ProTURN SLX 1630
ProtoTRAK SLX CNC
Safety, Installation, Maintenance, Service & Parts List Manual

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1.0 Safety Specifications

The safe operation of the PROTURN SLX 1630 depends on its proper use and the precautions taken by each operator.

- Read and study the PROTURN SLX 1630 CNC 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 this PROTURN SLX 1630 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.

STATEMENT OF INTENDED USE

To be used for the turning of cold metal within the stated capacity of the lathe, axes movement by manual use of handwheels or CNC control.
Only to be operated by trained and experienced operators.
To be used in a standard workshop environment, not suitable for potentially explosive atmosphere.

Any other uses should first be subjected to a risk assessment by a responsible person.

1.1 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.

1.2 Safety Precautions

WARNING! Use only chucks which are rated to the maximum RPM of the lathe.

1. Do not operate this machine before the PROTURN SLX 1630 ProtoTRAK SLX CNC Programming, Operating and Care Manual have been studied and understood.

2. Read and study this PROTURN SLX 1630 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 this machine without knowing the function of every control key, button, knob, or handle. Ask your supervisor or a qualified instructor for help when needed.

4. Protect your eyes. Wear approved safety glasses (with side shields) at all times. Do not rely on the lexan vision panels for eye protection.

5. Don't get caught in moving parts. Before operating this 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. Do a risk assessment before machining flammable materials.

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

26. 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

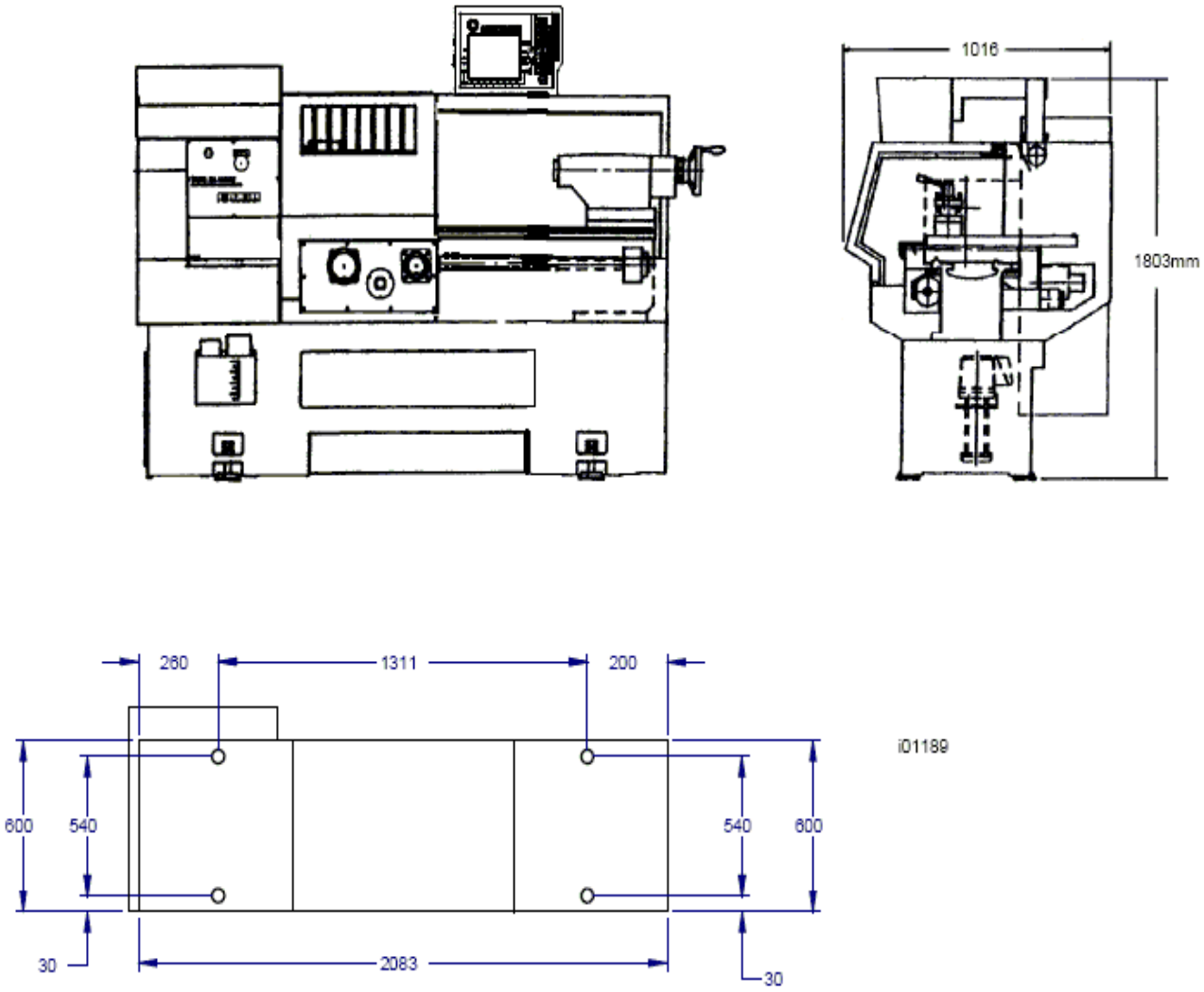

Figure 1 (May not represent actual machine)
SLX 1630 Floor Plan, Layout & Space Requirements

2.2 Uncrating

Carefully remove the 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 and 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.

2.3 Shortages: Inventory Checklist

_____Machine (check model and serial number)

_____Leveling pads and screws (4 for 1630)

_____Pendant Display (24000-4)

_____Pendant Cable Cover (24324)

_____Toolbox with various tools

_____SLX 1630 Safety, Operation & Programming Manual (P/N 24494)

_____SLX 1630 ProtoTRAK SLX CNC Safety, Install, Maint, Service & Parts List Manual (P/N 25099)

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

2.4 Installation Instructions & Checklist

Installer: Use this checklist to assure a complete set-up of the SLX 1630. * Items checked before leaving the factory

☐	1.	Shut off power to the machine.
☐	2.	Visually inspect the 415V 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. Note: Machine can only be wired for 415 VAC.
☐	3.	Clean the machine if needed and remove any remaining grease.
☐	4.	Mount the pendant on the bracket that is attached to the chip enclosure for the 1630.
☐	5.	Make and check all the proper electrical connections from the pendant to the electric box. Be sure to mount the cable cover to the left side of the pendant.
☐	6.	Slide the doors back and forth to make sure they slide smoothly. Adjust as necessary.
☐	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 115-volt line is plugged into the pendant.
☐	9.	Check to make sure the coolant pump is rotating in the correct direction.
☐	10.	Visually inspect the oil level through the site glass which is found under the rear spindle cover and verify that the oil level is correct in the head stock prior to turning on the machine tool. Add oil if necessary. Make a notation on the installation summary sheet if the oil level is incorrect. For the 1630, oil will only be visible on the headstock site glass when the spindle is running.
☐	11.	Manually override the automatic way oiler and pump oil to lubricate all sliding surfaces. This can be done by running service code 300 a few times.
☐	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 0.02 mm longitudinally and 0.01 mm transversely. Even though it is the responsibility of the customer, make any adjustments if necessary (see section 2.9 Leveling).
☐	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.	Run the spindle at 500 rpm or so for 15 to 20 minutes in order to warm the headstock. *
☐	17.	Run the spindle through it's various speeds.
☐	18.	Open and close the doors and verify the door switches are functional. The control should display a message of "DOOR OPEN" in DRO mode when the doors are open and it should disappear when the doors are closed. Open and close the chuck guard and verify a message is present on the screen and the spindle does not run with the chuck guard open.
☐	19.	Make sure the X and Z electronic handwheels and jogstick are functional.
☐	20.	Check to make sure that the E-Stop button on the pendant is functioning correctly. The 1630 only has an e-stop on the pendant. Undo the e-stop ad press the screen button on the right side of the pendant to reset.
☐	21.	Perform Service Code 12, Feed Forward Constant.*
☐	22.	Perform Service Code 123 to calibrate the X and Z-axis using a 150mm standard. *
☐	23.	Perform Service Code 127 and 128 to manually calculate the backlash for the X and Z-axis.*
☐	24.	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 0.01 mm. Programs can be found on the parts program disk that comes with each pendant. It may also be found in the PT4 folder followed by the SWI TEST PROGRAMS folder if the customer ordered the Network/Memory software option. Note: the doors must be closed to run these programs.*
☐	25.	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 4572 mm/min (180 ipm) for Z and 3048 mm/min (120 ipm) for X.*

☐	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.	Wipe down the machine prior to leaving.

CAUTION!

If the PRO TURN 1630 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.

Check to make sure the chuck is rated for the maximum rpm's of the machine. If it is not, do not run the machine above the chuck's maximum rated rpm.

2.5 Machine Specifications

Capacity	SLX 1630
Height of Centers	203.2 mm
Distance Between Centers	762 mm
Swing Over Bed	406.4 mm
Swing Over Saddle Wings	406.4 mm
Swing Over Cross Slide	218.4 mm
Cross Slide Travel	215.9 mm
Tool Section Max.	19 mm
Coolant	41.6 liter
Oil Pump – Way Lubrication	2 liter
Oil Reservoir – Headstock	13.3 liter
Bed	
Width	320 mm
Height	320 mm
Headstock	
Spindle Nose	D1-6
Spindle Through Hole	53.9 mm
Spindle Taper	MT#6
Taper in Reduction Sleeve	n/a
Spindle Diameter Front Bearing	80 mm
Number of Bearings	2
Bearing Class (Radial Runout)	P5
Number of Spindle Speed Ranges	1
Spindle Speed Range (RPM)	150-2500
Tailstock	
Quill Travel	127 mm
Quill Diameter	59.9 mm
Quill Taper Hole	MT#4
Spindle Motor	
H.P.	7.5
Voltage	415
Amps, Full Load	13
Phase, Hz	3/50
Dimensions	
Net meters L x W x H kg.	2.08 x 1.02 x 1.80m, 998
Ship meters L x W x H kg.	2.21 x 1.14 x 1.70m, 1247
Other	
Coolant Pump Motor, H.P.	1/8
Spindle Motor Brake	Dynamic Braking
Way Surface Hardness	400-450 HB
Headstock Lubrication	Oil Bath
Options	
Steady Rest (Type, Diameter)	Roller 12.7 – 139.7 mm
Tooling Kit	20 mm
Chuck	203 mm, D1-6
Indexer Option – 8 tool	20 mm
Indexer Option – 4 tool	20 mm
Gang Tooling	n/a
Noise Emissions (workstation) max RPM running with no material	69dB (A)

2.6 ProtoTRAK SLX Control Hardware

- 2 -axis CNC, 2-axis DRO
- 400 MHz PC-based processor
- 256 MB of RAM
- D.C. Servo Motors rated at 280 in-oz continuous torque for X, and 560 in-oz for the Z-axis.
- Precision ground ballscrews in the carriage and cross-slide to ensure smooth accurate contours without backlash
- Feedrate override of programmed feedrate and rapid
- Speed override of programmed RPM
- Polycarbonate sealed membrane and gasket sealed control enclosure to lock out contamination
- 266.7 mm color LCD for clear presentation of prompts, status information and part graphics
- Modular design simplifies service and maximizes uptime
- 256 MB flash drive
- (2) USB Ports
- Single floppy disk drive for additional part program storage

2.7 Lifting and/or Moving the Machine

CAUTION!

The 1630 machine weighs approximately 1247 kg when shipped. 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 813 mm apart as shown in the figure 3. Be certain to lift the lathe toward the headstock.

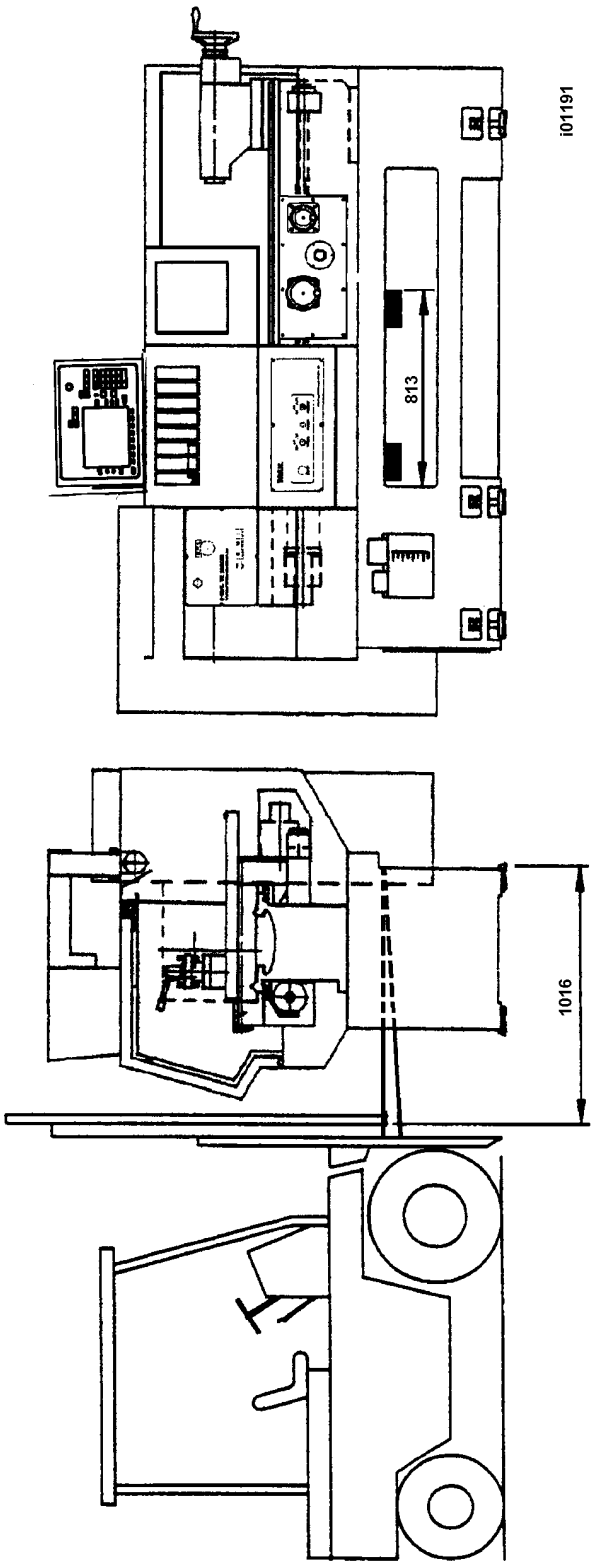

Figure 3
Lifting SLX 1630
(May not represent actual machine)

Do not attempt to lift this machine with a forklift having less than 2722 kg capacity for the 1630. The shipping weight of the machines including electronics is 1247 kg.

Place the machine in position on top of the (4) rest pads for the SLX 1630.

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 1 & 2).

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 the carriage back and forward and the cross-slide left and right.

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 4 rest pads, it must be leveled by the use of the 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 0.01 mm over 254 mm 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 4, Positions B & C). To take a reading off the level transversely, place it on top of 19 mm parallels at each end of the bedways (Figure 4, Positions A & D).

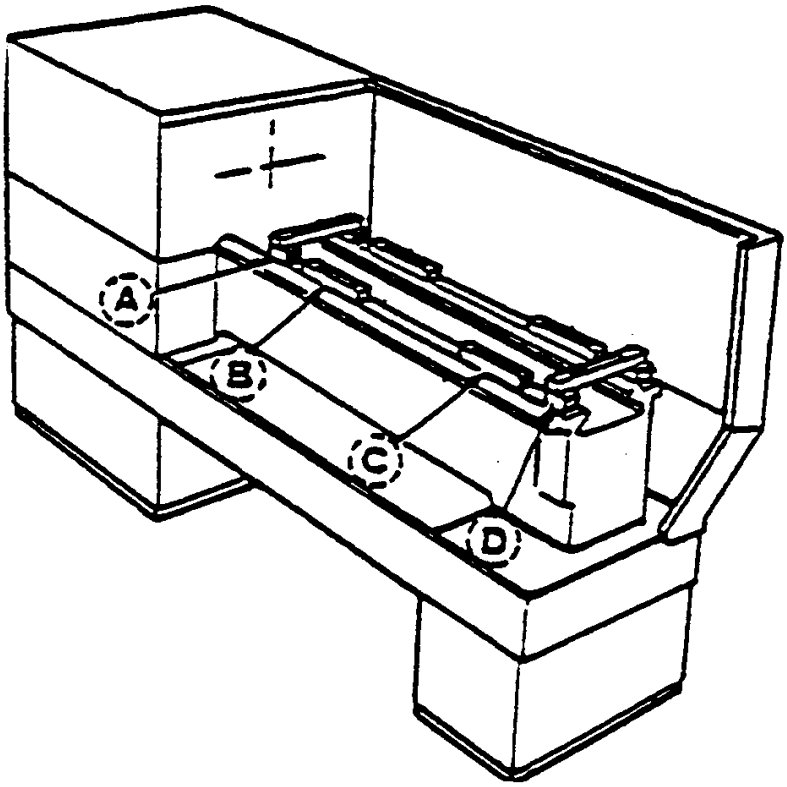

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Figure 4
Leveling

2.9.1 SLX 1630

Use the four (4) leveling screws, located at both ends of the base, to adjust the level of the machine.
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 SLX 1630 can only be wired for 415 volts, 3-phase electricity.
A 110-volt power source is needed for the pendant and is provided by the transformer.

DANGER!
Be certain that 415-volt electricity is used only with a machine labeled 415 volts and at the electric cabinet, in the back of the machine.

The incoming 415-volt power is wired to the machine through the electric cabinet located on the back of the machine. The wire enters the cabinet through a hole, from the top of the cabinet. The wires are to be wired into the door breaker. The main ground wire should be fastened to the breaker mounting bracket with the screw provided.

DANGER!
The 415 VAC, 3-phase electricity should be wired only by a qualified electrician.

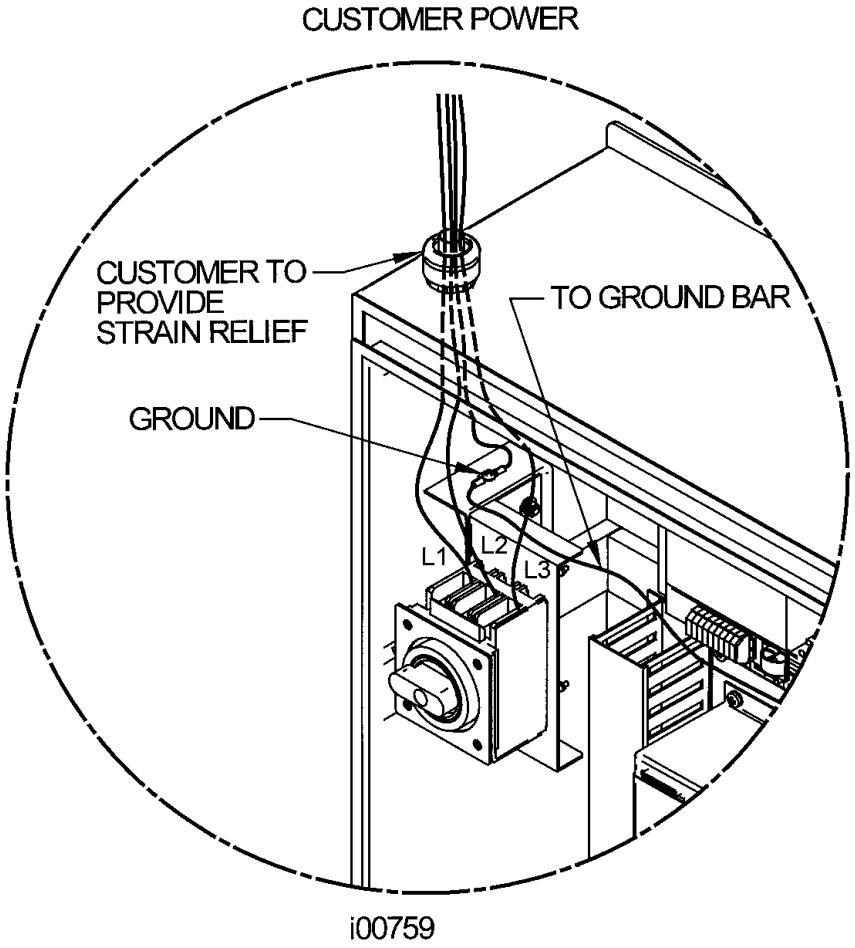

Figure 5
Wiring the 1630

2.10.1 Phase Converters

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

2.11 Mounting the Display Pendant

The 1630 pendant is fixed to a L bracket. The L bracket is attached to a 2nd bracket that comes mounted to the top of the chip enclosure.

Make the 6 cable connections to the left side of the pendant and cover these cables with the cable cover provided with the machine.

2.12 Cable Interconnections

All cable interconnections are made at the factory except for those connecting to the pendant display. There are a total of 6 cables that need to be connected to the pendant. See Figure 6 for pendant cable connections.

With the main 415 volt power to the machine turned off plug in the connectors that are bundled on the side of the machine. Each cable fits to only one connector on the pendant display, on the left side of the pendant. Use the key on the pendant to match up the connectors with the correct port. The machine ID key and option keys should be plugged into the port labeled as such. The test port and X and Y handwheel ports will be left empty during installation. If the customers sets this machine up on a network, this cable will also need to be plugged in.

Make sure the machine ID key is plugged in, otherwise the machine will not run. Also 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 key must be programmed according to the type of machine it is on and the options ordered.

CAUTION!

Make sure the main 415-volt power switch is disconnected on the back of the electrical cabinet before plugging in the cables.

