TRAK® TRL 1440EX Lathe
ProtoTRAK® ELX CNC

Safety, Installation, Maintenance, Service & Parts Lists Manual

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1.0 Safety Specifications

The safe operation of the TRAK TRL Lathe & ProtoTRAK ELX CNC depends on its proper use and the precautions taken by each operator.

- Read and study the TRAK TRL Lathe & ProtoTRAK ELX 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 the TRAK TRL Lathe Safety, Installation, Maintenance, Service & Parts List Manual. Be certain that every operator understands the operation and safety requirements of this machine **before** servicing.

- Always wear safety glasses and safety shoes.

- Always stop the spindle and check to ensure the CNC control is in the stop mode before changing or adjusting the tool or workpiece.

- Never wear gloves, rings, watches, long sleeves, neckties, jewelry, or other loose items when operating, or around the machine.

- Use adequate point of operation safeguarding. It is the responsibility of the employer to provide and ensure point of operation safeguarding per ANSI B11.6-2001.

1.1 Safety Publications

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

Safety Requirements for Manual Turning Machines with or without Automatic Control (ANSI B11.6-2001). Available from the American National Standards Institute, 1819 L Street N. W., Washington, D.C. 20036.

Concepts And Techniques Of Machine Safeguarding (OSHA Publication Number 3067). Available from The Publication Office - O.S.H.A., U.S. Department of Labor, 200 Constitution Avenue, NW, Washington, DC 20210.

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

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

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

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

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

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

⚠ WARNING

Do not operate this spindle at a higher RPM than rated by the chuck manufacturer.

Take special precautions with chucks that have four or more jaws and unbalanced parts.

Do not shift headstock gears while spindle or motor is running.

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⚠ WARNING

DO NOT EXTEND MATERIAL BEYOND THE SPINDLE WITHOUT SUITABLE GUARDING.

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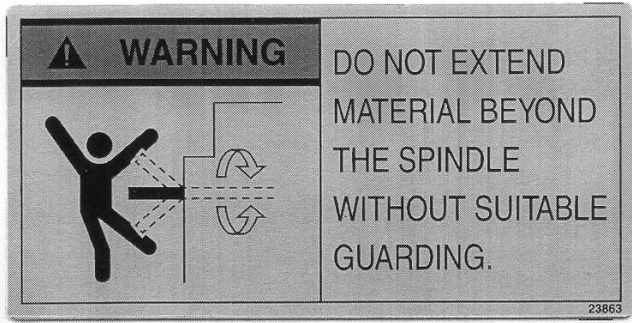
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Safety & Information Labels Used On The
TRAK TRL Lathe
It is forbidden by OSHA regulations and by law to deface, destroy or remove any of these labels

SOUTH WESTERN INDUSTRIES
2615 HOMESTEAD PLACE,
RANCHO DOMINGUEZ, CA 90220

MODEL
S/N

ELECTRICAL RATINGS:
VOLTS | 30 | AMPS | PHASE
Hz

FLA OF LARGEST MOTOR | AMPS
SHORT CIRCUIT INTERRUPT | AMPS
ELECTRICAL DRAWING #:

CNC CONTROL ELECTRICAL RATINGS:
IF APPLICABLE
115 VOLTS 8 AMPS 1 PHASE
60 Hz
MACHINE (ONLY) MADE IN "XXXXXX"

i00774

1.3 Safety Precautions

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

1. Do not operate this machine before the TRAK TRL Lathe and ProtoTRAK ELX CNC Programming, Operating and Care Manual has been studied and understood.

2. Read and study this TRAK TRL Lathe 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.

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.

