# TRAK® TRL 1540V, 1840V, & 2460V Lathes

## Safety, Installation, Maintenance Service & Parts List Manual

## Service Manual for Non-Current Lathe Products

Document: P/N 24970
Version: 062211

**Covering Machine Models:**

- TRAK TRL 1540V
- TRAK TRL 1840V
- TRAK TRL 2460V

**Covering Non-current Control Models:**

- ProtoTRAK VL

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# 1.0 Safety Specifications

The safe operation of the TRAK TRL 1540V, 1840V, and 2460V lathe depends on proper use and the precautions taken by each operator.

- Read and study the machine's corresponding Safety, Programming, Operating, and Care Manual. Be certain that every operator understands the operation and safety requirements of this machine ***before*** its use.
- Read and study the TRAK TRL 1540V, 1840V, 2460V Safety, Installation, Maintenance, Service & Parts List Manual. Be certain that every operator understands the operation and safety requirements of this machine ***before*** servicing.
- 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 ANSI B11.6-2001.

## 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 Turning Machines with or without Automatic Control (ANSI B11.6-2001). 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.**

All other regulations specific to the State in which the machine is installed.

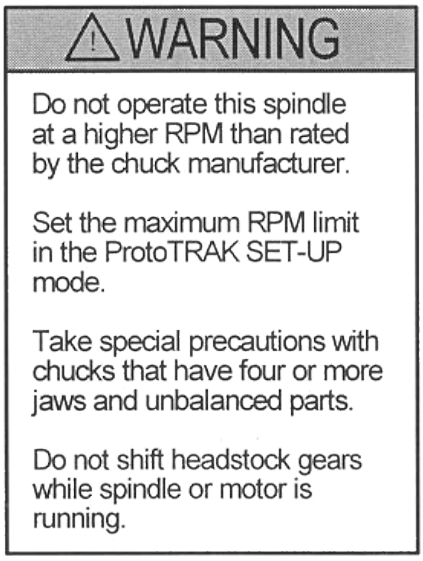
## 1.2 Danger, Warning, Caution, and Note Labels and Notices As Used In This Manual

**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 gold in color.

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

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

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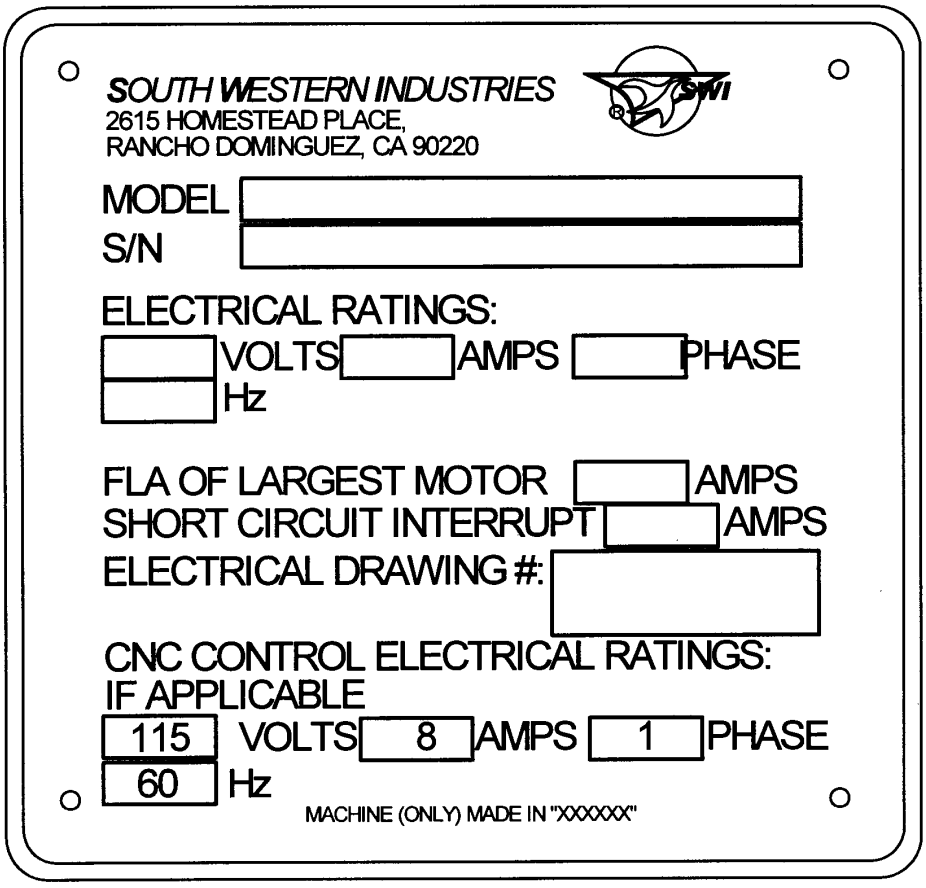
# 220 Volts

## Safety & Information Labels Used On The TRAK TRL 1540V, 1840V & 2460V Lathe

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

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# Safety & Information Labels Used On The TRAK TRL 1540V, 1840V, & 2460V Lathe

*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** |
| 1540V | 47 | 33 |
| 1840V | 36 | 33 |
| 2460V | 59 | 45 |

## 1.3 Safety Precautions

| WARNING!<br>Use only chucks that are rated to the maximum RPM of the lathe. |
|---|

1. Do not operate this machine before the machines' corresponding Programming, Operating and Care Manuals have been studied and understood.
2. Read and study this TRAK TRL V Safety, Installation, Maintenance, Service & Parts List Manual. Be certain that every operator understands the operation and safety requirements of this machine ***before*** servicing.
3. Do not run the machine without knowing the function of every control key, button, knob, or handle. Ask your supervisor or a qualified instructor for help when needed.
4. Protect your eyes. Wear approved safety glasses (with side shields) at all times.
5. Don't get caught in moving parts. Before operating the machine, remove all jewelry, including watches and rings, neckties, and any loose-fitting clothing.
6. Keep your hair away from moving parts. Wear adequate safety headgear.
7. Protect your feet. Wear safety shoes with oil-resistant, anti-skid soles, and steel toes.
8. Take off gloves before you start the machine. Gloves are easily caught in moving parts.
9. Remove all tools (wrenches, chuck keys, etc.) from the machine before you start. Loose items can become dangerous flying projectiles.
10. Never operate any machine tool after consuming alcoholic beverages, or taking strong medications, or while using non-prescription drugs.
11. 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, chuck, coolant nozzle or take measurements
    - Before you open safeguards (protective shields, etc.). Never reach for the part, tool, or fixture around a safeguard.
12. 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.).
13. Stop and disconnect the power to the machine before you change belts, pulley, gears, etc.
14. Keep work area well lighted. Ask for additional light if needed.
15. Do not lean on the machine while it is running.
16. Prevent slippage. Keep the work area dry and clean. Remove the chips, oil, coolant and obstacles of any kind around the machine.
17. Avoid getting pinched in places where the spindle, carriage, cross slide or sliding door create "pinch points" while in motion.
18. Securely clamp and properly locate the workpiece in the chuck or in the fixture. Use proper tool holding equipment.

19. Use correct cutting parameters (speed, feed, and depth of cut) in order to prevent tool breakage.
20. Use proper cutting tools for the job.
21. 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.
22. Don't use dull or damaged cutting tools. They break easily and may become airborne. Inspect the sharpness of the edges, and the integrity of cutting tools and their holders.
23. Large overhangs 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 your supervisor before machining these materials.
25. Prevent fires. Keep flammable materials and fluids away from the machine and hot, flying chips.
26. Never change gears when the spindle is rotating.
27. Do not rotate the spindle by hand unless the Red Emergency Stop button is pressed.

# 2.0 Installation

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

## 2.1 Floor Plan, Layout & Space Requirements – 1540V, 1840V, & 2460V

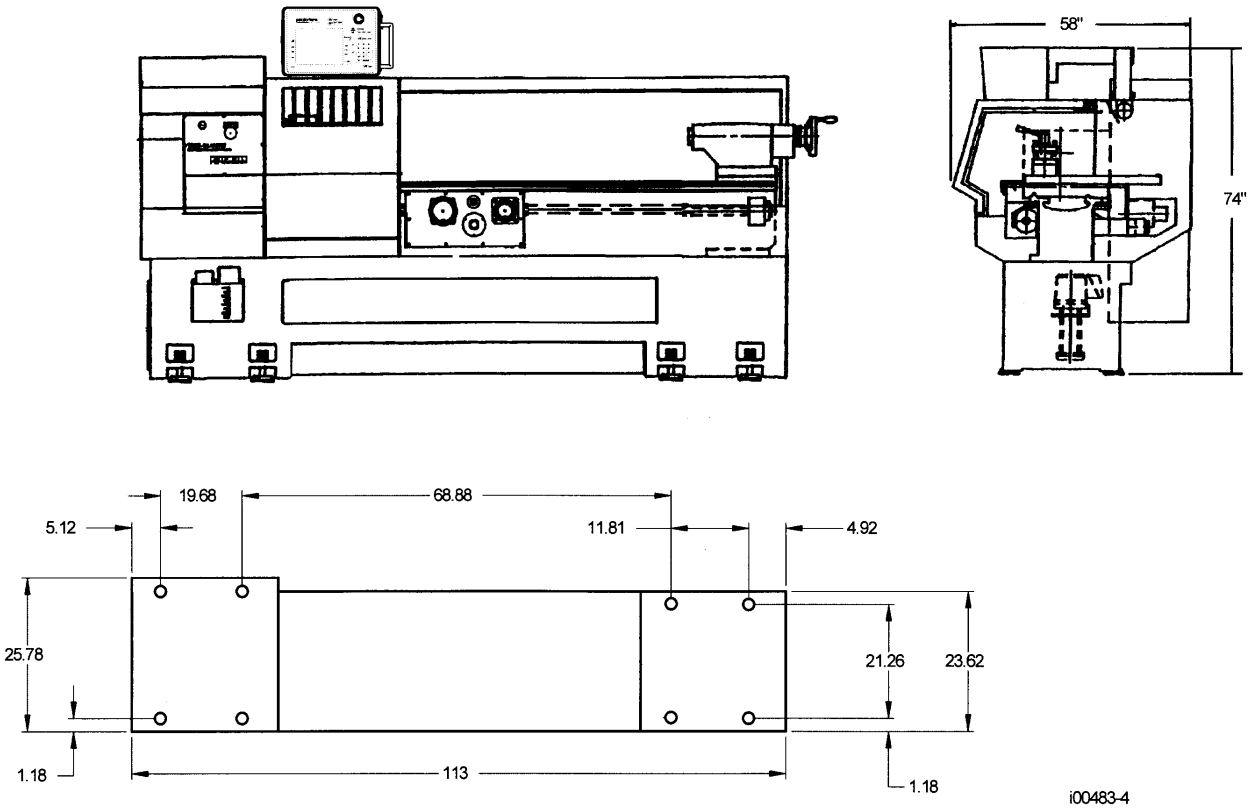


**Figure 2-1**
**2460 V Lathe**

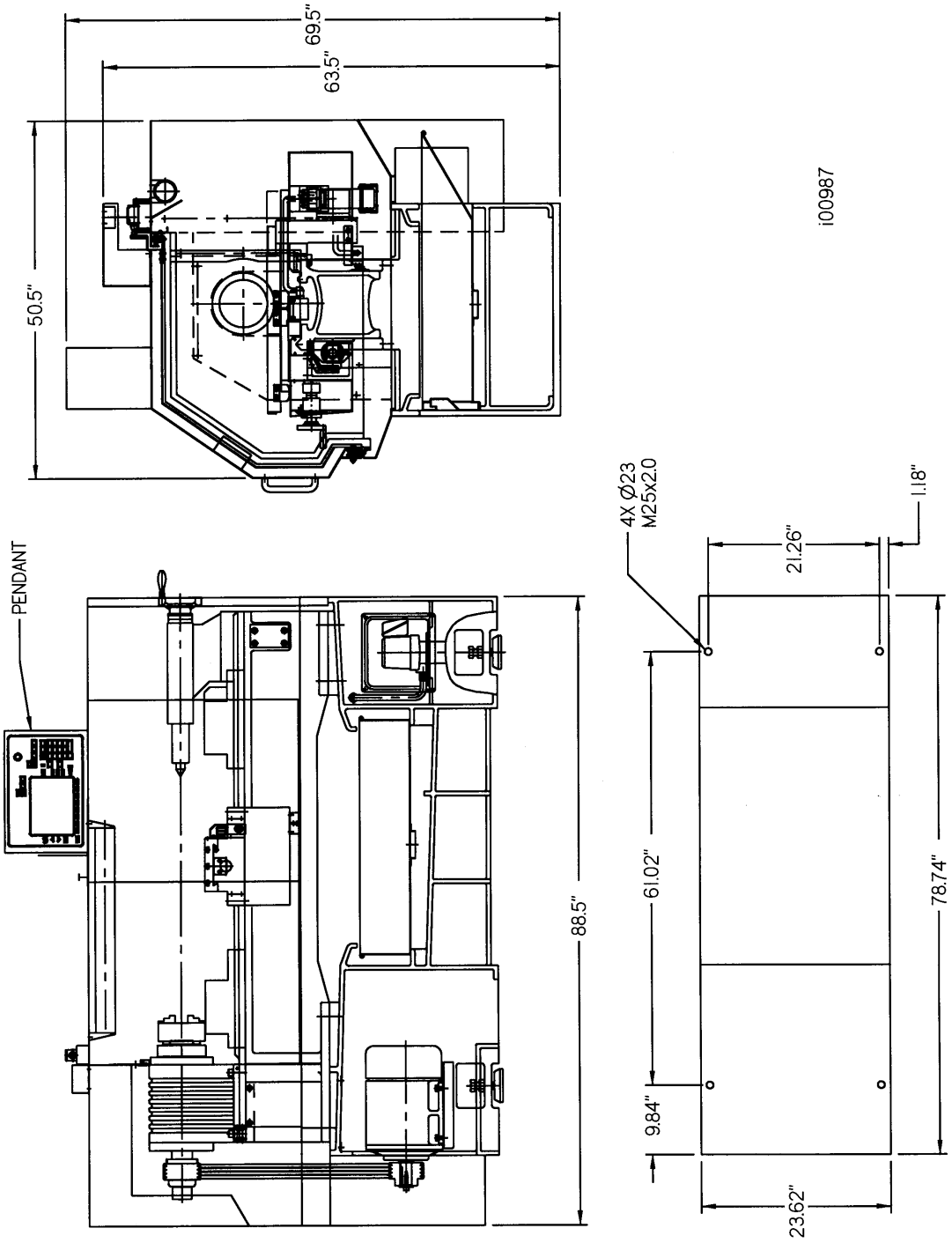


**Figure 2-2**
**1540V Lathe**

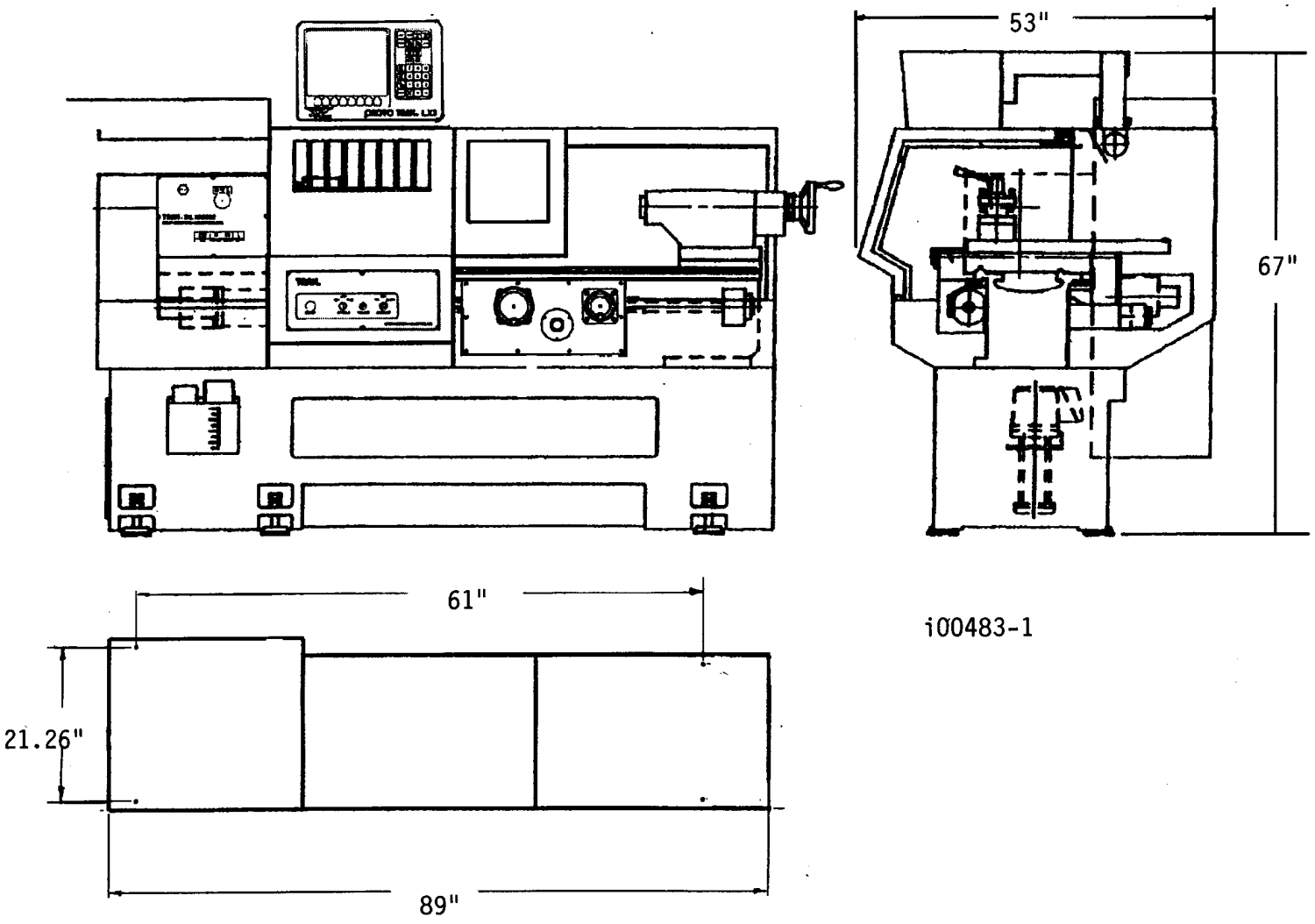


**Figure 2-3**
**1840V Lathe**

## 2.2 Lathe Specifications

| Capacity | 1540V | 1840V | 2460V |
|---|---|---|---|
| Height of Centers | 8” | 9” | 11.5” |
| Distance Between Centers | 40” | 40 ¼” | 60” |
| Swing Over Bed | 15” | 18 ½” | 24” |
| Swing Over Saddle Wings | 15” | 17” | 24” |
| Swing Over Cross Slide | 6 5/8” | 9” | 14.5” |
| Cross Slide Travel | 11 ½” | 13” | 12.5” |
| Tool Section Max. | ¾” | 1” | 1 ¼” |
| Coolant | 12 gal. | 13 gal. | 15 gal. |
| Oil Pump – Way Lubrication | 2 liter | 2 liter | 2 liter |
| Oil Reservoir – Headstock | None | 3.5 gal. | 3 gal. |
| **Bed** | | | |
| Width | 12 5/8” | 14 ½” | 15.75” |
| Height | 12 5/8” | 13 3/8” | 12 5/8” |
| **Headstock** | | | |

| | | | |
|---|---|---|---|
| Spindle Nose | A2-5 | D1-6 | D1-8 |
| Spindle Through Hole | 2 1/8" | 2.36" | 4.09" |
| Spindle Taper | MT #6 | MT #6 | MT #8 |
| Taper in Reduction Sleeve | MT #4 | MT #4 | MT #5 |
| Spindle Diameter Front Bearing | 3.15" | 3.35" | 5.51" |
| Number of Bearings | 5 | 3 | 2 |
| Bearing Class (Radial Runout) | P2 (ABEC 9) | P5 | P5 |
| Number of Spindle Speed Ranges | 1 | 2 | 2 |
| Spindle Speed Range (RPM) | 150–4000 | 80–850, 250-2500 | 40-670, 100-1800 |
| ID Thread on End of Spindle | N/A | M62 X 2MM Pitch | M106.5 X 1.5MM Pitch |
| **Tailstock** | | | |
| Quill Travel | 6 ½" | 6 ¼" | 12" 2 speed |
| Quill Diameter | 2 3/8" | 2.95" | 3.5" |
| Quill Taper Hole | MT #4 | MT #5 | MT #5 |
| **Spindle Motor** | | | |
| H.P. | 10 | 10 | 15 |
| Voltage | 220 | 220 | 220 |
| Amps, Full Load | 47 | 36 | 59 |
| Phase, Hz | 3/60 | 3/60 | 3/60 |
| **Dimensions** | | | |
| Net Inches L x W x H lbs. | 89 x 53 x 70, 4100 | 91 x 53 x 70, 4500 | 113 x 58 x 74, 7300 |
| Ship Inches L x W x H lbs. | 90 x 55 x 73, 4650 | 97 x 58 x 72, 5170 | 117 x 59 x 77, 8000 |
| **Other** | | | |
| Coolant Pump Motor, H.P. | 1/8 | 1/8 | 1/8 |
| Spindle Motor Brake | Dynamic Braking | | |
| Way Surface Hardness | 400 – 450 HB | | |
| Headstock Lubrication | *Grease | Oil Bath | Oil Bath |
| **Options** | | | |
| Tooling Kit | ¾" | ¾" | ¾" or 1" |
| Chuck | 6", A2-5 | 8", D1-6 | 12", D1-8 |
| 5C Collet Closer | A2-5 | D Camlock | n/a |
| Indexer Option | ¾", 8 Position<br>¾", 4 position | ¾", 8 Position<br>¾", 4 Position | 1", 8 position<br>1", 4 position |
| Gang Tooling | ¾" | ¾" | n/a |

* No maintenance grease cartridge

## 2.3 Uncrating

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

Remove the cardboard boxes with the PENDANT DISPLAY (handle carefully). The leveling pads and screws for the machine can be found in the toolbox.

Loosen and remove 4 screws for the 1540, 6 screws for the 1840V, and 8 screws for the 2460V and the nuts holding the machine to the wood pallet.

**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.

## 2.4 Shortages: Inventory Checklist

_____Machine (check model and serial number)

_____ Leveling pads and screws (4 each for 1540V, 6 each for the 1840V, and 8 each for 2460V)

_____ Pendant Display – 22328-2

_____ Pendant Cable Cover (22401)

_____ Toolbox with various tools

_____ 1540V, 1840V, & 2460V Safety, Operation & Programming Manual (P/N 24492)

_____ 1540V, 1840V, & 2460V Safety, Installation, Maintenance, Service & Parts List Manual (P/N 24970)

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

## 2.5 Installation Instructions & Checklist

Installer: Use this checklist to assure a complete set-up of the 1540V, 1840V or 2460V.

| | | |
|---|---|---|
| ☐ | 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. | Mount the pendant on top of the sliding door. Make sure the pendant swivels and slides easily. |
| ☐ | 5. | Make and check all the proper electrical connections from the pendant to the electric box. See the pendant and electric box wiring diagrams. Be sure to mount the cable cover to the left side of the pendant along with the servo cable bracket to ensure the cables stay in place. Note: the servo drive cables plug into the top and bottom connector, the middle connector is not used on the lathe 1540V, 1840V, & 2460V |
| ☐ | 6. | Slide the door or doors back and forth to make sure it slides smoothly. |
| ☐ | 7. | Remove the protective plastic covers from the headstock and the windows on the sliding doors. |
| ☐ | 8. | 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 4.6.6 for instructions. |
| ☐ | 9. | Perform motor alignment routine. Press Check System key on boot up screen. It can also be accessed through Service Code 203 for the 1540V and 1840V and code 204 for the 2460. This must be done initially before the machine can be moved. Use the handwheels first to move the carriage away from any obstructions. Total movement will be approximately 1" in all directions. See Section 4.4.1. |
| ☐ | 10. | On the 2460 verify oil is reaching the site glass. Oil is only flowing when the spindle is on. Also make sure the coolant pump is rotating in the correct direction. |
| ☐ | 11. | Lubricate all the way surfaces and the ball screws. Under service codes press code 300 to operate the lube pump. |
| ☐ | 12. | Jog the saddle and cross slide back and forth until the way surfaces are well lubricated. Oil should be visible on all the way surfaces. |
| ☐ | 13. | Position the saddle and tailstock to the center of the bed for leveling. |
| ☐ | 14. | Check the level of the machine. The machine should be level to within 0.0008" longitudinally and 0.0005" transversely. Even though it is the responsibility of the customer, make any adjustments if necessary. |
| ☐ | 15. | Check the tailstock and the tailstock barrel locks by locking and unlocking. Run the tailstock barrel in and out to ensure proper function. |
| ☐ | 16. | 1840V & 2460V only – shift the headstock in low and high gear and verify the control recognizes each gear. To run the spindle a maximum RPM must be set in SETUP mode. |
| ☐ | 17. | Open and close the door and verify the door switch is functional. The control should display a message of "DOOR OPEN" in DRO mode when the door is open and it should disappear when the door is closed. |
| ☐ | 18. | Make sure the X and Z electronic handwheels and jogstick are functional. |
| ☐ | 19. | Check to make sure that the E-Stop buttons on the pendant and door for the 1540V and 1840V and pendant and apron for the 2460V are functioning correctly. |
| ☐ | 20. | Perform Service Code 12, Feed Forward Constant. |
| ☐ | 21. | Perform Service Code 123 to calibrate the X and Z-axis using a 150mm standard. |
| ☐ | 22. | Perform Service Code 127 and 128 to manually calculate the backlash for the X and Z-axis. |
| ☐ | 23. | Check for positional accuracy and repeatability on the X and Z-axis using programs X LATHE REPEAT.PT4 and Z LATHE REPEAT.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. Note: the door must be closed to run these programs. |

| | | |
|---|---|---|
| ☐ | 24. | Perform Service Code 100 in both directions for the X and Z-axis to verify that the feed rate shown on the display is at least 300 ipm. |
| ☐ | 25. | On the 2460V and 1840V, run the spindle throughout each gear range at various speeds. On the 1540V, run the spindle at various speeds throughout the 150 to 4000 RPM range. |
| ☐ | 26. | Use accessory key on pendant and make sure the coolant pump turns on. The accessory key should be in the ON position in DRO to test. |
| ☐ | 27. | Check to make sure the limit switches are functioning properly. |
| ☐ | 28. | Cut the test part to check for taper. Measure the test bar and make any machine adjustments. If unacceptable taper is found, re-check the level before attempting to adjust the headstock. |
| ☐ | 29. | Wipe down the machine prior to leaving. |

**CAUTION!**

If the TRAK TRL 1540V has a chuck mounted to the spindle, make sure the chuck is mounted properly to the spindle and also make sure the chuck jaws are engaged onto themselves or a piece of material before running the machine.

If the TRAK TRL 1840V & 2460V has a chuck mounted to the spindle, make sure the cam locks are tight, and the chuck jaws are engaged onto themselves or a piece of material before running the machine.

If the chuck was not purchased from SWI, check to make sure the chuck is rated for the maximum rpm of the machine. If it is not, do not run the machine above the chuck's maximum rated rpm.

If the chuck's rpm rate is unknown, do not run the chuck over 1000 rpm.

The chucks purchased from SWI are rated for the machine's maximum rpm.

## 2.6 ProtoTRAK VL Control Hardware

- 2-axis CNC, 2-axis DRO
- 266 PC-based processor
- 64 MB of RAM
- A.C. Servo Motors rated at 704 in-oz continuous torque for X and Z-axes
- Precision ground ballscrews in the carriage and cross slide 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
- 10 GB minimum hard drive
- Single floppy disk drive for additional part program storage
- Limit switches for the X and Z-axes that are installed to prevent crashes.
- Electronic handwheels on the X and Z-axes.

## 2.7 Lifting and/or Moving the Machine

**CAUTION!**

The 1540V, 1840V, and 2460V machines weigh approximately 4100, 4500, and 7300 lbs. respectively. Proper equipment of sufficient capacity must be used when lifting and/or moving the machine.

To lift the machine, remove the chip pan. Place the forks of the forklift at least 32" apart as shown in the figure below. Be certain to lift the lathe toward the headstock.

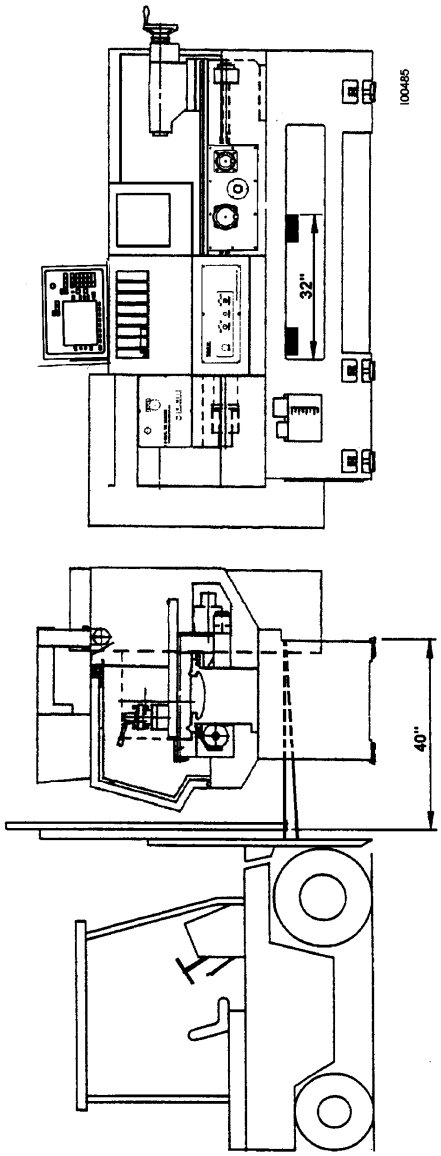


**Figure 2-4**
**Lifting the Lathe – 1540V, 1840V, & 2460V**

Do not attempt to lift this machine with a forklift having less than 10000 lb capacity for the 1540V and 1840V and 15000 lb for the 2460V. The shipping weight of the machine including electronics is 4650, 5170, and 8000 lbs respectively for the 1540V, 1840V, and 2460V.

Do not remove the skid from the machine until it is brought to its final position, especially if the machine is to be moved on rollers.

Once the skid has been removed, place the machine in position on top of the four (4) for rest pads for the 1540V, six (6) rest pads for the 1840V, and eight (8) rest pads for the 2460V.

For proper operation, the machine should be set on a substantial floor capable of supporting the weight safely. For the location of the bolt holes, size, and recommended mounting, see Figures 2-1, 2-2, & 2-3.

## 2.8 Cleaning

1. Remove rust protective coating from the machine before moving any slideways.
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 and left and right the carriage and cross slide.

**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 carriage, cross slide and spindle move freely and smoothly over their entire length.

## 2.9 Leveling

The precision and durability of the lathe depends on it being leveled properly. Final inspection can be done only when the machine has been correctly leveled.

After the machine is in position on top of the 8/6/4 rest pads, it must be leveled by the use of the 8/6/4 leveling bolts. It is important that the lathe be level in order to produce accurate work. It may be necessary to lag bolt the machine in order to eliminate a small amount of twist.

*NOTE: The use of a precision level having a minimum accuracy of .0005" over 10.0" will be required.*

Move the saddle and tailstock to the center of the bed. To take a reading off the level longitudinally, place the level at each of the four (4) corners of the bedways (Figure 2-5, Positions B & C). To take a reading off the level transversely, place it on top of .7500" parallels at each end of the bedways (Figure 2-5, Positions A & D).

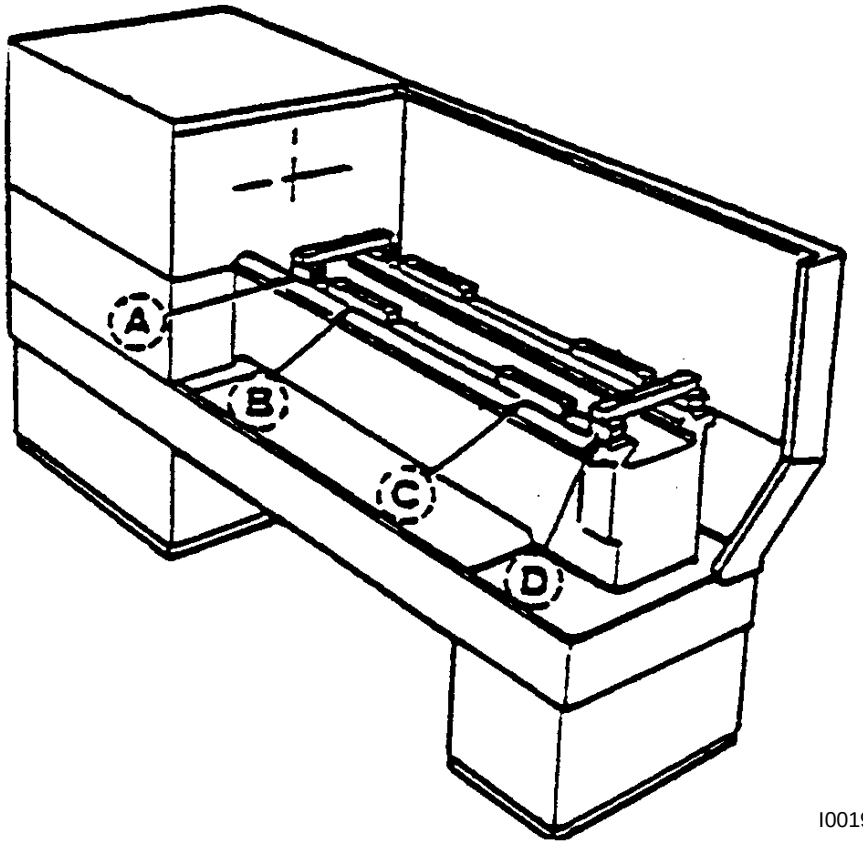


**Figure 2-5**
**Leveling**

Using the four (4) interior leveling screws (see Figure 2-5) on the lathe base, level the bedways longitudinally within .0008" over the total length and transversely within .0005" inches. After leveling with the four (4) interior leveling screws, bring the two (2) exterior leveling screws (see Figures 2-1, 2-2, & 2-3) into contact with the leveling pads using care not to disturb the level. The 1540V lathe only has 4 leveling screws.

For a newly installed machine, check the level once every week. Once the foundation is rigid enough, then check it once per month.

## 2.10 Electrical Connection

The 1540V, 1840V, & 2460V Lathes 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 and rated at a minimum of 20 KVA for the 1540V and 1840V and 23 KVA for the 2460V.

**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 60 amps for the 1540V and 60 amps for the 1840V and the 2460V.

**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 wires 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. The ground wire should be connected at the top or bottom of the breaker bracket.

**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.

### 2.10.1 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. CNC rated rotary phase converters allow for varying loads in the system. A CNC rated phase converter also regulates the new leg created so it does not end up being too high or low of a voltage. The electrical load on the machine will vary based on the type of cut taken and the speed of the motor. Static phase converters can only be used on machines with a non-varying load. The phase converter for the 1540V should be rated for 25 to 30 KVA, the 1840V machines should be rated for 20 to 25 KVA, and the 2460V machines should be rated for 30 to 35 KVA. Please contact your local phase converter distributor for precise sizing.

| Machine Type 220V | Phase Converter Size Recommended Range | Site Prep FLA |
|---|---|---|
| 1540V | ~25-30 | 47 |
| 1840V | ~20-25 | 35 |
| 2460V | ~30-35 | 59 |

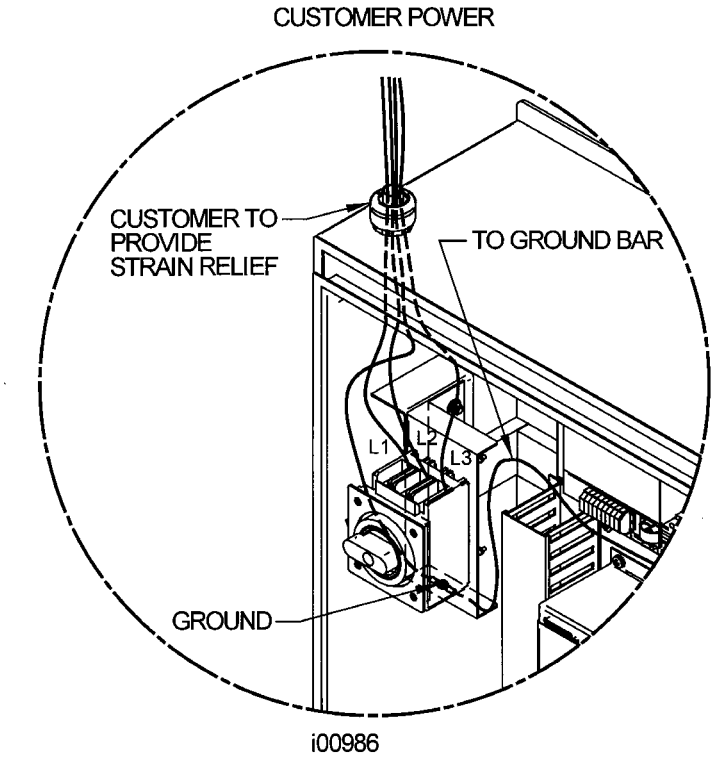


**Figure 2-6**
**Wiring the 1540V, 1840V, & 2460V**

## 2.11 Air Connection

The 1540V, 1840V, & 2460V machines have an air hookup in the rear of the machine only if they come with a Dorian indexer option.

The air regulator is set to 90 psi at the factory for the indexer unit.

## 2.12 Mounting the Display Pendant

The ProtoTRAK VL display pendant mounts to the top of the sliding doors and is held to an L bracket with 4 socket head cap screws.

Make sure the pendant rotates freely from side to side.

Make all of the cable connections to the left side of the pendant and cover these cables with the cable cover provided with the machine. Also make sure to fasten the servo cables with the bracket provided.

## 2.13 Cable Interconnections

All cable interconnections are made at the factory except for those connecting to the pendant display. There are a total of 8 cables that need to be connected to the pendant. See Section 7 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 following drawing describes all of the cable connections to the pendant. Make sure to plug the servo cables into the X and Z ports on the pendant. The Y-axis port is left empty. These cables also have a bracket that is used to fasten the cable securely to the pendant. Failure to install this bracket could cause intermittent problems.

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 number 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 2-7**
**Pendant Cable Connections**
**Left Side**

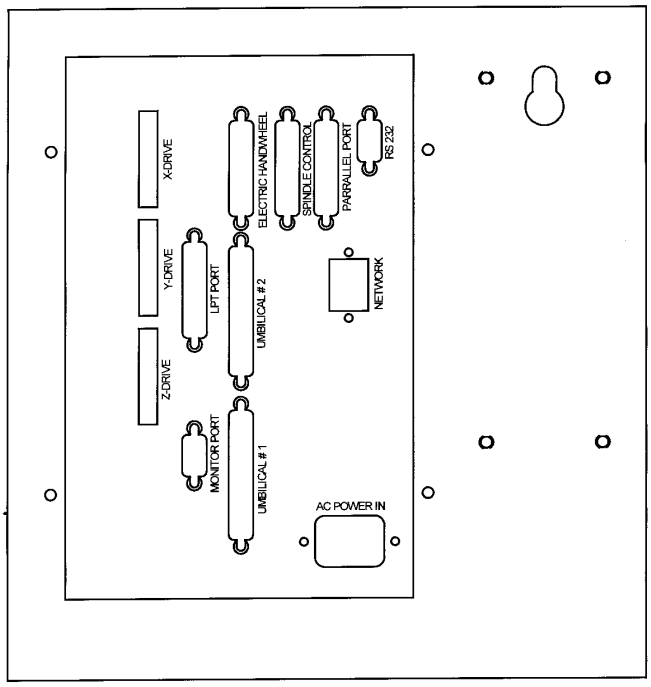


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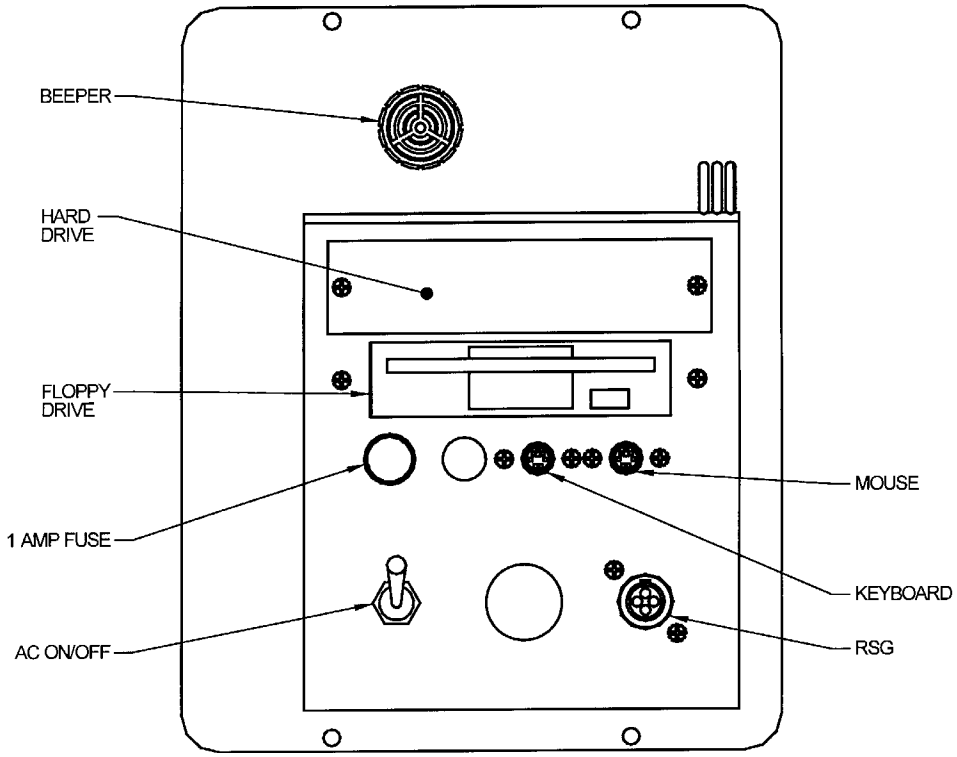
**Figure 2-8**
**Pendant**
**Right Side**



## 2.14 Lubrication

The 1540V, 1840V, and 2460V auto lube system provides centralized automatic lubrication for the carriage, cross slide and ballscrews. The lube pump has a 2-liter reservoir filled with Mobil Vactra Oil No. 2.

**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 motor. Even when the spindle is turned off, the lube pumps internal clock will not reset. The interval between pump cycles is based on axis motor movement time.

### 2.14.1 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.

### 2.14.2 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 lathe 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 1540V, 1840V, or 2460V lathe way surfaces and ballscrews.

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.

### 2.14.3 1840V & 2460V Headstock Oil Reservoirs

Before turning on the spindle, check to make sure the headstock oil reservoir is full. A site glass is located under the spindle cover. The reservoir holds approximately 3 gallons. If low, fill the site level with Mobil DTE 24 or equivalent oil through the plug located on the headstock cover.

## 2.15 Cutting the Test Part (See Figure 2-9)

**Tools Required**

- Chuck
- Tool Post
- Tool Block
- Tool Holder, right-hand face and turn type

In order to accurately machine the test part, the gears and bearings in the headstock must be properly warmed and preloaded. This is accomplished by running the spindle for 15 to 25 minutes prior to cutting the test bar at 500 RPM.

Load an approximately 2" dia. aluminum bar into the spindle chuck. Load a standard right hand face and turning tool into a tool block. Align and lock the tool block onto the tool post. Set the depth of cut to a maximum of .002.

Set the spindle to an acceptable speed for turning the test piece. A speed range from 650 to 950 RPM is recommended.

## 2.16 Measurement of the Test Part

**Tools Required:**

- O.D. Micrometers with .0001" graduations

Using a calibrated O.D. micrometer with .0001" graduations, measure and record the generated dimension at a 6.00 spacing. The acceptable measurement of parallelism of spindle axis to carriage movement (taper of test piece) is .0008" in 6". If the taper measured is not acceptable, re-machine the test part and/or check and adjust the level of the machine, or adjust the headstock.

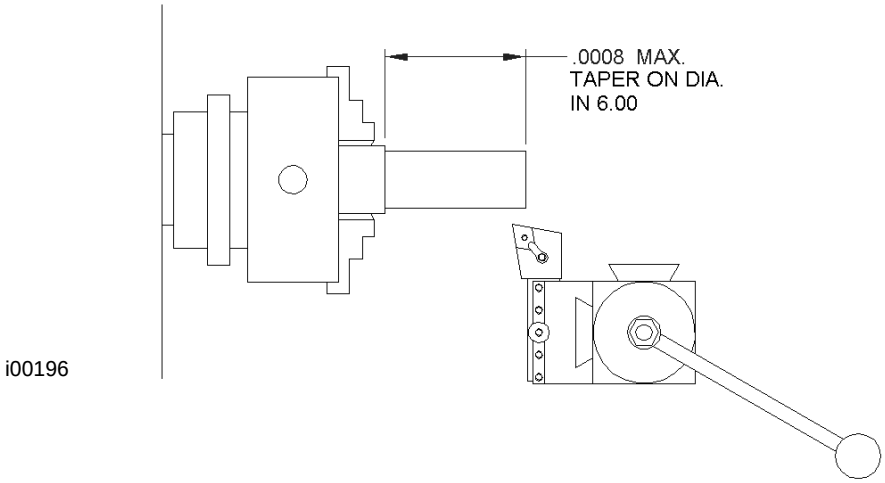



**Figure 2-9 – Test Part**

## 2.17 Mounting of A2-5 Chuck

The 1540V lathe has an A2-5 spindle and requires a chuck of this type. Use the following procedure to mount this style chuck.

Bolt the chuck adapter plate to the spindle with (4) M10 X 50 SHCS. The adaptor is orientated by the key on the spindle.

Then bolt the chuck to the adaptor plate with (3) M8 x 70 SHCS. The chucks SWI provides are self-aligning and need no adjustment.

# 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

Poor finish can be caused by a number of variables including: speeds, feeds, tooling, machine setup and chatter.

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 12** Feed Forward Constant.
- **Code 127** Measures backlash in the system.
- **Code 128** Enter backlash compensation.

| Possible Cause | Check This |
|---|---|
| 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. |
| X & Z-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, Z) 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. |
| Machine set-up problem | Machine's feet are not equally supporting weight. See Leveling, Section 2.9 |
| Tooling problem | Improper tooling, Work piece not properly supported speeds too fast, Feeds too slow.<br>See Machine Tool & Setup, Section 4.1 |
| X gib too tight or loose | See Gib Adjustment, Section 5.2.1 |
| Loose bearing problem | Looseness in the spindle bearings. Adjust spindle preload. Ball screw misalignment,<br>See Mechanical Drive Train (X,Z), Section 4.2. See Spindle Bearing Preload, Section 5.1.16 (1840V & 2460). See Section 5.1.19 for 1540V. |

### 3.1.2 Turning Diameters Out of Round

Parts are not round within .0004" TIR for 1840V & 2460V and 0.0002" for the 1540V. Runout for the spindle is best measured by using a .0001" dial indicator and mounting to the inside taper of the spindle. Rotate the spindle and measure the indicator movement.

*NOTE: 2460V - The typical geared head engine lathe is not capable of more precise diameters. Careful adjustments to this turning machine will insure to maintain this accuracy. Better accuracy should not be expected from a lathe of this class.*

Do the following service code and procedures:

| Possible Cause | Check This |
|---|---|
| Tooling problem | Improper tooling, workpiece not properly supported.<br>See Machine Tool & Setup, Section 4.1 |
| Loose bearing problem | Looseness in the spindle bearings. See Mechanical Drive Train (X, Z), Section 4.2. Spindle bearing not preloaded correctly. Reseat bearing and preload. See Adjust Spindle Bearing Preload, Section 5.1.16 (1840V & 2460V only) |

### 3.1.3 Cutting Taper

Parts are considered to be cutting on a taper if there is a difference in diameter of more than .0008" over 6 inches. This is best measured by using a .0001" micrometer.

Do the following service code and procedure:

- Code 12 Determines the feed forward constant for the axis motors.

| Possible Cause | Check This |
|---|---|
| Machine set-up problem | Machine not leveled properly<br>See Leveling - Section 2.9 |
| Tooling problem | Improper tooling; Work piece not properly supported. Use steady rest or follow rest, reduce overhang from chuck headstock or tailstock. |
| Looseness in the gib or misalignment of ball screw | Gib adjustment.<br>See Gib Adjustment - Section 5.2.1<br>See Z Ball screw Alignment - Section 5.1.14 |
| Loose bearing problem | Looseness in the spindle bearings.<br>See Mechanical Drive Train (X,Z) - 4.2<br>See Spindle Bearing Preload - Section 5.1.16 (1840V & 2460V only) |
| Headstock and/or tailstock not aligned | See Adjust Headstock for Taper - Section 5.1.15<br>To adjust tailstock from side to side, adjust grub screw. See Section 5.1.17 |

### 3.1.4 Parts Have Incorrect Dimensions

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

- Parts should be round within .0004" TIR on 1840V & 2460V and 0.0002" on 1540V.
- The acceptable measurement of parallelism of spindle axis to carriage movement is .0008" over 6 inches.

#### *3.1.4.1 Every Part Has the Same Error*

| Possible Cause | Check This |
|---|---|
| Programming Error | Programmed dimensions not correct. Check absolute and incremental values. |
| Machine & Setup Related | See Machine Tool & Setup - 4.1 |

#### *3.1.4.2 Errors are Random or Accumulate in Size over the Part Run*

| Possible Cause | Check This |
|---|---|
| Machining Setup | See Machine Tool & Setup - 4.1 |
| Looseness in the Drive Train, ball nut loose in yoke, split nut loose, yoke loose | See Mechanical Drive Train (X,Z) - 4.2 |

### 3.1.5 Threading Problems

Threads can be cut with and an unlimited number of pitches and up to 10 leads.

To reduce the relief area when threading up to a shoulder the spindle speed should be reduced as much as possible. The slower the speed of the spindle, the closer the cutting tool can come to the end of the programmed thread before it pulls out and retracts. If a nut must be turned all the way up to a shoulder, machine a relief area behind the last thread.