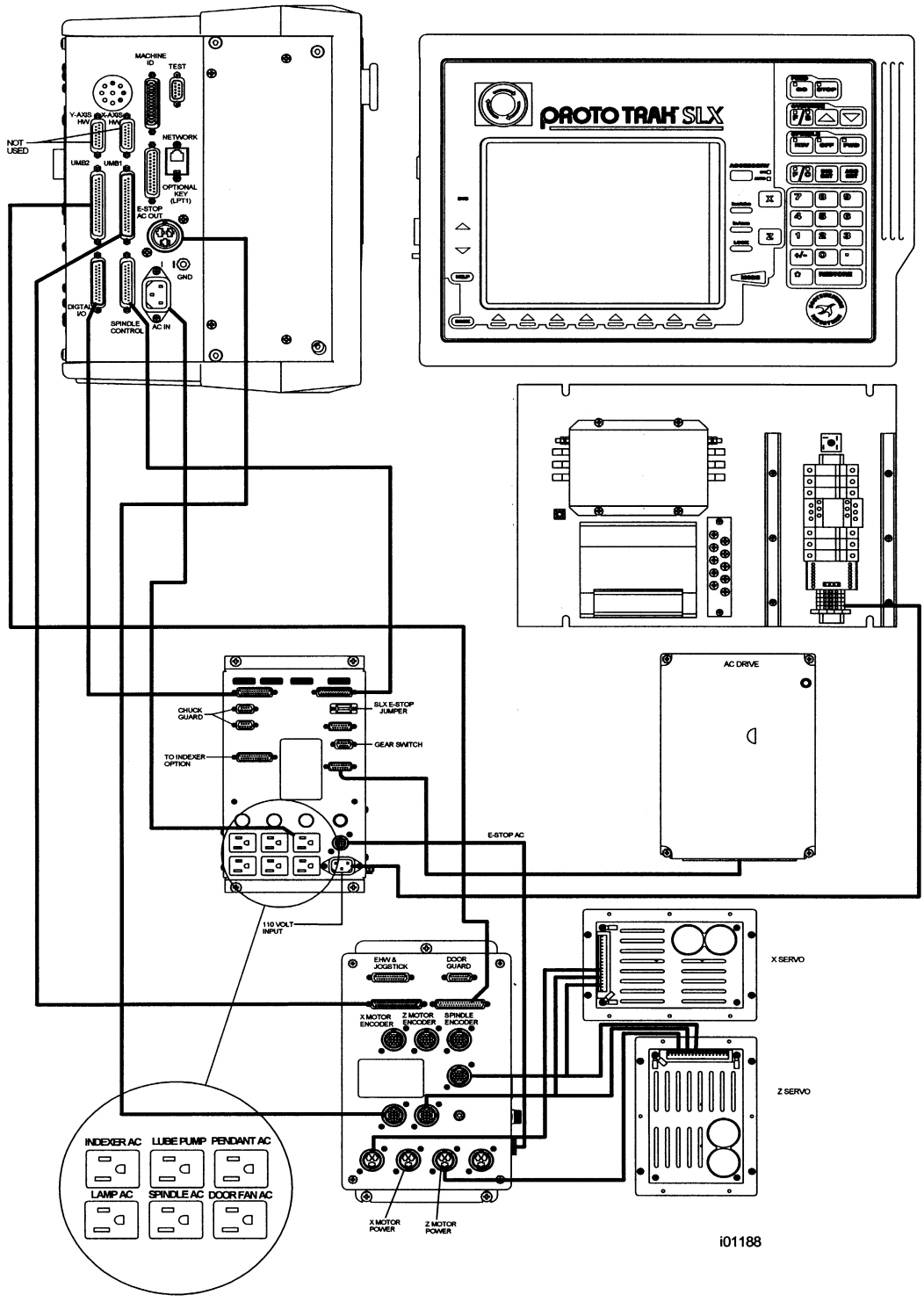

Figure 6
Cable Connections

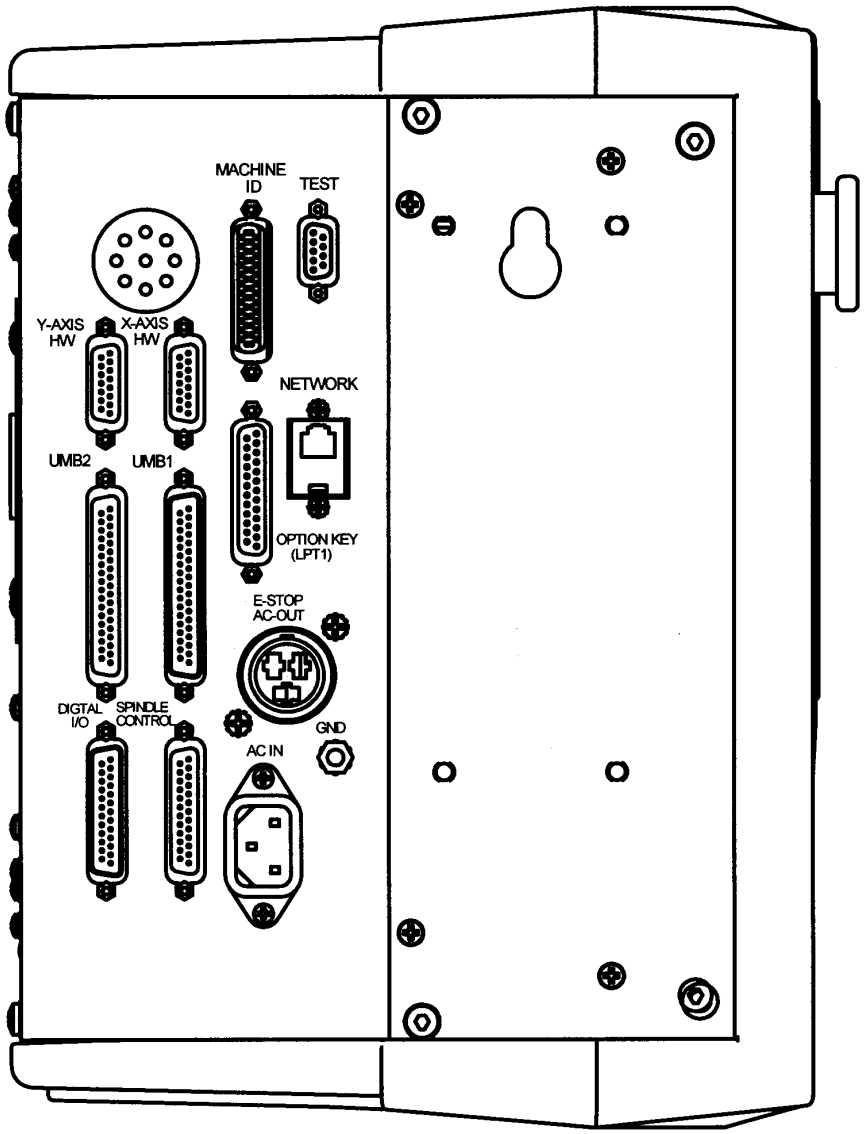

Figure 7
Pendant Cable Connections
Left Side

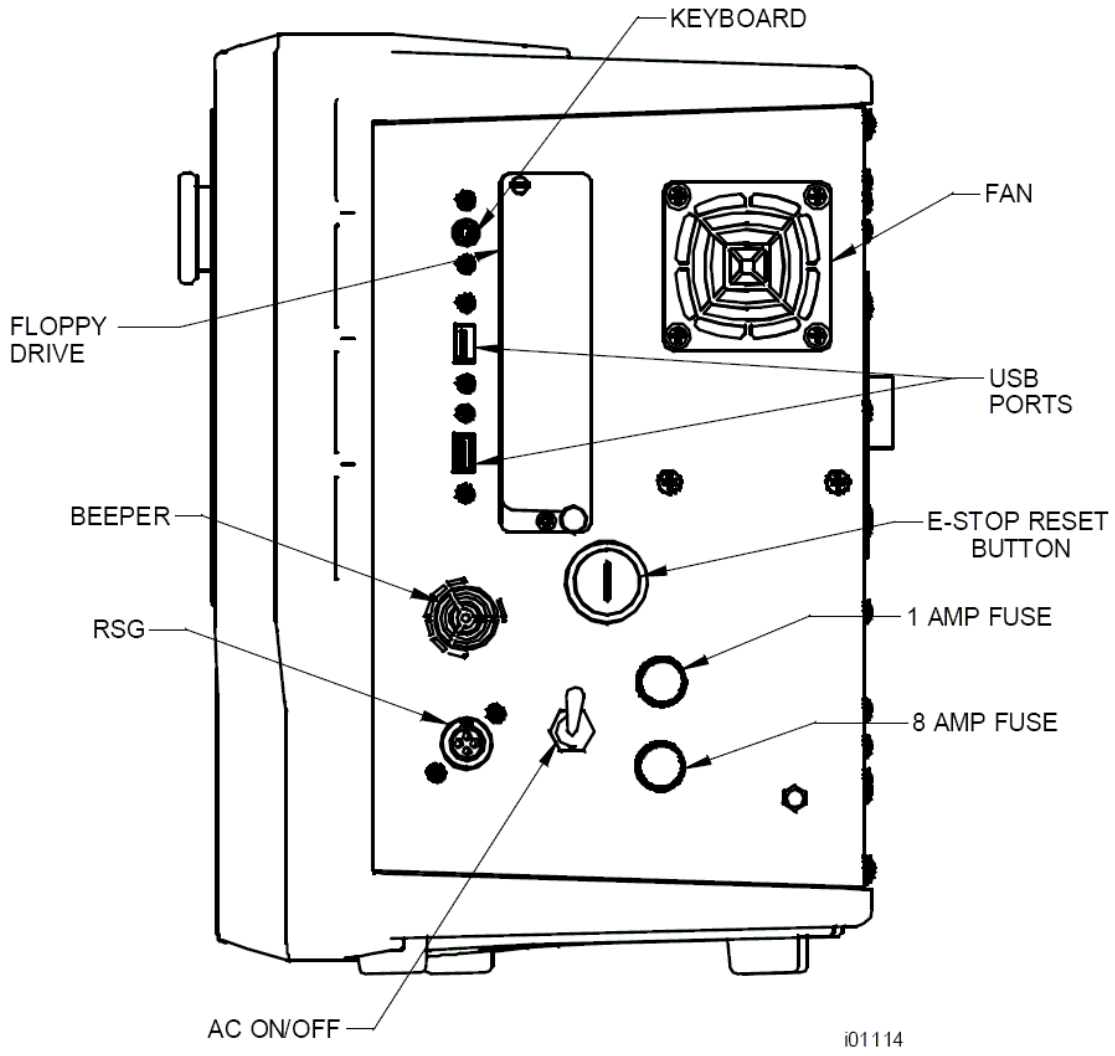

Figure 8
Pendant, Right Side

2.13 Lubrication System

2.13.1 Headstock

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

For the 1630, oil will only be visible on the headstock site glass when the spindle is running. If oil is not flowing to the site glass when the spindle is on, stop running

the spindle immediately and call for service. Failure to do so may ruin the spindle bearings.

2.13.2 Automatic Way Lubrication Pump

The 1630 auto lube system provides centralized automatic lubrication for the carriage, cross slide and ballscrews. The lube pump has a 2-liter reservoir filled with S.A.E. 30-weight oil.

CAUTION!
Oil that is too heavy and viscous such as 50W or 90W oil can clog oil line tubing. Do not mix detergent type automotive or multi-purpose oils with the S.A.E. No. 30 lubricating oil 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 axis motors are turned off, the lube pumps internal clock will not reset. The interval between pump cycles is based on axis motor movement time. Also, every time the control is first turned on, the lube pump will run for 1 lube cycle as soon as the axis motors are commanded to run.

2.13.3 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", "E" (Lube Pump Setup), Code 301, and then enter the desired Interval time in minutes.
- **Setting Discharge Time:** Service Code 302
  Press "Mode", "Set up", "Service Codes", "E" (Lube Pump 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.

2.13.4 Factory Default Values

Interval Time - 20 min
Discharge Time - 15 sec
Discharge Pressure - Approximately 690 – 1034 kPa (100-150 PSI)

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 1630 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.

3.0 Troubleshooting by Symptom

Electrical and Mechanical maintenance should only be carried out by trained and experienced machine tool engineers who fully understand the hazards of working with machine tools.

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 Customer Service
- **Code 12** Feed Forward Constant
- **Code 127** Measures backlash in the system (not used on Dual Feedback systems)
- **Code 128** Enter backlash compensation

Possible Cause	Check This
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. 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, See Mechanical Drive Train (X,Z), Section 4.2. See Spindle Bearing Preload, Section 5.1.16.

3.1.2 Turning Diameters Out of Round

Parts are not round within .015 mm TIR for SLX 1630. This is best measured by using a .002 mm dial indicator and mounting to the inside taper of the spindle. Rotate the spindle and measure the indicator movement.

Do the following service code and procedures:

Possible Cause	Check This
Tooling problem	Improper tooling, workpiece not properly supported. 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 Spindle Bearing Preload, Section 5.1.16.

3.1.3 Cutting Taper

Parts are considered to be cutting on a taper if there is a difference in diameter of more than .02 mm over 152.4 mm. This is best measured by using a .002 mm micrometer.

Do the following service code and procedures:

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

Possible Cause	Check This
Machine set-up problem	Machine not leveled properly 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. See Gib Adjustment - Section 5.2.1. See Z Ball screw Alignment - Section 5.1.14.
Loose bearing problem	Looseness in the spindle bearings. See Mechanical Drive Train (X,Z) - 4.2. See Spindle Bearing Preload - Section 5.1.16.
Headstock and/or tailstock not aligned	See Adjust Headstock for Taper - Section 5.1.15. To adjust tailstock from side to side, adjust gib screw. See Aligning Tailstock to Spindle 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 .015 mm TIR on both the SLX 1630.
- The acceptable measurement of parallelism of spindle axis to carriage movement is .02 mm over 152.4 mm.

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 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 See Gib Adjustment - Section 5.2.1.
Looseness in the drive train	The drive train Diagnostics See Mechanical Drive Train (X,Z) - Section 4.2.
Calibration	See Section 5.2.2 Calibration.
Failure of the spindle encoder Run service code 133 to check if the encoder counts.	Replace spindle encoder See Spindle Encoder replacement - Section 5.1.10.

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 Run service code 133 to check if the encoder counts.	Replace spindle encoder See Spindle Encoder replacement - Section 5.1.10.
Broken or slipping encoder coupling	Check and replace as necessary

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 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 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 0.13 mm. Perform Code 129 to check or change this value. See Service Codes Section 4.8. Values lower than 0.13 mm may reduce the feedrate even more.
Incoming AC voltage is inadequate	Perform Code 100. See Service Codes Section 4.8. 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 2.13.
X-axis Gib is not adjusted properly	Check the adjustment of the X-axis Gibs using the X-axis Gib adjustment procedures. See section 5.2.1.
Binding in the Drive Train	Check Repeatability using the Repeatability and Positional Accuracy procedure. Check the torque reading of the Drive Train. Step by step, carefully inspect the Drive Train for any binding. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Z) Section 4.2.
Servo Drive failure	See Servo Drive Section 4.5.
Motor failure	See Motor Section 4.4.

3.2.3 Axis Will Not Jog

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

Do the following Service Codes and procedures:

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

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

3.2.4 Axis Motor Motion Is Not Smooth

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

Do the following Service Codes and procedures:

- **Code 33** Software Identification. This is needed if you call 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-axis Gib are not adjusted properly	Check the adjustment of the X-axis Gib using the X-axis Gib adjustment procedures, See Section 5.2.1..
Calibration or Backlash problem	Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy. See Calibration & Backlash Constants section 5.2.2.
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.

3.2.5 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. See Section 5.2.2.
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 2.13.
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. See Section 5.2.1 Crosslide gib adjustment.
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.

3.2.6 Searching Axis

The ballscrews are slowly turning back and forth when the servos are engaged.

Do the following Service Code and procedures:

- **Code 12** Sets a feed forward power constant to drive axis motors.
- **Code 128** Backlash compensation on single feedback machines.

Possible Cause	Check This
Most often causes by excess backlash compensation	Check physical backlash in system and re-enter in code 128. Run code 11 on single feedback machines
High feed forward values	Check ball screw torque. Typical values should be between 1.1 – 1.7 N-m.
Excessive friction in the sliding ways	Lubrication, gib adjustments, gib locks. See Machine Tool & Setup - Section 4.1.
Looseness in the drive train	The drive train of the axis that is searching, especially the tightness of the drive assembly. See Mechanical Drive Train (X, Y) - Section 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 4.6.
Poor cable connection from Computer Module to LCD (Liquid Crystal Display)	Double-check the connection from the computer module to the LCD, see Section 5.1.3.
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 the ribbon cable connection from the LCD screen to the computer module . See Section 5.1.3.
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.

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 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 and Z servo cables at the pendant are in the correct ports.
X-axis Gibs are adjusted extremely tight	Check the adjustment of the X-axis Gibs using the X Gib adjustment procedures. See X-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 2.10.
Servo Drive failure	See Servo Driver - Section 4.5.
Motor failure	See Motor diagnostics, Section 4.4.
Computer/Pendant failure	See Computer/Pendant diagnostics, Section 4.3.

3.3.5 Problems Reading the Floppy Disk; Programs Not Saved Properly

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

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

3.3.6 System Will Not Turn On

Nothing happens when the switch is turned on.

Possible Cause	Check This
110 V line is not plugged in	Check incoming 110 V power source to electrical cabinet
Pendant On/Off switch is Off.	Check the Pendant On/Off switch
Fuse blown in pendant or electrical cabinet	Remove fuses and check continuity.
Transformer output	Check 110 V Transformer output
Computer/Pendant has failed	See Computer/Pendant diagnostics Section 4.3.

3.3.7 System Will Not Boot-Up

The system does not boot-up when the switch is turned on.

Flash 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 Flash Drive you will see "Detecting IDE Primary Master…Scan Disk SDCFB-256". If the Mother Board of the Computer Module is not communicating with the Flash Drive you will see "Detecting IDE Primary Master … None". Also, check the wiring connection between the Flash Drive and the Mother Board. See Computer/Pendant diagnostics Section 4.3.
Computer/Pendant has failed	See Computer/Pendant diagnostics Section 4.3.
Disk in drive A	Verify that there is no disk inserted in drive A.
System Bios	Verify the system bios is set correctly.

3.3.8 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 415 VAC is too high, too low or not present	Using a Voltmeter, check the incoming 415 VAC to the machine. See Electrical Section 4.6.
Poor wiring and cable connections	Check for any loose wiring.
Computer/Pendant failed	See Computer/Pendant diagnostics Section 4.3.
Transformer output	Check 110 V Transformer output

3.3.9 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 415 VAC is too high, too low or not present	Using a Voltmeter, check the incoming 415 VAC to the machine. See Electrical Section 4.6.
Poor wiring and cable connections	Check for any loose wiring.
Flash disk failure	Remove and reseat the flash disk. The flash disk is inside of the computer module. Please see section 5.1.4.
Transformer output	Check 110 V Transformer output
Computer/Pendant has failed	See Computer/Pendant diagnostics Section 4.3.

3.3.10 Will Not Hold Calibration

The control will not hold calibration. Go to the "Configuration Values" screen and write down the calibration values for the motor encoders (Encoder) and the position feedback encoders (Scales). 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 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 Diagnostics Section 4.3.

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

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

3.3.11 E-Stop Error

The E-Stop turns the power off to the axis and spindle motors. The 1630 has an e-stop on the front of the pendant and a green E-stop reset button on the side of the pendant. (See figures 6 & 8)

- For the axis motors this is done by stopping 110V power from reaching the cable breakout box through the use of a relay in the pendant. The AC E-stop out connector on the pendant should not have 110 volts coming out of it when the E-stop is pressed.
- The AC drive power is turned off by a contact relay (K1), located on the power module. The contact relay (K1) is turned off by the dual channel relay (safety relay), which is controlled by the E-stop on the pendant.
- The E-stop LED on the spindle control module will be on when the e-stop is in the out position. The LED will turn off when the E-stop is depressed. (See figure 11)
- Once power reaches the cable breakout box it distributes power to the axis motors, auxiliary functions. If power does not reach the cable breakout box then none of these functions will work.

If the E-Stop button is depressed, and no message is displayed on the screen, then either the E-Stop button, pendant, spindle control module, cables from pendant to spindle control module, or cables from spindle control module to dual channel relay (safety relay) is at fault.

Possible Cause	Check This
E-Stop reset button	Press the E-Stop reset button on the side of the pendant.
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 pendant	Does 110 V power come out of the cable breakout box power cord on the pendant? If yes and the screen has an E-stop message then replace the pendant.
Poor cable connection	Check spindle control cable connection at the pendant and spindle control box.
E-Stop jumper	Verify the E-Stop jumper in the electrical box on the spindle control module is correct.

3.4 Problem with the Measurements

3.4.1 X and Z-Axis Measurements Do Not Repeat

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

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

Expected repeatability numbers should be 0.01 mm 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-axis Gib using the X-axis Gib adjustment procedures. See section 5.2.1.
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 and 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. See Calibration & Backlash Constants
Incorrect backlash values	If the machine does not repeat bi-directionally check the backlash on the axis in question. See Calibration and Backlash Constant Section 5.2.2.

3.4.3 The DRO Is Not Counting

The DRO for one axis is not counting when an axis is moved. Often times if this is the case the axis will fault. See section on faulting.

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call 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 Encoder Test.

Possible Cause	Check This
Electronic handwheel failure	The Z handwheel should count 2.54 mm per revolution in both directions in fine mode and 10.2 mm per revolution in course mode. The X handwheel should count 0.51 mm per revolution in both directions in fine mode and 2.54 mm per revolution in course mode.
Servo driver failure	See Servo driver Section 4.5.
Motor Encoder not counting	See Motor diagnostics (not applicable with Glass Scale option)
Computer/Pendant failure	See Computer/Pendant diagnostics section 4.3.

3.4.4 X and Z-Axis DRO Counting in Wrong Direction

The DRO is counting in the wrong direction.

The positive directions for each axis are:

- **X-axis** – 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 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 and Z-Axis Electric Handwheels Turn in Wrong Direction

The Electric Handwheels turn in the wrong direction.

The positive directions for each Electric Handwheel are:

- **X-axis** - Electric Handwheel turns 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

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.

Possible Cause	Check This
Wrong voltage	Check the 415V voltage to the machine
Poor wiring connections	Check all the wiring connections to the electric's box.
Defective cable connections	Check all cable connections
Spindle Motor is bad	Check the resistance of the Spindle Motor windings on the Spindle Motor between L1 & L2, L2 & L3, and L1 & L3, using an Ohmmeter. The resistance should range from ".7 to 1.8 Ohm". If the Ohmmeter reads "0 Ohms" or "OL", then replace Spindle Motor. Next, check the resistance between L1 & Ground, L2 & Ground, and L3 & Ground, using an Ohmmeter. The resistance should read "OL". If not then replace Spindle Motor.

3.5.3 Spindle Runs Backwards

The spindle motor runs in the opposite direction.

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

Gearbox noise is louder than normal. Run the lathe at 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
Insufficient amount of oil in headstock	Check site glass to make sure oil is at sufficient level.
Spindle bearing not being lubricated properly, worn bearing	Remove top lid and check to make sure oil is overflowing freely to the spindle bearings.
Spindle preload loose	Tighten spindle preload on bearing. The spindle preload should be approximately 1.1 – 1.7 N-m.

3.5.5 Headstock is Leaking Oil

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 pinion shaft cover. Check the seal.
Oil leaking from the rear bearing assembly.	Make sure the spindle shaft cover is mounted correctly, if so remove the cover and check the o-ring.

3.5.5.2 Leaking Oil From Front of Gearbox

Possible Cause	Check This
Oil leaking between cover and gearbox	Remove gearbox cover. Thoroughly clean cover & top of gearbox. Replace gasket and reassemble.

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

Electrical and Mechanical maintenance should only be carried out by trained and experienced machine tool engineers who fully understand the hazards of working with machine tools.

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 .02 mm longitudinally and .01 mm transversely. See Leveling Procedures, Section 2.9.

4.1.2 A Special Word About The X 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.

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 ballscrews and way surfaces.

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. For the 1630, oil will be flowing 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) See below	Poor finish Excessive speeds and feeds can break cutting tools or wear out too fast.
Tooling Using the wrong cutter for an application	Poor finish Parts incorrect
Cutting too deep	Part dimensions incorrect 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 Reduce feedrate Increase spindle speed Use a higher rake angle tool Make sure tool is not dull or chipped Use proper grade of cutting tool Use coolant 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 Avoid extreme negative rake inserts Tool overhang too great, tool deflection Improper feeds and speeds X gib loose. See *Gib Adjustment, Section 5.2.1* Work improperly supported 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 manually turn the X and Z-axis ballscrews should be between 10-15 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 a 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.

