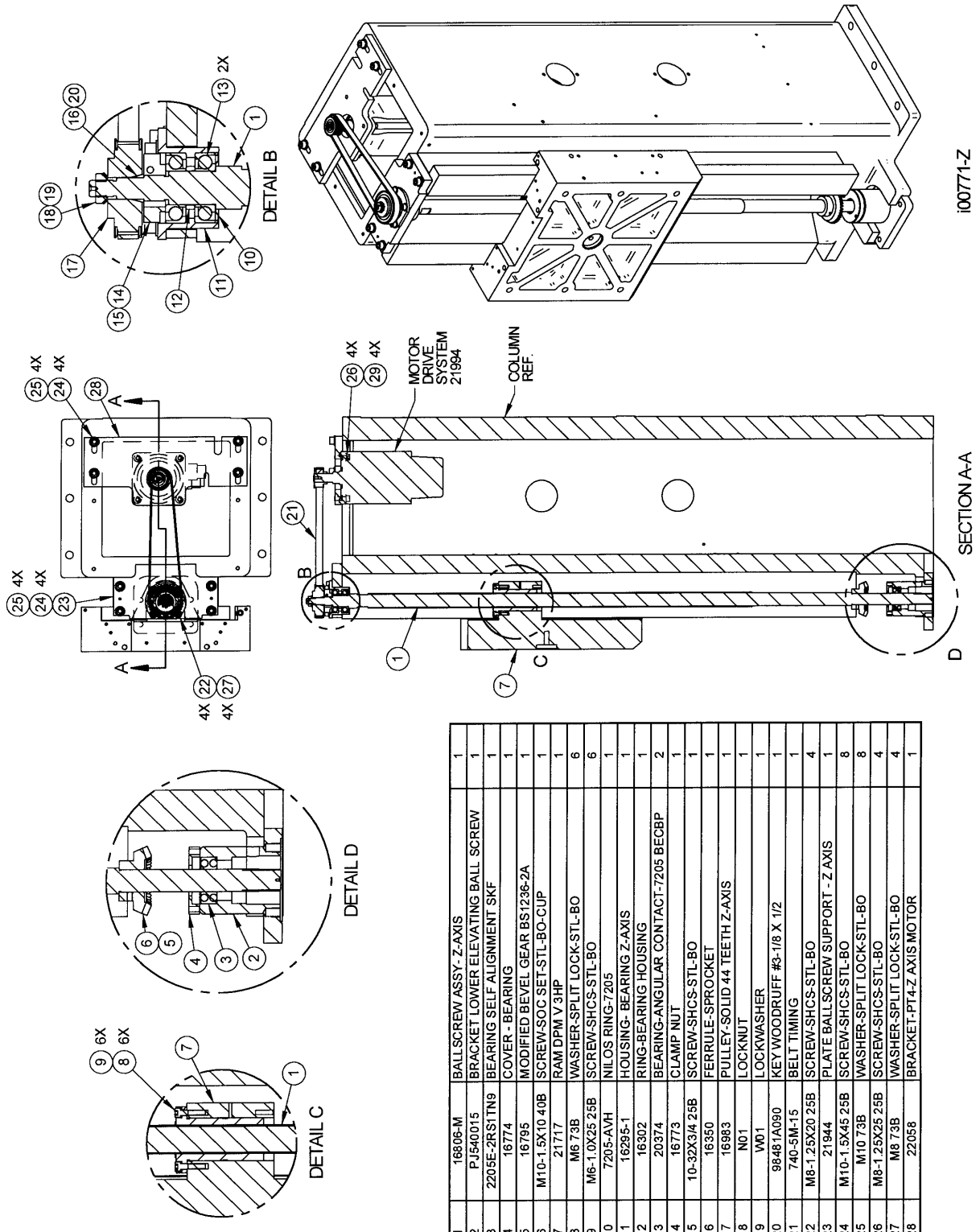
5.1.17 Z-Axis Ball Screw Removal & Replacement – DPMV3, DPMV5 & DPMV7

CAUTION!
Never screw a ball screw partially or totally out of its nut. They cannot be reassembled.

1. Ensure that there is sufficient vertical clearance above the top of the machine to remove the ball screw. Minimum clearance required is 32 inches.
2. Remove vertical column top cover.
3. Remove servomotor, belt and Z motor mounting bracket.
4. Remove upper and lower Z-axis way covers.
5. Lower head to table. Place 1 or 2 inch wood board between spindle nose and table to protect.
6. Lower head until weight of head is supported by the table.
7. Tighten both ram locks on the right side of ram.
8. Remove locknut and lock washer from the top of the Z ball screw.
9. Remove pulley and key.
10. For the DPMV3 & DPMV5, loosen #10-32 socket screw on clamp nut.
11. For the DPMV3 & DPMV5, using wrench flats on clamp nut and wrench flats on ball screw remove clamp nut.
12. Remove the four cap screws from bearing housing flange.
13. For the DPMV3 & DPMV5 remove the clamp nut, remove the locknut on the DPMV7.
14. Remove bearing, Nilos ring and bearing housing with matched spacer from ball screw.
15. Remove the cap screws and lock washers from ball nut flange.
16. Loosen setscrew from bevel gear. (DPMV3 & DPMV5 only) Rotate ball screw by hand, if necessary, to access set screw. Extract ball screw assembly from machine until ball nut flange is above the top of the ram. Support ball screw and remove lubrication line from ball nut flange.
17. Raise the ball screw until the bottom end of the ball screw is above the ram. Be careful to remove bevel gear as the ball screw is raised. Angle the ball screw out and away from the head. Lower the ball screw on the right side of the machine until the top of the ball screw clears the support plate.
18. Reassemble all components in reverse order as shown above, except leave off the pulley, locknut and lock washer until ball screw is realigned. Torque clamp nut to 50 ft. lb. for the DPMV3 & DPMV5 and lock nut for the DPMV7.
19. With the ball screw assembly installed, loosen four 5/16-18 cap screws from bearing housing, raise head to the uppermost position, and re-tighten 5/16-18 cap screws. Note that there is .060 clearance between the bearing housing outside diameter and the inside diameter of the support plate to allow for realignment. Traverse the head to the extreme of the up and down travel manually to check for freedom of movement. Use torque wrench to make sure torque is consistent along length of screw. Use torque wrench to make sure torque is consistent along length of screw.

    See Figure 33 for the DPMV3 & DPMV5, and Figure 34 for the DPMV7 for an illustration of the Z-axis drive train.

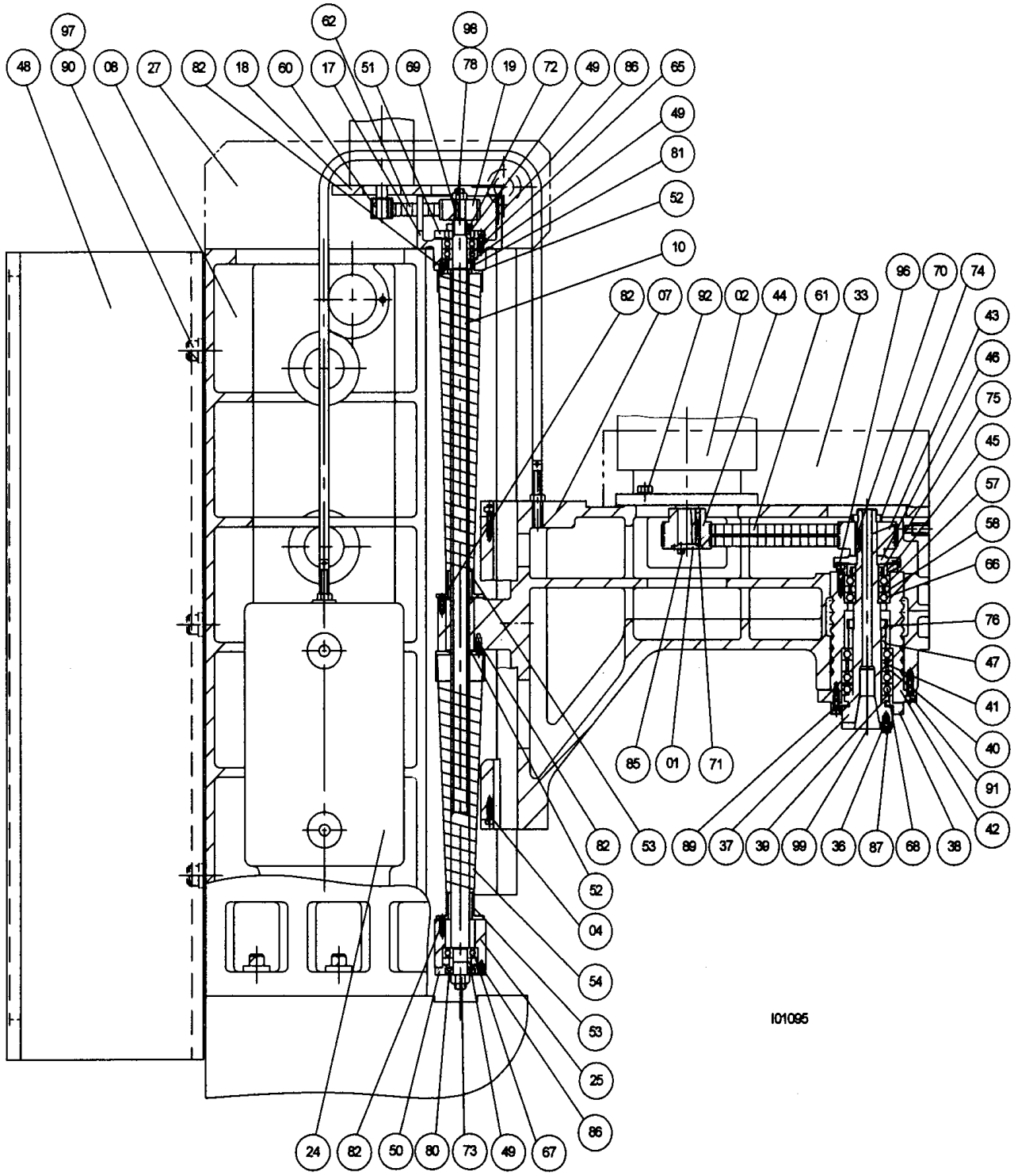
See Section 5.2.2 to properly measure and set the Z Backlash Compensation and calibration.



1	16806-M	BALLSCREW ASSY- Z-AXIS	1
2	PJ540015	BRACKET LOWER ELEVATING BALL SCREW	1
3	2205E-2RS1TN9	BEARING SELF ALIGNMENT SKF	1
4	16774	COVER - BEARING	1
5	16795	MODIFIED BEVEL GEAR BS1236-2A	1
6	M10-1.5X10 40B	SCREW-SOC SET-STL-BO-CUP	1
7	21717	RAM DPM V 3HP	1
8	M6 73B	WASHER-SPLIT LOCK-STL-BO	6
9	M6-1.0X25 25B	SCREW-SHCS-STL-BO	6
10	7205-AVH	NILOS RING-7205	1
11	16295-1	HOUSING- BEARING Z-AXIS	1
12	16302	RING-BEARING HOUSING	1
13	20374	BEARING-ANGULAR CONTACT-7205 BECBP	2
14	16773	CLAMP NUT	1
15	10-32X3/4 25B	SCREW-SHCS-STL-BO	1
16	16350	FERRULE-SPROCKET	1
17	16983	PULLEY-SOLID 44 TEETH Z-AXIS	1
18	N01	LOCKNUT	1
19	W01	LOCKWASHER	1
20	98481A090	KEY WOODRUFF #3-1/8 X 1/2	1
21	740-5M-15	BELT TIMING	1
22	M8-1.25X20 25B	SCREW-SHCS-STL-BO	4
23	21944	PLATE BALLSCREW SUPPORT - Z AXIS	1
24	M10-1.5X45 25B	SCREW-SHCS-STL-BO	8
25	M10 73B	WASHER-SPLIT LOCK-STL-BO	8
26	M8-1.25X25 25B	SCREW-SHCS-STL-BO	4
27	M8 73B	WASHER-SPLIT LOCK-STL-BO	4
28	22058	BRACKET-PT4-Z AXIS MOTOR	1

Figure 33
DPMV3 & DPMV5 Z—Axis

Figure 34
DPMV7 Z-Axis Drive Train



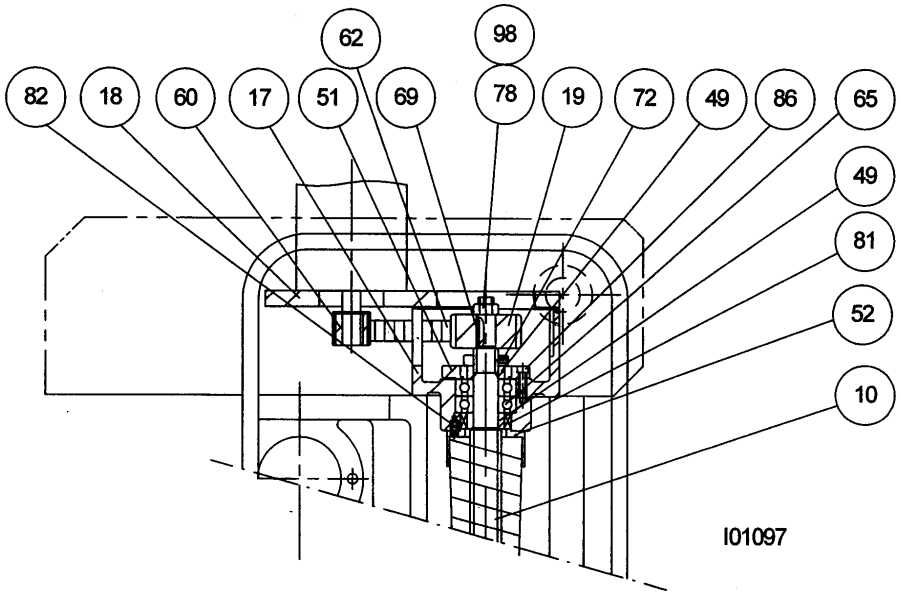


Figure 34a

DPMV7 Z-Axis Drive Train

DPMV7 Z-Axis Drive Train Parts List

Item	P/N	DESCRIPTION	Qty
1	760-5A	COVER - FIXED	1
2	24527	MOTOR – SPINDLE	1
3	24518	SCREW - GIB	3
4	H-026-B	SCREW	3
5	H-035-8	PLATE - ALUMINUM	4
6	24510	GIB – Z AXIS SIDE	1
7	H-045-14C	KNEE	1
8	H-067-8	BODY – MACHINE	1
9	H-077-3	SCREW	1
10	24502	BALLSCREW – Z AXIS	1
11	H-109-12	SEAT – GIB	1
12	H-110-12	SEAT - GIB	1
13	24511	GIB – Z AXIS REAR	2
14	H-124-5	HOLDER - MICRO SWITCH	1
15	H-139-8	BRACKET(R)-ROLLER'S	1
16	H-139-8A	BRACKET(L)- ROLLER'S	1
17	H-140-10	HOLDER FIXED MOTOR	1
18	H-140-10B	HOLDER - FIXED	1
19	24542	PULLEY – Z AXIS	1

20	H-145-8	ROLLER	4
21	H-146-8	SPACER	4
22	H-147-8	SHAFT - DRIVE	4
23	H-148-8	SCREW	4
24	H-149-8A	WEIGHT - BALANCE	1
25	H-160-9	BRACKET – BEARING	1
26	H-165-8	HOLDER - COOLANT NOZZLE	2
27	H-167-10B	COVER – TOP	1
28	H-168-8	HOLDER - BALANCE WEIGHT	1
29	H-170-8	WASHER	1
30	H-171-8	HOLDER - MICRO SWITCH	1
31	24550	VALVE	1
32	24551	COOLANT NOZZLE	1
33	H-310-8	COVER	1
34	H-331-8	BRACKET – ARM	1
35	H-332-14	COVER – ARM	1
36	HB-127-B	BRACKET	2
37	24531	SPINDLE	1
38	24536	COVER - FRONT BEARING	1
39	HB-134-10	BUSHING - BEARING	1
40	24560	SPACER – OUTER	1
41	24561	SPACER – INNER	1
42	24532	QUILL – FLANGE	1
43	24529	PULLEY – SPINDLE	1
44	24527	PULLEY - MOTOR	1
45	HB-199-10	SPACER	1
46	HB-200-10	SPACER	1
47	HB-201-13	SPACER	1
48	HT-067-14A	CABINET - ELECTRIC CONTROL	1
49	HX-002-10	BUSHING – BEARING	3
50	HX-007	COVER – BEARING	1
51	HX-007-9	COVER – BEARING	1
52	HX-028-10	SUPPORT - DUST HELMET	2
53	HX-030-10	SUPPORT - DUST HELMET	2
54	24523	COVER – EXPANSION – BALLSCREW	2
55	HX-046	STOP -LIMIT SWITCH	2
56	HY-043-14	ARM	1
57	24556	SPACER – BEARING – INNER	1
58	24557	SPACER – BEARING – OUTER	1
59	24553	BELT SET – SPINDLE – 5PK940	2

60	425-5M-15	BELT	1
61	24558	90° ELBOW	1
62	24555	BEARING TA3025	4
63	24513	BEARING SET - ANGULAR CONTACT	1
64	24554	BEARING SET – ANGULAR CONTACT	1
65	24512	BEARING - BALL:6305ZZ	1
66	24541	BEARING SET- ANGULAR CONTACT	1
67	24543	KEY:5x5x25	1
68	24530	KEY:8x7x50	1
69	24528	KEY:10x8x35	1
70	24520	NUT:YSF M25x1.5	1
71	24515	NUT:M25x1.5	1
72	24533	NUT:M35x1.5	1
73	24534	NUT – OIL:M40x1.5	1
74	24535	NUT - OIL:M50x1.5	1
75	ANI12014	NUT:1/4"-20NC	1
76	ANI11858	NUT:5/8"-18NC	1
77	ANI11034	NUT:3/4"-10NC	4
78	AOS255211	SEAL – OIL:25x52x11	1
79	AOS385216	SEAL - OIL:38x52x16	1
80	ASI631612	SCREW:3/16"-24NC-1/2"L	24
81	ASI631658	SCREW:3/16"-24NC-5/8"L	6
82	ASI61412	SCREW:1/4"-20NC-1/2"L	4
83	ASI61458	SCREW:1/4"-20NC-5/8"L	7
84	ASI61434	SCREW:1/4"-20NC-3/4"L	6
85	ASI6141	SCREW:1/4"-20NC-1"L	1
86	ASI351678	SCREW:5/16"-18NC-7/8"L	4
87	ASI65161	SCREW:5/16"-18NC-1"L	6
88	ASI6381	SCREW:3/8"-16NC-1"L	20
89	ASI638112	SCREW:3/8"-16NC-1 1/2"L	9
90	ASI612114	SCREW:1/2"-12NC-1 1/4"L	4
91	ASI6345	SCREW:3/4"-10NC-5"L	1
92	ASM305012	SCREW:M5x0.8x12L	8
93	ASM106012	SCREW:M6x1.0x12L	15
94	ASM106020	SCREW:M6x1.0x20L	3
95	AWIH0138	WASHER:3/8"	6
96	AWIH0158	WASHER:5/8"	1
97	24537	SPINDLE ASSEMBLY – MADE UP OF ITEMS 38, 68,87.37,76,75,39,36,40,41,47,66,58 & 57.	1

i01094.doc

5.1.18 Air Solenoid Replacement

1. Unhook the air from the machine.
2. Unplug the power cable that connects to the right side of the air regulator bracket.
3. Remove the 2 screws that hold the connector to the bracket.
4. Undo the airline that runs from the oiler to the power drawbar if that option is installed on the machine.
5. Remove the 2 screws on the left side of the bracket that holds the air manifold to the U-shaped bracket.
6. With the assembly in hand unthread the solenoid from the rear of the air regulator. The solenoid and cable will be replaced as a unit.

See Figure 11 in Section 2 for an illustration of this assembly.

5.1.19 Spindle Motor Replacement – DPMV3 & DPMV5

1. Turn machine off. Disconnect power to machine from the shop feeder box.
2. Open the motor junction box to gain access to the wiring.
3. Disconnect all the wires and conduit going to the motor. Take note of how the motor is wired. The spindle motors must be wired for low voltage in the Y configuration.
4. Remove the (4) screws that fasten the ventilation plate on the right side of the spindle head and remove vent plate.
5. Release the belt tension by adjusting the belt tension mechanism, which is integrated to the upper spindle plate cover.
6. Disengage the (2) belts from the motor pulley thru the vent/access hole.
7. Remove the (4) M10 hex-head screws that hold the motor. Remove the motor. Be careful the motor weighs approximately 70 lbs. for the DPMV5 and over 100 lbs. for the DPMV7.
8. Install new motor/pulley assembly and secure loosely with the (4) M10 hex-head screw.
9. Engage the belt to motor and spindle pulley. Make sure that the belt is 100% engaged to both pulleys.
10. Adjust belt tension mechanism until proper belt tension is reach. Belt is visible thru the vent hole.
11. Tighten the (4) M10 hex-head screws that secure the motor to the casting.
12. Connect all the wires that go to the motor. See the motor wiring section for further explanation.
13. Install remaining components in reverse order.
14. Turn on all the power to the machine. Run the head at low and high rpm. Listen for any obvious unusual noises.