*NOTE: No machine can thread up to a shoulder and instantaneously pull out.*

Do the following service codes and procedures:

- Code 12 Determines the feed forward constant for the axis motors.
- Code 133 Spindle encoder test

#### *3.1.5.1 Cross Threading*

Threaded parts are cross-threaded after completion of the threading event.

| Possible Cause | Check This |
|---|---|
| Looseness in the Gib | Gib adjustment<br>See Gib Adjustment - Section 5.2.1 |
| Looseness in the drive train | The drive train Diagnostics<br>See Mechanical Drive Train (X,Z) - Section 4.2 |
| Failure of the spindle encoder<br>Run service code 133 to check if the encoder counts. | Replace spindle encoder<br>See Spindle Encoder replacement - Section 5.1.8 |

#### *3.1.5.2 Not Threading*

The machine will not cut a thread at all.

| Possible Cause | Check This |
|---|---|
| Spindle speed too fast | Slow down spindle speed. |
| Failure of the spindle encoder<br>Run service code 133 to check if the encoder counts. | Replace spindle encoder<br>See Spindle Encoder replacement - Section 5.1.8 |
| Broken or slipping encoder coupling | Check and replace as necessary |
| Broken or loose belt on 1540V lathe only | Check belt tension |

## 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. |
| 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 0.005". Perform Code 129 to check or change this value. See Service Codes section. Values lower than 0.005” may reduce the feedrate. |
| Incoming AC voltage is inadequate | Perform Code 100. See Service Codes - Section 4.9 and Electrical Section 4.6 |
| 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 and Z-axis Gibs are not adjusted properly | Check the adjustment of the X and Z-axis Gibs using the X and Z-axis Gib adjustment procedures. |
| 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, Z) Section 4.2 |
| Servo Drive failure | See Servo Drive Section 4.5 |
| Motor failure | See Motor Section 4.4 |

### 3.2.3 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 12** Feed Forward Constant.
- **Code 127** Measure's the backlash in the system.
- **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 and Z-axis Gibs are not adjusted properly | Check the adjustment of the X and Z-axis Gibs using the X and Z-axis Gib adjustment procedures. |
| Calibration or Backlash problem | Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy. See Calibration & Backlash Constants section. |
| 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, Z) Section 4.2 |

### 3.2.4 Vibration in Motion

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

Do the following Service Codes and procedures:

- **Code 12** Feed Forward Constant.
- **Code 127** Measure's the backlash in the system.
- **Code 128** Enter backlash compensation.

| Possible Cause | Check This |
|---|---|
| Too much backlash entered in Code 128. | Recheck the machines backlash. |
| Inadequate or no Lubrication to Ballscrews and 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 Gib 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, Z) Section 4.2 |
| Axis Motor belt too tight. | Loosen belt. |
| Misalignment of ball screw | See Mechanical Drive Train (X, Z) 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 the power switch off, 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 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 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. |
| X and Z-axis Gibs are adjusted extremely tight | Check the adjustment of the X and Z-axis Gibs using the X and Z-axis Gib adjustment procedures. See X 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, Z) Section 4.2 |
| Incoming electrical power | Incoming voltage. See Electrical Section 4.6 |
| 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. A floppy holds 1.44 MB. |

### 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 4.6 |
| Bad Fuses in electrics box | Check the 2-Transformer fuses, 1-Power Strip fuse. See Electrical Section 4.6 |
| 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 4.6 |
| 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 4.6 |
| 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 4.6 |
| 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 4.6 |
| 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".<br>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 4.6 |
| 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 4.6 |
| 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 4.6 |
| 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 4.6 |
| 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 4.6 |
| 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 4.6 |
| Bad fuses in electrics box | Check the 2-Transformer fuses, 1-Power Strip fuse. See Electrical Section 4.6 |
| 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 4.6 |
| 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 4.6 |
| 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 4.6 |
| 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 4.6 |
| 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. 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 (Section 3.4.1)
- See Measurements Are Not Accurate (Section 3.4.2)

### 3.3.10 E-Stop Error

The E-Stop cuts power to the Coolant pump 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 and Z-Drive Modules. This cuts the power to the X and Z-axis Servomotors. These signals are fed down from the Computer Module to the X and Z-Drive Modules through the X and Z-Drive Module cables. Check the X 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. |

### 3.3.11 Motor Alignment Routine Does Not Work Properly

The Motor Alignment Routine Code 203 (1540V & 1840V only) 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. Each axis moves less than 1" during routine. The 2460V uses service code 204 to align the servo motors. This routine looks for the index pulse on the motor encoder and aligns the motor to this location.

| 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 |
| Loose connections | Check servo drive cables at pendant and servo drives. |

### 3.3.12 Limit Switch Error

Limit switches are installed on the carriage and cross slide 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 carriage or cross slide 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 X-axis Limit Switch is activated.
Use the Hand Wheels to Move off the Switch.

When this happens, the control will not allow the operator to continue to manually move the carriage or cross slide in the same direction.

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

1. Use the electronic hand wheel to move the carriage or cross slide 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<br><br>Try this<br>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.<br>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 1540 or 2460. 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 & Z-Axis Measurements Do Not Repeat

With a dial indicator mounted to the spindle, touch off a fixed surface either in the X or Z-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.

Expected repeatability numbers should be 0.0005" or less.

| Possible Cause | Check This |
|---|---|
| Machine Tool & Setup problem | Check for any looseness in the setup. See Machine Tool & Setup Section 4.1 |
| X and Z-axis Gibs are loose | Check the adjustment of the X and Z-axis Gibs using the X and Z-axis Gib adjustment procedures. |
| X and Z-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, Z) 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 Z-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. |

### 3.4.2 X & Z-Axis Measurements Are Not Accurate

Measurements repeat, but with a dial indicator mounted to 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 touch off a fixed surface either in the X 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.<br>See Calibration & Backlash Constants |
| 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 4.4.3.

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 131** Manual DRO test.

| Possible Cause | Check This |
|---|---|
| Electronic handwheel failure | Each handwheel should count 0.100" & 0.020" respectively for Z and X in fine mode; and 0.400" & 0.100" in course mode. |
| 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 |
| Computer/Pendant failure | See Computer/Pendant diagnostics |

### 3.4.4 X & Z-Axis DRO Counting in Wrong Direction

The DRO is counting in the wrong direction.

The positive directions for each axis are:

- **X-axis** – cross slide moves toward the operator.
- **Z-axis** – carriage moves toward tailstock.

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.

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

### 3.4.5 X & Z-Axis Electric Handwheels Count in Wrong Direction

The Electric Handwheels count in the wrong direction.

The positive directions for each Electric Handwheel are:

- **X-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 310** Reverse Z-axis Handwheel Direction

## 3.5 Problems with the Machine Tool

### 3.5.1 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 |
| Motor drive Belt is slipping | Check the alignment, condition, and tension of the Drive Belt. |
| Cut more than the machine is capable | Check speeds, feeds and depth of cut |
| Spindle Drive Thermal Overload Relay has tripped | IOUT - Current Out (located on the Spindle 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. |

### 3.5.2 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 |
| 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 Drive contains incorrect parameters and is not programmed correctly | Contact customer service. |

### 3.5.3 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. |

### 3.5.4 Excess Gearbox Noise – 1840V & 2460V Only

Gearbox noise is louder than normal. Take note of the gear where the noise is most noticeable. Remove the gearbox lid and try to isolate where the noise is coming from.

| Possible Cause | Check This |
|---|---|
| Headstock manual oil pump failure | Make sure oil is flowing in the site glass. The oil pump is run off a gear in the headstock. |
| Shift level out of position. Gears are not mating properly. | Move the shift lever in and out. Turn off spindle and put back in gear. Adjust the gear cluster in question to make sure it is mating properly. |
| Lack of lubrication to gear train | Check level of oil in gearbox |
| Spindle bearing not being lubricated properly, worn bearing | Check to make sure oil is finding its way to the bearings. |
| Spindle preload loose | Tighten spindle preload on bearing. The spindle preload should be approximately 10-15 in/lbs. |

### 3.5.5 Headstock is Leaking Oil – 1840V & 2460V Only

A Form-A-Gasket sealant should be use to seal any leaking areas. Make sure the sealant fills the leaking area thoroughly. Sealant must cure for 24 hours for best results.

#### *3.5.5.1 Leaking Oil from Rear of Gearbox*

| Possible Cause | Check This |
|---|---|
| Leaking from behind belt drive pulley | Replace shaft seal - o-rings or gaskets. |
| Oil leaking from behind the spindle encoder. | Remove spindle encoder and check seal. |
| Oil leaking from the rear bearing assembly. | Make sure the rear backing plate is mounted correctly. There should be a tapped hole located at the 12 o'clock position. If the tapped hole is located at the 6 o'clock position the seal will leak. |

#### *3.5.5.2 Leaking Oil From Front of Gearbox*

| Possible Cause | Check This |
|---|---|
| Oil leaking from seal between lid and gearbox | Remove gearbox lid and reseal. Thoroughly clean lid before resealing. Make sure the front backing plate matches up with the seal behind the cover. |

### 3.5.6 Tailstock Barrel is Stiff

The tailstock barrel is stiff or not smooth moving through its travel. The tailstock barrel subassembly jams inside the tailstock

| Possible Cause | Check This |
|---|---|
| Misalignment of tailstock housing | Realign bearing housing and tailstock screw. Loosen screw support and realign. |
| Too much grease. | Disassemble and remove excess grease. |
| Vernier Dial is binding or rubbing on screw support. | Remove dial and machine off a couple of thousandths or shim. |

# 4.0 Diagnostics

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

## 4.1 The Machine Tool & Set-Up

### 4.1.1 Leveling

Leveling is one of the most important aspects of setting up the machine properly. Improper leveling can lead to a variety of machining problems.

The machine should be level to within .0008" longitudinally and .0005" transversely. See Leveling Procedures, Section 2.9.

### 4.1.2 A Special Word About the X & Z Gib

The X gib is vital to the performance of your lathe.

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.

The Z gib is used to keep the carriage firmly planted down to the ways. There are two Z gibs, one located on each way.

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 lathe. 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.

2460 only - Make sure the oil pump for the headstock is working properly at the start of each day. Check periodically the site glass for the headstock oil. The site glass is located under the spindle cover. Lack of lubrication in the headstock can lead to increased wear of the gear train as well as premature wearing or failure of the spindle bearings. Oil flows to the site glass only when the spindle is on.

### 4.1.4 Machining Set-Up

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

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

The following is a list of common machining problems and some possible solutions.

| Problem | Check or Try This |
|---|---|
| Poor surface finish | Dull tool<br>Reduce feedrate<br>Increase spindle speed<br>Use a higher rake angle tool<br>Make sure tool is not dull or chipped<br>Use proper grade of cutting tool<br>Use coolant<br>Check to see if tools are on the centerline |
| Long workpieces out of round | Use a follow or steady rest |
| Excessive chatter | Tool bit improperly ground or not on center<br>Avoid extreme negative rake inserts<br>Tool overhang too great, tool deflection<br>Improper feeds and speeds<br>X gib loose. See *Gib Adjustment,* Section 5.2.1.<br>Work improperly supported<br>Machine tool out of level - See *Leveling Procedures, Section 2.9.* |

#### *4.1.4.1 Spindle Speeds*

Spindle speeds are influenced by a number of variables:

- Material
- Rigidity of the Machine Setup
- Coolant
- Insert, geometry and material of insert
- Depth of cut

#### *4.1.4.2 Feedrates*

Factors that affect feedrates:

- Depth of cut
- Design or type of insert
- Sharpness of the insert
- Workpiece material
- Type of finish or accuracy required

## 4.2 The Mechanical Drive Train (X,Z)

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 carriage or cross slide.
- Carriage walk-up due to Z ball screw misalignment.

1. Check for machine considerations, especially X gib adjustments and leveling. See Gib Adjustments, Section 5.2.1.
2. Do the following special service codes:
   - **Code 12** - this is a procedure that helps the control adjust to the friction characteristics unique to the machine. Write down the resulting values from the display. If your problem is control related, check to see if this procedure has resolved the problem.
3. The torque required to manual turn the X and Z-axis ballscrews should be between 10 to 15 in-lbs. These values should be consistent in both directions and along all areas of the axis travel. Values that differ from that of above may correspond to misaligned ball screws.

   The following steps take you in logical sequence through the assemblies. If the step doesn't isolate or resolve the problem, it will be necessary to disassemble the indicated item and move to the next step.

   See Figures 5-4 and 5-6 in Section 5.0.

1. Ensure that the screws that hold the bearing housing in place are not loose.
2. 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.
3. When tightening, snug the 10-32 screw to keep the clamp nut from spreading, tighten it again after the clamp nut is tight.
4. Take out the angular contact bearings in the X & Z-axis and inspect them. They should roll smoothly and be lightly greased. If not, replace them. The Z-axis has 2 bearing housings.

   *NOTE: The bearing housing and spacer rings are matched sets - keep them together.*
5. With the motor and drives removed, inspect the ball screw, ball nut and yoke for the potential problems shown in the chart below.

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

| Potential Problem: | Check By: |
|---|---|
| Bad ball screw | • Visual inspection of 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.<br>• Cranking the ball screw through a significant part of its travel. If it jams, feel loose or has rough spots, replace the ball screw.<br>• Dial indicator on a vertical flat of the ball screw indicates backlash between the ball screw and ball nut. |
| 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 carriage | • 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, ball screws and cross-slide. |
| Z Ball screws not aligned properly | • Manually turn the ball screw through the length of its travel. Pay particular attention to the movement near the headstock, the middle and the tailstock. |

*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.*

See: *Z Ball Screw Removal,* Section 5.1.13
*X Ball Screw Removal,* Section 5.1.11
*Aligning Z Ball Screw,* Section 5.1.14

## 4.3 Computer/Pendant Diagnostics

The pendant consists of 3 separate modules: the computer module, 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:<br>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<br>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. |
| Possible problems | Can lead to |

| | |
|---|---|
| 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 or Demo," 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 Z 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

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 (1540V & 1840V only) calculates the relative position between the motor poles on the stator and the magnets on the rotor through the use of the motor encoder. Code 204 is used on the 2460V. The alignment is set by reading the index off 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:

Run Service Code 131. 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.

### 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 Z motors | Has problem moved to Z-axis? If yes, replace motor. If no, the motor is not the problem. |
| Switch X and Z encoder cables on encoder module and X and Z servo driver cables at the computer module.<br><br>This runs the Z motor with the X port on the computer. Jog the X and the Z-axis should move. | Has the problem moved to the Y-axis?<br>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.<br>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 Z motor power cables at the servo driver, switch X and Z motor encoder cables on encoder module.<br><br>Jog the Z-axis key and the X-axis will move. Jog the X-axis key and the Z will move. | This allows the X motor to be run with the Z servo driver and Z port on the computer module and the Z motor to be run with the X servo driver and X port on the computer.<br>Has the problem moved to the Z-axis?<br>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 and Z.

Indications:

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

Servo Types:

- X 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 Z 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 12-volt signal will only be present when the temperature reaches 131° F. 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.

**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 servoing.

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 droop.

**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.

**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 Electrical

The electrical box is broken down into 4 different modules: power module, drive module, auxiliary module and encoder module. See Figure 4-1 for an illustration of the box layout. See figures 7-33 through 7-37 for cable diagrams.

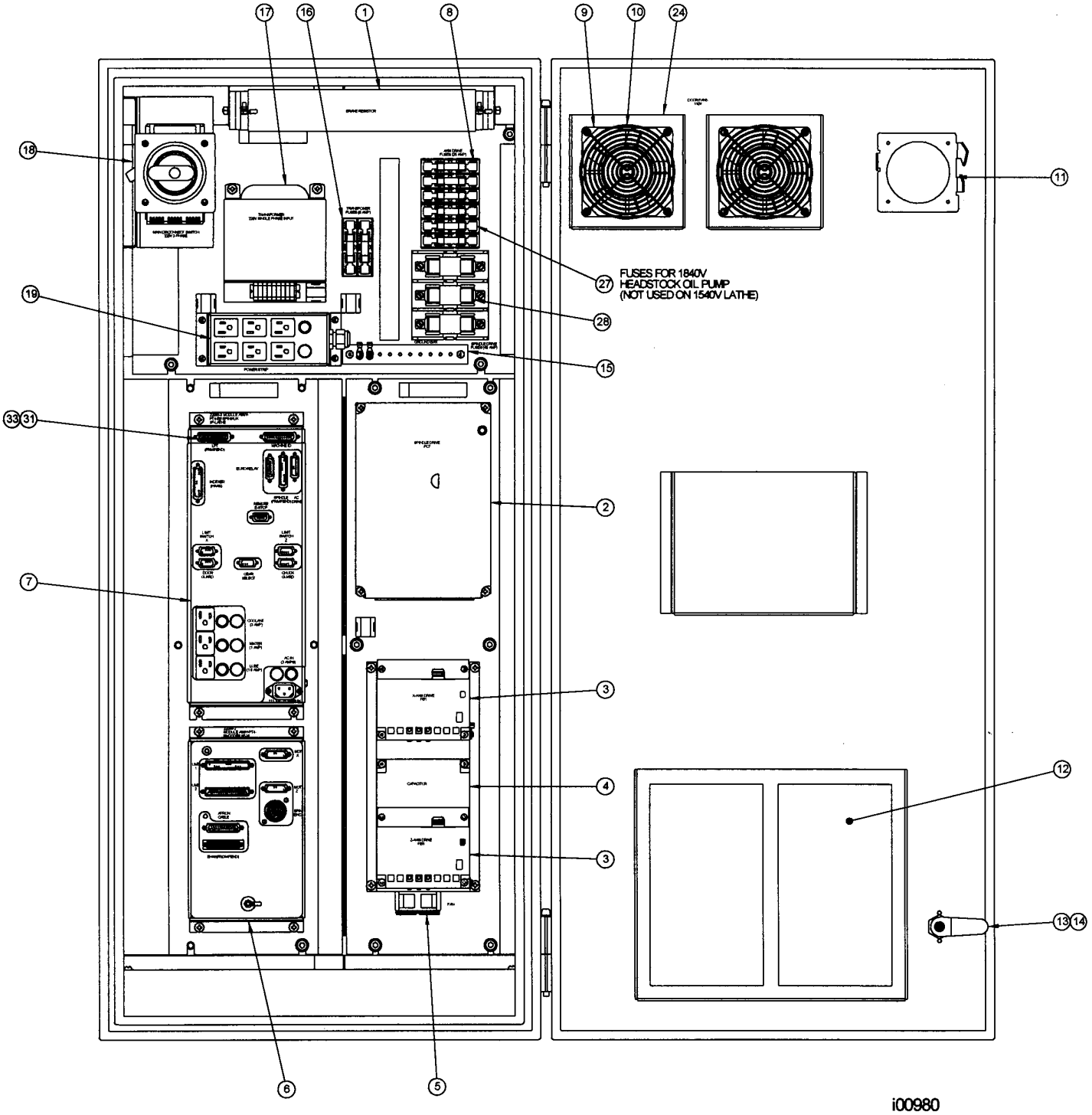



**Figure 4-1**
**Electrical Cabinet**

## Electrical Cabinet, Parts List

| Item | P/N | Title | Use As | Qty |
|---|---|---|---|---|
| 1 | 22157-32 | RESISTOR- 750 W 32 OHM | EA | 2 or 3 |
| 2 | 22287-1540V<br>24084-2460V | AC DRIVE-10 HP VECTOR<br>AC DRIVE 15 HP VECTOR | EA | 1 |
| 3 | 22027-220 | SERVO- POWERBLOK- 220V | EA | 2 |
| 4 | 22028-220 | CAPBLOK MODULE-PT4 220V | EA | 1 |
| 5 | 22149 | FAN-PT4-12V-DRIVE MODULE | EA | 1 |
| 6 | 22068-2 | MODULE ASSY-VL- ENCODER INTERFACE | EA | 1 |
| 7 | 22065-2 | MODULE ASSY-PT4-EB-SPIN/AUX I/F-LATHE | EA | 1 |
| 8 | 21893-25 | FUSE- 500 VOLT- SLO-BLO TYPE | EA | 3 |
| 9 | 22164 | FAN-PT4-ENCLOSURE | EA | 1 |
| 10 | 22656 | GUARD- FAN | EA | 1 |
| 11 | 22653 | HANDLE OPERATING MECHANISM | EA | 1 |
| 12 | 22552 | FILTER-PT4 ELECTRICS BOX | EA | 1 |
| 13 | 22553 | HANDLE-PT4-ELECTRICS BOX | EA | 1 |
| 14 | 22554 | WASHER- SEALING | EA | 1 |
| 15 | 21753 | GROUND BAR-PT4 | EA | 1 |
| 16 | 21893-6 | FUSE- 500 VOLT- SLO-BLO TYPE | EA | 2 |
| 17 | 21258 | TRANSFORMER -1000VA EI | EA | 1 |
| 18 | 22654<br>22654-1 | BREAKER-220 VOLT- 60 AMP – 2460<br>BREAKER-220 VOLT- 50 AMP - 1540 | EA | 1 |
| 19 | 22288 | MODULE ASSY- PT4- POWER PANEL POWER STRIP | EA | 1 |
| 20 | 21824-8 | FUSE-3AG-SLOW BLOW | EA | 1 |
| 21 | 21824-3 | FUSE-3AG-SLOW BLOW | EA | 1 |
| 22 | 21824-1 | FUSE-3AG-SLOW BLOW | EA | 1 |
| 23 | 21824-1.6 | FUSE-3AG-SLOW BLOW | EA | 1 |
| 24 | 22552-1 | FILTER-PT4 COOLING FAN | EA | 1 |
| 27 | 21893-2 | FUSE- 500 VOLT- SLO-BLO TYPE – not used on 1540 or 2460 | EA | 3 |
| 28 | 22026-40<br>22026-60 | FUSE- CLASS J TIME DELAY-AJT-40 AMP-1540<br>FUSE- CLASS J TIME DELAY-AJT-40 AMP-2460 | EA | 3 |
| 30 | 22758-2460V | KEY-PT4-MACHINE ID (2460V) | EA | 1 |
| 33 | 22758-1540V | KEY-PT4-MACHINE ID (1540V) | EA | 1 |

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### 4.6.1 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. 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) 40 amp fuses (1540V & 1840V) or (3) 60 amp fuses (2460V) to protect the spindle AC drive and (3) 25 amp fuses to protect the X and Z servo drivers. It also has (2) 6 amp fuses for the transformer. The power module also has a ground bar where all of the panels are grounded. The 1840V has an additional 2 fuses rated at 2 amps to protect the headstock oil pump.

## 4.6.2 Drive Module

The drive module consists of 2 servo drivers for X 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.

### *4.6.2.1 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 1540V, 1840V, & 2460V machines are shown below. The corresponding RPM's for each machine are listed in the table below. Note that the 1840V & 2460V have a low and high gear while the 1540V has only 1 speed range.

| 1540V – Spindle RPM - Frequency | 1840V – Spindle RPM – Frequency | 2460V – Spindle RPM - Frequency |
|---|---|---|
| 150 – 7.5 Hz | Low Gear 80 High 250 10.5 Hz | Low Gear 40 High 100 – 8 Hz |
| 4000 – 200 Hz | Low Gear 850 High 2500 106 Hz | Low Gear 670 High 1800 – 145 Hz |

### *4.6.2.2 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 2 (1540V & 1840V) or 3 (2460V) brake resistors and mounted to the top of the electrical cabinet. The motor is set to brake in 3-4 seconds for the 1540 & 1840 and 6 seconds for the 2460. Chucks larger than 12" may require the braking parameter N22 to be adjusted to a higher value.

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

*Note: the values in the AC drive are programmed at the factory and should never be adjusted without approval.*

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 16 ohms for the 1540V & 1840V and 11 ohms for the 2460V. If the ohmmeter displays an overload then the resistor is bad or there is a bad connection. Each individual resistor should measure 32/33 ohms.

## 4.6.3 Spindle Auxiliary Module

This module is located on the lower left side of the electrical cabinet above the encoder module. See Figure 4-1. 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, coolant pump, lube pump, and spindle 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 lathes
- **Indexer Port** - An auxiliary function that uses Logic signals to operate the indexer.
- **XZ-Limit Switch Ports** - Logic signals from limit switches. These signals are also direction specific.
- **Door Guard Port –** feeds signal back to control from door switch.
- **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.
- **Lube Pump Outlet** - An auxiliary function that uses a 110V signal to power the lube 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.
- **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.

### 4.6.4 Encoder Module

This module is located on the lower left side of the electrical cabinet below the spindle auxiliary module. See Figure 4-1. 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 lathes have (2) motor encoder signals which are communicated between the Encoder module and the Pendant by use of (2) Umbilical cables. The X signal is communicated through umbilical #1 and the Z motor signal is transferred through umbilical #2.
- **Electric Hand Wheel Port (To Pendant)** - Communication for X & Z-Hand Wheel and jogstick logic signals between the Pendant and the Encoder module.
- **X & Z-Electric Hand Wheel & Jogstick Ports -** This port is used to receive logic signals from of the X and Z-Electric Hand Wheels and jogstick.
- **X & Z-Motor Encoder Ports** - These ports are used to receive logic signals from each of the XYZ-Motor Encoders.

### 4.6.5 Cable Connections

The lathe machines use 15+ 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 the screws are tightened on each of the connectors.

### 4.6.6 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!

#### *4.6.6.1 Checking Fuses*

There are 15 fuses that make up the system on these lathes. 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).

#### *4.6.6.2 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, indexer and coolant pump outlets are activated. The indexer light should always be on unless there is an E-stop pressed. The lube and coolant pumps lights are on only when these devices are programmed to run. If they do not come on when they should check the fuse next to the light.

## 4.7 Door & Gear Switch

The 1540V, 1840V and 2460V machines use a door interlock switch to verify to the control that the door is closed in various modes of operation. This switch is wired normally open but is forced closed when the door is closed during CNC run mode. There should be continuity between pins 1 and 6 when the switch is forced closed and no continuity when the switch is in the open position.

Gear Switch – 1840V & 2460V only

On the 1840V & 2460V, the gearbox has 2 gear ranges. See the table in section 4.6.2. on page 53. A switch is mounted under the sheet metal cover on the left side of the headstock. The switch closest to the headstock casting controls high gear and the other one controls low gear. If the gear shifter is in the middle of both gears, neither switch will be engage and the spindle will be in neutral. Both switches are wired normally closed. This means the switch is open when the switch is triggered. There should be no continuity between pins 1 and 6 when the high gear switch is forced closed and continuity when the switch is in the open position. There should be no continuity between pins 2 and 7 when the low gear switch is forced closed and continuity when the switch is in the open position.

## 4.8 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.

### 4.8.1 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.

#### *4.8.1.1 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.

#### *4.8.1.2 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.

#### *4.8.1.3 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.

#### *4.8.1.4 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.*

#### *4.8.1.5 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 = 1540V (displays machine ID key of machine)
Lube pump cycle time – 60 minutes
Lube pump discharge time – 15 seconds
Motor encoder calibration constants X=242.0411 Z=242.0342
(These numbers above are typical numbers for the calibration constants)
Arc accuracy – 0.005"
Limit switches – on or off
Spindle on or off during run – On or Off

| | | |
|---|---|---|
| Code 128 | X=0.001" | Z=0.0016" |
| Code 12 (+) | X=000005 | Z=000006 |
| (-) | X=000005 | Z=000006 |
| Code 100 (+) | X=352.7 | Z=325.2 |
| (-) | X=350.1 | Z=333.1 |

#### *4.8.1.6 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.

#### *4.8.1.7 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.

#### *4.8.1.8 CODE 318: Activate Converters or Options*

See programming and operating manual.

### 4.8.2 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.

#### *4.8.2.1 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 the Z axis and 10 to 18 for the X 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. Divide the X-axis values by 2 and apply the torque values from above.

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.

#### *4.8.2.2 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 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.

**Your input** X +

| Display | Data displayed. |
|---|---|
| X | motor encoder reading |
| | |
| Z | |
| Feedrate | the maximum feedrate attained |

**Your input** X -

| | |
|---|---|
| X | motor encoder reading |
| | |
| Z | |
| Feedrate | the maximum feedrate attained |

**Your input** Z +

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

**Your input** Z -

| | |
|---|---|
| X | 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".

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.

#### *4.8.2.3 CODE 123: Calibration*

See Section 5.22 for a further explanation of this code.

#### *4.8.2.4 CODE 127 - Set X or Z Backlash Constant*

See Section 5.22 for a further explanation of this code.

#### *4.8.2.5 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.

#### *4.8.2.6 CODE 203 or 204: 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.

**1840V & 1540V Only:** 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. or glass scale on or off.

The 2460V Lathe uses Code 204 to align the motors.

#### *4.8.2.7 Code 308: Reverse X Hand Wheel Direction*

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

#### *4.8.2.8 Code 310: Reverse Z Hand Wheel Direction*

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

#### *4.8.2.9 Code 311: Run Machine with Spindle Off*

This service code toggles this function on or off. It defaults to off 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.

#### *4.8.2.10 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.

### 4.8.3 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.

#### *4.8.3.1 Code 54: Program Continuous Run*

This Code runs a program continuously without stopping for tool change 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.

#### *4.8.3.2 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.

#### *4.8.3.3 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.

#### *4.8.3.4 Code 132 - Electronic Hand Wheel Test*

Turn the X 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 0.4000" for Z and 0.1000" for X in course, and 0.100" & 0.020" for fine mode.

#### *4.8.3.5 Code 133 – Spindle Encoder Test*

Turn the spindle or run the spindle at low RPM's. The display should show the counts from the spindle encoder. It should count to 360 on the Z display and then reset. Each time it resets it displays the number in the X display area.

#### *4.8.3.6 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.

#### *4.8.3.7 Code 319: Error Log*

This code when turned on captures the commands that were sent to the servo system. It includes items such as positioning commands, errors, stop and go commands, 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.

#### *4.8.3.8 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.

### 4.8.4 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.

#### *4.8.4.1 Code 66: Default Metric*

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

#### *4.8.4.2 Code 67: Default English*

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

#### *4.8.4.3 Code 79: Beeper On*

This turns on the beeper to the control keys.

#### *4.10.4.4 Code 80: Beeper Off*

This turns off the beeper to the control keys.

#### *4.8.4.5 Code 129: Arc Accuracy*

When the VL 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 0.005 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 lathe 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**.

#### *4.8.4.6 Code 323: RS232 Com Port*

This code switches between COM ports for RS232 applications.

#### *4.8.4.7 Code 143: Toggle Tool Change Spindle Mode*

This code allows the spindle to stay on at tool changes when turned to the ON position.

#### *4.10.4.8 Code 147: Initialize Indexer*

This code is to be used on machines with indexers only. It will reinitialize (reset) the indexer if the unit is in the wrong position. This type of situation may occur if the E-stop is pressed while the unit is rotating to a new tool position. This code will also need to be run, for example, if the indexer is in tool position 4 and the control thinks it is in some other tool position.

### 4.8.5 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.

#### *4.8.5.1 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.

#### *4.8.5.2 Code 301: Set Lube Pump cycle time*

This code sets the interval time between lube cycles.

#### *4.8.5.3 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. 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.

See Figure 10 for an illustration of the motor and adapter plate.

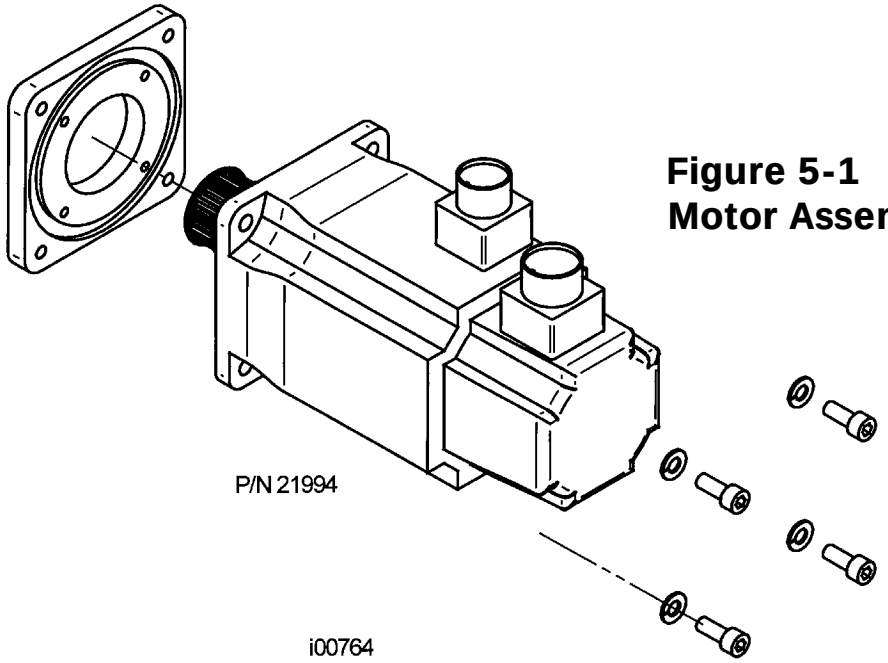


**Figure 5-1**
**Motor Assembly**

### 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 Z 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 5-2 for an illustration of the wiring of the servo drive.

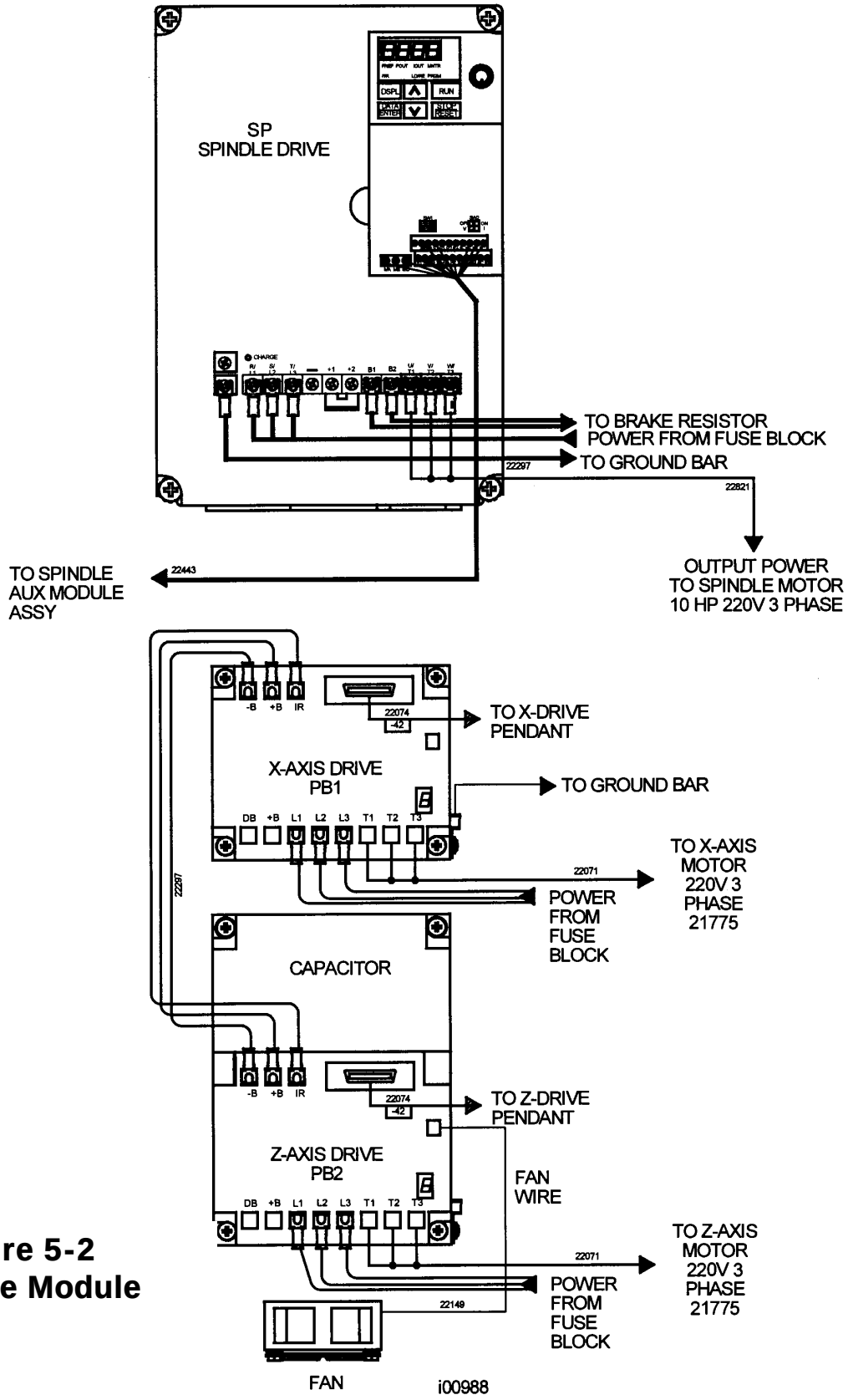


**Figure 5-2**
**Drive Module**

### 5.1.3 AC Spindle 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 or 22443-1) already wired to the drive.*

See Figure 5-3 for an illustration of the wiring of the AC drive.

| ITEM 17 PIN # | FUNCTION | SPINDLE PIN – 1540/1840 | SPINDLE PIN - 2460 |
|---|---|---|---|
| 1 | SPD FWD | S1 | S1 |
| 2 | SPD REV | S2 | S2 |
| 3 | SPD E-STOP | S3 | S3 |
| 4 | TAP MODE | S5 | S5 |
| 5 | SPD RESET | S4 | S4 |
| 6 | SPD GND | SC | SN |
| 7 | A GND | FC | AC |
| 8 | DAC OUT | FR | A1 |
| 9 | GND | MC | MC |
| 10 | GND | PC | M2 |
| 11 | FAULT FDB | MA | MA |
| 12 | RUN FDB EN | P1 | M1 |
| 13 | - | | |
| 14 | - | | |
| 15 | A GND | FC | AC |

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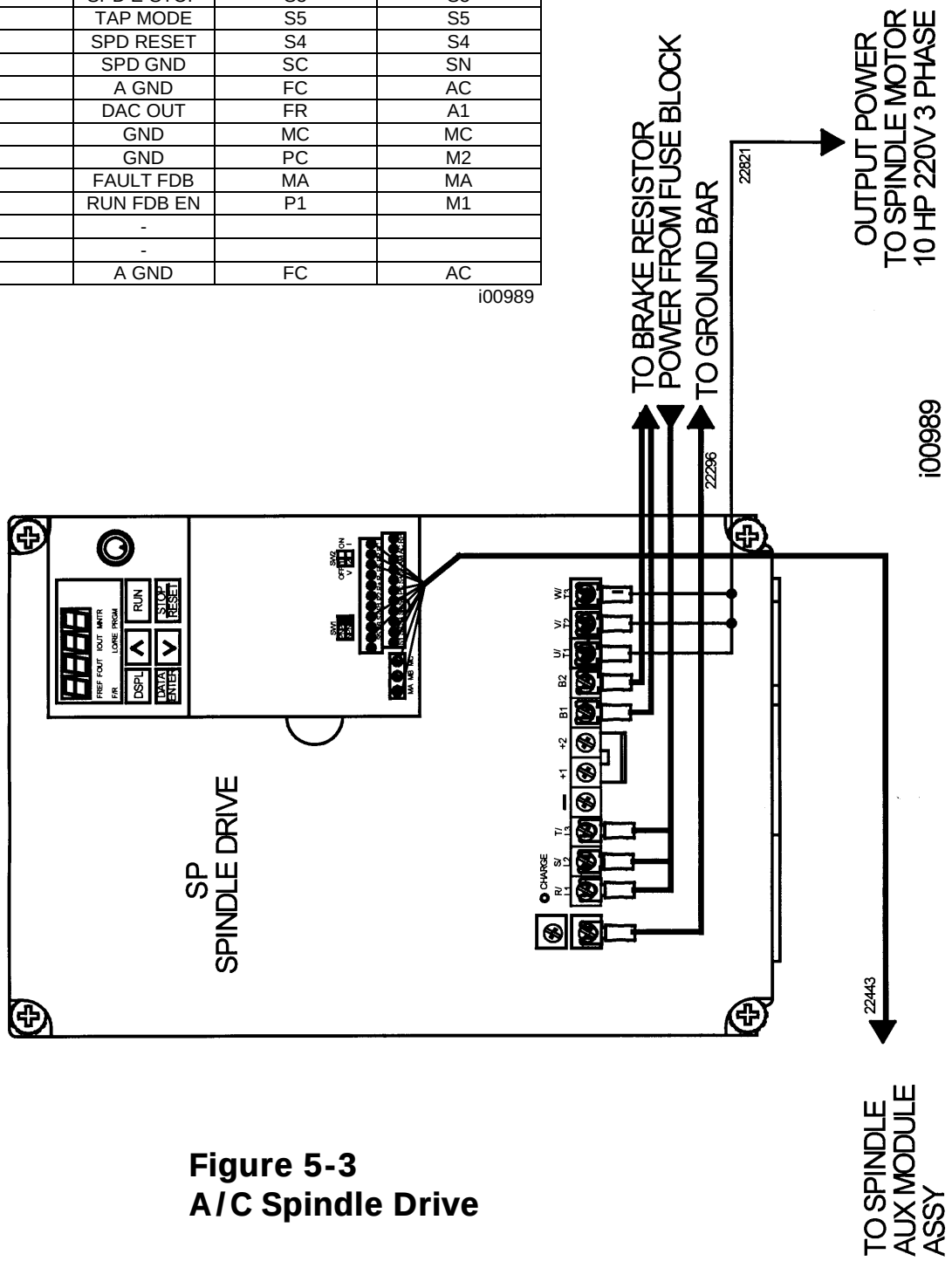



**Figure 5-3**
**A/C Spindle Drive**

**Note – 2460 AC drive looks slightly different**

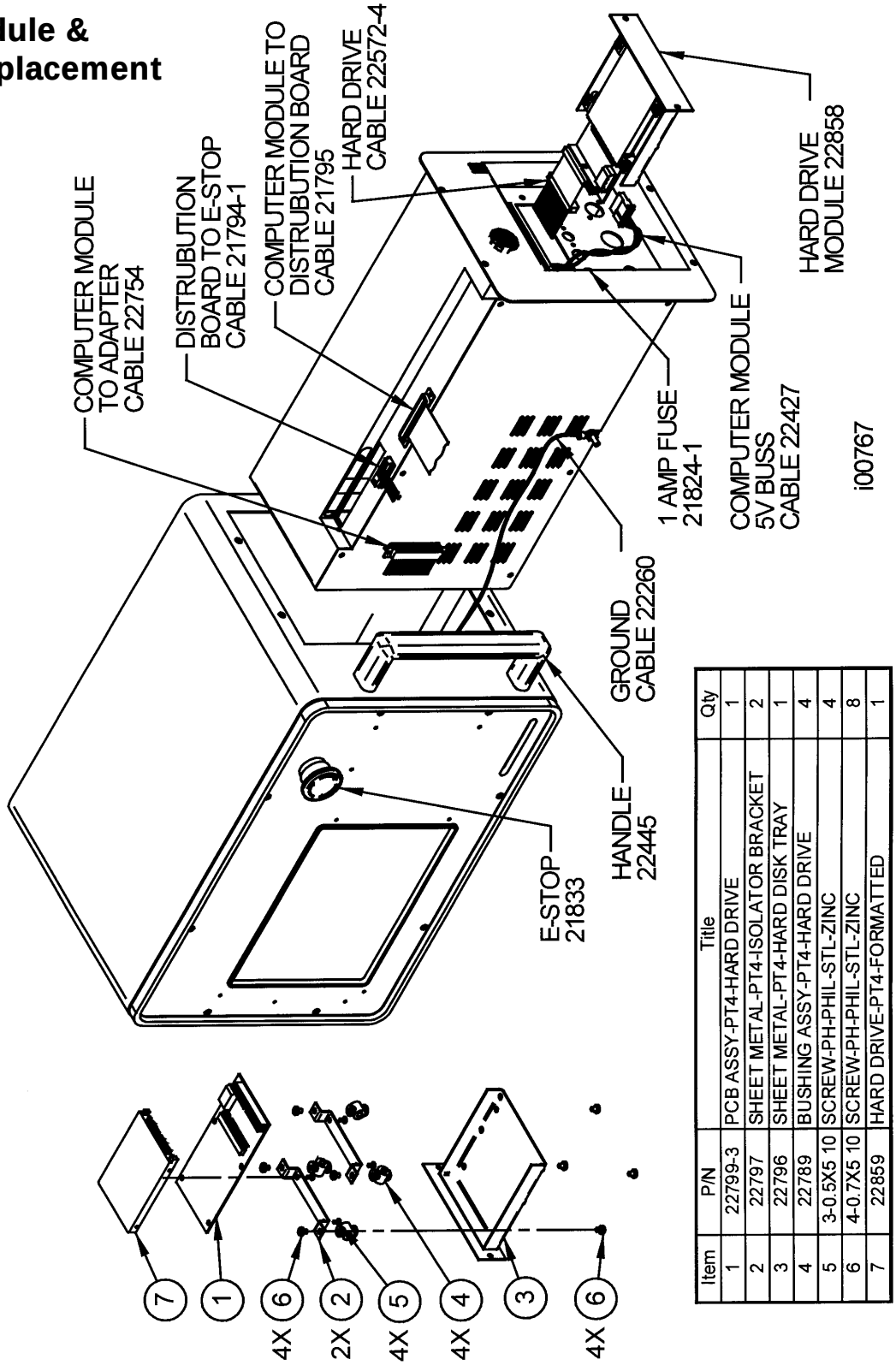
### 5.1.4 Computer Module Replacement

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.*

See figure 5-4

**Figure 5-4**
**Computer Module &**
**Hard Drive Replacement**




| 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 |

| Part # | Description |
|---|---|
| 22328-2 | Pendant Assembly |
| 24200-2 | VL Pendant W/Out Computer |

### 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. See figure 5-4.

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 & Jogstick

There are 2 electronic handwheels on the lathes and 1 jogstick to move the carriage quickly into position. Each unit is replaced as an assembly. Disconnect the handwheels and jogstick from the apron cable.

### 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 (6) 110-volt power cables for the pendant, spindle motor fan, work light, coolant pump, lube pump and spindle auxiliary module. 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 Spindle Encoder Replacement

1. Unplug or remove all power from the lathe.
2. Remove the spindle cover to gain access to the encoder.
3. Loosen setscrews on flexible coupling and the bolts that hold the encoder on.
4. Slide the encoder off.
5. The spindle encoder assembly is only available as a complete unit. Do not disassemble.

*Note: on the 1540 make sure the belt between the spindle and encoder bracket is properly fastened.*

### 5.1.9 Spindle Drive Belt Tightening/Replacement

The spindle drive motor is located inside the base pedestal, underneath the headstock. Access is gained by opening the upper cover on the headstock and removing the lower access panel on the pedestal.

When removing the belt, loosen the top nut and raise motor with the bottom nut until the belt is loose.

To tighten the spindle belt, loosen the bottom nut “A” under the motor bracket and use the top nut “B” to tighten the belt. See the figure below. Make sure the tension on the belt is such that there is no slippage when the lathe is started at its maximum speed. The belt tension can be checked by pulling on one of the belts in the center of its travel with a scale until you reach 15 lbs. on the scale. At this point the deflection of the belt relative to the other belt should be no more than 1/2”. If the deflection is more than 1/2” tighten the belt.

Belt tension should be checked frequently during the first days of operation, and periodically thereafter. Keep the pulleys and belt clean and free of any foreign material to ensure long life and maximum traction.

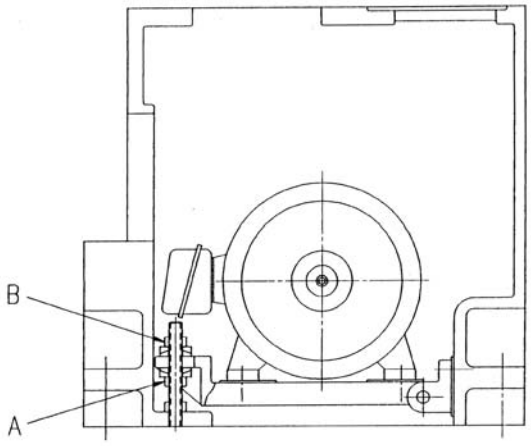



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**Figure 5-5**
**Spindle Motor Belt Adjustment**

### 5.1.10 Spindle Motor Removal

1. Unplug or remove all power from the lathe.
2. Mark and remove motor electrical leads.
3. Because of the weight and size of the spindle motor, and the restricted working space, extreme caution should be used in sliding the motor from its mounting plate.
4. Loosen the belt tension. See section above.
5. The motor is secured with four screws to a flange plate. See the figure above.

### 5.1.11 X-Axis Ball Screw Removal

1. Unplug or remove all power from the lathe.
2. Access to the X-axis ball screw is gained by removing the back cover in the chip guard and removing the X-axis motor cover.
3. Remove the motor.
4. Remove all items on the right end of the ball screw. See Figure 5-6 & 5-7.
5. Unbolt the ballscrew nut from the yoke.
6. The X ball screw is removed through the exposed hole when the cross slide is removed.