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, after applying the appropriate torque (50 ft lbs), tighten the 10-32 screw.

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. The tailstock bearing housing only contains 1 ball bearing.

   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. • Cranking the ball screw through a significant part of its travel. If it jams, feel loose or has rough spots, replace the ball screw. • Dial indicator movement when indicating on the end of the ballscrew 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 mm 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 2 separate modules: the computer module and the pendant enclosure minus the computer module.

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 6 cable connections to the left side of the pendant. Make sure all cables are properly fastened.
Pendant locks up	Press the E-stop button and see if lock up clears if not then do the following: Turn the pendant off, wait at least 30 seconds, and turn it back on and check to see if the malfunction has been reset.
No voltage to RSG port	RSG will not work – should be 5 DC volts present Check with a voltmeter.
Low voltage to flash drive or slave board.	Can cause the system to lock up and the flash drive to act abnormally. Check voltage to the RSG port with a voltmeter. It should be 4.8 DC volts and above. Lower values than this can cause problems.
Flash disk failure	If the flash disk 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 flash drive from time to time.** Only the flash disk 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 Section 4.3.

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. The E-Stop reset button may need to be pressed.
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 "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 110 VAC 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 110 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 Cable Connections

Check the motor cable connections on the cable breakout box. Verify there are no pushed in pins on the connector.

4.4.2 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 100 or 131. This will display on the DRO if the motor encoder is counting. If this axis does not count, 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.

4.4.3 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 cable breakout box
- Umbilical #1 and #2 at the pendant
- Umbilical #1 carries the X-axis signals and Umbilical #2 carries the Z-axis signal.

4.4.4 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 X-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.

4.5 Servo Drivers

The two (2) servo drivers are located in the electrical cabinet.

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

Servo Types:
- X is a light duty driver
- Z is a heavy duty driver

Objective:
- Isolate the problem to the particular Servo Driver

Steps:
1. Turn off and unplug the system.
2. Physically swap the servo module from the axis that is not working to one that is.

WARNING!
Do not work with the Servo Driver unless the power is disconnected from the machine. There is possibility of death by electrocution!

Note: To avoid pulling the wires out of the connector, use the loop to pull the connector from the Servo Driver.

If the problem moves to the other axis and clears up from the original axis, replace the Servo Driver.

WARNING!
Do not work run each axis very long when swapping servo's. They are not rated to run each motor for long periods of time.

4.6 Electrical

4.6.1 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.

The system is shipped out assuming the customers shop has 415 V power. If 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 430 V or above will cause the 110 voltage to be high and voltage that is 405 V or below typically causes 110 voltage to be low.

4.6.2 Checking Fuses

There are 11 fuses that make up the system on the 1630. There are 2 fuses in the pendant, 3 fuses on the spindle control module and 6 fuses on the power module. To check fuses:

1. Use a Volt/Ohmmeter; select "OHM" or "Ω".
2. Remove the fuse completely from the pendant display or electrical box.
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).

4.6.3 Main Electrical Box

Only qualified electrical engineers should work in this box.

The electrical box is made up of the following main components:

1. AC drive – used to control the spindle motor.

2. 2 braking resistors – used to brake the spindle motor. To verify the resistors are good, measure the resistance across B1 and B2 of the AC drive. It should read 32 ohms when both resistors are good and 64 ohms if 1 resistor is bad and one is good. Values lower or higher than this could mean one or both resistors are bad.

3. Spindle Control Module – used to control spindle related functions, indexer option, and the remote e-stop. The spindle control module has (1) 5-amp fuse, (1) 3-amp fuse and (1) 12-amp fuse. The spindle control module also has (6) 110 V outlets that supply power to the pendant, spindle, lube pump, indexer, lamp, and the door fan.

4. Cable breakout box – used to send encoder information to the pendant and provide power to the motors.

5. Servo drivers – servo drivers for the X and Z-axis motors.

6. Power Module - The purpose of the power module is to fuse and distribute 415 V 3 phase power to the drive module assembly. L1 and L2 lines from the 3 phase 415 VAC is used for the primary side of the transformer to produce 110 V single-phase power to the spindle control module. The power module has (3) 25 amp fuses to protect the entire system. It also has (2) 4 amp and (1) 2 amp secondary fuses. The power module also has a ground bar where all the panels are grounded and a dual channel relay (safety relay) that is controlled by the E-stop and E-stop reset button on the pendant.

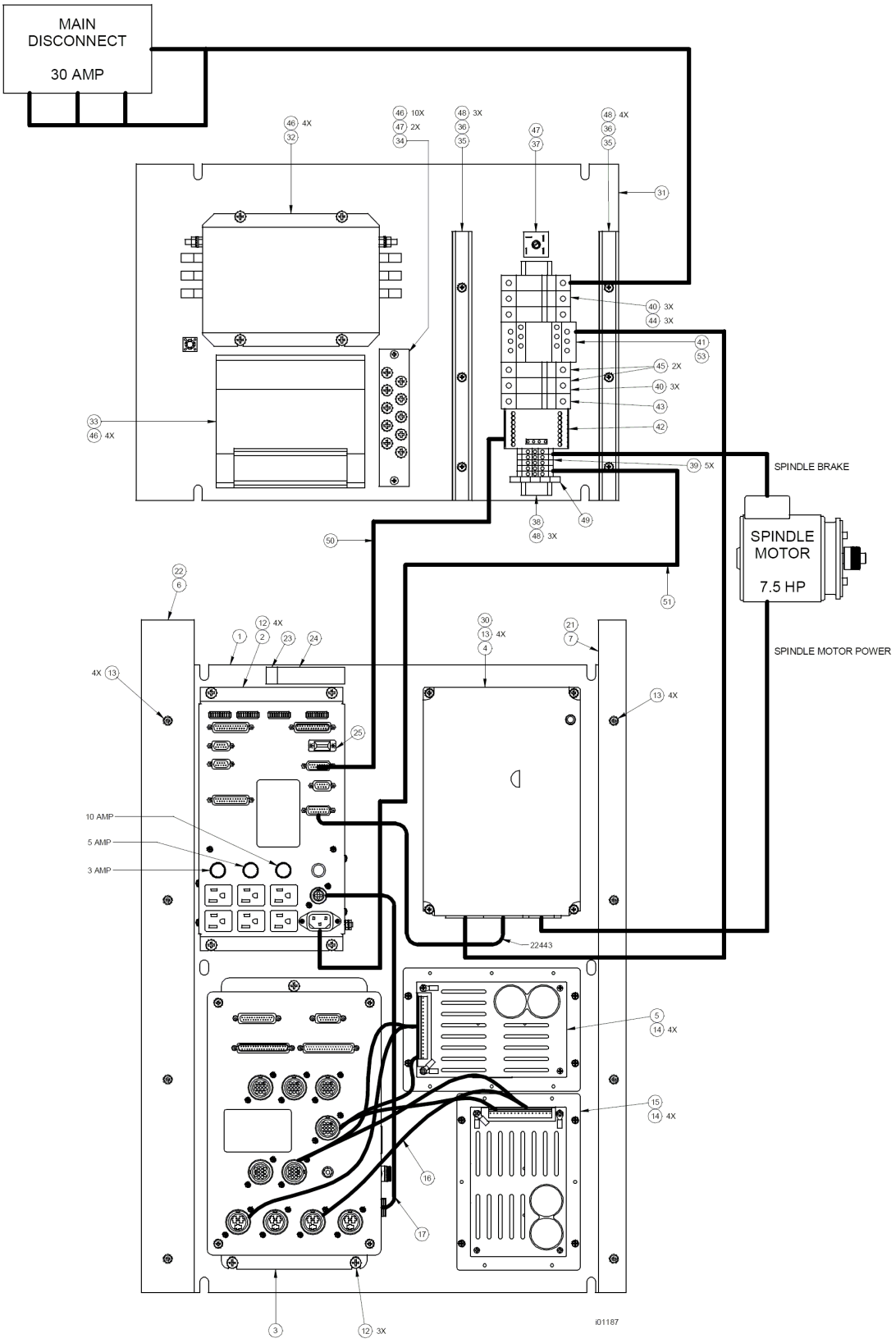

Figure 10
Electrical Box Parts

Electrical Box Parts List

Item	P/N	DESCRIPTION	Qty
1	24039	SHEETMETAL-SLX-DRIVE MODULE	0
2	24042	MODULE-SPINDLE CONTROL	1
3	24999-2	CABINET ASSY-PT4 -SL-CABLE BREAKOUT BOX-AUXILARY FUNCTIONS	1
4	22287-euro	AC DRIVE PROGRAMMED	1
5	20201	SERVO DRIVER ASSY	1
6	22283-2-3-30	WIREWAY- TYPE G LIGHT GRAY	1
7	22283-1-3-30	WIREWAY- TYPE G LIGHT GRAY	1
12	1/4-20X3/8 31Z	SCREW-PH-PHIL-EXT SEMS-STL-ZINC	7
13	10-32X3/8 31Z	SCREW-PH-PHIL-EXT SEMS-STL-ZINC	12
14	6-32X5/8 31B	SCREW-PH-PHIL-EXT SEMS-STL-BO	8
15	20327-3	SERVO DRIVER ASSY - 4050D	1
16	20689	CABLE ASSY-L2 SERVO DRIVERS TO CONN PCB	1
17	24181	CABLE ASSY-LATHE CBB TO SPINDLE CONTROL	1
21	22392-1-30	COVER- WIREWAY- TYPE G	1
22	22392-2-30	COVER- WIREWAY- TYPE G	1
23	22778	LABEL-REVISION LEVEL	1
24	22779-21	LABEL-	1
25	21786-4	ADAPTER ASSY - SLX E-STOP JUMPER	1
30	24360-SLX 1630	AC DRIVE PROGRAMMED - SLX 1630	1
31	24144	SHEETMETAL-SLX-POWER MODULE	1
32	21891	FILTER- HIGH POWER	1
33	21258-2	TRANSFORMER - 1.2kVA	1
34	21753-2	GROUND BAR-SLX 1630	1
35	22283-3/4-2-12	WIREWAY- TYPE G LIGHT GRAY	2
36	22392-3/4-12	COVER- WIREWAY- TYPE G	2
37	23037	DIODE-BRIDGE RECTIFIER-HIGH CURRENT-25 WATT	1
38	24426-1	RAIL-DIN	1
39	22557-1	TERMINAL BLOCK - 6mm BLOCK	5
40	23036	FUSE HOLDER-32 AMP-690V	6
41	22892-3	CONTACTOR -	1
42	22891	RELAY-DUAL CHANNEL	1
43	23152-2	FUSE-500 VOLT-	1
44	23152-25	FUSE-500 VOLT-	3
45	23152-4	FUSE-500 VOLT-	2
46	M6-1.0X6 10Z	SCREW-PH-PHIL-STL-ZINC	18
47	M5-0.8X16 10Z	SCREW-PH-PHIL-STL-ZINC	3
48	M5-0.8X6 10Z	SCREW-PH-PHIL-STL-ZINC	9
49	24299	TERMINAL BLOCK	1
50	21455-2	CABLE ASSY - SX AUX SAFETY I/O	1
51	24429	CABLE ASSY - 1630 SLX POWER CABLE	1
52	24424	TERMINAL BLOCK - JUMPER	1
53	24423	SUPPRESSOR - NOISE	1
54	M6 70Z	WASHER-FLAT USS-STL-ZINC	8
55	M6 73B	WASHER-SPLIT LOCK-STL-BO	8

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4.6.3.1 Spindle Control Module LED Segments

1st 10 LED Segment

1. LED labeled GEAR 4 – not used.
2. LED labeled GEAR 3 – not used.
3. LED labeled GEAR 2 –The 1630 does not have a gear switch.
4. LED labeled GEAR 1 This light should be off when it is in high gear or neutral. This light is not on for the 1630 because it has no gears.
5. LED labeled SPD-FAULT – this light will be on whenever the AC drive is in a fault condition, which includes an E-stop message from the pendant.
6. LED labeled SPD-RUN – this light should be on whenever the spindle is on.
7. LED labeled SPD-ENABLE – this light should be on whenever you are in DRO, tool setup and RUN mode.
8. LED labeled LUBE PUMP – this light should be on whenever the lube pump is on and off when it is not on.

LED's 9 and 10 are not used.

2nd 10 LED Segment

1. LED labeled E-STOP OUT – this light should be on whenever the E-stop is in the out position. When the E-stop is pressed, this light should go off.
2. LED labeled OFF RELAY – this light should be on whenever the off button on the pendant is pressed.
3. LED labeled TAP MODE – light should be on whenever you are not tapping. Light will be off when in the tap event.
4. LED labeled TAP REVERSE – this light will be on when the spindle changes direction at the bottom of the hole on a tap event and back off after the spindle changes direction once outside of the tap event.
5. LED labeled REV-RELAY – this light should be on whenever the spindle is running in reverse.
6. LED labeled FWD-RELAY – this light should be on whenever the spindle is running in forward.
7. LED labeled LI-BIT 1 – this LED should be on whenever the lathe indexer is at any odd tool position.
8. LED labeled LI-BIT 2 – this LED should be on whenever the lathe indexer is at tool positions 2, 3, 6 or 7.

LED's 9 and 10 are not used.

3rd 10 LED Segment

1. LED labeled LI-BIT 3 – this LED should be on whenever the lathe indexer is at tool positions 4, 5, 6 or 7. For the 4 tool indexer, if you program tools 5, 6, 7 or 8, the indexer will physically move to tools 1, 2, 3 or 4 respectively. For example, if you program tool 7, LED light LI BIT 3 should be on.
2. LED labeled LI-BIT 4 – this LED should be on whenever the lathe indexer is at tool position 8.
3. LED labeled REMOTE E-STOP – this LED should be on whenever the remote e-stop or pendant e-stop is in the out position.
4. LED labeled OIL PRESSURE – not used.

5. LED labeled LI-PROX SWITCH – this LED should be on whenever the lathe indexer is locked in position.
6. LED labeled LI-AIR PRESSURE – this LED should be on whenever the air pressure for the lathe indexer is incorrect.
7. LED labeled 24VDC OK – this LED should be on whenever the 24 volts for the lathe indexer is not present.
8. LED labeled 5VDC OK – this LED should be on whenever the 5 volts for the lathe indexer is not present.

LED's 9 and 10 are not used.

4th 10 LED Segment

1. LED labeled FWD-KEY – this LED should be on whenever the FWD key on the pendant is being pressed.
2. LED labeled OFF-KEY – this LED should be on whenever the OFF key on the pendant is being pressed.
3. LED labeled REV-KEY – this LED should be on whenever the REV key on the pendant is being pressed.
4. LED labeled LI-SEL 4 – is not used and should never be on.
5. LED labeled LI-SEL 3 – this LED should be on whenever a tool position on the Dorian indexer is commanded which would increment the tool by 4 positions or decrement the tool by 1, 2, 3 or 4 positions. For increment, the Dorian indexer is rotating in a CCW path when facing the turret. May not apply to the 4-tool indexer.
6. LED labeled LI-SEL 2 – this LED should be on whenever a tool position on the Dorian indexer is commanded which would increment the tool by 1, 2 or 4 positions or decrement the tool by 1or 4 positions. May not apply to the 4-tool indexer.
7. LED labeled LI-SEL 1 – this LED should be on whenever a tool position on the Dorian indexer is commanded which would increment the tool by 1, 3 or 4 positions or decrement the tool by 2 or 4 positions. May not apply to the 4-tool indexer.
8. LED labeled CHUCK GUARD – not used
9. LED labeled FWD-REVERSE – not used

LED 10 is not used.

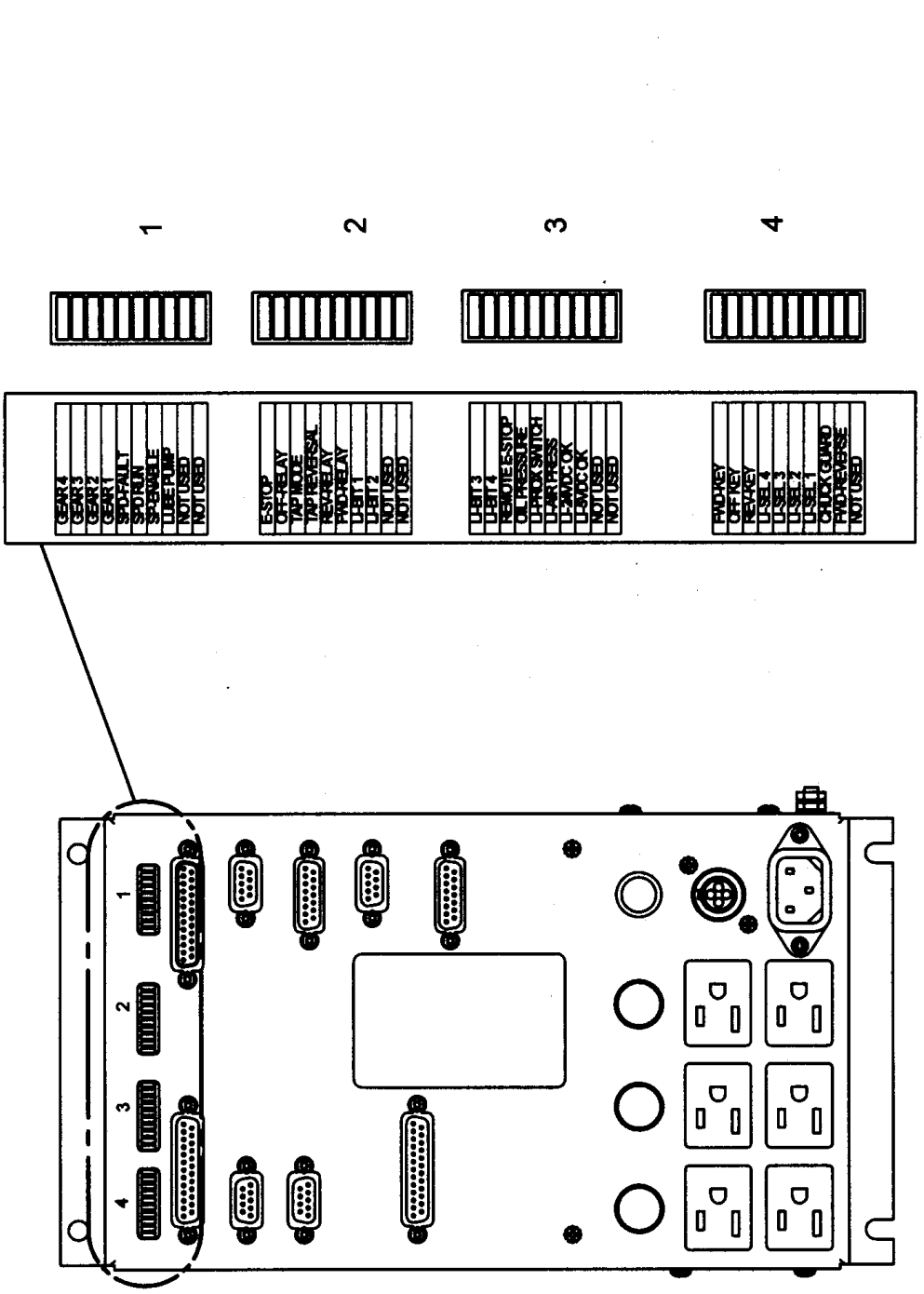

Figure 11
Spindle Control Module LED's

4.6.4 Cable Breakout Box Connections

The list below describes what takes place through each connection. Power reaches the cable breakout box through AC IN from the pendant. From there power is distributed through the system.

- **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.
- **Apron Port** - Communication for X & Z-Handwheel and jogstick logic signals between the Pendant and the cable breakout box.
- and Z- servos.
- **X & Z - Motor Ports** - are used to receive power from the servo and distribute it to the motors.
- **X & Z-Motor Encoder Ports** - These ports are used to receive logic signals from each of the X & Z-Motor Encoders.
- **Spindle Encoder Port** - The port is used to receive logic signals from the spindle encoder, when it is engaged for a threading routine.
- **Logic to Servo (PWM)** - This port is used to keep continuous feedback between the servos and the cable breakout box.
- **110 VAC Outlet** - The outlet is for powering up the coolant pump. Beside the outlet is an LED light signifying power is reaching the pump when it is active, and a fuse to protect the pump.
- **E-Stop and Spindle Out Port** - used to disable power to the spindle motor when the E-Stop is activate.

4.6.5 Cable Connections

The lathe machines use 7+ 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.

4.7 Door Interlock Switch

The 1630 uses door interlock switches to verify to the control that the doors are closed in various modes of operation. This switch is wired normally open but is forced closed when the doors are closed during CNC run mode. The switches are wired in series to a 9 pin DB connector. There should be continuity between pins 1 and 6 when the switches are forced closed and no continuity when the switches are in the open position.

4.8 Service Codes

Service codes are broken down into the 4 following categories: software, machine setup, diagnostics, and user options/defaults.

All Service Codes are accessed in the SET-UP Mode by pressing the soft key for "SERV CODES". The service codes can be located within 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 - 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

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.
- **Operating System Version** – displays the version of the operating system.

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 = 1440S/1745S (displays machine ID key)
Motor encoder calibration constants 610.0712 1143.8921
(These numbers above are typical numbers for the calibration constants)
Arc accuracy – 0.13

Code 128	X=0.13	Z=0.04
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.

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 4.04 and 11.11 are considered normal for each axis. Higher values indicate excessive friction in the system. Lower values indicate a loose system and may mean a gib adjustment is necessary. Value 4.04 means the friction is a factor of 4 in one direction, and 4 in the other direction. The values should be within 3 or 4 of each other in both directions. A value of 6.08 would still be considered normal.

On S products, do not equate Code 12 values to torque on ballscrew. Measure friction in system with an N-m torque wrench.

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 12 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 starting with the cross-slide and saddle centered. MAKE SURE THAT NO ONE IS STANDING IN THE WAY OF THE CROSS-SLIDE 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 cross-slide and saddle.
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	Display	Data displayed.
X +	X	Motor encoder reading
	Z	Nothing (should be 0)
	Feedrate	the maximum feedrate attained

Your input		
X -	X	Motor encoder reading
	Z	Nothing (should be 0)
	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 76 mm to 127 mm.

- If the motor encoder value is not within specification it may be the problem. If the encoder is not reading then it will need to be replaced.
- The feedrate should be a minimum of 180 ipm for X, and 120 ipm for Z. Shops with higher voltages will see higher values.
- If the feedrate is less than 4572 mm/min (180 ipm) and inconsistent in both directions, check the incoming AC voltage and mechanics of the drive train.

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.

4.8.2.7 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.

4.8.3 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 10.2 mm for Z and 2.54 mm for X in course mode and 2.54 mm for Z and 0.51 mm for X in 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 is 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.

4.8.3.9 Code 326: Error Message Display

Error Message Display is used to describes error messages.

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.

4.8.4.4 Code 80: Beeper Off

This turns off the beeper to the control keys.

4.8.4.5 Code 129: Arc Accuracy

When the SL 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 0.13 mm. The feedrate will automatically be adjusted around sharp corners so as to not violate this limit. This code only applies to arcs that are programmed and ones that are created in the tool path to generate the shape you want. This code will not make a difference on mill moves.