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

26. Never change gears when the spindle is rotating.

27. Do not rotate the spindle by hand unless the Red Emergency Stop button is pressed.

2.0 Installation

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

2.1 Floor Plan, Layout & Space Requirements
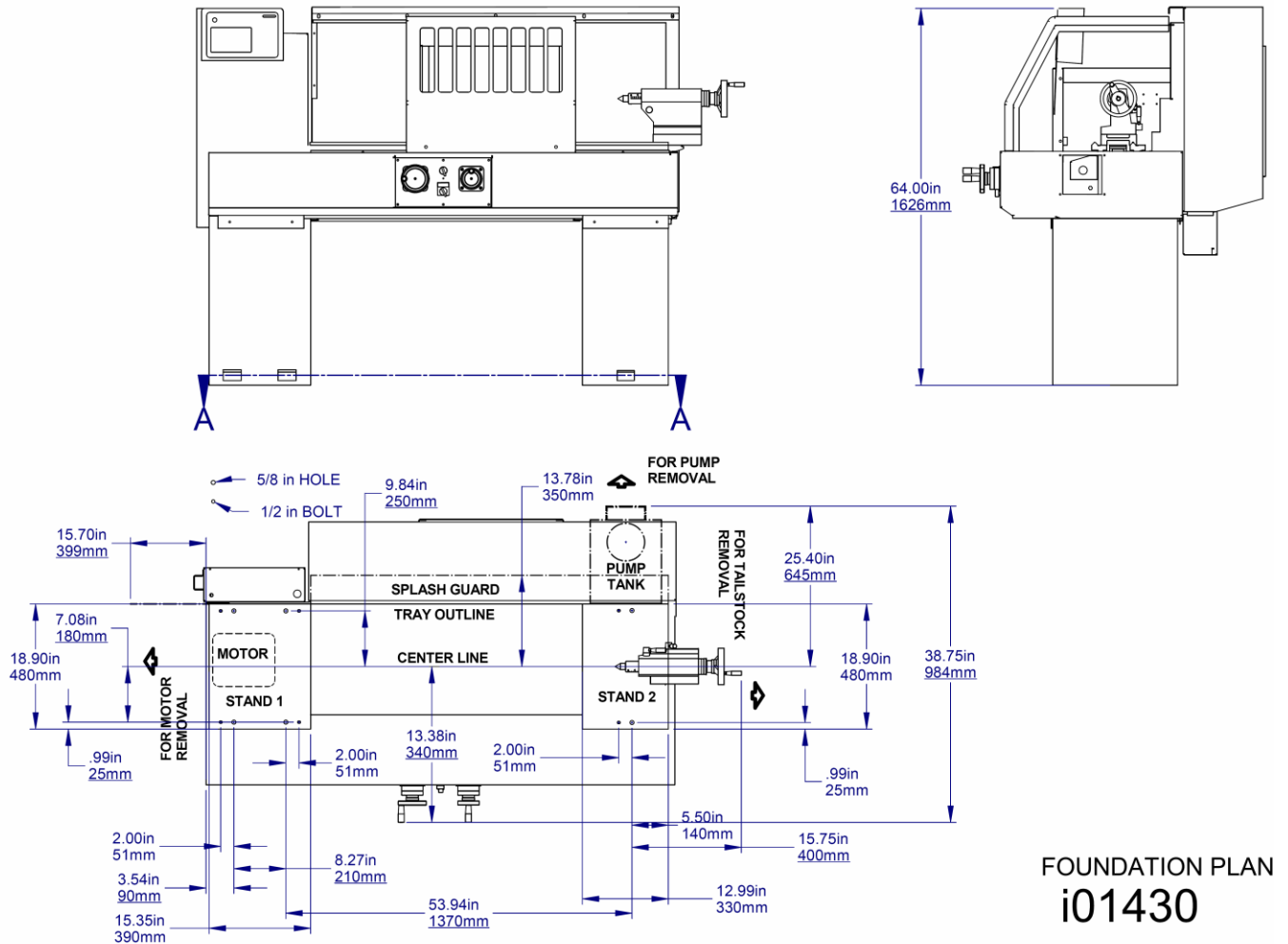
**Figure 2-1 - 1440EX -
Dimensions and Layout Requirements**