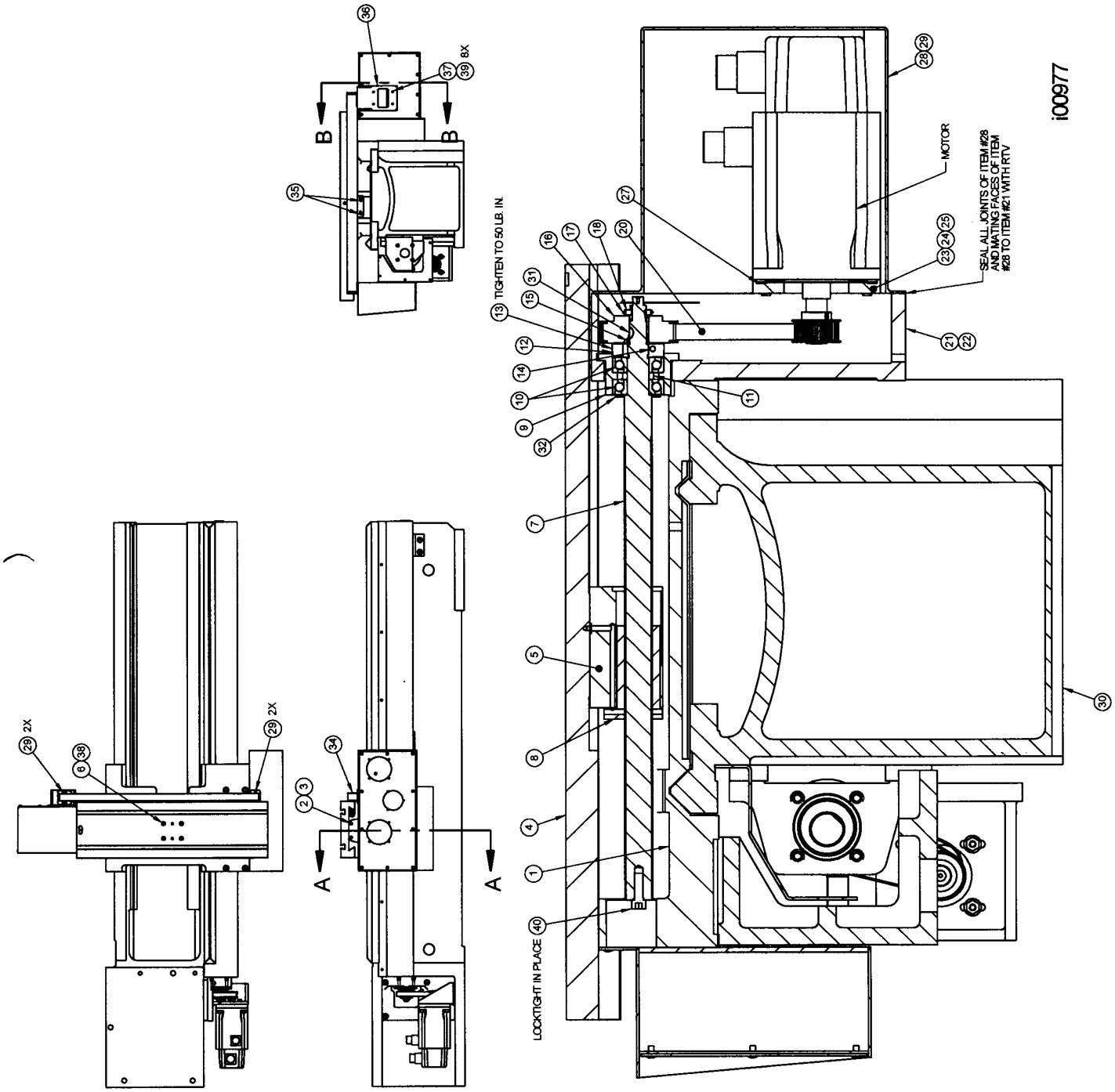


**Figure 5-6**
**X Axis Drive Train – 1540V & 1840V**

# X Axis Drive Train Parts List – 1540V & 1840V

| Item | P/N | Title | UseAs | Qty |
|---|---|---|---|---|
| 1 | 20982 | SADDLE-TRL 1840 CSS | EA | 1 |
| 2 | 20996 | COVER PLATE-TRL 1840 X AXIS | EA | 1 |
| 3 | M6-1.0X12 27B | SCREW-BHCS-STL-BO | EA | 2 |
| 4 | 20981 | CROSS SLIDE-TRL 1840 CSS X AXIS | EA | 1 |
| 5 | 20960 | YOKE-TRL 1840 X AXIS | EA | 1 |
| 21 | 21978 | BRACKET-PT4- X-AXIS DRIVE | EA | 1 |
| 22 | M10-1.5X80 25B | SCREW-SHCS-STL-BO-FULLY THD | EA | 4 |
| 23 | 21979 | BRACKET-MOUNTING MOTOR-PT4- X AXIS DRIVE | EA | 1 |
| 25 | M8-1.25X30 25B | SCREW-SHCS-STL-BO | EA | 4 |
| 28 | 21996 | COVER ASSY-PT4- X AXIS DRIVE | EA | 1 |
| 29 | M5-0.8X10 27B | SCREW-BHCS-STL-BO | EA | 13 |
| 30 | 20980 | BED-TRL 1840 CSS | EA | 1 |
| 34 | 20988 | CABLE WAY | EA | 1 |
| 35 | M6-1.0X14 25B | SCREW-SHCS-STL-BO | EA | 2 |
| 36 | 20987 | CONNECTOR-CABLE WAY | EA | 1 |
| 37 | M6-1.0X20 25B | SCREW-SHCS-STL-BO | EA | 8 |
| 39 | M6 70B | WASHER-FLAT USS-STL-BO | EA | 8 |
| 40 | 22521 | FITTING - LIQUID TIGHT 3/8 NPT | EA | 1 |
| | | | | |
| **Item** | **P/N** | **Title** | **UseAs** | **Qty** |
| 7 | 20984 | BALLSCREW - X AXIS | 1 | 1 |
| 8 | 5/16-18X1 25B | SCREW-SHCS-STL-BO | EA | 4 |
| 9 | 16300 | BEARING HOUSING | EA | 1 |
| 10 | 23930 | BEARING-ANGULAR CONTACT- 7204 BECBP | SET | 1 |
| 11 | 15885 | RING-BEARING HOUSING | EA | 1 |
| 12 | M6-1.0X25 25B | SCREW-SHCS-STL-BO | EA | 4 |
| 13 | 16314 | NUT CLAMP-X AXIS | EA | 1 |
| 14 | 10-32X3/4 25B | SCREW-SHCS-STL-BO | EA | 1 |
| 15 | 16350 | FERRULE-SPROCKET | EA | 1 |
| 16 | 16983-1 | PULLEY-SOLID 44 TEETH W/O GUIDES | EA | 1 |
| 17 | W02 | LOCKWASHER | EA | 1 |
| 18 | NT02 | NUT-LOCK | EA | 1 |
| 20 | 500-5M-15 | TIMING BELT | EA | 1 |
| 24 | M8 70B | WASHER-FLAT USS-STL-BO | EA | 4 |
| 25 | M8-1.25X30 25B | SCREW-SHCS-STL-BO | EA | 4 |
| 27 | M8-1.25X25 25B | SCREW-SHCS-STL-BO | EA | 4 |
| 31 | 98481A090 | KEY WOODRUFF #404-1/8 X 1/2 | EA | 1 |
| 32 | 7204-AVH | NILOS RING-7204 | EA | 1 |
| 33 | 1/4 73B | WASHER-SPLIT LOCK-STL-BO | EA | 4 |
| 38 | 93501A030 | WASHER SERRATED | EA | 4 |
| 40 | M8-1.25X20 25B | SCREW-SHCS-STL-BO | EA | 1 |

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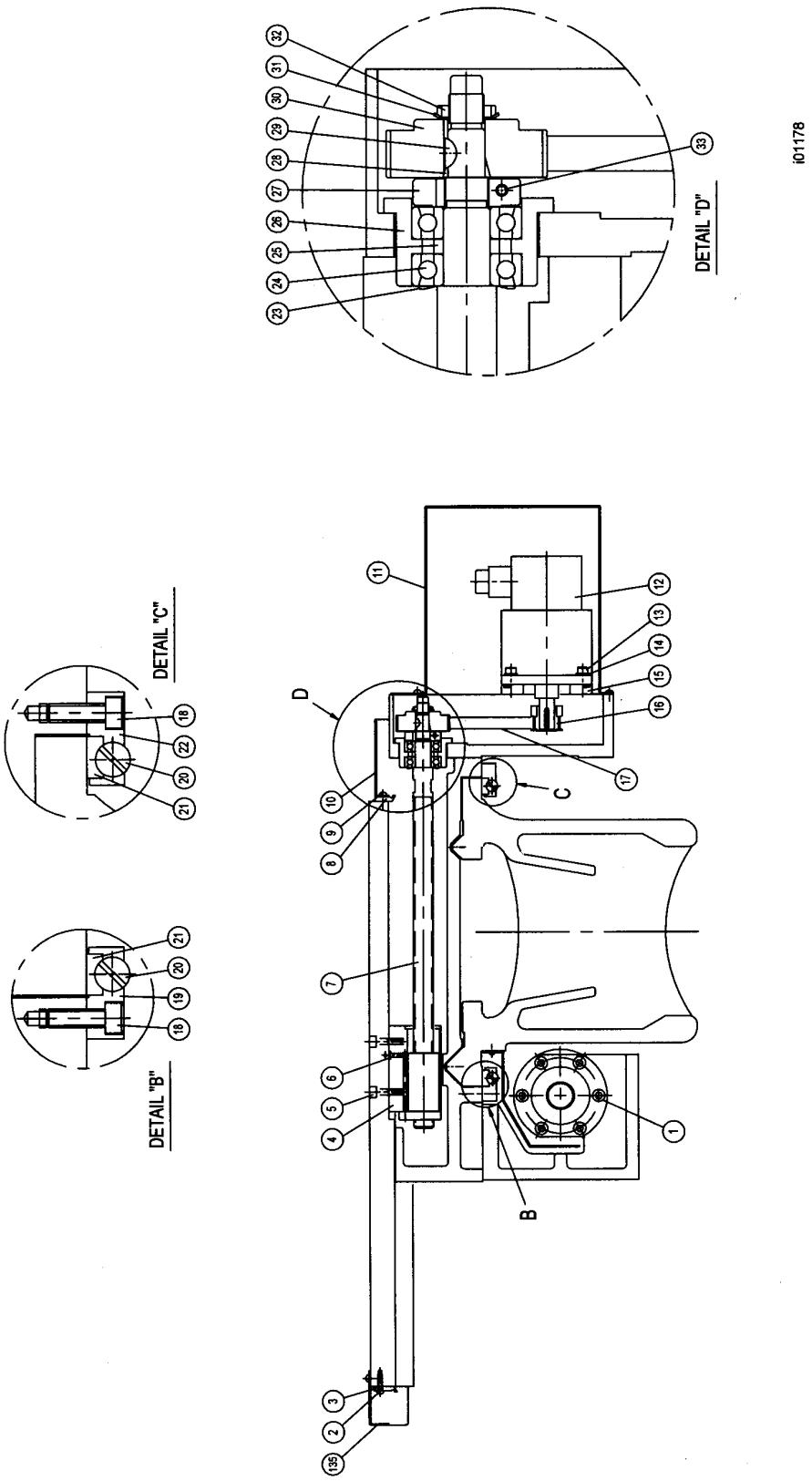


**Figure 5-7 - X Axis Drive Train – 2460V**

# X Axis Drive Train Parts List – 2460V

| Item | Parts No. | Description | Material | Specifications | Q'ty |
|---|---|---|---|---|---|
| 1 | | Socket Head Cap Screw | | M8x30L | 6 |
| 2 | 25200-1 | Wiper - Bedway (Front) | Rubber | 87-0244 | 1 |
| 3 | | Hexagon Socket Screw | | M6x16L | 4 |
| 4 | 77USA-0213 | Nut Seat | FC25 | | 1 |
| 5 | | Socket Head Cap Screw | | M8x30L | 4 |
| 6 | | O-Ring | | P7 | 1 |
| 7 | 20984 | X-Axis Ballscrew | SCM415 | 24-0211 | 1 |
| 8 | 25200-2 | Wiper - Bedway (Rear) | Rubber | 87-0245 | 1 |
| 9 | | Hexagon Socket Screw | | M6x20L | 4 |
| 10 | 87-0228 | Rear Cover Plate | SS41 | | 1 |
| 11 | 24-0728 | X-Axis Motor Cover Plate | SS41 | | 1 |
| 12 | 21994 | Motor - X Axis | | | 1 |
| 13 | | Socket Head Cap Screw | | M8x25L | 4 |
| 14 | | Spring Washer | | M8 | 4 |
| 15 | 24-0208 | Motor Plate | S20C | | 1 |
| 16 | | Symchronous Pulley | Aluminum | | 1 |
| 17 | 500-5M-15 | Belt - X Axis | | | 1 |
| 18 | | Socket Head Cap Screw | | M8x25L | 8 |
| 19 | 77A-0202 | Lock Block | FC25 | | 1 |
| 20 | 50-0325 | Adjusting Screw | S30C | | 4 |
| 21 | 21050-3F | Gib - Z Axis | FC25 | 77A-0218 | 1 |
| 22 | 77A-0216 | Lock Block | FC25 | | 1 |
| 23 | 7204-AVH | Ring - Nilos | | | 1 |
| 24 | 23930 | Bearing Set - Angular Contact | | 7204BECBP | 2 |
| 25 | 15885 | Spacer | S45C | | 1 |
| 26 | 16300 | Bearing Housing | S45C | | 1 |
| 27 | 16314 | Nut - Clamp | S45C | ☐ 19x16UNF | 1 |
| 28 | 16350 | Ferrule | Brass | | 1 |
| 29 | 98481A090 | Key - Woodruff | | #3 (1/8"x1/2") | 1 |
| 30 | 16983-1 | Pulley - Ballscrew | | | 1 |
| 31 | W02 | Lock Washer | | W02 (☐ 15) | 1 |
| 32 | NT02 | Lock Nut | | N02 (☐ 15x32UNF) | 1 |
| 33 | | Socket Head Cap Screw | | 10-32x3/4" | 1 |
| 34 | | Socket Head Cap Screw | | M8x16L | 2 |
| 35 | | Flat Washer | | M8 | 2 |
| 36 | | Spring Washer | | M8 | 2 |
| 37 | 87-0738 | Clamping Block | SS41 | | 1 |
| 38 | | Socket Head Cap Screw | | M10x90L | 4 |
| 39 | | Socket Head Cap Screw | | M6x10L | 2 |
| 40 | | Flat Washer | | M6 | 2 |
| 41 | | Spring Washer | | M6 | 2 |
| 42 | 77USA-0698 | Cam | SS41 | | 1 |
| 43 | | Socket Head Cap Screw | | M8x30L | 4 |
| 44 | | Flat Washer | | M8 | 4 |
| 45 | | Spring Washer | | M8 | 4 |
| 46 | | Socket Head Cap Screw | | M6x20L | 4 |
| 47 | | Flat Washer | | M6 | 2 |
| 48 | | Spring Washer | | M6 | 4 |
| 49 | 87-0730 | Bracket | FC20 | | 1 |
| 50 | | Wire Protector | | 88x45ax1850L | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 51 | | Hexagon Socket Screw | | M5x10L | 11 |
| 52 | 24-0729 | End Cover | SS41 | | 1 |
| 53 | | Socket Head Cap Screw | | M8x20L | 2 |
| 54 | | Flat Washer | | M8 | 2 |
| 55 | | Spring Washer | | M8 | 2 |
| 56 | 77USA-0307 | Switch Seat | SS41 | | 1 |
| 57 | | Socket Head Cap Screw | | M6x20L | 2 |
| 58 | 22551-1 | Switch - Limit | | NBNS543-BO2D12-61-12-10 | 1 |
| 59 | | Socket Head Cap Screw | | M6x16L | 2 |
| 60 | | Flat Washer | | M6 | 2 |
| 61 | | Spring Washer | | M6 | 2 |
| 62 | 77USA-0698 | Cam | SS41 | | 2 |
| 63 | 24-0207 | X Axis Transmission Box | FC30 | | 1 |
| 64 | | Cross Recessed Head Screw | | M6x16L | 6 |
| 65 | 25200-6 | Wiper - Bedway (Right, Rear) | Rubber | 63-0362 | 1 |
| 66 | 25200-7 | Wiper - Bedway (Left, Rear) | Rubber | 63-0363 | 1 |
| 67 | | Socket Head Cap Screw | | M6x25L | 2 |
| 68 | | Spring Washer | | M6 | 2 |
| 69 | | Micro Switch | | BNS543-BO2D12-61-12-10 | 1 |
| 70 | | Socket Head Cap Screw | | M6x16L | 2 |
| 71 | | Flat Washer | | M6 | 2 |
| 72 | | Spring Washer | | M6 | 2 |
| 73 | 87-0714 | Cam | SS41 | | 1 |
| 74 | 25200-4 | Wiper - Bedway (Left, Front) | Rubber | 63-0360 | 1 |
| 75 | 25200-5 | Wiper - Bedway (Right, Front) | Rubber | 63-0361 | 1 |
| 76 | | Cross Recessed Head Screw | | M6x16L | 6 |
| 77 | 87-0715 | Cam | SS41 | | 2 |
| 78 | | Socket Head Cap Screw | | M5x16L | 4 |
| 79 | | Flat Washer | | M6 | 4 |
| 80 | | Spring Washer | | M6 | 4 |
| 81 | | Socket Head Cap Screw | | M6x16L | 4 |
| 82 | | Flat Washer | | M6 | 4 |
| 83 | | Spring Washer | | M6 | 4 |
| 84 | 24-0723 | Operation Box | SS41 | | 1 |
| 85 | 24-0724 | Operation Box Cover | SS41 | | 1 |
| 86 | | Hexagon Socket Screw | | M5x6L | 8 |
| 87 | 77USA-0311 | Apron | FC25 | | 1 |
| 88 | 77USA-0605 | Ballscrew Cover | SS41 | | 1 |
| 89 | | Cover - Round Hole | | ☐ 30 | 1 |
| 90 | N04 | Lock Nut | S45C | N04(☐ 20x16UNF) | 1 |
| 91 | W04 | Lock Washer | | W04 | 1 |
| 92 | 22446 | Bearing - Ball - Double Row Angular Contact | | 2204E-2RSITN9 | 1 |
| 93 | 77USA-0307 | Nut Seat | FC20 | | 1 |
| 94 | | Socket Head Cap Screw | | M12x50L | 4 |
| 95 | | Spring Washer | | M12 | 4 |
| 96 | 77USA-0316 | Bedway - Wiper (Right) | Rubber | | 1 |
| 97 | | Cross Recessed Head Screw | | M6x16L | 3 |
| 98 | | Rod | S45C | | 1 |
| 99 | 87-0727 | Support Bracket | SS41 | | 1 |
| 100 | 97-0716 | Cross Slide Cover | SS41 | | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 101 | | Hexagon Socket Screw | | M6x10L | 5 |
| 102 | 25200-3 | Gib - X Axis | FC30 | 87-2017 | 1 |
| 103 | 17-0321 | Adjusting Screw | S30C | | 2 |
| 104 | | Socket Head Cap Screw | | M8x25L | 4 |
| 105 | 87-0215 | Cross Slide | FC25 | | 1 |
| 106 | 87-0201 | Saddle | FC25 | | 1 |
| 107 | | Socket Head Cap Screw | | M12x90L | 4 |
| 108 | | Cross Recessed Head Screw | | M6x16L | 3 |
| 109 | 77A-0317 | Bedway Wiper (Left) | Rubber | | 1 |
| 110 | 23983 | Ballscrew - Z Axis | SCM415 | 77A-0310A | 1 |
| 111 | 7205-AVH | Ring - Nilos | | AVH7205 | 1 |
| 112 | 23940 | Bearing Set - Angular Contact | | 7205 BECBP | 2 |
| 113 | | Spacer | S45C | | 1 |
| 114 | 16295-1 | Housing - Bearing | S45C | | 1 |
| 115 | | Socket Head Cap Screw | | M8x25L | 4 |
| 116 | 16314 | Nut - Clamp | S45C | ☐ 19x16UNF | 1 |
| 117 | 16350 | Ferrule | Brass | | 1 |
| 118 | 16983-1 | Pulley - Ballscrew | | | 1 |
| 119 | 98481A090 | Woodruff Key | | #3 (1/8"x1/2") | 1 |
| 120 | W01 | Lock Wsaher | | W01 (☐☐12) | 1 |
| 121 | N01 | Lock Nut | | N01 (☐ 12x32UNF) | 1 |
| 122 | | Socket Head Cap Screw | | M8x25L | 4 |
| 123 | | Spring Washer | | M8 | 4 |
| 124 | | Socket Head Cap Screw | | 10-32x3/4" | 1 |
| 125 | | Socket Head Cap Screw | | M12x35L | 4 |
| 126 | | Spring Washer | | M12 | 4 |
| 127 | 400-5M-15 | Belt - Z Axis | | | 1 |
| 128 | 24-0304 | Z Axis Motor Seat | FC30 | | 1 |
| 129 | | Pulley | | | 1 |
| 130 | | Socket Head Cap Screw | | M6x25L | 4 |
| 131 | | Flat Washer | | M6 | 4 |
| 132 | | Spring Washer | | M6 | 4 |
| 133 | 24-0306 | Z Axis Motor Plate | S20C | | 1 |
| 134 | 21994 | Motor - Z Axis | | | 1 |
| 135 | 87-0229 | Front Cover Plate | SS41 | | 1 |

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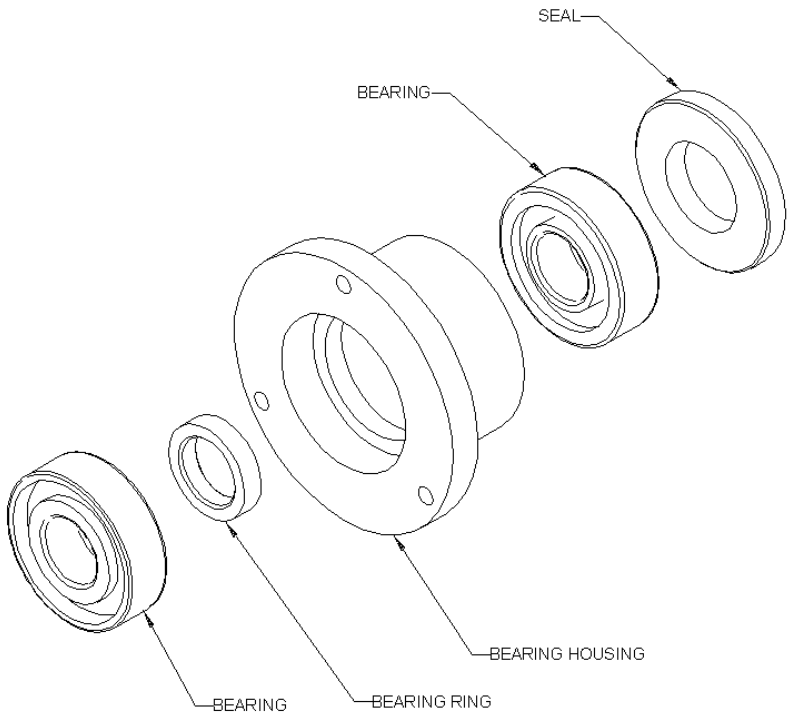


## Figure 5-8
## Angular Contact Bearings

### 5.1.12 Installing Angular Contact Bearings

1. On the inner race of the angular contact bearings, the thin walls face each other.
2. 50 ft/lb. torque is needed to tighten the clamp nut. See the figure above.

### 5.1.13 Z-Axis Ball Screw Removal

1. Unplug or remove all power from the lathe.
2. The Z-axis ball screw is attached to the lathe in three places:
   a. The left end where the Z-axis motor, the pulley, the clamp and the pair of angular contact bearings are mounted.
   b. Behind the apron assembly where the ball nut is attached to the yoke and the oil line is located.
   c. The right end where the floating bearing is located.
3. Access to the left end is gained by removing the sheet metal panel below the headstock nameplate.
4. Access to the ball nut and the yoke is gained by removing the apron assembly.
5. For easy assess to the ball screw, remove the ball screw cover.

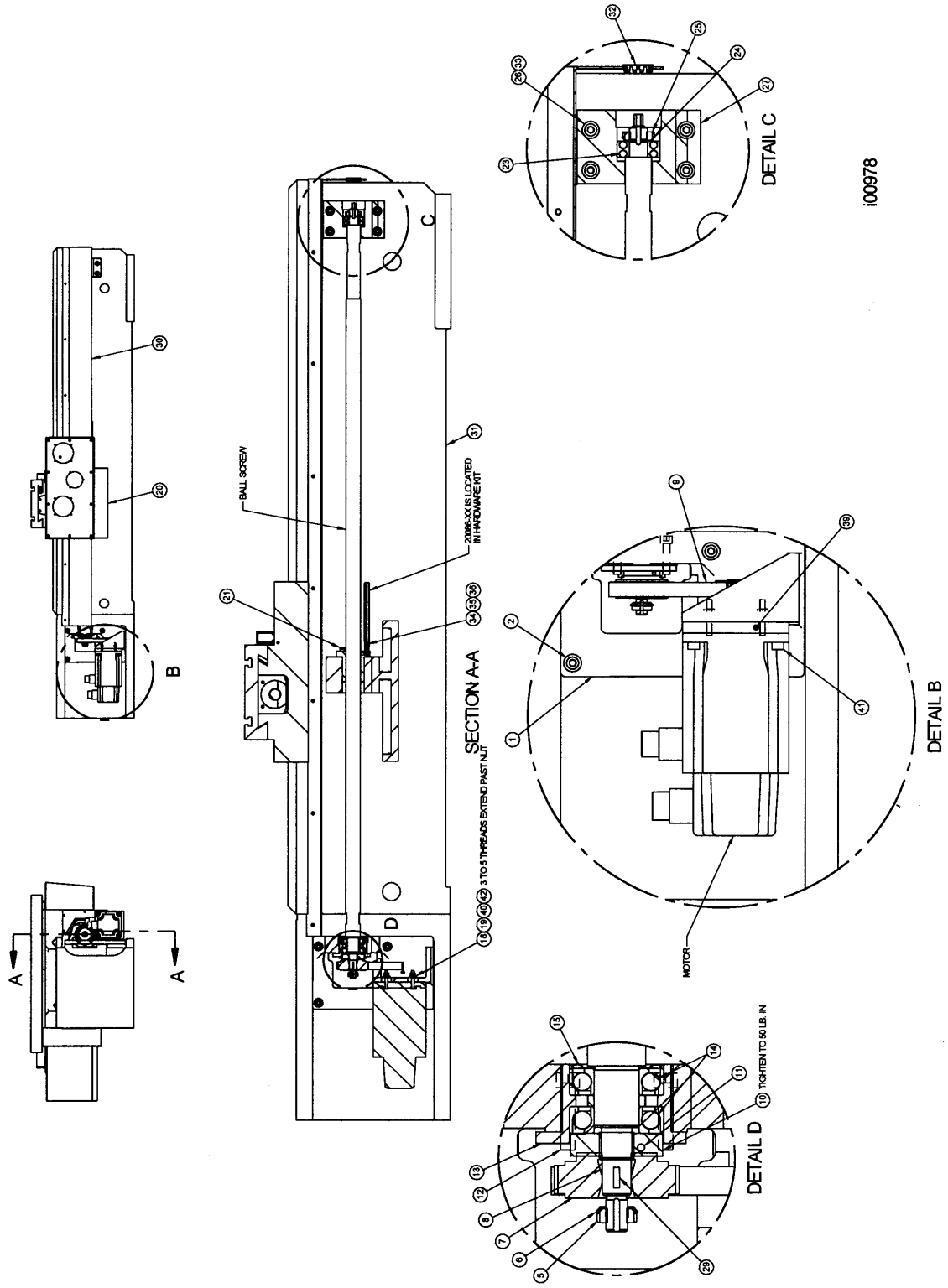


**Figure 5-9**
**Z Axis Drive Train – 1540V & 1840V**

## Z-Axis Drive Train Parts List – 1540V & 1840V

| Item | P/N | Title | Use As | Qty |
|---|---|---|---|---|
| 1 | 21997 | BRACKET-PT4-Z AXIS DRIVE | EA | 1 |
| 2 | M12-1.75X35 25B | SCREW-SHCS-STL-BO | EA | 4 |
| 20 | 20995 | YOKE-Z AXIS | EA | 1 |
| 26 | M12-1.75X45 25B | SCREW-SHCS-STL-BO | EA | 4 |
| 27 | 20962 | HOUSING-TAILSTOCK BEARING | EA | 1 |
| 30 | 20999 | COVER-TRL 2460 Z AXIS | EA | 1 |
| 31 | 20980 | BED-TRL 2460 CSS | EA | 1 |
| 33 | M12 73B | WASHER-SPLIT LOCK-STL-BO | EA | 5 |
| 39 | 22062 | SPACER-PT4-Z-AXIS DRIVE | EA | 1 |
| 5 | N01 | LOCKNUT | EA | 1 |
| 6 | W01 | LOCKWASHER | EA | 1 |
| 7 | 16983-1 | PULLEY-SOLID 44 TEETH W/O GUIDES | EA | 1 |
| 8 | 16350 | FERRULE-SPROCKET | EA | 1 |
| 9 | 400-5M-15 | BELT - TIMING 5MM POWERGRIP | EA | 1 |
| 10 | 16452 | NUT CLAMP-X ,Y, & Z AXIS | EA | 1 |
| 11 | 10-32X3/4 25B | SCREW-SHCS-STL-BO | EA | 1 |
| 12 | M8-1.25X35 25B | SCREW-SHCS-STL-BO | EA | 4 |
| 13 | 16295-1 | HOUSING- BEARING Z-AXIS | EA | 1 |
| 14 | 23940 | BEARING SET-ANGULAR CONTACT-7205 BECBP | SET | 1 |
| 15 | 7205-AVH | NILOS RING-7205 | EA | 1 |
| 18 | 15759 | WASHER-1/4 HARD BLK OX 1/8 THK | EA | 8 |
| 19 | 23054 | STUD-M6-1.0X40-FULLY THREADED-CLASS 4.6 | EA | 4 |
| 21 | M8-1.25X30 25B | SCREW-SHCS-STL-BO | EA | 7 |
| 23 | 22446 | BEARING-SELF ALIGNING-2204 E-2RS1TN9 | EA | 1 |
| 24 | W04 | LOCKWASHER | EA | 1 |
| 25 | N04 | LOCKNUT | EA | 1 |
| 29 | 98481A090 | KEY WOODRUFF #404-1/8 X 1/2 | EA | 1 |
| 32 | 21155 | PLUG-Z AXIS COVER | EA | 1 |
| 34 | 185210 | CONTROL UNIT CSA-5 | EA | 1 |
| 35 | 186251 | COMPRESSION NUT | EA | 1 |
| 36 | 106254 | COMPRESSION SLEEVE | EA | 1 |
| 40 | M6-1.0 52P | NUT-HEX-STL-PLAIN | EA | 4 |
| 41 | M8-1.25X20 25B | SCREW-SHCS-STL-BO | EA | 4 |
| 42 | 1/4 73B | WASHER-SPLIT LOCK-STL-BO | EA | 4 |

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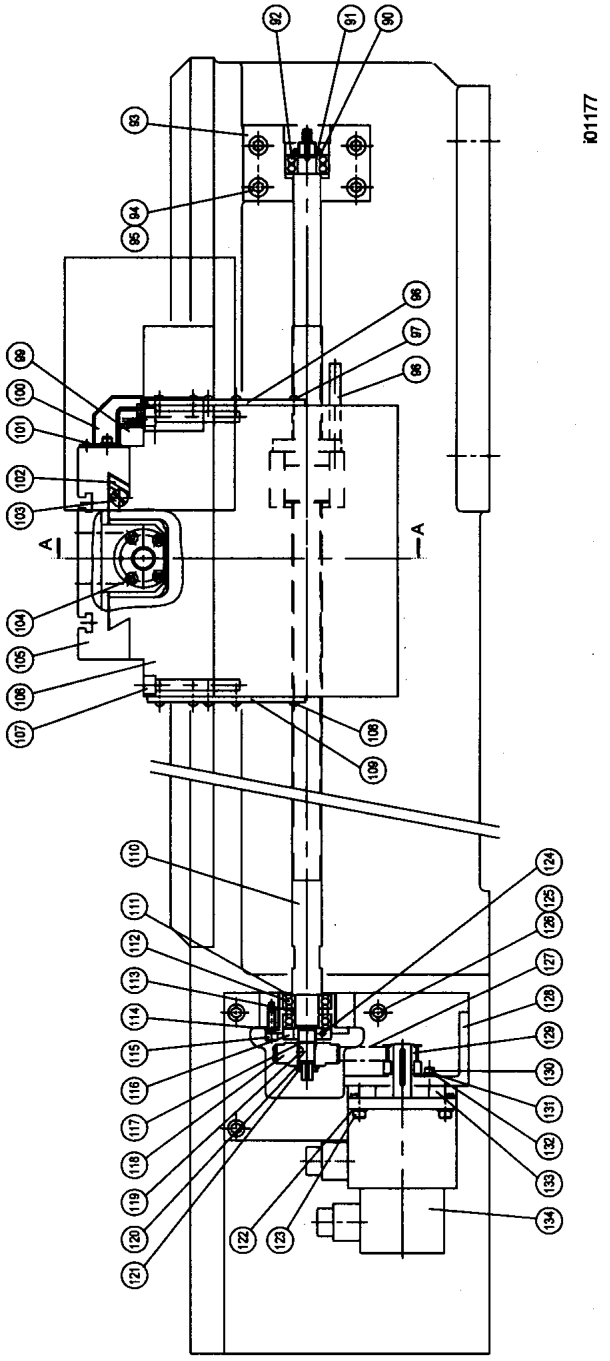


**Figure 5-10 -- Z Axis Drive Train – 2460V**

# Z Axis Drive Train Parts List – 2460V

| Item | Parts No. | Description | Material | Specifications | Q'ty |
|---|---|---|---|---|---|
| 1 | | Socket Head Cap Screw | | M8x30L | 6 |
| 2 | 25200-1 | Wiper - Bedway (Front) | Rubber | 87-0244 | 1 |
| 3 | | Hexagon Socket Screw | | M6x16L | 4 |
| 4 | 77USA-0213 | Nut Seat | FC25 | | 1 |
| 5 | | Socket Head Cap Screw | | M8x30L | 4 |
| 6 | | O-Ring | | P7 | 1 |
| 7 | 20984 | X-Axis Ballscrew | SCM415 | 24-0211 | 1 |
| 8 | 25200-2 | Wiper - Bedway (Rear) | Rubber | 87-0245 | 1 |
| 9 | | Hexagon Socket Screw | | M6x20L | 4 |
| 10 | 87-0228 | Rear Cover Plate | SS41 | | 1 |
| 11 | 24-0728 | X-Axis Motor Cover Plate | SS41 | | 1 |
| 12 | 21994 | Motor - X Axis | | | 1 |
| 13 | | Socket Head Cap Screw | | M8x25L | 4 |
| 14 | | Spring Washer | | M8 | 4 |
| 15 | 24-0208 | Motor Plate | S20C | | 1 |
| 16 | | Symchronous Pulley | Aluminum | | 1 |
| 17 | 500-5M-15 | Belt - X Axis | | | 1 |
| 18 | | Socket Head Cap Screw | | M8x25L | 8 |
| 19 | 77A-0202 | Lock Block | FC25 | | 1 |
| 20 | 50-0325 | Adjusting Screw | S30C | | 4 |
| 21 | 21050-3F | Gib - Z Axis | FC25 | 77A-0218 | 1 |
| 22 | 77A-0216 | Lock Block | FC25 | | 1 |
| 23 | 7204-AVH | Ring - Nilos | | | 1 |
| 24 | 23930 | Bearing Set - Angular Contact | | 7204BECBP | 2 |
| 25 | 15885 | Spacer | S45C | | 1 |
| 26 | 16300 | Bearing Housing | S45C | | 1 |
| 27 | 16314 | Nut - Clamp | S45C | ☐ 19x16UNF | 1 |
| 28 | 16350 | Ferrule | Brass | | 1 |
| 29 | 98481A090 | Key - Woodruff | | #3 (1/8"x1/2") | 1 |
| 30 | 16983-1 | Pulley - Ballscrew | | | 1 |
| 31 | W02 | Lock Washer | | W02 (☐ 15) | 1 |
| 32 | NT02 | Lock Nut | | N02 (☐ 15x32UNF) | 1 |
| 33 | | Socket Head Cap Screw | | 10-32x3/4" | 1 |
| 34 | | Socket Head Cap Screw | | M8x16L | 2 |
| 35 | | Flat Washer | | M8 | 2 |
| 36 | | Spring Washer | | M8 | 2 |
| 37 | 87-0738 | Clamping Block | SS41 | | 1 |
| 38 | | Socket Head Cap Screw | | M10x90L | 4 |
| 39 | | Socket Head Cap Screw | | M6x10L | 2 |
| 40 | | Flat Washer | | M6 | 2 |
| 41 | | Spring Washer | | M6 | 2 |
| 42 | 77USA-0698 | Cam | SS41 | | 1 |
| 43 | | Socket Head Cap Screw | | M8x30L | 4 |
| 44 | | Flat Washer | | M8 | 4 |
| 45 | | Spring Washer | | M8 | 4 |
| 46 | | Socket Head Cap Screw | | M6x20L | 4 |
| 47 | | Flat Washer | | M6 | 2 |
| 48 | | Spring Washer | | M6 | 4 |
| 49 | 87-0730 | Bracket | FC20 | | 1 |
| 50 | | Wire Protector | | 88x45ax1850L | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 51 | | Hexagon Socket Screw | | M5x10L | 11 |
| 52 | 24-0729 | End Cover | SS41 | | 1 |
| 53 | | Socket Head Cap Screw | | M8x20L | 2 |
| 54 | | Flat Washer | | M8 | 2 |
| 55 | | Spring Washer | | M8 | 2 |
| 56 | 77USA-0307 | Switch Seat | SS41 | | 1 |
| 57 | | Socket Head Cap Screw | | M6x20L | 2 |
| 58 | 22551-1 | Switch - Limit | | NBNS543-BO2D12-61-12-10 | 1 |
| 59 | | Socket Head Cap Screw | | M6x16L | 2 |
| 60 | | Flat Washer | | M6 | 2 |
| 61 | | Spring Washer | | M6 | 2 |
| 62 | 77USA-0698 | Cam | SS41 | | 2 |
| 63 | 24-0207 | X Axis Transmission Box | FC30 | | 1 |
| 64 | | Cross Recessed Head Screw | | M6x16L | 6 |
| 65 | 25200-6 | Wiper - Bedway (Right, Rear) | Rubber | 63-0362 | 1 |
| 66 | 25200-7 | Wiper - Bedway (Left, Rear) | Rubber | 63-0363 | 1 |
| 67 | | Socket Head Cap Screw | | M6x25L | 2 |
| 68 | | Spring Washer | | M6 | 2 |
| 69 | | Micro Switch | | BNS543-BO2D12-61-12-10 | 1 |
| 70 | | Socket Head Cap Screw | | M6x16L | 2 |
| 71 | | Flat Washer | | M6 | 2 |
| 72 | | Spring Washer | | M6 | 2 |
| 73 | 87-0714 | Cam | SS41 | | 1 |
| 74 | 25200-4 | Wiper - Bedway (Left, Front) | Rubber | 63-0360 | 1 |
| 75 | 25200-5 | Wiper - Bedway (Right, Front) | Rubber | 63-0361 | 1 |
| 76 | | Cross Recessed Head Screw | | M6x16L | 6 |
| 77 | 87-0715 | Cam | SS41 | | 2 |
| 78 | | Socket Head Cap Screw | | M5x16L | 4 |
| 79 | | Flat Washer | | M6 | 4 |
| 80 | | Spring Washer | | M6 | 4 |
| 81 | | Socket Head Cap Screw | | M6x16L | 4 |
| 82 | | Flat Washer | | M6 | 4 |
| 83 | | Spring Washer | | M6 | 4 |
| 84 | 24-0723 | Operation Box | SS41 | | 1 |
| 85 | 24-0724 | Operation Box Cover | SS41 | | 1 |
| 86 | | Hexagon Socket Screw | | M5x6L | 8 |
| 87 | 77USA-0311 | Apron | FC25 | | 1 |
| 88 | 77USA-0605 | Ballscrew Cover | SS41 | | 1 |
| 89 | | Cover - Round Hole | | ☐ 30 | 1 |
| 90 | N04 | Lock Nut | S45C | N04(☐ 20x16UNF) | 1 |
| 91 | W04 | Lock Washer | | W04 | 1 |
| 92 | 22446 | Bearing - Ball - Double Row Angular Contact | | 2204E-2RSITN9 | 1 |
| 93 | 77USA-0307 | Nut Seat | FC20 | | 1 |
| 94 | | Socket Head Cap Screw | | M12x50L | 4 |
| 95 | | Spring Washer | | M12 | 4 |
| 96 | 77USA-0316 | Bedway - Wiper (Right) | Rubber | | 1 |
| 97 | | Cross Recessed Head Screw | | M6x16L | 3 |
| 98 | | Rod | S45C | | 1 |
| 99 | 87-0727 | Support Bracket | SS41 | | 1 |
| 100 | 97-0716 | Cross Slide Cover | SS41 | | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 101 | | Hexagon Socket Screw | | M6x10L | 5 |
| 102 | 25200-3 | Gib - X Axis | FC30 | 87-2017 | 1 |
| 103 | 17-0321 | Adjusting Screw | S30C | | 2 |
| 104 | | Socket Head Cap Screw | | M8x25L | 4 |
| 105 | 87-0215 | Cross Slide | FC25 | | 1 |
| 106 | 87-0201 | Saddle | FC25 | | 1 |
| 107 | | Socket Head Cap Screw | | M12x90L | 4 |
| 108 | | Cross Recessed Head Screw | | M6x16L | 3 |
| 109 | 77A-0317 | Bedway Wiper (Left) | Rubber | | 1 |
| 110 | 23983 | Ballscrew - Z Axis | SCM415 | 77A-0310A | 1 |
| 111 | 7205-AVH | Ring - Nilos | | AVH7205 | 1 |
| 112 | 23940 | Bearing Set - Angular Contact | | 7205 BECBP | 2 |
| 113 | | Spacer | S45C | | 1 |
| 114 | 16295-1 | Housing - Bearing | S45C | | 1 |
| 115 | | Socket Head Cap Screw | | M8x25L | 4 |
| 116 | 16314 | Nut - Clamp | S45C | ☐ 19x16UNF | 1 |
| 117 | 16350 | Ferrule | Brass | | 1 |
| 118 | 16983-1 | Pulley - Ballscrew | | | 1 |
| 119 | 98481A090 | Woodruff Key | | #3 (1/8"x1/2") | 1 |
| 120 | W01 | Lock Wsaher | | W01 (☐☐12) | 1 |
| 121 | N01 | Lock Nut | | N01 (☐ 12x32UNF) | 1 |
| 122 | | Socket Head Cap Screw | | M8x25L | 4 |
| 123 | | Spring Washer | | M8 | 4 |
| 124 | | Socket Head Cap Screw | | 10-32x3/4" | 1 |
| 125 | | Socket Head Cap Screw | | M12x35L | 4 |
| 126 | | Spring Washer | | M12 | 4 |
| 127 | 400-5M-15 | Belt - Z Axis | | | 1 |
| 128 | 24-0304 | Z Axis Motor Seat | FC30 | | 1 |
| 129 | | Pulley | | | 1 |
| 130 | | Socket Head Cap Screw | | M6x25L | 4 |
| 131 | | Flat Washer | | M6 | 4 |
| 132 | | Spring Washer | | M6 | 4 |
| 133 | 24-0306 | Z Axis Motor Plate | S20C | | 1 |
| 134 | 21994 | Motor - Z Axis | | | 1 |
| 135 | 87-0229 | Front Cover Plate | SS41 | | 1 |

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## 5.1.14 Align Z-Axis Ball Screw Assembly

See Figure 5-9 or 5-10.

1. Recheck machine level. Adjust as necessary.
2. Move carriage to middle of travel.
3. Loosen headstock bearing housing and mounting bracket and loosen tailstock bearing housing.
4. Snug but do not tighten the yoke mounting bolts.
5. Move the ball screw manually and move the carriage to the tail stock end.
6. Tighten the yoke, this will align it vertically.
7. Tighten the tailstock bearing housing.
8. Loosen the yoke and retighten to realign ball horizontally.
9. Using a 3/8" socket extension, move the carriage to the headstock.
10. Tighten the Z-axis housing.
11. Tighten the bearing housing.
12. Turn the ball screw manually with the 3/8" socket extension and move the carriage to the middle of the travel.
13. Loosen the yoke mounting bolts to readjust the apron plate after the bearings have been tightened.
14. Retighten the yoke.
15. Move the ball screw manually and move the carriage through the entire length of the Z-axis. Pay special attention to the areas near the headstock, tailstock, and in the middle of the travel. If there is any binding or rough spots, the alignment procedure must be repeated. The axis should feel equally free throughout the entire range.
16. Using a torque wrench, measure the torque to move the z-axis at each end, and in the middle of the axis travel. The torque reading should be a maximum of 10-15 in-lb.

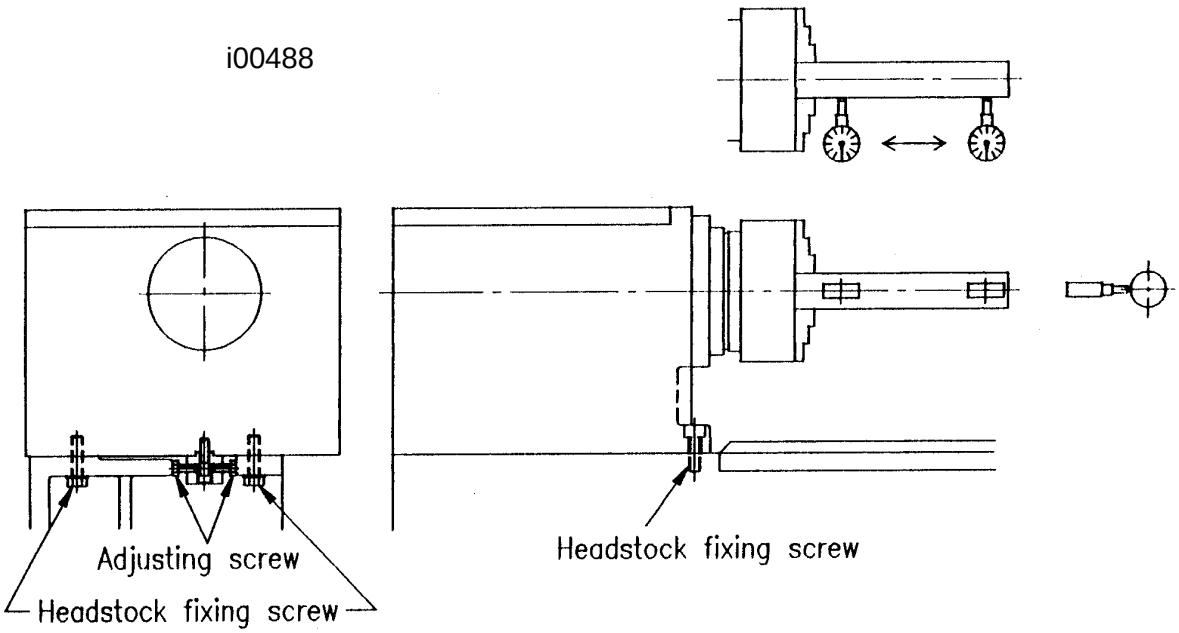
## 5.1.15 Headstock Taper Adjustment

The headstock may be adjusted to remove turning a taper if the taper is caused by a lack of parallelism of the spindle to the bed ways. Ensure that the level of the bed is correct prior to any headstock adjustments.

**1840V & 2460 Machine**

To adjust the headstock alignment, loosen the four socket head cap screws that attach the headstock housing to the bed. Using the adjusting screw located at the rear of the headstock, (see figure 5-11) adjust the headstock position in the direction necessary to remove the taper. Note that the headstock will pivot about a pin located between the two front attaching screws. Tighten the attaching screws and test for taper.

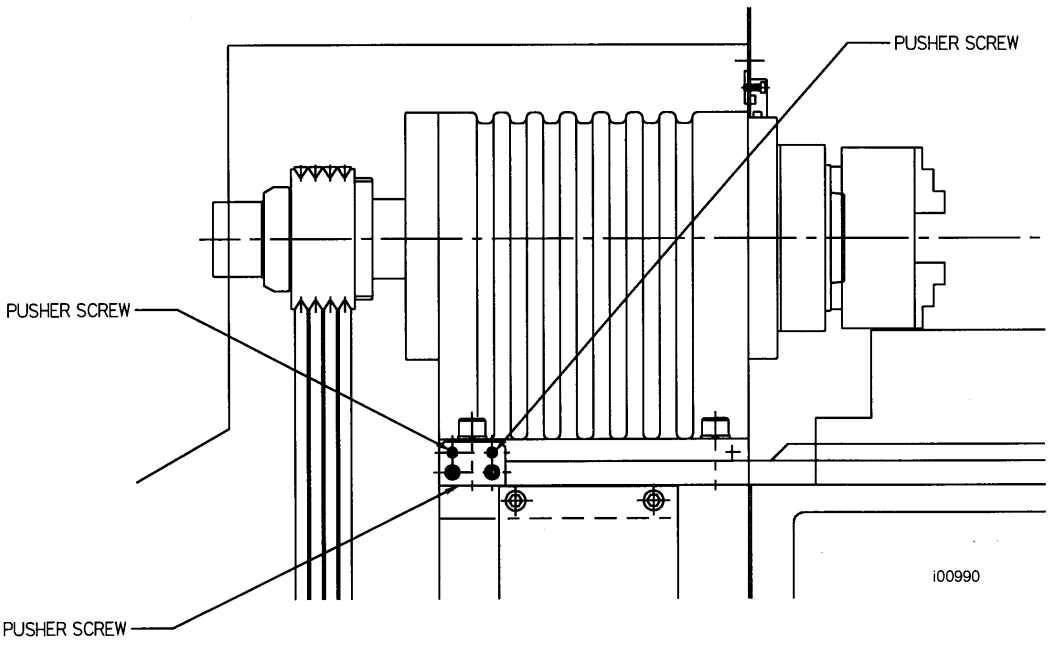
To access the front two cap screws the front cover guard will have to be removed.




## Figure 5-11
## 1840V & 2460V Headstock Taper Adjustment

**1540 Machine**

1. Remove the headstock sheet metal cover.
2. Loosen the bolts holding the headstock splash guard. This should be fine if the adjustments are minor.
3. Loosen the 4 bolts that hold the headstock down to the lathe bed.
4. Use the adjusting screws to pivot the headstock in or out. When facing the encoder side of the headstock the right screw on the adjusting bracket will push the headstock away from you while the left screw will pull the headstock toward you.
5. After the necessary adjustments are made, tighten the 4 bolts that hold the headstock in place. Be careful when tightening these bolts that the headstock does not move.
6. Replace the sheet metal cover.




## Figure 5-12
## 1540 Headstock Taper Adjustment

### 5.1.16 Spindle Bearing Preload – 1840V & 2460V Only

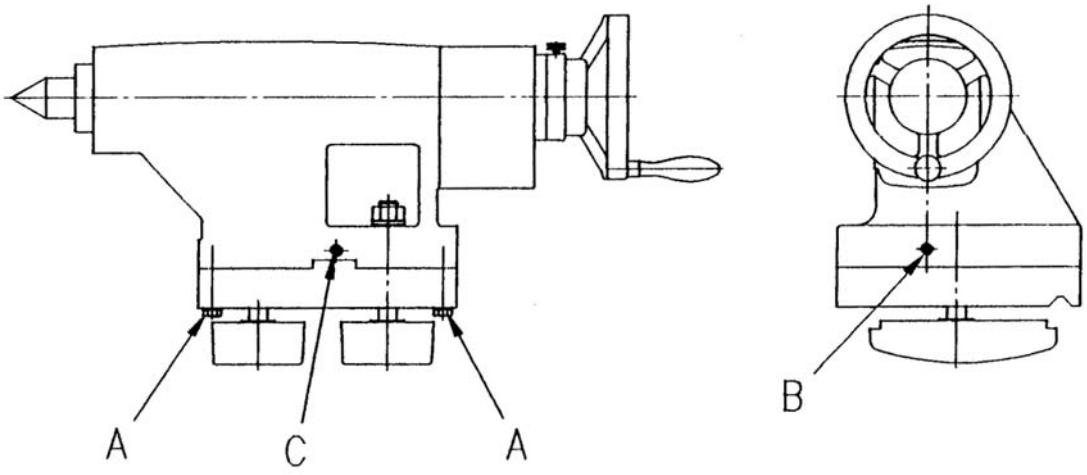
1. Run the lathe for 10 minutes to insure the bearings are lubricated and slightly warmed. Run the lathe at 500 RPM.
2. Stop lathe and set the gearbox in neutral between low and high gears. Using the torque wrench, measure the spindle rolling torque. The acceptable range of rolling torque is around 10 - 15 in-lb. Note that the torque required to start ("breaking away torque") the spindles rotation will be higher.
3. If torque is out of tolerance. Remove the spindle belt cover. You will then need to remove a bearing cover to gain access to the spindle adjusting nut. Loosen the three setscrews on the spindle-adjusting nut before tightening or loosening (Figure 34).
4. Torque too low: Lock the spindle in low gear. With a spanner wrench tighten the adjusting nut. Return the speed selection lever to the neutral position. Measure the rolling torque and repeat until 10 – 15 in -lb. of rolling torque is achieved. Tighten the three setscrews to retain the adjustment.
5. Torque too high: Lock the spindle in gear. With a spanner wrench loosen the adjusting nut two full turns. Place an aluminum block over the end of the spindle and with a hammer drive the spindle forward until it is loose. (Near zero rolling torque) With a spanner wrench tighten the adjusting nut. Return the speed selection lever to the neutral position. Measure the rolling torque and repeat until 10 - 15 in -lb. of rolling torque is achieved. Tighten the three setscrews to retain the adjustment.

### 5.1.17 Aligning Tailstock to Spindle

If there is taper appearing on the workpiece while machining by using the tailstock, the tailstock will need to be realigned to the spindle. Follow the steps below.

1. Insert a gage bar between the spindle and tailstock, attach a base of a dial indicator to the saddle, apply the needle of the indicator to the surface of the bar, then move the saddle through the longitudinal travel. Take the measurement of its maximum difference from end to end for later adjustment.
2. Release the 4 bolts labeled “A” in the drawing.
3. Release the screw labeled “B”.
4. Adjust screw “C” until the tailstock is aligned with the spindle.
5. Tighten up the locking nuts “A”.

i00515




## Figure 5-13 – Tailstock Adjustment

### 5.1.18 Spindle Motor Wiring

The 1540V, 1840V, & 2460V spindle motors are wired for 220 volts (low voltage configuration). The wiring consists of 3 phase power for the motor and 110 V power for the spindle motor fan. Please see the motor junction box diagram for wiring information.

Each junction box contains 6 terminals. Make sure to hook up the wires in the same terminals after the replacement motor is installed. Failure to do so may run the motor in the wrong direction.

The spindle motor fan wires are also found in the junction box. There is 1 hot wire, 1 neutral wire and 1 ground wire. It does not matter which wires are connected to the hot and neutral wires. All grounds from each cable are connected to either of the screws in the junction box.

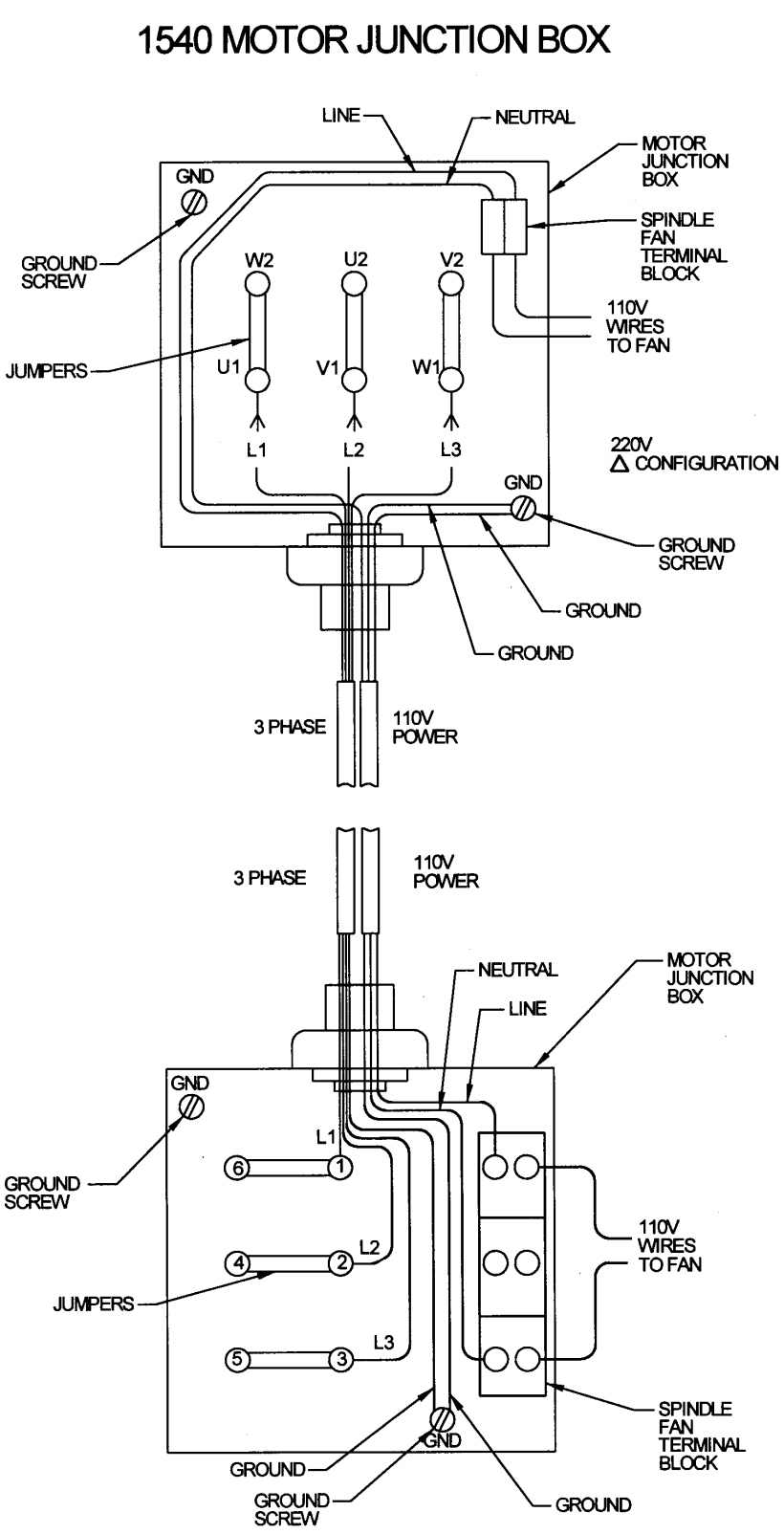



**Figure 5-14 Spindle Motor Wiring**

### 5.1.19 Spindle Cartridge Replacement – 1540V Only (see Figure 5-15)

The spindle and bearings on the 1540 lathe are to be replaced as an assembly. The spindle and bearings are encased within a cartridge that bolts to the headstock. Problems with the spindle or bearings are to be solved by replacing the entire cartridge.