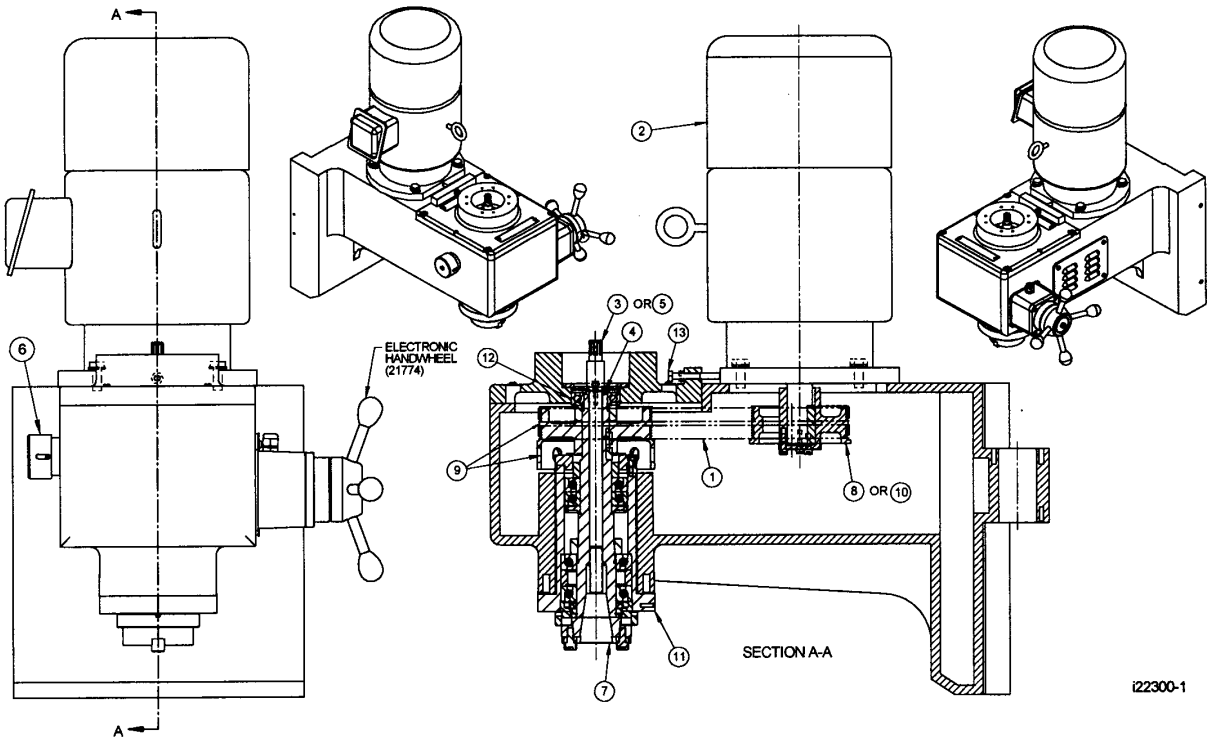


Figure 35
DPMV3 & DPMV5 Head

DPMV3 & DPMV5 Head Parts List

Item	P/N	Description
1	K050360	SPINDLE BELT (SET OF 2)
2	23326 = 1-piece head; 21732 = 2-piece head	SPINDLE MOTOR
3	23171-NMTB	DRAWBAR-NMTB - POWER
4	21661	DRAWBAR SPACER – POWER
5	23171-CAT	DRAWBAR-CAT – POWER
6	23131	LOCK ASSEMBLY
7	23762	SPINDLE ASSEMBLY
8	23765	PULLEY-MOTOR WITH KEY
9	23764	PULLEY-SPINDLE WITH KEY
11	23322	QUILL
12	6206 ZZ C3	BEARING-TOP SPINDLE
13	M8-1.25x60 24B	SCREW-HEX HEAD-STL-BO
	23284	DRAWBAR-MANUAL
	22116	DRAWBAR SPACER-MANUAL

5.1.20 Spindle Motor Replacement – DPMV7 (see Figure 34)

1. Turn machine off. Disconnect power from machine.
2. Remove the spindle head cover to gain access to the spindle motor.
3. Open motor junction box and disconnect all wires and conduit from motor. Take note how the motor is wired and re-wire in the low voltage configuration.
4. Release the belt tensioning device that is used to tight the belt.
5. Remove the 4 screws that hold the motor down in place.
6. Slide the motor forward to remove the belt from the motor pulley.
7. Remove the motor. Be careful, the motor weights over 100 lbs. Use a lift to remove the motor and to put the new motor in place.
8. Slid the belt over the motor pulley and snug the 4 bolts that fastens the motor down.
9. Tension the belt by use the belt tensioning device in front of the motor. Be careful not to over tighten the belt. The belt should deflect about ¼" in the center of the belt when applying force in this spot.
10. Tighten the 4 bolts that hold the motor down.
11. Connect all wires and the conduit back to the motor junction box.
12. Install the head cover plate and turn power back on to the machine.

5.1.21 Spindle Assembly Replacement – DPMV3 & DPMV5

Note: The quill should never have to be disassembled from the spindle head. The spindle will be replaced as an assembly.

1. Turn off and unplug all the power to the machine.
2. Loosen the (4) M8 hex-nut securing the spindle motor.
3. Release the belt tension by adjusting the belt tension mechanism, which is integrated to the upper spindle plate cover.
4. For machine fitted with the optional Power Drawbar unit, remove power drawbar unit, rod and spacer.
5. Remove the (4) SHCS securing the upper spindle plate cover.
6. Use (2) M8 x 30 SHCS to jack the upper spindle plate cover off from the spindle shaft.
7. Using a bearing-puller, remove the upper bearing from the spindle shaft.
8. Remove the (2) spindle belt.
9. Loosen the (3) setscrew securing the upper lock nut on the spindle shaft.
10. Remove the lock nut using a spanner wrench.
11. Remove pulley and key from the spindle shaft
12. Loosen the setscrew that holds the nosepiece to the quill.
13. Tap the spindle quill assembly down with a rubber mallet.
14. Using an adjustable spanner wrench, loosen the nosepiece by turning it "**counter clockwise**".

15. The spindle collar will start to tighten up as you continue to loosen it. Use a dead blow hammer to hit the top of the spindle shaft little by little while simulta neously loosening the spindle collar. Eventually the spindle shaft and bearings will drop out through the bottom of the spindle quill.
16. Replace components in reverse order.

See Figure 35 for an illustration.

5.1.22 Spindle Assembly Replacement – DPMV7

1. Turn off power to the machine.
2. Remove the spindle head cover to gain access to the spindle.
3. Remove the power drawbar if one is installed.
4. Loosen the 4 screws that fasten the spindle motor down.
5. Release the belt tension by sliding the motor forward.
6. Remove the spindle motor belt.
7. Remove the locknut that fastens the upper spindle pulley and key.
8. Remove the dust cover that covers the top of the upper spindle bearings.
9. Remove the upper bearing cap.
10. Remove the locknut that fastens the upper spindle bearings. NOT E – the upper bearings will not come out with the spindle assembly. They are removed from the top of the quill.
11. Remove the screws that hold the lower spindle collar to the bottom of the quill housing.
12. To remove the spindle assembly, tap the top of the spindle shaft to push the spindle down.
13. Install the new upper spindle bearings and the bearing cap. Make sure to put the upper spindle bearings on correctly. The thicker outer race of each bearing should be facing each other. The spacers should be in between the bearings.
14. Now go ahead and install the new spindle assembly back up into the quill. The upper shaft of the spindle must go through the upper spindle bearings.
15. Once the spindle assembly is all the way up, tighten the spindle collar back to the quill.
16. Now remove the upper bearing cap and fasten the locknut back down to load the upper bearings.
17. Re-install the bearing cap and dust shield.
18. Install the spindle pulley and key and locknut.
19. Install the spindle belt and re-tension the belt.
20. Install the power drawbar and head cover.

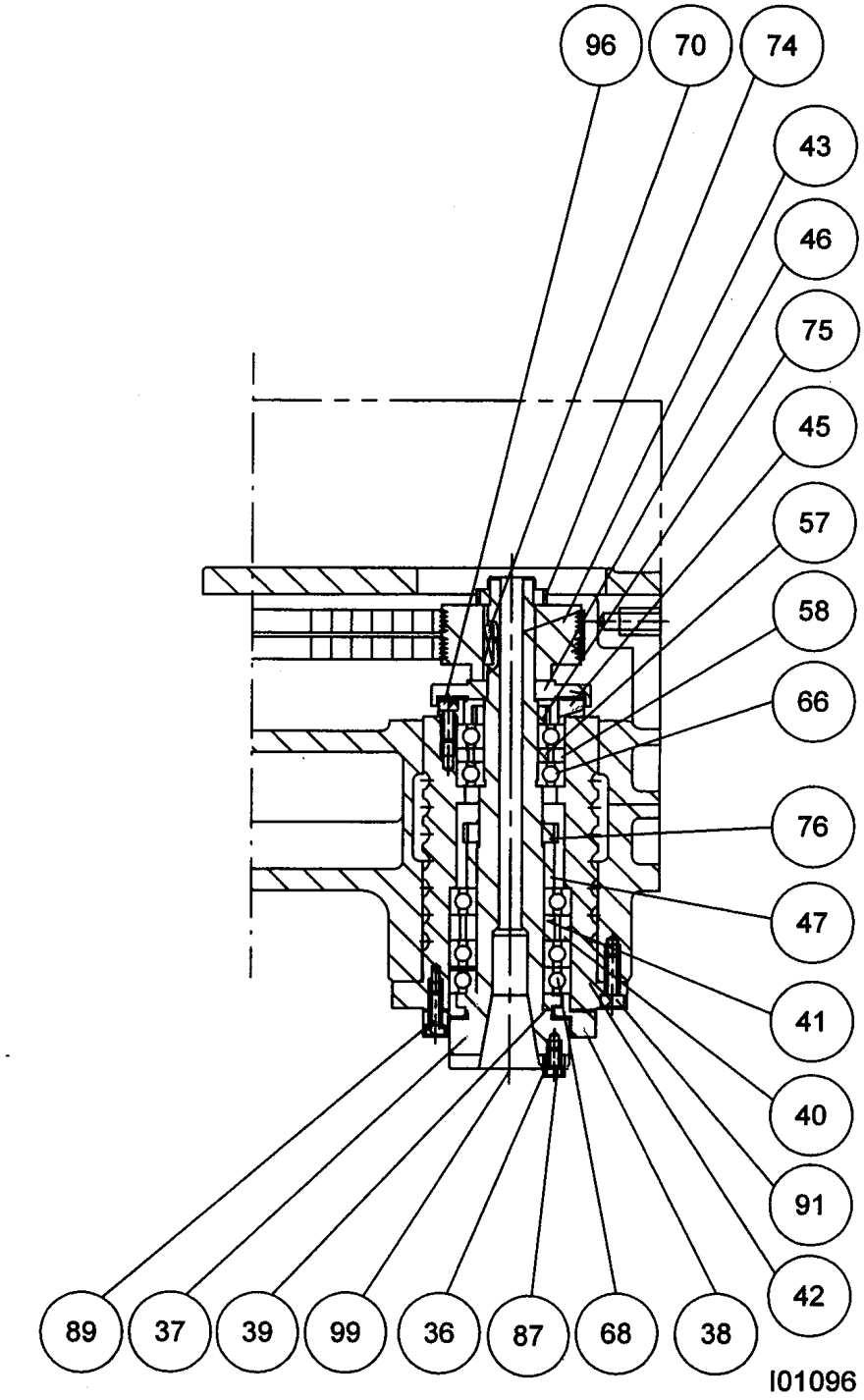


Figure 36 DPMV7 Head

Z-Axis Spindle Parts List (Note: See Section 5.1.17)

5.1.23 Spindle Motor Wiring

The DPMV spindle motors are wired for 220 volts (low voltage) in the Y configuration.

Each junction box contains 6 terminals. The 3 upper terminals should be jumpered together and have wires labeled U2, V2 and W2 as shown in figure 37. The bottom 3 terminals should have 3 wires on each terminal as shown. It is important to hook up the incoming 3-phase wires in the same order as what is shown in the figure. Failure to do this will run the spindle motor backwards on the control.

The spindle motor fan wires are also found in the junction box. There is 1 hot wire, 1 neutral wire and 1 ground wire. The hot and neutral wires are connected to 2 wires coming out of the spindle fan by the use of wire nuts. It does not matter which wires are connected to the hot and neutral wires. There are also 3 ground wires inside the junction box: 2 ground wires from the incoming 3-phase cable and 1 ground wire from the spindle motor fan cable.

Please refer to Figure 37 for an illustration of how to wire the spindle motor.

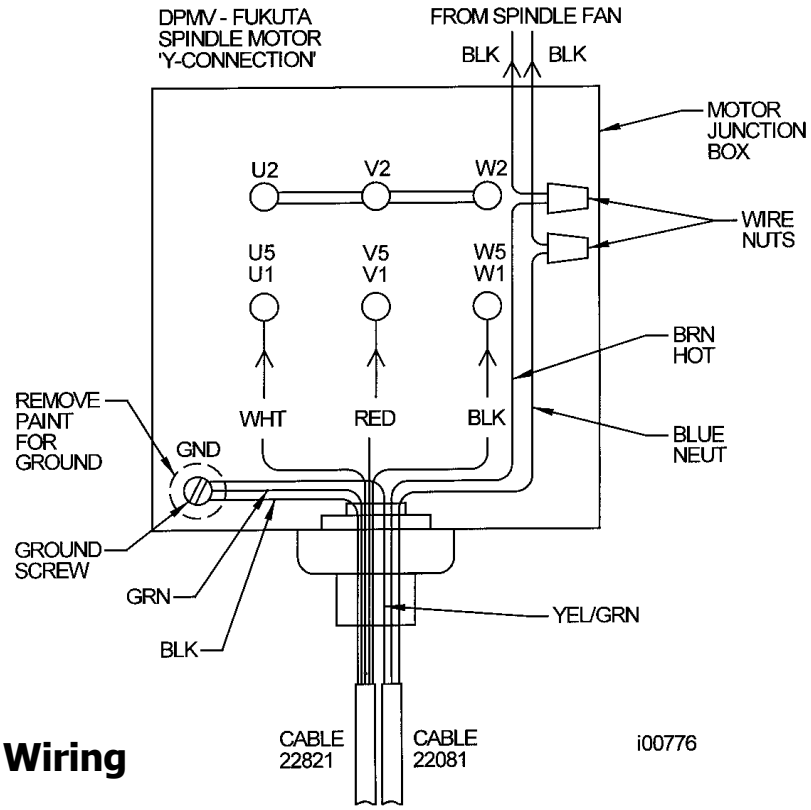


Figure 37
Spindle Motor Wiring

5.2 Maintenance

5.2.1 Gib Adjustments

The objective of adjusting the gibs is to eliminate as much play in the table, saddle and ram sliding surfaces as possible without having the tightness of the gib interfere with their free movement and cause a decrease in the accuracy and/or performance of the machine due to excessive friction.

5.2.1.1 Table Gib Adjustment, X-Axis – DPMV3 **(See Figure 38)**

1. Clean all chips, dirt and excess oil from the table and saddle.
2. Center the saddle on the bed ways.
3. Move the table fully to the left side of the saddle.

   Note: For machines that have excessive wear in the center of the table way, it will be necessary to center the table on the saddle. The resulting adjustment of the gib will be compromised to account for the varying clearance from the center to the ends of the table.

4. Attach a .0001 dial indicator with a magnetic base to the left front of the saddle. Place the indicator stylus on the front surface of the table as close to the indicator base as possible.
5. Move the left end of the table back and forth and note the amount of movement on the dial indicator. Adjust the X-axis gib until the registered movement is .0010-.0015.

   - To adjust the gib for excessive clearance: Loosen the gib lock screw on the right end of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the left end of the saddle. Tighten the gib lock screw on the right end of the saddle to lock the give in place, and recheck. Repeat as necessary.

   - To adjust the gib for too small of a clearance: Loosen the gib lock screw on the left end of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the right end of the saddle. Tighten the gib lock screw on the left end of the saddle to lock the gib in place, and recheck. Repeat as necessary.

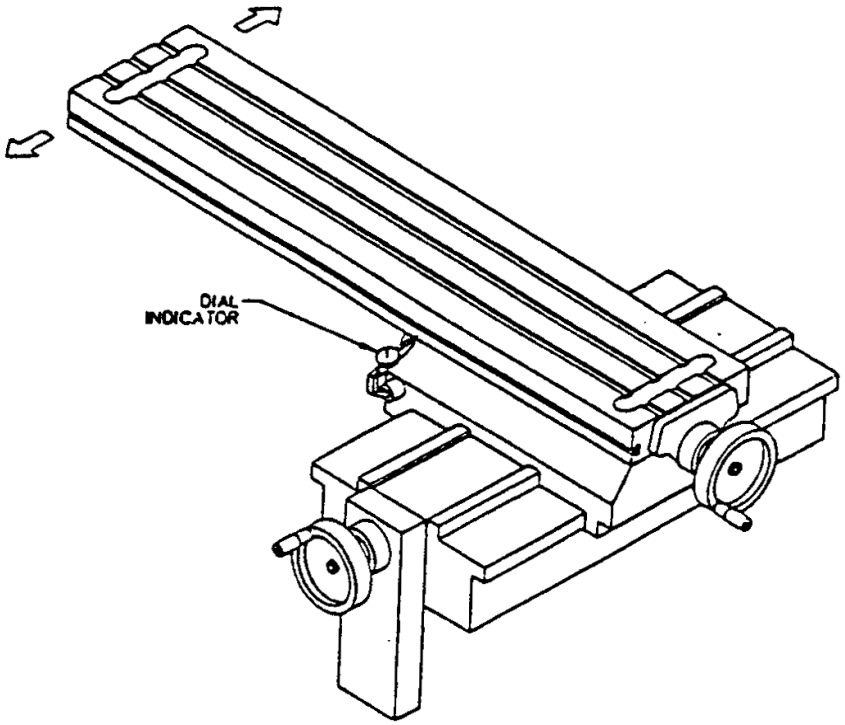


Figure 38 – DPMV3 Table Gib Adjustment

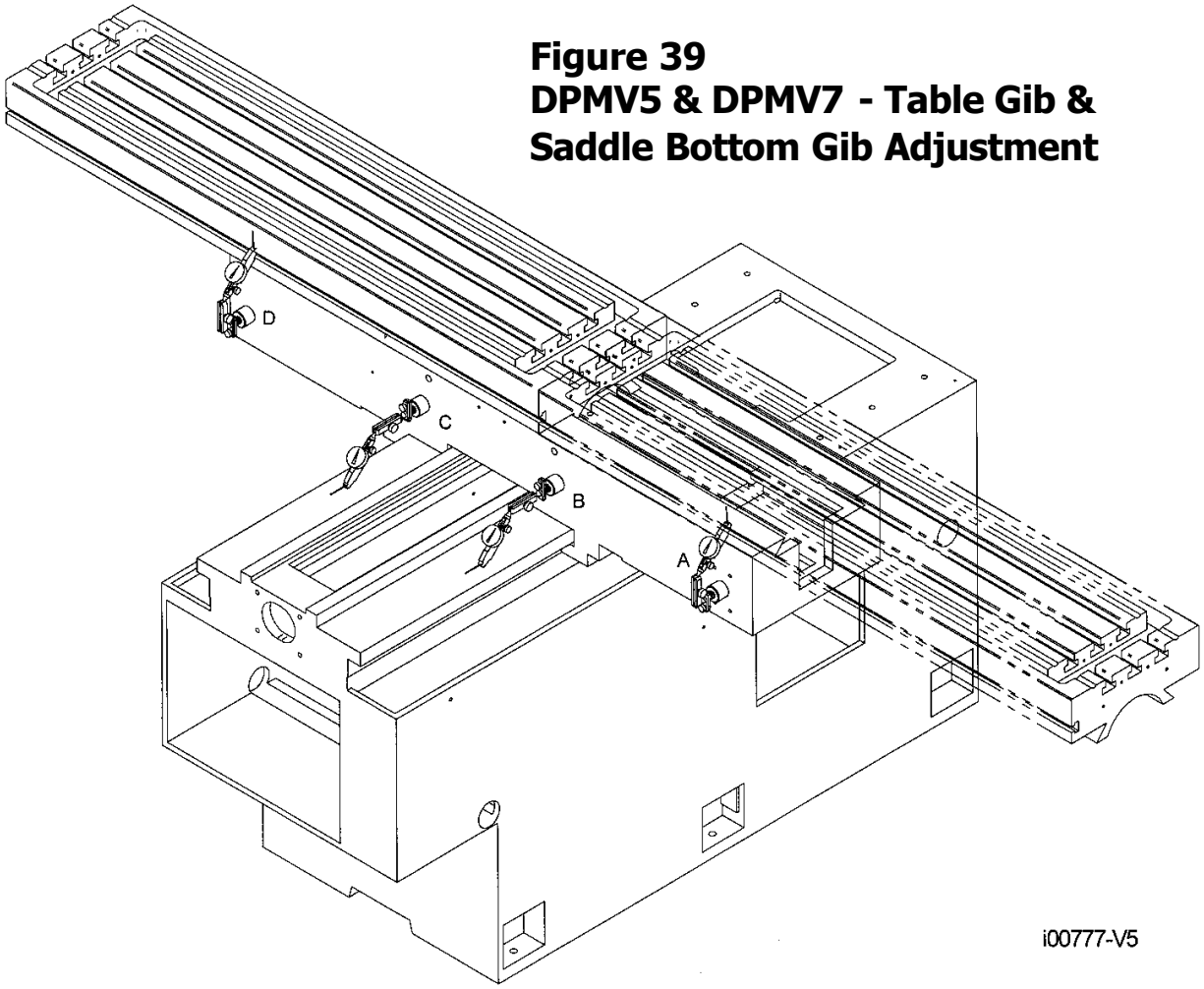
5.2.1.2 Gib Adjustment, X-Axis – DPMV5 & DPMV7

The X-axis has 2 gibs for the table because of the length of the saddle. Each gib is adjusted from each end of the table. There are not 2 adjustment screws at either end of the gib like the Y-axis and Z-axis.