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TRAK TRL Lathe, ProtoTRAK ELX CNC Safety, Installation, Maintenance, Service & Parts List

2.2 Lathe Specifications

	1440EX
Height of Centers	7"
Distance Between Centers	40"
Swing Over Bed	14"
Swing Over Saddle Wings	14"
Swing Over Cross Slide	7"
Cross Slide Travel	8"
Tool Section Max.	¾"
Coolant Tank Capacity	3 gal
Oil Pump – Way Lubrication	.5 quart
Oil Reservoir – Headstock	2 gal
Bed	
Width	8.1"
Height	10.6"
Headstock	
Spindle Nose	D1-4
Spindle Through Hole	1.57"
Spindle Taper	MT#5
Taper in Reduction Sleeve	3
Spindle Diameter Front Bearing	2.36"
Number of Bearings	2
Number of Spindle Speed Ranges	12
Spindle Speed Range (RPM)	60-2400
Tailstock	
Quill Travel	5"
Quill Diameter	1.575"
Quill Taper Hole	MT#3
Spindle Motor	
H.P.	5
Voltage	220V / 440V
Amps, Full Load	14 / 7
Phase, Hz	3P, 60Hz
Dimensions	
Net Inches L x W x H lbs.	73 x 44 x 57; 1800
Ship Inches L x W x H lbs.	78 x 49 x 67; 2200
Other	
Coolant Pump Motor, H.P.	1/8
Spindle Motor Brake	Magnetic
Way Surface Hardness	400-450HB
Headstock Lubrication	Splash Lube
Options	
Tooling Kit	¾"
Chuck	6", D1-4
5C Collet Closer	D1-4
Indexer Option	None
Gang Tooling	None

2.3 Uncrating

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

The leveling pads and screws for the machine can be found in the toolbox.

Loosen and remove the 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.**

2.4 Shortages: Inventory Checklist

_____Machine (check model and serial number)

_____ Leveling pads and screws (6 each) – (P/N 26331)

_____ Pendant Display (P/N 26015-4)

_____ Toolbox with various tools

_____ TRAK Lathe Safety, Operation & Programming Manual (P/N 26010)

_____ TRAK Lathe Safety, Installation, Maintenance, Service & Parts List Manual (P/N 26008)

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

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2.5 Installation Instructions & Checklist

Installer: Use this checklist to assure a complete set-up of the lathe.

☐	1.	Shut off power to the machine.
☐	2.	Visually inspect the 220/440 wiring going into the electrical panel. Visually verify the wiring is correct per our wiring diagram. Make sure a strain relief is being used where the wiring enters the cabinet. Have the customer repair any wiring discrepancies.
☐	3.	Clean the machine if needed and remove any remaining grease.
☐	4.	Ensure the pendant is securely mounted to the mounting arm.
☐	5.	Check all the electrical connections from the pendant to the electric box. See the pendant and electric box wiring diagrams.
☐	6.	Slide the door back and forth to make sure it slides smoothly.
☐	7.	Remove the protective plastic covers from the headstock and the window on the sliding door.
☐	8.	Turn on the power to the machine and to the pendant. Ensure that the 220/440V and 110V lines are plugged in.
☐	9.	Check the oil level on the sight glass on the headstock. Fill if low. Ensure that the coolant pump is rotating in the correct direction.
☐	10.	Lubricate all the way surfaces and the ballscrews by manually operating the lubrication pump
☐	11.	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.
☐	12.	Position the saddle and tailstock to the center of the bed for leveling.
☐	13.	Check the level of the machine. The machine should be level to within 0.0008" longitudinally and 0.0005" transversely. Even though it is the responsibility of the customer, make any adjustments if necessary.
☐	14.	Check the tailstock and the tailstock barrel locks by locking and unlocking. Run the tailstock barrel in and out to ensure proper function.
☐	15.	Open and close the door and verify the door switch is functional. The control should display a message of "DOOR OPEN" in DRO mode when the door is open and it should disappear when the door is closed.
☐	16.	Make sure the X and Z electronic handwheels are functional.
☐	17.	Check to make sure that the E-Stop button is functioning correctly.
☐	18.	Perform Service Code 12, Feed Forward Constant.
☐	19.	Perform Service Code 123 to calibrate the X and Z-axis using a 150mm standard.
☐	20.	Perform Service Code 127 and 128 to manually calculate the backlash for the X and Z-axis.
☐	21.	Check for positional accuracy and repeatability on the X and Z-axis using programs 1.LX2 for the X-axis and 2.LX2 for the Z-axis. Positioning and repeatability values should be less than or equal to 0.0005". Programs can be found on the hard drive. Note: the door must be closed to run these programs.
☐	22.	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 120 ipm.
☐	23.	Run the spindle throughout each gear at each speed.
☐	24.	Flip the coolant switch on and off to make sure coolant is working properly – optional.
☐	25.	Cut the test part to check for taper. Measure the test bar and make any machine adjustments. If unacceptable taper is found, re-check the level before attempting to adjust the headstock.
☐	26.	Wipe down the machine prior to leaving.