1. Remove the headstock sheet metal cover.
2. Remove the spindle encoder belt.
3. Remove the chuck guard from the headstock splash shield.
4. Loosen the spindle motor and remove belt from spindle to headstock pulley.
5. Remove headstock splash shield for easier access to the cartridge.
6. Remove the rear clamping plate from the headstock casting. (Item 3) This can be done by removing 8 (M6) SHCS and 6 (M8) SHCS. This will allow the spindle assembly to easily slide through the opening of the casting. This plate may be left on but it makes it more difficult to remove the cartridge. If it is left on the M6 SHCS will still need to be removed.
7. Remove the 6 (M12) SHCS that hold the front of the cartridge to the headstock. Once these are remove the cartridge should slide out of the headstock. This assembly weighs over 100 lbs please get additional help to remove the cartridge.
8. Slide the new cartridge into the casting. Make sure to place the drain holes pointed down towards the floor when mounting. This will allow any coolant that makes it in between the spindle and cartridge to drain out.
9. Reverse the steps to install the new cartridge.

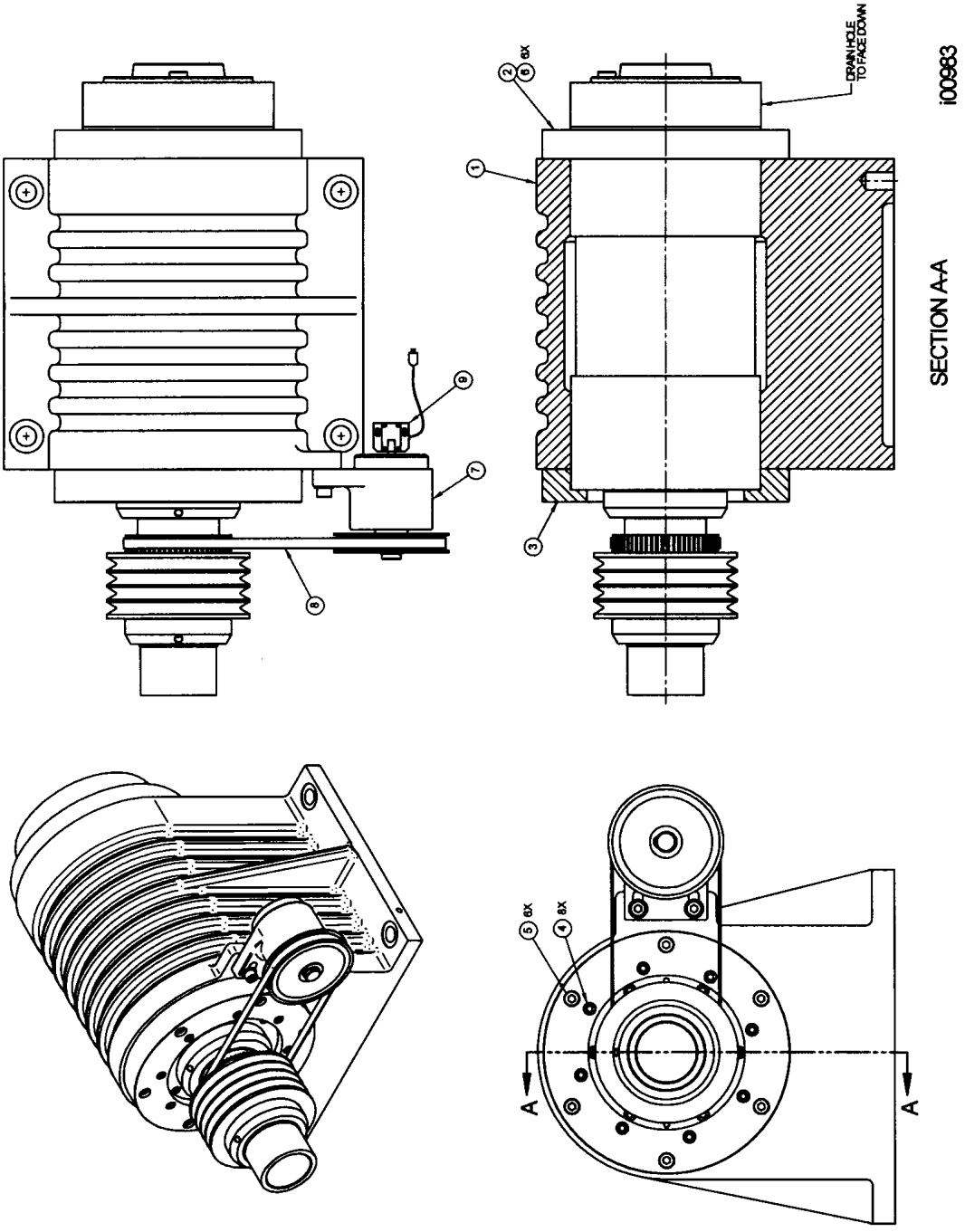



**Figure 5-15**
**1540 Headstock Cartridge Removal**

## 1540 Headstock Cartridge Parts List

| Item | P/N | Title | Use As | Qty |
|---|---|---|---|---|
| 1 | 22171 | 24-0101-00 | EA | 1 |
| 2 | 22170 | SPINDLE ASSY - 1540V LATHE -PT4 | EA | 1 |
| 3 | 22183 | 24-0113-00 | EA | 1 |
| 4 | M6-1.0X20 25B | SCREW-SHCS-STL-BO | EA | 8 |
| 5 | M8-1.25X35 25B | SCREW-SHCS-STL-BO | EA | 6 |
| 6 | M12-1.75X35 25B | SCREW-SHCS-STL-BO | EA | 6 |
| 7 | 22206 | ENCODER DRIVE ASSY - LATHE | EA | 1 |
| 8 | 23359 | BELT - HEADSTOCK ASSY - 1540V | EA | 1 |
| 9 | 16873 | SPINDLE ENCODER ASSY | EA | 1 |

i00983

# 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 Cross Slide Gib Adjustment*

1. Remove the yoke bolts from the top of the cross slide and slide it back and forth and feel for any looseness in the system. If it is loose tighten up the adjusting screws.

   *NOTE: Adjustments should be made where the gibs are worn the worst.*

2. Turn the X-axis ball screw with a torque wrench and measure the torque. The torque should be less than 15 in/lb. and consistent over the travel of the X-axis. If the measurement is higher than this then loosen the gib. Make sure the cross slide is aligned properly. One easy way to check for this is to remove the yoke bolts and see if the yoke springs back into position. Misalignment is also evident if the torque is higher when the yoke is up against the rear bearing housing.

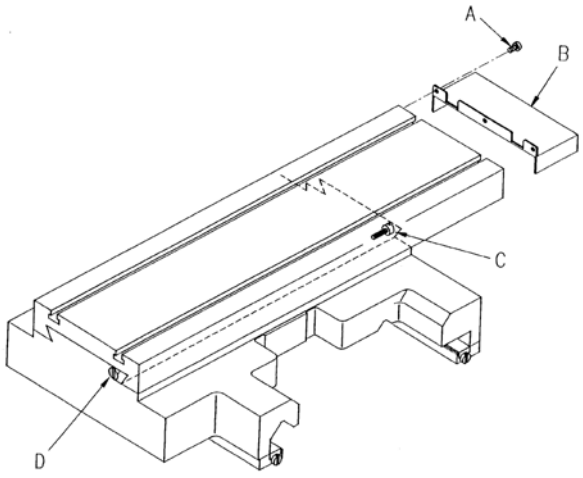



**Figure 5-16**
**X Axis Gib**

*5.2.1.2 Z-Axis Gib Adjustment*

1. Mount a dial indicator on the Z-axis ways and locate on top of the carriage.
2. Lift the carriage up to measure the amount of play. The dial indicator should not move more than 0.001". If it moves more tighten the gibs. Make sure not to over tighten the gibs.
3. This procedure with the dial indicator will need to be done in the front and rear of the saddle.

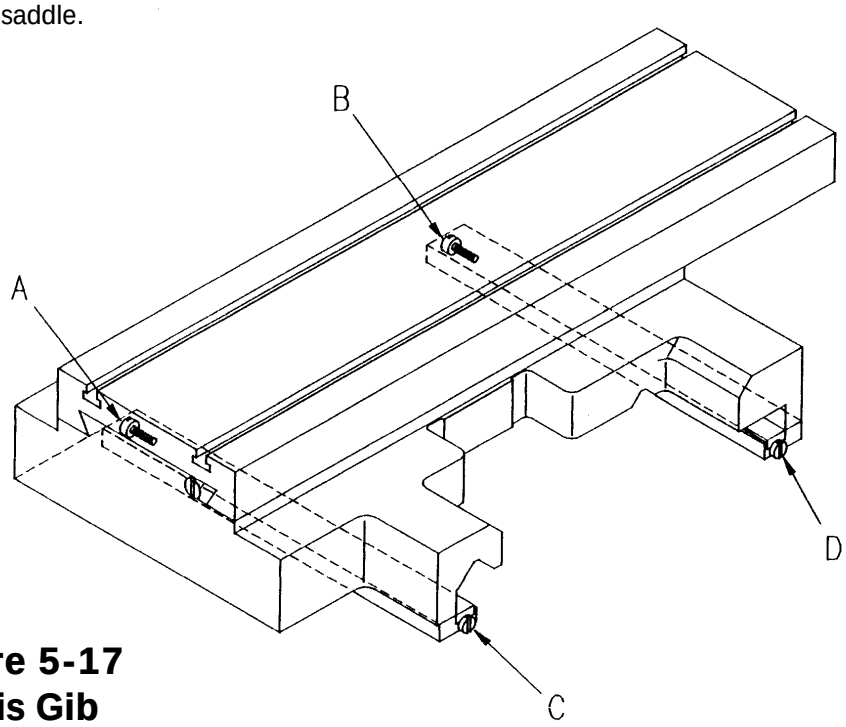



**Figure 5-17**
**Z-Axis Gib**

## 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.

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.

*5.2.2.1 Calibration*

*NOTE: Calibration usually is only done after replacing a computer module or adjusting the drive train.*

1. Recheck machine level and adjust as necessary.
2. Press the "SERV CODE" soft key.
3. Input 123 on the keyboard, then press the "INC SET" key.
4. Input the "X" key to tell the control the x-axis is being calibrated.
5. Place the .0001 indicator in the spindle and set up the metric standard on the cross slide. Make sure the standard is parallel to the cross slide by using a combination square. Ensure that the standard is set up so that the readings will

be taken with the cross slide extended towards the operator and moving in towards the motor end of the X-axis.

6. When the indicator is zeroed at the beginning of the standard press the “INC SET” key.
7. Move the cross slide towards the motor side of the x-axis until the indicator zeros on the end of the standard. Input 300 on the keyboard.
8. If the calibration was successful the screen will return to the set up screen.
9. Press the “SERV CODE” soft key.
10. Input 123 on the keyboard, then press the “INC SET” key.
11. Press the “Z” key to tell the control that the z-axis is being calibrated.
12. Set up the metric standard on the Z-axis ways.
13. Set up the magnetic base and .0001 indicator on the cross slide.
14. When the indicator is zeroed at the beginning of the standard press the “INC SET” key.
15. Move the saddle towards the chuck until the indicator zeros on the end of the standard, then press the “INC SET” key.
16. Input 150 on the keyboard.
17. If the calibration is successful the screen will change to the set up screen.

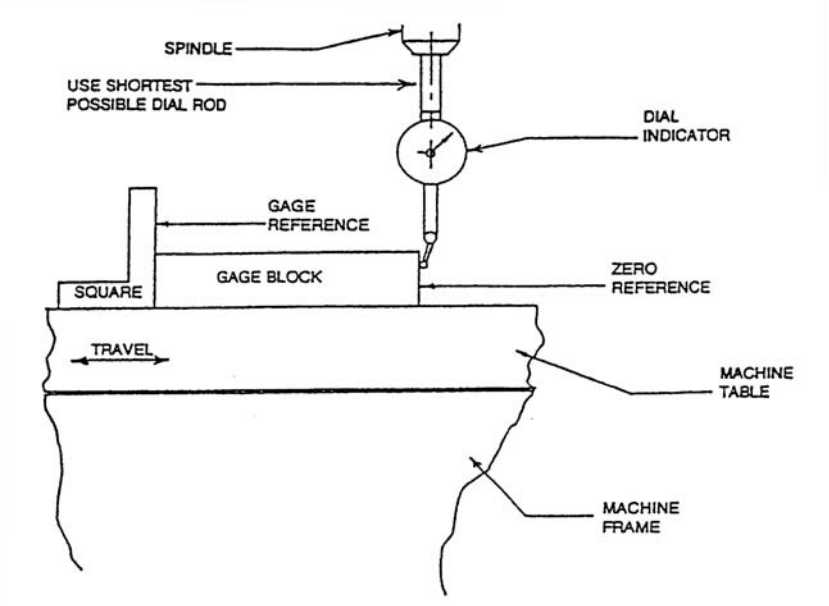



**Figure 5-18**
**Calibration Set-Up**

*5.2.2.2 Backlash Compensation*

**Code 127: Calculate X or Z Backlash Constant**

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 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 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.
Be sure not to enter too much backlash on any given axis. Too much backlash in the system may cause bi-directional repeatability problems or axis motor searching.

## 5.2.3 Lubrication

### *5.2.3.1 1840V & 2460V Headstock Lubrication*

An oil pump provides lubrication for an even distribution of oil to all the gears and bearings in the headstock. One of the oil lines pumps oil to a site glass located on the

headstock. Periodically check to see that oil is flowing. Oil flows to this site glass only when the spindle is running.

The plug to drain the headstock is located under the spindle cover towards the bottom of the casting. See the figure below. Oil can be added to the reservoir by a plug in the top of the headstock cover or by removing the cover and pouring it into the headstock. There is a level site glass located under the spindle cover. The headstock reservoir holds approximately 3 gallons. Fill the headstock with Mobil DTE 24 oil or an equivalent grade.

The headstock gearbox oil must be drained and flushed after the first 150 hours of operation. A small percentage of kerosene may be added to the gearbox to flush out dirt and sediment. Operate the machine for several minutes without load so that the flushing oil can circulate through the reservoir and remove the dirt. The flushing oil must then be drained and new oil added. Do not flush with solvents that will soften the paint. Thereafter, the oil should be flushed and drained every 1500-2000 hours of operation.

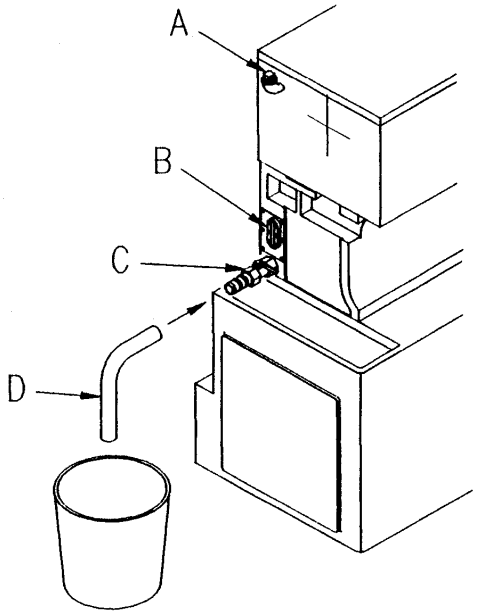



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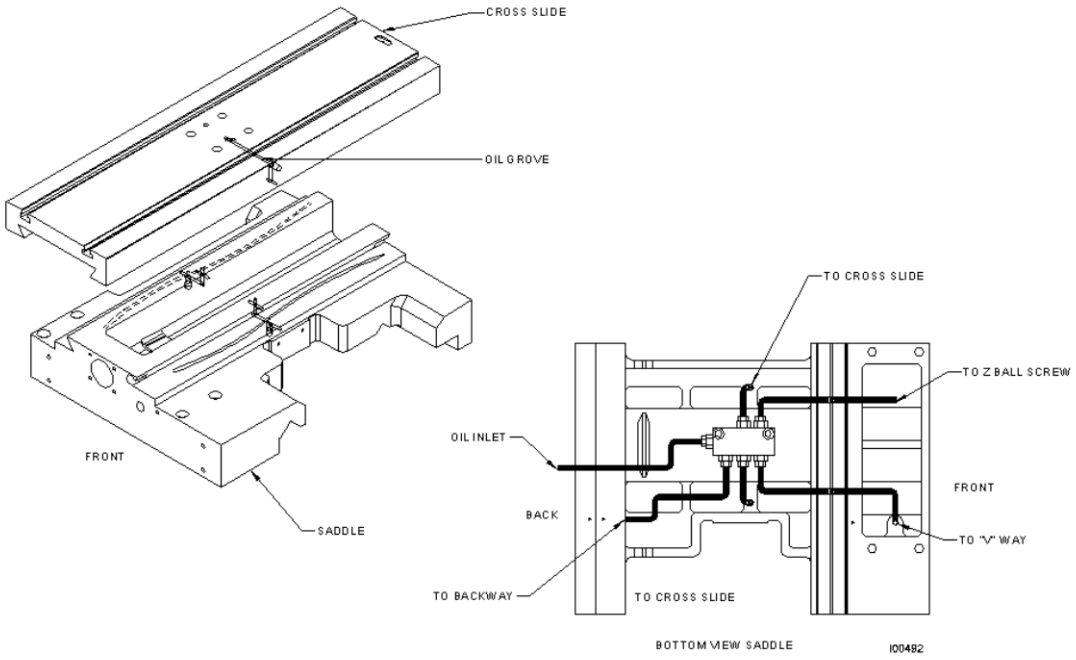
**Figure 5-19**
**Headstock Oil Removal**




## Figure 5-20
## 1540V, 1840V, & 2460V Way Lubrication

*5.2.3.2 Tailstock*

Three oilers located on top of the spindle housing lubricate the spindle and screw. The bedways on which the tailstock slides should be cleaned and oiled frequently.

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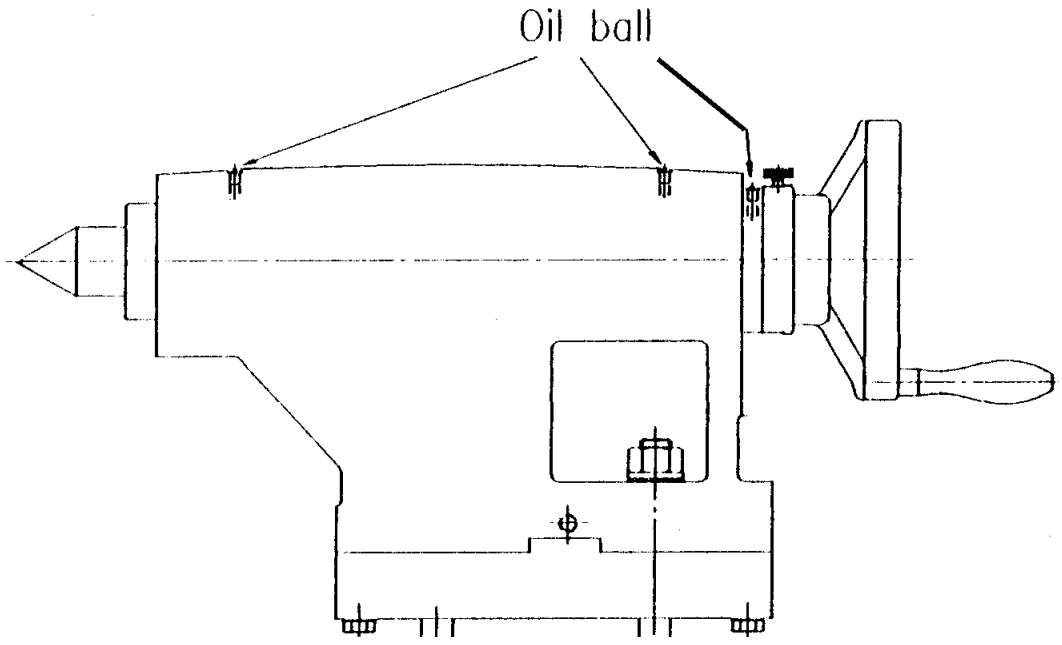



## Figure 5-21 – Tailstock Lubrication

#### *5.2.3.3 Miscellaneous Information*

For all oilers on the machine, use medium S.A.E. NO. 30 machine oil. Before filling reservoirs or oil cups, always wipe off with a clean rag any accumulation of old oil, grease or dirt that might get into a part being lubricated.

Do not mix detergent type automotive oil, or multi-purpose oils with the regular grade of S.A.E. No. 30 lubricating oil.

### 5.2.4 X & Z Limit Switch Adjustments

#### *5.2.4.1 X-Axis Limit Switch-Stop Installation & Adjustment*

The limit switch-stops for the X-axis are mounted to the side of the crosslide. They are slotted for adjustment front to back. Each limit switch-stop must be set to a specific distance from the end of the crosslide in order to maximize travel and simultaneously prevent serious damage to the machine in the event of a crash. All limit switches are set at the factory for maximum travel. The switch is mounted to the carriage. The switch as well as the stops are covered by a sheet metal cover.

#### *Procedure for setting X limit switch:*

1. Loosen the stops on each side of the crosslide.
2. Slowly move the crosslide to the extremes of travel.
3. 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.

4. Using the DRO display, back the table off 1/2".
5. Tighten the stops in place.
6. 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.

#### *5.2.4.2 Z-Axis Limit Switch-Stop Installation & Adjustment*

The limit switch-stops for the Z-axis are mounted on the side of the bed at the headstock side and attached by a bracket to the tailstock for the positive direction. Each limit switch-stop must be set to a specific distance from the headstock and tailstock to maximize travel and simultaneously prevent serious damage to the machine in the event of a crash. The limit switch bracket and stops contains slotted holes, which allow for side to side positioning adjustments of the limit switch assembly.

#### *Procedure for setting Z limit switch:*

1. Slowly move the carriage to the front of the spindle with the handwheel until you are approximately ¾" from the spindle.

**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.

2. Lock the stop in place and make sure when you hit the stop the switch is triggered and the carriage comes to rest before hitting the spindle. Make sure you have adjusted the stop far enough away to prevent a crash.

**WARNING!**

The Z axis limit switch at the headstock end is set to prevent crashes into the spindle. It is not adjusted for the various chuck or collet closer combinations.

3. Perform a similar adjustment at the tailstock end of the bed. Make sure the carriage does not hit the tailstock when the limit switch is triggered at maximum feedrate. At the tailstock end there is slight adjustment up and down and more adjustment side to side.

# 6.0 Indexer Options

## 6.1 Dorian Indexer Option

### 6.1.1 Field Installation Instructions

1. Turn power on to the machine.
2. Verify air has been hooked up to the machine. The air regulator is mounted to the bottom left of the electrical cabinet.
3. Make sure the on/off switch on the white box on top of the chip guard is turned on. When it is on a green light will be illuminated.
4. Go to SETUP mode under TOOL GROUPS to verify the indexer softkey is activated. Then press the INDEXER key to activate the indexer. It will turn gray when activated.
5. Go to DRO mode and press **TOOL #** and enter a number from 1 to 8. The indexer should move to this tool number. The tool number on the indexer is found right above the tool slot. If the tool # in the control and on the indexer is in the wrong position, enter Service Code 147 to re-initialize the indexer.
6. To verify the indexer is working properly run a program with all 8 tools. To run the program, enter a home position in Setup Mode. Make sure you set the X and Z absolute zero position 12 to 18 inches from the chuck. Set the home position to X = 3 and Z = 3. Run a program and make sure the indexer moves to the correct tool stations programmed. Verify that the indexer positions to each tool station. If there is a problem refer to the troubleshooting section.

### 6.1.2 Removing the Indexer from the Lathe

1. Turn the main power off to the machine.
2. Unhook the air line from the air regulator.
3. Disconnect 2 air lines and 2 electrical lines. The 2 air lines need to be disconnected at the white box that is mounted on the top of the chip enclosure. The fittings are the quick-disconnect type where you push in on the connector and pull the air lines loose. One electrical cable needs to be removed from the white electrical box and one cable from the black electrical box. All four connections to the indexer are inside a flexible black conduit. See Figure 6-2 at the end of this section for layout of cable connections.
4. Unhook the black cable from the brackets that run on top of the chip enclosure.
5. Remove the cabling that goes runs across the crosslide.
6. Remove the indexer from the cross slide. It is fastened down with 6 socket head cap screws to the riser block. Remove the riser block from the cross slide. You may want to remove the indexer and riser block assembled together but it may be difficult to slide the whole thing out of the T-slots. Be careful, the indexer weighs approximately 80 lbs.
7. To re-install the indexer, follow these steps in reverse order. Make sure you install the riser block at least 2 ¼" from the front of the cross slide**, not the front bracket**. Failure to do this will cause the indexer to hit the sliding door when the cross slide is all the way toward the operator.

### 6.1.3 Troubleshooting the Indexer

The following fault messages will appear on the screen when there is a problem with the indexer. There are also LED's in the black box on top of the chip guard that may be helpful when troubleshooting the indexer. Please refer to that section below.

- *Fault 85 – Impossible Tool Position*
  This message will appear if the indexer goes to a tool number that you did not select. For example, the operator chose Tool 2 and the indexer went to Tool Station 6. To fix this problem, re-initialize the system by choosing Service Code 147. If this does not solve the problem, refer to the LED troubleshooting section.
- *Fault 86 – Indexer Power Problem*
  This message will appear if the power is interrupted to the indexer. It could indicate that no power or low power is getting to the indexer. The black box on top of the chip enclosure receives 115V power from the main electrical cabinet and sends it to the white box. From there it is reduced to 24V by a power supply in the black box and reduced to12V in the white box by a transformer. If there is a power problem you will need to back track to find out where the power is being interrupted. If voltage drops outside of the 20–28 volts range in the black box this message could also appear. To make sure power is getting to the white box verify that the green light on the side of the box is illuminated. If it is not, check the fuse next to the light.
- *Fault 87 – Indexer Air Pressure Problem*
  This message will appear if the air pressure sensor senses low air or no air pressure. The recommended air pressure for the indexer is 80 psi. The air pressure should be at least 70 psi and no more than 150 psi for the indexer to work correctly. **Do not exceed 150 psi. This will void the warranty on the indexer.** Check to make sure the air regulator is set to at least 80 psi.
- *Fault 88 – Indexer Not Initialized*
  This message will appear if the indexer does not know its present position. An example of this would be if the turret stops in the middle of a tool change. An interruption of power or air may cause this fault. Pressing the E-stop button can also cause this problem if the tool is not in a known position. Initialize with Service Code 147.
- *Fault 89 – Indexer Time Out*
  This message appears if the indexer does not get to position after a few seconds. This may be caused by an internal problem inside the indexer such as a broken gear or jammed component. Very low air pressure may also cause this fault. It should take no longer than 2 or 3 seconds for the indexer.

### 6.1.4 Troubleshooting from LED's in Black Box

Inside the black box, which is mounted on top of the chip enclosure, there is an LED that signifies indexer position. It reads numbers from 1 to 8. There are also directional LED's to signify how far and in what direction the indexer is told to rotate by the control. Remove the lid from the box in order to see the LED's. The number in the black box should correspond to the tool number of the indexer. If these numbers are different, re-initialize the indexer with Service Code 147. The directional LED's will be helpful in verifying that the command from the control is getting to the black box and to the indexer. If the command is getting to the black box but not the indexer, there is a problem with the indexer. For example, if you command the indexer to move from Tool 1 to Tool 3 the LED for -90° should light up for a second. When facing the indexer, the rotation of the turret in a CW direction signifies a negative move and a CCW move signifies a positive move. Since the indexer takes the shortest path between tool changes, it can only move 45, 90, 135 in the positive direction, and 45, 90, 135 in the negative direction.

### 6.1.5 Indexer Encoder Re-Alignment

This procedure is necessary only if the indexer does not return to a true home position after initializing with Service Code 147. If the encoder is misaligned the turret will consistently be off by some angle. In order to perform the operation it may be necessary to use two people. One will adjust the encoder while the other watches the strobe 2 light inside the black box on top of the chip enclosure. If the encoder is misaligned, a LED labeled strobe 2 will be lit.

1. Remove the 4 screws that hold the back cover onto the indexer. The encoder is mounted to the far right of the indexer if you are at the front of the machine and facing it. Please refer to the Dorian manual that is included with the machine for an illustration.
2. If initialization does not work, attempt to index the indexer until it sits in a true position. A true position means the tool stations are parallel to the crosslide. This can be done by reversing the air lines on the indexer. Reverse the blue and red air lines and then use a breaker bar or piece of square stock to rotate the turret manually to a true position. Make sure to reverse the air lines back when complete. It will be obvious when the indexer is back to a true position. The indexer moves in approximately 15° increments.
3. Using an allen wrench, loosen the set screw holding the encoder onto the shaft.
4. Rotate the encoder with the allen wrench until the strobe 2 light turns off in the black box. Carefully tighten down the setscrew making sure not to move the encoder. If the encoder moves, the number in the box will disappear and it will be necessary to re-align the encoder.
5. Reassemble the unit.

### 6.1.6 Indexer Maintenance

Dorian recommends that the indexer be lubricated twice a year after the first year. The worm and worm gear should be lubricated with quality lithium based grease every 6 months after the first year. Remove the side cover, top cover and stepper motor and grease the gears. When re-mounting make sure the O-ring and side seal are intact so that no coolant can enter the turret. Refer to the Dorian manual that is supplied with each machine for more information and drawings.

### 6.1.7 Warranty Issues

Dorian warrants the Dorian Indexer for 1 year. If it is determined that there is a problem with the indexer it will need to be sent back to Dorian for repair. Please refer to the Dorian manual that was shipped with the indexer. Control problems are warranted by Southwestern Industries, Inc. for 1 year.

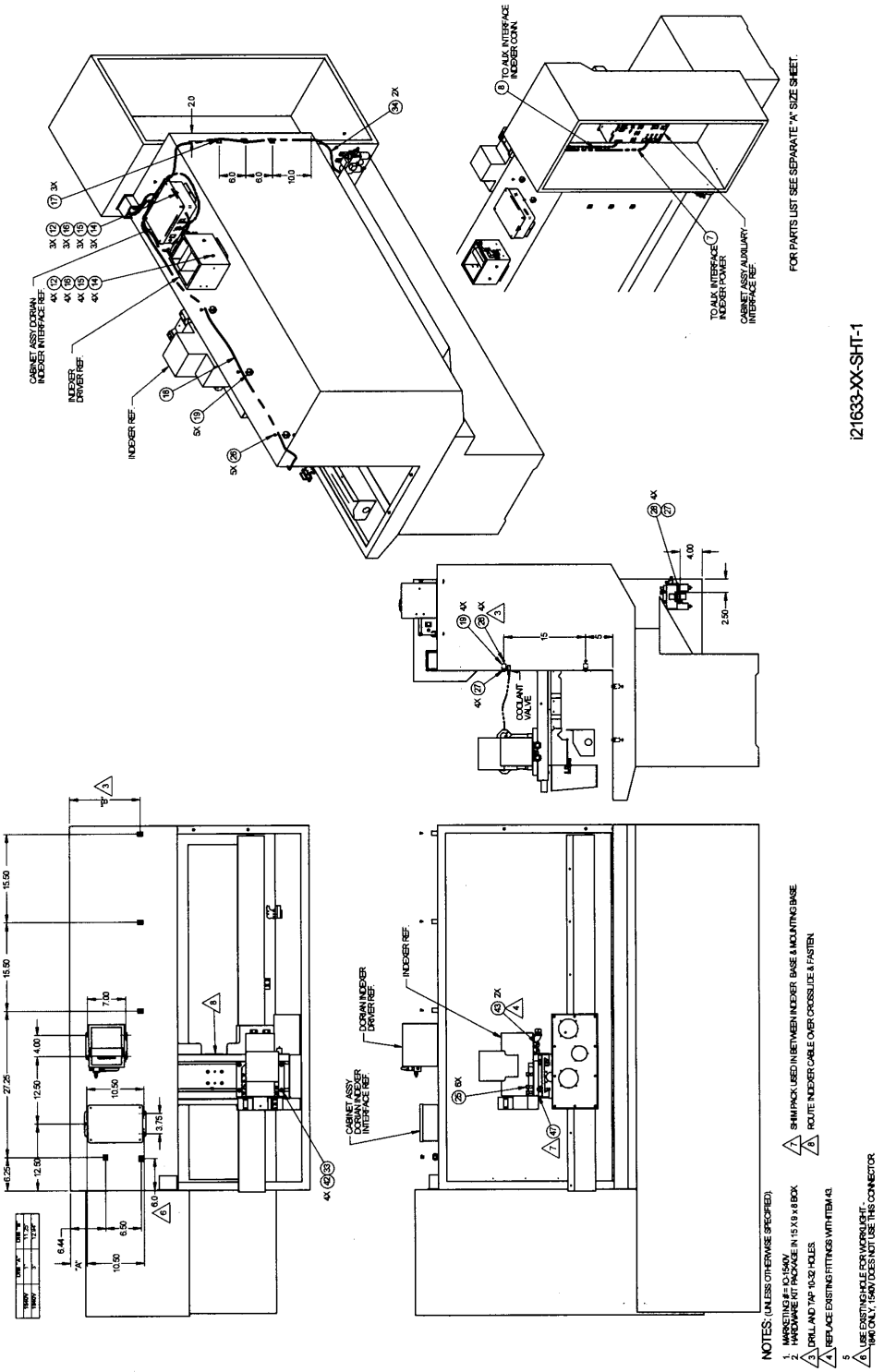



**Figure 6-1**
**Indexer Mounting**

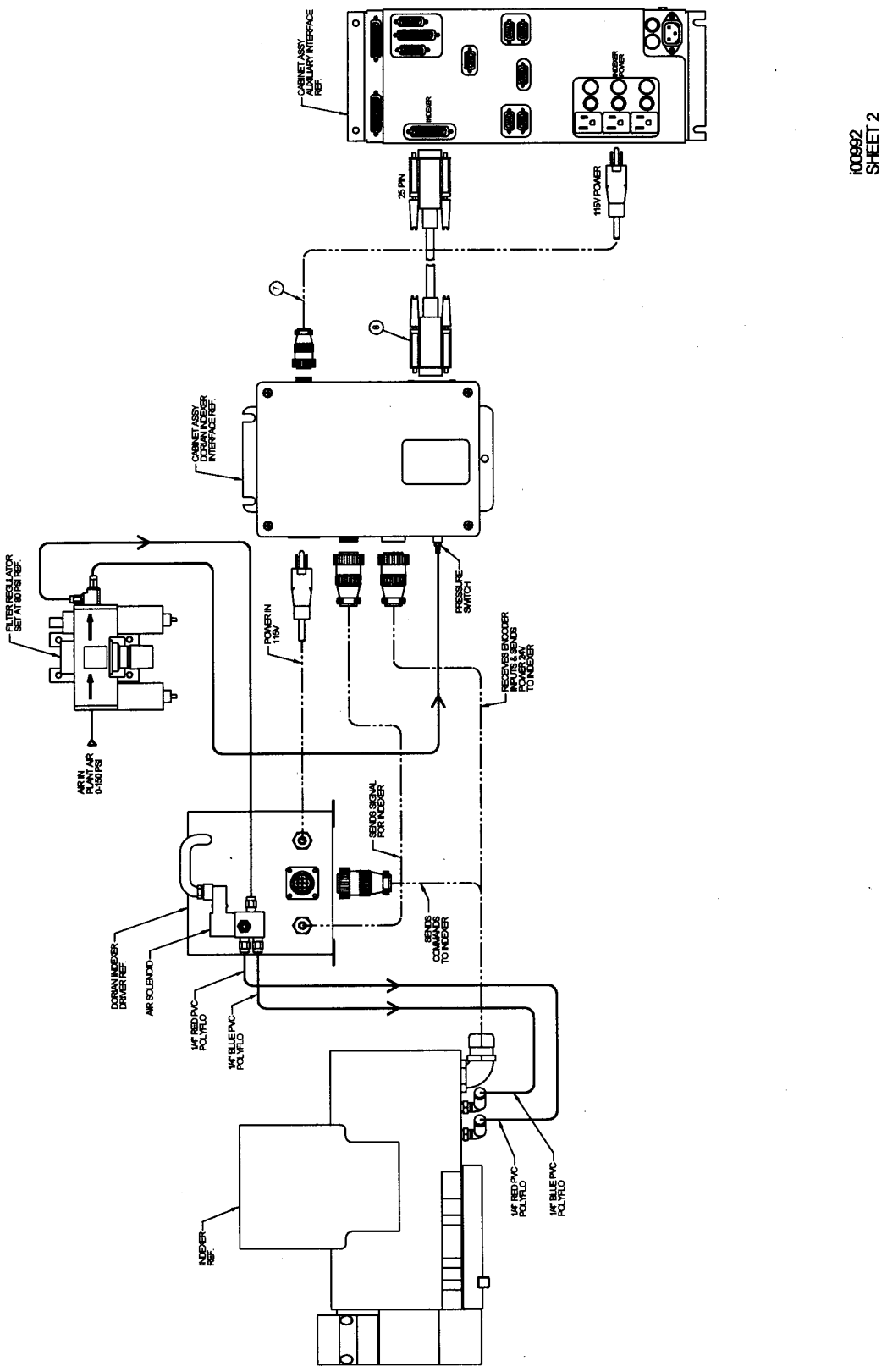



**Figure 6-2**
**Indexer Cable Routing**

## Dorian Indexer Spare Parts List

| Item | P/N | Title |
|---|---|---|
| 1 | 22852 | CABLE ASSY-DORIAN POWER INDEXER |
| 2 | 22556-15 | CABLE ASSY-PT4-PARALEL PORT-EB TO PENDANT |
| 3 | 21615 | INDEXER ASSY - MODIFIED DORIAN - 3/4 IN |
| 4 | 21615-2 | INDEXER ASSY - MODIFIED DORIAN - 1 IN |
| 5 | 21604 | CABINET ASSY-DORIAN INDEXER INTERFACE |
| 6 | 21630 | INTERFACE BOX – DORIAN – WHITE |
| 7 | 22065-2 | MODULE ASSY-PT4-EB-SPIN/AUX I/F-LATHE |

# 6.2 4-Tool Indexer Option

### 6.2.1 Field Installation Instructions

1. Turn power on to the machine.
2. Go to SETUP mode under TOOL GROUPS to verify the indexer softkey is activated. Then press the INDEXER key to activate the indexer. It will turn gray when activated.
3. Run service code 147 to initialize the indexer.
4. Go to DRO mode and press **TOOL #** and enter a number from 1 to 8. The indexer should move to this tool number. The tool number on the indexer is found on top of each tool.
5. To verify the indexer is working properly run a program with all 4 tools. To run the program, enter a home position in Setup Mode. Make sure you set the X and Z absolute zero position 12 to 18 inches from the chuck. Set the home position to X = 3 and Z = 3. Run a program and make sure the indexer moves to the correct tool stations programmed. Verify that the indexer positions to each tool station. If there is a problem refer to the troubleshooting section.

### 6.2.2 Removing the Indexer from the Lathe

1. Turn the main power off to the machine.
2. Disconnect 2 cables from the black box mounted on top of the lathe. See Figure 6-5 at the end of this section for layout of cable connections.
3. Unhook the black cable from the brackets that run on top of the chip enclosure.
4. Remove the cabling that goes runs across the crosslide.
5. Remove the indexer together with the mounting base from the cross slide. It is fastened down with 4 socket head cap screws to the crosslide. Be careful, the indexer weighs approximately 70 lbs.
6. To re-install the indexer, follow these steps in reverse order. Make sure you install the riser block at least 2 ¼" from the front of the cross slide**, not the front bracket**. Failure to do this will cause the indexer to hit the sliding door when the cross slide is all the way toward the operator.

### 6.2.3 Troubleshooting the Indexer

The following fault messages will appear on the screen when there is a problem with the indexer. There are also LED's in the black box on top of the chip guard that may be helpful when troubleshooting the indexer. Please refer to that section below.

- *Fault 85 – Impossible Tool Position*
  This message will appear if the indexer goes to a tool number that you did not select. For example, the operator chose Tool 2 and the indexer went to Tool Station 3. To fix this problem, re-initialize the system by choosing Service Code 147.
- *Fault 86 – Indexer Power Problem*
  This message will appear if the power is interrupted to the indexer. It could indicate that no power or low power is getting to the indexer.
- *Fault 87 – Indexer Air Pressure Problem*
  This message will appear if the air pressure sensor jumper is faulty on the black cable breakout box on top of the lathe.
- *Fault 88 – Indexer Not Initialized*
  This message will appear if the indexer does not know its present position. An example of this would be if the turret stops in the middle of a tool change. An interruption of power or air may cause this fault. Pressing the E-stop button can also cause this problem if the tool is not in a known position. Initialize with Service Code 147.
- *Fault 89 – Indexer Time Out*
  This message appears if the indexer does not get to position after a few seconds. This may be caused by an internal problem inside the indexer such as a broken gear or jammed component. Very low air pressure may also cause this fault. It should take no longer than 2 or 3 seconds for the indexer.

### 6.2.4 Troubleshooting the Cable Breakout Box

The following describes the inputs and outputs from the PLC used to run the 4 tool indexer.

#### *6.2.4.1 PLC Inputs*

There are 8 inputs to the PLC, 7 of which are used for the 4 tool indexer. For inputs 1 through 4, the corresponding LED light will be on depending on which tool is in position. In other words, when the indexer is locked for tool 1, the I1 LED on the PLC will be lit. For inputs 5, 6 and 7, the LED light for these will only be on for a second or so when a new command is sent to the PLC from the control. A change of tool in DRO mode or within a program will cause these lights to come on. See further below for which lights will come on when changing tools.

I1 = Turret proximity sensor position #1
I2 = Turret proximity sensor position #2
I3 = Turret proximity sensor position #3
I4 = Turret proximity sensor position #4
I5 = Select #1
I6 = Select #2
I7 = Select #3
I8 = not used

I1 - I4 is from the 4 tool indexer - identifies turret position
I5 - I7 is from SWI control - identifies index command

The 3 select lines gives us 8 possible incremental moves as follows. A few examples have also been given.

+1 tool (select 1 and 2) For example, if you command the indexer to move 1 tool position, like from tool 2 to 3, you will see the select 1 and 2 lights come on briefly.

+2 tools (select 2)

+3 tools (select1) For example, if you command the indexer to move 3 tool positions, like from 1 to 4, you will see the select 1 light come on briefly.

+4 tools (select 1, 2, and 3) – tool stays where it is

-1 tool (select2 and 3)

-2 tools ( select 1 and 3) For example, if you command the indexer to move from tool 4 to tool 2,you will see the select 1 and 3 lights come on briefly.

-3 tools ( select 3)

don't move ( nothing active) this means no commands were sent, therefore no lights come on.

The following table reflects the description above:

| ITEM | + 1 Tool | + 2 Tools | + 3 Tools | + 4 Tools | - 1 Tool | - 2 Tools | - 3 Tools | DON'T MOVE |
|---|---|---|---|---|---|---|---|---|
| **SELECT 1** | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| **SELECT 2** | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| **SELECT 3** | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |

#### *6.2.4.2.1 PLC Outputs*

There are 6 outputs from the PLC to the 4 tool indexer.

Q1 = Motor on - fwd direction This light will be on when the indexer motor is running forward

Q2 = Motor on - rev direction This light will be on when the indexer motor is running reverse

See the table below for the bit patterns for corresponding tools.

Q3 = Bit #1

Q4 = Bit #2

Q5 = Bit #3

Q6 = Bit #4

Q1 & Q2 goes to the motor driver PCB

Q3 - Q6 goes to SWI control - identifies position feedback to control

The following table reflects the meaning of the bit signals back to the control. Keep in mind that the 4 tool indexer reports back up to 4 absolute positions to the PLC and the PLC will output up to 8 absolute positions back to the control.

| ITEM | TOOL 1 | TOOL 2 | TOOL 3 | TOOL 4 | TOOL 5 | TOOL 6 | TOOL 7 | TOOL 8 |
|---|---|---|---|---|---|---|---|---|
| **BIT 1** | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| **BIT 2** | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| **BIT 3** | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| **BIT 4** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

You can verify the bit pattern below by getting a voltmeter and seeing if a 5 volt signal is present when a bit reads 1 in the above table. For example, if the indexer is physically on tool 3, bits 1 and 2 should read 5 volts and bits 3 and 4 should read 0 volts. This procedure is best done when checking the inputs 1 through 4 above with the outputs.

To measure a bit with your voltmeter you will need to do the following. For example, for bit 1, place you meter across Q3 on the PLC and a ground point.

#### *6.2.4.3 Motor Driver Settings*

Please see the following drawing for an illustration of how the pots are to be adjusted on the motor driver board in the cable breakout box. The flat part of the pot should be in the location shown in the figure below. Customer service may require a visual inspection of these settings. Also, please verify the position of 2 switches on the motor drive board.

**CAUTION!**
Do not adjust any of these settings. This may cause the indexer to not run correctly or not run at all and will void the warranty of the hardware.