1. Clean all chips, dirt and excess oil from the table.
2. Remove the table trays.
3. Move the table to the left and mount the indicator at Point D and move the table back and forth perpendicular to the length of the table. Note the amount of movement of the dial indicator. Adjust gib until the movement is between .0005-.001.
4. Move the table to the right and mount the indicator at Point A and move the table back and forth perpendicular to the length of the table. Note the amount of movement of the dial indicator. Adjust gib until the movement is between .0005-.001.
    - To adjust the gib for excess clearance: Loosen the nut closest to the table and tighten the nut furthest from the table. Once the clearance has been taken up tighten each nut against the gib bracket. Do this for each end of the table.
    - To adjust the gib for too small of a clearance: Loosen the nut furthest from the table and tighten the inside nut up against the bracket to pull the gib away from the machine. Once the clearance has been taken up tighten each nut against the gib bracket. Do this for each end of the table.
5. Replace table trays.

See Figure 39.

Figure 39
DPMV5 & DPMV7 - Table Gib & Saddle Bottom Gib Adjustment



5.2.1.3 Saddle Side Gib Adjustment, Y-Axis – DPMV3 & DPMV5

See Figure 40

1. Clean all chips, dirt and excess oil from the table and saddle.
2. Center the saddle on the bed ways.
3. Move the table fully to the left side of the saddle.
4. Remove the chip wiper guard and chip wiper from the front and rear of the left side box way.

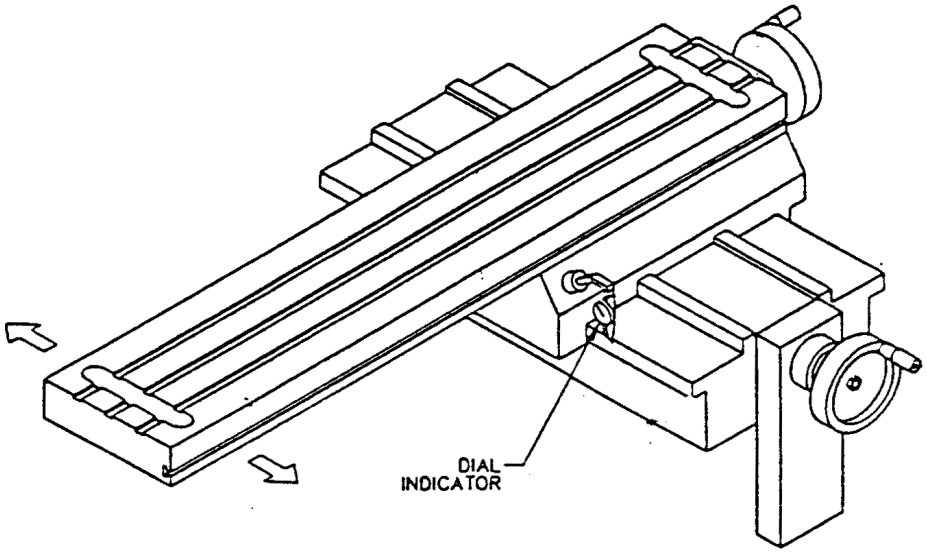


Figure 40
DPMV3 & DPMV5 - Saddle Side Gib Adjustment

5. Attach a .0001 dial indicator with a magnetic base to the left front of the saddle. Place the indicator stylus on the edge of the large box way.
6. Move the left end of the table back and forth and note the amount of movement on the dial indicator. Adjust the Y-axis side gib until the registered movement is .0010-.0015.
   - **To adjust the gib for excessive clearance**:
     Loosen the gib lock screw on the back of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the front of the saddle. Tighten the gib lock screw on the back end of the saddle to lock the gib in place, and recheck. Repeat as necessary
   - **To adjust the gib for too small of a clearance**:
     Loosen the gib lock screw on the front of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the back of the saddle. Tighten the gib lock screw on the front of the saddle to lock the gib in place, and recheck. Repeat as necessary.
7. Replace the front and rear chip wiper, and chip wiper guard.

5.2.1.4 Saddle Side Gib Adjustment, Y-Axis – DPMV7

1. Clean all chips, dirt and excess oil from the table and saddle.
2. Center the saddle on the bed ways.
3. Move the table fully to the right side of the saddle.
4. Remove the chip wiper guard and chip wiper from the front and rear of the left side box way.
5. Attach a .0001 dial indicator with a magnetic base to the right front of the saddle. Place the indicator stylus on the edge of the large box way.

6. Move the right end of the table back and forth and note the amount of movement on the dial indicator. Adjust the Y-axis gib until the registered movement is .0010-.0015.

   - **To adjust the gib for excessive clearance**:
     Loosen the gib lock screw on the right backside of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the right front side of the saddle. Tighten the gib lock screw on the back end of the saddle to lock the gib in place, and recheck. Repeat as necessary
   - **To adjust the gib for too small of a clearance**:
     Loosen the gib lock screw on the front right side of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the right backside of the saddle. Tighten the gib lock screw on the front right side of the saddle to lock the gib in place, and recheck. Repeat as necessary.

7. Replace the front and rear chip wiper and wiper guard.

5.2.1.5 Saddle Bottom Gib Adjustment, Y-Axis (DPMV3 only)

See Figure 41.

1. Clean all chips, dirt and excess oil from the table and saddle.
2. Center the saddle on the bed ways.
3. Move the table fully to the left side of the saddle.
4. Attach a .0001 dial indicator with a magnetic base to the left front of the saddle. Place the indicator stylus on the top surface of the box way.
5. Lift the end of the table up and note the amount of movement on the dial indicator. Adjust the Y-axis left bottom gib until the registered movement is .0010-.0015.
6. Move the table fully to the right.
7. Reposition the indicator to the right front of the saddle.
8. Lift the right end of the table up and note the amount of movement on the dial indicator. Adjust the Y-axis right bottom gib until the registered movement is .0010-.0015.

   - **To adjust the gib for excessive clearance**:
     Loosen the gib lock screw on the back of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the front of the saddle. Tighten the gib lock screw on the back end of the saddle to lock the gib in place, and recheck. Repeat as necessary.
   - **To adjust the gib for too small of a clearance**:
     Loosen the gib lock screw on the front of the saddle. Estimate the amount of gib lock screw adjustment required and tighten the gib lock screw on the back of the saddle. Tighten the gib lock screw on the front of the saddle to lock the gib in place, and recheck. Repeat as necessary.

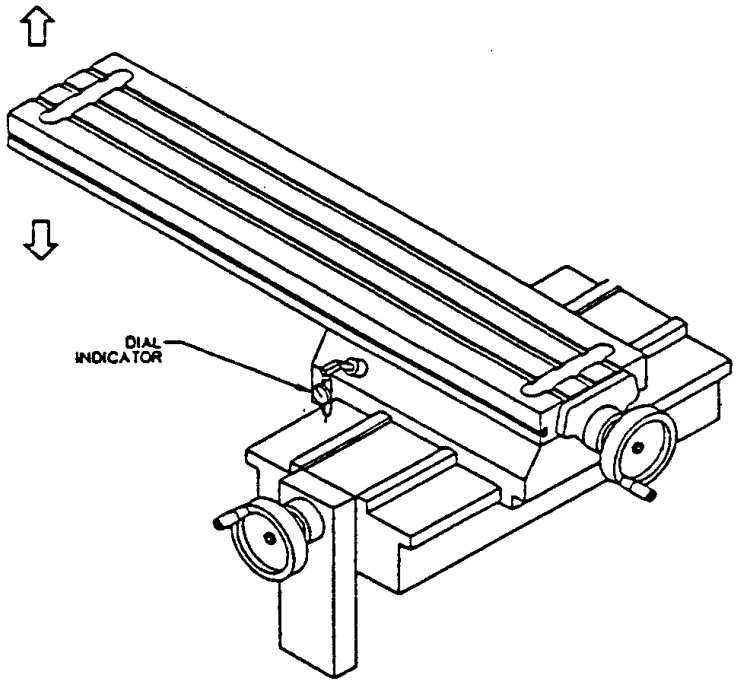


Figure 41

Saddle Bottom Gib Adjustment (DPMV3 Only)

5.2.1.6 Saddle Bottom Gib Adjustment, Y-Axis – DPMV5 & DPMV7

See Figure 39

1. Clean all chips, dirt and excess oil from the table and saddle.
2. Center the saddle on the bed ways.
3. Mount your indicator on the left side of the saddle (Point C) with the table in the center of its travel and zero out your indicator.
4. Then move the table all the way to the right side. When the gibs are adjusted properly you should see no more than 0.0003" movement on the indicator.
5. Do the same thing on the right side of the saddle (Point B) this time moving the table all the way to the left. The reading should be positive on the indicator because the saddle should rise where you are indicating.

Note: You can get better readings than 0.0003" but the torque on the Y ball screw may exceed our recommended levels. Remove the ball screw cover and check the torque with an in-lb torque wrench. Normally, the torque should be around 15 in-lbs. Do not exceed 20 in-lbs. Values higher than this may cause circularity problems.

- **To adjust the gib for excessive clearance**:
  Loosen the gib lock screw on the back of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the front of the saddle. Tighten the gib lock screw on the back end of the saddle to lock the gib in place, and recheck. Repeat as necessary.

- **To adjust the gib for too small of a clearance**:
  Loosen the gib lock screw on the front of the saddle. Estimate the amount of gib lock screw adjustment required and tighten the gib lock screw on the back of the saddle. Tighten the gib lock screw on the front of the saddle to lock the gib in place, and recheck. Repeat as necessary.

5.2.1.7 Ram Back Gib Adjustment, Z-Axis (see Figure 42)

1. Clean all chips, dirt and excess oil from the table and saddle.
2. Remove the lower way cover on the ram to gain access to Z crank.
3. Disconnect the upper way cover to expose the back ram gibs.
4. Remove drawbar nosepiece if present.
5. Place a piece of wood on the table underneath the quill.
6. Position the milling head so that the table can be reached by cranking the Z-axis down with the hand crank.
7. Attach a .0001 dial indicator with a magnetic base to the column near the base of the ram on the left side of the machine. Place the indicator stylus on the rear surface of the ram near the bottom.

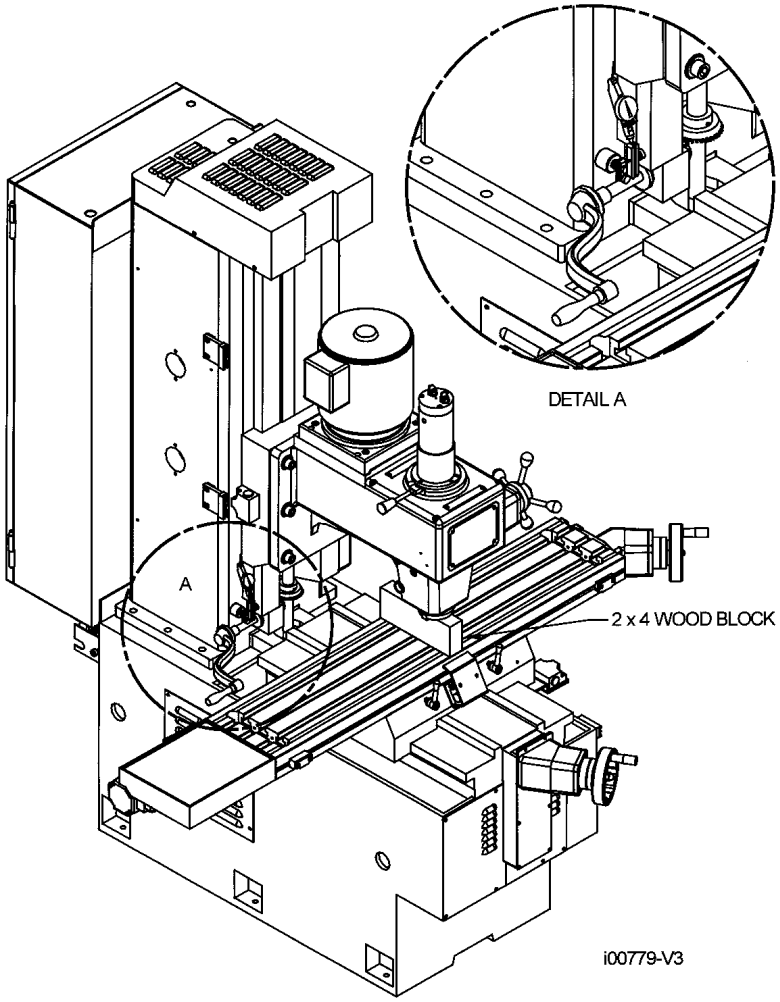


Figure 42
Ram Back Gib Adjustment

6. Crank the Z-axis until it touches the wood block. Place a moderate amount of force on the crank (DPM5 only) and note the indicator reading. For the DPMV7, use the Z-electronic handwheel to move the head down on the wood block. Adjust the left side gib until the registered movement is .001-.0015.
    - **To adjust the gib for excessive clearance**: Loosen the gib lock screw on the bottom of the ram. Estimate the amount of gib lock screw adjustment required and tighten the gib lock screw on the top of the ram. Tighten the gib lock screw on the bottom of the ram to lock the gib in place, and recheck. Repeat as necessary.
    - **To adjust the gib for too small of a clearance**: Loosen the gib lock screw on the top of the ram. Estimate the amount of gib lock screw adjustment required and tighten the gib lock screw on the bottom of the ram. Tighten the gib lock screw on the bottom of the ram. Tighten the gib lock screw on the top of the ram to lock the gib in place, and recheck. Repeat as necessary.
7. Repeat the procedure for the back gib on the right side of the machine.

CAUTION!

Be careful not to over tighten the ram gibs. Over tightening may lead to faulting and repeatability problems. Double-check the gib adjustment by checking the torque on the Z-axis. Use an in-lb torque wrench on top of the ball screw and typical readings should be from 12 to 17 in-lbs and consistent across the Z travel.

5.2.1.8 Ram Side Gib Adjustment, Z-Axis (see Figure 43)

1. Clean all chips, dirt and excess oil from the column ways.
2. Attach a .0001 dial indicator with a magnetic base towards the rear of the table on the right side of the ram. Place the indicator stylus on the ram in line and below the lower mounting bolt for the coolant hose connector block.
3. Lock and unlock the lower ram side gib lock and note the amount of movement on the dial indicator. Adjust the ram side gib until the registered movement is .0005-.0010.
    - **To adjust the gib for excessive clearance**: Loosen the gib lock screw on the bottom of the ram. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the top of the ram. Tighten the gib lock screw on the bottom of the ram to lock the gib in place, and recheck. Repeat as necessary.
    - **To adjust the gib for too small of a clearance**: Loosen the gib lock screw on the top of the ram. Estimate the amount of gib lock screw adjustment required and tighten the gib lock screw on the bottom of the ram. Tighten the gib lock screw on the top of the ram to lock the gib in place, and recheck. Repeat as necessary.
4. Reattach the upper and lower way cover to the ram.

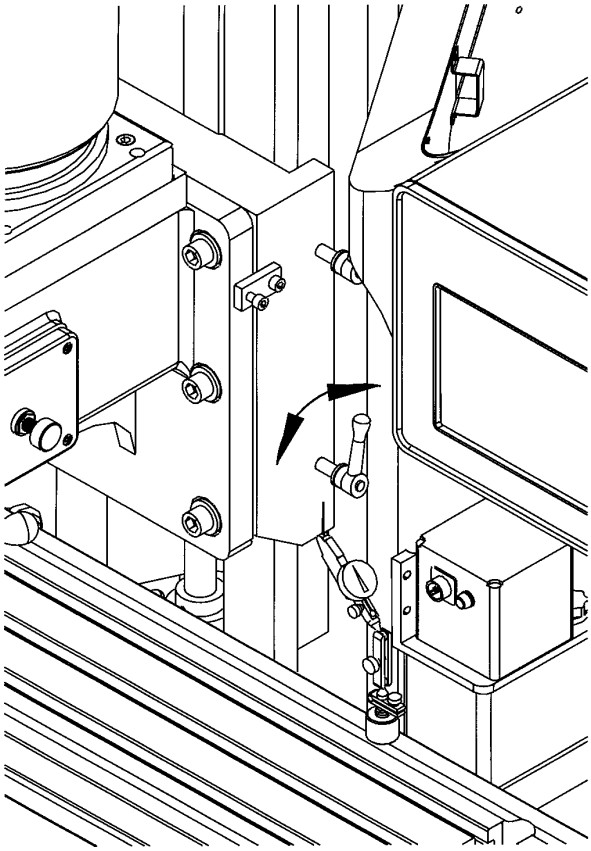


Figure 43
Ram Side Gib Adjustment

5.2.2 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.

5.2.2.1 X, Y and Z Calibration

Calibration is used 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. If you have installed TRAK Sensors, move each axis through its travel 4-6 times in order to allow the gage wheel to establish its track.
2. 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 and Y -- 150mm or 6”
   - Z -- 75 mm or 3”
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, select “Service Codes”, go to section “B” and press CODE 123.
5. Select the axis you want to calibrate.
6. Follow the instructions on the screen to complete calibration.

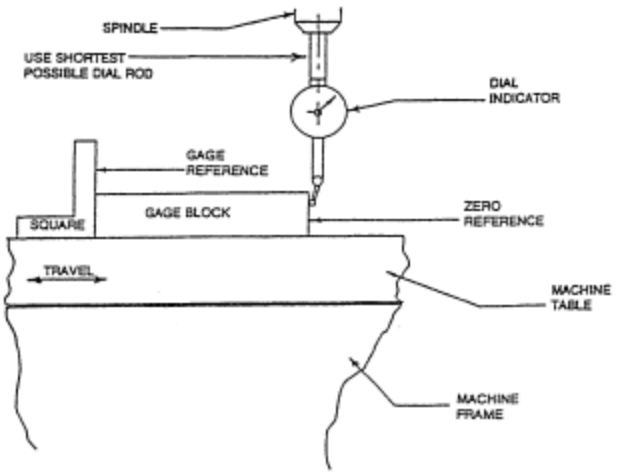


Figure 44
Calibration Set-Up

5.2.2.2 Backlash Compensation

Code 11: Set X or Y backlash constant

Note: this procedure is on systems with TRAK Sensors or Glass Scales only.

Go to setup mode, go to section "B" and press CODE 11. Refer to service code section for further explanation.

Code 127: Set X or Y Backlash Constant

Note: this procedure is only for systems without TRAK Sensors or Glass Scales.

Every mechanical system has at least a little backlash or lost motion. It is produced by the small amount of play between the gibs and ways, and mostly by the accumulative bending or elasticity of all the parts of the drive train under load. The backlash constant is factory set, but may need to be adjusted periodically.

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, or set the backlash constant.
2. Turn on the ProtoTRAK and at the Main Menu, follow the procedure below precisely:

Conversation Says	You Do
a. ---	a. Press MODE
b. Select Mode	b. Press SET UP
c. Select	c. Press SERV CODES
d. Select	d. Press "B"
e. Select Code 127	e. Press X or Y or Z
f. Backlash Value = _ _ _ _	f. What is shown is the current value. Follow the instruction on the screen and press the appropriate soft keys. Wait a few seconds between each INCR VALUE or DECR VALUE press.
g. The following is an example of what you might see when running this code.	For example, if the up and down "Oscillation Value" shown in the conversation line is .00278 inch, and the dial indicator is moving back and forth .0012, then the true backlash value is .00278 -.0012 = .00158 inch. Input this by pressing MODE, SET UP, SERV CODE, 128, SET and then .00158, SET, RETURN.

3. The X backlash identified and stored in Step 2 should be less than 0.003" on a new machine. If it is appreciably larger, inspect the drive train for loose bolts, brackets, bearings, etc.

   The backlash can also be found manually with a 0.0001" indicator with the following method.

   - Load the indicator to zero from one direction and zero out the DRO.
   - Move the indicator to 0.002" and then back to zero. Do not over shoot 0, otherwise start over.
   - Whatever number appears on the screen is the backlash value.
   - Enter this value into service code 128.
   - After entering this number redo the process. The DRO and indicator should now both read 0.

CODE 128: Input Backlash Constant

Code 128 allows you to enter the backlash values for each axis. It displays the value after it enters. This code is only used on machines with motor encoders only.

5.2.3 Tramming the Head

The purpose of tramming the head is make sure the head is perpendicular to the top of the table from both side to side and back to front.

Side to side tolerance – 0.001"

5.2.3.1 Side-to-Side Alignment – DPMV3 & DPMV5 (2-pc. head only)

1. Make sure the machine is level.
2. Make sure the table has been clean and the Z gibs are adjusted properly. Mount a dial indicator in a tool holder and mount in the quill.
3. Adjust the Y-axis so that the spindle is in the center of the table.
4. Adjust the Z ram so that the dial indicator will reach the table.
5. Move the dial indicator to 6 o'clock position and adjust the face so the needle is zero.
6. Do a series of sweeps from 3 o'clock to 9 o'clock and check for the repeatability of the setup. The head should be trammed with 0.001"
7. If the head is out of tram from side to side then loosen the 6 head bolts. An Allen wrench and breaker bar is provided in the toolbox. There are also 2 tram blocks in the toolbox to help with the alignment of the head. They are bolted to the side of the head, as shown in Figure 45, with 2 M8 SHCS. Then use 2 M8 SHCS as jackscrews to move the head in the direction it needs to go to align the head and adjust the tram with the bolt mounted on the right side of the head.
8. Once the head has been trammed tighten the 6 heads bolts. Be careful not to move the head while tightening. Tighten the bolts in a criss-cross pattern.