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CAUTION!

If the TRAK Lathe has a chuck mounted to the spindle, make sure the chuck is mounted properly to

the spindle and also make sure the chuck jaws are engaged onto themselves or a piece of material
before running the machine.

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

If the chuck's rpm rate is unknown, do not run the chuck over 1200 rpm.

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

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2.6   Lifting and/or Moving the Machine

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CAUTION!
Proper equipment of sufficient capacity must be used when lifting and/or moving the machine.

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To lift the machine, remove the chip pan. Place the forks of the forklift at least 32" apart as shown in figure 2-2. Be certain to lift the lathe toward the headstock.
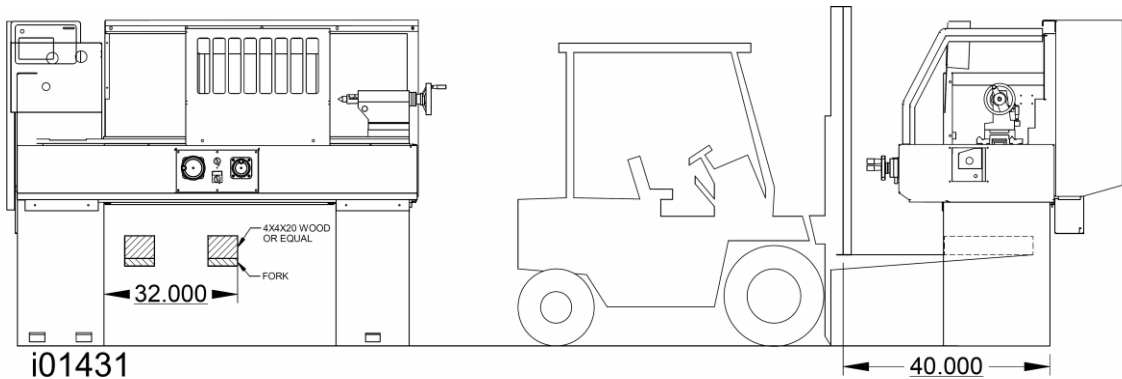
Figure 2-2 -
Lifting the Lathe

Machine Weight	Approximate Machine Shipping Weight	Minimum Forklift Capacity
1,800 lbs	2,200 lbs	6,000 lbs

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

Once the skid has been removed, place the machine in position on top of the six (6) rest pads.

For proper operation, the machine should be set on a substantial floor capable of supporting the weight safely.

2.7 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.

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3. It may be necessary to move back and forward and left and right the carriage and cross slide.

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

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4. Be certain the carriage, cross slide and tailstock move freely and smoothly over their entire length.