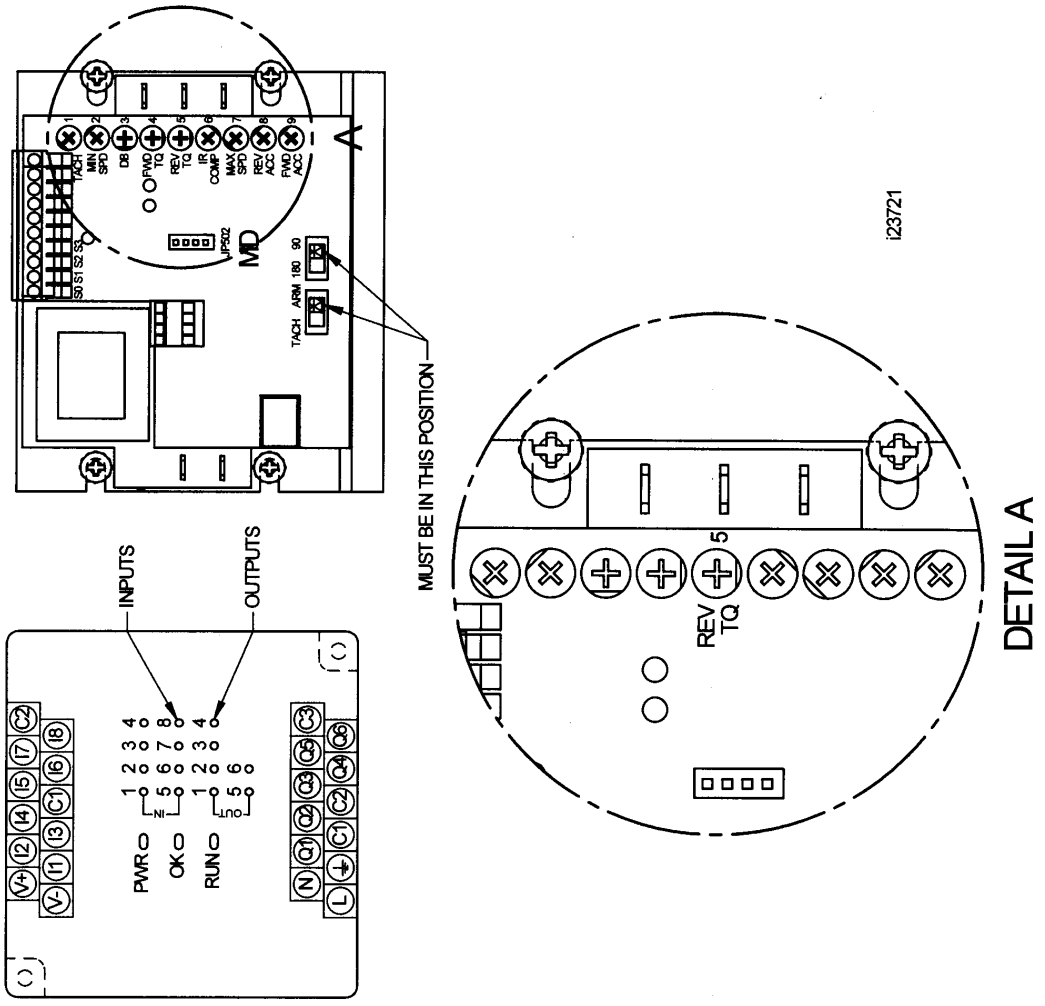



**Figure 6-3**
**Motor Driver Adjustments & PLC Inputs and Outputs**

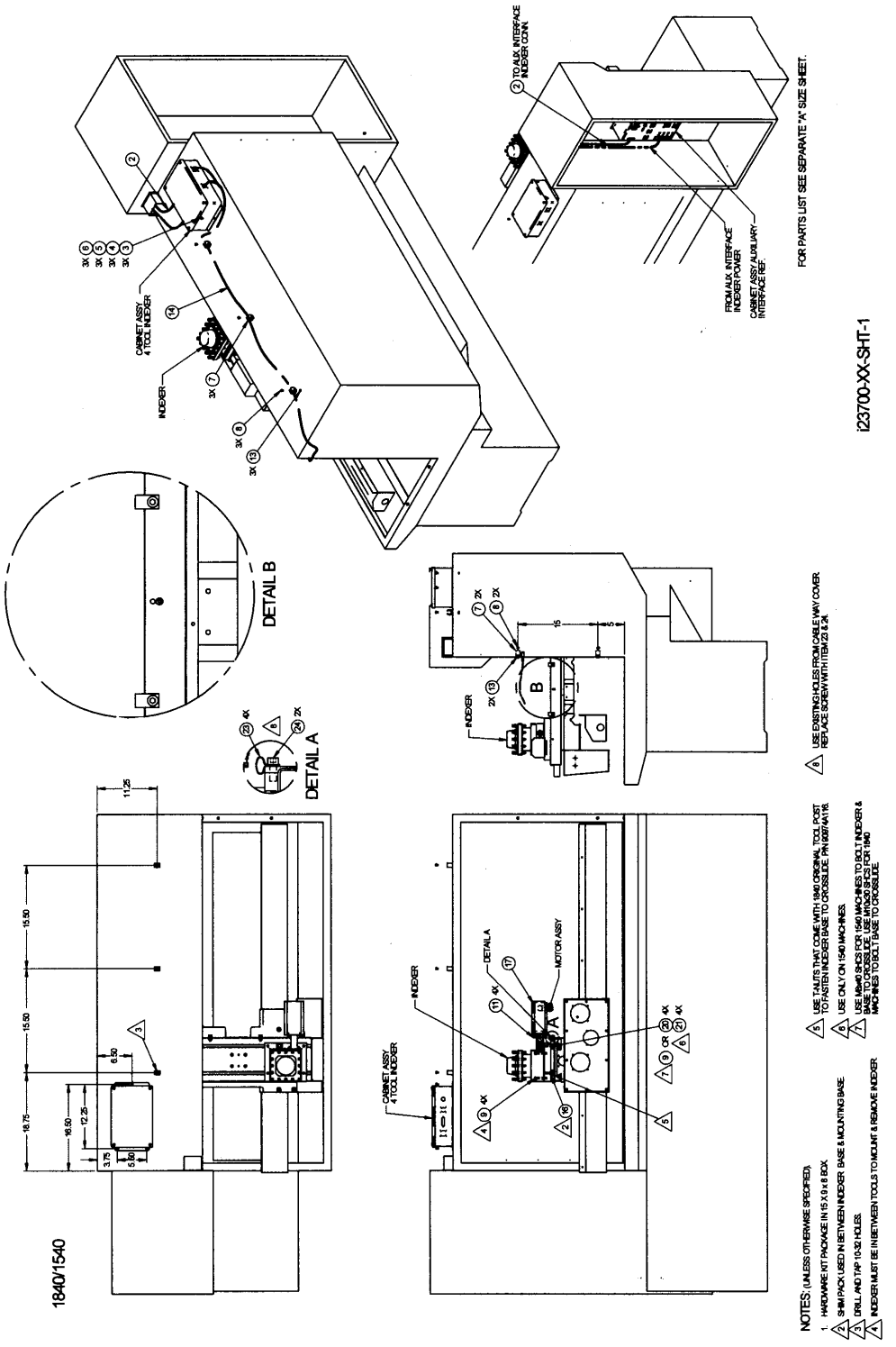
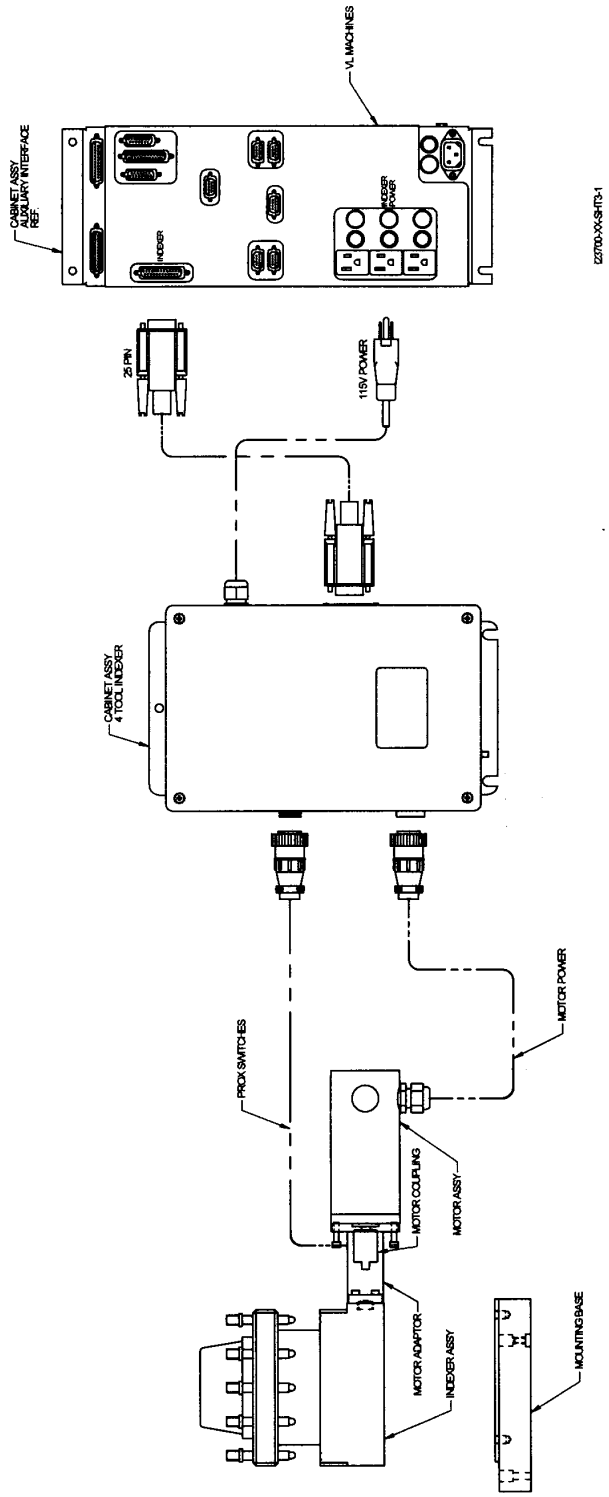



**Figure 6-4**
**Indexer Mounting – 1540V, 1840V & 2460V**




4 TOOL INDEXER COMPONENTS

## Figure 6-5 – 4-Tool Indexer Cable Routing

## 4-Tool Indexer Spare Parts List

| Item | P/N | Title |
|---|---|---|
| 1 | 23720 | CABINET ASSY-4 TOOL INDEXER |
| 2 | 23719 | MOTOR ASSY-4 TOOL INDEXER |
| 3 | 23718-1 | INDEXER ASSY-MODIFICATION-4 TOOL INDEXER-1" |
| 4 | 23718-3/4 | INDEXER ASSY-MODIFICATION-4 TOOL INDEXER-3/4" |
| 5 | 23771-M10 | T-HANDLE - 3/4" 4 TOOL INDEXER |
| 6 | 23771-M12 | T-HANDLE - 1" 4 TOOL INDEXER |
| 7 | 23872 | SQUARE HEAD SCREW M10 - 3/4" 4 TOOL INDEXER |
| 8 | 23873 | SQUARE HEAD SCREW M12 - 1" 4 TOOL INDEXER |

# 7.0 Drawings & Parts Lists

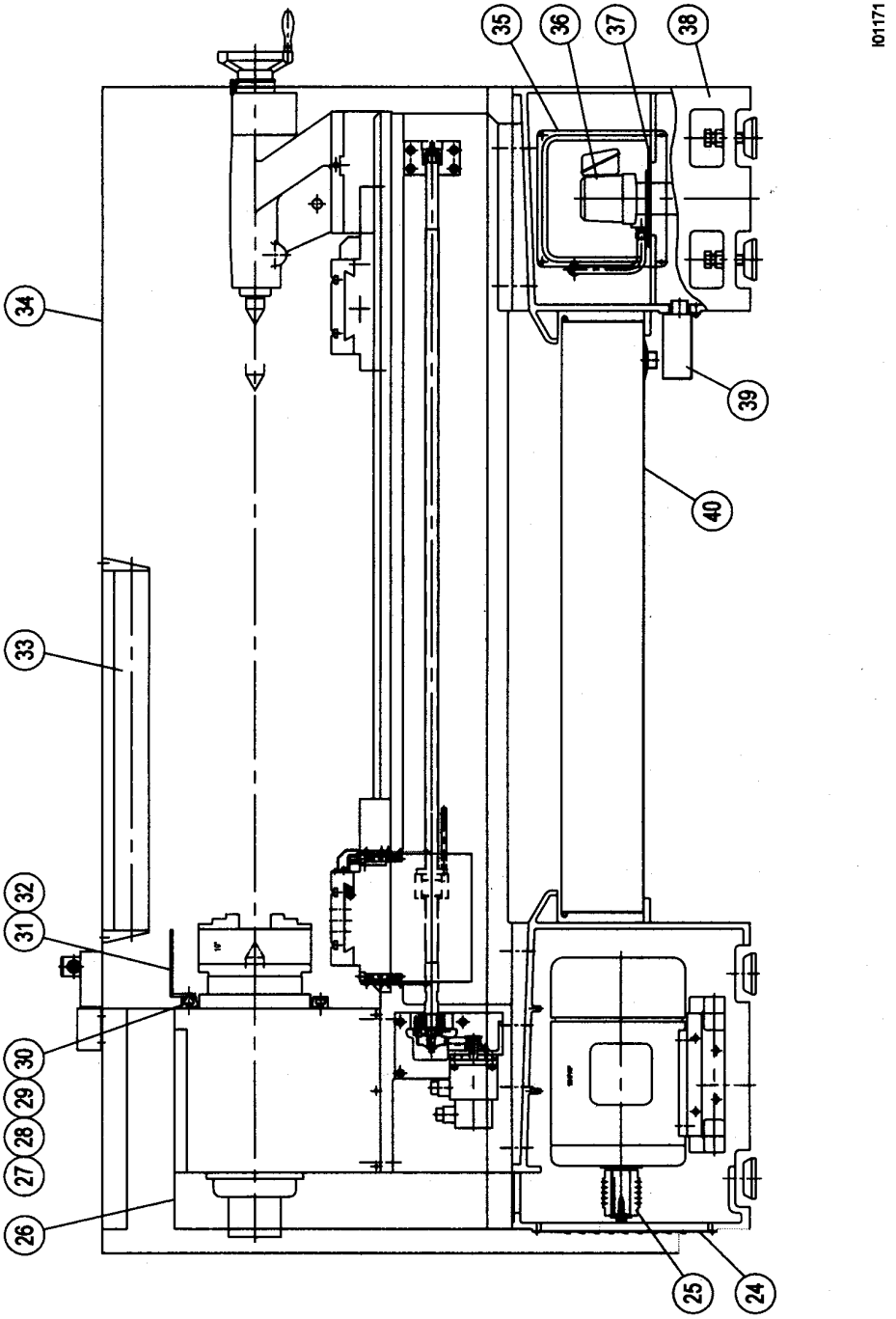



**Figure 7-1**
**2460V Overall Machine Drawing**

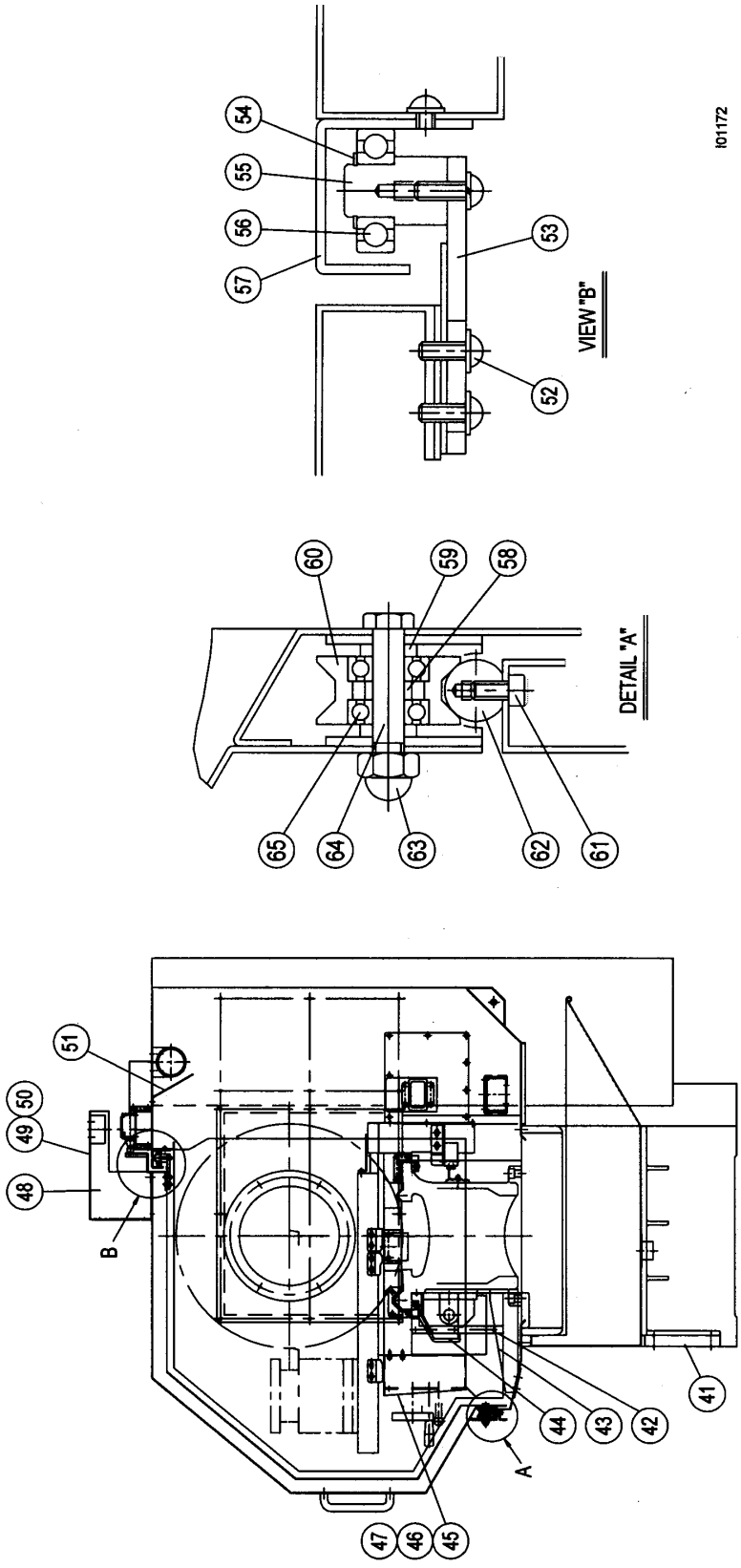



**Figure 7-2**
**2460V Overall Machine Drawing**

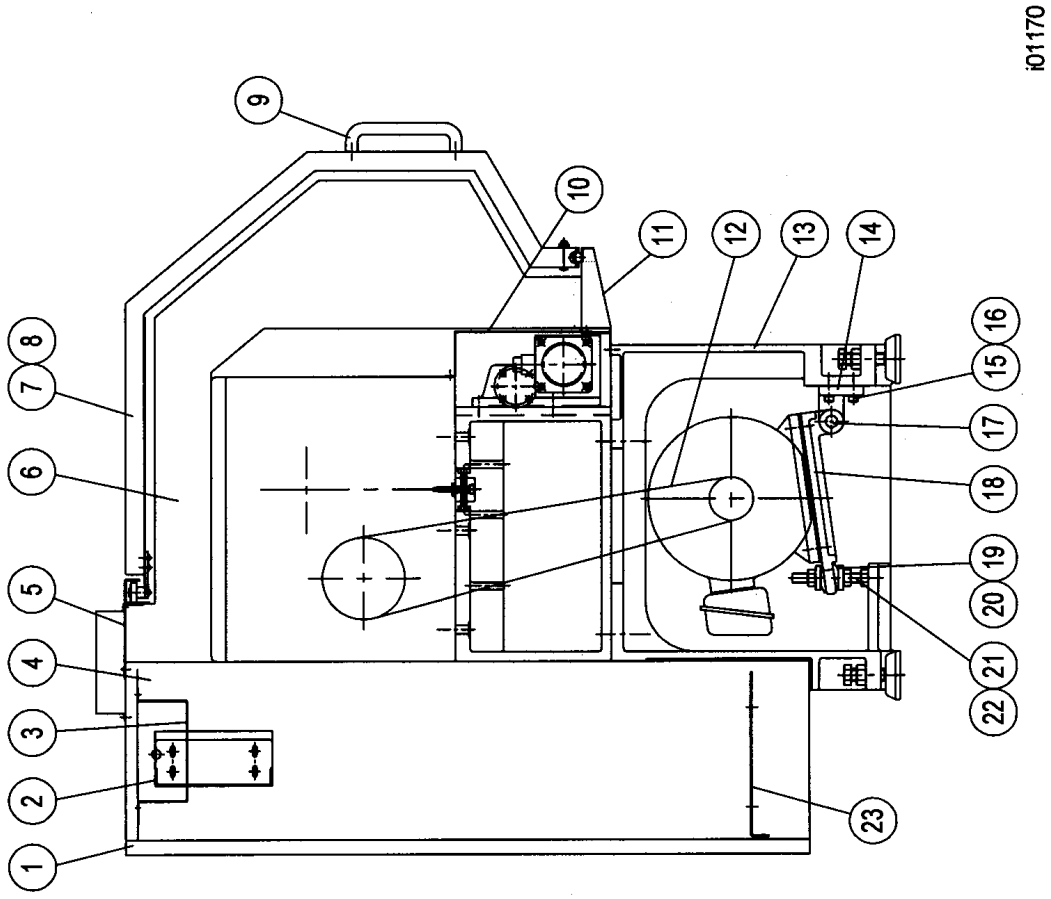



**Figure 7-3**
**2460V Overall Machine Drawing**

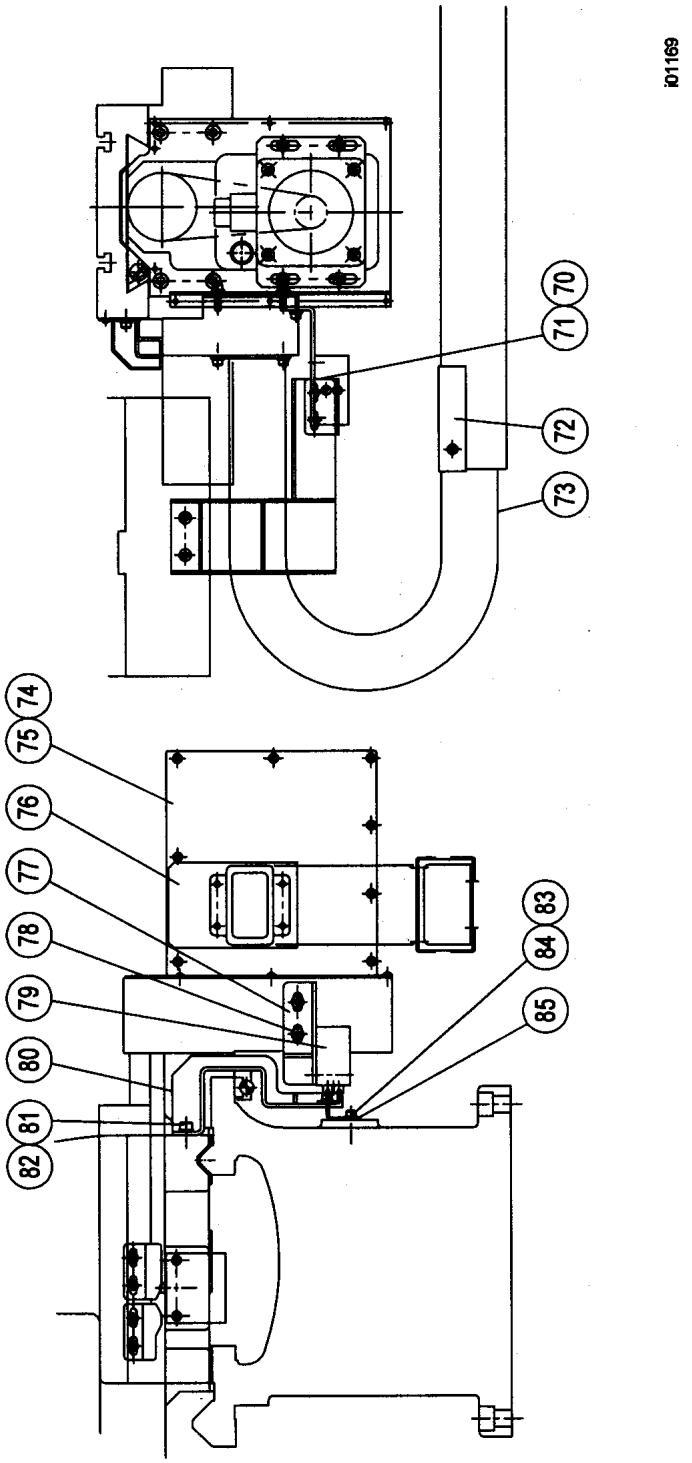



**Figure 7-4**
**2460V Overall Machine Drawing**

## Parts List - 2460V Machine Parts List

| Item | Parts No. | Description | Material | Specification | Q'ty |
|---|---|---|---|---|---|
| 1 | 87-0707 | Electrical Control Box Door | SS41 | | 1 |
| 2 | 24-0748 | Switch Seat | SS41 | | 1 |
| 3 | 24-0735 | Protection Cover | SS41 | | 1 |
| 4 | 87-0706 | Electrical Control Box | SS41 | | 1 |
| 5 | 87-0728 | Support Plate | SS41 | | 1 |
| 6 | 87-0704 | Protection Guard | SS41 | | 1 |
| 7 | 87-0721 | Safety Door | SS41 | | 1 |
| 8 | 25050-5 | Safety Glass | | 87-0722 | 1 |
| 9 | 21241-36 | Handle - door | Rubber | | 2 |
| 10 | 87-0711 | Z Axis Motor Cover Plate | SS41 | | 1 |
| 11 | 87-0709 | Front Protection Guard | SS41 | | 1 |
| 12 | 25002 | Belt Set – Spindle Motor | | 2R-11M-2000 – 25050-2<br>3R-11M-2000 – 25050-3 | 1 |
| 13 | 87-0674 | Left Stand Casting | FC25 | | 1 |
| 14 | 87-0676 | Bracket | FC25 | | 1 |
| 15 | | Socket Head Cap Screw | | M12x45L | 4 |
| 16 | | Spring Washer | | M12 | 4 |
| 17 | 87-0677 | Shaft | S45C | | 1 |
| 18 | 87-0678 | Motor Plate | FC25 | | 1 |
| 19 | 50-0681 | Adjusting Washer | SS41 | | 2 |
| 20 | 50-0682 | Adjusting Washer | SS41 | | 2 |
| 21 | | Adjusting Screw | S45C | M20x2.5x175L | 1 |
| 22 | | Hexagon Nut | | M20x2.5 | 3 |
| 23 | 87-0708 | Bottom Plate | SS41 | | 1 |
| 24 | 87-0733 | End Cover | SS41 | | 1 |
| 25 | 25050-1 | Motor – Spindle – 15 HP | FC20 | 87-0684 | 1 |
| 26 | 87-0731 | Cover | SS41 | | 1 |
| 27 | 87-0617 | Anti-Leaking Guard | SS41 | | 1 |
| 28 | | O-Ring | | G270 | 1 |
| 29 | | O-Ring | | G290 | 1 |
| 30 | | Socket Head Cap Screw | | M6x12L | 6 |
| 31 | 87-0618 | Headstock Chuck Guard | SS41 | | 1 |
| 32 | | Socket Head Cap Screw | | M10x20L | 3 |
| 33 | 22714-26<br>23341 | Tube – Lamp<br>Bult - Worklight | | A-W515DB | 1 |
| 34 | 87-0701 | Rear Protection Guard | SS41 | | 1 |
| 35 | 24-0741 | Cover | SS41 | | 1 |
| 36 | 23265 | Pump – Coolant | | 1/8HP | 1 |
| 37 | 24-0742 | Pump Seat | SS41 | | 1 |
| 38 | 87-0675 | Right Stand Casting | FC25 | | 1 |
| 39 | 25-0723 | Coolant Tank | SS41 | | 1 |
| 40 | 87-0734 | Chip Tray | SS41 | | 1 |
| 41 | 87-0732 | Front Connection Plate | SS41 | | 1 |
| 42 | 87-0705 | Cover | SS41 | | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 43 | 87-0735 | Support Bracket | SS41 | | 1 |
| 44 | 87-0712 | Protection Covr | SS41 | | 1 |
| 45 | 87-0723 | Operation Box | SS41 | | 1 |
| 46 | 87-0724 | Operation Box Cover | SS41 | | 1 |
| 47 | | Hexagon Socket Screw | | M5x6L | 8 |
| 48 | 24-0714 | Connection Tube | SS41 | | 1 |
| 49 | 24-0711 | Cover | SS41 | | 1 |
| 50 | | Wiring Protector | | 0450.41-2200L-KR52 | 1 |
| 51 | 24-0703 | Plate | SS41 | | 1 |
| 52 | | Socket Head Cap Screw | | M6x16L | 9 |
| 53 | 77A-0615 | Upper Roller Setting Base | SS41 | | 3 |
| 54 | | Retaining Ring | | S17 | 3 |
| 55 | 77A-0614 | Shaft | S20C | | 3 |
| 56 | | Deep Groove Ball Bearing | | #6203ZZ | 3 |
| 57 | 87-0713 | Upper Door | SS41 | | 1 |
| 58 | 77-0627 | Spacer | S20C | | 4 |
| 59 | 77-0628 | Spacer | S20C | | 2 |
| 60 | 77-0626 | Roller | S45C | | 2 |
| 61 | | Socket Head Cap Screw | | M6x12L | 5 |
| 62 | 87-0725 | Lower Guide Way | S45C | | 1 |
| 63 | | Domed Cap Screw | | M10 | 4 |
| 64 | 77-0629 | Shaft | S45C | | 4 |
| 65 | | Deep Groove Ball Bearing | | #6000ZZ | 4 |
| 66 | 77USA-06125 | Cam | SS41 | | 1 |
| 67 | | Micro Switch | | | 1 |
| 68 | 77USA-0672 | Cover Plate | SS41 | | 1 |
| 69 | 87-0726 | Cover Plate | SS41 | | 1 |
| 70 | 77B-0698 | Cam | SS41 | | 1 |
| 71 | | Socket Head Cap Screw | | M6x12L | 2 |
| 72 | 77A-0610 | Cover Plate | SS41 | | 1 |
| 73 | 25050-4 | Carrier - cable | | 80x45SA2000L | 1 |
| 74 | 24-0728 | X Axis Motor Covr | SS41 | | 1 |
| 75 | 24-0729 | End Cover | SS41 | | 1 |
| 76 | 87-0730 | Bracket | FC20 | | 1 |
| 77 | 77USA-0307 | Micro Switch Seat | SS41 | | 1 |
| 78 | | Socket Head Cap Screw | | M8x12L | 2 |
| 79 | 22551-1 | Switch - Limit | | BNS543B03D12 | 1 |
| 80 | 87-0738 | Cam Setting Seat | SS41 | | 1 |
| 81 | | Socket Head Cap Screw | | M8x12L | 2 |
| 82 | | Flat Washer | | M8 | 2 |
| 83 | | Socket Head Cap Screw | | M6x12L | 2 |
| 84 | | Flat Washer | | M6 | 2 |
| 85 | 77USA-0698 | Cam | SS41 | | 1 |
| 86 | 22683 | Switch – Door | | | 1 |

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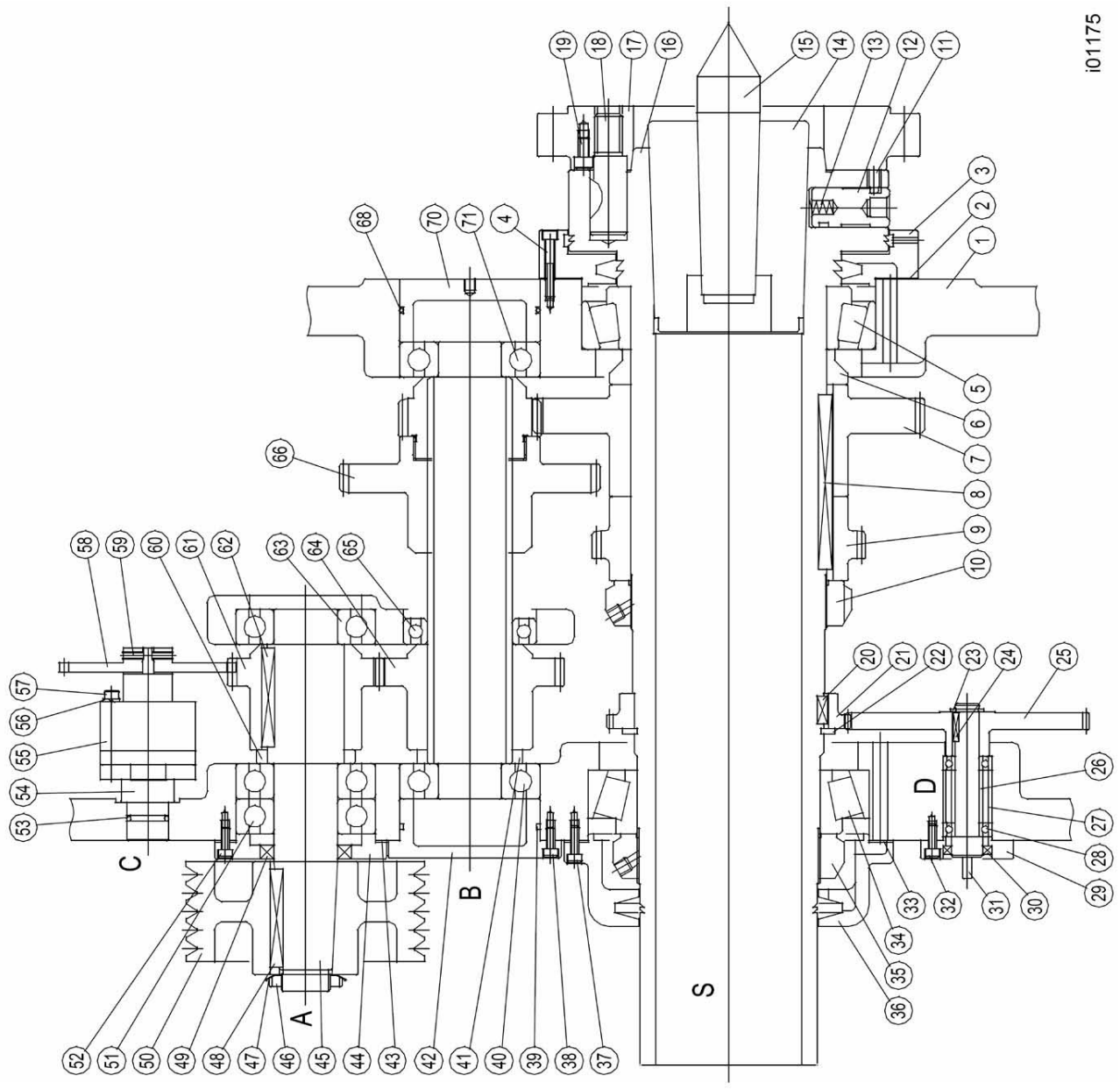


**Figure 7-5**
**2460V Headstock Drawing**

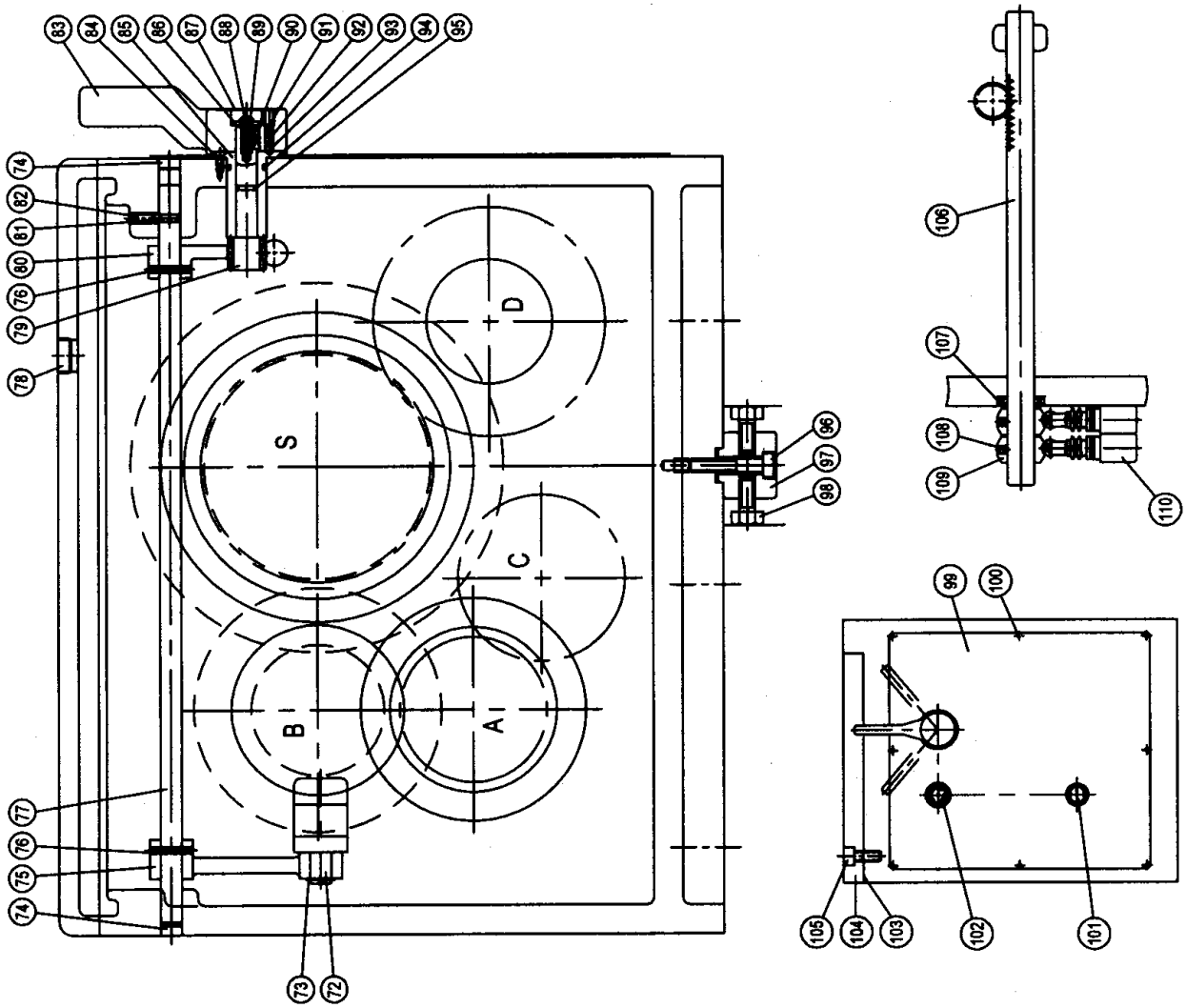


**Figure 7-6**
**2460V Headstock Drawing**

## Parts List - 2460V Headstock Parts List

| Item | Parts No. | Description | Material | Specifications | Q'ty |
|---|---|---|---|---|---|
| 1 | 87-0101 | Headstock Casting | FC25 | | 1 |
| 2 | 87-0106 | Gasket | | | 1 |
| 3 | 25100-2 | Cover - Bearing (Front) | AC2 | 87-0105 | 1 |
| 4 | | Socket Head Cap Screw | | M6x40L | 6 |
| 5 | 25100-3 | Taper Roller Bearing | | #32028XJ | 1 |
| 6 | 25100-4 | Spacer | S45C | 87-0107 | 1 |
| 7 | 25100-5 | Gear 0 Low - Main Shaft | SCM415 | 87-0108 | 1 |
| 8 | 25100-6 | Key - Double Round Head | | 16x10x125 | 1 |
| 9 | 25100-7 | Gear - High - Main Shaft | SCM415 | 87-0109 | 1 |
| 10 | 25100-8 | Lock Nut | YSF140x2.0 | 69-0147 | 1 |
| 11 | 87-0127 | Detent Screw | S45C | M10x16L | 6 |
| 12 | 69-01110-A0 | Cam | SCM21 | | 6 |
| 13 | 50-01111 | Detent Spring | SWP | | 6 |
| 14 | 69-01117 | Center Sleeve | SK2 | | 1 |
| 15 | 63-01118 | Center | SK5 | | 1 |
| 16 | 25100-1 | Spindle | SCM440 | 87-0102 | 1 |
| 17 | 63-01122A | Back Plate for 3-Jaw Chuck | FC20 | 10" | 1 |
| 18 | 63-01119 | Cam Lock Stud | SCM21 | | 6 |
| 19 | | Socket Head Cap Screw | | 5/16"-18UNCx16L | 6 |
| 20 | 25100-9 | Key - Double Round Head | | 8x7x20L | 1 |
| 21 | 25100-10 | Gear - Encoder - Main Shaft | S45C | 87-0110 | 1 |
| 22 | 25100-11 | Snap Ring | | S135 | 1 |
| 23 | | Retaining Ring | | S17 | 1 |
| 24 | | Double Round Head Key | | 4x4x20L | 1 |
| 25 | 25100-15 | Gear - Encoder | S45C | 87-0126 | 1 |
| 26 | 25100-16 | Spacer | SS41 | 87-0144 | 1 |
| 27 | 25100-17 | Spacer | SS41 | 87–0145 | 1 |
| 28 | 6003-2RS | Dee[p Groove Ball Bearing | | #6003 | 2 |
| 29 | 25-0142 | Bearing Cover | FC20 | | 1 |
| 30 | 25100-18 | Oil Seal | | TC22x35x6 | 1 |
| 31 | 25100-19 | Shaft - Encoder | S45C | 87-0143 | 1 |
| 32 | | Socket Head Cap Screw | | M6x16L | 3 |
| 33 | 87-0111 | Gasket | | | 1 |
| 34 | 25100-12 | Taper Roller Bearing | | #32026XJ | 1 |
| 35 | 25100-13 | Lock Nut | YSF130x2.0 | 69-0146 | 1 |
| 36 | 25100-14 | Cover - Bearing (Front) | FC20 | 87-0112 | 1 |
| 37 | | Socket Head Cap Screw | | M6x20L | 6 |
| 38 | | Socket Head Cap Screw | | M6x16L | 4 |
| 39 | | O-Ring | | G95 | 1 |
| 40 | 25100-22 | Deep Groove Ball Bearing | | #6309 | 1 |
| 41 | 87-0118 | Collar | SS41 | | 1 |
| 42 | 87-0119 | Bearing Cover | FC20 | | 1 |
| 43 | 25100-34 | Gasket | | 88-0125 | 1 |
| 44 | 25100-33 | Bearing Cover | FC20 | 87-0122 | 1 |
| 45 | 25100-29 | Input Shaft | SCM415 | 87-0121 | 1 |
| 46 | 2510-36 | Lock Nut | | AN07 | 1 |
| 47 | 25100-37 | Lock Washer | | AW07 | 1 |
| 48 | 25100-35 | Key - Double Round Head | | 14x9x70L | 1 |
| 49 | 25100-32 | Oil Seal | | TC45x65x10 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 50 | 25100-38 | Pulley | FC20 | 88-0149B | 1 |
| 51 | 25100-22 | Deep Groove Ball Bearing | | #6309 | 2 |
| 52 | | Socket Head Cap Screw | | M6x16L | 4 |
| 53 | 25100-42 | O-Ring | | P24 | 1 |
| 54 | 25100-41 | Seat - Pump | SS41 | 50-01131 | 1 |
| 55 | 25100-39 | Pump - Oil - Manual | | LP01AM2 | 1 |
| 56 | | Spring Washer | | M6 | 3 |
| 57 | | Socket Head Cap Screw | | M6x55L | 3 |
| 58 | 25100-40 | Gear - Oil Pump | UMC-1 | 87-0125 | 1 |
| 59 | | Set Screw | | M5x16L | 2 |
| 60 | 25100-31 | Spacer | SS41 | 87-0124 | 1 |
| 61 | 25100-28 | Gear | SCM415 | 87-0120 | 1 |
| 62 | 25100-30 | Key - Double Round Head | | 14x9x70L | 1 |
| 63 | 25100-22 | Bearing - Deep Groove Ball | | #6309 | 1 |
| 64 | 25100-27 | Gear | SCM415 | 87-0117 | 1 |
| 65 | 25100-24 | Bearing - Deep Groove Ball | | #6012 | 1 |
| 66 | 25110 | Cluster Gear & Shaft Ass'y | | | 1 |
| 68 | 25100-20 | O-Ring | | G95 | 1 |
| 70 | 25100-21 | Bearing Plug | FC20 | 87-0113 | 1 |
| 71 | 25100-22 | Bearing - Deep Groove Ball | | #6309 | 1 |
| 72 | 25100-44 | Change Spped Jaw | BC2 | 87-0130 | 1 |
| 73 | | Retaining Ring | | S16 | 1 |
| 74 | 17-0629 | Plug | SS41 | | 2 |
| 75 | 25100-45 | Swing Arm | FC20 | 87-0129 | 1 |
| 76 | | Spring Pin | | 5x30L | 2 |
| 77 | 25100-43 | Shaft | SS41 | 87-0128 | 1 |
| 78 | | Oil Plug | | PT-3/4 | 1 |
| 79 | 65-0177 | Speed Changing Shaft | S45C | | 1 |
| 80 | 82-0152 | Quadrant Gear | FC20 | | 1 |
| 81 | | Steel Ball | | 1/4 | 1 |
| 82 | | Socket Head Set Screw | | M8x16L | 1 |
| 83 | 77A-0133 | Speed Changing Knob | FC20 | | 1 |
| 84 | | Cross Recessed Head Head Screw | | M5x12L | 2 |
| 85 | 65-0193 | Sleeve | SS41 | | 1 |
| 86 | 50-0167 | Washer | SS41 | | 1 |
| 87 | 65-0174 | Indicator | ALP | | 1 |
| 88 | 17-0542 | Screw | S30C | | 1 |
| 89 | | Socket Head Cap Screw | | M5ξ20Λ | 1 |
| 90 | | Double Round Head Key | | 5x5x15L | 1 |
| 91 | | Socket Head Set Screw | | M8x8L | 1 |
| 92 | | Compression Spring | | φ 6x φ 0.8x30L | 1 |
| 93 | | Steel Ball | | φ 1/4 | 1 |
| 94 | | O-Ring | | P24 | 1 |
| 95 | | O-Ring | | P12 | 1 |
| 96 | | Socket Head Cap Screw | | M12x55L | 1 |
| 97 | 50-01114 | Adjusting Block | SS41 | | 1 |
| 98 | | Socket Head Cap Screw | | M12x25L | 1 |
| 99 | 87-0131 | Indicator | ALP | | 1 |
| 100 | | Rivet | | φ 2x5L | 8 |
| 101 | 50-01145 | Oil Sight Glass | | HE30 | 1 |
| 102 | 50-01146 | Oil Sight Glass | | HFTX22 | 1 |
| 103 | 87-0104 | Gasket | | | 1 |
| 104 | 87-0103 | Headstock Cover | FC20 | | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 105 | | Socket Head Cap Screw | | M8x20L | 6 |
| 106 | 77U-0152 | Position Rack | S45C | | 1 |
| 107 | | Oil Seal | | TC20x35x7 | 1 |
| 108 | | Set Screw | | M6xP1.0x8L | 1 |
| 109 | 77A-0153 | Cam | S20C | | 2 |
| 110 | 22680 | Switch - Gear | | | 2 |

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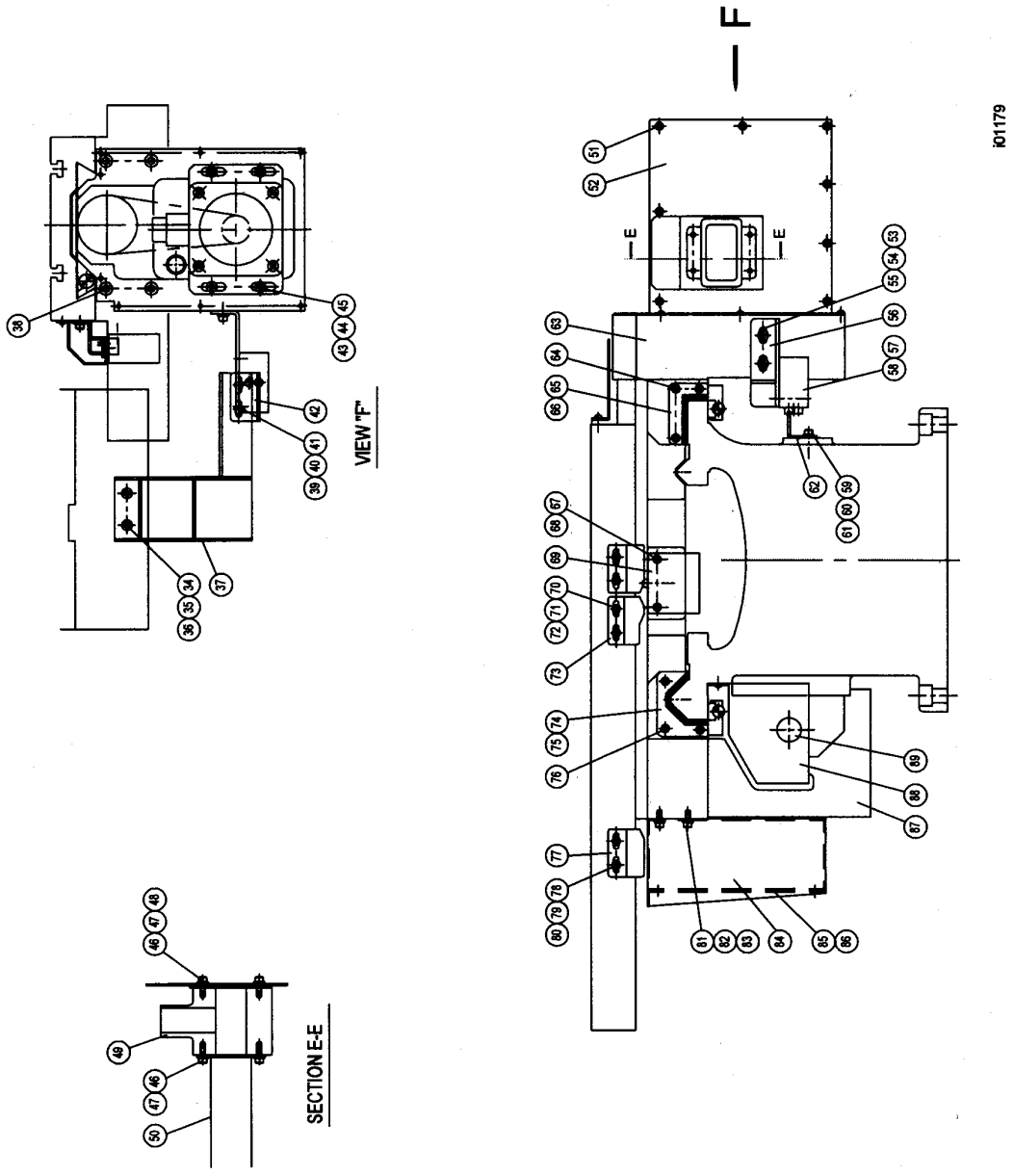


## Figure 7-7 - 2460V Carriage Side View

See page 78 for Parts List (X Axis Drive Train)

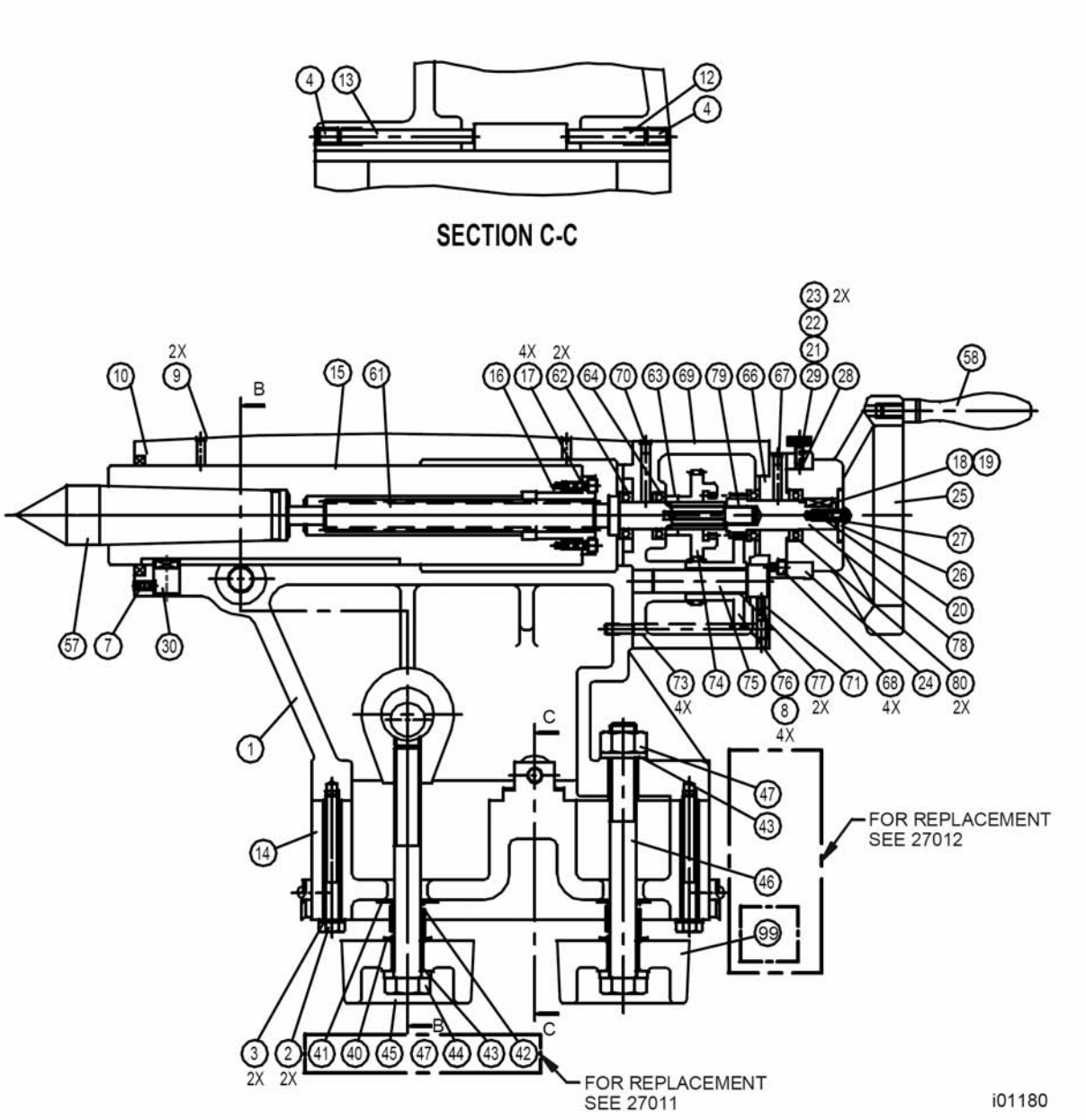


**Figure 7-8**
**2460V Tailstock Assembly**

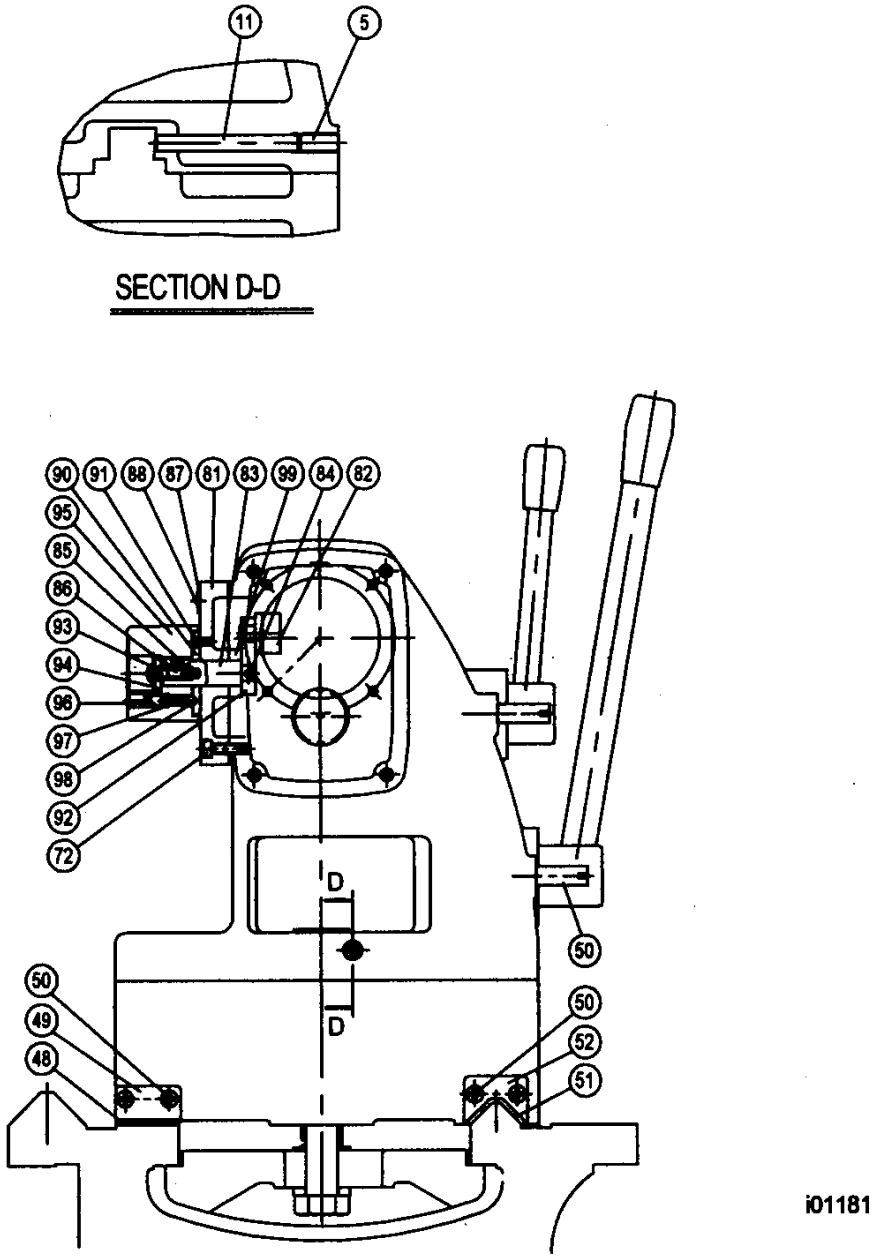


**Figure 7-9**
**2460V Tailstock Assembly**

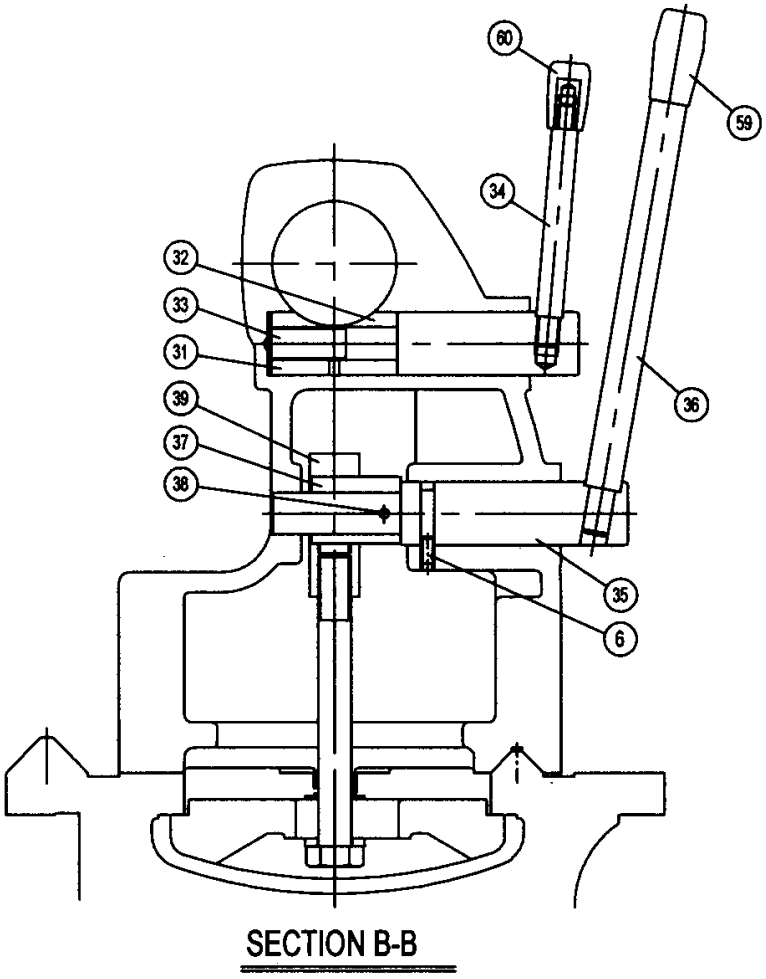


**Figure 7-10**
**2460V Tailstock Assembly**

## Parts List – 2460V Tailstock Assembly

| Item | Parts No. | Description | Material | Specification | Qty |
|---|---|---|---|---|---|
| 1 | 63-0501-00 | Tailstock Body | FC-25 | | 1 |
| 2 | | Hexagon Head Screw | | M10x80L | 2 |
| 3 | | Washer | SS41B-D | M10 | 2 |
| 4 | | Socket Head Set Screw | | M12x16L | 2 |
| 5 | | Socket Head Set Screw | | M12x25L | 1 |
| 6 | | Socket Head Set Screw | | M8x16L | 1 |
| 7 | | Socket Head Set Screw | | M6x30L | 1 |
| 8 | | Socket Head Cap Screw | | M6x30L | 4 |
| 9 | | Ball Cup | | Ø1/4” | 2 |
| 10 | | Oil Seal | | TC75x90x8 | 1 |
| 11 | | Parallel Pin | | Ø10x90L | 1 |
| 12 | | Parallel Pin | | Ø10x60L | 1 |
| 13 | | Parallel Pin | | Ø10x100L | |
| 14 | 63-0502-00 | Tailstock Base | FC-25 | | 1 |
| 15 | 63-0503-00 | Quill | S-45C | | 1 |
| 16 | 25026 | Feed Nut (Imperial) | BC2 | 63-0505-00 | 1 |
| 17 | | Socket Head Cap Screw | | M6x12L | 4 |
| 18 | 63-0507-00 | Feed Screw (Imperial) | S45C-D | | 1 |
| 19 | | Double Round Head Key | | 6x6x20L | 1 |
| 20 | | Socket Head Set Screw | | M5x20L | 1 |
| 21 | 50-0508-00 | Bracket | | | 1 |
| 22 | | Ball Cup | | Ø1/4” | 1 |
| 23 | | Thrust Bearing | | #51104 | 2 |
| 24 | 50-0510-00 | Dial (Imperial) | FC-20 | | 1 |
| 25 | 50-0511-00 | Handwheel | FC-20 | | 1 |
| 26 | 50-0513-00 | Washer | SS41B-D | | 1 |
| 27 | 17-0504-00-2 | Socket Button Head Screw | | | 1 |
| 28 | 50-0538-00 | Pad Piece | | | 1 |
| 29 | 50-03111-00 | Screw | | | 1 |
| 30 | 27013 | Guide Pin | | 63-0514-00 | 1 |
| 31 | 63-0515-00 | Lock Nut | | | 1 |
| 32 | 63-0516-00 | Lock Sleeve | | | 1 |
| 33 | 63-0517-00 | Lock Rod | S45C-D | | 1 |
| 34 | 50-0518-00 | Lever | SS41B-D | | 1 |
| 35 | 63-0519-00 | Shaft | | | 1 |
| 36 | 63-0520-00 | Lever | | | 1 |
| 37 | 50-0521-00 | Eccentric Collar | | | 1 |
| 38 | | Spring Pin | | Ø6x40L | 1 |
| 39 | 50-0522-00 | Adjusting Block | | | 1 |
| 40 | 50-0523-00 | Washer | | | 1 |
| 41 | 50-0524-00 | Washer | | | 1 |
| 42 | 50-0525-00 | Compression Spring | | | 1 |
| 43 | 50-0526-00 | Washer | | | 2 |
| 44 | 63-0527A-00 | Hexagon Head Screw | | | 1 |
| 45 | 63-0528-00 | Clamping Block | | | 1 |
| 46 | 63-0527B-00 | Hexagon Head Screw | | | 1 |
| 47 | | Nut | | M20xP2.5 | 1 |
| 48 | 25025 | Wiper - Bedway | | 50-0362-00 | 2 |