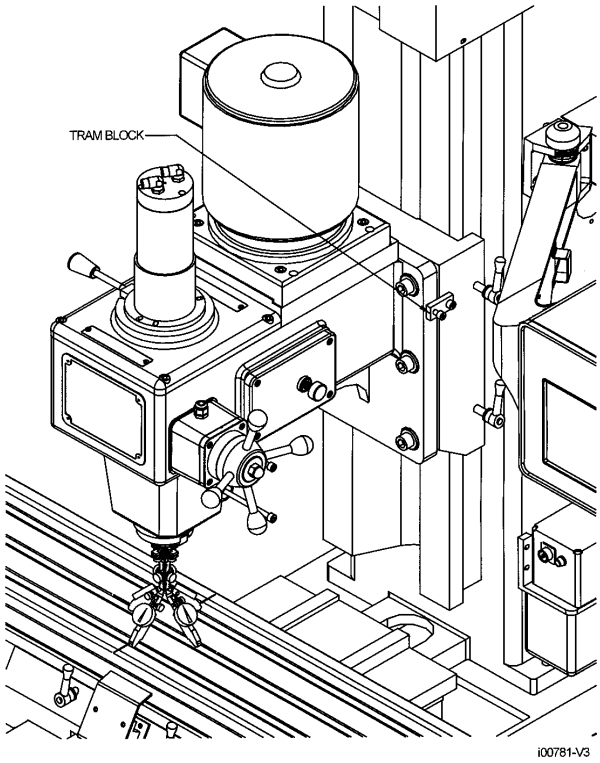


Figure 45
Tramming of Head

5.2.3.2 Back to Front Adjustment

Note: The head of the DPMV machine is adjusted at the factory. This procedure should only be needed for a head replacement. It is placed in this section for continuity with the tramming discussion.

With the dial indicator sweep the table from 6 o'clock to 12 o'clock. The head should be trammed within 0.0000 to 0.0005" from front to back. (Note: the table must droop down rather than up because tool pressure will take care of the extra 0.0005".)

Note: Minor adjustments can be made with the back ram gibs. Tightening the gibs will tend to tilt the head up from the table. Loosening the gibs tends to allow the head to droop down toward the table. Over tightening or loosening can lead to other problems with the machine. Typical adjustments with the gibs is 0.0005" or less.

5.2.4 X, Y and Z Limit Switch Adjustments

5.2.4.1 Limit Switch Assembly Configurations

There are two different types of limit switch assembly configurations. One type has the cable exiting from the right and the other type has the cable exiting from the left. The following table lists which machines get what type of limit switch assembly configurations for each axis.

5.2.4.2 X-axis Limit Switch-Stop Installation and Adjustment

The limit switch-stops for the X-axis are mounted to the front side of the table. The limit switch-stop consists of a cam and spacer, which is fastened to the T-slot on the front side of the table. Each limit switch-stop must be set to a specific distance from the end of the table in order to maximize travel and simultaneously prevent serious damage to the machine in the event of a crash. Also, the cam must be set to a specific distance from

the limit switch assembly in order for the limit switch to trigger properly. The cam contains slotted holes, which allows for up and down adjustment. All limit switches are set at the factory for maximum travel.

5.2.4.2.1 Procedure for setting X limit switch

1. Loosen the X-axis cams and spacers on each side of the table.
2. Slide each X-axis cam and spacer within the T-slot to the end of the table.
3. Slowly move the table to one side by hand until the end of the travel is reached.
4. In DRO mode set X = 0 ABS.

CAUTION!
The limit switch must be triggered a minimum of ½" before the machine reaches its travel limits in both directions. This allows sufficient room for the servomotors to stop when the limit switch is hit at 250 ipm.

5. Using the DRO display, back the table off 1/2".
6. Loosely mount the cam and the spacer on the same side of the table that the end of travel was reached.
7. Slide the cam and the spacer up next to the plunger, which is located on the limit switch assembly.
8. Set the height of the cam such that the cam initially makes contact near the bottom, but not past, the tapered portion of the plunger as shown below in Figure 46.
9. Slide the cam along with the spacer up against the plunger until the limit switch is triggered. Note: The moment when the limit switch is triggered can be seen on the DRO display.
10. Mount the cam and the spacer in this position.
11. Repeat Steps 2-6 for setting the position of the cam and the spacer for the other side of the table.
12. Jog the table at 250ipm to each side and verify that the limit switches are working properly. Also, make sure that the table does not exceed its travel and crash.

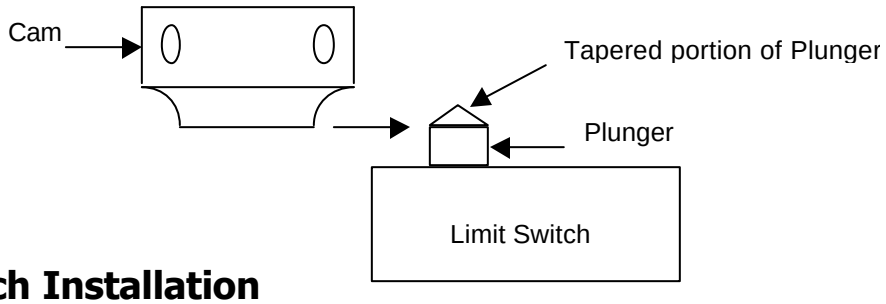


Figure 46
Limit Switch Installation

5.2.4.3 Y-axis Limit Switch-Stop Installation and Adjustment

The limit switch-stops for the Y-axis are mounted on the side of the bed. The limit switch-stop consists of a cam attached to a cam holder. Each limit switch-stop cam must be set to a specific distance from the end of the bed in order to maximize travel and simultaneously prevent serious damage to the machine in the event of a crash. Also, the

limit switch assembly must be set to a specific distance from the cam in order for the limit switch to trigger properly. The limit switch bracket contains slotted holes, which allow for in and out positioning adjustments of the limit switch assembly.

5.2.4.3.1 Cam and cam holder

The cam holder is mounted to the side of the bed by use of a couple of screws. However, the cam is mounted to the cam holder by a special means. Each of the two set-screws on the cam itself push against the top side of two ball bearings (located inside the cam) forcing them out of the side of the cam and up against the inner walls of the cam holder. This action clamps the cam to the cam holder. Also, the cam holder is longer than the cam, which allows for side-to-side positional adjustment of the cam within the cam holder.

5.2.4.3.2 Procedure for setting Y limit switch

1. Remove the limit switch assembly from its bracket to prevent any interference between the limit switch assembly and the cam assembly in Step 2.
2. Slowly move the saddle to the front of the bed by hand until the end of the travel is reached. In DRO mode set X = 0 ABS.
3. Using the DRO display, back the saddle off 1/2".

CAUTION!
The limit switch must be triggered a minimum of ½" before the machine reaches its travel limits in both directions. This allows sufficient room for the servomotors to stop when the limit switch is hit at 250 ipm.

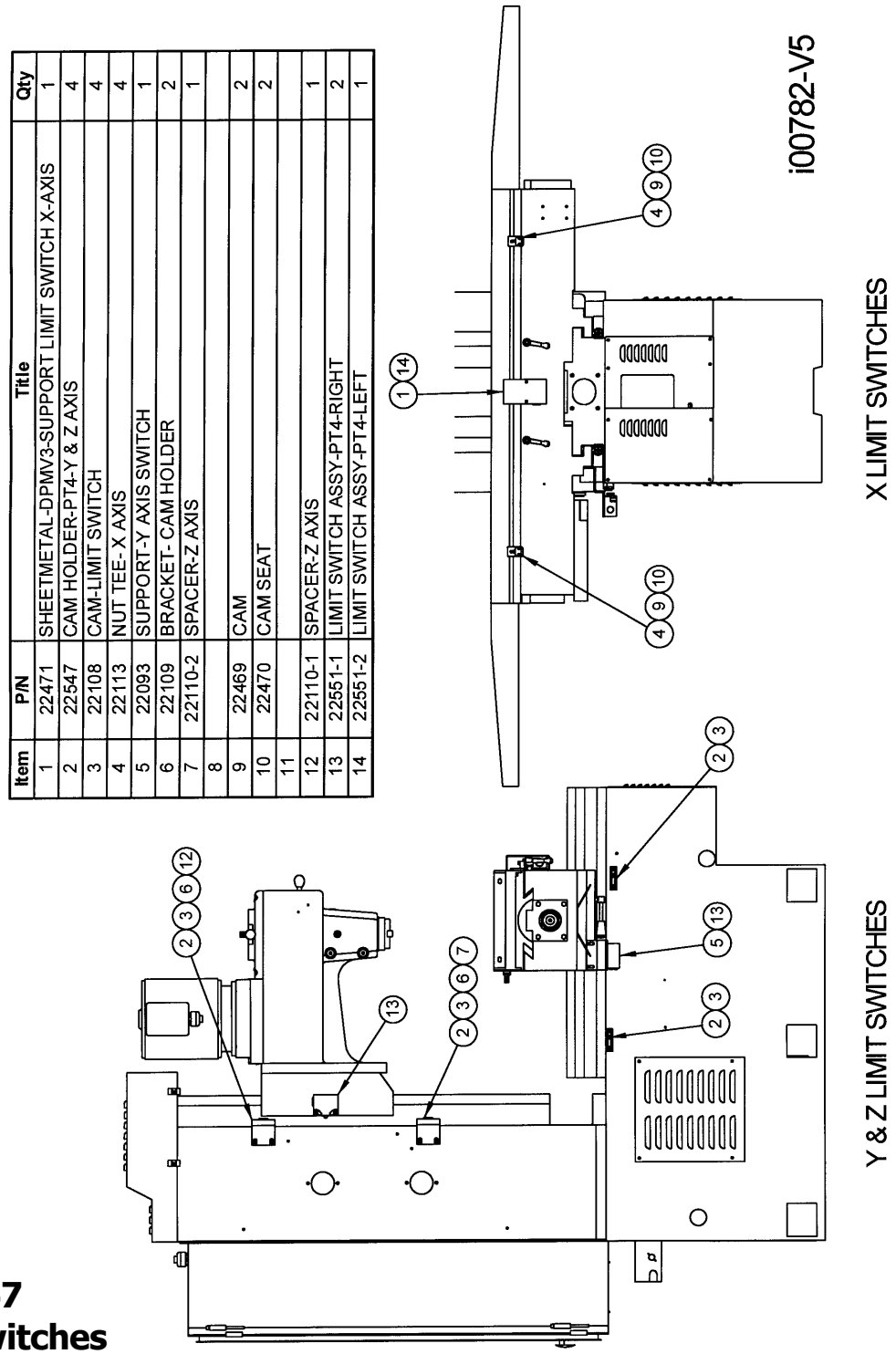
4. Loosen the (2) setscrews on the cam so that the cam can slide back and forth freely within its cam holder.
5. Loosely mount the limit switch assembly.
6. Slide the cam up next to the plunger located on the limit switch assembly.
7. Mount the limit switch assembly to its bracket such that the cam will initially make contact near the bottom, but not past, the tapered portion of the plunger.
13. Slide the cam up against the plunger until the limit switch is triggered. Note: The moment when the limit switch is triggered can be seen on the DRO display.
14. Mount the cam in this position.
15. Loosen the (2) set screws on the other cam located near the back of the bed so that the cam can slide back and forth freely within its cam holder.
16. Slowly move the saddle to the rear of the bed by hand until the end of the travel is reached. In DRO mode set X = 0 ABS.
17. Using the DRO display, back the saddle off 1/2".
18. Slide the cam up against the plunger until the limit switch is triggered. Note: The moment when the limit switch is triggered can be seen on the DRO display.
19. Mount the cam in this position.
20. Jog the saddle at 250ipm to the front and then to the back to verify that the limit switches are working properly. Also, make sure that the table does not exceed its travel and crash.

5.2.4.4 Z-axis Limit Switch-Stop Installation and Adjustment

The limit switch-stops for the Z-axis are mounted on the side of the column. The limit switch-stop consists of a cam, cam holder, bracket, and spacer. Each limit switch-stop cam must be set to a specific distance from each end of the column in order to maximize travel and simultaneously prevent serious damage to the machine in the event of a crash. Also, the cam assembly must be set to a specific distance from the limit switch assembly in order for the limit switch to trigger properly. The cam bracket assembly contains slotted holes, which allow for in and out positioning adjustments of the cam assembly.

5.2.4.4.1 Procedure for setting Z limit switch

1. On the lower cam assembly, loosen the (2) setscrews on the cam.
2. Slide the cam to the bottom of its cam holder.
3. Tighten the (2) setscrews on the cam to hold it in place.
4. Loosen the two screws that mount the cam bracket assembly to the column of the machine.
5. The cam bracket assembly contains slotted holes to allow for in and out positioning adjustments of the cam assembly. Move the cam bracket assembly away from the limit switch assembly and then tighten the cam bracket screws to hold in place.
6. By hand, slowly move the head down to approximately 1 1/2" above the top of the table. Note: Use a tape measure to measure the distance between the spindle and the table.
7. Slide the cam up next to the plunger located on the limit switch assembly.
8. Mount the cam bracket assembly to the column such that the cam will initially make contact near the bottom, but not past, the tapered portion of the plunger.
9. Slide the cam up against the plunger until the limit switch is triggered. Note: The moment when the limit switch is triggered can be seen on the DRO display.
10. Mount the cam in this position.
11. On the upper cam assembly, loosen the (2) setscrews on the cam.
12. Slide the cam to the top of its cam holder.
13. Tighten the (2) setscrews on the cam to hold it in place.
14. Loosen the two screws that mount the cam bracket assembly to the column of the machine.
15. The cam bracket assembly contains slotted holes to allow for in and out positioning adjustments of the cam assembly. Move the cam bracket assembly away from the limit switch assembly and then tighten the cam bracket screws to hold in place.
16. By hand, slowly move the head up toward the top of the column until just before the Z-axis upper way cover begins to squish together.
17. Back the head off 1/2" in the downward direction.
18. Slide the cam up next to the plunger located on the limit switch assembly.
19. Mount the cam bracket assembly to the column such that the cam will initially make contact near the bottom, but not past, the tapered portion of the plunger.
20. Slide the cam up against the plunger until the limit switch is triggered. Note: The moment when the limit switch is triggered can be seen on the DRO display.
21. Mount the cam in this position.



Item	P/N	Title	Qty
1	22471	SHEETMETAL-DPMV3-SUPPORT LIMIT SWITCH X-AXIS	1
2	22547	CAM HOLDER-PT4-Y & Z AXIS	4
3	22108	CAM-LIMIT SWITCH	4
4	22113	NUT TEE- X AXIS	4
5	22093	SUPPORT-Y AXIS SWITCH	1
6	22109	BRACKET- CAM HOLDER	2
7	22110-2	SPACER-Z AXIS	1
8			
9	22469	CAM	2
10	22470	CAM SEAT	2
11			
12	22110-1	SPACER-Z AXIS	1
13	22551-1	LIMIT SWITCH ASSY-PT4-RIGHT	2
14	22551-2	LIMIT SWITCH ASSY-PT4-LEFT	1

Figure 47
Limit Switches
DPMV5
(see Figures 60 & 62b for DPMV7)

6.0 Parts Lists & Drawings

6.1 Counter Balance System Drawing (DPMV3 & DPMV5)

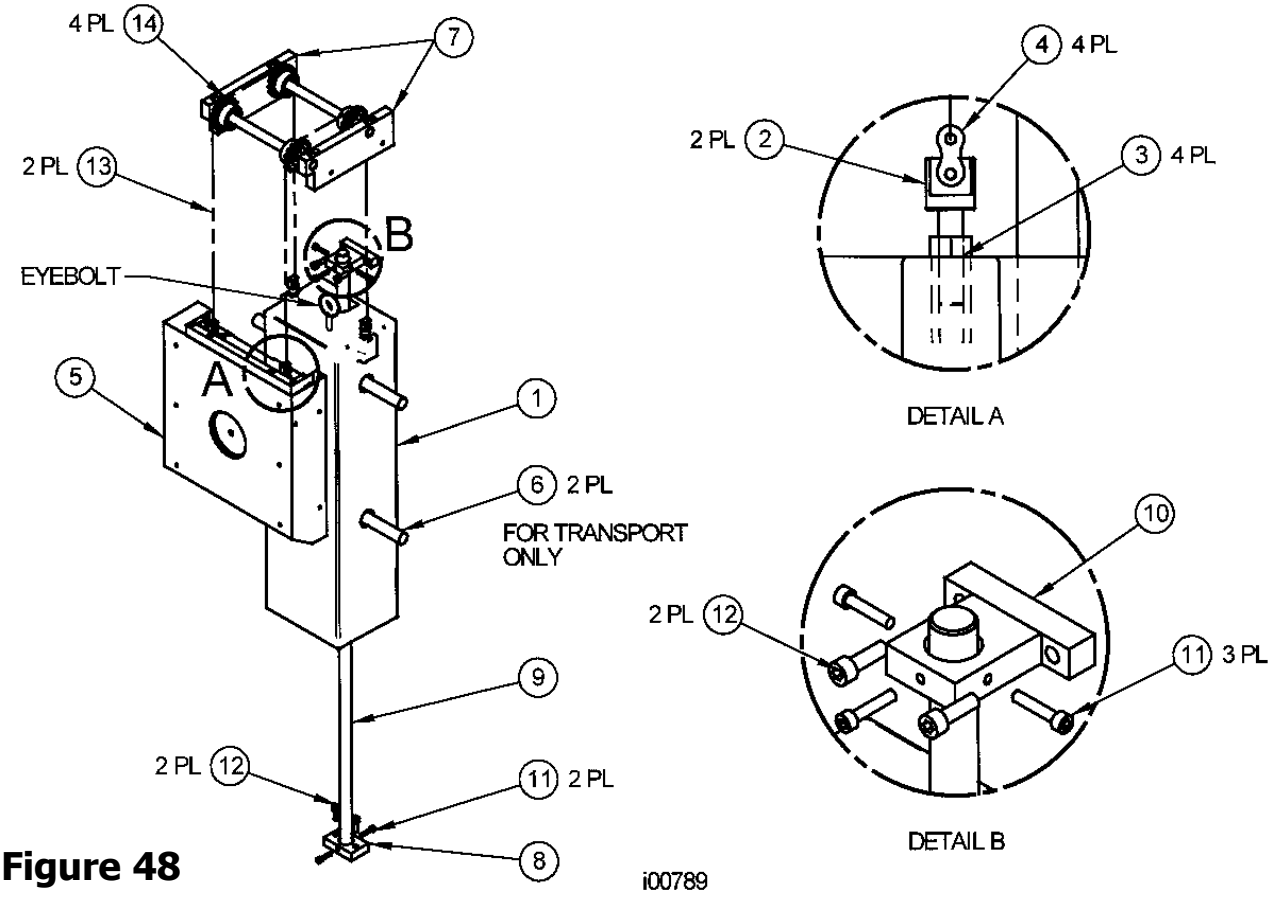


Figure 48

Item	P/N	Description	Qty
1		CASTING-COUNTERWEIGHT	1
2	21766	SCREW CHAIN (PJ 500030)	4
3	M10-1.5 50B	NUT-HEX-STL-BO	4
4	6261K194	MASTERLINK	4
5	21717	RAM	1
6		BAR - C'WEIGHT (TRANSPORT)	2
7	21937-1, -2	SUPPORT BAR	1
8		GUIDE - LOWER C'WEIGHT (PJ - SW0011)	1
9		CENTERING BAR (PJ - SW0009-1)	1
10		GUIDE ASSY. UPPER - C'WEIGHT ASSY.	1
11	M6-1.0X30 25B	SCREW-SHCS-STL-BO	5
12	M8-1.25X30 25B	SCREW-SHCS-STL-BO	2
13	500068-3	CHAIN	1
14	21765	SPROCKET-13 TEETH	4