2.8 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 6 rest pads, it must be leveled by the use of the 6 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: Next to each leveling screw is another hole used to bolt the machine to the floor. Southwestern Industries recommends that the TRAK 1440EX be bolted to the floor.

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

Move the saddle and tailstock to the center of the bed. To take a reading off the level longitudinally, place the level at each of the four (4) corners of the bedways (Figure 2-3, Positions B & C). To take a reading off the level transversely, place it on top of .7500" parallels at each end of the bedways (Figure 2-3 Positions A & D).
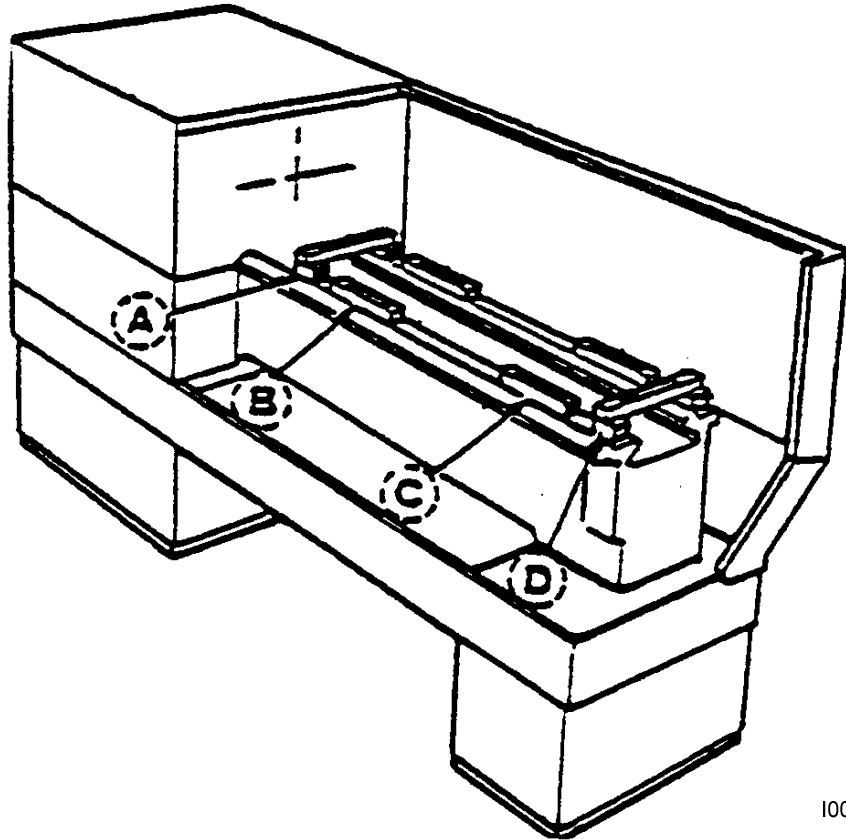
Figure 2-3 -
Leveling

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Using the four (4) interior leveling screws on the lathe base, level the bedways longitudinally within .0008" over the total length and transversely within .0005". After leveling with the four (4) interior leveling screws, bring the exterior leveling screws on the lathe (see Figure 2-1) into contact with the leveling pads using care not to disturb the level.

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

Note: Each 1/2" leveling screw hole is accompanied by a 5/8" bolt hole to fasten the lathe to the ground.

2.9 Electrical Connection

The TRAK Lathe can be configured for 208-240 volt or 416-480 volt 3 phase electricity. To run at 440V, you will need to order the 440V option. The control system also needs a dedicated 110 volt line with a minimum capacity of 10 amps.

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

	WARNING!
	Running at a voltage other than what the machine is wired for will damage expensive electrical components. These components are not covered under warranty.

	DANGER!
	The 208-240/416-480 volt line must originate from a dedicated and independent fused box with a manual shut-off lever. It is the responsibility of the purchaser to supply a wired box that meets all local codes and regulations.