You may adjust the maximum following error to a value as small as .003 mm. 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 .003 to .3 mm) and press **INC SET**.

5.0 Procedures for Replacements & Maintenance

Electrical and Mechanical maintenance should only be carried out by trained and experienced machine tool engineers who fully understand the hazards of working with machine tools.

5.1 Replacements

5.1.1 Motor Replacement

1. Turn off power to the machine.
2. Each motor is mounted by the use of (4) ¼-20 screws. Be careful not to over tighten these bolts and strip the threads.

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 110 VAC. There is possibility of death by electrocution!

The Servo Driver for each axis is located inside the electric cabinet.

DANGER!
Always engage (push in) the Emergency Stop switch, turn the ProtoTRAK SLX Control off, and disconnect the servo driver cable at the cable breakout box.

1. Press in the Emergency Stop.
2. Remove the servo driver from the panel, inside the electric cabinet.
3. Remove the 4 cap screws that hold the servo driver and its heat sink plate to the panel.
4. Disconnect the cable connector from the servo driver.
5. Reinstall the new servo driver with its heat sink plate.

5.1.3 Computer Module and LCD/Enclosure 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 the pendant from the pendant arm by removing the (4) ¼-20 x 3/4" SCHS that secure it in place.
4. Place the pendant assembly on a clean and secured table with the display pointing away from you.
5. Remove the (6) 10-32 x 3/8" Pan Phillips Head Screws and (4) 10-32 x 3/8" FHCS securing the computer module to the LCD/enclosure.
6. Pull the computer module a few inches and stop. Pulling the computer module too far will damage the ribbon cables.
7. Now reach from the top and remove the 37-pin LCD cable, 37-pin distribution cable and the 9-pin E/Stop cables. The cables are to stay with the computer module.
8. Now slide the module about ½ way out of the LCD/enclosure.
9. Remove the ground wire from the LCD/enclosure side.

10. Lastly, slide the unit completely out of the LCD/enclosure.
11. Replace computer module or LCD/enclosure.
12. Follow the instructions in reverse order when reinstalling the new computer module or LCD/enclosure.
13. Make sure that all connectors are properly seated before fastening the unit back in place.

Note: if the flash drive is functional, you may want to remove the flash disk and install it in the new flash drive.

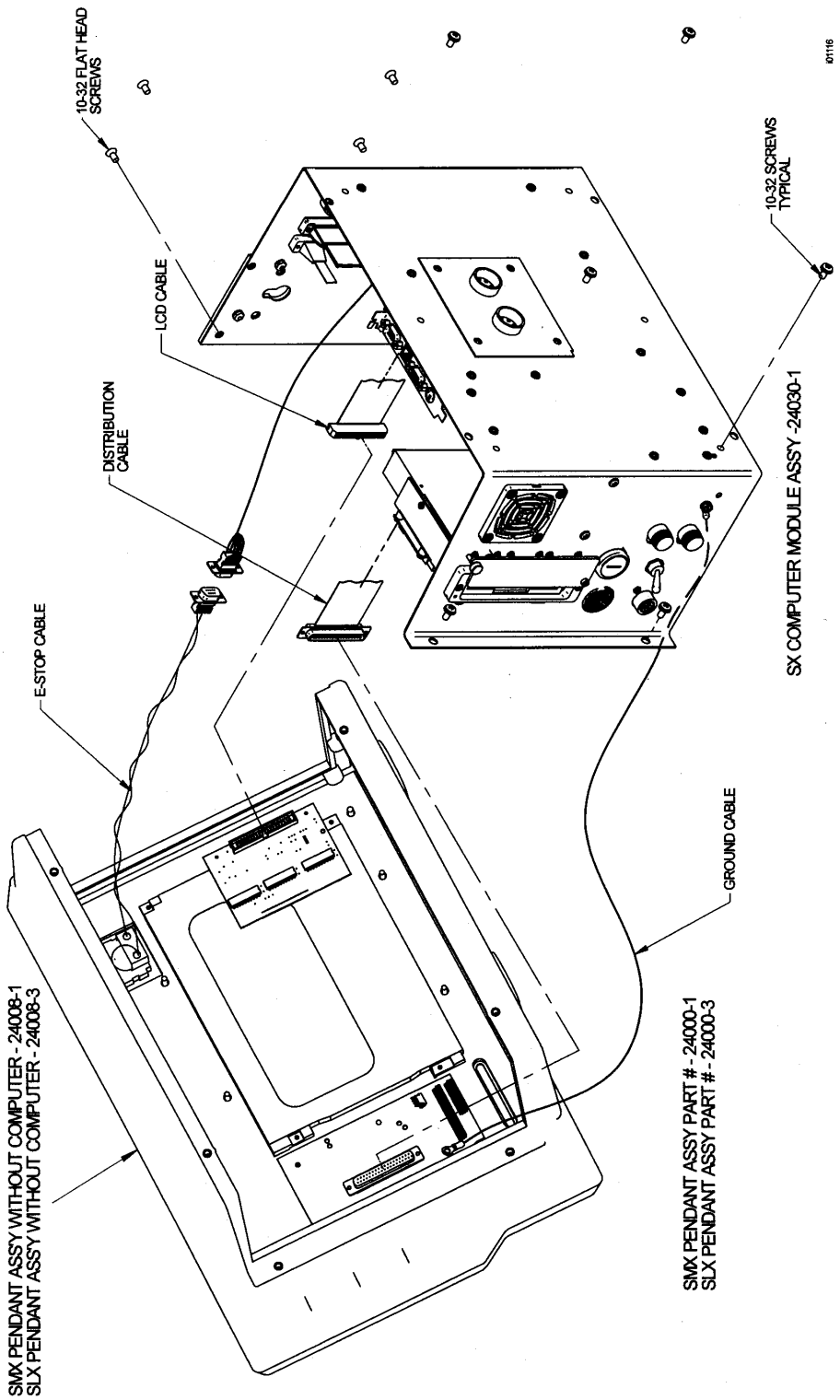

Figure 12 (Figure shown with inner sheet metal removed)
Computer Module & LCD/Enclosure Replacement

5.1.4 System Flash Disk Replacement (See Figure 13)

1. From the control, go to SETUP, SERV CODES, SECTION A, and then code 142 and save your Configuration file (calibration values, etc.) on a floppy disk. There is a disk in the electric's cabinet for this purpose. Label this disk as "Backup Configuration" and store it for later use.
2. Turn power off to the machine and control.
3. Unplug all the connectors on the pendant arm side of the pendant.
4. Remove the pendant from the pendant arm by removing the (4) ¼-20 x 3/4" SCHS that secure it in place.
5. Place the pendant assembly on a clean and secured table with the display pointing away from you.
6. Remove the (6) 10-32 x 3/8" Pan Phillips Head Screws and (4) 10-32 x 3/8" FHCS securing the computer module to the LCD/enclosure.
7. Pull the computer module a few millimeters and stop. Pulling the computer module too far will damage the ribbon cables.
8. Remove the defective System Flash Disk (located on the back side of the mother board) by pushing the eject button on the flash drive.
9. Firmly insert the replacement System Flash Disk into the drive, making sure that the label with the serial number is pointing towards the motherboard.
10. Secure the computer module back to the LCD/enclosure by following the instructions in reverse order.
11. Make sure that all connectors are properly seated before fastening the unit back in place.
12. Turn power on to the machine and control.
13. When the system boots, you may get a message stating that the system cannot find your configuration file. Press NO if asked to load defaults.
14. Update the System Software by inserting the PT4SX update disk into the floppy drive. Go to service codes 316 and 317 found in section A. Update the master and slave software.
15. Restore the Configuration file saved on your backup configuration disk with service code 141 found in section A of the service code section.

CAUTION!

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

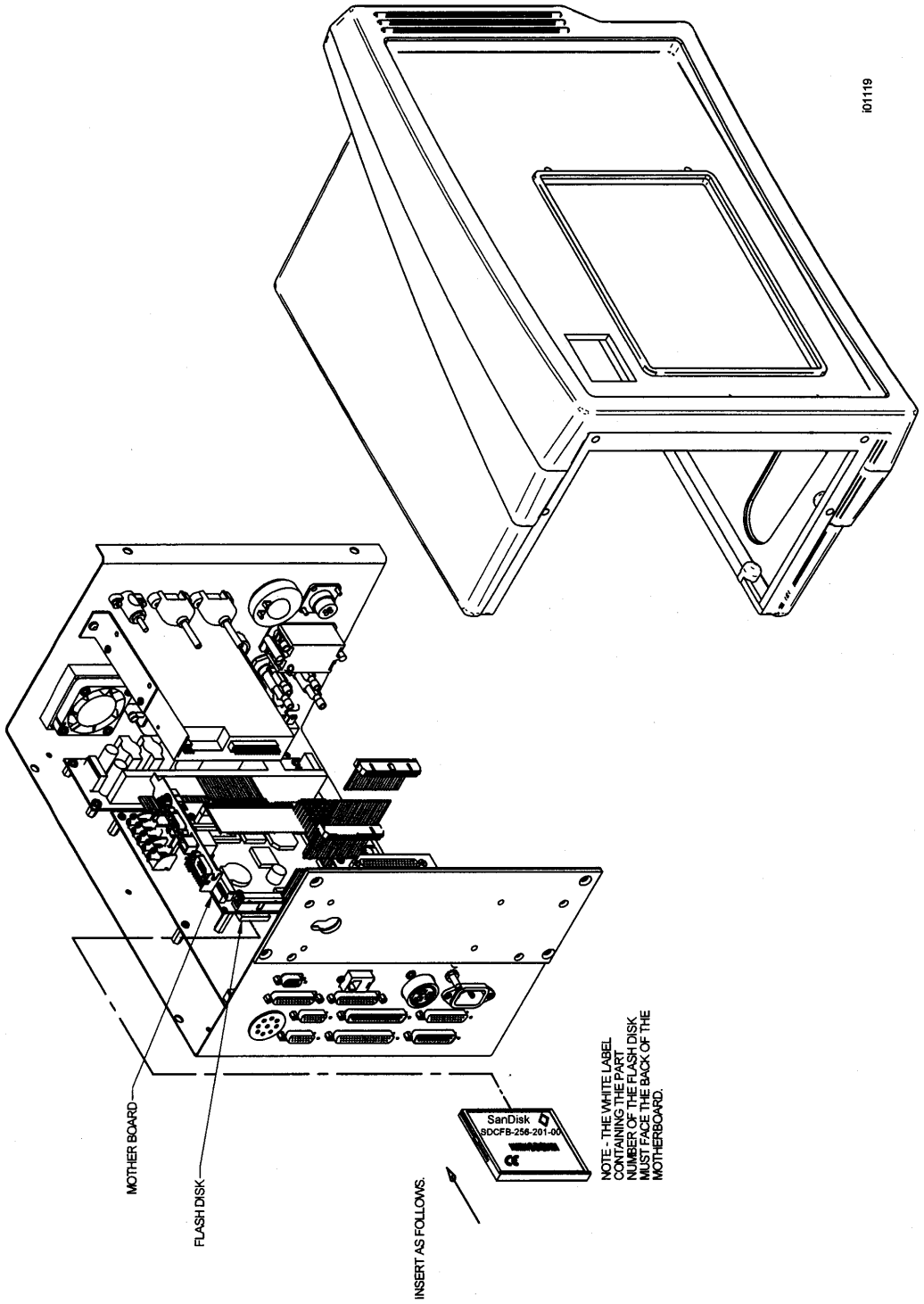

Figure 13 (Figure shown with inner sheet metal removed)
Flash Disk Replacement

5.1.5 Cable Routing on Machine

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 (2) 110-volt motor cables and (2) 110-volt power cables for the pendant, and a coolant pump or solenoid power cable. The logic cables are used to carry encoder signals between the cable breakout box and computer module. 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.

5.1.6 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. (See Figure 41, Section 7)

5.1.7 Cable Routing in Electrics Box

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 (2) 110 volt servo motor cables and (4) 110-volt power cables for the pendant, spindle motor fan, coolant pump, and lube pump. The logic cables are used to carry signals between modules, handwheels, encoders, etc. 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 Drive Belt Replacement (See Figure 14)

The spindle drive motor is located inside the base pedestal, underneath the headstock gearbox. Access is gained by opening the upper door on the headstock and removing the lower access panel on the pedestal. When removing the belt, loosen nut "G" and advance nut "H" until the belt has sufficient slack to be removed from the pulleys.

When installing the belt, retract nut "H" and tighten nut "G". Initially, tension the belt such that there is no slippage when the lathe is started at its maximum speed.

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.

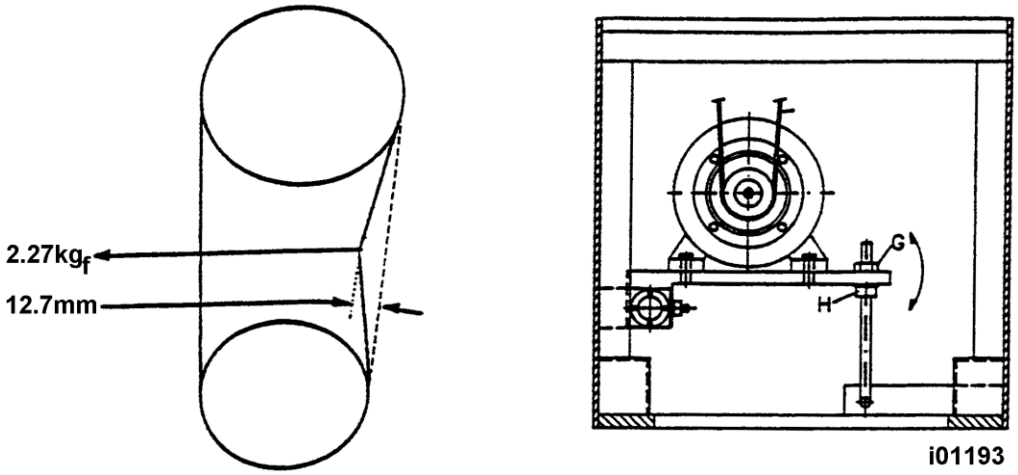

Figure 14
Spindle Drive Belt/Motor Mounting

5.1.9 Spindle Motor Removal (see Figure 14)

1. Unplug or remove all power from the lathe.
2. Remove the motor belt.
3. Mark and remove motor electrical leads.
4. 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.
5. Loosen the belt tension. See section above.
6. The motor is secured with four screws to a flange plate.

5.1.10 Spindle Encoder Replacement

1. Unplug or remove all power from the lathe.
2. Open the rear 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.

5.1.11 X-Axis Ball Screw Removal (see Figure 15)

1. Unplug or remove all power from the lathe.
2. Access to the X-axis ball screw is gained by removing the access guard and removing the X-axis motor cover.
3. Remove the motor.
4. Remove all items on the right end of the ball screw.
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.

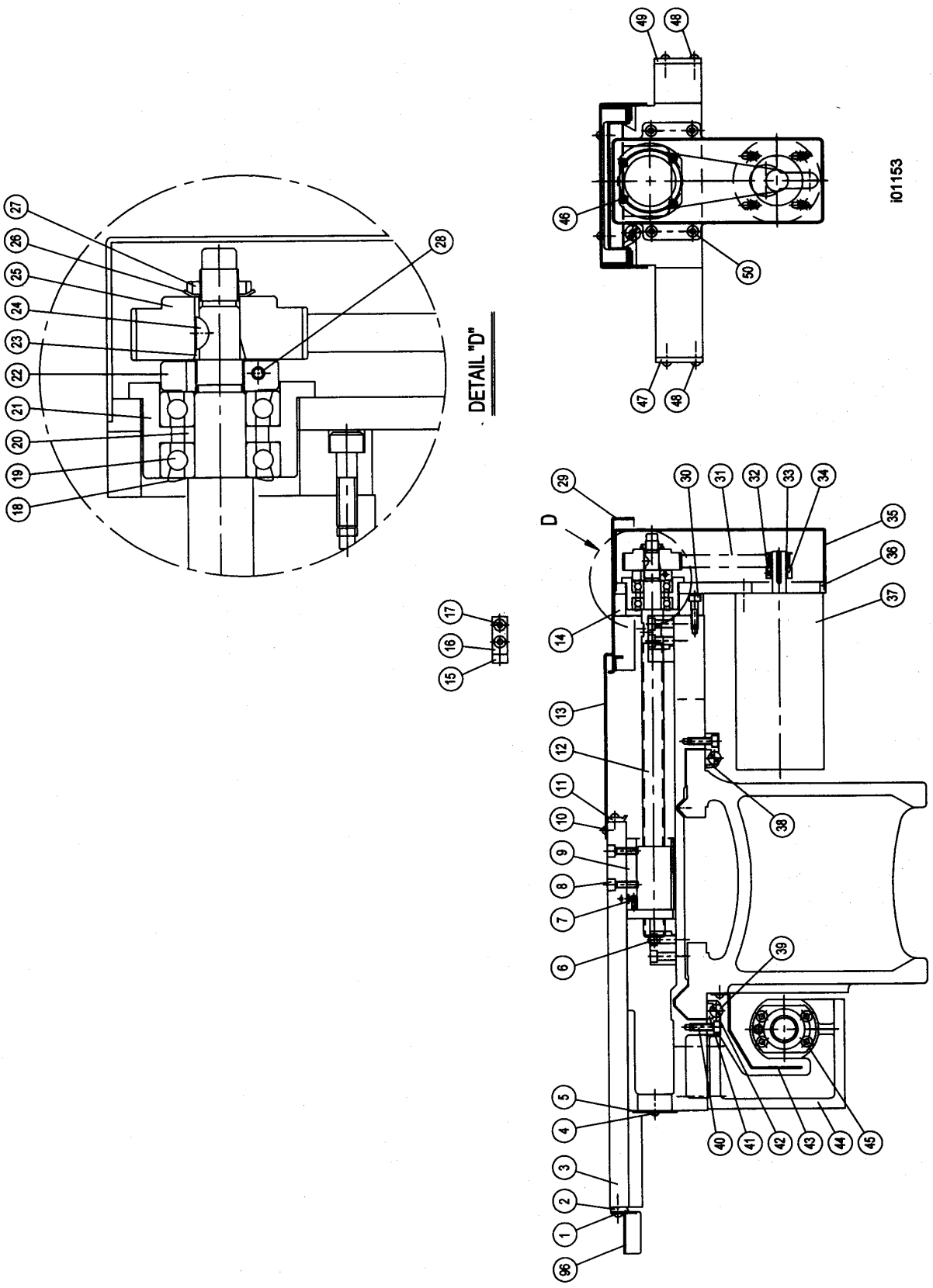

Figure 15
SLX 1630 X-Axis Drive Train

SLX 1630 X-Axis Drive Train Parts List

Item	Parts No.	Description	Material	Specification	Q'ty
1		Hexagon Socket Screw		M6x16L	6
2	24698	Wiper - Crosslide (front)	Rubber	25-0220	1
3	25-0215	Cross Slide	FC25		1
4		Socket Button Head Screw		M6x10L	2
5	25-0739	Front Cover Plate	SS41		1
6		Socket Head Cap Screw		M8x16L	1
7		O-Ring		P7	1
8		Socket Head Cap Screw		M8x30L	4
9	25-0212	Seat - Nut	FC25		1
10		Socket Button Head Screw		M6x10L	4
11	24699	Wiper - Crosslide (Rear)	Rubber	25-0221	1
12	20984	Ballscrew - X Axis	SCM415	25-0211	1
13	25-0218	Rear Cover Plate	SS41		1
14	25-0209	Clamping Block	FC20		1
15	25-0206	Bumper	PU		2
16	25-0205	Cam	SS41		2
17		Socket Head Cap Screw		M8x35L	4
18		Cover - Bearing		7204AVH	1
19	23930	Bearing Set - Angular Contact Ball		7204BECBP	2
20	15885	Spacer	S45C		1
21	SLX 16300	Bearing Housing	S45C		1
22	16314	Nut - Clamp	S45C	j19x16UNF	1
23	24A-0216	Cone Clamping Element	Brass		1
24	98481A090	Woodruff Key		#3(1/8"x1/2")	1
25	16983-1	Pulley-ballscrew	S45C	5Mx44T	1
26	W02	Lock Washer		W02(j15)	1
27	NT02	Lock Nut		N02(j15x32UNF)	1
28		Socket Head Cap Screw		10-32x3/4"	1
29	25-0219	Rear Cover Plate	SS41		1
30		Socket Head Cap Screw		M8x30L	4
31	450-5M-15	Belt-X Axis		5M-450-15	1
32		Set Screw		M5x6L	3
33		Pulley	Aluminum	5Mx16T	1
34		Lock Ring	SS41		1
35	25-0208	Plate - Cover - X Axis Motor	SS41		1
36	25-0207	Plate - Motor	SS41		1
37	24316	Motor - X Axis Servo			1
38	24-0315	Clampiing Block (Rear)	FC25		1
39	50-0325-00	Screw - Adjusting	S30C		4
40		Socket Head Cap Screw		M8x25L	10
41	23337-28	Gib - Z Axis	FC25	24-0313	2
42	24-0314	Clamping Block (Front)	FC25		1
43	25-0712	Cover - Protection	SS41		1
44	24-0311	Apron	FC25		1
45		Socket Head Cap Screw		M8x30L	4
46		Socket Head Cap Screw		M6x30L	4
47	23337-72	Wiper - Bedway (Right, Rear)	Rubber	24-0337	1
48		Crossed Recessed Head Screw		M6x16L	12

49	23337-73	Wiper - Bedway (Left, Rear)	Rubber	24-0336	1
50		Hexagon Socket Screw		M5x6L	8
57	22446	Bearing - self aligning		2204E-2RS1TN9	1
58	N04	Lock Nut	S45C	N04(j20x16UNF)	1
59	W04	Lock Washer		W04	1
60	16295-1	Bearing Housing	FC20		1
61		Socket Head Cap Screw		M12x50L	4
62		Washer - Spring		M12	4
63		Socket Head Cap Screw		M6x20L	2
64	25-0321	Bumper	Rubber		2
65	25-0320	Cam	SS41		1
66		Socket Head Cap Screw		M8x70L	2
67	23337-82	Wiper - Bedway (Right, Front)	Rubber	25-0335	1
68	24714	Gib - X Axis	FC30	25-0217	1
69	17-0321-00	Screw - Adjusting	S30C		2
70		Socket Head Cap Screw		M8x25L	4
71	25-0201	Saddle	FC25		1
72		Socket Head Cap Screw		M12x65L	4
73	23337-81	Wiper - Bedway (Left, Front)	Rubber	25-0334	1
74	24704	Ballscrew - Z Axis	SCM415	25-0310	1
75		Cover - Bearing		AVH7205	1
76	23940	Bearing Set - Angular Contact Ball		7205 BECBP	2
77	SLX 16302	Spacer	S45C		1
78	24A-0308	Seat - Bearing	S45C		1
79		Socket Head Cap Screw		M8x25L	4
80	16452	Nut - Clamp	S45C	j19x16UNF	1
81	24A-0216	Cone Clamping Element	Brass		1
82	16983-1	Pulley-ballscrew	Aluminum		1
83	98481A090	Woodruff Key		#3 (1/8"x1/2")	1
84	W01	Lock Washer		W01 (j12)	1
85	N01	Lock Nut		N01 (j12x32UNF)	1
86		Set Screw		M5x10L	3
87		Socket Head Cap Screw		10-32x3/4"	1
88		Socket Head Cap Screw		M12x35L	4
89	400-5M-15	Belt - Z Axis		400-5M-15	1
90		Pulley	Aluminum	5M-30T	1
91		Socket Head Cap Screw		1/4-20UNCx30L	4
92		Washer - Flat		1/4"	4
93		Washer -Spring		1/4"	4
94	77USDA-0304	Base - Motor - Z Axis	FC30		1
95	16775-1	Motor - Z Axis Servo			1
96	25-0223	Cover Plate (Front)	SS41		1

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5.1.12 Installing Angular Contact Bearings (See Figure 16)

1. On the inner race of the angular contact bearings, the thin walls face each other.
2. When tightening the clamp nut, first engage a few threads. Then lightly tighten the locking screw slowly, so that when you slowly thread the lock nut inwards you can feel some contact between the two threads.
3. Once the clamp nut is completely threaded inwards you will need to use a torque wrench to apply 68 N-m. of torque, properly seating the bearings.
4. Completely thread in the locking screw to prevent the lock nut from unthreading.