| | | | | | |
|---|---|---|---|---|---|
| 49 | 50-0363-00 | Bedway Wiper Plate | SS41PL | | 2 |
| 50 | | Cross Recessed Head Screw | | M6x16L | 4 |
| 51 | 25024 | Wiper - Bedway | | 63-0532-00 | 2 |
| 52 | 63-0533-00 | Bedway Wiper Plate | SS41PL | | 2 |
| 53 | 50-0534-00 | Stud | | | 2 |
| 54 | 50-0536-00 | Set-Over Indicating Chart | | | 1 |
| 55 | 50-0537-00 | Indicator | | | 1 |
| 56 | | Button Head Rivet | | Ø2x5L | 4 |
| 57 | 63-01118-00 | Center | SK5 | MT#4 | 1 |
| 58 | 50-0431-00 | Handle | ABS | | 1 |
| 59 | 50-0166-00 | Knob | ABS | | 1 |
| 60 | 50-01138-00 | Knob | ABS | | 1 |
| 61 | 25021 | Feed Screw (Imperial) | S45C-D | 63-0507B-00 | 1 |
| 62 | 25023 | Thrust Bearing | | #51104 | 2 |
| 63 | 80-0541-00 | Lock Nut | | | 1 |
| 64 | | Lock Washer | | AW04 | 1 |
| 65 | | | | | |
| 66 | 80-0508B-00 | Bracket | | | 1 |
| 67 | | Ball Cup | | Ø1/4” | 1 |
| 68 | | Socket Head Cap Screw | | M6x16L | 4 |
| 69 | 63-0539-00 | Speed Change Box | | | 1 |
| 70 | | Ball Cup | | Ø1/4” | 1 |
| 71 | | Socket Head Set Screw | | M6x10L | 1 |
| 72 | | Socket Head Cap Screw | | M6x20L | 4 |
| 73 | 80-0540-00 | Socket Head Cap Screw | | | 4 |
| 74 | 80-0542-00 | Clutch Gear | | M1.5x44T | 1 |
| 75 | 80-0543-00 | Shaft | | | 1 |
| 76 | 80-0544-00 | Gear | | M1.75x40T<br>M1.5x22T | 1 |
| 77 | | Dry Bearing | | Ø17xØ19x15L | 2 |
| 78 | 80-0545-00 | Gear Shaft | | M1.75x16 | 1 |
| 79 | | Dry Bearing | | Ø12xØ14x15L | 1 |
| 80 | 25022 | Thrust Bearing | 80-0545-00-1 | Ø7/8xØ1-1/2”<br>x3/8” | 2 |
| 81 | 80-0546-00 | Speed Change Box Cover | | | 1 |
| 82 | 80-0547-00 | Shifting Block | | | 1 |
| 83 | 63-0548-00 | Shaft | | | 1 |
| 84 | | Spring Pin | | Ø4x25L | 1 |
| 85 | | Double Round Head Key | | 5x5x15L | 1 |
| 86 | | Socket Head Set Screw | | M5x20L | 1 |
| 87 | 80-0551-00 | Indicator | ACP | | 1 |
| 88 | | Button Head Rivet | | Ø2x5L | 2 |
| 89 | | | | | |
| 90 | 80-0552-00 | Setting Plate | | | 1 |
| 91 | | Counter Sunk Flat Screw | | M5x8L | 2 |
| 92 | 28-0229-00 | Shifting Arm | | | 1 |
| 93 | 17-0504-00-2 | Socket Button Head Screw | S30C | M8x20L | 1 |
| 94 | 50-0167-00 | Washer | | | 1 |
| 95 | 50-0246-01 | Feed Selector Knob | | | 1 |
| 96 | | Socket Head Set Screw | | M8x8L | 1 |
| 97 | | Compression Spring | | Ø6xØ0.8x30L | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 98 | | Steel Ball | | Ø1/4 | 1 |
| 99 | 27046 | Clamping Block Rear | | 63-0529-00 | 1 |
| 100 | 63-0549-00 | Spacer | | | 1 |

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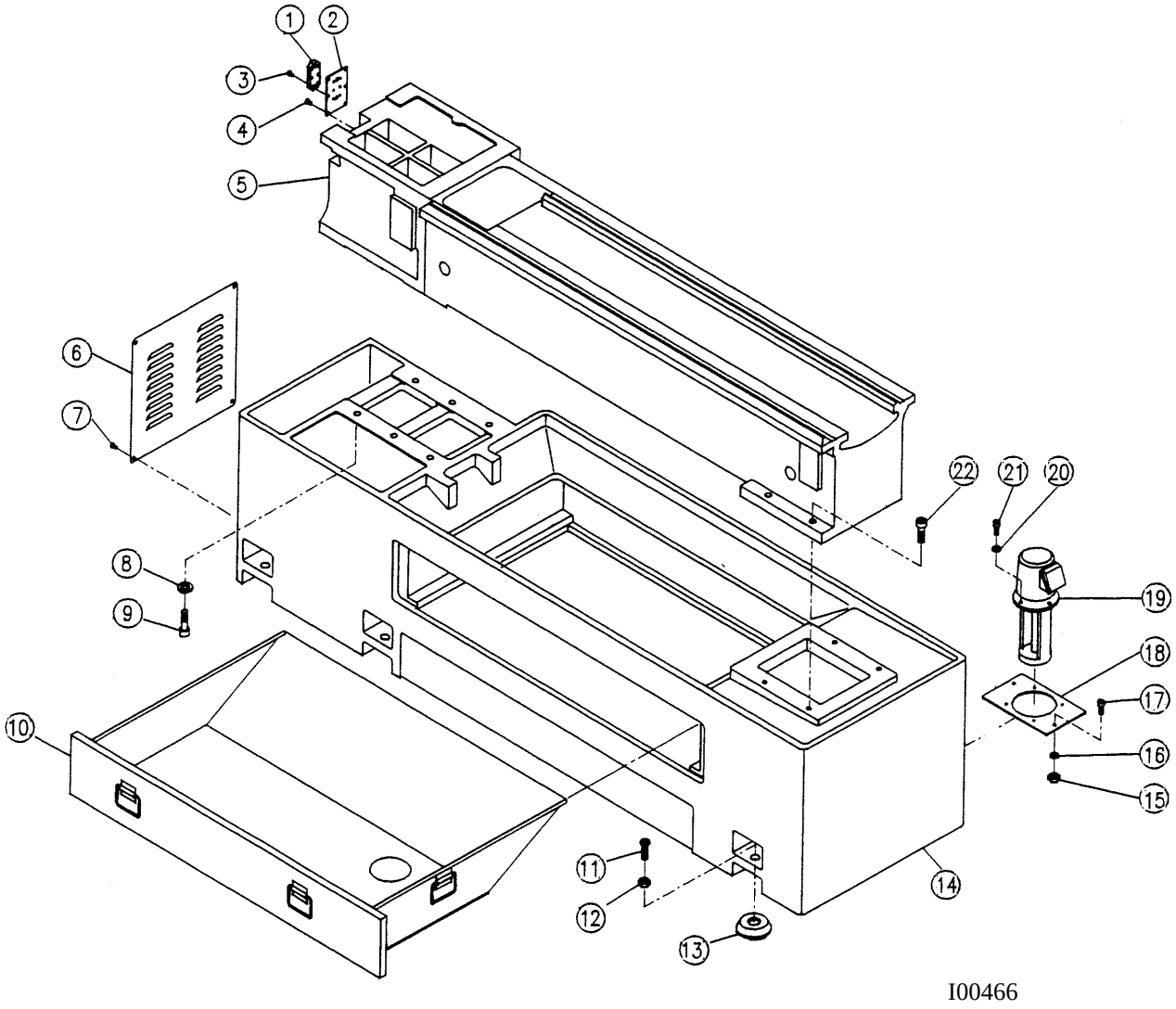


**Figure 7-12**
**1840V Bed and**
**Chip Pan**

## Parts List – 1840V Bed & Chip Pan

| Item | P/N | Title | UseAs | Qty |
|---|---|---|---|---|
| 1 | 21239-01 | COVER | EA | 2 |
| 2 | 21239-02 | OIL SIGHT GLASS | EA | 2 |
| 3 | 21239-03 | ROUND SCREW M5X10L | EA | 12 |
| 4 | 21239-04 | SOCKET HEAD CAP SCREW M5X10L | EA | 12 |
| 5 | 20980 | BED-TRL 1840 CSS | EA | 0 |
| 6 | 21239-06 | END COVER | EA | 1 |
| 7 | 21239-07 | ROUND SCREW M6X8L | EA | 4 |
| 8 | 21239-08 | SPRING WASHER M16 | EA | 6 |
| 9 | 21239-09 | SOCKET HEAD CAP SCREW M16 X60L | EA | 6 |
| 10 | 21239-10 | CHIP TRAY | EA | 1 |
| 11 | 21239-11 | ADJUSTING SCREW | EA | 6 |
| 12 | 21239-12 | LOCKING NUT | EA | 6 |
| 13 | 21239-13 | INSTALLATION BLOCK | EA | 6 |
| 14 | 21239-14 | STAND | EA | 1 |
| 15 | 21239-15 | HEXAGON NUT M8 | EA | 2 |
| 16 | 21239-16 | SPRING WASHER M8 | EA | 2 |
| 17 | 21239-17 | SOCKET HEAD CAP SCREW M8 X30L | EA | 2 |
| 18 | 22714-31 | PUMP BRACKET | EA | 1 |
| 19 | 23265 | COOLANT PUMP 1/8HP | EA | 1 |
| 20 | 21239-20 | SPRING WASHER M6 | EA | 0 |
| 21 | 21239-21 | SOCKET HEAD CAP SCREW M6X16L | EA | 4 |
| 22 | 21239-22 | SOCKET HEAD CAP SCREW M16 X50L | EA | 4 |
| 23 | 21239-23 | LUBE PUMP-HEADSTOCK | EA | 1 |
| 24 | 23973 | BELT SET-SPINDLE MOTOR | EA | 1 |
| 25 | 21239-25 | SPINDLE MOTOR | EA | 1 |
| 27 | 22157-32 | BRAKE RESISTOR | EA | 1 |
| 28 | 21239-28 | MAIN ELECTRIC SWITCH | EA | 1 |
| 29 | 21239-29 | CABLE CARRIER-METAL | EA | 1 |
| 30 | 21239-30 | MOVING DOOR-GLASS | EA | 1 |
| 31 | 21239-31 | MOTOR PULLEY-SPINDLE | EA | 1 |
| 32 | 22291-1 | LUBRICATION PUMP-WAY | EA | 1 |
| 33 | 21239-33 | OIL FILTER | EA | 1 |

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ITEMS 23-33 ARE NOT ON FIGURE

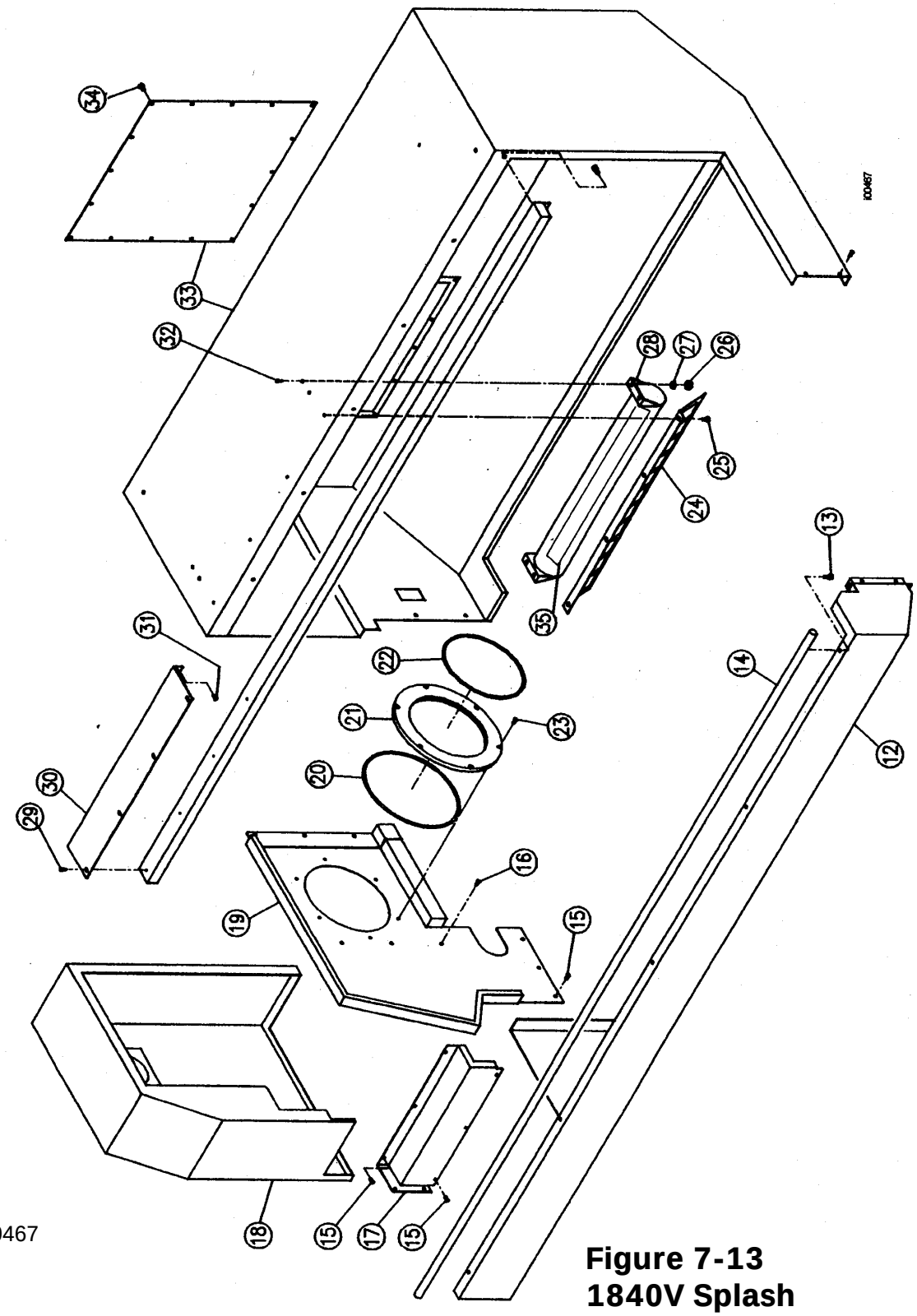


**Figure 7-13**
**1840V Splash Guard & Cover**

## Parts List – 1840 Splash Guard & Cover

| Item | P/N | DESCRIPTION | Qty |
|---|---|---|---|
| 12 | 21241-12 | PROTECT COVER (FRONT) | 1 |
| 13 | 21241-13 | SOCKET HEAD CAP SCREW M6X10L | 5 |
| 14 | 21241-14 | SLIDE WAY | 1 |
| 15 | 21241-15 | ROUND SCREW M5X6L | 20 |
| 16 | 21241-16 | ROUND SCREW M6X10L | 5 |
| 17 | 21241-17 | PLATE-Z-AXIS MOTOR | 1 |
| 18 | 21241-18 | END COVER | 1 |
| 19 | 21241-19 | PROTECTOR PLATE | 1 |
| 20 | 21241-20 | O-RING G250 | 1 |
| 21 | 21241-21 | ANTI-LEAKING PLATE | 1 |
| 22 | 21241-22 | O-RING G210 | 1 |
| 23 | 21241-23 | SOCKET HEAD CAP SCREW M5X10L | 6 |
| 24 | 21241-24 | PLATE | 1 |
| 25 | 21241-25 | ROUND SCREW M5X6L | 4 |
| 26 | 21241-26 | HEXAGON NUT M6 | 4 |
| 27 | 21241-27 | FLAT WASHER M6 | 4 |
| 28 | 21241-28 | LAMP TUBE | 1 |
| 29 | 21241-29 | ROUND SCREW M5X6L | 4 |
| 30 | 21241-30 | SUPPORTING PLATE | 1 |
| 31 | 21241-31 | ROUND SCREW M5X6L | 4 |
| 32 | 21241-32 | ROUND SCREW M6X16L | 4 |
| 33 | 21241-33 | REAR PROTECTOR COVER | 1 |
| 34 | 21241-34 | ROUND SCREW M5X6L | 16 |
| 35 | 23341 | WORK LIGHT BULB | 1 |
| 36 | 21241-36 | DOOR HANDLE | 2 |

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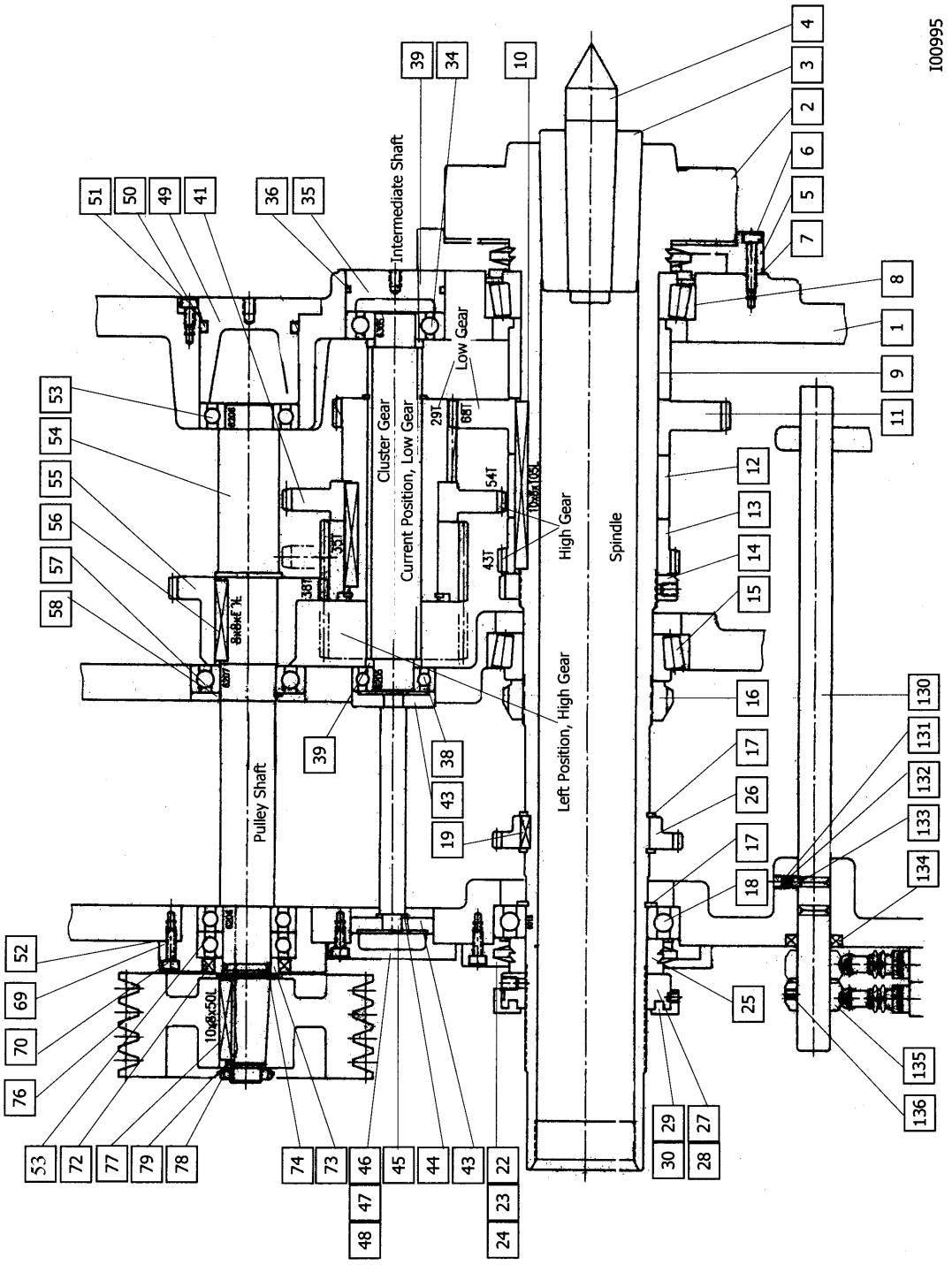
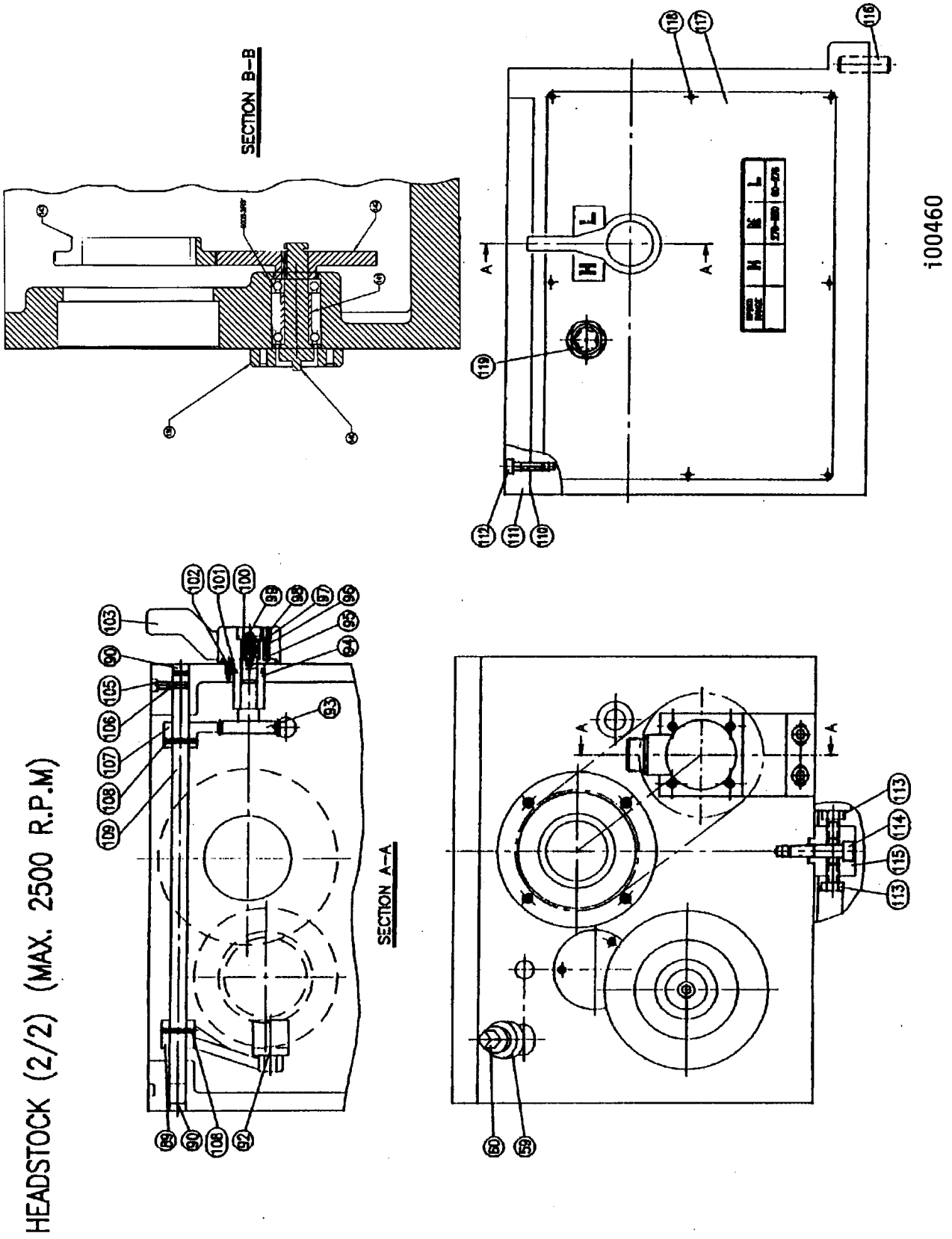



**Figure 7-14**
**1840V Headstock Assembly**

**Figure 7-15**



## Parts List – 1840V Headstock Assembly

| Item | P/N | Title | Use As | Qty |
|---|---|---|---|---|
| 1 | 21234-001 | HEADSTOCK CASTING | EA | 4 |
| 2 | 21234-002 | SPINDLE D1-6 | EA | 4 |
| 3 | 21234-003 | CENTER SLEEVE | EA | 4 |
| 4 | 21234-004 | CENTER | EA | 4 |
| 5 | 21234-005 | BEARING COVER (FRONT) D1-6 | EA | 4 |
| 6 | 21234-006 | SOCKET HEAD CAP SCREW M6X30L | EA | 24 |
| 7 | 21234-007 | PACKING | EA | 4 |
| 8 | 21234-008 | TAPER ROLLER BEARING #32017XC/P5 | EA | 4 |
| 9 | 21234-009 | SPACER | EA | 4 |
| 10 | 21234-010 | DOUBLE ROUND HEAD KEY 10X8X105L | EA | 4 |
| 11 | 21234-011 | LOW SPEED GEAR | EA | 4 |
| 12 | 21234-012 | SPACER | EA | 4 |
| 13 | 21234-013 | HIGH SPEED GEAR | EA | 4 |
| 14 | 21234-014 | LOCKING NUT | EA | 4 |
| 15 | 21234-015 | TAPER ROLLER BEARING #32016XC/P5 | EA | 4 |
| 16 | 21234-016 | LOCKING NUT | EA | 4 |
| 17 | 21234-017 | RETAINING RING #STW75 | EA | 4 |
| 18 | 21234-018 | TAPER ROLLER BEARING #6015 | EA | 4 |
| 19 | 21234-019 | DOUBLE ROUND HEAD KEY 8X7X18L | EA | 8 |
| 22 | 21234-022 | PACKING | EA | 3 |
| 23 | 21234-023 | BEARING COVER (REAR) | EA | 3 |
| 24 | 21234-024 | SOCKET HEAD CAP SCREW M6X16L | EA | 12 |
| 25 | 21234-025 | SPACER | EA | 12 |
| 26 | 21234-026 | SYNCHRONOUS BELT | EA | 3 |
| 27 | 21234-027 | DYNAMIC BALANCING COLLAR | EA | 3 |
| 28 | 21234-028 | SOCKET HEAD SET SCREW M8X8L | EA | 6 |
| 29 | 21234-029 | DYNAMIC BALANCING BLOCK | EA | 9 |
| 30 | 21234-030 | SOCKET HEAD SET SCREW M6X8L | EA | 18 |
| 34 | 21234-034 | BALLBEARING-DEEP GROOVE #6305 | EA | 3 |
| 35 | 21234-035 | BEARING PLUG | EA | 3 |
| 36 | 21234-036 | O-RING G55 | EA | 3 |
| 38 | 21234-038 | BALLBEARING-DEEP GROOVE #6205 | EA | 3 |
| 39 | 21234-039 | SPACER | EA | 6 |
| 41 | 24934 | CLUSTER GRAR & SHAFT ASS'Y - 1840 | EA | 1 |
| 42 | 21234-042 | GEAR | EA | 3 |
| 43 | 21234-043 | SPACER | EA | 6 |
| 44 | 21234-044 | WASHER | EA | 3 |
| 45 | 21234-045 | ROD | EA | 3 |
| 46 | 21234-046 | PACKING | EA | 3 |
| 47 | 21234-047 | BEARING PLUG | EA | 3 |
| 48 | 21234-048 | SOCKET HEAD CAP SCREW M6X12L | EA | 9 |
| 49 | 21234-049 | BEARING COVER | EA | 3 |
| 50 | 21234-050 | O-RING P52 | EA | 3 |
| 51 | 21234-051 | SOCKET HEAD CAP SCREW M6X12L | EA | 9 |
| 52 | 21234-052 | PACKING | EA | 3 |

| | | | | |
|---|---|---|---|---|
| 53 | 21234-053 | BALLBEARING-DEEP GROOVE #6206 | EA | 3 |
| 54 | 21234-157 | INPUT SHAFT (77U-0131-02) | EA | 3 |
| 55 | 21234-055 | GEAR | EA | 3 |
| 56 | 21234-056 | DOUBLE ROUND HEAD KEY 8X8X50L | EA | 3 |
| 57 | 21234-057 | BALLBEARING-DEEP GROOVE #6207 | EA | 3 |
| 58 | 21234-058 | RETAINING RING | EA | 3 |
| 59 | 21234-059 | ELBOW | EA | 3 |
| 60 | 21234-060 | DRAIN PLUG | EA | 3 |
| 69 | 21234-069 | COVER | EA | 3 |
| 70 | 21234-070 | SOCKET HEAD CAP SCREW M6X20L | EA | 9 |
| 72 | 21234-072 | OIL SEAL TC38X55X8 | EA | 3 |
| 73 | 21234-073 | SPACER | EA | 3 |
| 76 | 21234-076 | PULLEY | EA | 3 |
| 77 | 21234-077 | DOUBLE ROUND HEAD KEY 10X8X50L | EA | 3 |
| 78 | 21234-078 | LOCKING NUT AN04 | EA | 3 |
| 79 | 21234-079 | LOCK WASHER AN04 | EA | 3 |
| 80 | 21234-080 | CAM | EA | 18 |
| 81 | 21234-081 | DETENT SPRING | EA | 18 |
| 82 | 21234-082 | DETENT SCREW | EA | 18 |
| 83 | 21234-083 | CAM STUD | EA | 18 |
| 84 | 21234-084 | SOCKET HEAD CAP SCREW 3/8-16UNCX16L | EA | 18 |
| 85 | 21234-085 | DRIVING PLATE | EA | 3 |
| 86 | 21234-086 | DRIVING COLLAR | EA | 3 |
| 87 | 21234-087 | SOCKET HEAD CAP SCREW M12X25L | EA | 3 |
| 88 | 21234-088 | DRIVING PIN | EA | 6 |
| 89 | 21234-089 | SHIFTING ARM | EA | 3 |
| 90 | 21234-090 | PLUG | EA | 6 |
| 92 | 21234-092 | SHIFTING FORK | EA | 2 |
| 93 | 21234-093 | CHANGE SPEED SHAFT | EA | 2 |
| 94 | 21234-094 | SLEEVE | EA | 2 |
| 95 | 21234-095 | STEEL BALL 1/4 | EA | 2 |
| 96 | 21234-096 | COMPRESSION SPRING 6X 0.8X30L | EA | 2 |
| 97 | 21234-097 | SOCKET HEAD SET SCREW M8X8L | EA | 2 |
| 98 | 21234-098 | DOUBLE ROUND HEAD KEY 5X15L | EA | 2 |
| 99 | 21234-099 | SCREW | EA | 2 |
| 100 | 21234-100 | WASHER | EA | 4 |
| 101 | 21234-101 | O-RING P24 | EA | 2 |
| 102 | 21234-102 | SOCKET HEAD SET SCREW M5X12L | EA | 4 |
| 103 | 21234-103 | KNOB | EA | 2 |
| 105 | 21234-105 | SOCKET HEAD SET SCREW M8X8L | EA | 4 |
| 106 | 21234-106 | STEEL BALL | EA | 2 |
| 107 | 21234-107 | QUADRANT GEAR | EA | 2 |
| 108 | 21234-108 | SPRING PIN 5X30L | EA | 4 |
| 109 | 21234-109 | CHANGE SPEED ROD | EA | 2 |
| 110 | 21234-110 | PACKING | EA | 2 |
| 111 | 21234-111 | HEADSTOCK COVER | EA | 2 |
| 112 | 21234-112 | SOCKET HEAD CAP SCREW M8X30L | EA | 12 |
| 113 | 21234-113 | SOCKET HEAD CAP SCREW M12X25L | EA | 2 |

| | | | | |
|---|---|---|---|---|
| 114 | 21234-114 | SOCKET HEAD CAP SCREW M12X55L | EA | 2 |
| 115 | 21234-115 | ADJUSTING BLOCK | EA | 2 |
| 116 | 21234-116 | POSITIONING PIN | EA | 2 |
| 117 | 21234-117 | HEADSTOCK NAME PLATE | EA | 2 |
| 118 | 21234-118 | REVIT 2X5L | EA | 16 |
| 119 | 21234-119 | OIL SIGHT GLASS | EA | 2 |
| 121 | 21234-121 | COLLAR | EA | 2 |
| 122 | 21234-122 | DOUBLE ROUND HEAD KEY 5X5X20L | EA | 2 |
| 123 | 21234-123 | BALLBEARING-DEEP GROOVE #6006ZZ | EA | 4 |
| 124 | 21234-124 | INTERNAL RING | EA | 2 |
| 125 | 21234-125 | SYNCHRONOUS BELT 270L050 | EA | 2 |
| 126 | 21234-126 | SYNCHRONOUS PULLEY | EA | 2 |
| 127 | 21234-127 | DOUBLE ROUND HEAD KEY 5X5X20L | EA | 2 |
| 128 | 21234-128 | WASHER 8.5X 30X3T | EA | 2 |
| 129 | 21234-129 | SPRING WASHER M8 | EA | 2 |
| 130 | 21234-130 | SOCKET HEAD CAP SCREW M8 X25L | EA | 2 |
| 131 | 21234-131 | SHAFT | EA | 2 |
| 132 | 21234-132 | EXTERNAL RING | EA | 2 |
| 133 | 21234-133 | BRACKET | EA | 2 |
| 134 | 21234-134 | SOCKET HEAD CAP SCREW M10 X30L | EA | 4 |
| 135 | 21234-135 | FLAT WASHER M10 | EA | 4 |
| 136 | 21234-136 | SPEED CODER | EA | 2 |
| 137 | 21234-137 | SOCKET HEAD CAP SCREW M5X25L | EA | 4 |
| 138 | 21234-138 | SPRING WASHER M5 | EA | 4 |
| 139 | 21037-01 | BEARING CAP | EA | 1 |
| 140 | 21037-02 | GEAR SHAFT | EA | 1 |
| 141 | 21037-03 | SLEEVE | EA | 1 |
| 142 | 21037-04 | GEAR | EA | 1 |
| 143 | 21037-05 | GEAR | EA | 1 |
| 144 | 6003-2NSE | BALLBEARING-DEEP GROOVE | EA | 2 |
| 150 | 21234-150 | POSITION CHECK ROD | EA | 1 |
| 151 | 21234-151 | SOCKET HEAD SET SCREW M8 X8L | EA | 1 |
| 152 | 21234-152 | COMPRESSION SPRING | EA | 1 |
| 153 | 21234-153 | STEEL BALL 1/4 | EA | 1 |
| 154 | 21234-154 | OIL SEAL TC20X35X7 | EA | 1 |
| 155 | 21234-155 | SET SCREW M6X8L | EA | 1 |
| 156 | 21234-156 | TOUCH BLOCK | EA | 1 |
| 157 | 21037 | HEADSTOCK ASSY MODIFICATIONS | EA | 1 |

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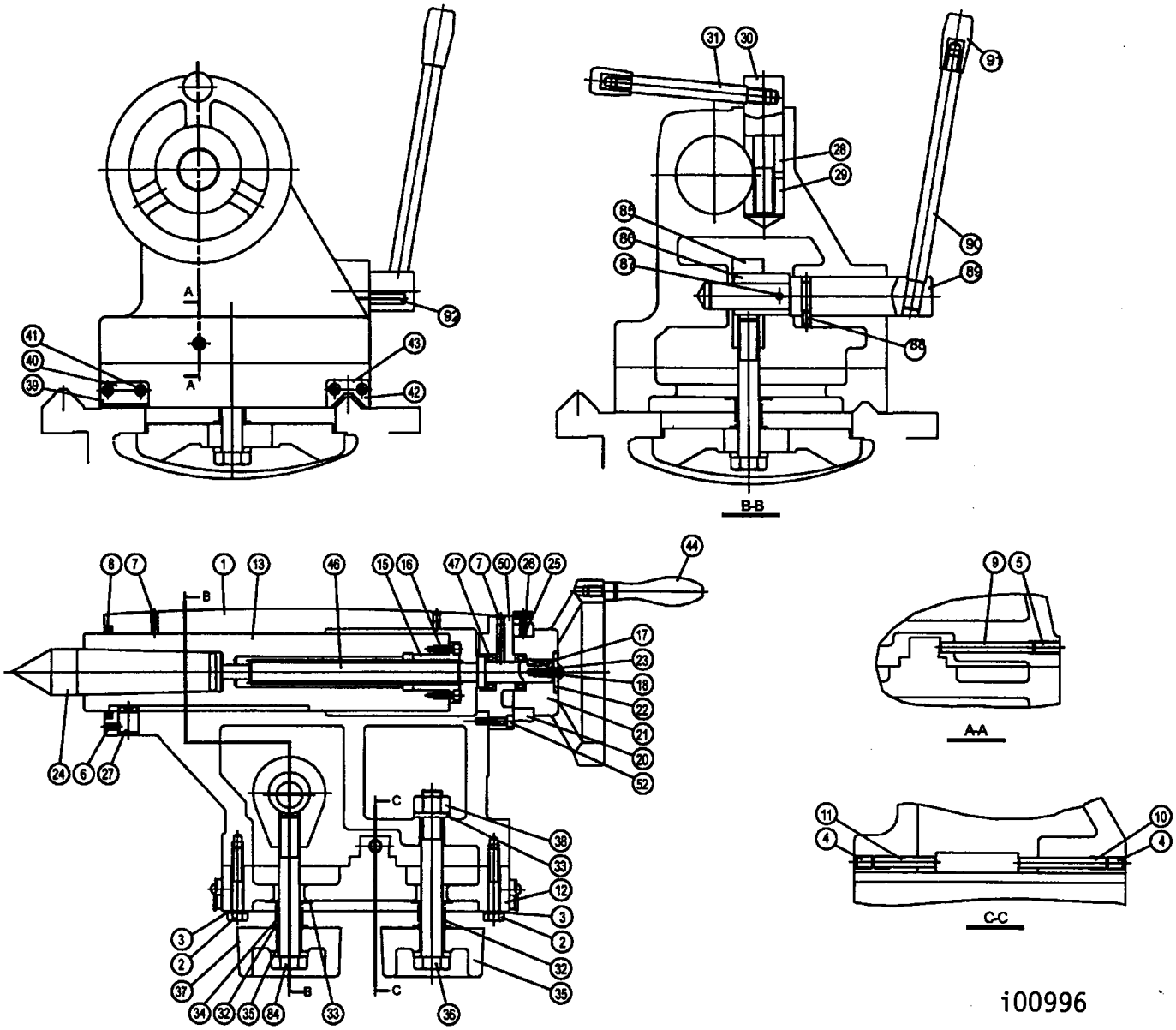


**Figure 7-16**
**1840V Tailstock Assembly**

## Parts List – 1840V Tailstock Assembly

| Item | P/N | Title | Use As | Qty |
|---|---|---|---|---|
| 1 | 21236-01 | TAILSTOCK BODY | EA | 1 |
| 2 | 21236-02 | SOCKET HEAD CAP SCREW M10X60L | EA | 2 |
| 3 | 21236-03 | FLAT WAHER M10 | EA | 2 |
| 4 | 21236-04 | SOCKET HEAD SET SCREW M12X16L | EA | 2 |
| 5 | 21236-05 | SOCKET HEAD SET SCREW M12X25L | EA | 1 |
| 6 | 21236-06 | SOCKET HEAD SET SCREW M6X10L | EA | 1 |
| 7 | 21236-07 | BALL CUP 1/4" | EA | 2 |
| 8 | 21236-08 | OIL SEAL TC75X90X8 | EA | 1 |
| 9 | 21236-09 | STRAIGHT PIN 10X85L | EA | 1 |
| 10 | 21236-10 | STRAIGHT PIN 10X60L | EA | 1 |
| 11 | 21236-11 | STRAIGHT PIN 10X90L | EA | 1 |
| 12 | 21236-12 | TAILSTOCK BASE | EA | 1 |
| 13 | 21236-13 | SLEEVE | EA | 1 |
| 15 | 21236-15 | FEED SCREW NUT IMPERIAL | EA | 1 |
| 16 | 21236-16 | SOCKET HEAD CAP SCREW M6X12L | EA | 4 |
| 17 | 21236-17 | DOUBLE ROUND HEAD KEY 6X6X20L | EA | 1 |
| 18 | 21236-18 | SOCKET HEAD SET SCREW M5X20L | EA | 1 |
| 20 | 21236-20 | DIAL- INCH | EA | 1 |
| 21 | 21236-21 | HANDWHEEL | EA | 1 |
| 22 | 21236-22 | WASHER | EA | 1 |
| 23 | 21234-099 | SCREW & SET SCREW ASSEMBLY | EA | 1 |
| 24 | 21236-24 | CENTER | EA | 1 |
| 25 | 21236-25 | PAD-BRASS | EA | 1 |
| 26 | 21236-26 | ROUND SCREW | EA | 1 |
| 27 | 21236-27 | PIN | EA | 1 |
| 28 | 21236-28 | LOCKING BLOCK | EA | 1 |
| 29 | 21236-29 | CLAMPING BLOCK | EA | 1 |
| 30 | 21236-30 | LOCKING ROD | EA | 1 |
| 31 | 21236-31 | SHIFTING ROD | EA | 1 |
| 32 | 21236-32 | FLAT WASHER | EA | 2 |
| 33 | 21236-33 | FLAT WASHER | EA | 2 |
| 34 | 21236-34 | COMPRESSION SPRING | EA | 2 |
| 35 | 21236-35 | FLAT WASHER | EA | 3 |
| 36 | 21236-36 | HEXAGON SCREW M20X160L | EA | 1 |
| 37 | 21236-37 | CLAMPING BLOCK | EA | 2 |
| 38 | 21236-38 | HEXAGON NUT M20XP2.0 | EA | 1 |
| 39 | 21236-39 | BEDWAY WIPER | EA | 2 |
| 40 | 21236-40 | BEDWAY WIPER PLATE | EA | 2 |
| 41 | 21236-41 | CROSS RECESS HEAD SCREW M6X16L | EA | 8 |
| 42 | 21236-42 | BEDWAY WIPER | EA | 2 |
| 43 | 21236-43 | BEDWAY WIPER PLATE | EA | 2 |
| 44 | 21236-44 | KNOB | EA | 1 |
| 46 | 21236-46 | FEED SCREW IMPERIAL | EA | 1 |
| 47 | 21236-47 | THRUST BEARING #51104 | EA | 2 |
| 50 | 21236-50 | BRACKET | EA | 1 |
| 52 | 21236-52 | SOCKET HEAD CAP SCREW M6X16L | EA | 4 |
| 84 | 21236-84 | HEXAGON SCREW M20X125L | EA | 1 |

| 85 | 21236-85 | ADJUSTING BLOCK | EA | 1 |
|---|---|---|---|---|
| 86 | 21236-86 | ECCENTRIC COLLAR | EA | 1 |
| **Item** | **P/N** | **Title** | **Use As** | **Qty** |
| 87 | 21236-87 | SPRING PIN 6X40L | EA | 1 |
| 88 | 21236-88 | SOCKET HEAD SET SCREW M8X 12L | EA | 1 |
| 89 | 21236-89 | SHAFT | EA | 1 |
| 90 | 21236-90 | LEVER | EA | 1 |
| 91 | 21236-91 | KNOB | EA | 1 |
| 92 | 21236-92 | STUD | EA | 1 |
| 93 | 21247 | NUT AND FEED SCREW ASSY | EA | 1 |

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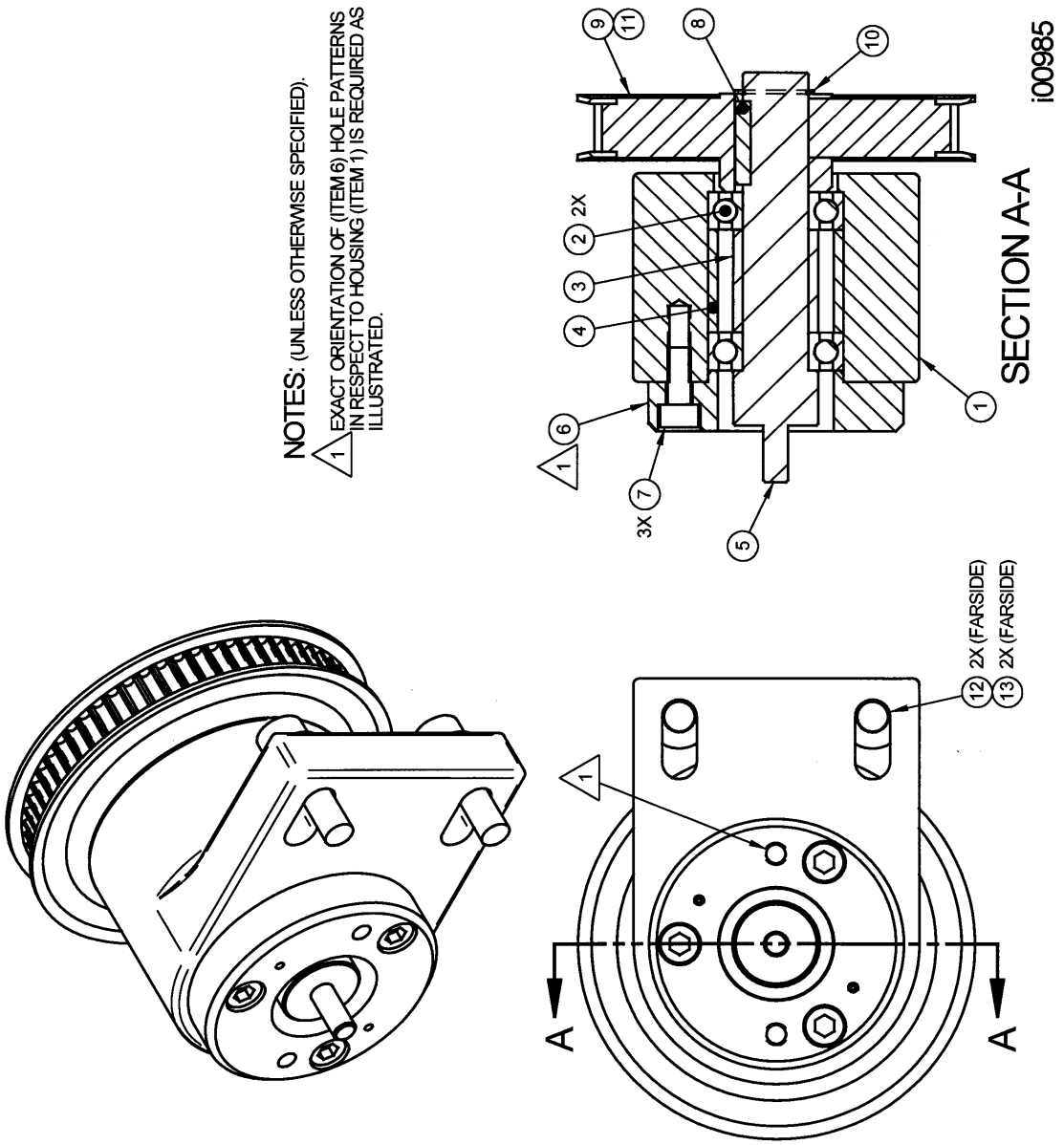