The 208-240/416-480 volts wires to the machine through the electrical box located on the back of the headstock. The wire passes through a hole on the top of the box. The ground wire should be connected at the top or bottom of the breaker bracket.

	DANGER!
	Only a qualified electrician should wire the 208-240/416-480 volt 3-phase electricity.

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

2.9.1 Phase Converters

For those machines that will be run with a phase converter it must be a CNC rated rotary type rather than a static phase converters. CNC rated rotary phase converters allow for varying loads in the system. A CNC rated phase converter also regulates the new leg created so it does not end up being too high or low of a voltage. The electrical load on the machine will vary based on the type of cut taken and the speed of the motor. Static phase converters can only be used on machines with a non-varying load. Please contact your local phase converter distributor for precise sizing.

Model	Recommended Size of Phase Converter	Full-load Amp of Machine
1440EX	7-10 KVA	14 FLA

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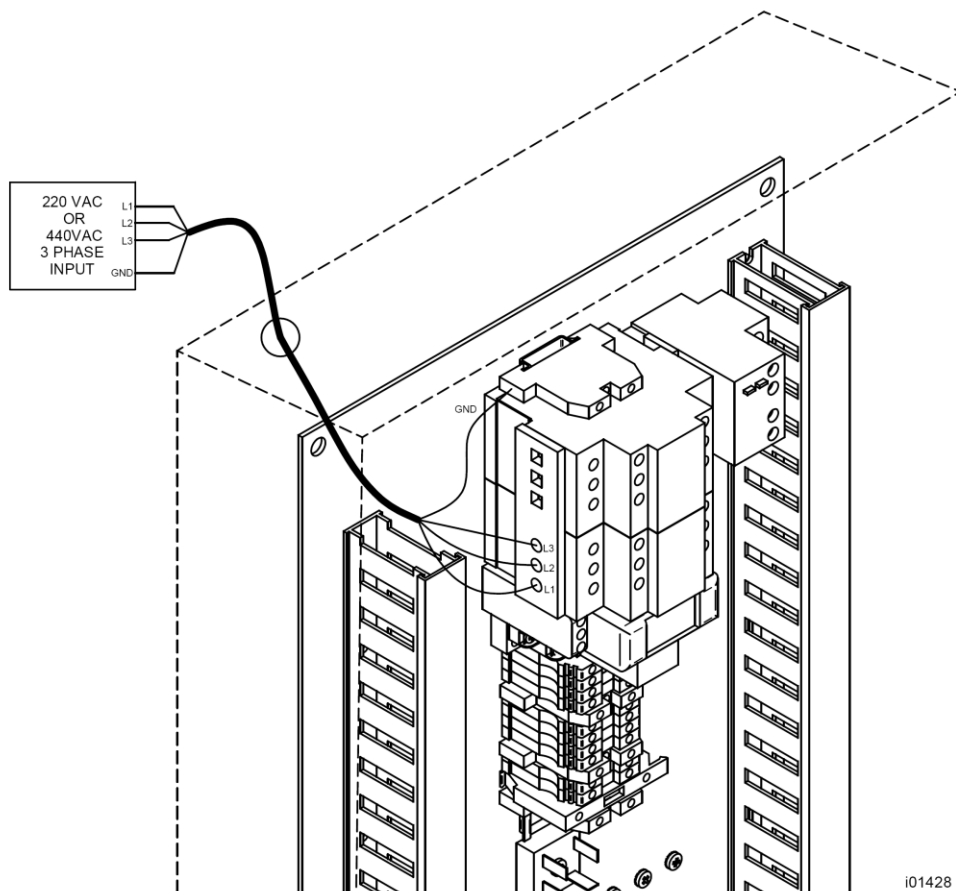
Figure 2-4 -
Wiring the 1440EX Lathe

NOTE: Please connect the incoming ground wire to either the green terminal block as shown in Figure 2-4 or the ground screws below the terminal blocks where other green wires are attached.