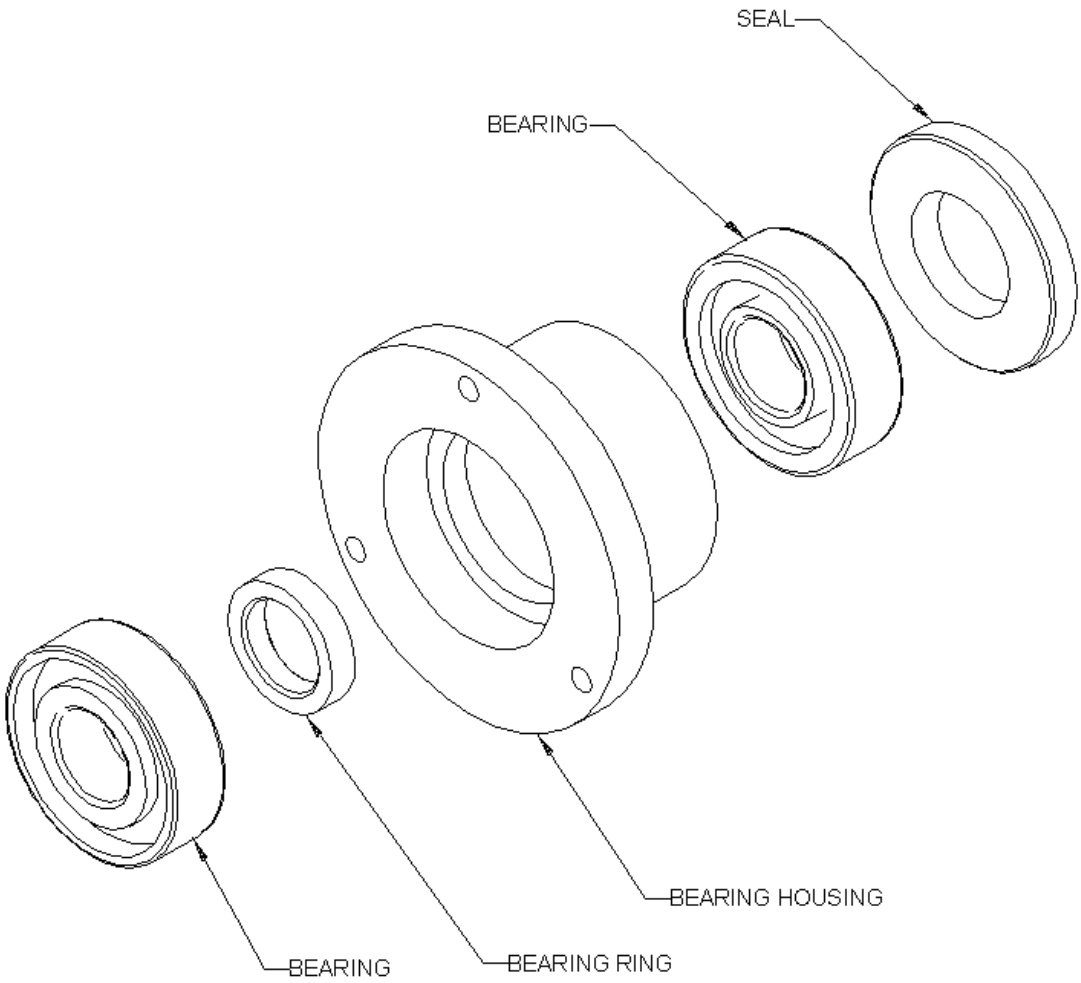


Figure 16
Angular Contact Bearings

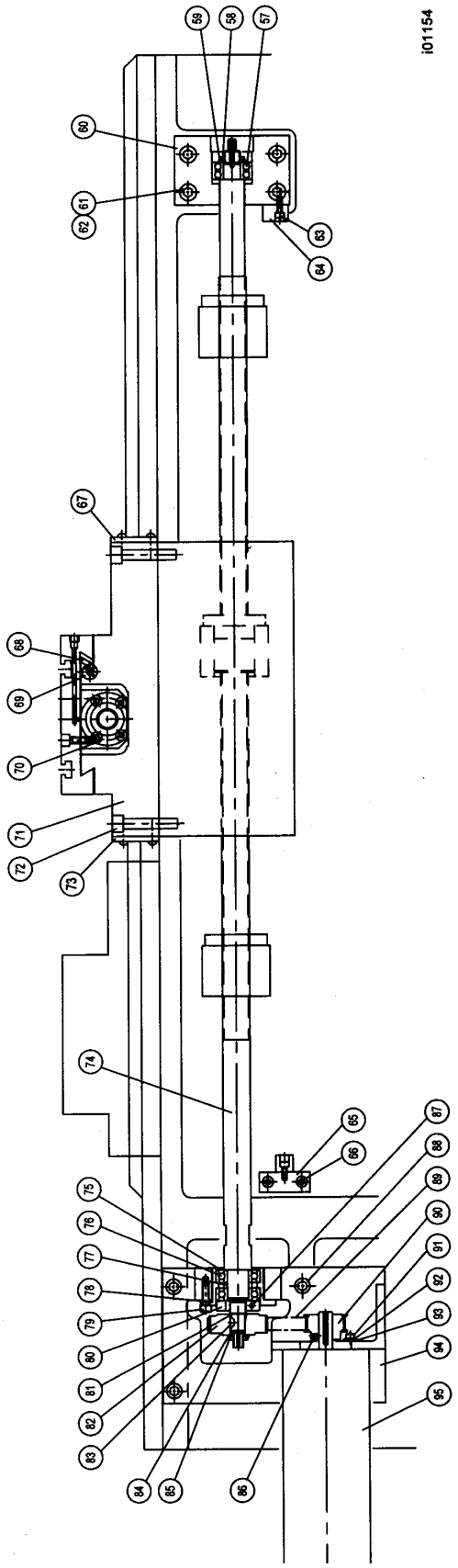
5.1.13 Z-Axis Ball Screw Removal (see Figure 17)

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.

5.1.14 Align Z-Axis Ball Screw Assembly (See Figure 17)

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 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 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 1.1 - 1.7 N-m.

Figure 17
SLX 1630 Z-Axis Drive Train



SLX 1630 Z-Axis Drive Train Parts List

Item	Parts No.	Description	Material	Specification	Q'ty
1		Hexagon Socket Screw		M6x16L	6
2	24698	Wiper - Crosslide (front)	Rubber	25-0220	1
3	25-0215	Cross Slide	FC25		1
4		Socket Button Head Screw		M6x10L	2
5	25-0739	Front Cover Plate	SS41		1
6		Socket Head Cap Screw		M8x16L	1
7		O-Ring		P7	1
8		Socket Head Cap Screw		M8x30L	4
9	25-0212	Seat - Nut	FC25		1
10		Socket Button Head Screw		M6x10L	4
11	24699	Wiper - Crosslide (Rear)	Rubber	25-0221	1
12	20984	Ballscrew - X Axis	SCM415	25-0211	1
13	25-0218	Rear Cover Plate	SS41		1
14	25-0209	Clamping Block	FC20		1
15	25-0206	Bumper	PU		2
16	25-0205	Cam	SS41		2
17		Socket Head Cap Screw		M8x35L	4
18		Cover - Bearing		7204AVH	1
19	23930	Bearing Set - Angular Contact Ball		7204BECBP	2
20	15885	Spacer	S45C		1
21	SLX 16300	Bearing Housing	S45C		1
22	16314	Nut - Clamp	S45C	φ19x16UNF	1
23	24A-0216	Cone Clamping Element	Brass		1
24	98481A090	Woodruff Key		#3(1/8"x1/2")	1
25	16983-1	Pulley-ballscrew	S45C	5Mx44T	1
26	W02	Lock Washer		W02(φ15)	1
27	NT02	Lock Nut		N02(φ15x32UNF)	1
28		Socket Head Cap Screw		10-32x3/4"	1
29	25-0219	Rear Cover Plate	SS41		1
30		Socket Head Cap Screw		M8x30L	4
31	450-5M-15	Belt-X Axis		5M-450-15	1
32		Set Screw		M5x6L	3
33		Pulley	Aluminum	5Mx16T	1
34		Lock Ring	SS41		1
35	25-0208	Plate - Cover - X Axis Motor	SS41		1
36	25-0207	Plate - Motor	SS41		1
37	24316	Motor - X Axis Servo			1
38	24-0315	Clamping Block (Rear)	FC25		1
39	50-0325-00	Screw - Adjusting	S30C		4
40		Socket Head Cap Screw		M8x25L	10
41	23337-28	Gib - Z Axis	FC25	24-0313	2
42	24-0314	Clamping Block (Front)	FC25		1
43	25-0712	Cover - Protection	SS41		1
44	24-0311	Apron	FC25		1
45		Socket Head Cap Screw		M8x30L	4
46		Socket Head Cap Screw		M6x30L	4
47	23337-72	Wiper - Bedway (Right, Rear)	Rubber	24-0337	1
48		Crossed Recessed Head Screw		M6x16L	12

49	23337-73	Wiper - Bedway (Left, Rear)	Rubber	24-0336	1
50		Hexagon Socket Screw		M5x6L	8
57	22446	Bearing - self aligning		2204E-2RS1TN9	1
58	N04	Lock Nut	S45C	N04(φ20x16UNF)	1
59	W04	Lock Washer		W04	1
60	16295-1	Bearing Housing	FC20		1
61		Socket Head Cap Screw		M12x50L	4
62		Washer - Spring		M12	4
63		Socket Head Cap Screw		M6x20L	2
64	25-0321	Bumper	Rubber		2
65	25-0320	Cam	SS41		1
66		Socket Head Cap Screw		M8x70L	2
67	23337-82	Wiper - Bedway (Right, Front)	Rubber	25-0335	1
68	24714	Gib - X Axis	FC30	25-0217	1
69	17-0321-00	Screw - Adjusting	S30C		2
70		Socket Head Cap Screw		M8x25L	4
71	25-0201	Saddle	FC25		1
72		Socket Head Cap Screw		M12x65L	4
73	23337-81	Wiper - Bedway (Left, Front)	Rubber	25-0334	1
74	24704	Ballscrew - Z Axis	SCM415	25-0310	1
75		Cover - Bearing		AVH7205	1
76	23940	Bearing Set - Angular Contact Ball		7205 BECBP	2
77	SLX 16302	Spacer	S45C		1
78	24A-0308	Seat - Bearing	S45C		1
79		Socket Head Cap Screw		M8x25L	4
80	16452	Nut - Clamp	S45C	φ19x16UNF	1
81	24A-0216	Cone Clamping Element	Brass		1
82	16983-1	Pulley-ballscrew	Aluminum		1
83	98481A090	Woodruff Key		#3 (1/8"x1/2")	1
84	W01	Lock Washer		W01 (φ12)	1
85	N01	Lock Nut		N01 (φ12x32UNF)	1
86		Set Screw		M5x10L	3
87		Socket Head Cap Screw		10-32x3/4"	1
88		Socket Head Cap Screw		M12x35L	4
89	400-5M-15	Belt - Z Axis		400-5M-15	1
90		Pulley	Aluminum	5M-30T	1
91		Socket Head Cap Screw		1/4-20UNCx30L	4
92		Washer - Flat		1/4"	4
93		Washer -Spring		1/4"	4
94	77USDA-0304	Base - Motor - Z Axis	FC30		1
95	24425	Motor - Z Axis Servo			1
96	25-0223	Cover Plate (Front)	SS41		1

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5.1.15 Headstock Taper Adjustment

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

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 18) 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.

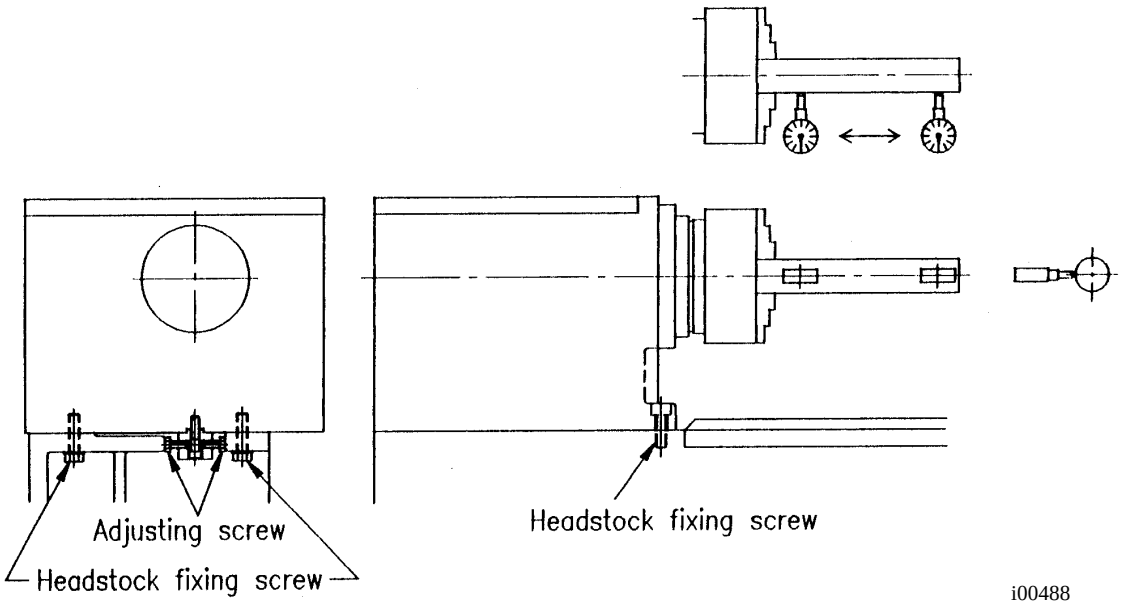

Figure 18
Headstock Alignment

5.1.16 Spindle Bearing Preload

1. Run the lathe for 10 minutes to ensure the bearings are lubricated and slightly warmed. Run the lathe at 500 RPM.
2. For the SLX 1630 you will need to remove the spindle motor belt because this machine does not have a neutral. Using the torque wrench, measure the spindle rolling torque. The acceptable range of rolling torque is around 1.1 – 1.7 N-m. Note that the torque required to start ("breaking away torque") the spindles rotation will be higher.
3. Loosen the three setscrews on the spindle-adjusting nut. The spindle-adjusting nut on the SLX 1630 is outside the gearbox so the headstock access cover will not need to be removed.
4. Torque too low: With a spanner wrench tighten the adjusting nut. Measure the rolling torque and repeat until 1.1 – 1.7 N-m. of rolling torque is achieved. Tighten the three setscrews to retain the adjustment.
5. Torque too high: 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 1.1 – 1.7 N-m. of rolling torque is achieved. Tighten the three setscrews to retain the adjustment.

5.1.17 Aligning Tailstock to Spindle (See Figure 19)

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 these steps:

1. Insert a mandrel 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 2 bolts labeled "A" in the drawing.
3. Release the screw labeled "B".
4. Adjust using the 2 opposing screws "C" until the tailstock is aligned with the spindle.
5. Tighten screw "B" first and then lock "A".

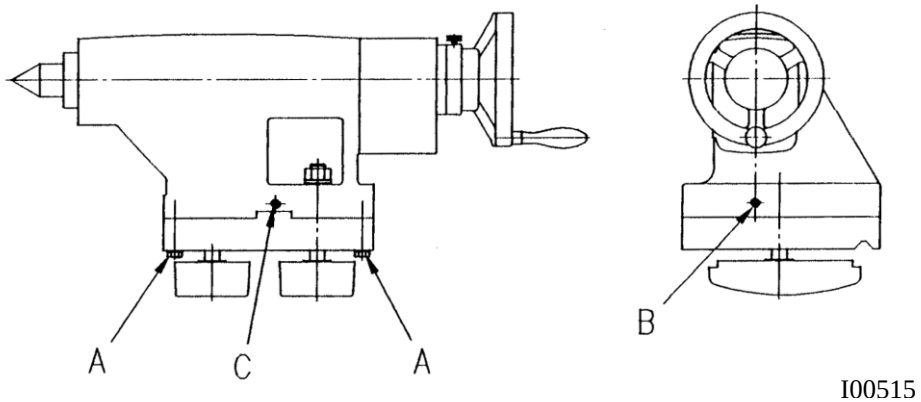

Figure 19
Tailstock Alignment

5.1.18 Spindle Motor Wiring

The SLX 1630 spindle motor is wired for 415 volts in the configuration. The wiring consists of 3-phase power for the motor and 110 V power for the spindle motor fan. Please see the diagram found on the motor junction box cover for wiring information.

Each machine does however use a different spindle motor and pulley combination.

Each junction box contains 6 terminals. The terminals should be jumpered together as shown in the figure. Connect the incoming 3 phase power to the 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. The hot and neutral wires are connected as shown for each motor. 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 labeled ground.

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 (See Figure 20)

1. Mount a dial indicator on the carriage and measure the slop in the cross slide. The dial indicator should be mounted a few millimeters in front of the tool post. (Note: this should be where the gibs are worn the worst.).
2. Try to move the cross slide back and forth to measure the amount of play. The dial indicator should only move between a 0.005 mm and a 0.01 mm. If it moves more than this then tighten the gibs.
3. Turn the X-axis ball screw with a torque wrench and measure the torque. The torque should be less than 1.7 N-m. 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.
4. You can also check the gib by taking out the yoke screws on top of cross slide.
5. Tighten gib screw and move cross slide back and forth. It should feel somewhat tight, but not to the point where it is hard to move.

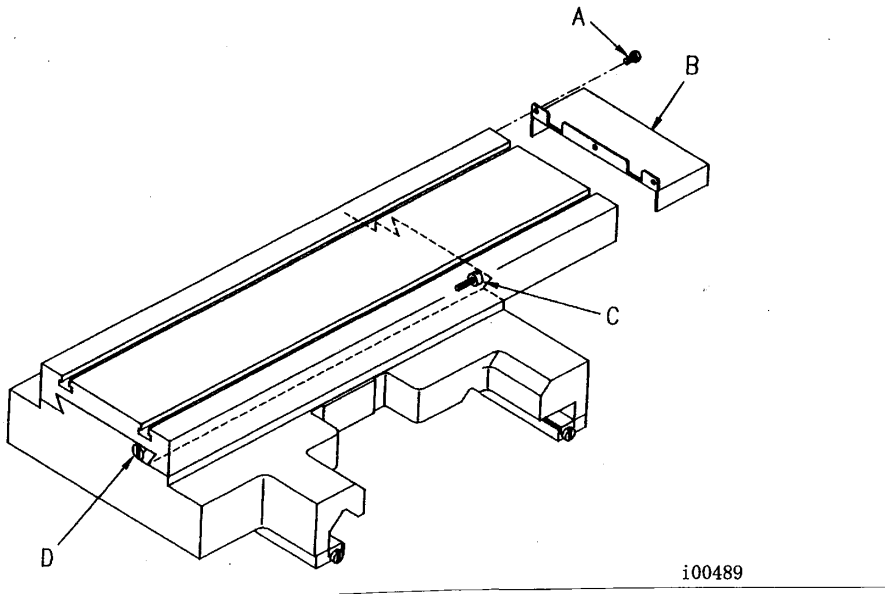

Figure 20
X Axis Gib Adjustment

5.2.1.2 Z-Axis Gib Adjustment (See Figure 21)

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 0.025. 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.

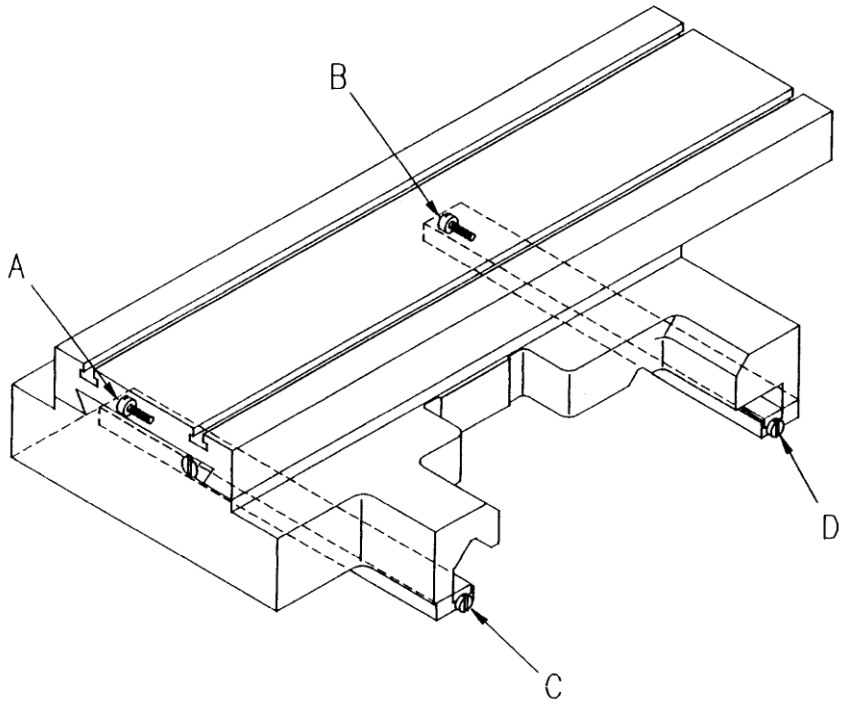

Figure 21
Z-Axis Gib

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 .002 mm 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 150mm standard. Input 300mm when control prompts for a standard length.
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 in a chuck in the spindle.
13. Set up the magnetic base and .002 mm 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 away from 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.