**Figure 7-17**
**1540V Spindle Encoder Drive Assembly**

## Parts List – 1540V Spindle Encoder Drive Assembly

| Item | P/N | Title | Use As | Qty |
|---|---|---|---|---|
| 1 | 22205 | HOUSING - SPINDLE ENCODER DRIVE | EA | 1 |
| 2 | 6003-2RS | BEARING (SWI P/N 21047) | EA | 2 |
| 3 | 21037-03 | SPACER | EA | 1 |
| 4 | 21037-06 | SNAP RING | EA | 1 |
| 5 | 22203 | SHAFT - SPINDLE ENCODER DRIVE | EA | 1 |
| 6 | 21037-01 | ADAPTOR - ENCODER MOUNTING | EA | 1 |
| 7 | M6-1.0X15 25B | SCREW-SHCS-STL-BO | EA | 3 |
| 8 | 22202 | KEY 4x4x22 | EA | 1 |
| 9 | 22204 | SPROCKET ASSY - SPINDLE ENCODER DRIVE | EA | 1 |
| 10 | 5100-66 | RETAINING RING - 17mm | EA | 1 |
| 11 | 670-5M-09 | BELT | EA | 1 |
| 12 | M8 70B | WASHER-FLAT USS-STL-BO | EA | 2 |
| 13 | M8-1.25X30 25B | SCREW-SHCS-STL-BO | EA | 2 |

i00985

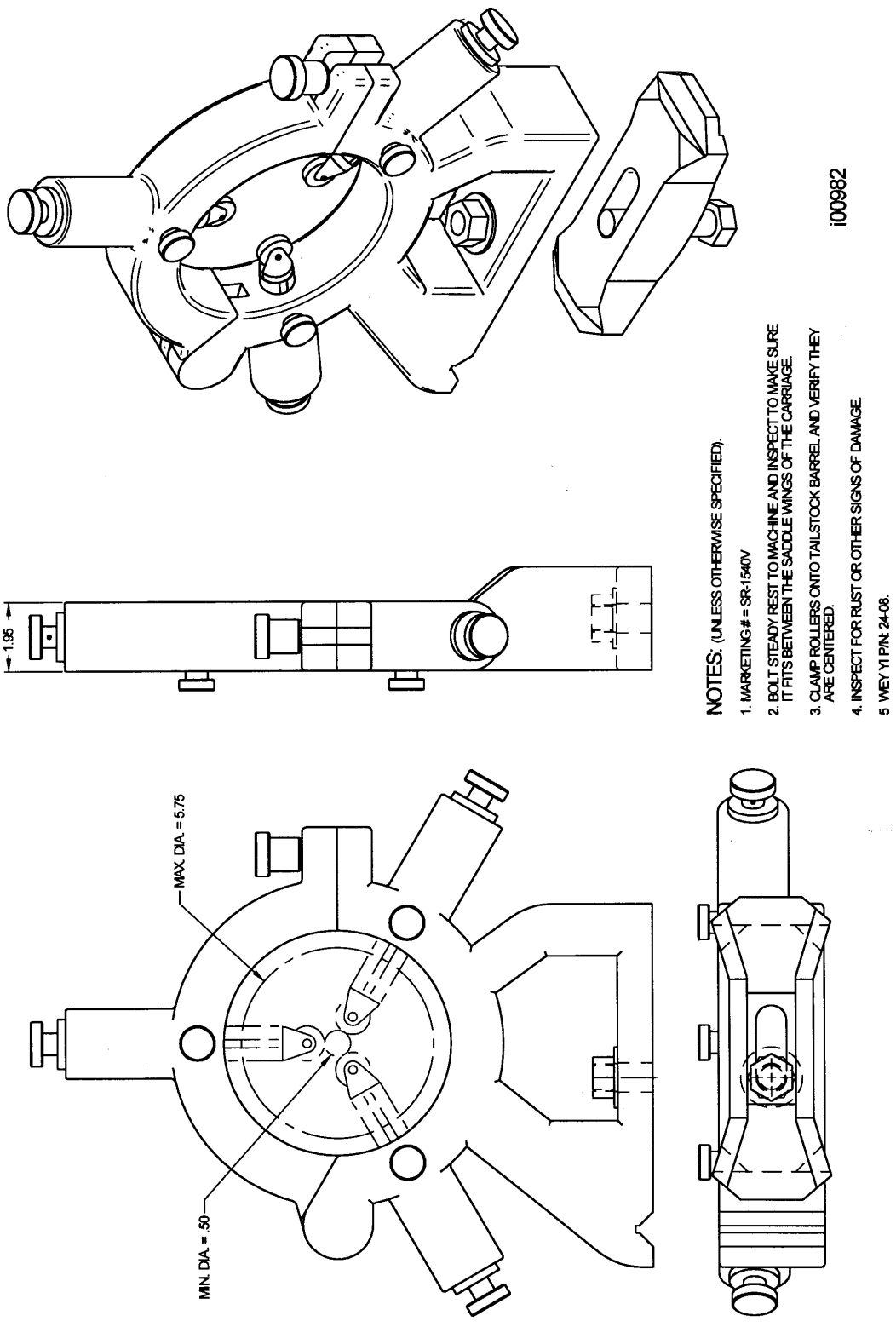


**Figure 7-18**
**1540V Steady Rest**

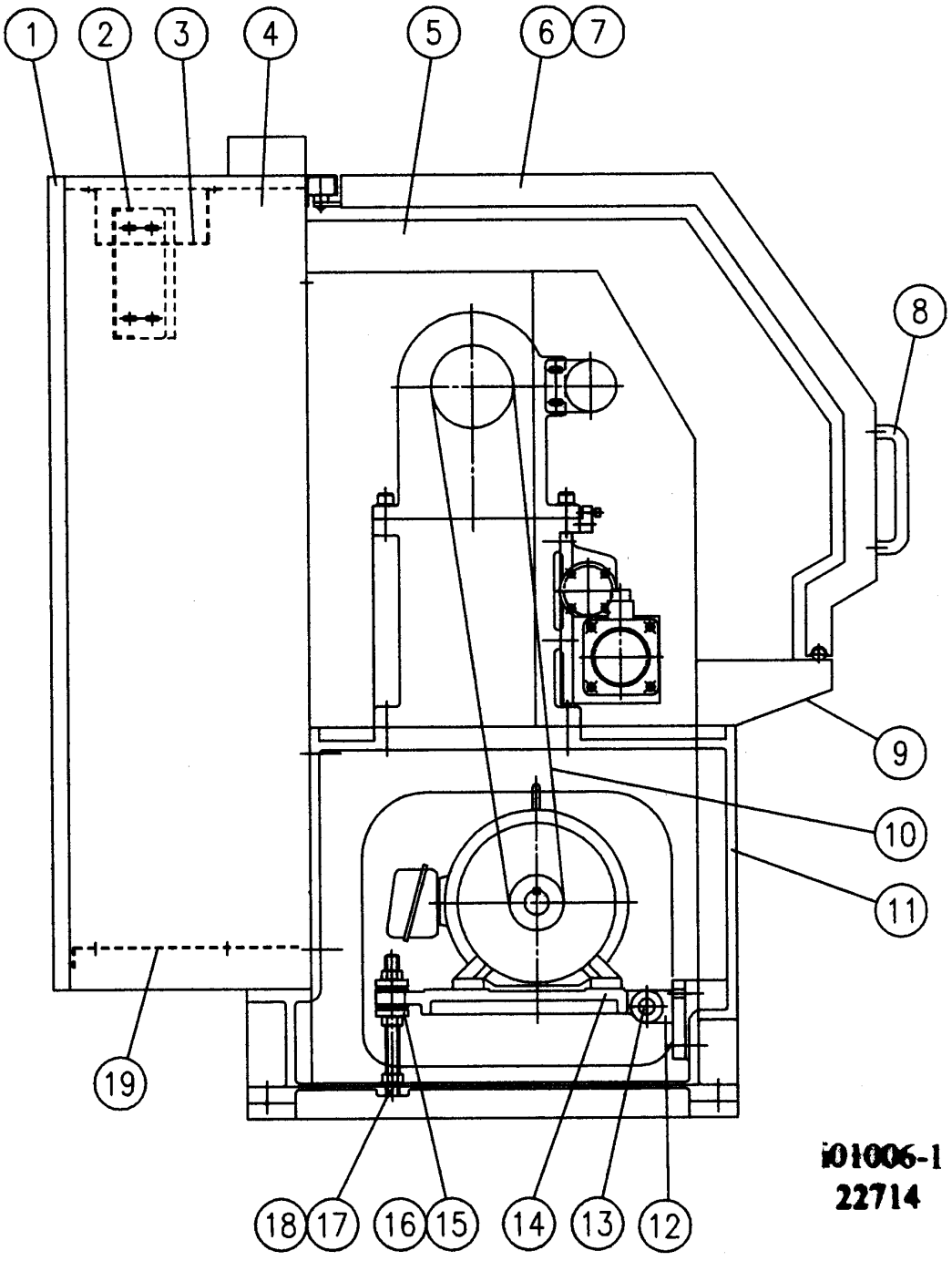


**Figure 7-19**
**1540V Overall Machine**

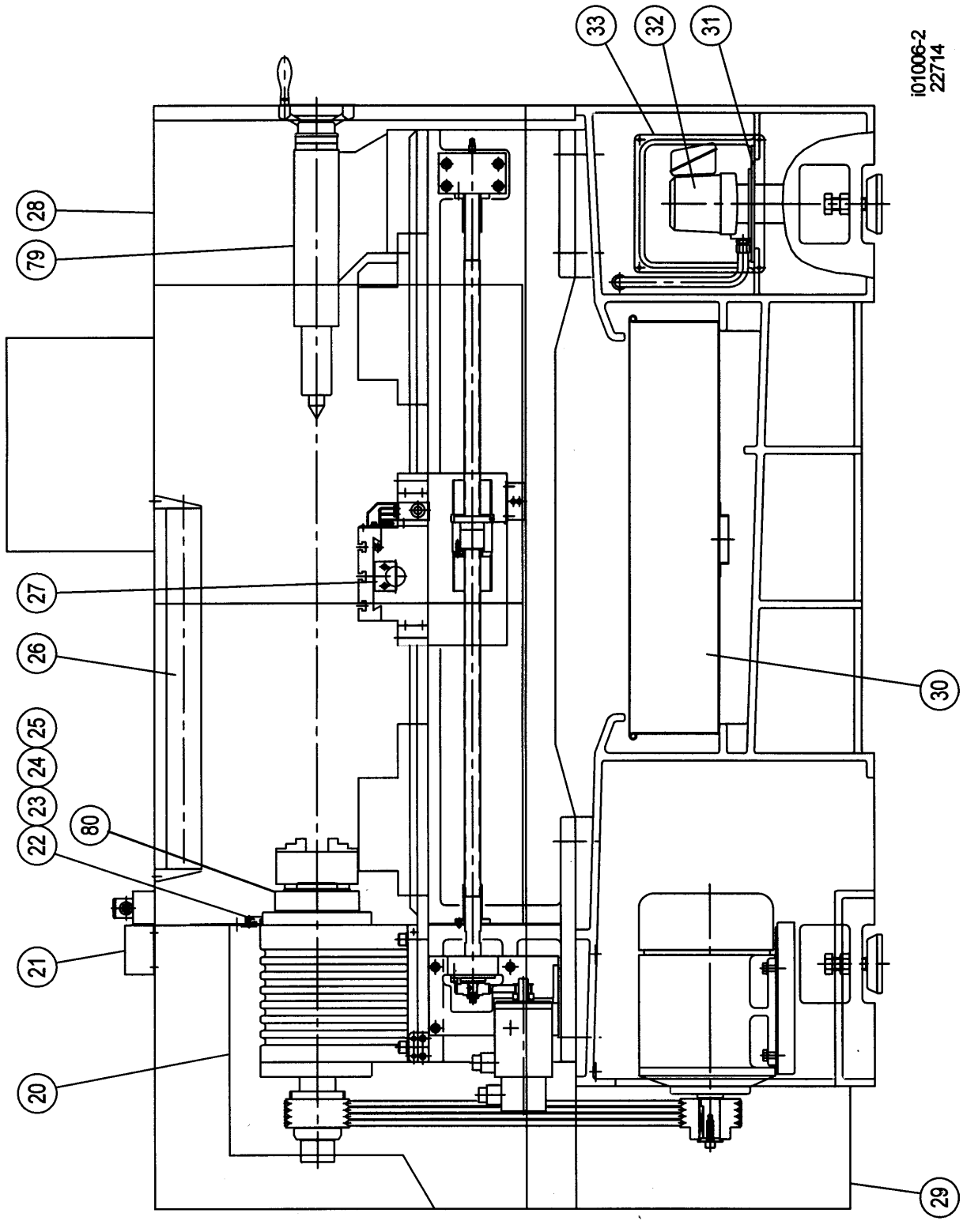


**Figure 7-20**
**1540V Overall Machine**

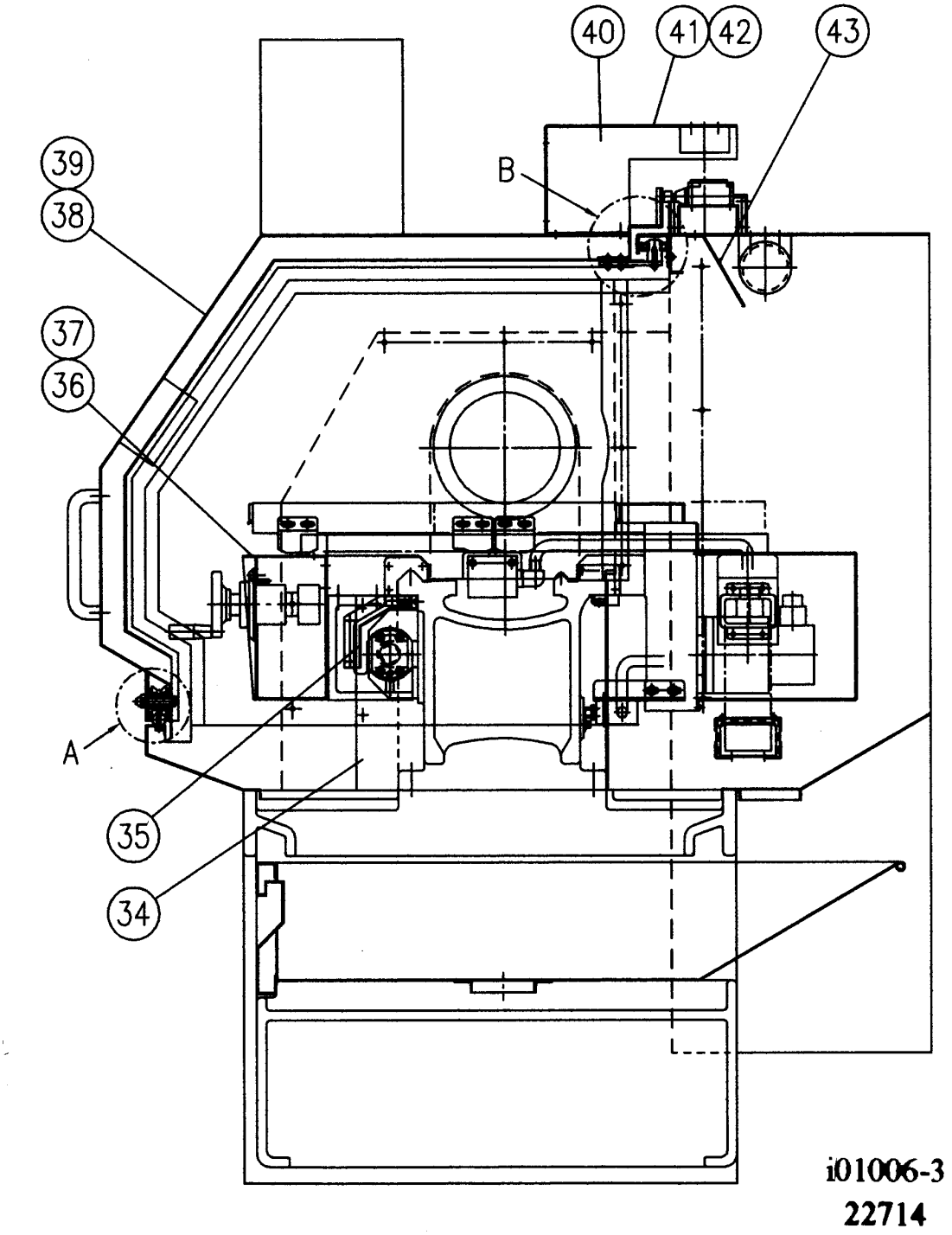


**Figure 7-21**
**1540V Overall Machine**

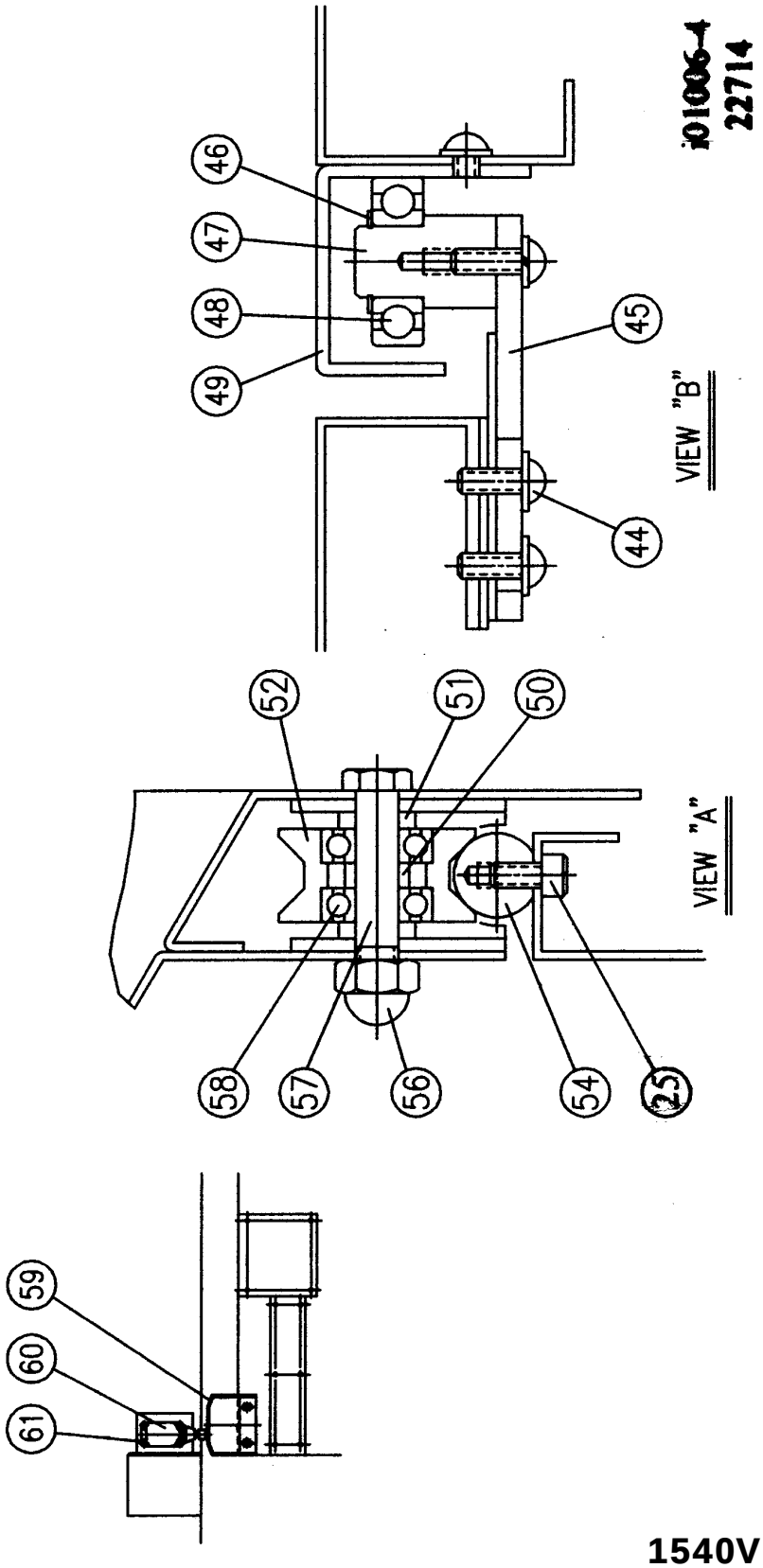


**Figure 7-22**
**1540V Overall Machine**

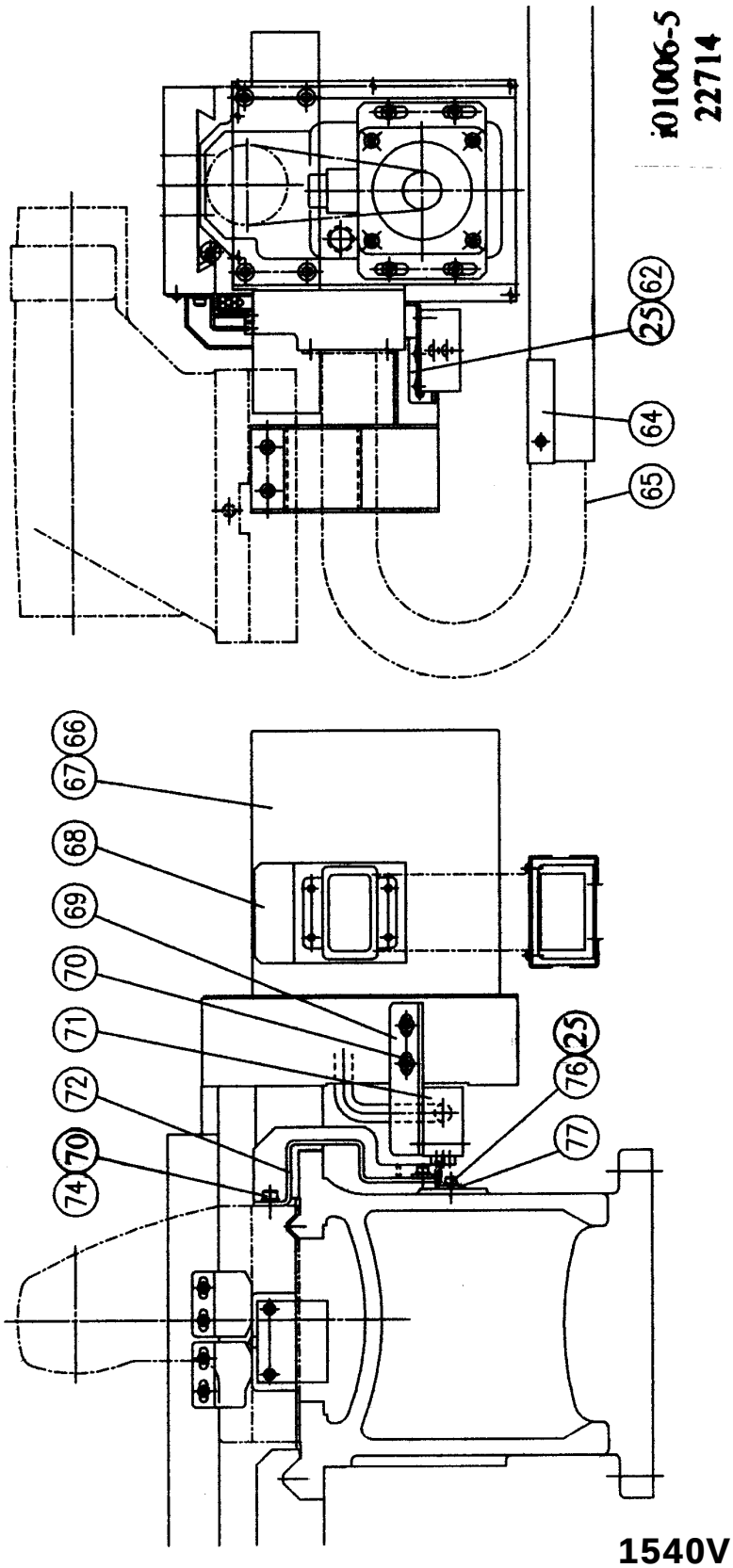


**Figure 7-23**
**1540V Overall Machine**

## Parts List – 1540V Overall Machine

| Item | P/N | Mfr P/N | Title | Use As | Qty |
|---|---|---|---|---|---|
| 1 | 22714-1 | 24-0707 | ELECTRICAL CONTROL BOX DOOR | EA | 1 |
| 2 | 22714-2 | 77A-0648 | SWITCH SEAT | EA | 1 |
| 3 | 22714-3 | 24-0735 | ELECTRICAL CONTROL BOX | EA | 1 |
| 4 | 22714-4 | 24-0706 | ELECTRICAL CONTROL BOX | EA | 1 |
| 5 | 22714-5 | 24-0704 | PROTECTION COVER | EA | 1 |
| 6 | 22714-6 | 24-0719 | LEFT MOVING DOOR | EA | 1 |
| 7 | 22714-7 | 24-0720 | SAFETY GLASS | EA | 1 |
| 8 | 21241-36 | 77A-06103-AI | DOOR HANDLE | EA | 1 |
| 9 | 22714-9 | 24-0709 | FRONT PROTECTION GUARD | EA | 1 |
| 10 | 21239-24 | 2R-11M-1950 | BELT-SPINDLE MOTOR | EA | 2 |
| 11 | 22714-11 | 24-0674 | STAND | EA | 1 |
| 12 | 22714-12 | 24-0676 | BRACKET | EA | 1 |
| 13 | 22714-13 | 24-0677 | SHAFT | EA | 1 |
| 14 | 22714-14 | 24-0678 | MOTOR PLATE | EA | 1 |
| 15 | 22714-15 | 50-0681 | ADJUSTING WASHER | EA | 2 |
| 16 | 22714-16 | 50-0682 | ADJUSTING WASHER | EA | 2 |
| 17 | M20-2.5 X22 | | ADJUSTMENT SCREW | EA | 1 |
| 18 | M20-2.5 50B | | NUT-HEX-STL-BO | EA | 3 |
| 19 | 22714-19 | 24-0708 | SETTING PLATE | EA | 1 |
| 20 | 22714-20 | 24-0731 | COVER PLATE | EA | 1 |
| 21 | 22714-21 | 24-0726 | COVER PLATE | EA | 1 |
| 22 | 22714-22 | 24-0716 | ANTI-LEAKING COVER | EA | 1 |
| 23 | 22714-23 | G220 | 0-RING | EA | 1 |
| 24 | 22714-24 | G250 | 0-RING | EA | 1 |
| 25 | M6-1.0X12 25B | | SCREW-SHCS-STL-BO | EA | 15 |
| 26 | 22714-26 | A-W515DB | LAMPTUBE | EA | 1 |
| 27 | 22714-27 | 24-0739 | PLATE | EA | 1 |
| 28 | 22714-28 | 24-0701 | REAR PROTECTION GUARD | EA | 1 |
| 29 | 22714-29 | 24-0733 | END COVER | EA | 1 |
| 30 | 22714-30 | 24-0734 | CHIP TRAY | EA | 1 |
| 31 | 22714-31 | 24-0742 | PUMP BRACKET | EA | 1 |
| 32 | 23265 | | PUMP COOLANT 1/8 HP | EA | 1 |
| 33 | 22714-33 | 24-0741 | REAR COVER | EA | 1 |
| 34 | 22714-34 | 24-0705 | COVER PLATE | EA | 1 |
| 35 | 22714-35 | 24-0712 | BALL SCREW COVER | EA | 1 |
| 36 | 22714-36 | 24-0723 | OPERATION BOX | EA | 1 |
| 37 | 22714-37 | 24-0724 | COVER | EA | 1 |
| 38 | 22714-38 | 24-0721 | RIGHT MOVING DOOR | EA | 1 |
| 39 | 22714-39 | 24-0722 | SAFETY GLASS | EA | 1 |
| 40 | 22714-40 | 24-0710 | CABLE CARRIER | EA | 1 |
| 41 | 22714-41 | 24-0711 | COVER | EA | 1 |
| 42 | 22714-42 | 80X45SS2000L | WIRE PROTECTOR | EA | 1 |
| 43 | 22714-43 | 24-0703 | PLATE | EA | 1 |
| 44 | M6-1.0X16 25B | | SCREW-SHCS-STL-BO | EA | 18 |
| 45 | 22714-45 | 77A-0615 | SETTING BASE | EA | 6 |
| 46 | 22714-46 | S17 | RETAINING RING | EA | 6 |
| 47 | 22714-47 | 77A-0614 | SHAFT | EA | 6 |

| 48 | FVS65 | | BALL BEARING (2 REQ.) 6203ZZ | EA | 6 |
|---|---|---|---|---|---|
| 49 | 22714-49 | 24-0713 | UPPER DOOR GUIDE | EA | 1 |
| **Item** | **P/N** | **Mfr P/N** | **Title** | **Use As** | **Qty** |
| 50 | 22714-50 | 77-0627 | SPACER | EA | 8 |
| 51 | 22714-51 | 77-0628 | SPACER | EA | 4 |
| 52 | 22714-52 | 77-0626 | ROLLER | EA | 4 |
| 54 | 22714-54 | 24-0725 | SLIDE WAY | EA | 1 |
| 56 | M10-1.5 54B | | NUT-ACORN-BLK OX | EA | 4 |
| 57 | 22714-57 | 77-0629 | SHAFT | EA | 4 |
| 58 | 22714-58 | 6000ZZ | TAPER ROLLER BEARING | EA | 4 |
| 59 | 22714-59 | 24-0743 | TOUCH BLOCK | EA | 1 |
| 60 | 22683 | TZ-5109 | LIMIT SWITCH- DOOR LIMIT | EA | 1 |
| 61 | 22714-61 | 77A-0672 | COVER PLATE | EA | 1 |
| 62 | 22714-62 | 77B-0698 | Z AXIS TOUCH BLOCK | EA | 1 |
| 64 | 22714-64 | 77A-0610 | COVER PLATE | EA | 1 |
| 65 | 22714-65 | 80X45SA150000L | WIRE PROTECTOR | EA | 1 |
| 66 | 22714-66 | 24-0728 | X AXIS MOTOR COVER | EA | 1 |
| 67 | 22714-67 | 24-0729 | END COVER | EA | 1 |
| 68 | 22714-68 | 24-0730 | BRACKET | EA | 1 |
| 69 | 22714-69 | 24-0307 | MICRO SWITCH SEAT | EA | 1 |
| 70 | M8-1.25X12 25B | | SCREW-SHCS-STL-BO | EA | 4 |
| 71 | 22551-2 | | LIMIT SWITCH ASSY-PT4-LEFT | EA | 1 |
| 72 | 22714-72 | 24-0738 | BRACKET | EA | 1 |
| 74 | M8 70B | | WASHER-FLAT USS-STL-BO | EA | 2 |
| 76 | M6 70B | | WASHER-FLAT USS-STL-BO | EA | 2 |
| 77 | 22714-77 | 24-0698 | BRACKET | EA | 1 |
| 78 | 22551-1 | | LIMIT SWITCH ASSY-PT4-RIGHT | EA | 1 |
| 79 | 22712 | | TAIL STOCK-1540V | EA | 1 |
| 80 | 22170 | | SPINDLE ASSY | EA | 1 |

22714

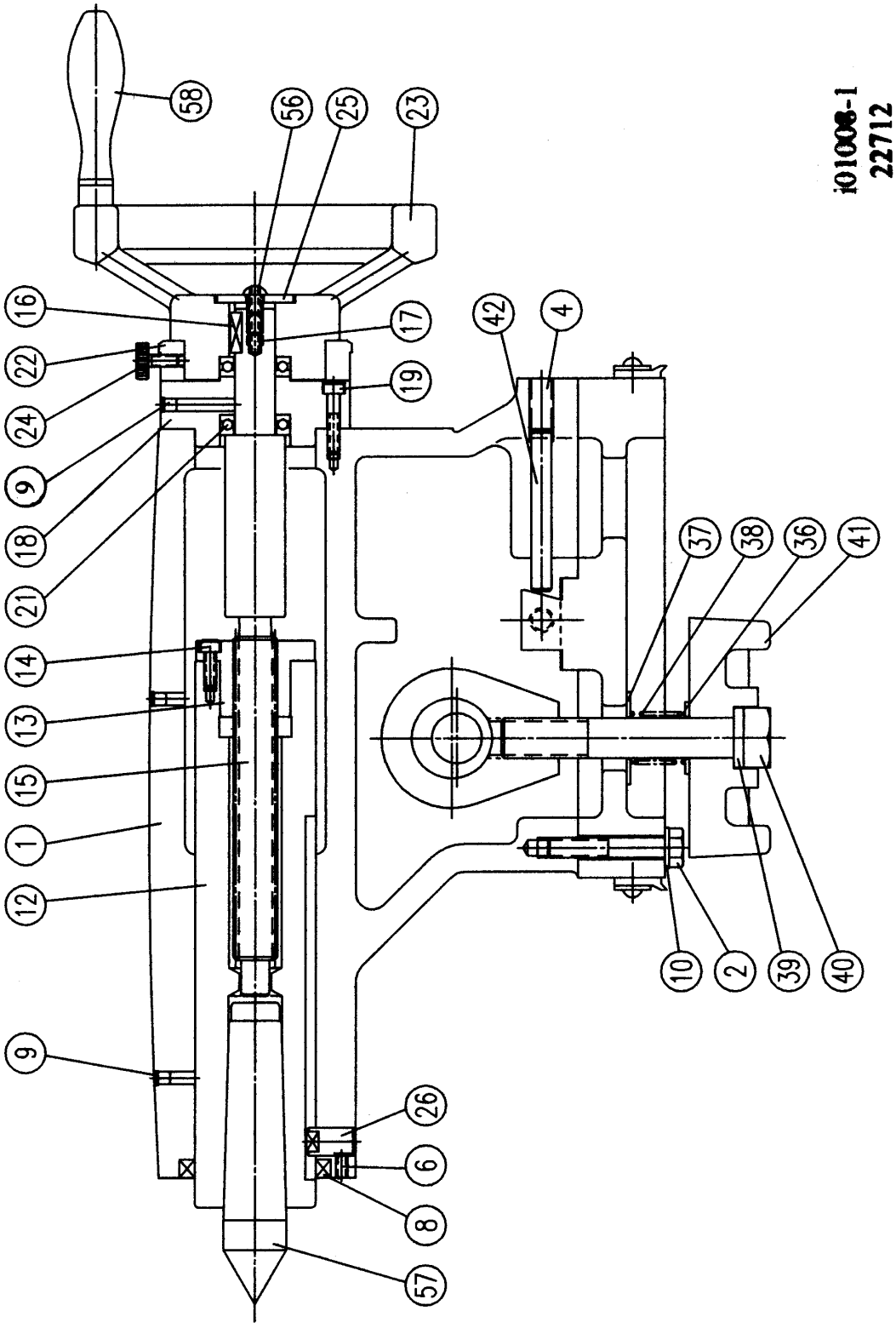


**Figure 7-24**
**1540V Tailstock Assembly**

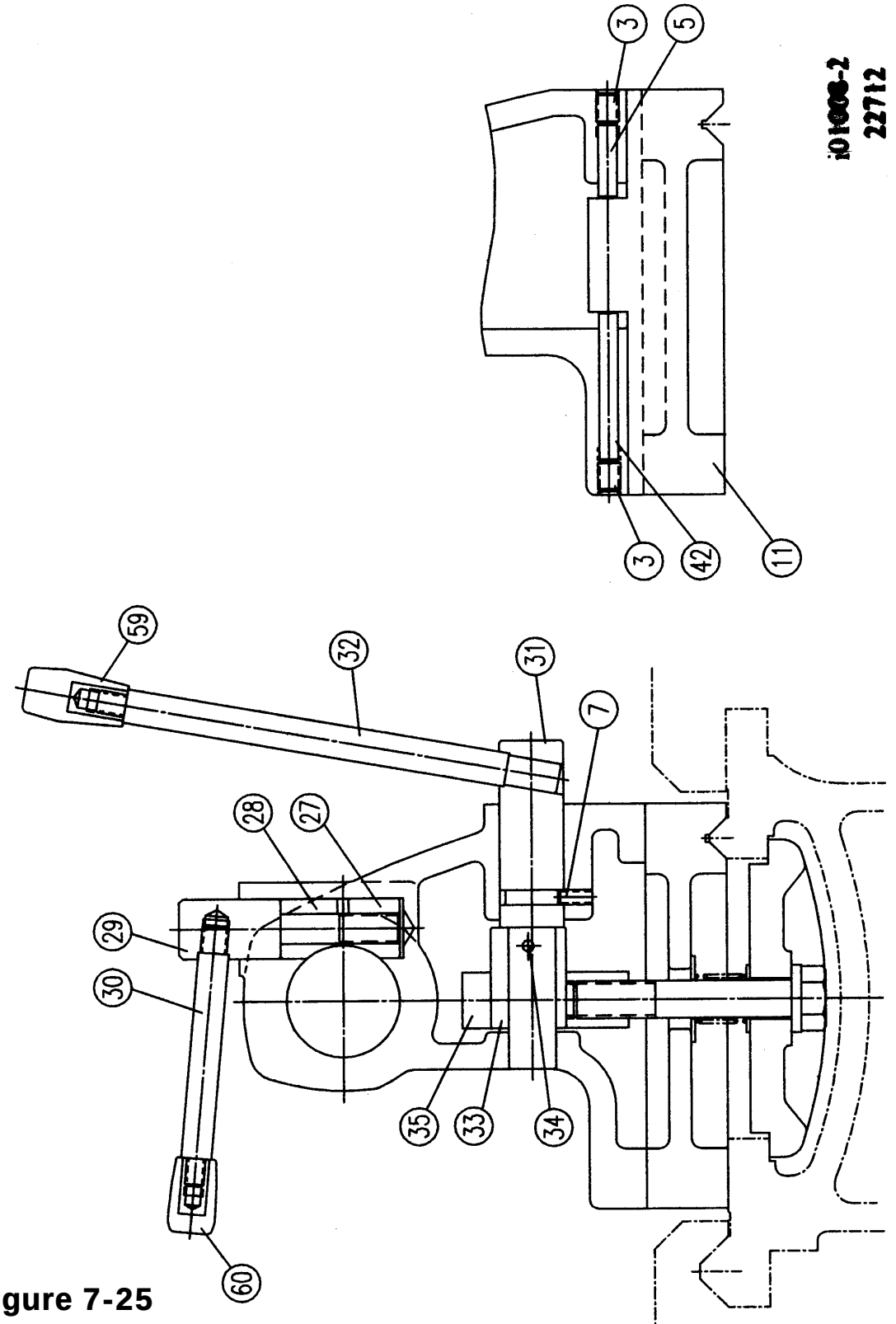


**Figure 7-25**
**1540V Tailstock Assembly**

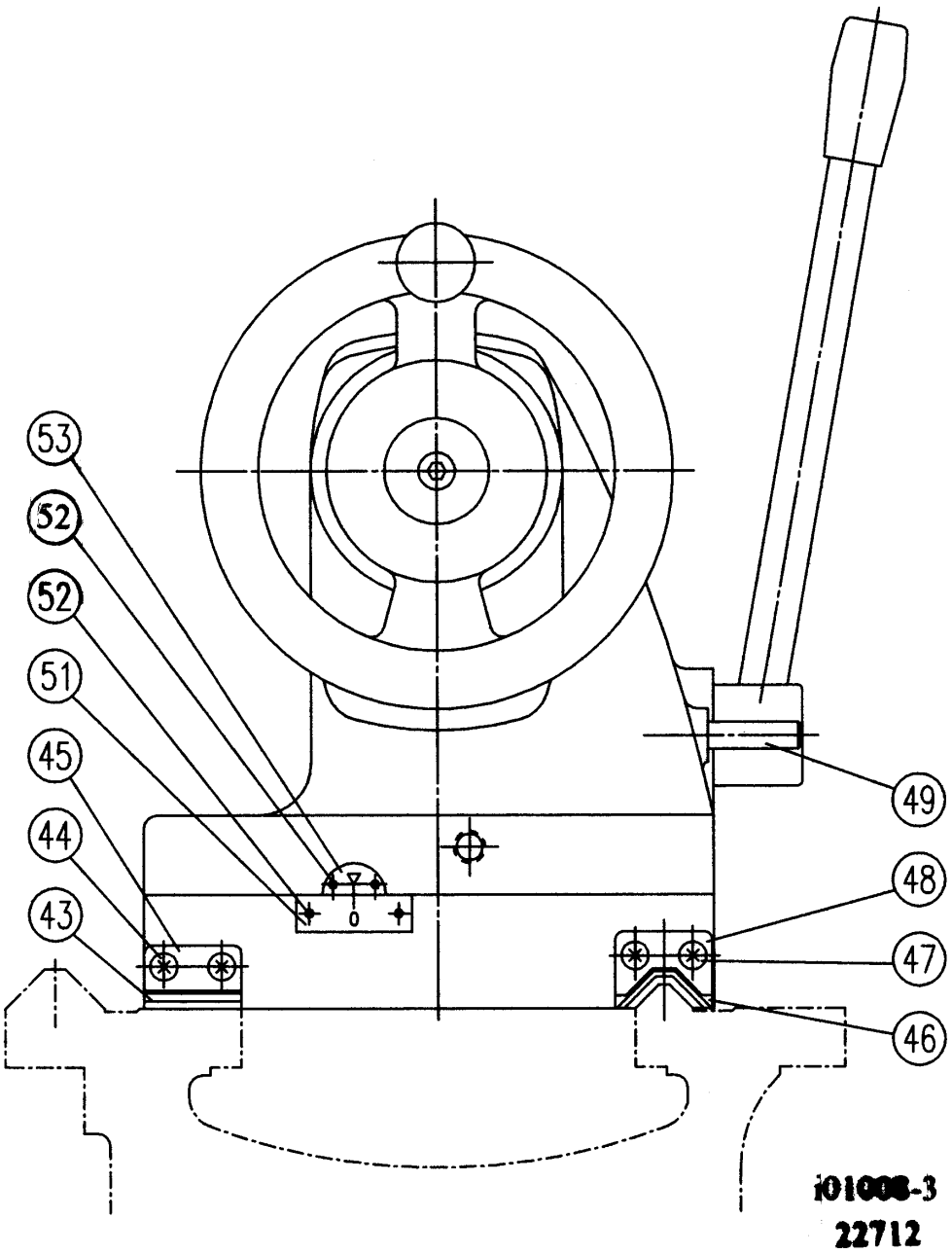


**Figure 7-26**
**1540V Tailstock Assembly**

## Parts List – 1540V Tailstock Assembly

| Item | P/N | Mfr P/N | Title | Use As | Qty |
|---|---|---|---|---|---|
| 1 | 22712-1 | 24-0501-00 | TAILSTOCK BODY | EA | 1 |
| 2 | M10-1.5X60 25B | | SCREW-SHCS-STL-BO | EA | 2 |
| 3 | M12-1.75X16 25B | | SCREW-SHCS-STL-BO | EA | 2 |
| 4 | M12-1.75X25 25B | | SCREW-SHCS-STL-BO | EA | 1 |
| 5 | 22712-5 | 10X40LG | STRAIGHT PIN | EA | 1 |
| 6 | M6-1.0X10 40B | | SCREW-SOC SET-STL-BO-CUP | EA | 1 |
| 7 | M8-1.25X10 40B | | SCREW-SOC SET-STL-BO-CUP | EA | 1 |
| 8 | 22712-8 | TCØ60XØ75X9 | OIL SEAL | EA | 1 |
| 9 | 22712-9 | Ø1/4 | BALL CUP | EA | 3 |
| 10 | 22712-10 | 23-0112-00 | WASHER-Ø10.5X25.4XT2 | EA | 2 |
| 11 | 22712-11 | 24-0502-00 | TAILSTOCK BASE | EA | 1 |
| 12 | 22712-12 | 50-0503-00 | SLEEVE-TAILSTOCK BARREL | EA | 1 |
| 13 | 23974 | 50-0505-00 | FEED SCREW/NUT ASS'Y<br>FEED NUT - 22712-13 | EA | 1 |
| 14 | 22712-14 | 50-0505-01 | SHCS-M6-1.0X12 | EA | 4 |
| 15 | 23974 | 24-0507-00 | FEED SCREW/NUT ASS'Y<br>FEED SCREW -IMPERIAL - 22712-15 | EA | 1 |
| 16 | 22712-16 | 6X6X20LG | DOUBLE ROUND HEAD KEY | EA | 1 |
| 17 | M5-0.8X20 40B | | SCREW-SOC SET-STL-BO-CUP | EA | 1 |
| 18 | 22712-18 | 50-0508-00 | BRACKET | EA | 1 |
| 19 | M6-1.0X30 25B | | SCREW-SHCS-STL-BO | EA | 4 |
| 21 | 23982 | 51104 | THRUST BEARING SET –<br>INDIVIDUAL BEARING - 22712-21 | EA | 2 |
| 22 | 22712-22 | 50-0510-00 | DIAL-IMPERIAL | EA | 1 |
| 23 | 22712-23 | 50-0511-00 | HANDWHEEL | EA | 1 |
| 24 | 22712-24 | 50-03111-00 | LOCKSCREW | EA | 1 |
| 25 | 22712-25 | 50-0513-00 | WASHER | EA | 1 |
| 26 | 22712-26 | 50-0514-00 | PIN | EA | 1 |
| 27 | 22712-27 | 50-0515-00 | LOCKING BLOCK | EA | 1 |
| 28 | 22712-28 | 50-0516-00 | CLAMPING BLOCK | EA | 1 |
| 29 | 22712-29 | 50-0517-00 | LOCKING ROD | EA | 1 |
| 30 | 22712-30 | 50-0518-00 | LEVER | EA | 1 |
| 31 | 22712-31 | 50-0519-00 | SHAFT | EA | 1 |
| 32 | 22712-32 | 50-0520-00 | LEVER | EA | 1 |
| 33 | 22712-33 | 50-0521-00 | ECCENTRIC COLLAR | EA | 1 |
| 34 | 22712-34 | Ø6X40LG | SPRING PIN | EA | 1 |
| 35 | 22712-35 | 50-0522-00 | ADJUSTING BLOCK | EA | 1 |
| 36 | 22712-36 | 50-0523-00 | FLAT WASHER | EA | 1 |
| 37 | 22712-37 | 50-0524-00 | FLAT WASHER | EA | 1 |
| 38 | 22712-38 | 50-0525-00 | COMPRESSION WASHER | EA | 1 |
| 39 | 22712-39 | 50-0526-00 | FLAT WASHER | EA | 1 |
| 40 | 22712-40 | S35C | HEX SCREW | EA | 1 |
| 41 | 22712-41 | 24-0528-00 | CLAMPING BLOCK | EA | 1 |
| 42 | 22712-42 | 24-0528-00 | CLAMPING BLOCK | EA | 2 |
| 43 | 22712-43 | 24-0530-00 | BEDWAY WIPER | EA | 2 |
| 44 | M6-1.0X16 10B | | SCREW-PH-PHIL-STL-BO | EA | 4 |
| 45 | 22712-45 | 24-0531-00 | BEDWAY WIPER PLATE | EA | 2 |

| | | | | | |
|---|---|---|---|---|---|
| 46 | 22712-46 | 24-0532-00 | BEDWAY WIPER | EA | 2 |
| 47 | M6-1.0X15 10B | | SCREW-PH-PHIL-STL-BO | EA | 4 |
| 48 | 22712-48 | 24-0533-00 | BEDWAY WIPER PLATE | EA | 2 |
| **Item** | **P/N** | **Mfr P/N** | **Title** | **Use As** | **Qty** |
| 49 | 22712-49 | 50-0534-00 | SET SCREW | EA | 2 |
| 51 | 22712-51 | 50-0536-00 | INDICATOR | EA | 1 |
| 52 | 22712-52 | Ø2X5LG | RIVET-Ø2x5LG | EA | 4 |
| 53 | 22712-53 | 50-0537-00 | INDICATOR | EA | 1 |
| 56 | 22712-56 | 17-0504-0-2 | SCREW | EA | 1 |
| 57 | 22712-57 | 14-0129 | CENTER-MT#4 | EA | 1 |
| 58 | 22712-58 | 50-0431-00 | KNOB | EA | 1 |
| 59 | 22712-59 | 50-0166-00 | GRIP | EA | 1 |
| 60 | 22712-60 | 50-01138-00 | GRIP | EA | 1 |

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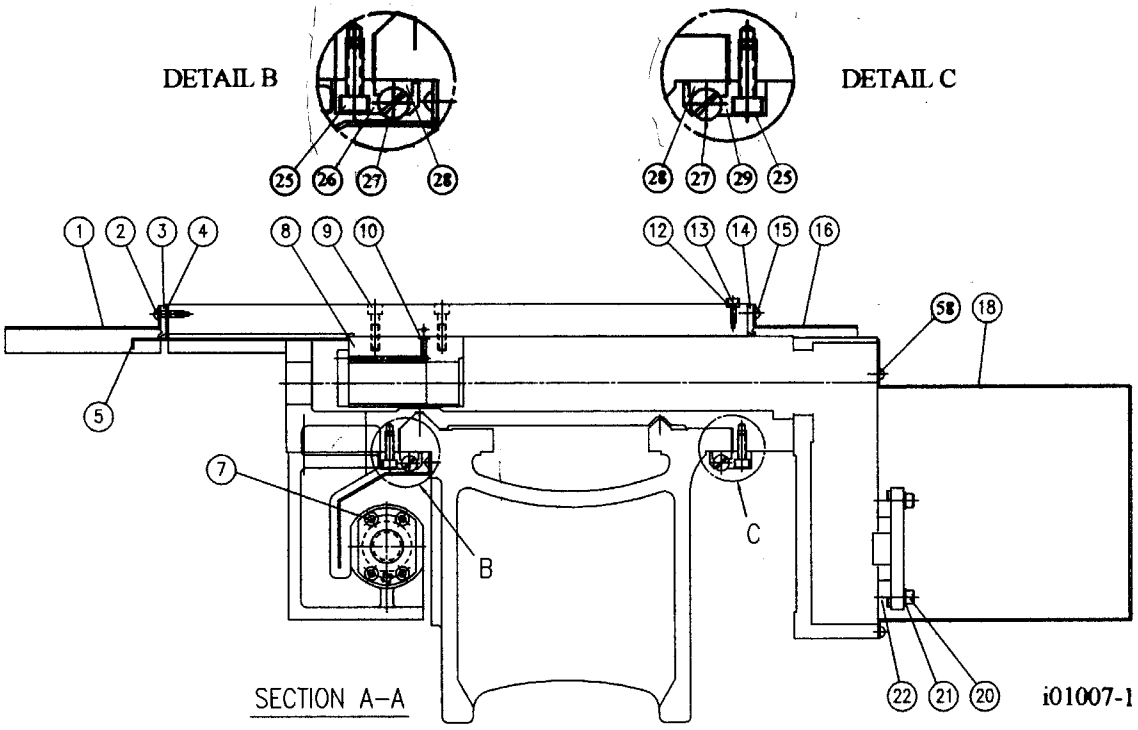