6.2 Lubrication System Drawings

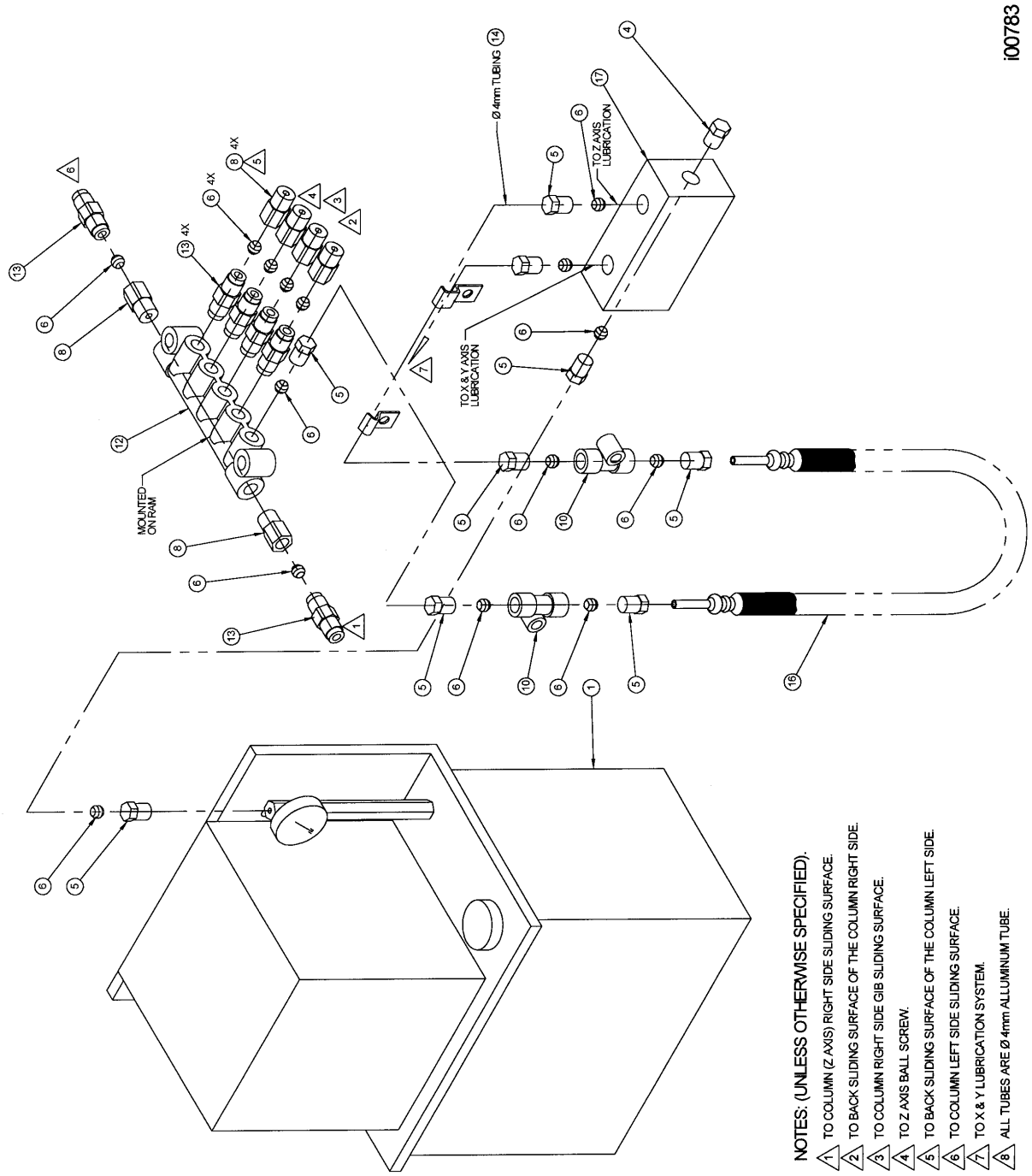


Figure 49
DPMV Lubrication Drawing
Pump & Ram

DPMV Lubrication Drawing, Pump & Ram, Parts List

Item	P/N	Description	Qty
1	22291-1	LUBE PUMP	1
2			
4	L015	PLUG- M8 X 1.0-PG004	1
5	L013	BUSHING-PA4	9
6	L014	SLEEVE-4 MM-PB4	15
8	PAN4	NUT	6
10	L011	TEE ADAPTER-PKD4	2
12	L002	DISTRIBUTOR-DB8	1
13	PSS4	OIL DISTRIBUTOR	6
14	L005	TUBING-4MM ALUM-A4	
15			
16	L008	HOSE	1
17	L010	DISTRIBUTOR	1

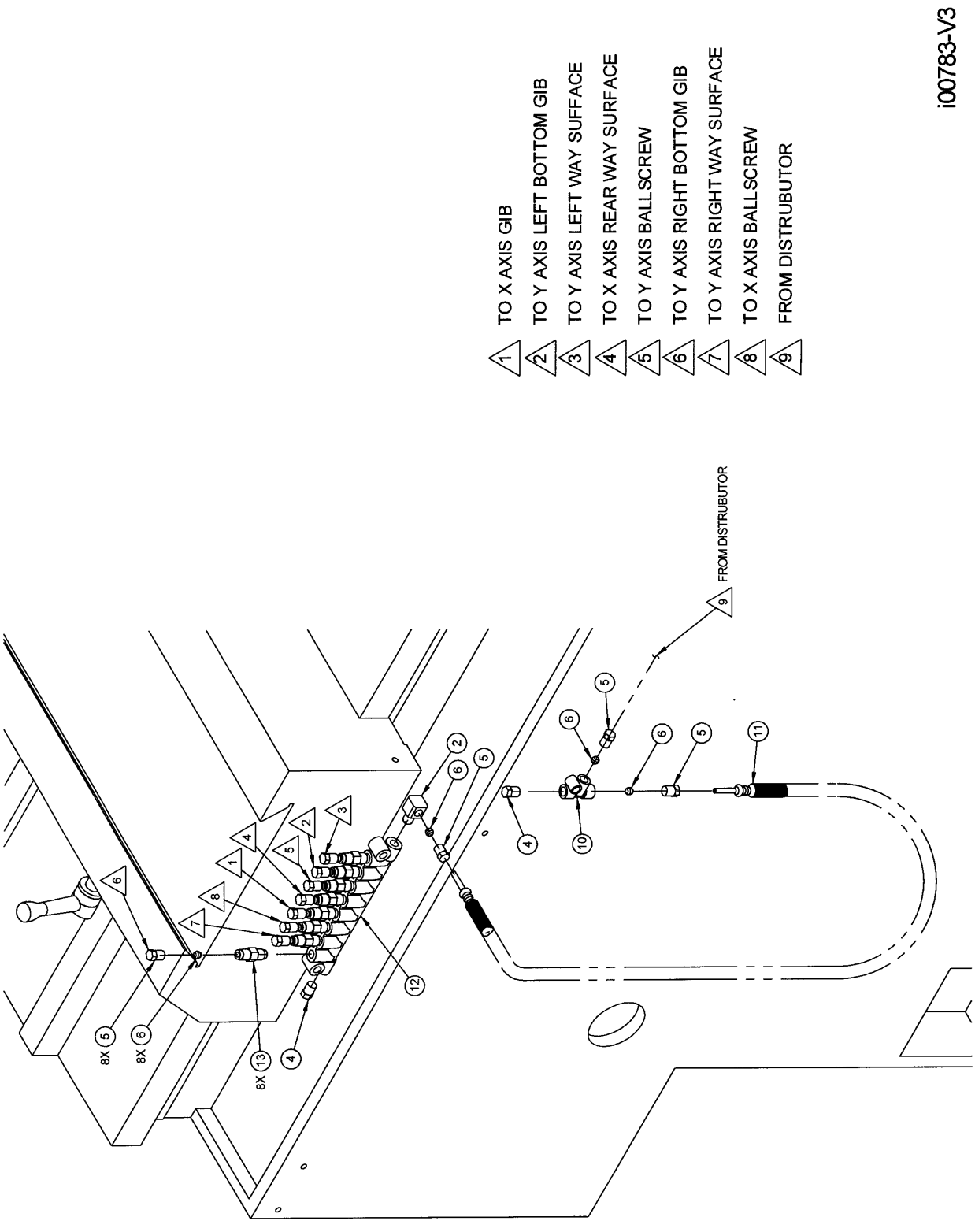


Figure 50 - DPMV3 Lubrication Drawing - X & Y Axis

DPMV3 Lubrication Drawing - X & Y Axis, Parts List

Item	P/N	Description	Qty
1			
2	PH4-8	ELBOW	1
3			
4	L015	PLUG- M8 X 1.0-PG004	2
5	L013	BUSHING-PA4	11
6	L014	SLEEVE-4 MM-PB4	11
7			
8			
10	L012	TEE ADAPTER-PKD4	1
11	L008	HOSE	1
12	L006	DISTRIBUTOR-DB10	1
13	PSS4	OIL DISTRIBUTOR	8
14	L005	TUBING-4 MM ALUM-A4	XX
15			

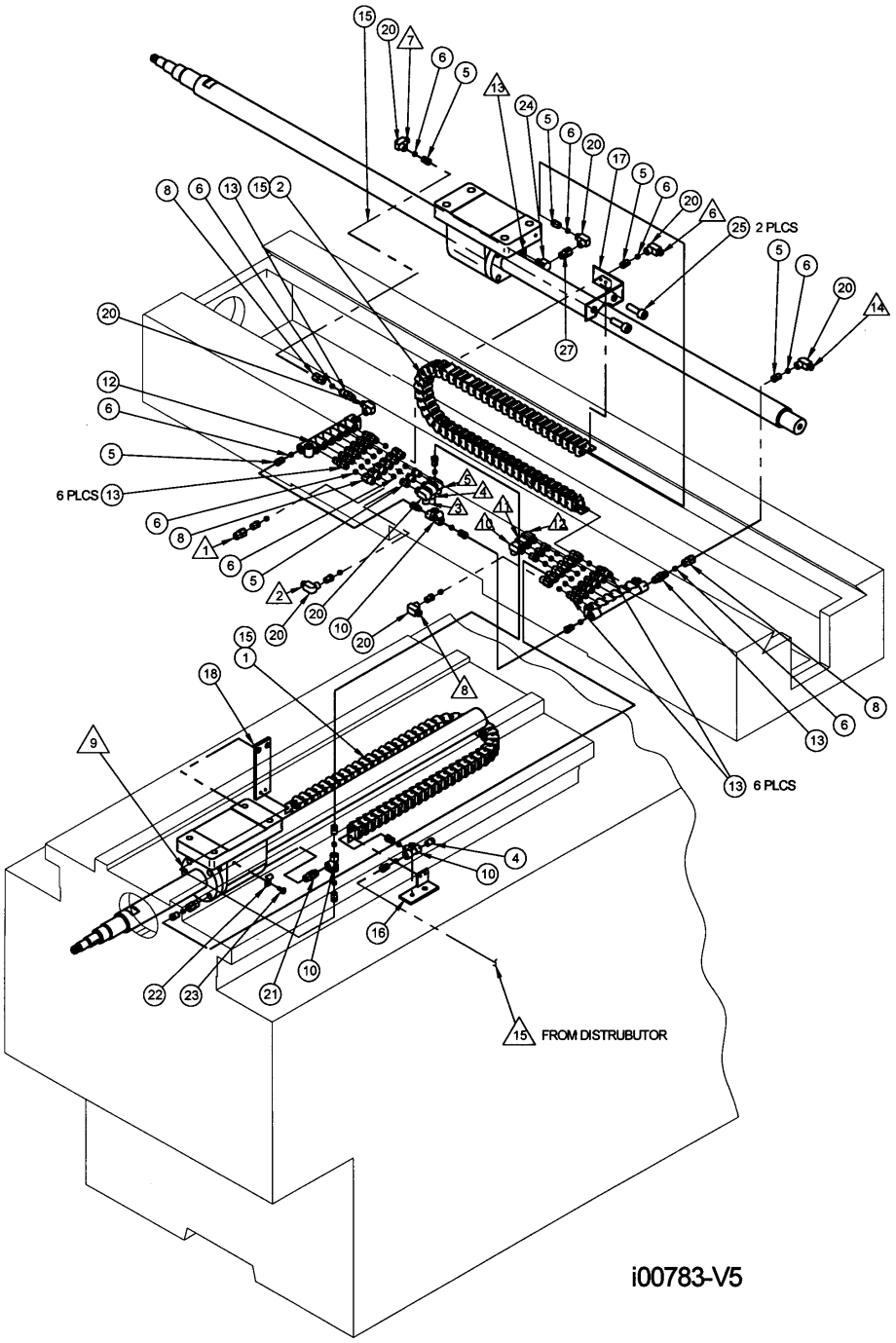


Figure 51
DPMV5 Lubrication Drawing
X & Y Axis

DPMV5 Lubrication Drawing, X & Y Axis, Parts List

Item	P/N	Title	Qty
1	P8011010	CHAIN 10MMX10MMX34 UNITS	1
2	P8621010	CHAIN 10MMX10MMX42 UNITS	1
4	L015	PLUG- M8 X 1.0-PG004	1
5	L013	BUSHING-PBA	21
6	L014	SLEEVE-4 MM-PB4	35
8	PAN4	NUT	14
10	L011	TEE ADAPTER	2
12	L002	DISTRIBUTOR-DB8	2
13	PSS4	OIL DISTRIBUTOR	14
14	L005	TUBING-4MM ALUM-A4	144
15	P04	TUBING-4MM PLASTIC	108
16	21738	BRACKET- X & Y AXIS LUBRICATION	1
17	22346	BRACKET- LUBE X-AXIS BALLSCREW	1
18	21737	BRACKET- X & Y AXIS LUBRICATION	1
19	PD408	ADAPTER	2
20	PH408	ADAPTER- RIGHT ANGLE	13
21	PQ8T	NIPPLE- M8	1
22	PZ0104	CLAMP	1
23	M5-0.8X10 10B	SCREW-PH-PHIL-STL-BO	1
24	PH4-8	CONNECTOR-	1
25	M8-1.25X25 25B	SCREW-SHCS-STL-BO	2
26	M6-1.0X16 20B	SCREW-RH-PHIL-STL-BO	2
27	PD401	ADPATER	1

6.3 Bed Parts List (DPMV3 & DPMV5)

B230	VENT-LEFT SLIDE
B246	VENT-LEFT FRONT
B231	VENT-RIGHT SLIDE
22051	VENT-RIGHT FRONT
B238	COOLANT SCREEN
B239	FOOT PADS
B240	FOOT PAD BOLT/NUT

6.4 Table/Saddle Spare Parts List (DPMV3 & DPMV5)

B260	TABLE GIB LOCK HANDLE & PLUNGER
	SADDLE GIB LOCK HANDLE & PLUNGER
B262	TABLE GIB
B263	SADDLE BOTTOM GIB
B264	SADDLE SIDE GIB
B265	TABLE GIB ADJUSTMENT SCREW
B266	SADDLE GIB ADJUSTMENT SCREW
B267	WAY COVER-BACK BED
B268	WAY COVER-FRONT BED
B269	TABLE STOP DOG
B270	TABLE ADJUSTMENT STOPS
B271	SADDLE GIB CHIP GUARDS & GASKETS
B279	CHIP GUARD PLATE COVERING Y BALL SCREW

6.4.1 Table/Saddle Spare Parts List (DPMV7)

	TABLE GIB LOCK HANDLE & PLUNGER
	SADDLE GIB LOCK HANDLE & PLUNGER
24507	X-AXIS GIB
24509	SADDLE BOTTOM GIB
24508	SADDLE SIDE GIB
24549	TABLE GIB ADJUSTMENT SCREW
24518	SADDLE GIB ADJUSTMENT SCREW
24505	TABLE WAY COVER
24504	WAY COVER-FRONT BED
24506	WAY COVER-Y-AXIS (REAR)
24522	WAY COVER-Z-AXIS (TOP)
24523	Z-AXIS BALLSCREW COVER

6.5 Manual Ram Elevation Drawing (DPMV3 & DPMV5)

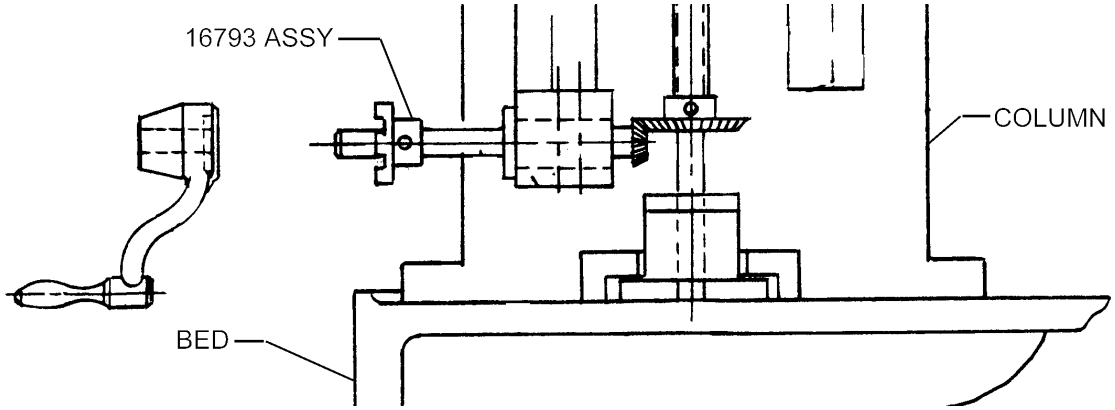
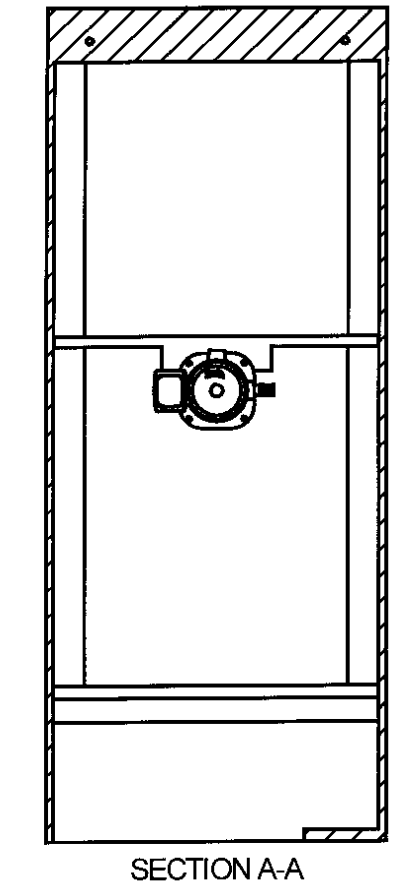