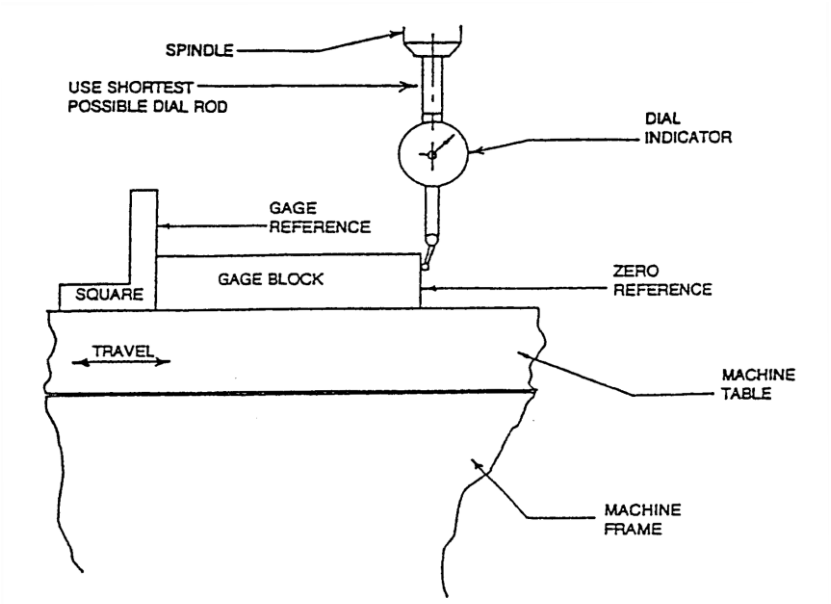

Figure 22
Calibration Set-Up

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 .002-millimeter 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 millimeters, and the dial indicator is moving back and forth .0012, then the true backlash value is .00278 -.0012 = .00158 millimeters. 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 0.05 mm 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 0.002 mm indicator with the following method.

- Load the indicator to zero from one direction and zero out the DRO.
- Move the indicator to 0.05 mm 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 Headstock Lubrication

The SLX 1630 has a manual oil pump that is run off of the spindle through a gear. One of the oil lines pumps oil to a site glass located on the headstock. Periodically check to see that oil is flowing. For the SLX 1630, the oil should be flowing when the spindle is on only.

A drain plug is found on the machine to drain the headstock. 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 9.5 liters for the SLX 1630. 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.

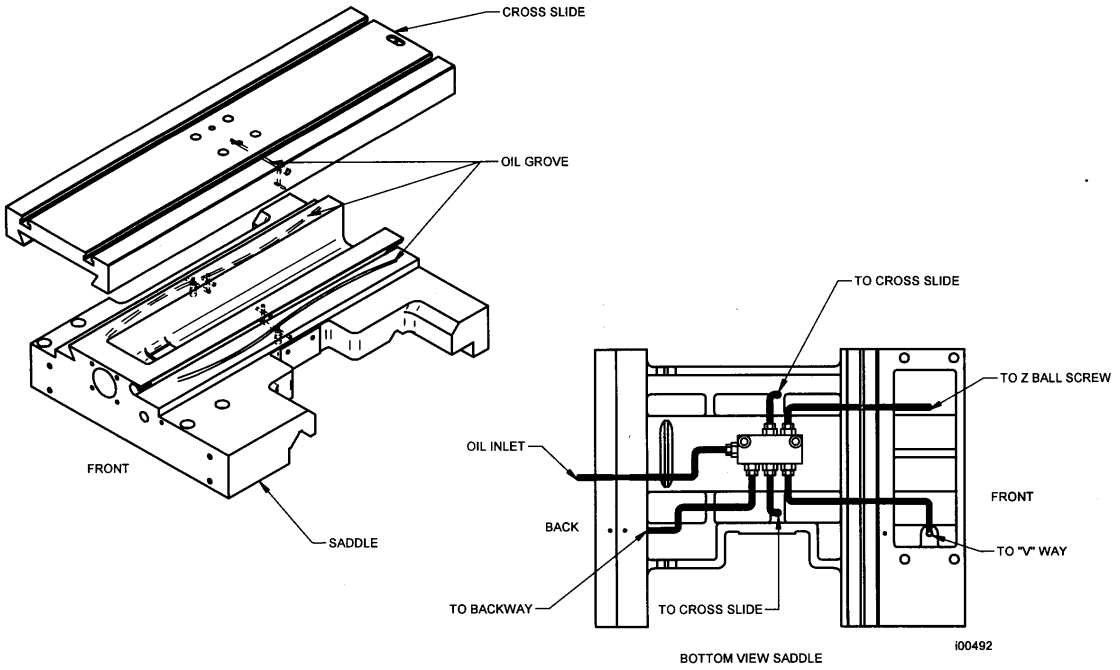

Figure 23
SLX 1630 Lubrication

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.

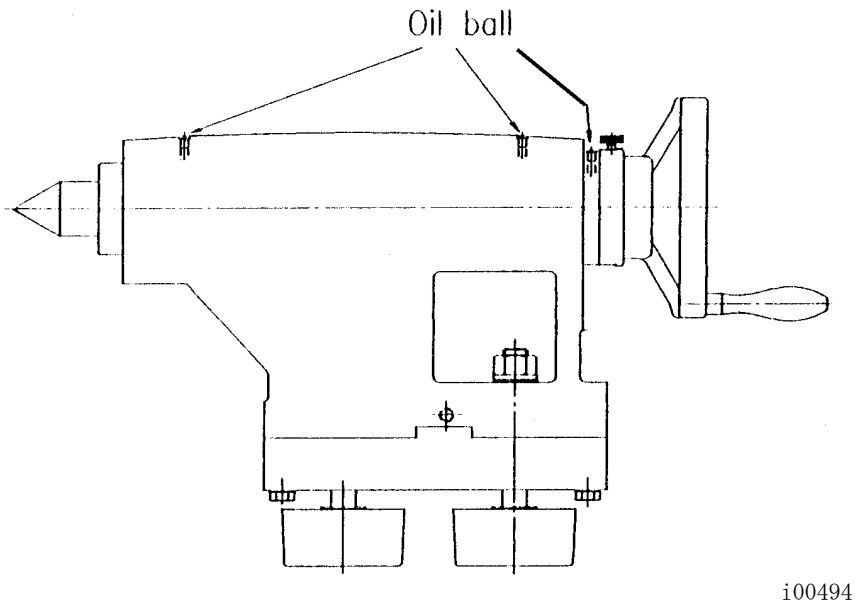

Figure 24
Tailstock Oil

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.

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 300 – 450 mm 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 26) 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 36 kg.
7. To re-install the indexer, follow these steps in reverse order. Make sure you install the riser block at least 57 mm 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 552 kPa (80 PSI). The air pressure should be at least 483 kPa (70 PSI) and no more than 1034 kPa (150 PSI) for the indexer to work correctly. **Do not exceed 1034 kPa (150 PSI). This will void the warranty on the indexer.** Check to make sure the air regulator is set to at least 552 kPa (80psi).
- *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 setscrew 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, be 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.

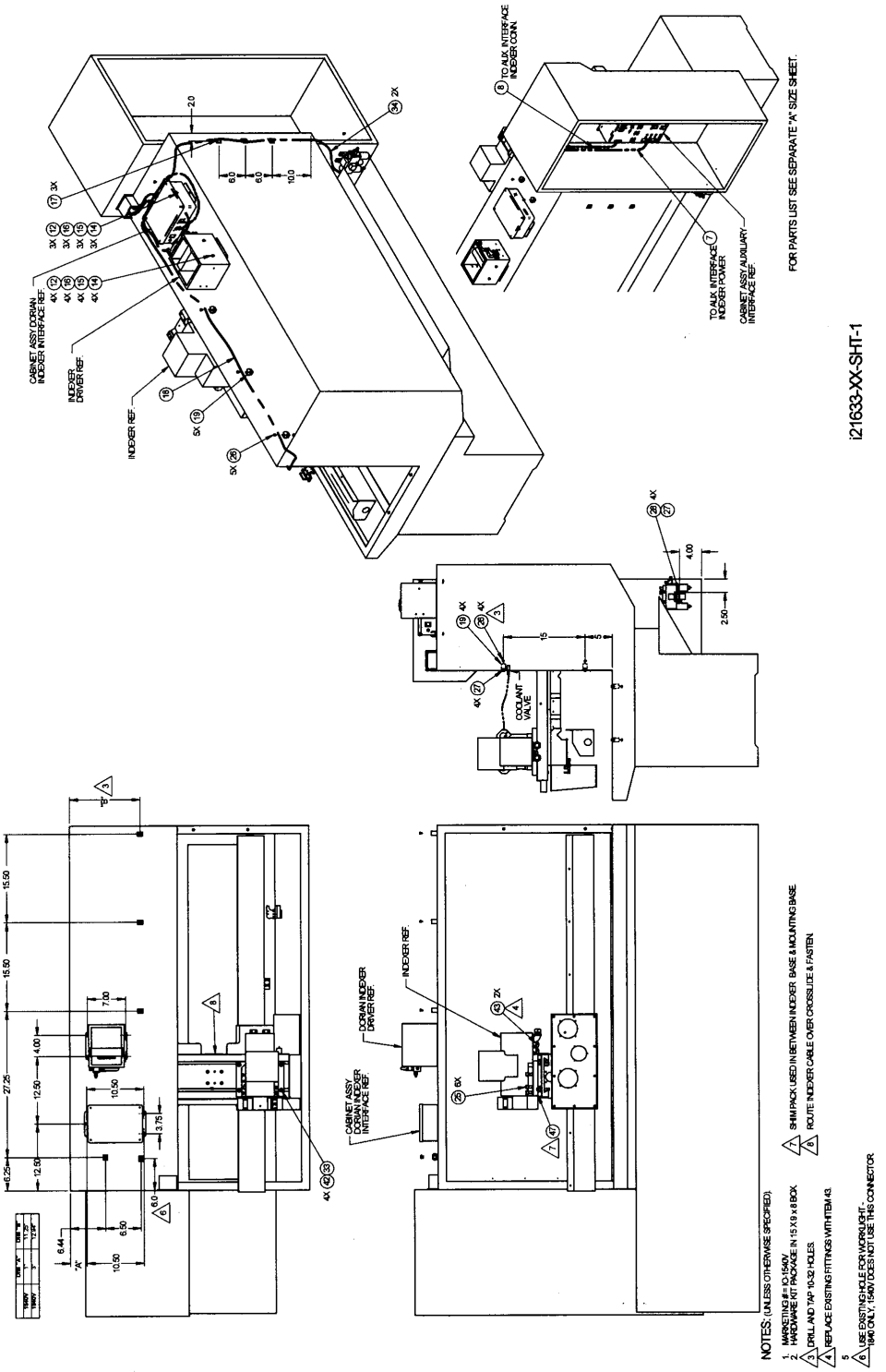

Figure 25
Indexer Mounting

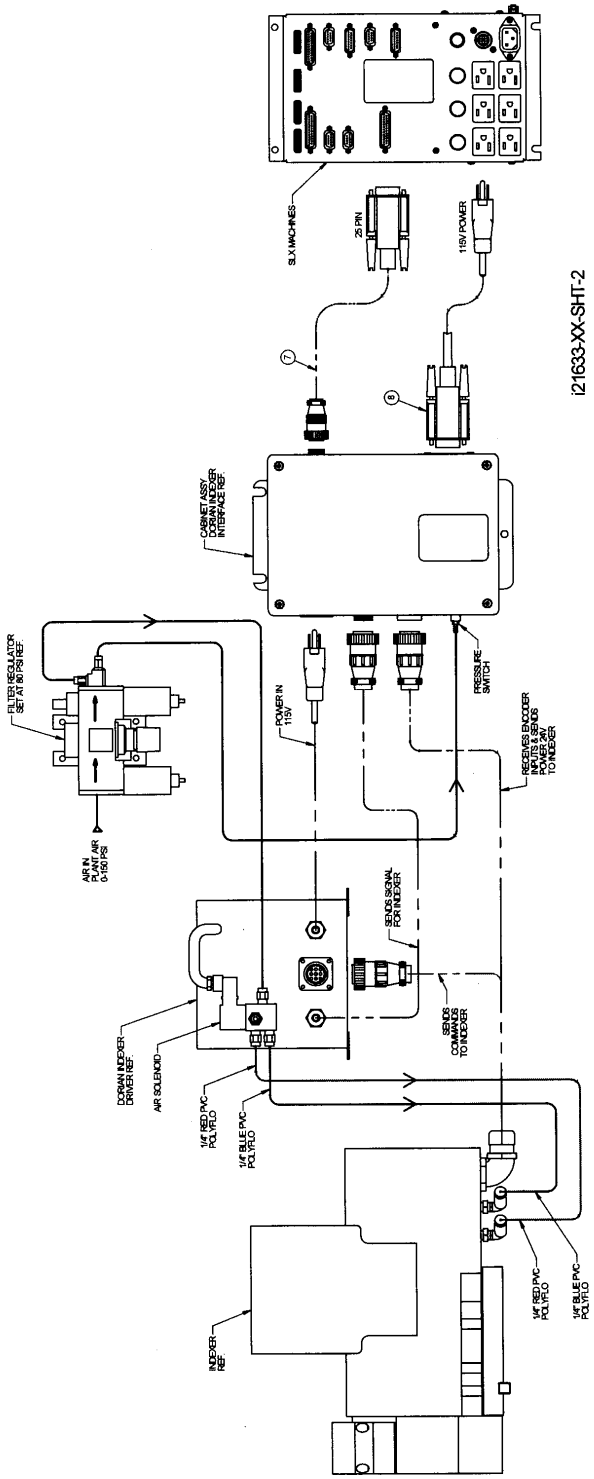

Figure 26
Indexer Cable Routing

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 – 20 mm
4	21604	CABINET ASSY-DORIAN INDEXER INTERFACE
5	21630	INTERFACE BOX – DORIAN - WHITE

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 305 to 457 mm 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 29 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 32 kg.
6. To re-install the indexer, follow these steps in reverse order. Make sure you install the riser block at least 57 mm 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 below for which lights will be lit 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 the 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 the 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. 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.

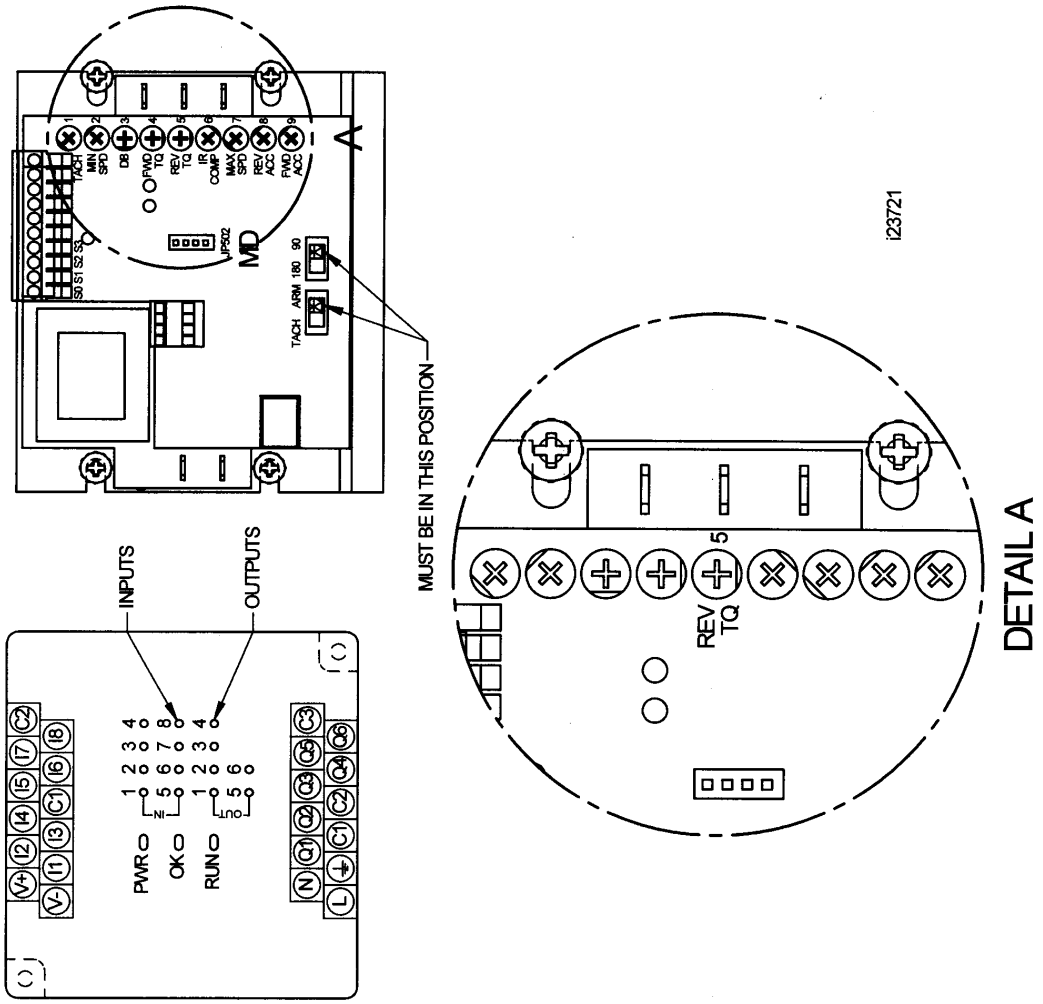

Figure 27
Motor Driver Adjustments & PLC Inputs and Outputs

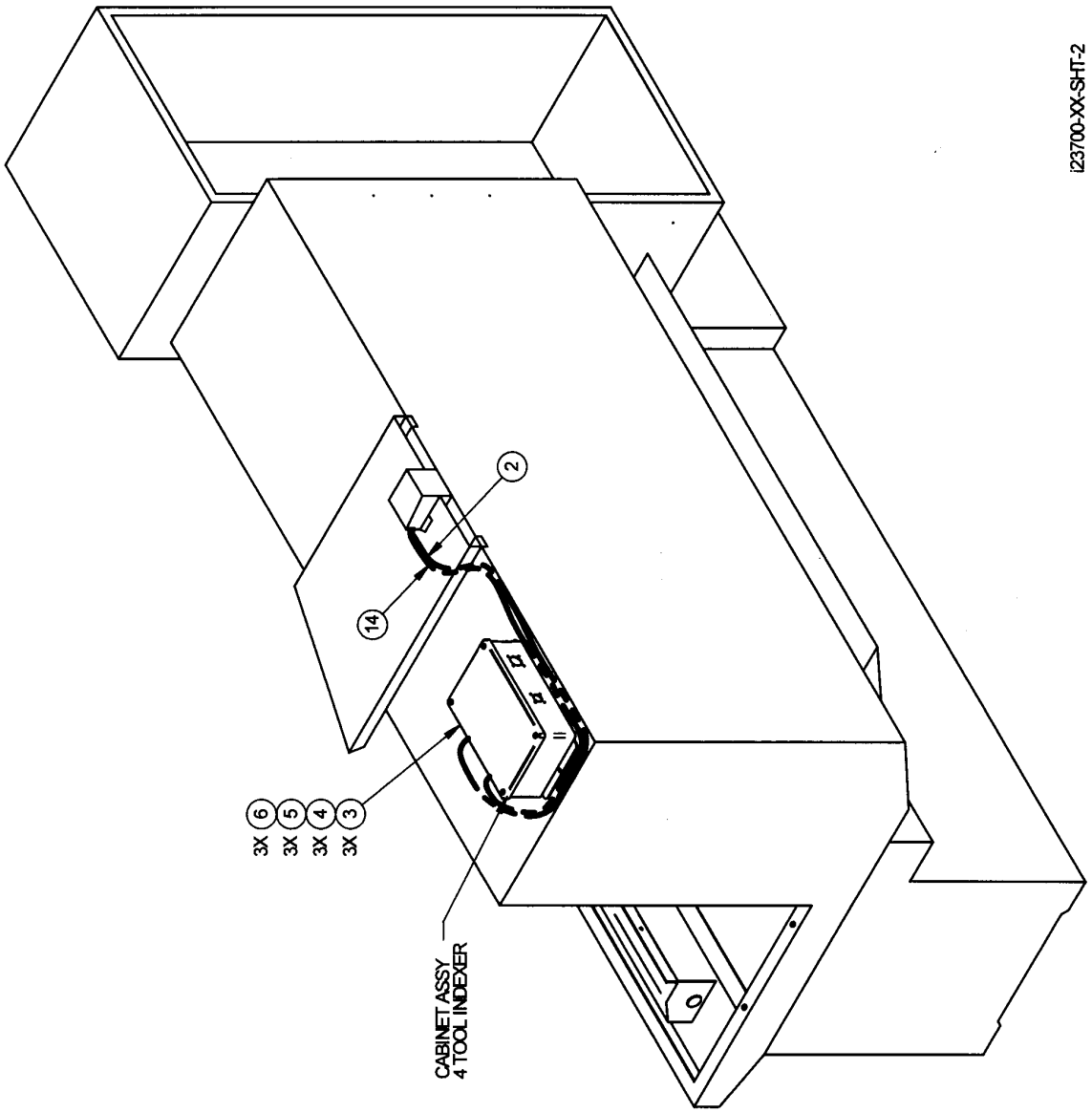

Figure 28
Indexer Cable Breakout Box Mounting - 1630

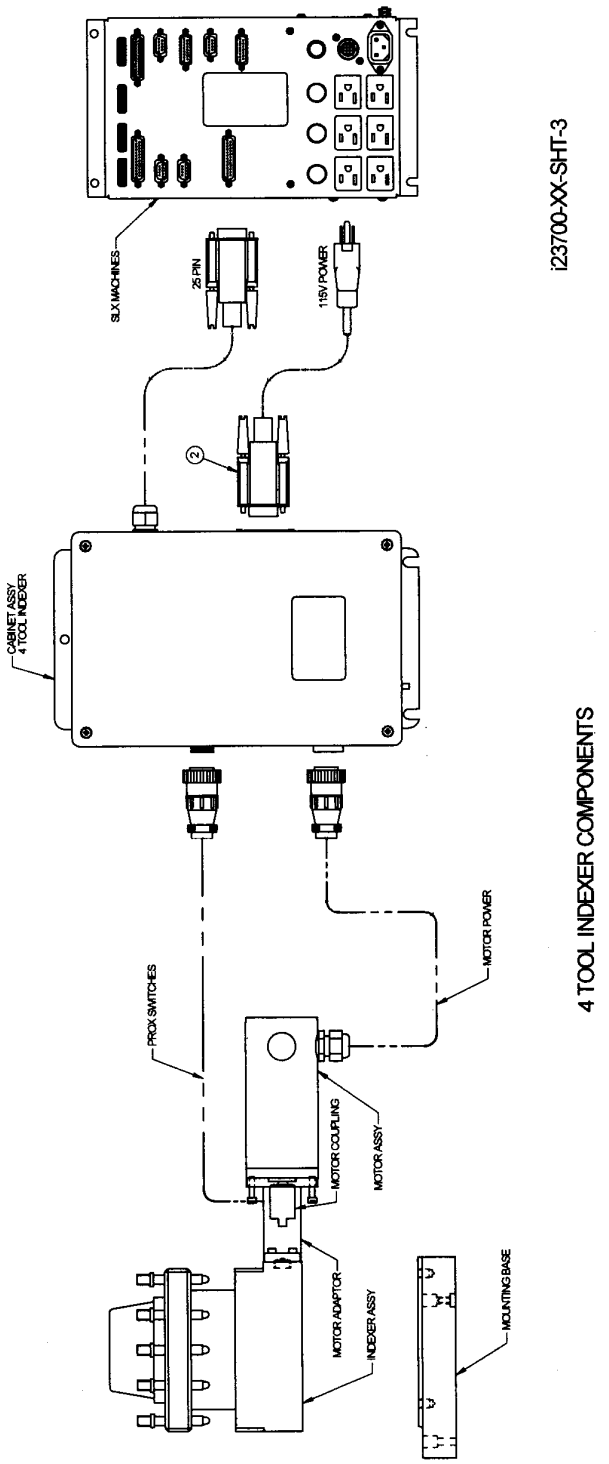

Figure 29
4 Tool Indexer Cable Routing

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	23718-3/4	INDEXER ASSY-MODIFICATION-4 TOOL INDEXER-20 mm
4	23771-M10	T-HANDLE – 20 mm 4 TOOL INDEXER
5	23872	SQUARE HEAD SCREW M10 – 20 mm 4 TOOL INDEXER