**Figure 7-27**
**1540V Bed & Carriage**

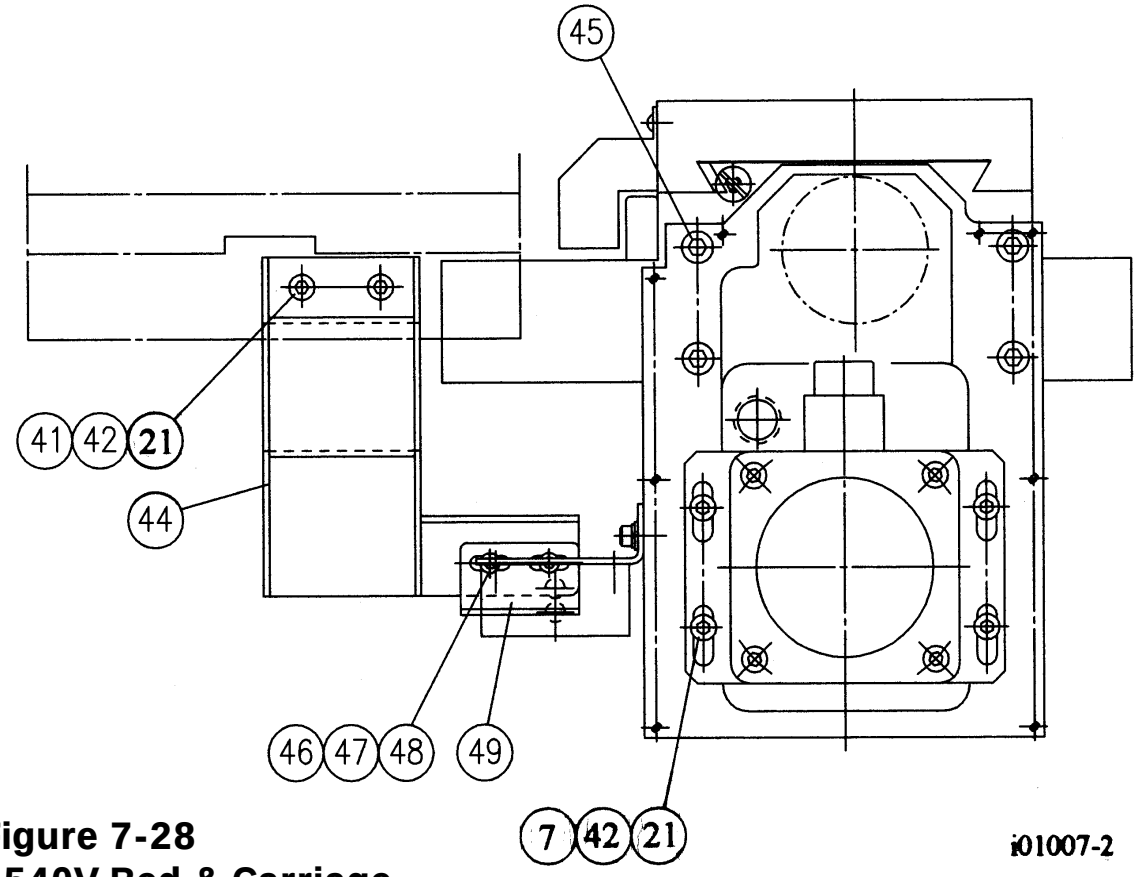



**Figure 7-28**
**1540V Bed & Carriage**

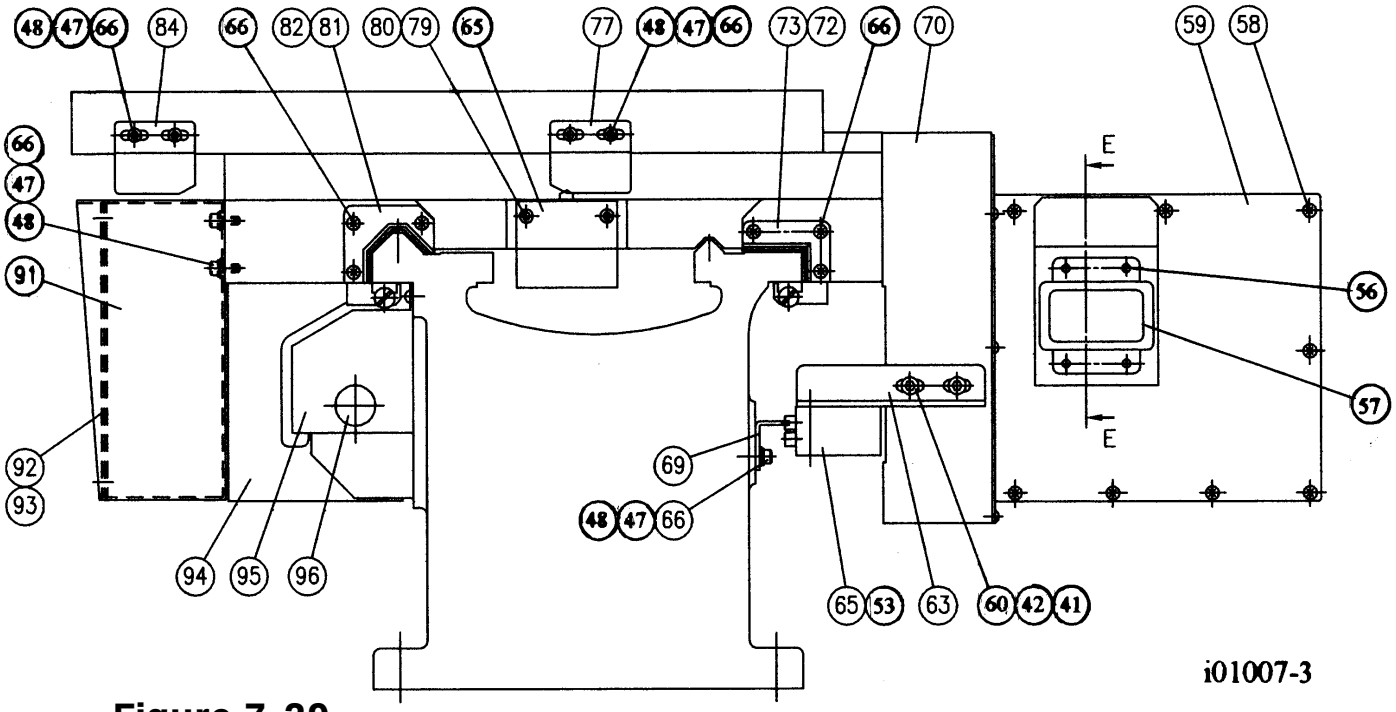



**Figure 7-29**
**1540V Bed & Carriage**

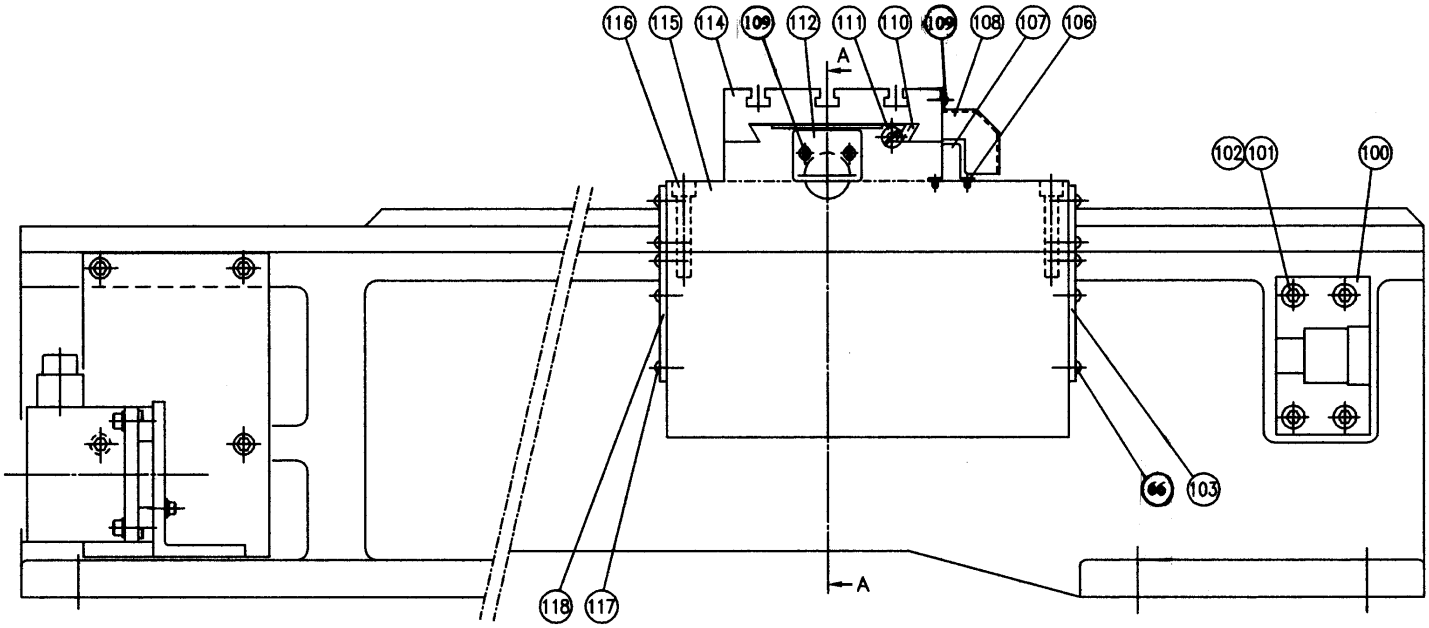



**Figure 7-30**
**1540V Bed & Carriage**

## Parts List – Bed & Carriage

| Item | P/N | Mfr P/N | Title | UseAs | Qty |
|---|---|---|---|---|---|
| 1 | 23337-1 | 24-0227-00 | CROSS SLIDE WAY COVER-FRONT | EA | 1 |
| 2 | M6-1.0X16 10Z | | SCREW-PH-PHIL-STL-ZINC | EA | 6 |
| 3 | 23337-3 | 24-0220-00 | WAY WIPER-FRONT-RUBBER | EA | 1 |
| 4 | 23337-4 | 24-0222-00 | WIPER PLATE | EA | 1 |
| 5 | 23337-5 | 24-0223-00 | SADDLE COVER | EA | 1 |
| 7 | M8-1.25X30 25B | | SCREW-SHCS-STL-BO | EA | 8 |
| 8 | 23337-8 | 77USA-0213-00 | X AXIS YOKE | EA | 1 |
| 9 | M8-1.25X40 25B | | SCREW-SHCS-STL-BO | EA | 4 |
| 10 | 23337-10 | P7 | O RING | EA | 1 |
| 12 | 23337-12 | 24-0218-00 | KEY | EA | 1 |
| 13 | M5-0.8X16 25B | | SCREW-SHCS-STL-BO | EA | 1 |
| 14 | 23337-14 | 24-0221-00 | WAY WIPER-REAR-RUBBER | EA | 1 |
| 15 | M6-1.0X25 10B | | SCREW-PH-PHIL-STL-BO | EA | 6 |
| 16 | 23337-16 | 24-0228-00 | CROSS SLIDE WAY COVER-REAR | EA | 1 |
| 18 | 22714-66 | 24-0728 | X AXIS MOTOR COVER | EA | 6 |
| 20 | M5-0.8X25 25B | | SCREW-SHCS-STL-BO | EA | 4 |
| 21 | M8 73B | | WASHER-SPLIT LOCK-STL-BO | EA | 12 |
| 22 | 23337-22 | 24-0208-00 | X AXIS MOTOR ADAPTER | EA | 1 |
| 26 | 23337-26 | 24-0314-01 | GIB BLOCK-FRONT | EA | 1 |
| 27 | 23337-27 | 50-0325-00 | ADJUSTMENT SCREW | EA | 4 |
| 28 | 23337-28 | 24-0313-01 | GIB | EA | 1 |
| 29 | 23337-29 | 24-0315-01 | GIB BLOCK-BACK | EA | 1 |
| 41 | M8-1.25X16 25B | | SCREW-SHCS-STL-BO | EA | 2 |
| 42 | M8 70B | | WASHER-FLAT USS-STL-BO | EA | 8 |
| 44 | 23337-44 | 24-0738 | BRACKET | EA | 1 |
| 45 | M10-1.5X90 25B | | SCREW-SHCS-STL-BO-FULLY THD | EA | 4 |
| 46 | M6-1.0X10 25B | | SCREW-SHCS-STL-BO | EA | 2 |
| 47 | M6 70B | | WASHER-FLAT USS-STL-BO | EA | 16 |
| 48 | M6 73B | | WASHER-SPLIT LOCK-STL-BO | EA | 16 |
| 49 | 23337-49 | 24-0698 | BRACKET | EA | 1 |
| 53 | M6-1.0X20 25B | | SCREW-SHCS-STL-BO | EA | 44 |
| 56 | 23337-56 | 24-0730 | BRACKET-CABLE CARRIER | EA | 1 |
| 57 | 23337-57 | 88X45SAX1350L | CABLE CARRIER | EA | 1 |
| 58 | M5-0.8X10 10B | | SCREW-PH-PHIL-STL-BO | EA | 17 |
| 59 | 23337-59 | 24-0729 | END COVER | EA | 1 |
| 60 | M8-1.25X20 25B | | SCREW-SHCS-STL-BO | EA | 2 |
| 63 | 23337-63 | 24-0307 | MICRO SWITCH SEAT | EA | 1 |
| 65 | 22551-1 | | LIMIT SWITCH ASSY-PT4-RIGHT | EA | 2 |
| 66 | M6-1.0X16 25B | | SCREW-SHCS-STL-BO | EA | 22 |
| 69 | 23337-69 | 24-0697-00 | Z AXIS STOPPER | EA | 1 |
| 70 | 23337-70 | 24-0207-01 | MOTOR MOUNTING BRACKET | EA | 1 |
| 72 | 23337-72 | 24-0337-00 | REAR WIPER-RIGHT-RUBBER | EA | 1 |
| 73 | 23337-73 | 24-0336-00 | REAR WIPER-LEFT-RUBBER | EA | 1 |
| 77 | 23337-77 | 24-0226-01 | X AXIS STOPPER | EA | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 79 | M6-1.0X25 25B | | SCREW-SHCS-STL-BO | EA | 2 |
| 81 | 23337-81 | 24-0334-00 | FRONT WIPER-LEFT-RUBBER | EA | 2 |
| 82 | 23337-82 | 24-0335-00 | FRONT WIPER-RIGHT-RUBBER | EA | 1 |
| 84 | 23337-84 | 24-0225-00 | X AXIS STOPPER | EA | 1 |
| 91 | 22714-36 | 24-0723 | OPERATION BOX | EA | 1 |
| 92 | 22714-37 | 24-0724 | COVER | EA | 1 |
| 93 | M5-0.8X6 10B | | SCREW-PH-PHIL-STL-BO | EA | 8 |
| 94 | 23337-94 | 24-0311-00 | YOKE | EA | 1 |
| 95 | 22714-35 | 24-0712 | BALL SCREW COVER | EA | 1 |
| 96 | 23337-96 | Ø30 | CAP | EA | 1 |
| 100 | 23337-100 | 77USA-0308-00 | BEARING HOUSING TAILSTOCK | EA | 1 |
| 101 | M12-1.75X16 25B | | SCREW-SHCS-STL-BO | EA | 4 |
| 102 | M12 73B | | WASHER-SPLIT LOCK-STL-BO | EA | 4 |
| 103 | 23337-103 | 24-0316-00 | WIPPER RIGHT-RUBBER | EA | 1 |
| 106 | M5-0.8X12 12B | | SCREW-FH-PHIL-STL-BO | EA | 3 |
| 107 | 23337-107 | 24-0727-01 | CABLE WAY | EA | 1 |
| 108 | 23337-108 | 24-0224-01 | LIMIT SWITCH COVER | EA | 1 |
| 109 | M6-1.0X10 27B | | SCREW-BHCS-STL-BO | EA | 9 |
| 110 | 23337-110 | 24-0217-00 | X AXIS GIB | EA | 1 |
| 111 | 23337-111 | 17-0321-00 | ADJUSTMENT SCREW | EA | 2 |
| 112 | 23337-112 | SS41 | FRONT COVER | EA | 1 |
| 114 | 23337-114 | 24-0215-02 | CROSS SLIDE | EA | 1 |
| 115 | 23337-115 | 24-0201-01 | SADDLE | EA | 1 |
| 116 | M12-1.75X70 25B | | SCREW-SHCS-STL-BO | EA | 4 |
| 117 | M6-1.0X16 10B | | SCREW-PH-PHIL-STL-BO | EA | 3 |
| 118 | 23337-118 | 24-0317-00 | WIPPER LEFT-RUBBER | EA | 1 |

i01007

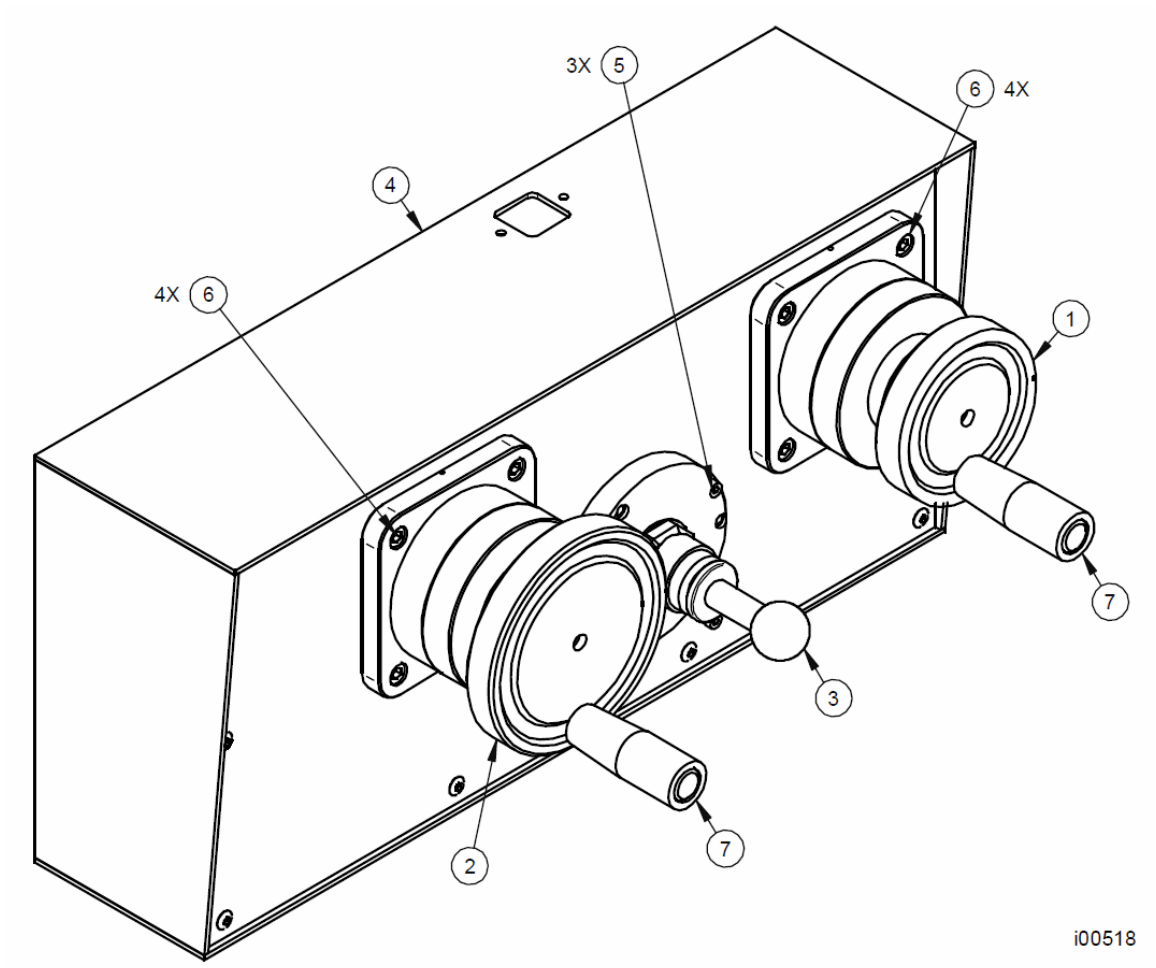



**Figure 7-31**
**Lathe Apron Assembly – 1540V, 1840V, & 2460V**

## Parts List – Lathe Apron Assembly

| Item | P/N | Title | Qty |
|---|---|---|---|
| 1 | 20082-2 | ELECTRONIC HANDWHEEL-X-AXIS TRL | 1 |
| 2 | 20082-3 | ELECTRONIC HANDWHEEL-Z-AXIS TRL | 1 |
| 3 | 20295 | JOGSTICK-ASSY | 1 |
| 4 | 21046 | HOUSING & PANEL ASSY. HANDWHEEL (VER: II) | 0 |
| 5 | M4-0.7X16 25B | SCREW-SHCS-STL-BO | 3 |
| 6 | M6-1.0X12 25B | SCREW-SHCS-STL-BO | 8 |
| 7 | 30889 | HANDLE REVOLVING | 2 |

i00518

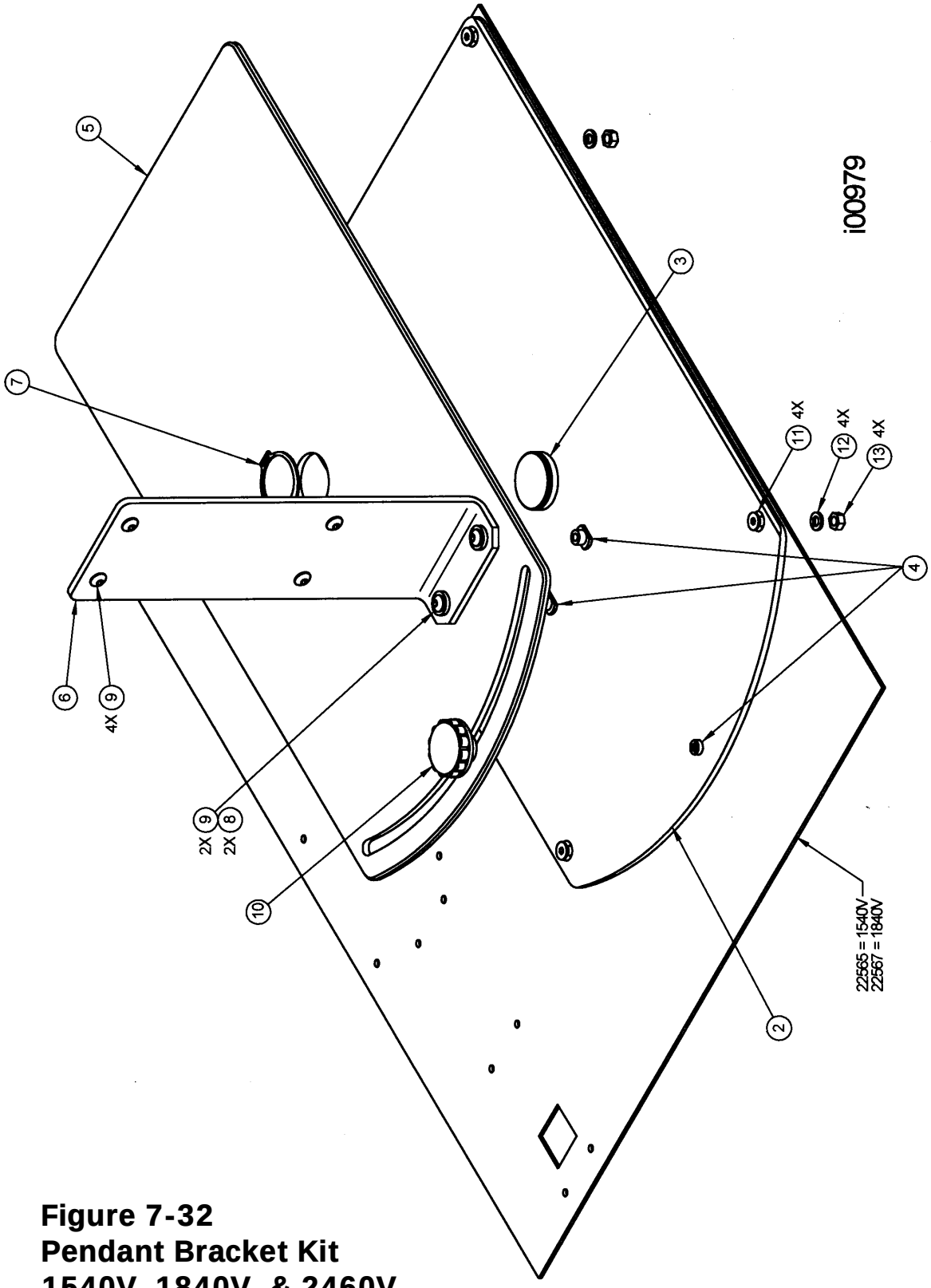



**Figure 7-32**
**Pendant Bracket Kit**
**1540V, 1840V, & 2460V**

## Parts List – Pendant Bracket Kit

| Item | P/N | Title | Use As | Qty |
|---|---|---|---|---|
| 2 | 22473 | SWIVEL PLATE BASE-2460V/1540V WEY YII | EA | 1 |
| 3 | 21063 | PIVIOT PIN | EA | 1 |
| 4 | 21062 | T-NUT | EA | 3 |
| 5 | 22474 | SWIVEL PLATE-2460V/1540V WEY YII | EA | 1 |
| 6 | 22484 | PENDANT BRACKET - 2460V/1540V | EA | 1 |
| 7 | 21104-150 | SNAP RING-TYPE SH 1.5 DIA | EA | 1 |
| 8 | 15759 | WASHER-1/4 HARD BLK OX 1/8 THK | EA | 2 |
| 9 | 1/4-20X1/2 27B | SCREW-BHCS-STL-BO | EA | 6 |
| 10 | 21103 | KNOB - MODIFIED | EA | 1 |
| 11 | M6-1.0X16 26B | SCREW-FHCS-STL-BO | EA | 4 |
| 12 | M6 73B | WASHER-SPLIT LOCK-STL-BO | EA | 4 |
| 13 | M6-1.0 50P | NUT-HEX-STL-PLAIN | EA | 4 |

i00979

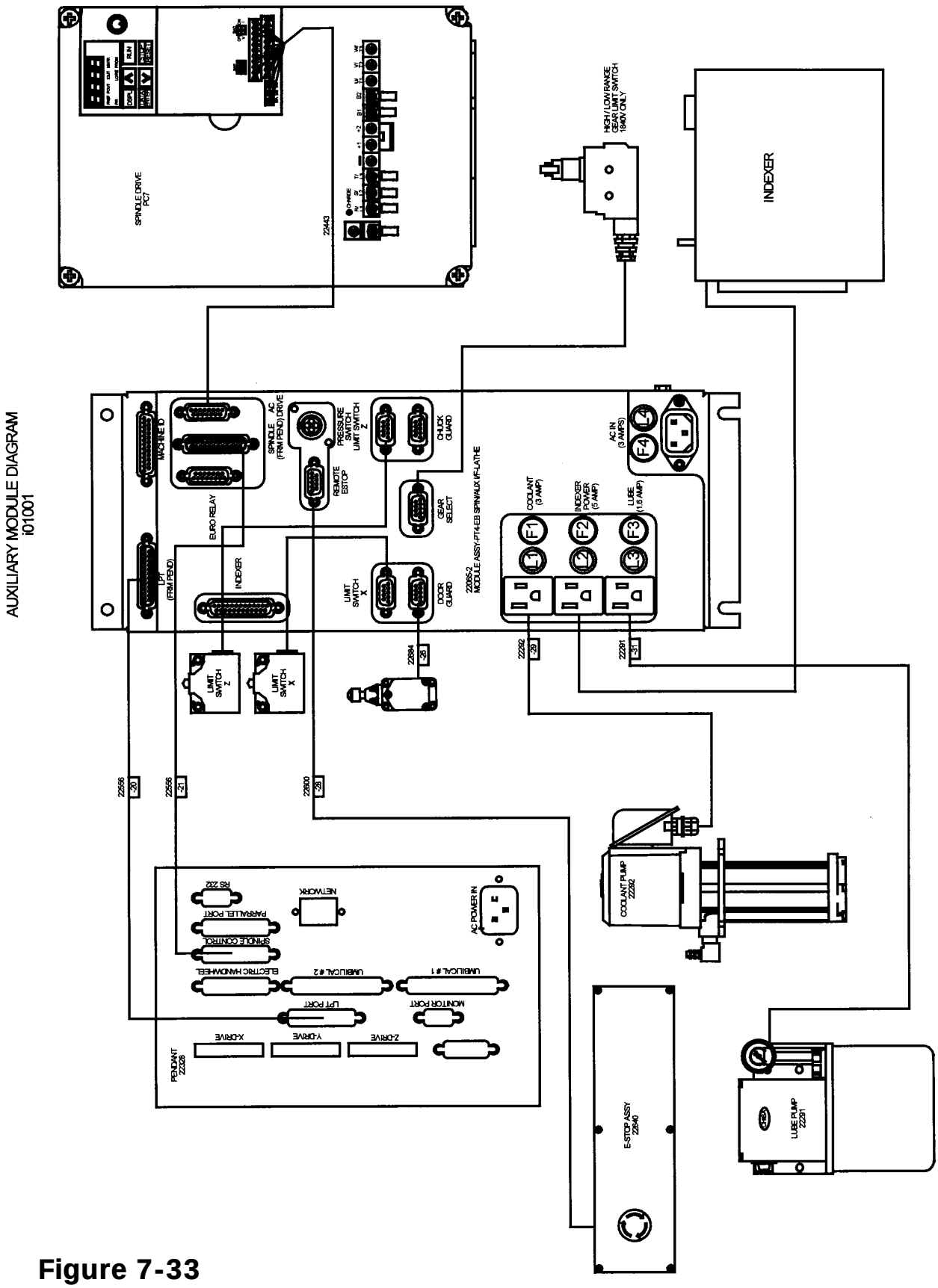



**Figure 7-33**
**Auxiliary Module Diagram**

i01001

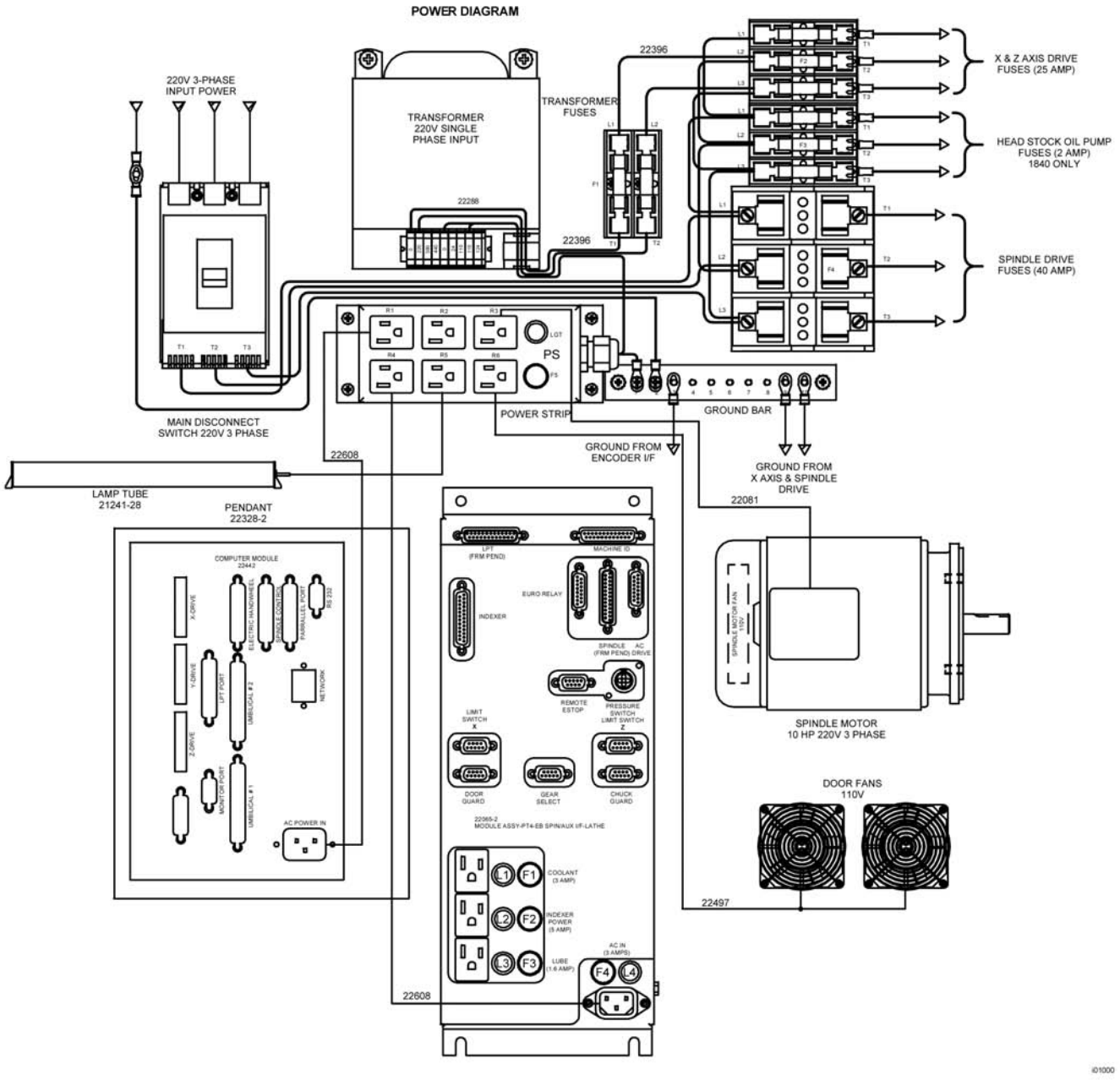



**Figure 7-34**
**Power Diagram**

i01000

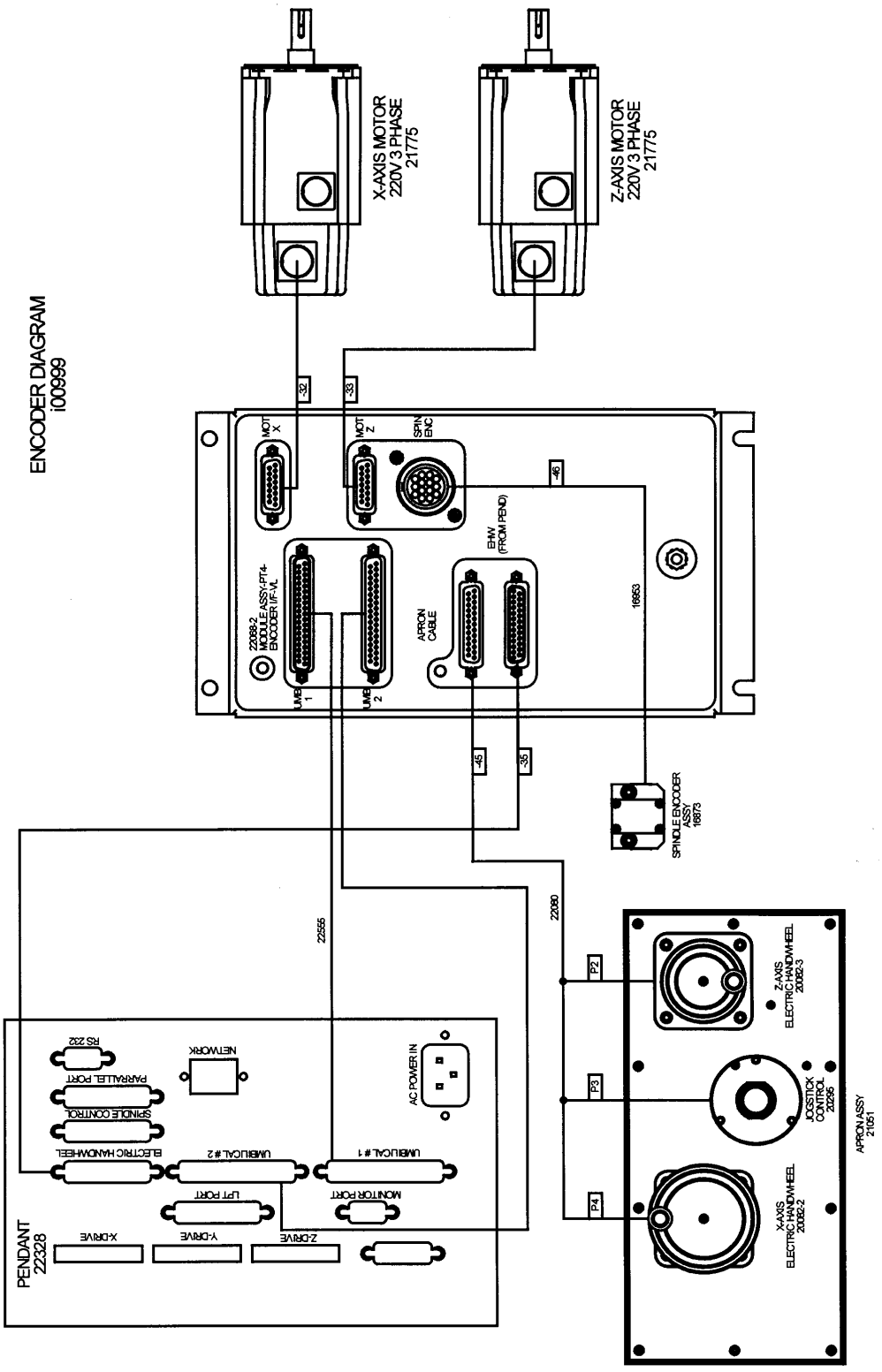



**Figure 7-35**
**Encoder Diagram**

i00999

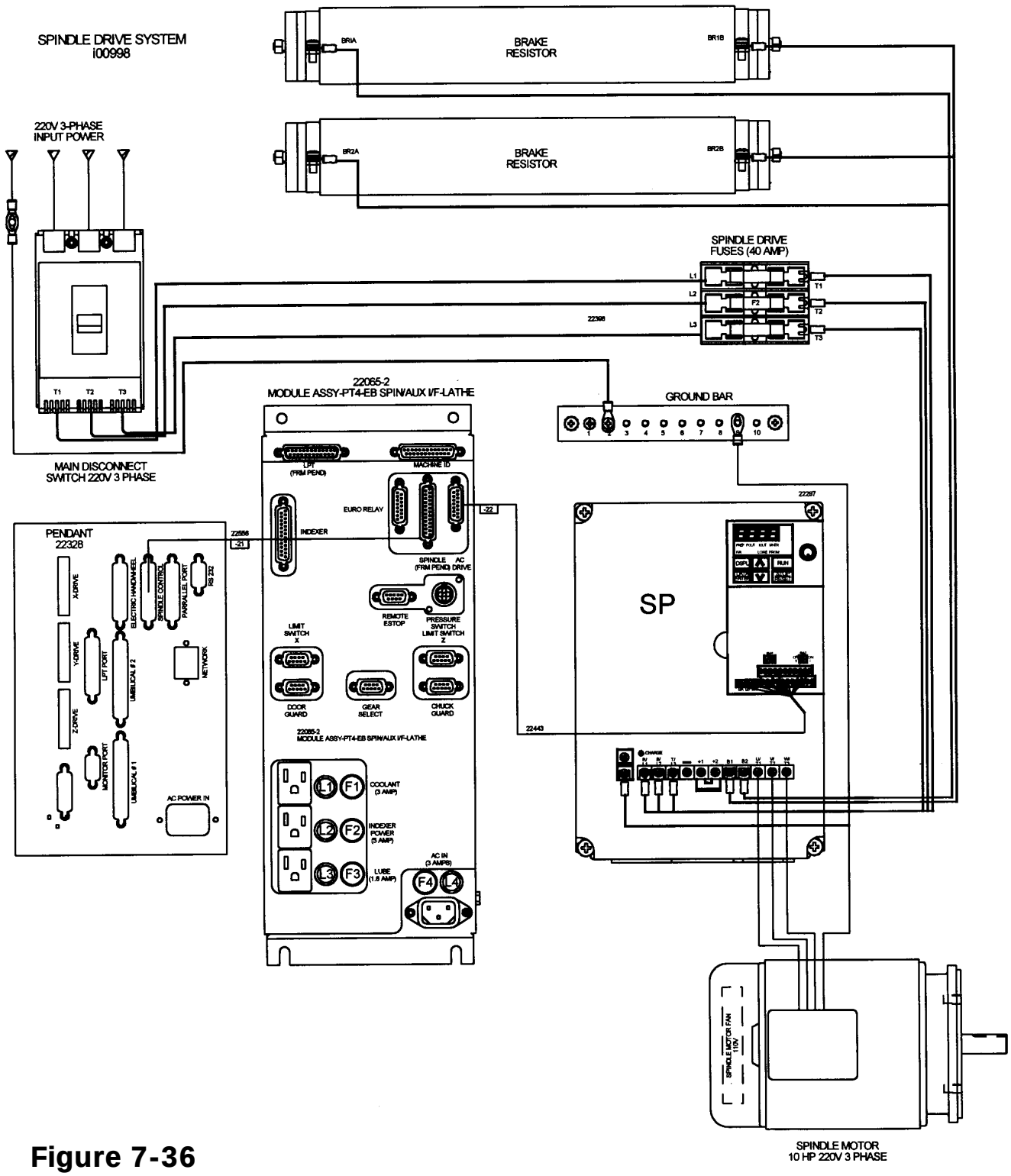



**Figure 7-36**
**Spindle Drive System**

i00998

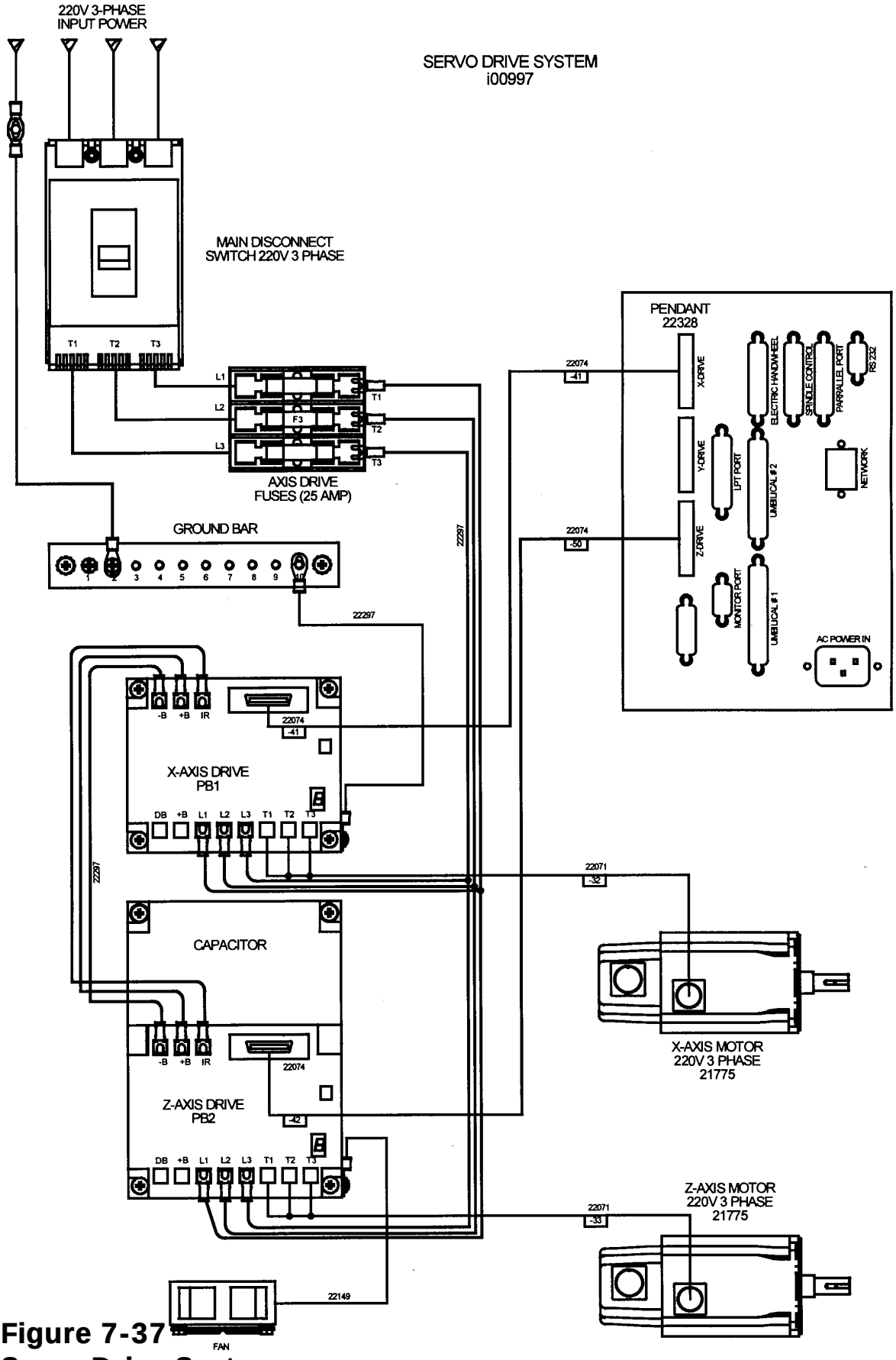



**Figure 7-37**
**Servo Drive System**

i00997

SERVO DRIVE SYSTEM
i00794-1

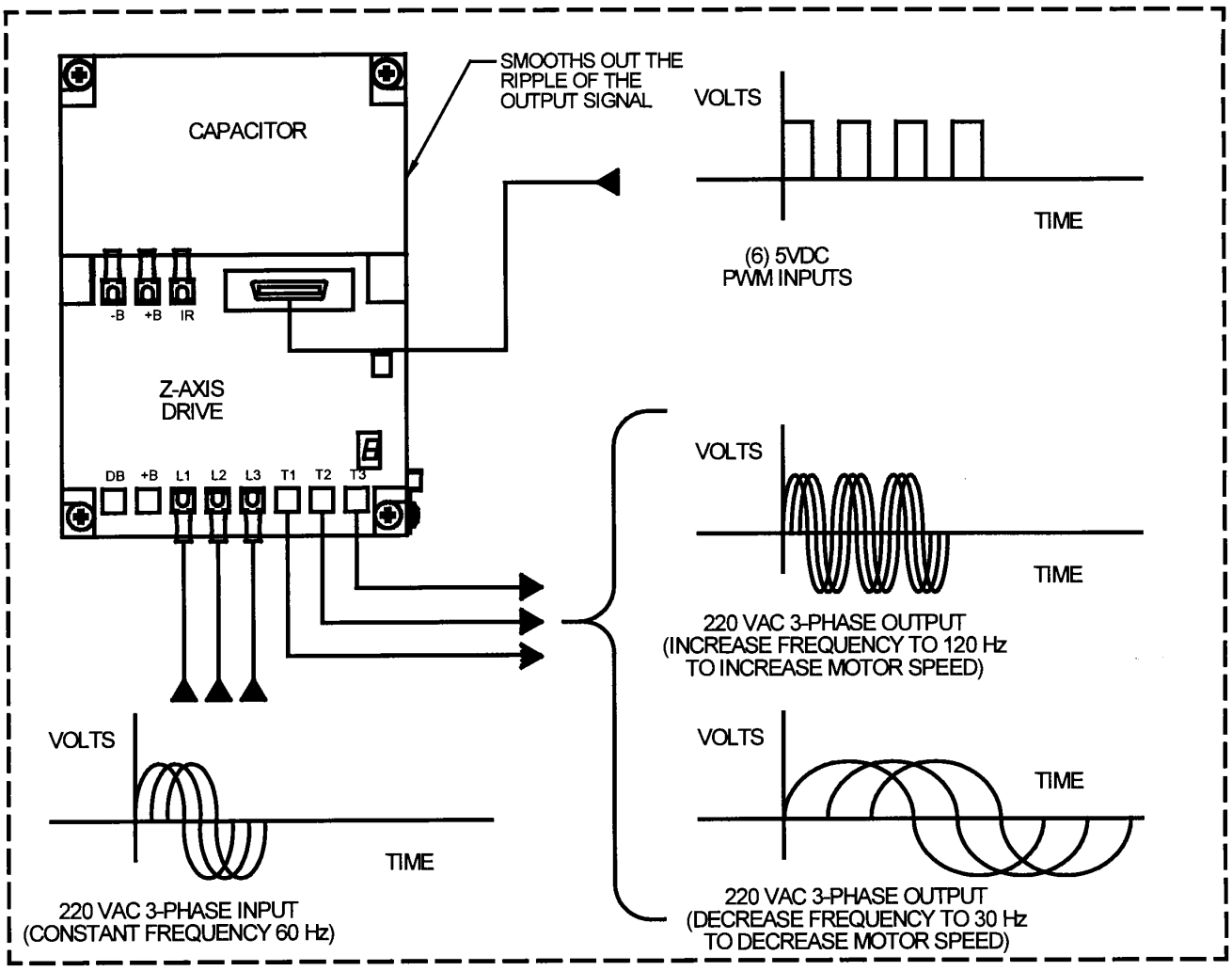
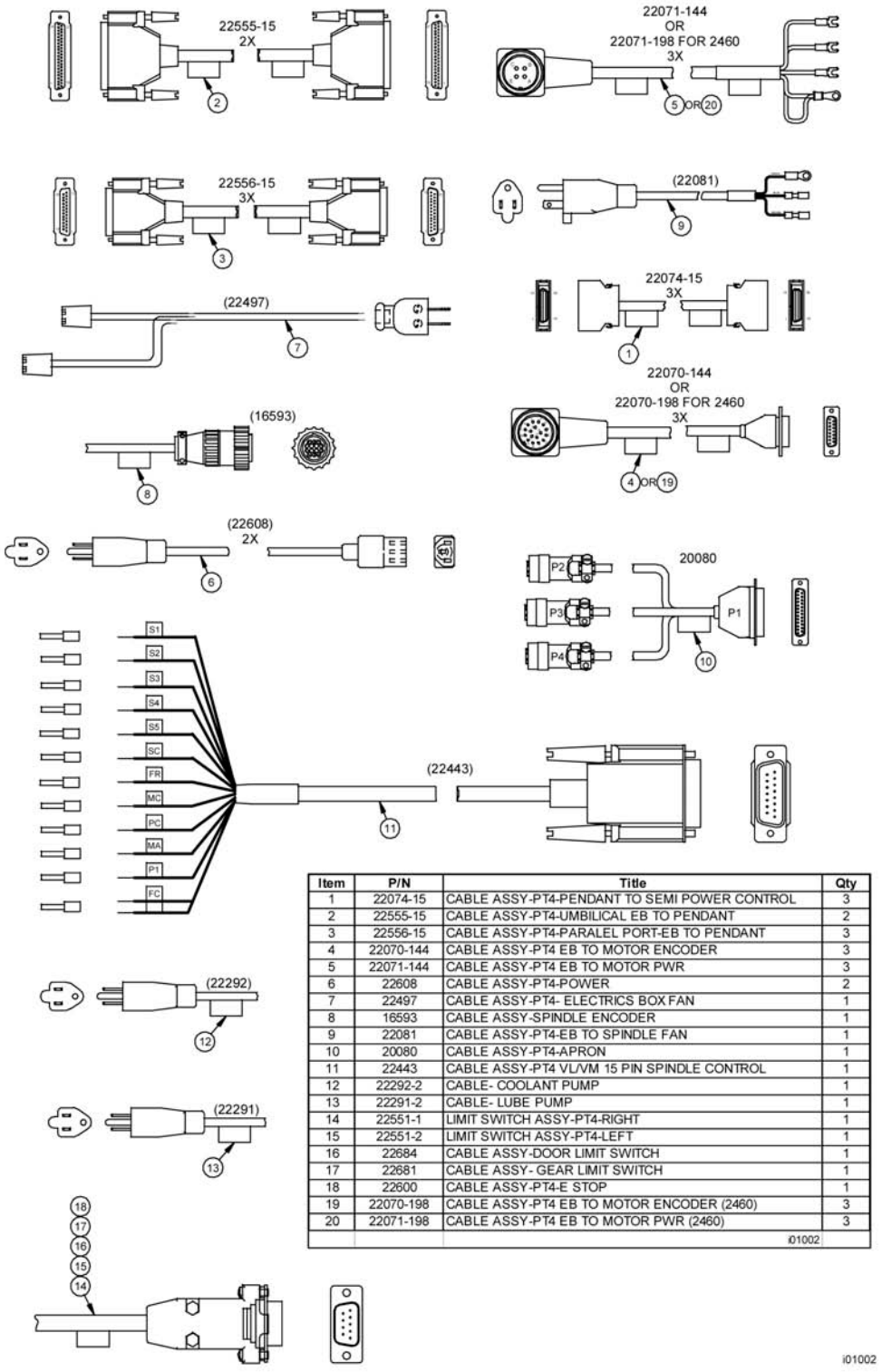



**Figure 7-38**
**Servo Drive Output**

i00794-1




| Item | P/N | Title | 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 | 16593 | CABLE ASSY-SPINDLE ENCODER | 1 |
| 9 | 22081 | CABLE ASSY-PT4-EB TO SPINDLE FAN | 1 |
| 10 | 20080 | CABLE ASSY-PT4-APRON | 1 |
| 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 | 1 |
| 15 | 22551-2 | LIMIT SWITCH ASSY-PT4-LEFT | 1 |
| 16 | 22684 | CABLE ASSY-DOOR LIMIT SWITCH | 1 |
| 17 | 22681 | CABLE ASSY- GEAR LIMIT SWITCH | 1 |
| 18 | 22600 | CABLE ASSY-PT4-E STOP | 1 |
| 19 | 22070-198 | CABLE ASSY-PT4 EB TO MOTOR ENCODER (2460) | 3 |
| 20 | 22071-198 | CABLE ASSY-PT4 EB TO MOTOR PWR (2460) | 3 |
| | | i01002 | |

**Figure 7-39**
**Cable Set**

## Miscellaneous Service Parts

| # | Part # | Description | Machine used on |
|---|---|---|---|
| 1 | 22683 | Door Interlock Switch | 1540V |
| 2 | 22714-26 | Light Assembly | 1540V |
| 3 | 23341 | Bulb | |
| 4 | 23343 | Spindle Motor | 1540V |
| 5 | 22714-7 | Window, left door | 1540V |
| 6 | 22714-39 | Window, right door | 1540V |
| 7 | 23337-10 | Crosslide gib, X-axis | 1540V |
| 8 | 23337-28 | Carriage gib, Z-axis | 1540V |
| 9 | 21050-3G | Crosslide gib, X-axis | 1840V |
| 10 | 21050-3F | Carriage gib, Z-axis | 1840V |
| 11 | 22680 | Gear Switch | 1840V |
| 12 | 22654 | Breaker, 60 amp | |
| 13 | 22653 | Breaker operator | |
| 14 | 21239-25 | Spindle Motor | 1840V |

## 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.