Figure 52

6.6 Coolant Pump Mounting



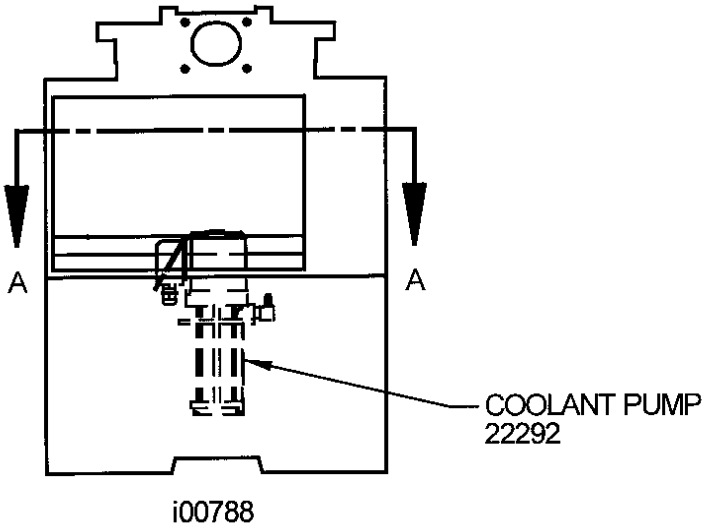


Figure 53
Coolant Pump Mounting

Figure 54
Servo System

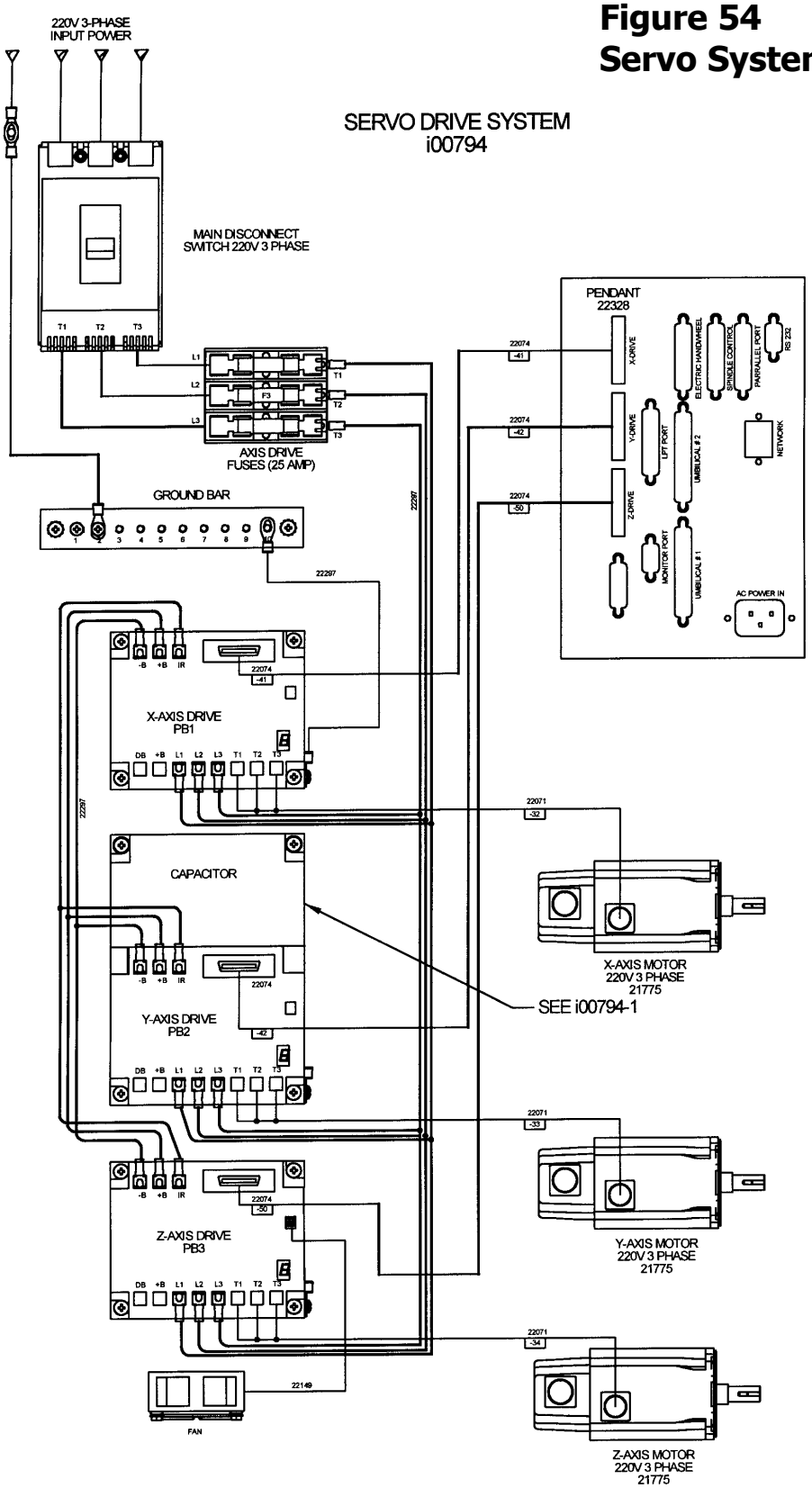
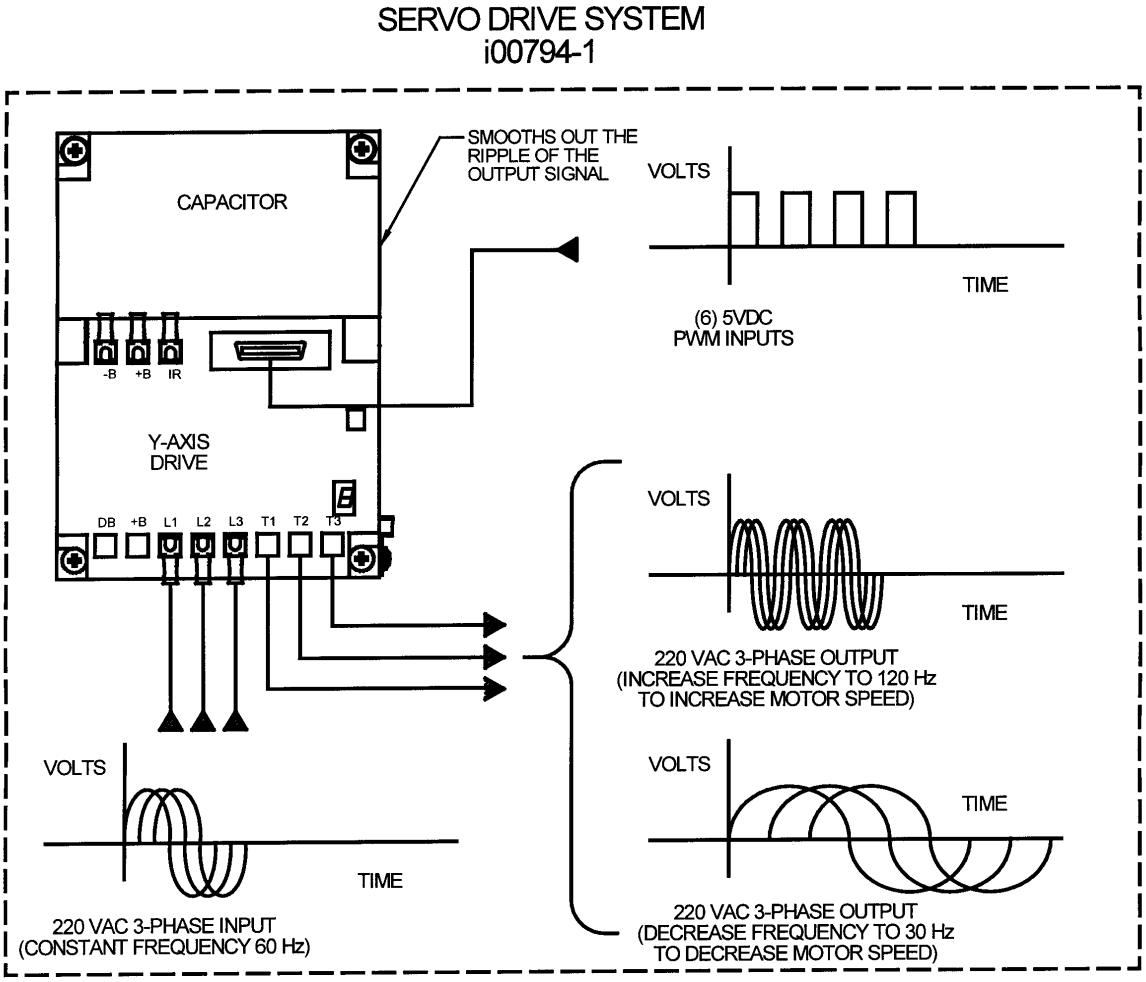
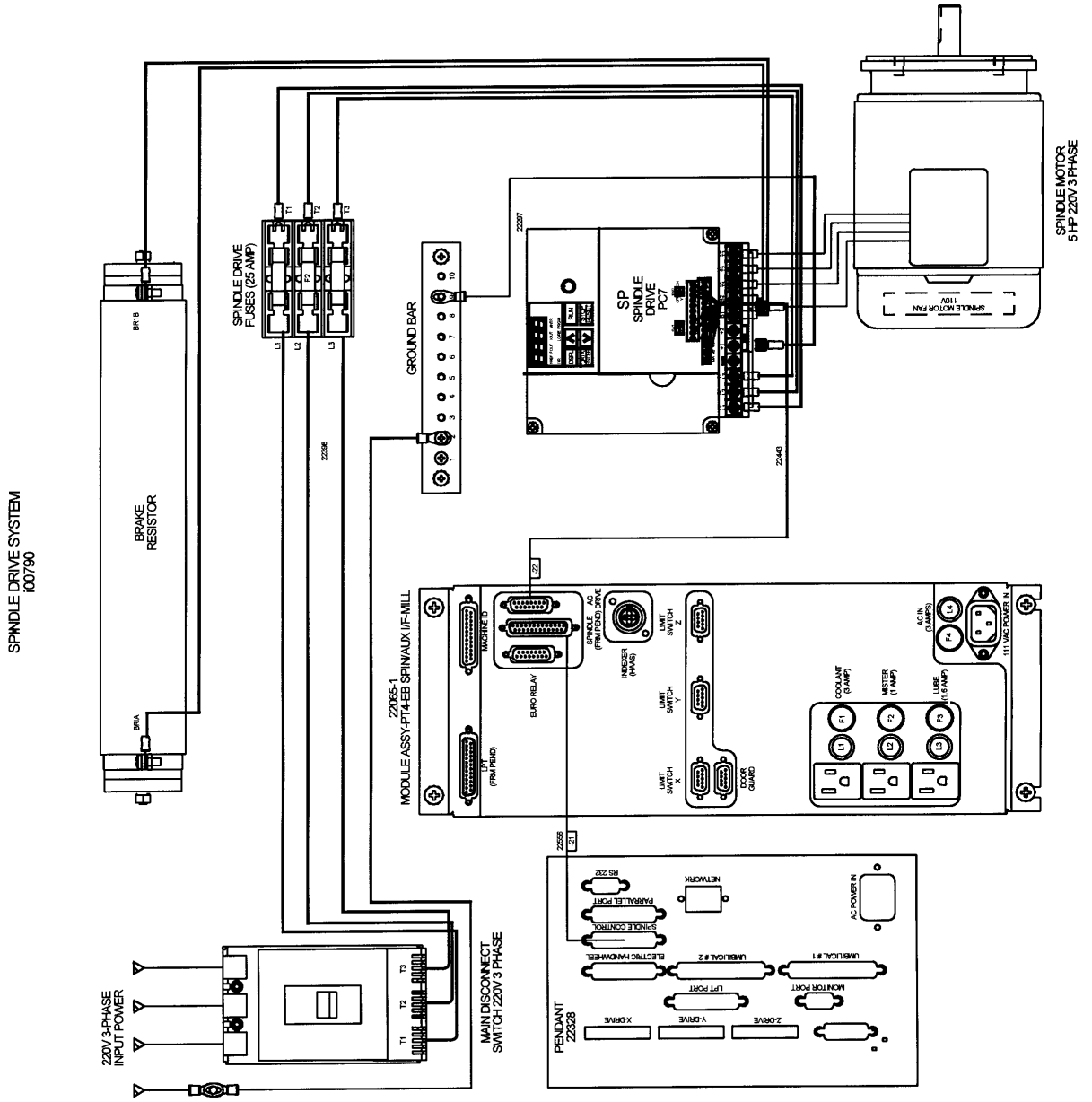


Figure 54a


SERVO DRIVE SYSTEM
i00794-1
SMOOTHS OUT THE RIPPLE OF THE OUTPUT SIGNAL
CAPACITOR
VOLTS
TIME
(6) 5VDC PWM INPUTS
-B +B IR
Y-AXIS DRIVE
DB +B L1 L2 L3 T1 T2 T3
VOLTS
TIME
220 VAC 3-PHASE OUTPUT (INCREASE FREQUENCY TO 120 Hz TO INCREASE MOTOR SPEED)
VOLTS
TIME
VOLTS
TIME
220 VAC 3-PHASE INPUT (CONSTANT FREQUENCY 60 Hz)
220 VAC 3-PHASE OUTPUT (DECREASE FREQUENCY TO 30 Hz TO DECREASE MOTOR SPEED)



A/C DRIVE CABLE WIRING TABLE		
ITEM 17 PIN #	**FUNCTION**	**SPINDLE PIN**
1	SPD FWD	S1
2	SPD RFV	S2
3	SPD E-STOP	S3
4	TAP MODE	S5
5	SPD RESET	S4
6	SPD GND	SC
7	A GND	FC
8	DAC OUT	FR
9	GND	MC
10	GND	PC
11	FAULT FDB	MA
12	RUN FDB EN	P1
13	-	
14	-	
15	A GND	FC

Figure 55
Spindle Drive System

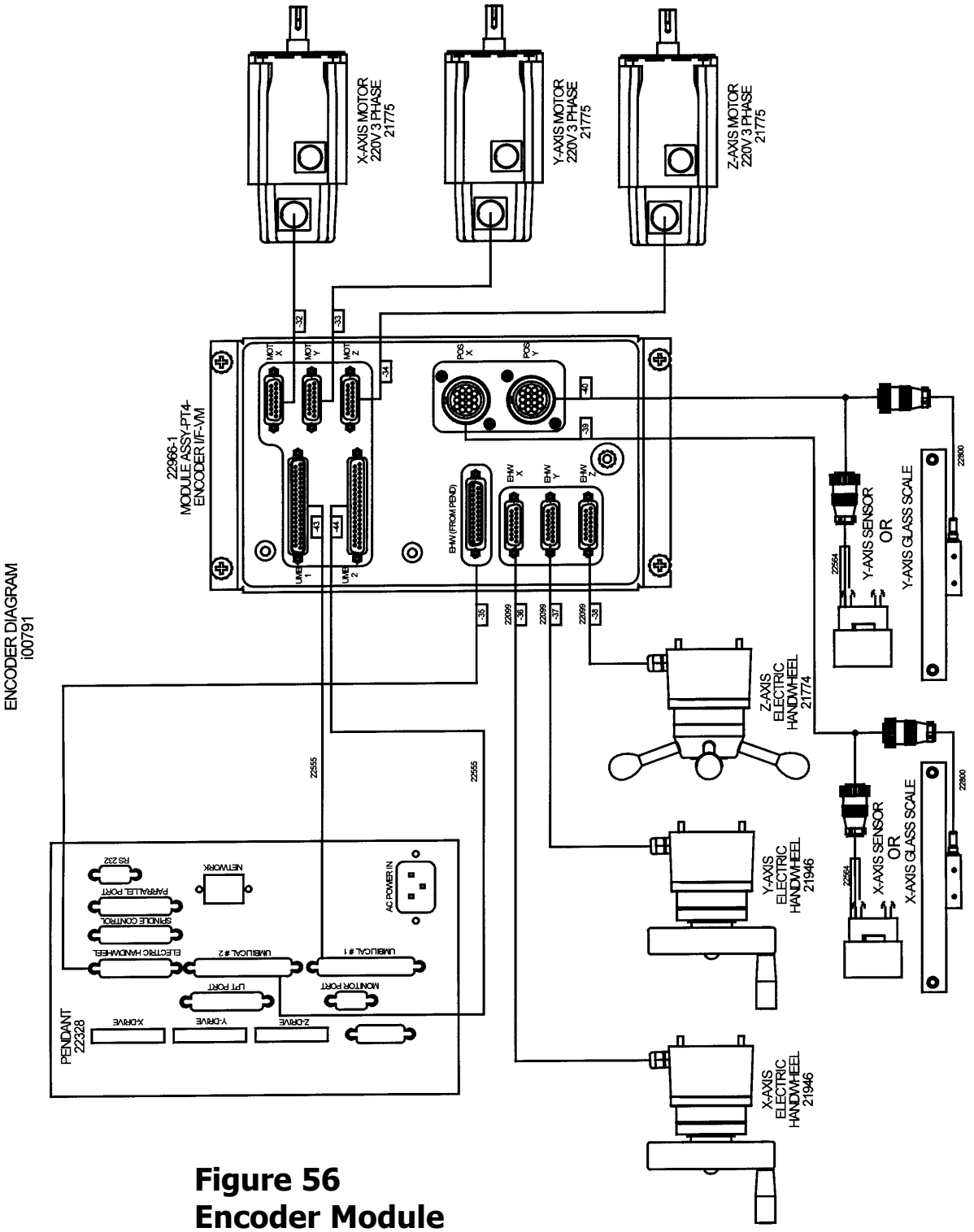


Figure 56
Encoder Module

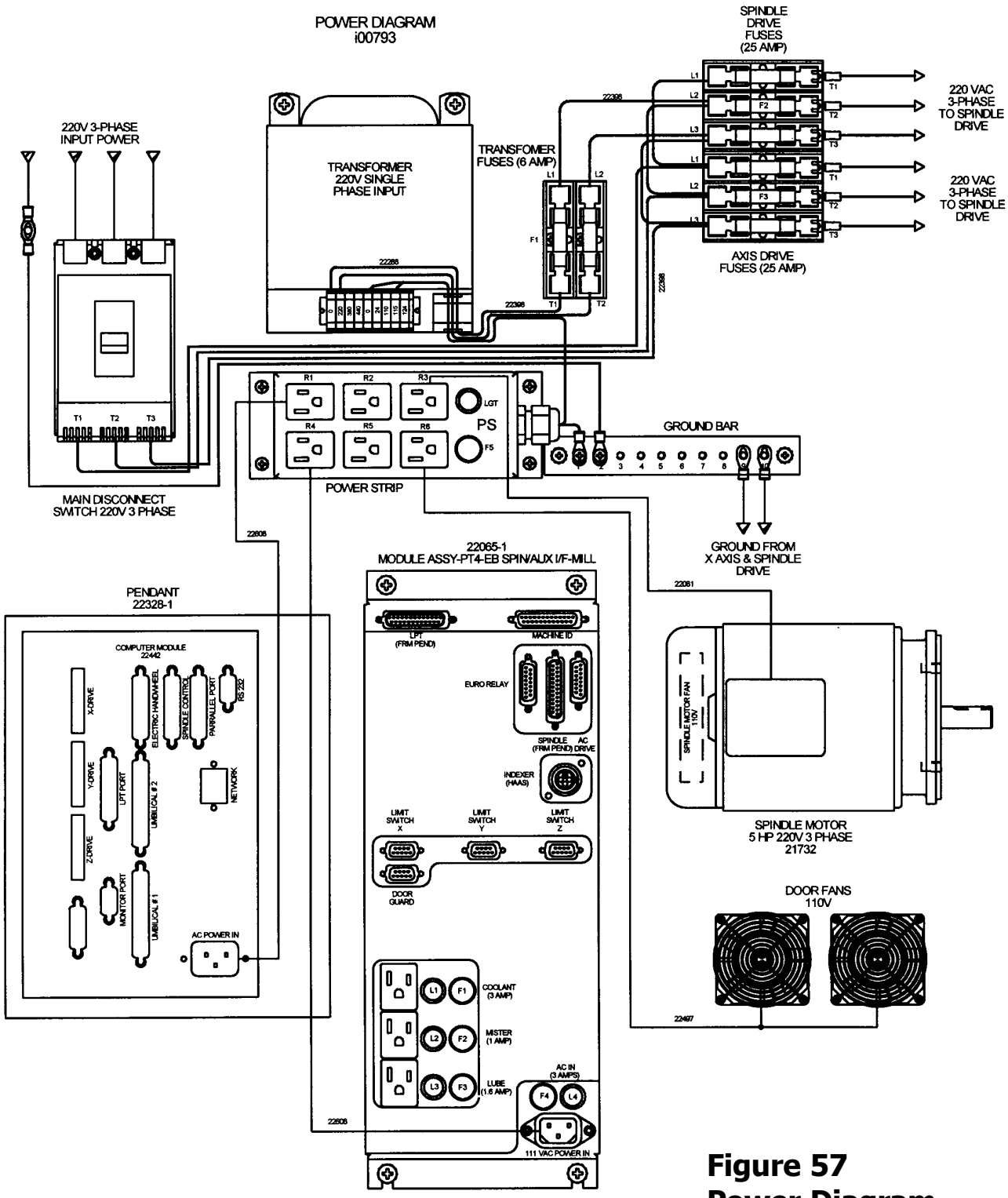
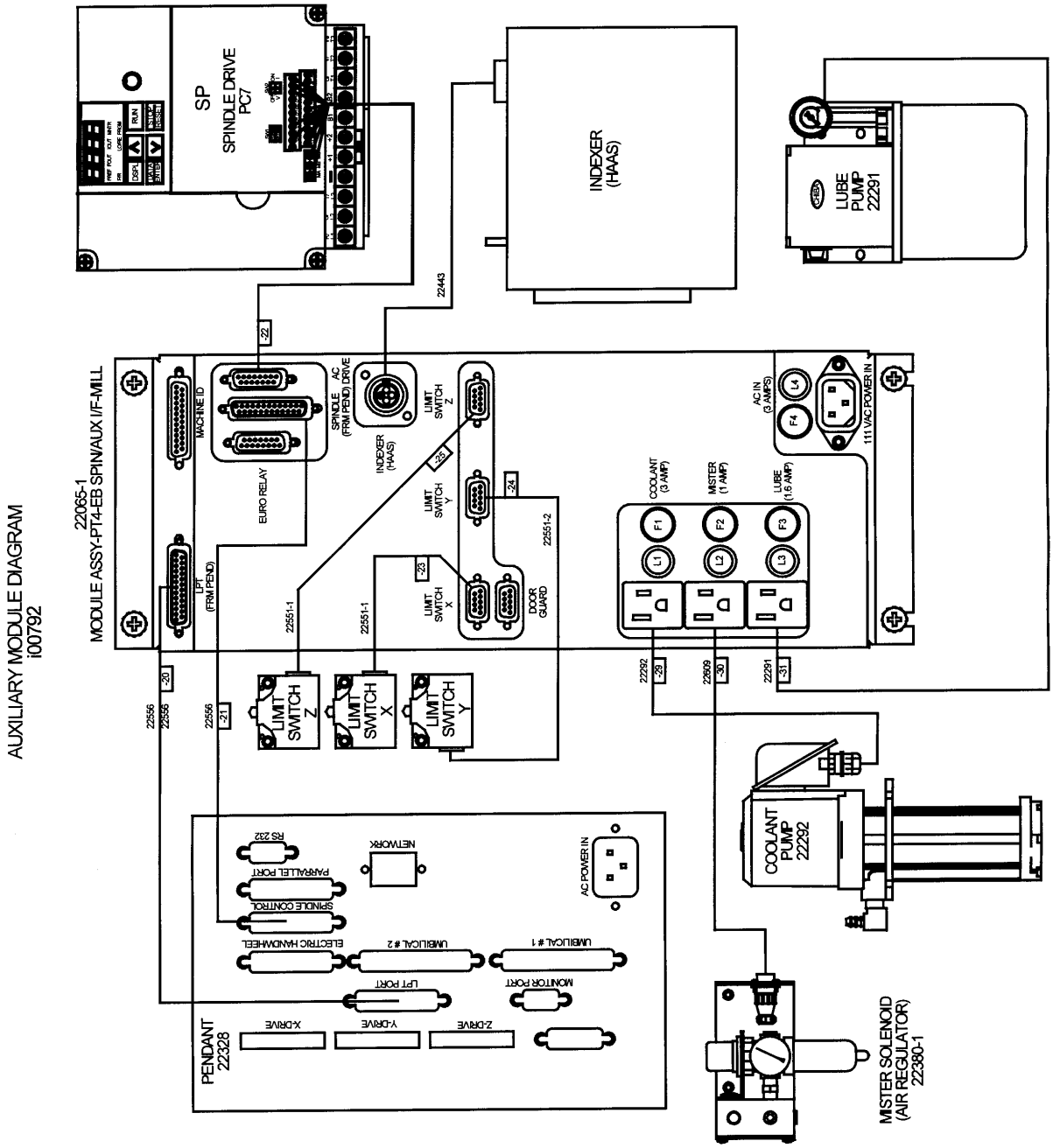