7.0 Drawings & Parts Lists

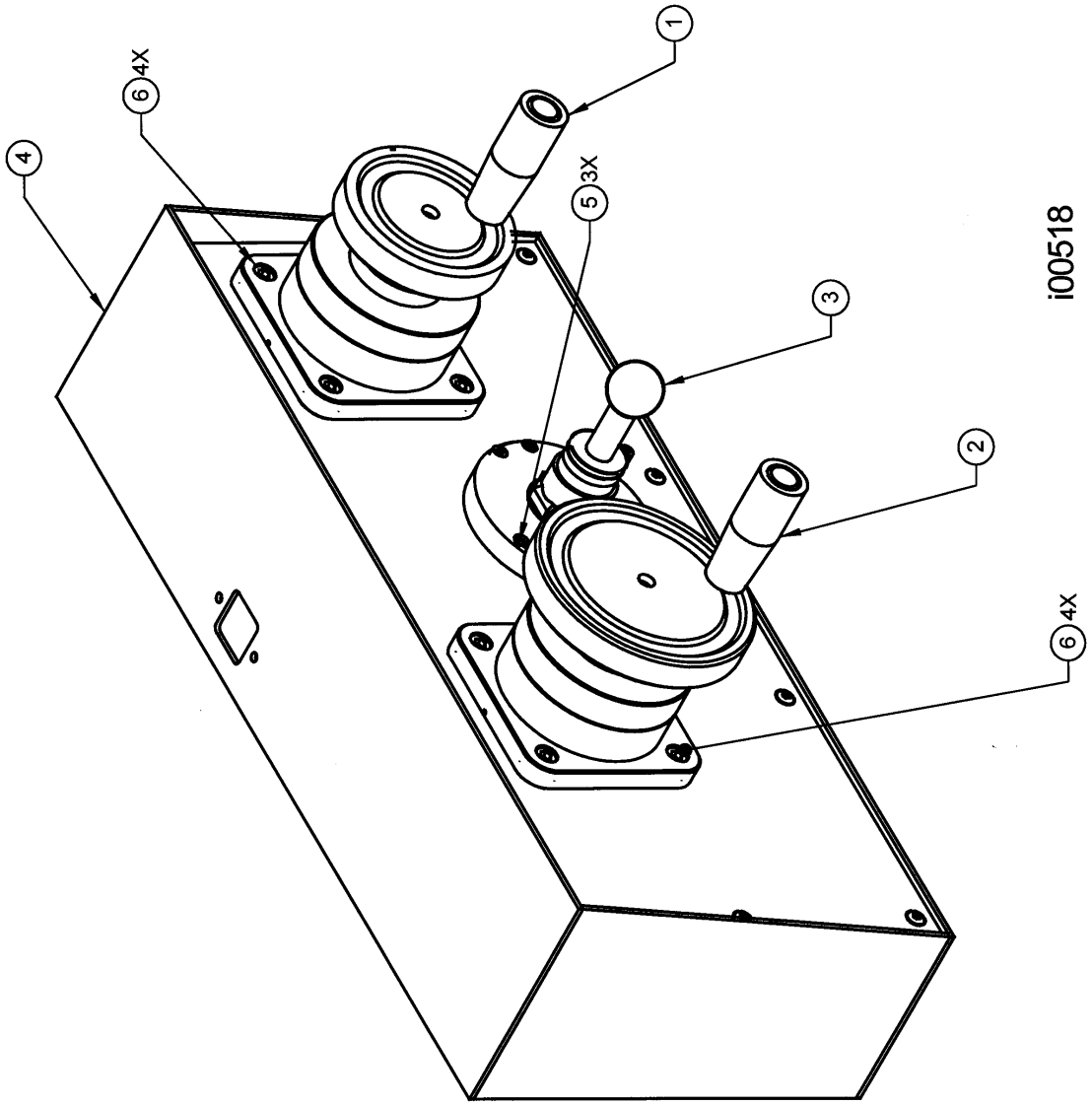

Figure 30
Lathe Apron Assembly

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

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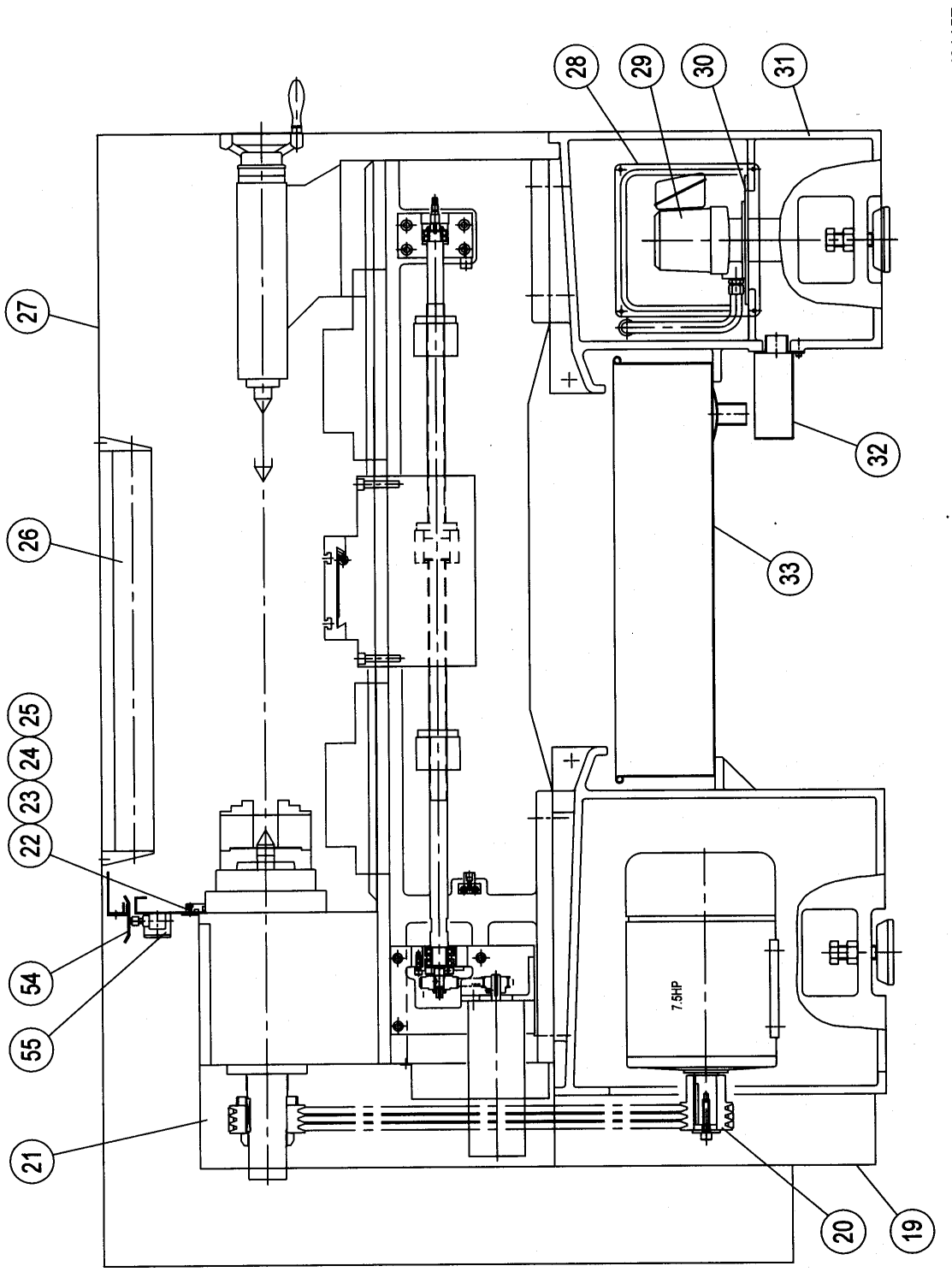

Figure 31
1630 Machine Assembly

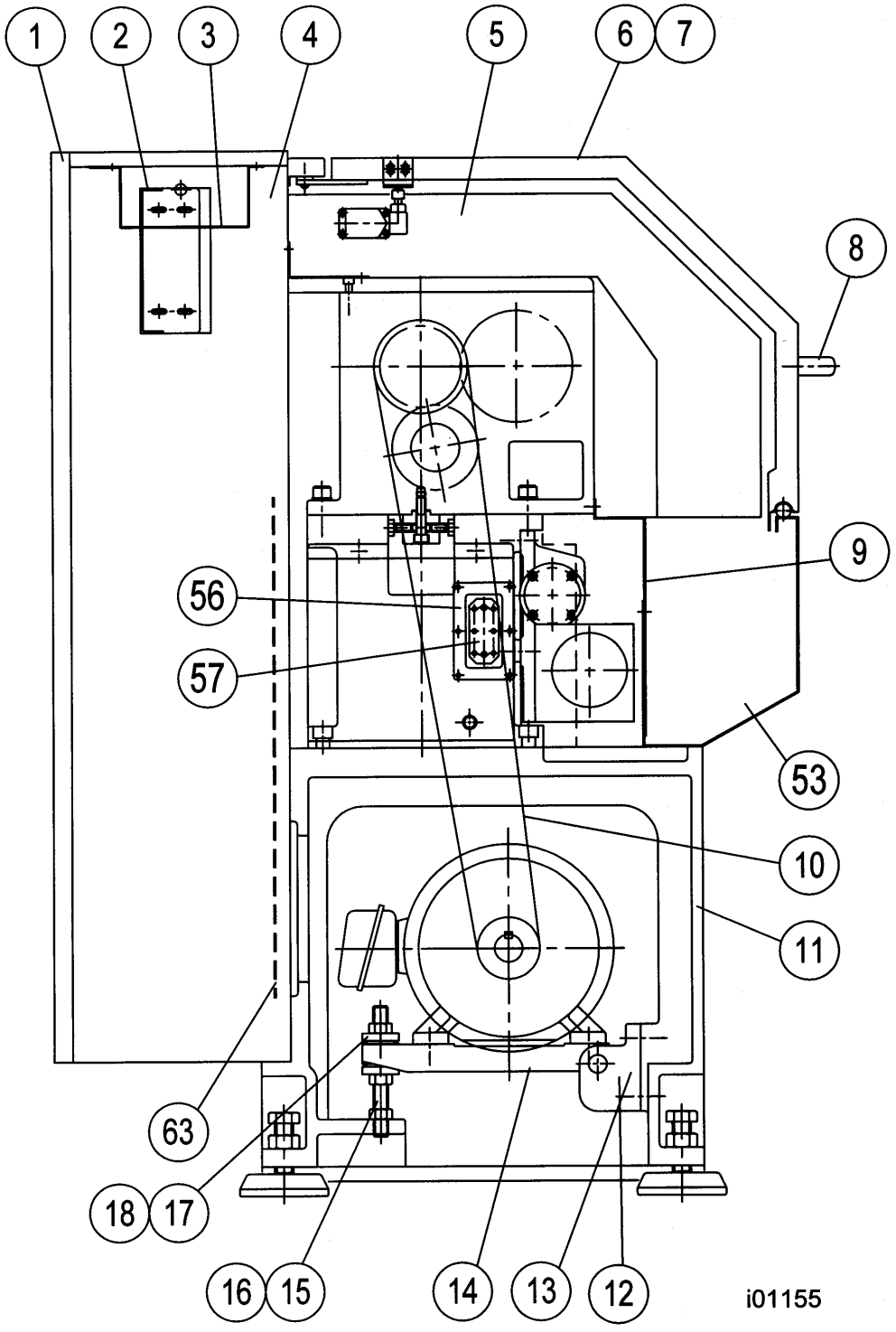

Figure 32
1630 Machine Assembly

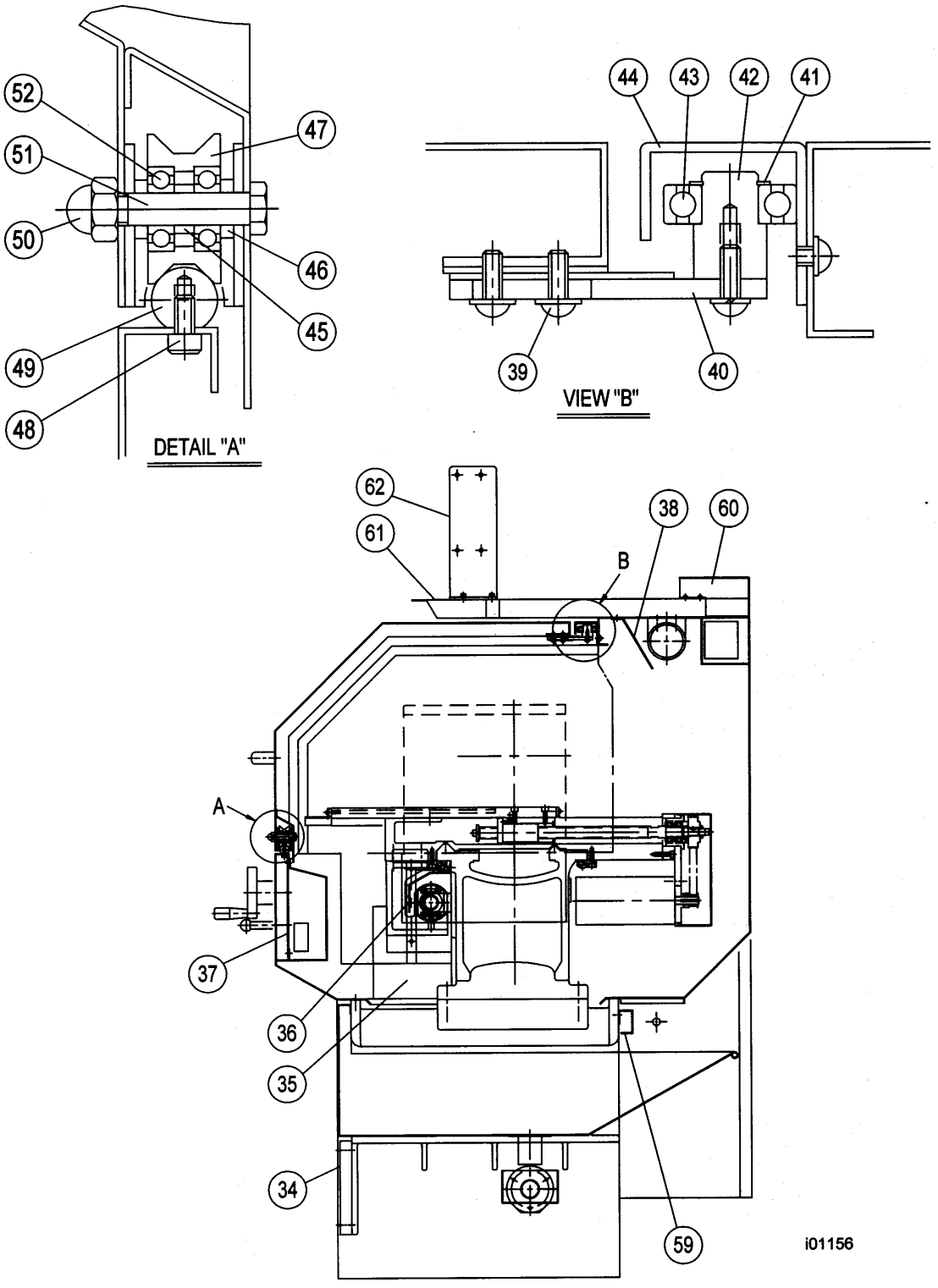

Figure 33
1630 Machine Assembly

1630 Machine Assembly Parts List

1630 Overall Machine Parts List

Item	Parts No.	Description	Material	Specification	Q'ty
1	25-0707	Electrical Control Box Door	SS41		1
2	24-0748	Seat - Switch	SS41		1
3	24-0735	Cover - Protection	SS41		1
4	25-0706	Electrical Control Box	SS41		1
5	25-0704	Guard - Protection	SS41		1
6	25-0721	Safety Door	SS41		1
7	24693	Glass - safety	25-0722		1
8	21241-36	Handle - Door	Rubber		2
9	25-0711	Cover Plate	SS41		1
10	24694	Belt Set – Spindle Motor (3 belts)		A-76"	1
11	25-0674	Left Stand Casting	FC25		1
12	50-0676	Bracket - Motor	FC25		1
13	50-0677	Shaft	S45C		1
14	50-0678	Plate - Motor	FC25		1
15		Screw - Adjusting	S45C	M20x2.5x220L	1
16		Hexagon Nut		M20x2.5	3
17	50-0681	Spherical Washer (Concave)	SS41		2
18	50-0682	Spherical Washer (Convex)	SS41		2
19	25-0733	Stand End Cover	SS41		1
20	24695	Motor - Spindle			1
21	25-0731	Headstock Plate	SS41		1
22	24-0716	Anti-Leaking Cover	SS41		1
23		O-Ring		G220	1
24		O-Ring		G250	1
25		Socket Head Cap Screw		M6x12L	6
26	22714-26 23341	Tube – Lamp Bulb - Worklight		A-W515DB	1 1
27	25-0701	Guard - Protection	SS41		1
28	24-0741	Base Rear Cover	SS41		1
29	23265	Pump – Coolant		1/8HP	1
30	24-0742	Seat - Pump	SS41		1
31	25-0675	Right Stand Casting	FC25		1
32	25-0723	Coolant Tank	SS41		1
33	25-0734	Chip Tray	SS41		1
34	25-0732	Base Cover Plate (Front)	SS41		1
35	25-0705	Cover	SS41		1
36	25-0712	Cover – Protection - Ballscrew	SS41		1
37	25-0724	Operation Box Cover	SS41		1
38	24-0703	Protection Guard	SS41		1
39		Socket Head Cap Screw		M6x16L	6
40	77A-0615	Upper Roller Setting Base	SS41		3

1630 Overall Machine Parts List

Item	Parts No.	Description	Material	Specification	Q'ty
41		Ring - Retaining		S17	3
42	77A-0614	Shaft	S20C		3
43	FVS65	Bearing - Deep Groove Ball		#6203ZZ	3
44	25-0713	Guide Way - Upper Door	SS41		1
45	77-0627	Spacer	S20C		4
46	77-0628	Spacer	S20C		2
47	77-0626	Roller	S45C		2
48		Socket Head Cap Screw		M6x12L	5
49	25-0725	Guide Way - Lower	S45C		1
50		Domed Cap Screw		M10	2
51	77-0629	Shaft	S45C		2
52	22714-58	Bearing - Deep Groove Ball		#6000ZZ	4
53	25-0709	Front Connection Plate	SS41		1
54	25-0726	Safety Door Touch Block	SS41		1
55	24696	Switch - Door			1
56	25-0714	Cover	SS41		1
57		Oil Sight Glass			1
58	25-0724	Anti-Leaking Pad	Rubber		1
59	25-0718	Carrier - Cable	SS41		1
60	25-0720	Cover	SS41		1
61	25-0719	Plate	SS41		1
62	25-0735	Bracket	SS41		1
63	25-0708	Bottom Plate	SS41		1

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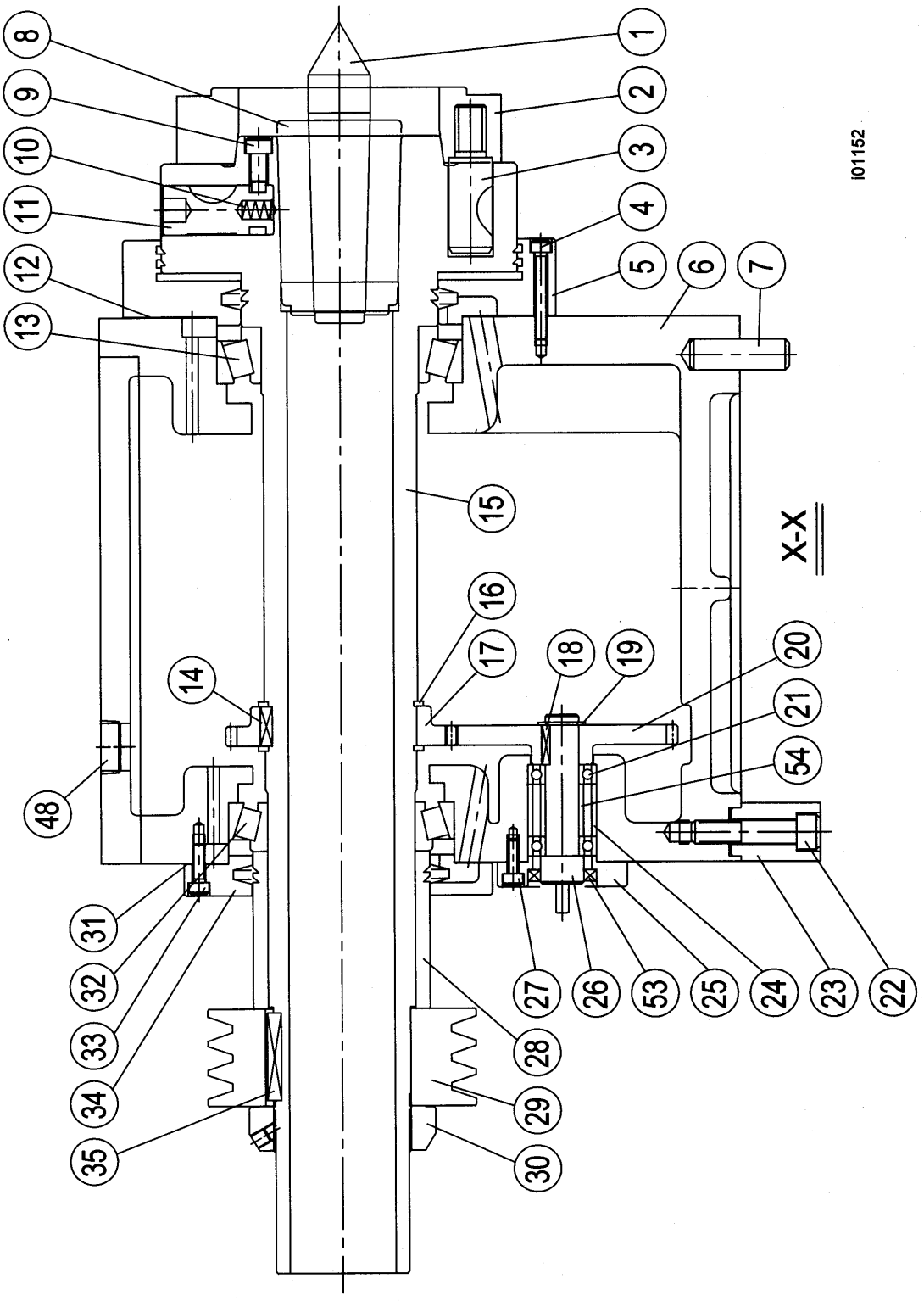