2.10 Mounting the Display Pendant

The ProtoTRAK ELX display pendant mounts to the mounting arm attached to the electrical cabinet.

The machine will arrive with the pendant already installed.

2.11 Cable Interconnections

All cable interconnections are made at the factory including those connecting to the pendant display.

With the main power to the machine turned off, verify all cable connections to the pendant. Each cable mates to only one connector on the pendant display back panel. Each cable is labeled with a sticker. Use the key on the pendant to verify the connectors with the correct port.

The following drawing describes all of the cable connections to the pendant.

CAUTION!
Make sure the main power is disconnected before plugging in the cables.

AIR EXIT

DOOR GUARD

USB PORTS

FAN ASSY AIR IN

X-MOTOR

Z-MOTOR

RSG

X-HAND WHEEL

Z-HAND WHEEL

ACCESS TO DIAGNOSTIC LED'S

TEST PORT

GND

E-STOP

PROXIMITY SENSOR

PENDANT MOUNTING BRACKET

AC ON/OFF
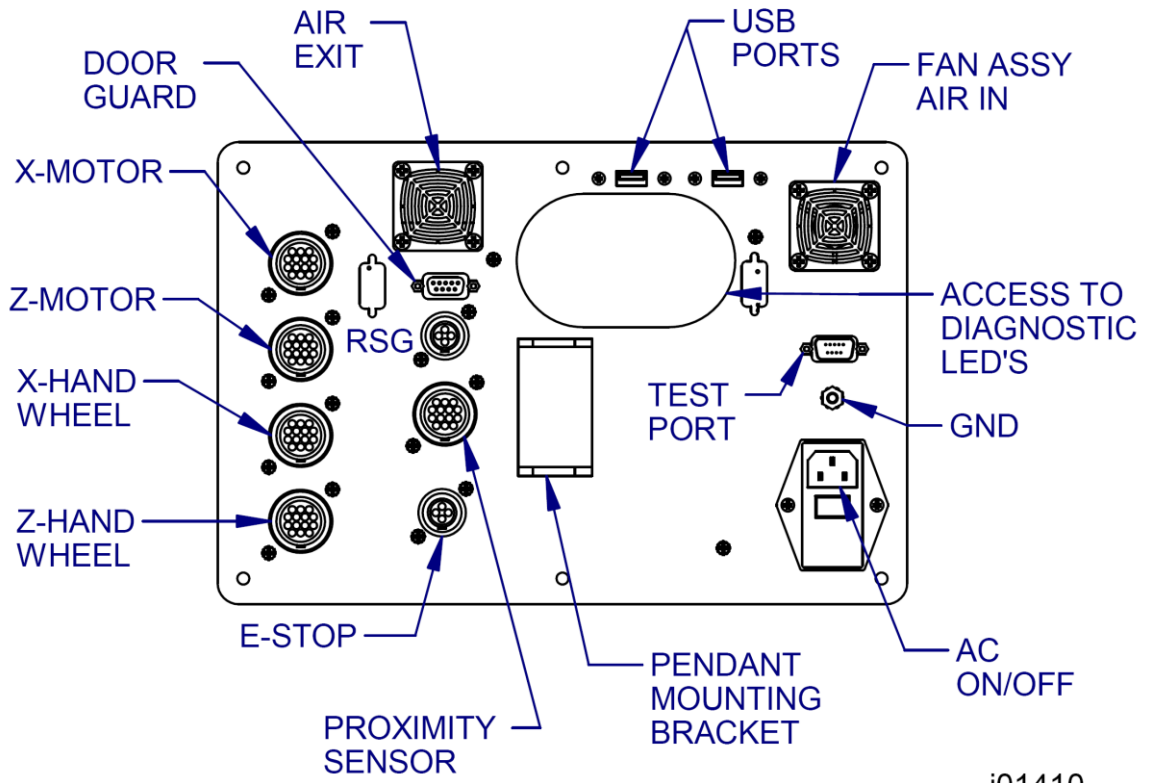
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**Figure 2-5 -
Pendant Rear View**