Figure 57
Power Diagram



LIMIT SWITCH TABLE			
MACHINE	**AXIS**	**CABLE DIRECTION**	**P/N**
DPMV5	Y & Z	RIGHT	22551-1
DPMV5	X	LEFT	22551-2

Figure 58
Auxiliary Module

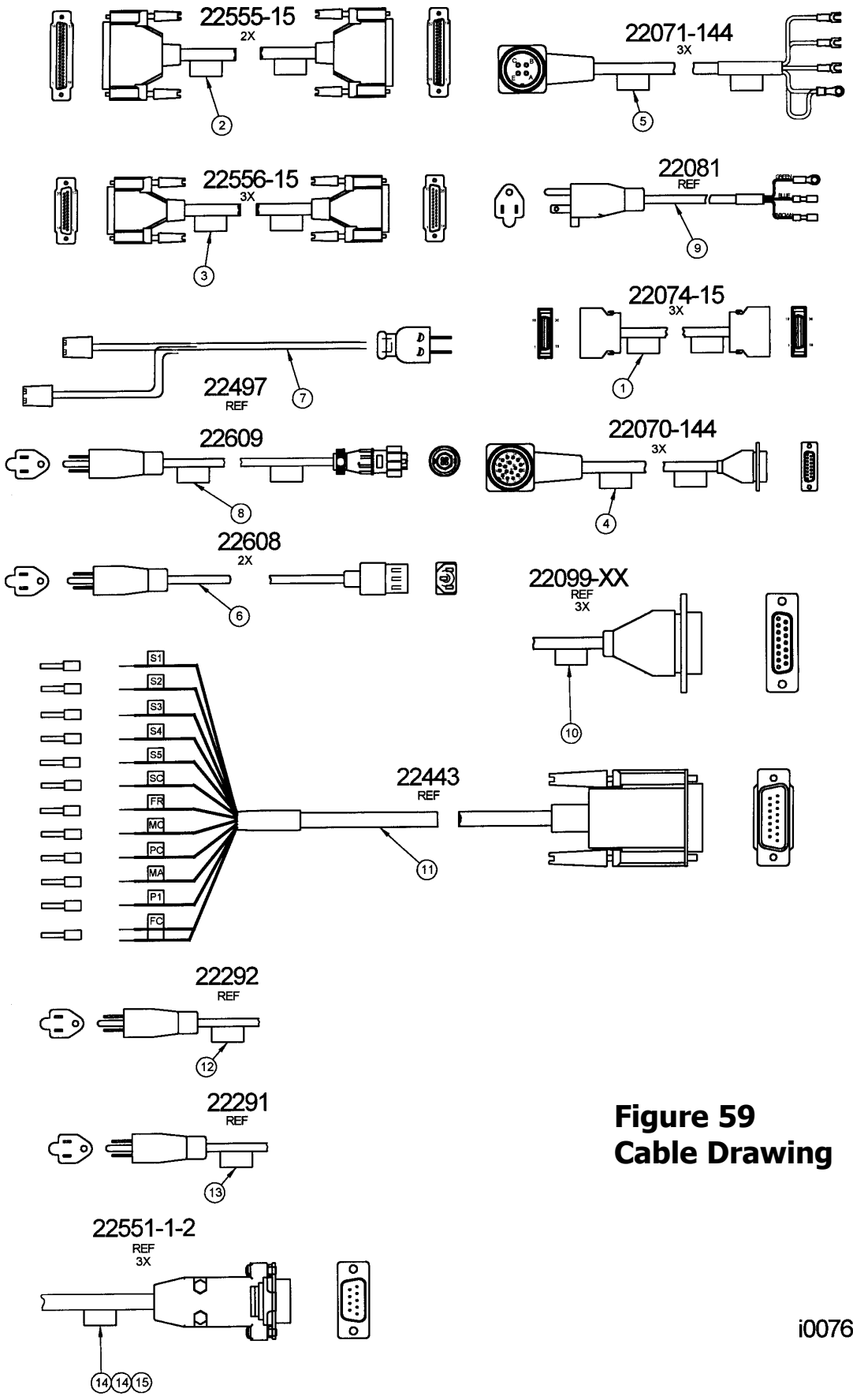


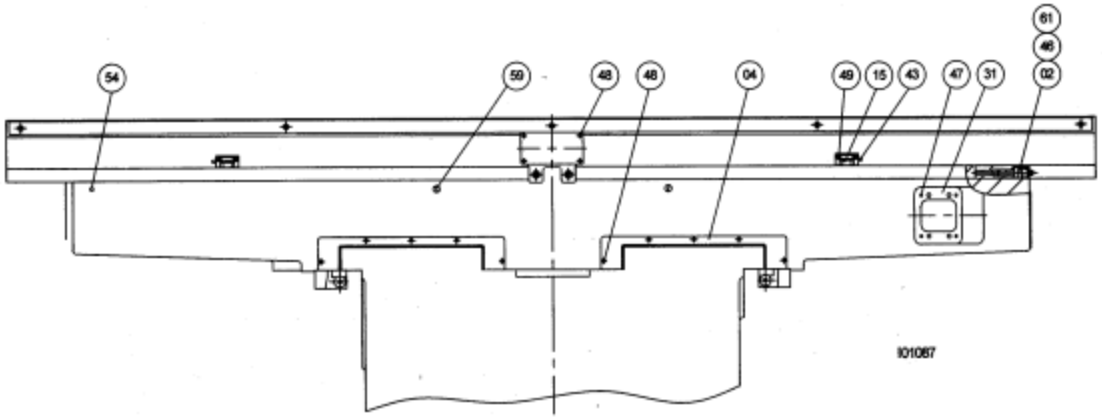
Figure 59
Cable Drawing

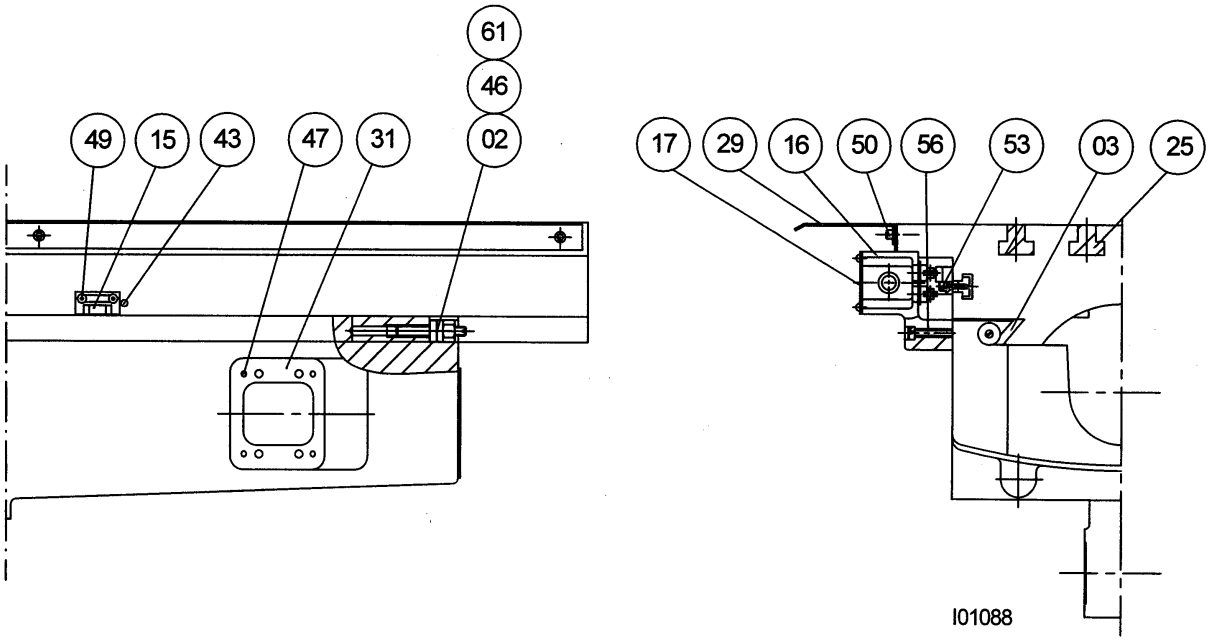
i00762-1

Cable Drawing Parts List

Item	P/N	Description	Qty
1	22074-15	CABLE ASSY-PT4-PENDANT TO SEMI POWER CONTROL	3
2	22555-15	CABLE ASSY-PT4-UMBILICAL EB TO PENDANT	2
3	22556-15	CABLE ASSY-PT4-PARALEL PORT-EB TO PENDANT	3
4	22070-144	CABLE ASSY-PT4 EB TO MOTOR ENCODER	3
5	22071-144	CABLE ASSY-PT4 EB TO MOTOR PWR	3
6	22608	CABLE ASSY-PT4-POWER	2
7	22497	CABLE ASSY-PT4- ELECTRICS BOX FAN	1
8	22609	CABLE ASSY-PT4-MISTER TO AUX	1
9	22081	CABLE ASSY-PT4-EB TO SPINDLE FAN	1
10	22099-144	CABLE ASSY-PT4-EB TO EHW	3
11	22443	CABLE ASSY-PT4 VL/VM 15 PIN SPINDLE CONTROL	1
12	22292-2	CABLE- COOLANT PUMP	1
13	22291-2	CABLE- LUBE PUMP	1
14	22551-1	LIMIT SWITCH ASSY-PT4-RIGHT	2
15	22551-2	LIMIT SWITCH ASSY-PT4-LEFT	1

Figure 60
DPMV7 Table & Saddle





DPMV7 Table & Saddle Parts List

NO	PART NUMBER	DESCRIPTION	QTY
1	24518	SCREW - GIB ADJUSTING	3
2	24549	SCREW - GIB	2
3	24507	GIB – X AXIS	1
4	24521	WIPER – WAY	4
5	24508	GIB – Y AXIS SIDE	1
6	H-034-14B	SADDLE	1
7	H-042-8	COVER – PLATES (SMALL) - CHIP GUARD	1
8	H-043-8	COVER – PLATES (LARGE) - CHIP GUARD	1
9	H-044-8	COVER – PLATES (MIDDLE) - CHIP GUARD	1
10	H-067-9C	BASE – MACHINE	1
11	H-106-8	SEAT – GIB (LEFT)	1
12	H-107-8	SEAT – GIB (RIGHT)	1
13	24509	GIB – Y AXIS BOTTOM	2
14	H-120-6	COVER	1
15	H-122-6	STOP	2
16	24514	SWITCH – LIMIT	2
17	H-124-7A	COVER	1
18	24505	COVER – WAY -TABLE	2
19	HT-011-8B	BRACKET - RIGHT BEARING	1
20	HT-012-8B	BRACKET - LEFT BEARING	1
21	24500	BALLSCREW – X AXIS	1
22	HT-022-8	BRACKET – FEED NUT	1
23	HT-022-8B	BRACKET - CROSS SCREW	1
24	HT-029-14	TABLE	1
25	HT-032	PLUNGER –RUBBER	8
26	HT-040-7	COVER - BEARING	1
27	HT-041-6	SLEEVE – LOCKING	1
28	24545	PULLEY – X AXIS	1
29	HT-090-8B	COVER	1
30	HT-098-8	COVER	1
31	HT-157-8	BRACKET – HANDWHEEL	1
32	HT-166-8	BUSHING	1
33	HT-167	SEAL – OIL	1
34	HT-181	SEAL – OIL	1
35	HX-002	BUSHING	1
36	21994	MOTOR	1
37	635-5M-15	BELT	1
38			
39	24513	BEARING SET - ANGULAR CONTACT	1
40	24514	BEARING – BALL 6305ZZ	1
41			

NO	PART NUMBER	DESCRIPTION	QTY
42	24546	KEY: 5x5x20	1
43	AKP205030	PIN: Ø5x30	6
44	24515	NUT - LOCKING: M25x1.5	2
45	ANI11858	NUT:5/8"-18NF	1
46	ANI118516	NUT:5/16"-18NC	2
47	ASM206010	SCREW:M6x1.0x15L	4
48	ASI231612	SCREW:3/16"-24NC-1/2"L	32
49	ASI231658	SCREW:3/16”-24NC-5/8”L	4
50	ASI61412	SCREW:1/4"-20NC-1/2"L	5
51	ASI61458	SCREW:1/4"-20NC-5/8"L	3
52	ASI61434	SCREW:1/4"-20NC-3/4"L	3
53	ASI61478	SCREW:1/4"-20NC-7/8"L	4
54	ASI651634	SCREW:5/16"-18NC-3/4"L	8
55	ASI65161	SCREW:5/16"-18NC-1"L	4
56	ASI6516134	SCREW:5/16"-18NC-1 3/4"L	2
57	ASI6381	SCREW:3/8"-16NC-1"L	12
58	ASI638178	SCREW:3/8"-16NC-1 7/8"L	4
59	ASI6121	SCREW:1/2"-12NC-1"L	2
60	ASI612112	SCREW:1/2"-12NC-1 1/2"L	8
61	AWIH01516	WASHER:5/16"-18NC	2
62	AWIH0158	WASHER:5/8"-18NF	1
63	24548	WASHER:M25x1.5	1

Figure 61
DPMV7 Bed

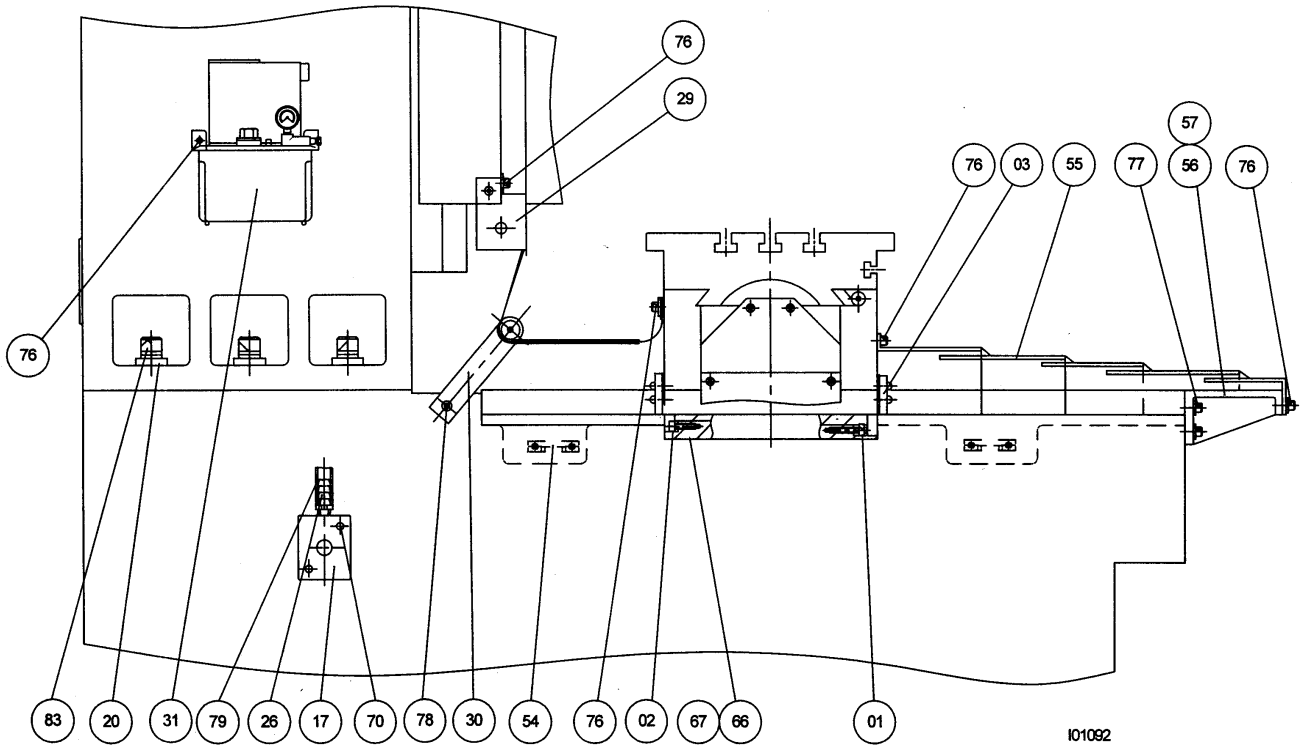
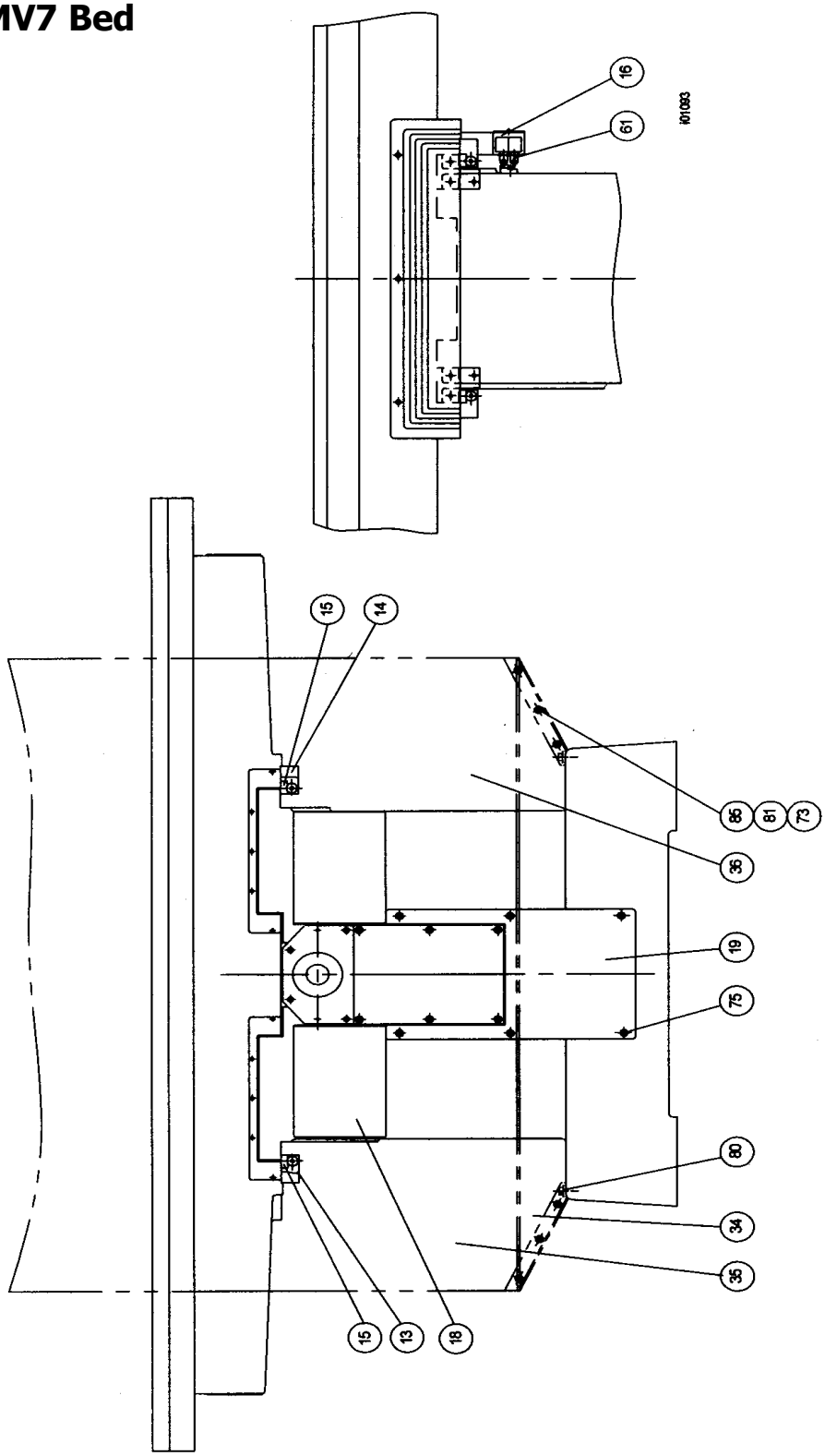


Figure 61a
DPMV7 Bed



DPMV7 Bed Parts List

NO	PART NUMBER		QTY
1			
2	H-026-B	SCREW	3
3	H-029-8A	PLATE - ALUMINUM	4
4			
5	H-034-14B	SADDLE	1
6			
7	H-060	COVER - BEARING	1
8	H-067-8	BODY - MACHINE	1
9	H-067-9C	BASE - MACHINE	1
10	H-075	HOLDER - COOLANT NOZZLE	1
11	24524	SCREW – LEVELING	6
12	H-103	BLOCK - ADJUSTING	6
13	H-106-8	SEAT – GIB (LEFT)	1
14	H-107-8	SEAT – GIB (RIGHT)	1
15	H-108-3	GIB	3
16	H-124-7B	BOX - LIMIT SWITCH	1
17	H-165-8	PIPE – CONNECTION	1
18	H-166-8C	COVER	2
19	H-166-14B	COVER - FRONT	1
20	H-170-8	WASHER	6
21	H-172-9	COVER	1
22	H-173-8B	COVER	1
23	H-237-8	COVER	1
24	H-237-9	COVER	1
25	H-239-10	NETWORK – OIL	2
26	H-254	NETWORK - OIL	5
27	23265	PUMP - COOLANT	1
28	H-259	PLUG - COOLANT	1
29	24506	COVER – WAY – Y AXIS REAR	1
30	H-263-10	BRACKET - UP-DOWN CHIP GUARD	1
31	22291-1	PUMP - LUBRICATION	1
32	H-267-10	TEFLON (L)	1
33	H-268-10	TEFLON (R)	1
34	H-279-8	GUARD	1
35	H-280-8	PLATE (L) – FIXED	1
36	H-281-8	PLATE(R) – FIXED	1
37			
38			
39			
40			
41	HT-022-8	BRACKET – FEED NUT	1
42	HT-022-8B	HOLDER - BALL SCREW	1
NO	**PART NUMBER**		**QTY**