Figure 34
1630 Headstock Assembly

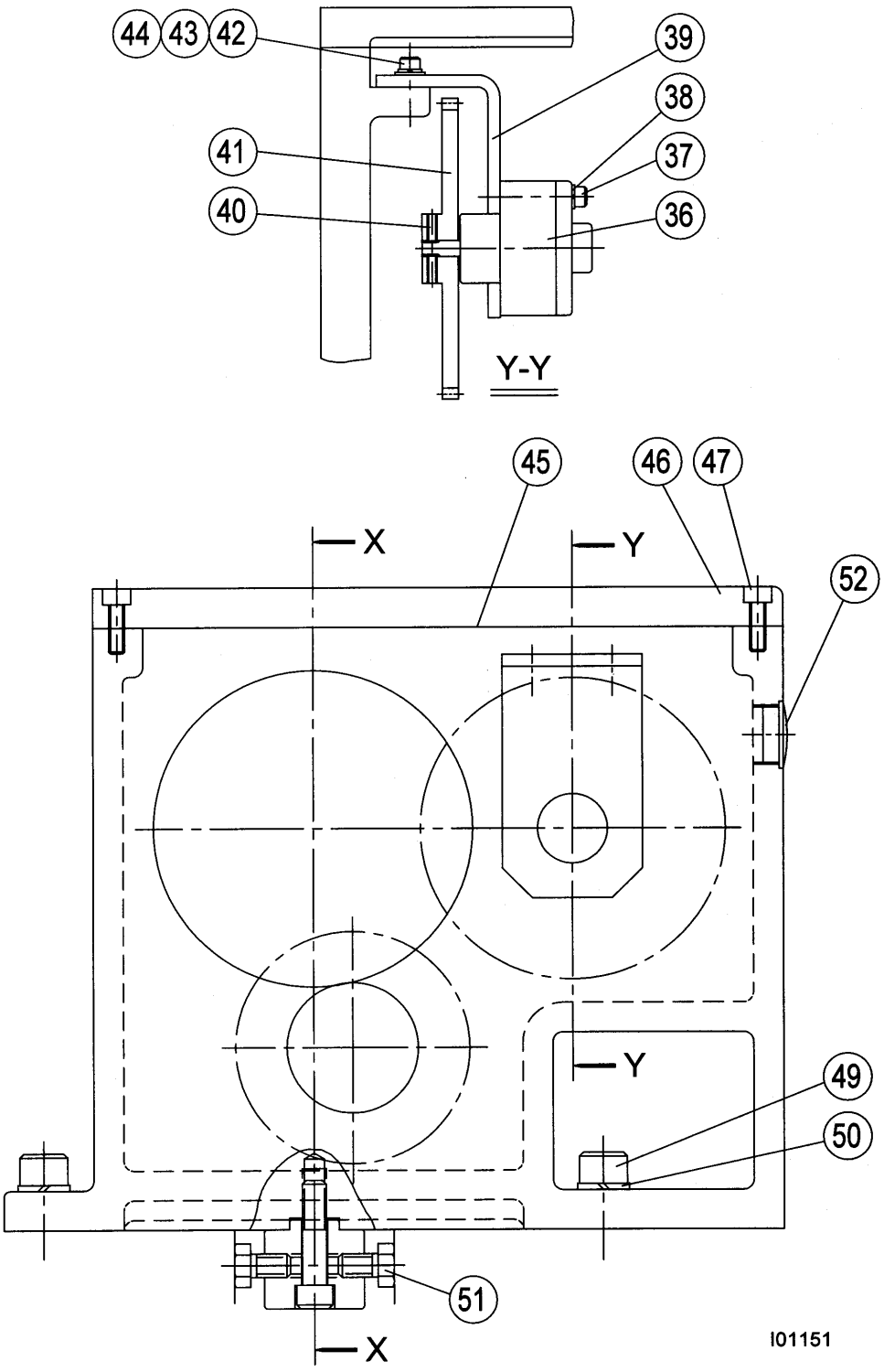

Figure 35
1630 Headstock Assembly

1630 Headstock Parts List

Item	Parts No.	Description	Material	Specification	Q'ty
1	21234-004	Center	SK5	MT#4	1
2	50-01120A	Driving Plate - 8"	FC25	D1-6	1
3	50-01119	Cam Lock Stud	SCM415	D1-6	6
4		Socket Head Cap Screw		M6x45L	6
5	24715	Cover - Bearing (Front)	FC20	25-0105	1
6	25-0101	Headstock Casting	FC25		1
7	50-01113	Positioning Pin	S45C		1
8	21234-003	Center Sleeve	SK5	MT#6xMT#4	1
9	24728	Detent Screw	SS41	50-01112	6
10	24729	Detent Spring	SWP	50-01111	6
11	24730	Cam	SCM415	50-01110	6
12	24727	Gasket		25-0106	1
13	21234-015	Bearing - Taper Roller - front		#32016XJ	1
14	24718	Key – spindle encoder gear		6x6x20L	1
15	24705	Spindle	SCM440	25-0102	1
16	24717	Snap Ring		S-78	2
17	24706	Gear – Main Spindle	S45C	77USA-0146	1
18	24732	Key		6x6x20L	1
19	24733	Snap Ring		S-17	1
20	24707	Gear – Spindle Encoder	S45C	77USA-0145	1
21	6003-2RS	Deep Groove Ball Bearing		6003	2
22		Socket Head Cap Screw		M12x1.75X55L	1
23	50-01114	Adjusting Block	SS41		1
24	24724	Spacer	SS41	24-0127	1
25	24722	Ring – Mounting, spin enc	FC20	25-0142	1
26	24721	Shaft – spindle encoder	S45C	25-0143	1
27		Socket Head Cap Screw		M6xP1.0x16L	3
28	24719	Spacer - spindle	S45C	25-0109	1
29	24708	Pulley - Spindle	FC30	25-0110	1
30	24709	Lock Nut – Spindle Pulley	SS41	SK70 60-0163	1
31	24726	Gasket		25-0108	1
32	24710	Bearing - Taper Roller - rear		#32015XJ	1
33		Socket Head Cap Screw		M6x20L	6
34	24716	Cover - Rear	FC20	25-0107	1
35	24720	Key – spindle pulley		8x7x45L	2
36	24711	Pump – Oil - Manual		AM2A	1
37		Hexagon Head Screw		M6x45L	3
38		Washer - Spring		M6	3
39	24723	Bracket – oil pump	SS41	25-0112	1
40		Socket Head Set Screw		M5x16L	2

1630 Headstock Parts List

Item	Parts No.	Description	Material	Specification	Q'ty
41	24712	Gear – Oil Pump	UMC1	25-0111	1
42		Socket Head Cap Screw		M6x20L	2
43		Washer - Flat		M6	2
44		Washer - Spring		M6	2
45	24731	Gasket		25-0104	1
46	25-0103	Cover - Headstock	FC20		1
47		Socket Head Cap Screw		M8x25L	6
48		Plug - Oil		PT-3/4	1
49		Socket Head Cap Screw		M16x50L	4
50		Washer - Spring		M16	4
51		Hexagon Head Screw		M12x1.75X20L	2
52	21234-119	Oil Sight Glass	50-01146	HFTX22	1
53	24713	Seal - Oil		TC22x35x6	1
54	24725	Spacer	SS41	77USA-0144	1

i01152

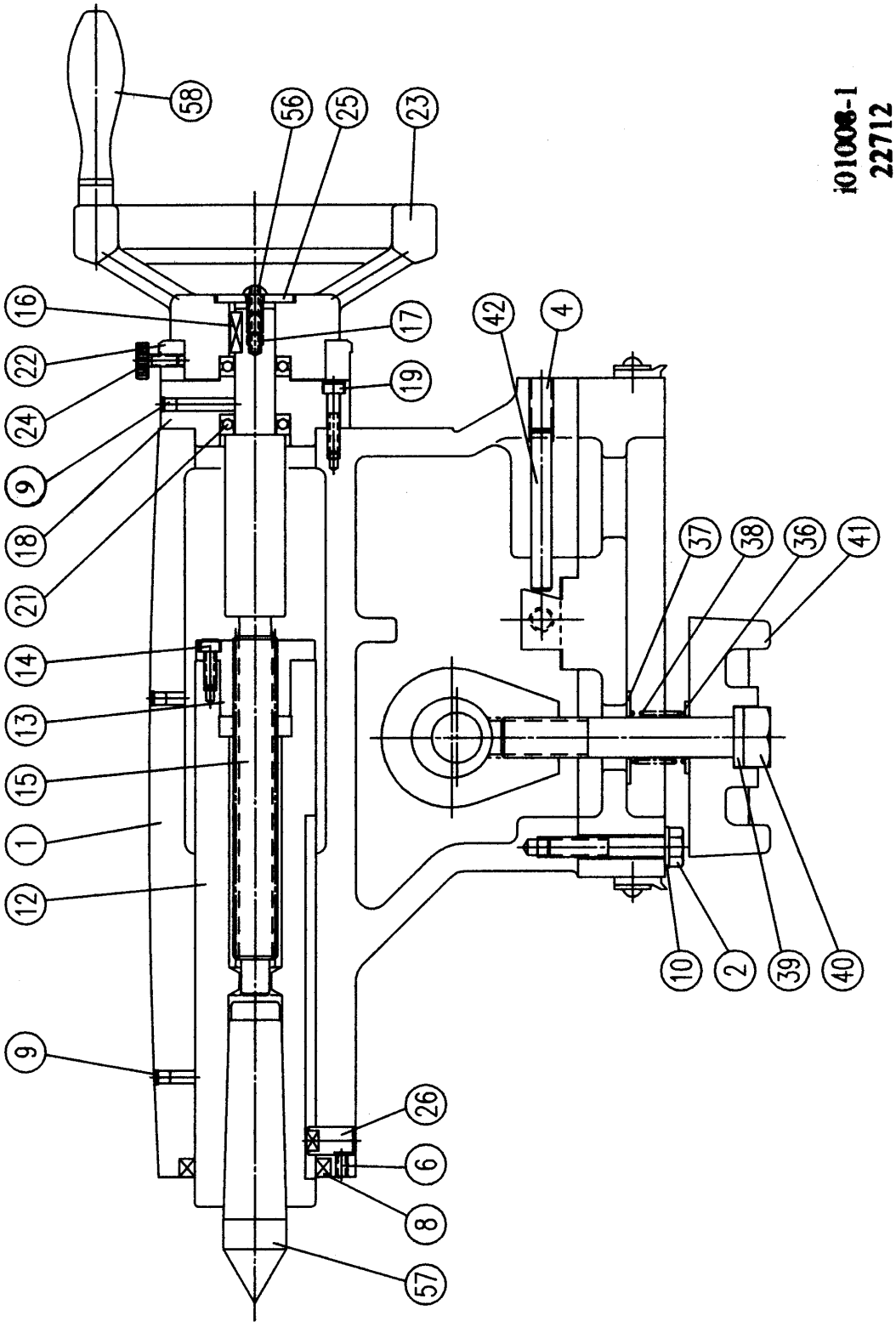

Figure 36
1630 Tailstock Assembly

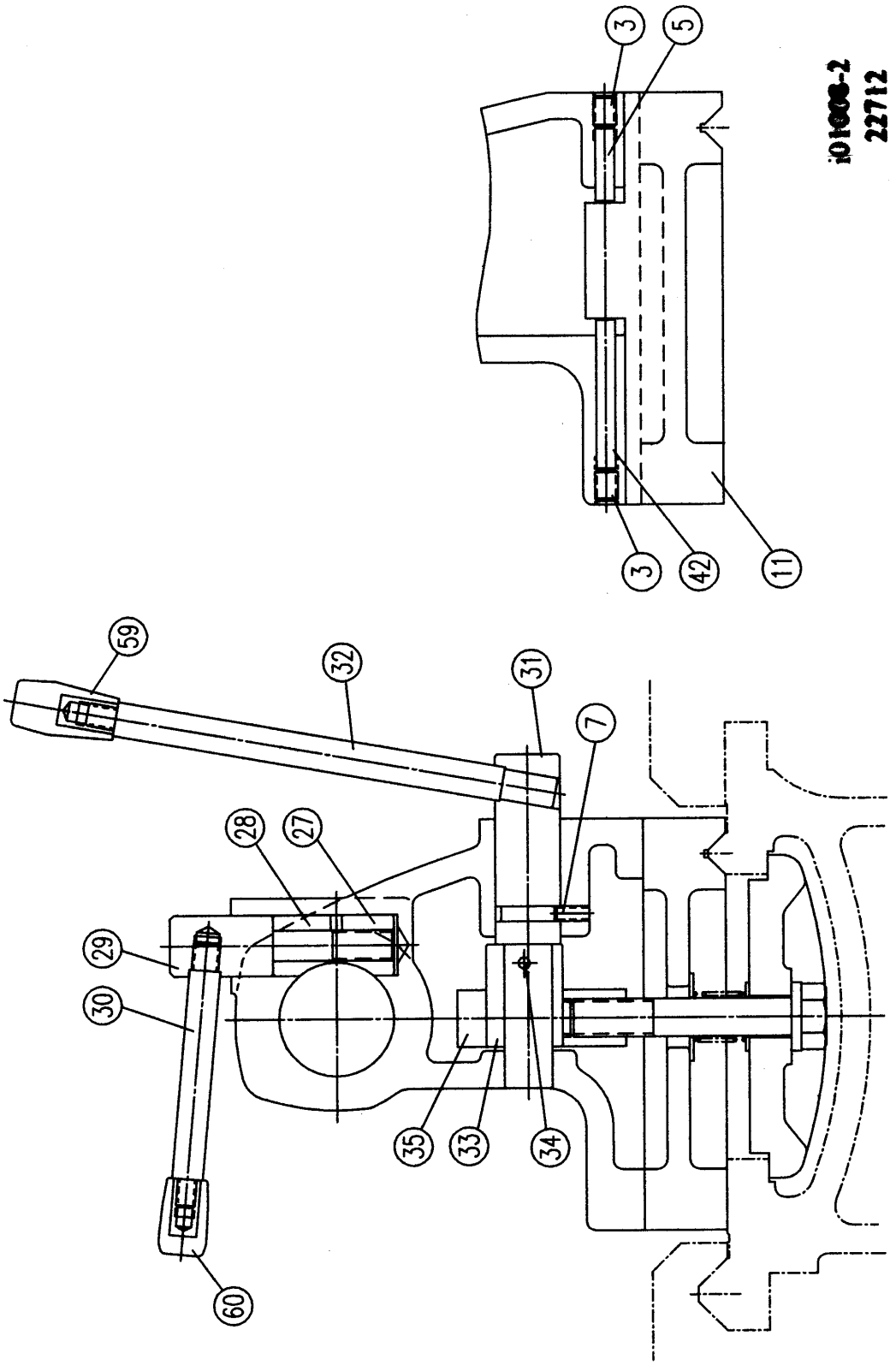

Figure 37
1630 Tailstock Assembly

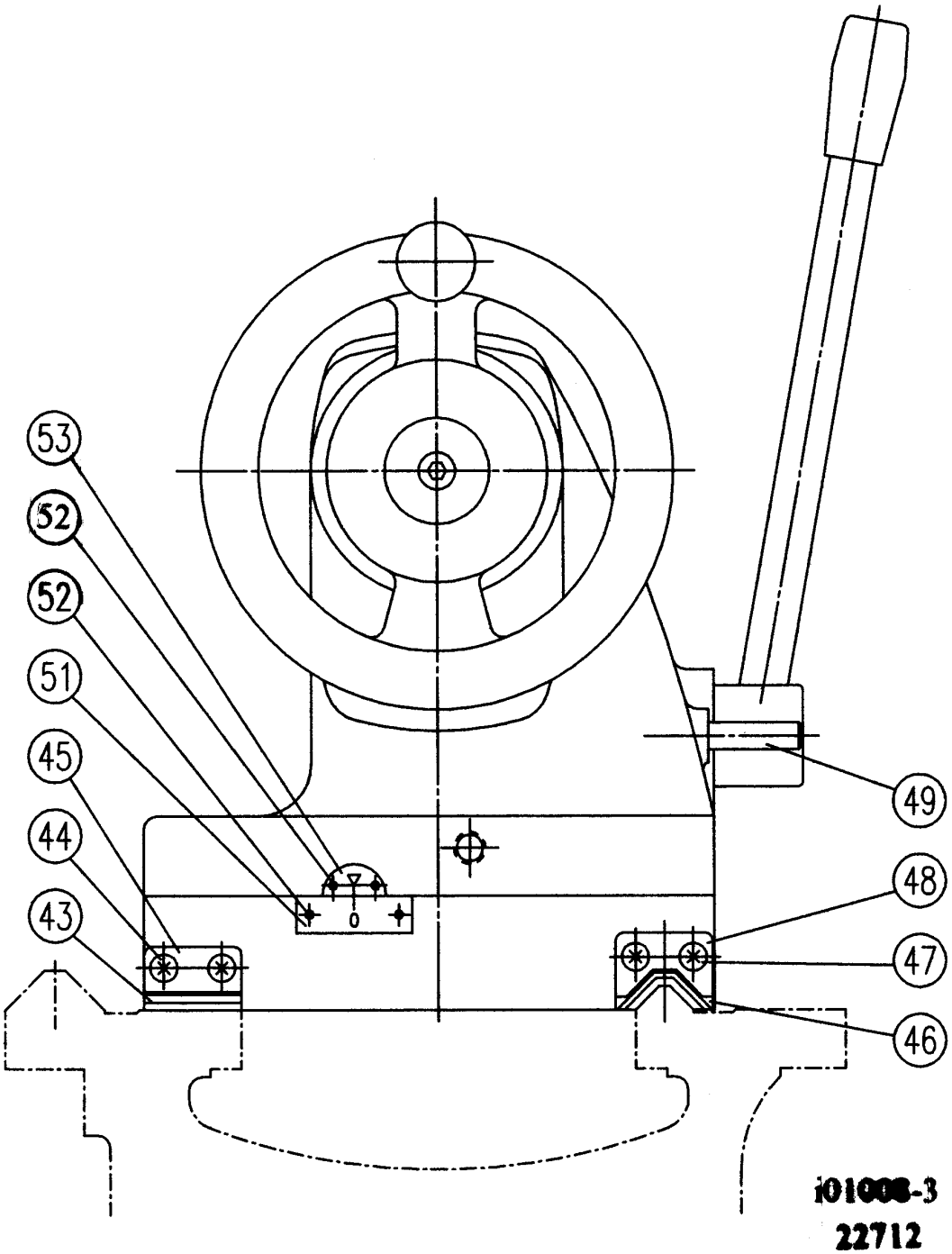

Figure 38
1630 Tailstock Assembly

Parts List

Item	P/N	Mfr P/N	Title	UseAs
1	22712-1	24-0501-00	TAILSTOCK BODY	EA
2	M10-1.5X60 25B		SCREW-SHCS-STL-BO	EA
3	M12-1.75X16 25B		SCREW-SHCS-STL-BO	EA
4	M12-1.75X25 25B		SCREW-SHCS-STL-BO	EA
5	22712-5	10X40LG	STRAIGHT PIN	EA
6	M6-1.0X10 40B		SCREW-SOC SET-STL-BO-CUP	EA
7	M8-1.25X10 40B		SCREW-SOC SET-STL-BO-CUP	EA
8	22712-8	TCØ60XØ75X9	OIL SEAL	EA
9	22712-9	Ø1/4	BALL CUP	EA
10	22712-10	23-0112-00	WASHER-Ø10.5X25.4XT2	EA
11	22712-11	24-0502-00	TAILSTOCK BASE	EA
12	22712-12	50-0503-00	SLEEVE-TAILSTOCK BARREL	EA
13	22712-13	50-0505-00	FEED NUT-IMPERIAL	EA
14	22712-14	50-0505-01	SHCS-M6-1.0X12	EA
15	22712-15	24-0507-00	FEED SCREW-IMPERIAL	EA
16	22712-16	6X6X20LG	DOUBLE ROUND HEAD KEY	EA
17	M5-0.8X20 40B		SCREW-SOC SET-STL-BO-CUP	EA
18	22712-18	50-0508-00	BRACKET	EA
19	M6-1.0X30 25B		SCREW-SHCS-STL-BO	EA
21	22712-21	51104	THRUST BEARING	EA
22	22712-22	50-0510-00	DIAL-IMPERIAL	EA
23	22712-23	50-0511-00	HANDWHEEL	EA
24	22712-24	50-03111-00	LOCKSCREW	EA
25	22712-25	50-0513-00	WASHER	EA
26	22712-26	50-0514-00	PIN	EA
27	22712-27	50-0515-00	LOCKING BLOCK	EA
28	22712-28	50-0516-00	CLAMPING BLOCK	EA
29	22712-29	50-0517-00	LOCKING ROD	EA
30	22712-30	50-0518-00	LEVER	EA
31	22712-31	50-0519-00	SHAFT	EA
32	22712-32	50-0520-00	LEVER	EA
33	22712-33	50-0521-00	ECCENTRIC COLLAR	EA
34	22712-34	Ø6X40LG	SPRING PIN	EA
35	22712-35	50-0522-00	ADJUSTING BLOCK	EA
36	22712-36	50-0523-00	FLAT WASHER	EA
37	22712-37	50-0524-00	FLAT WASHER	EA
38	22712-38	50-0525-00	COMPRESSION WASHER	EA
39	22712-39	50-0526-00	FLAT WASHER	EA
40	22712-40	S35C	HEX SCREW	EA
41	22712-41	24-0528-00	CLAMPING BLOCK	EA
42	22712-42	24-0528-00	CLAMPING BLOCK	EA
43	22712-43	24-0530-00	BEDWAY WIPER	EA
44	M6-1.0X16 10B		SCREW-PH-PHIL-STL-BO	EA
45	22712-45	24-0531-00	BEDWAY WIPER PLATE	EA
46	22712-46	24-0532-00	BEDWAY WIPER	EA
47	M6-1.0X15 10B		SCREW-PH-PHIL-STL-BO	EA
48	22712-48	24-0533-00	BEDWAY WIPER PLATE	EA

49	22712-49	50-0534-00	SET SCREW	EA
51	22712-51	50-0536-00	INDICATOR	EA
52	22712-52	Ø2X5LG	RIVET-Ø2x5LG	EA
53	22712-53	50-0537-00	INDICATOR	EA
56	22712-56	17-0504-0-2	SCREW	EA
57	22712-57	14-0129	CENTER-MT#4	EA
58	22712-58	50-0431-00	KNOB	EA
59	22712-59	50-0166-00	GRIP	EA
60	22712-60	50-01138-00	GRIP	EA

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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/ProtoTRAK	1 Year	1 Year
Any EXCHANGE Unit	90 Days	90 Days

The warranty period starts on the date of the invoice to the original purchaser from Southwestern Industries, Inc. (SWI) or their authorized distributor.

If a product, subsystem or component 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/electronic systems and must be given the reasonable care that these types of products require.
- Accidental damage, beyond the control of SWI, is not covered by the warranty. Thus, the warranty does not apply if a product has been abused, dropped, hit or disassembled.
- Improper installation by or at the direction of the customer in such a way that the product consequently fails, is considered to be beyond the control of the manufacturer and outside the scope of the warranty.