43	24501	BALLSCREW – Y-AXIS	1
44	HT-028-7A	BRACKET – BEARING – CROSS FEED	1
45	HT-028-8B	BRACKET – BEARING – CROSS FEED	1
46	HT-029-14	TABLE	1
47	HT-041-8	BUSHING	1
48	24544	PULLEY – Y AXIS	1
49	HT-077-7	BLOCK – BEARING	1
50	HT-078-7	COVER - BEARING	1
51	HT-096-8A	COVER	1
52	HT-142-8A	COVER	1
53	24519	NUT – LOCKING	2
54	HX-046	STOP - LIMIT SWITCH	2
55	24504	COVER – WAY – Y AXIS FRONT	1
56	HY-066-8	REST – FOOT	1
57	HY-066-8A	REST – FOOT	1
58	HY-073-8	BRACKET – BEARING BALL SCREW	1
59	HY-083-9	BUSHING	2
60			
61	24514	SWITCH - LIMIT	1
62	21994	MOTOR	1
63			
64	670-5M-15	BELT	1
65	6204ZZ	BEARING-BALL:6204ZZ	2
66	24513	BEARING SET - ANGULAR CONTACT	1
67			
68	24546	KEY:5x5x20	2
69	AK0505022	KEY:5x5x22	1
70	AKP138	PIPE:3/8"	2
71	AKP212	PIPE:1/2"	2
72	24515	NUT – LOCKING:M25x1.5	2
73	24547	NUT:3/4"-10NC	6
74	ASM105010	SCREW:M5x0.8x10L	5
75	ASI231638	SCREW:3/16"-24NC-3/8'L	26
76	ASI61458	SCREW:1/4"-20NC-5/8"L	29
77	ASI61434	SCREW:1/4"-20NC-3/4"L	10
78	ASI614158	SCREW:1/4"-20NC-1 5/8"L	2
79	ASI614134	SCREW:1/4"-20NC-1 3/4"L	2
80	ASI651612	SCREW:5/16"-18NC-1/2'L	4
81	ASI651634	SCREW:5/16"-18NC-3/4"L	14
82	ASI65161	SCREW:5/16"-18NC-1"L	6
83	ASI678312	SCREW:7/8"-9NC-3 1/2"L	6
84	AWIH0114	WASHER:1/4"	1
85	AWIH01516	WASHER: 5/16"	18

Figures 62a through 62d
DPMV7 Column Parts

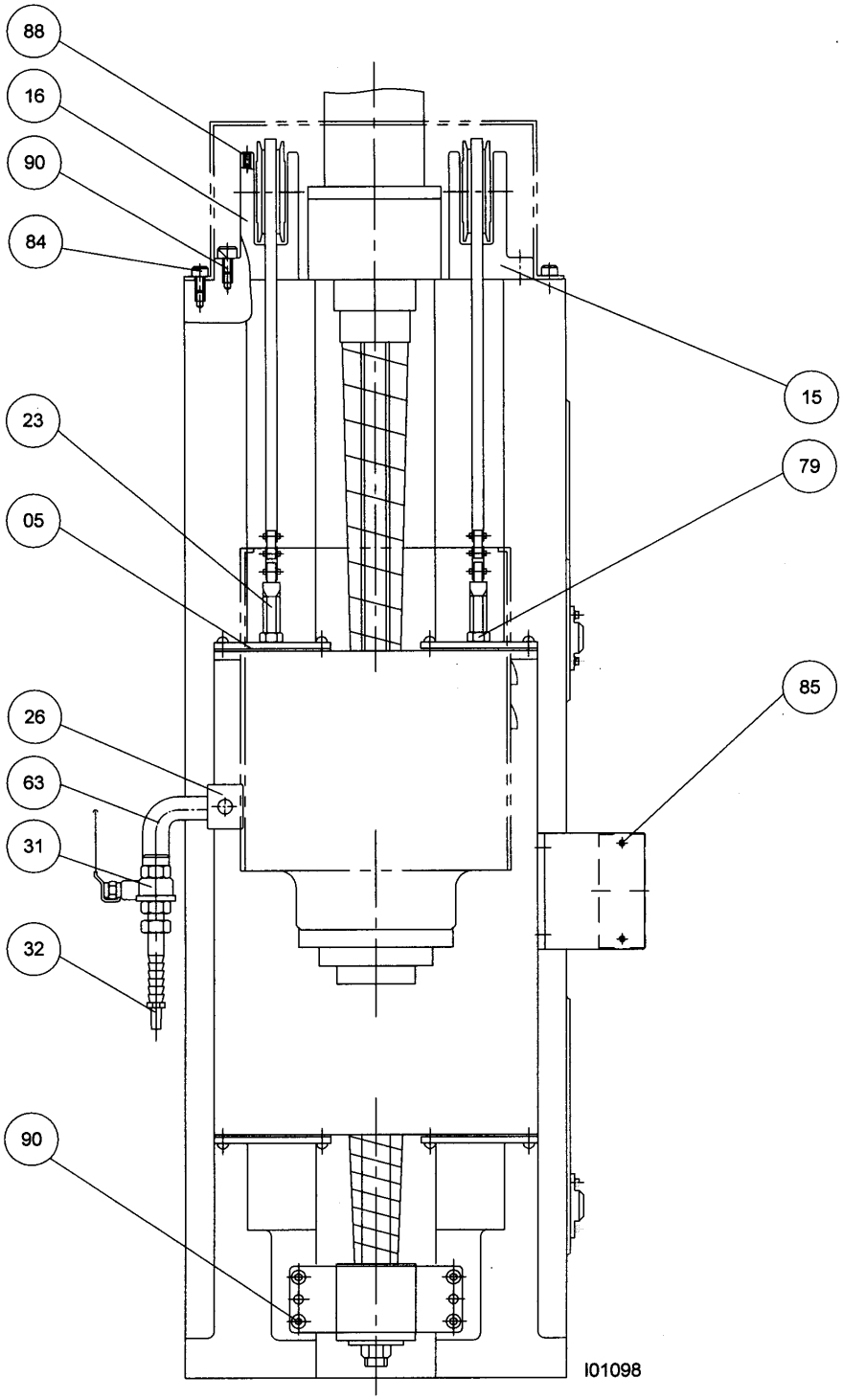


Figure 62a

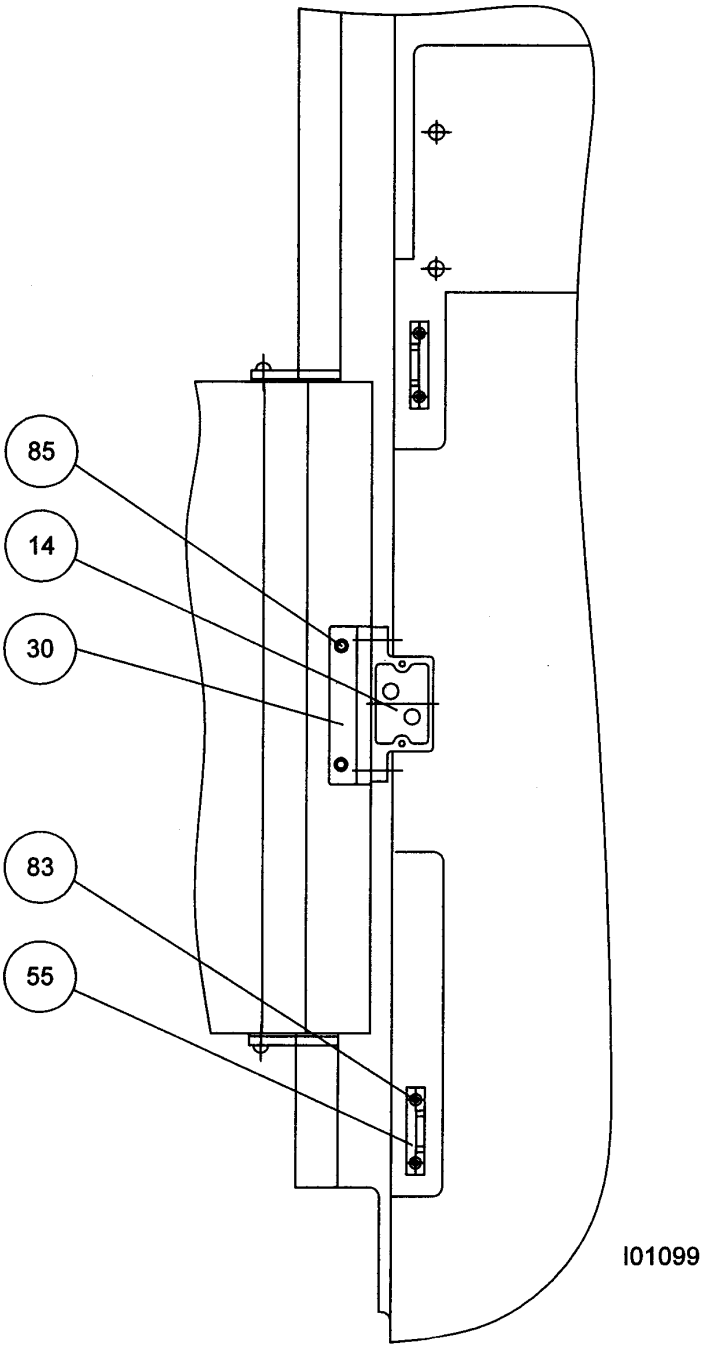


Figure 62b

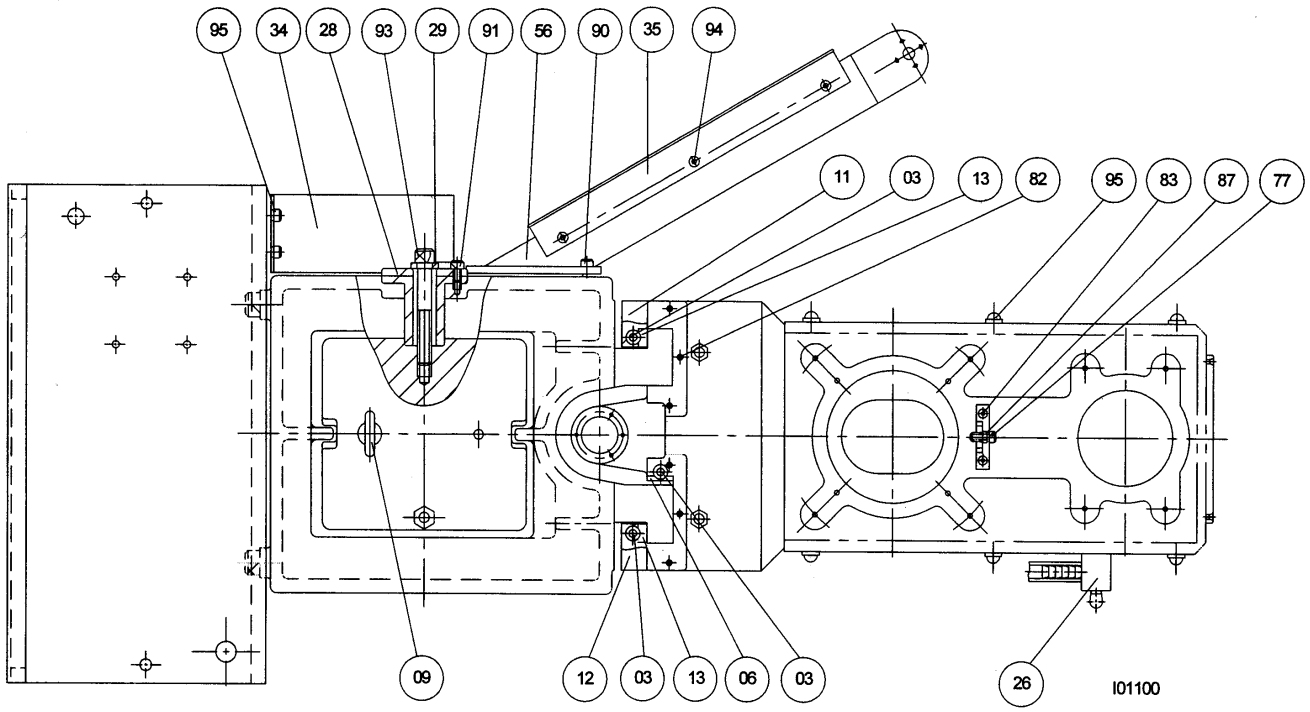

95
34
28
93
29
91
56
90
35
94
11
03
13
82
95
83
87
77
09
12
03
13
06
03
26
I01100

Figure 62c

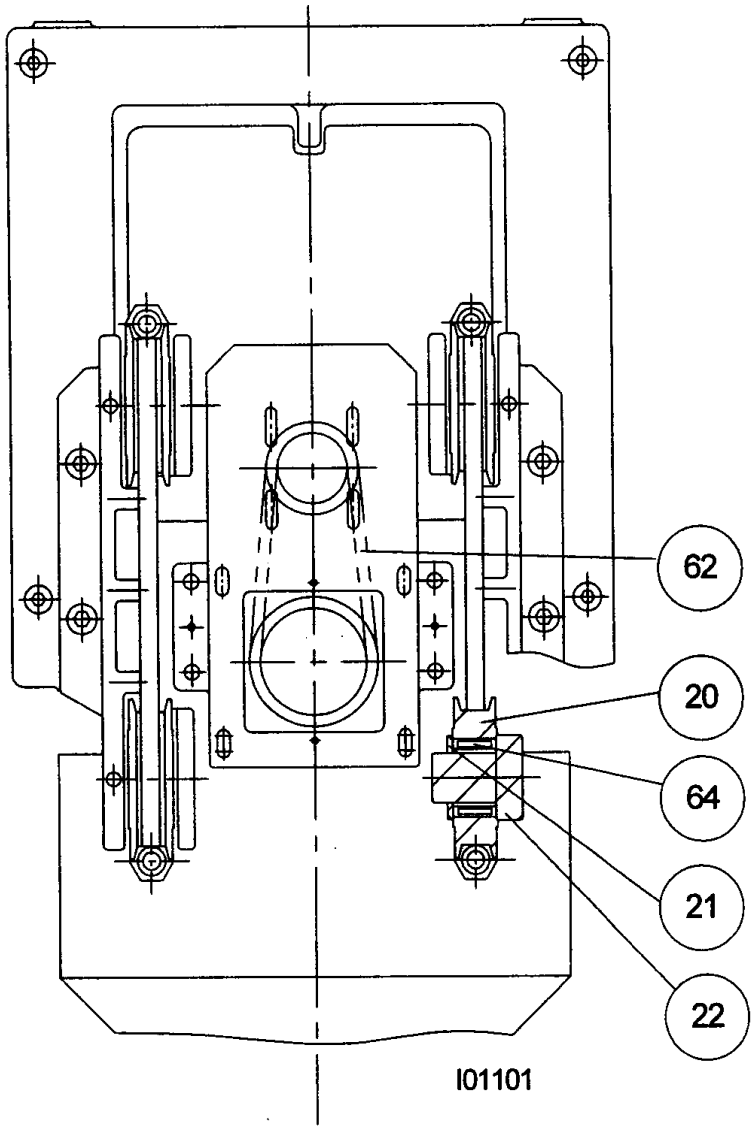


Figure 62d

Z-AXIS DRIVE TRAIN Parts List – DPMV7

Item	P/N	DESCRIPTION	Qty
1	760-5A	COVER - FIXED	1
2	24527	MOTOR – SPINDLE	1
3	24518	SCREW - GIB	3
4	H-026-B	SCREW	3
5	H-035-8	PLATE - ALUMINUM	4
6	24510	GIB – Z AXIS SIDE	1
7	H-045-14C	KNEE	1

8	H-067-8	BODY – MACHINE	1
9	H-077-3	SCREW	1
10	24502	BALLSCREW – Z AXIS	1
11	H-109-12	SEAT – GIB	1
12	H-110-12	SEAT - GIB	1
13	24511	GIB – Z AXIS REAR	2
14	H-124-5	HOLDER - MICRO SWITCH	1
15	H-139-8	BRACKET(R)-ROLLER'S	1
16	H-139-8A	BRACKET (L)- ROLLER'S	1
17	H-140-10	HOLDER FIXED MOTOR	1
18	H-140-10B	HOLDER - FIXED	1
19	24542	PULLEY – Z AXIS	1
20	H-145-8	ROLLER	4
21	H-146-8	SPACER	4
22	H-147-8	SHAFT - DRIVE	4
23	H-148-8	SCREW	4
24	H-149-8A	WEIGHT - BALANCE	1
25	H-160-9	BRACKET – BEARING	1
26	H-165-8	HOLDER - COOLANT NOZZLE	2
27	H-167-10B	COVER – TOP	1
28	H-168-8	HOLDER - BALANCE WEIGHT	1
29	H-170-8	WASHER	1
30	H-171-8	HOLDER - MICRO SWITCH	1
31	24550	VALVE	1
32	24551	COOLANT NOZZLE	1
33	H-310-8	COVER	1
34	H-331-8	BRACKET – ARM	1
35	H-332-14	COVER – ARM	1
36	HB-127-B	BRACKET	2
37	24531	SPINDLE	1
38	24536	COVER - FRONT BEARING	1
39	HB-134-10	BUSHING - BEARING	1
40	24560	SPACER – OUTER	1
41	24561	SPACER – INNER	1
42	24532	QUILL – FLANGE	1
43	24529	PULLEY – SPINDLE	1
44	24527	PULLEY - MOTOR	1
45	HB-199-10	SPACER	1
46	HB-200-10	SPACER	1
47	HB-201-13	SPACER	1
48	HT-067-14A	CABINET - ELECTRIC CONTROL	1
49	HX-002-10	BUSHING – BEARING	3
50	HX-007	COVER – BEARING	1
51	HX-007-9	COVER – BEARING	1
52	HX-028-10	SUPPORT - DUST HELMET	2
53	HX-030-10	SUPPORT - DUST HELMET	2
54	24523	COVER – EXPANSION – BALLSCREW	2
55	HX-046	STOP -LIMIT SWITCH	2
56	HY-043-14	ARM	1
57	24556	SPACER – BEARING – INNER	1

58	24557	SPACER – BEARING – OUTER	1
59			
60			
61	24553	BELT SET – SPINDLE – 5PK940	2
62	425-5M-15	BELT	1
63	24558	90° ELBOW	1
64	24555	BEARING TA3025	4
65	24513	BEARING SET - ANGULAR CONTACT	1
66	24554	BEARING SET – ANGULAR CONTACT	1
67	24512	BEARING - BALL:6305ZZ	1
68	24541	BEARING SET- ANGULAR CONTACT	1
69	24543	KEY:5x5x25	1
70	24530	KEY:8x7x50	1
71	24528	KEY:10x8x35	1
72	24520	NUT:YSF M25x1.5	1
73	24515	NUT:M25x1.5	1
74	24533	NUT:M35x1.5	1
75	24534	NUT – OIL:M40x1.5	1
76	24535	NUT - OIL:M50x1.5	1
77	ANI12014	NUT:1/4"-20NC	1
78	ANI11858	NUT:5/8"-18NC	1
79	ANI11034	NUT:3/4"-10NC	4
80	AOS255211	SEAL – OIL:25x52x11	1
81	AOS385216	SEAL - OIL:38x52x16	1
82	ASI631612	SCREW:3/16"-24NC-1/2"L	24
83	ASI631658	SCREW:3/16"-24NC-5/8"L	6
84	ASI61412	SCREW:1/4"-20NC-1/2"L	4
85	ASI61458	SCREW:1/4"-20NC-5/8"L	7
86	ASI61434	SCREW:1/4"-20NC-3/4"L	6
87	ASI6141	SCREW:1/4"-20NC-1"L	1
88	ASI351678	SCREW:5/16"-18NC-7/8"L	4
89	ASI65161	SCREW:5/16"-18NC-1"L	6
90	ASI6381	SCREW:3/8"-16NC-1"L	20
91	ASI638112	SCREW:3/8"-16NC-1 1/2"L	9
92	ASI612114	SCREW:1/2"-12NC-1 1/4"L	4
93	ASI6345	SCREW:3/4"-10NC-5"L	1
94	ASM305012	SCREW:M5x0.8x12L	8
95	ASM106012	SCREW:M6x1.0x12L	15
96	ASM106020	SCREW:M6x1.0x20L	3
97	AWIH0138	WASHER:3/8"	6
98	AWIH0158	WASHER:5/8"	1
99	24537	SPINDLE ASSEMBLY – MADE UP OF ITEMS 38, 68,87.37,76,75,39,36,40,41,47,66,58 & 57.	1

i01094.doc

Southwestern Industries, Inc

TRAK Warranty Policy

Warranty

TRAK products are warranted to the original purchaser to be free from defects in work-manship and materials for the following periods:

Product	Warranty Period	
	Materials	Factory Labor
New TRAK	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 unit under warranty fails, 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 measurement systems and must be given the reasonable care that these types of instruments require:
- Replacement of chip scrapers and wipers is the responsibility of the customer. Consequently, the warranty does not apply if chips have been allowed to enter the mechanism.
- Accidental damage, beyond the control of SWI, is not covered by the warranty. Thus, the warranty does not apply if an instrument has been abused, dropped, hit, disassembled or opened.
- 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.