Figure 2-6 - Pendant Cable Connections

DOOR GUARD

RSG

PROXIMITY SENSOR

X-MOTOR

Z-MOTOR

SPINDLE SWITCH

COOLANT SWITCH

LAMP

COOLANT PUMP

X-HAND WHEEL

Z-HAND WHEEL

SPINDLE MOTOR

SPINDLE BRAKE

AC IN

GROUND SCREWS

GND   GND   GND

K1   K2   K3

L3 L2 L1

W1 V1 U1

L1 L2 L3

220/440 VAC 3 PHASE INPUT

WIRING DETAIL

SPINDLE FWD / REV SWITCH

SPINDLE ENABLE / E-STOP AC CABLE

COOLANT SWITCH

SPINDLE BRAKE

K3

TB1 TB2 TB3 TB4   GB1   TB5 TB6 TB7 TB8   GB2   TB9 TB10   F3   GB3

WIRING CHART

TERMINAL	COLOR	CABLE
TB1-4	BLUE	SPINDLE FWD / REV SWITCH
TB2-4	BLACK	
TB3-4	RED	
TB4-4	ORANGE	
GB1-2	GREEN	
TB4-3	BLACK	SPINDLE ENABLE / E-STOP AC CABLE
TB5-4	TAN	COOLANT SWITCH
TB6-4	BLACK	

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Parts List - Pendant Cable Connections (Figure 2-6)

Item	P/N	Title	Qty
1	20082-3	ELECTRONIC HANDWHEEL ASSY-Z-AXIS TRL	1
2	20082-2	ELECTRONIC HANDWHEEL-X-AXIS TRL	1
3	20296	MOTOR ASSY ENCODER/DRIVER 4020	1
4	20296-1	MOTOR ASSY ENCODER/DRIVER	1
5	26015-4	PENDANT ASSY - PROTOTRAK ELX	1
6	26159	SWITCH ASSEMBLY - FWD/REV	1
7	26155	SWITCH ASSEMBLY - COOLANT	1
8	26071	SENSOR - PROXIMITY	1
9	23265	PUMP COOLANT 1/8 HP	1
10	26180	BRAKE - MAGNETIC	1
11	26329	MOTOR - SPINDLE	1

i26009-2

2.12 Lubrication

The TRAK Lathe lube system provides centralized lubrication for the carriage, cross slide and ballscrews. The lube pump has a ½ quart reservoir filled with Mobil Vactra Oil No. 2 or non-detergent 30 weight.

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

We recommend that you manually pump the oil 5-10 times at the start of every day and every hour during the day.

CAUTION!
Failure to properly lubricate the lathe will result in the premature failure of ballscrews and sliding surfaces.

2.12.1 Headstock Oil Reservoir

Before turning on the spindle, check to make sure the headstock oil reservoir is full. A site glass is located on the headstock. The reservoir holds approximately 2 gallons.   If low, fill with SAE 30 weight oil or equivalent oil through the plug located on the headstock cover.

2.13 Cutting the Test Part (See Figure 2-7)

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

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In order to accurately machine the test part, the gears and bearings in the headstock must be properly warmed and preloaded. This is accomplished by running the spindle for 15 to 25 minutes prior to cutting the test bar at 450 RPM.

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

Set the spindle to an acceptable speed for turning the test piece. A speed range from 640 to 830 RPM is recommended.

2.14 Measurement of the Test Part

Tools Required:
- O.D. Micrometers with .0001" graduations

Using a calibrated O.D. micrometer with .0001" graduations, measure and record the generated dimension at a 6.00 spacing. The acceptable measurement of parallelism of spindle axis to carriage movement (taper of test piece) is .0008" in 6". If the taper measured is not acceptable, re-machine the test part and/or check and adjust the level of the machine, or adjust the headstock.
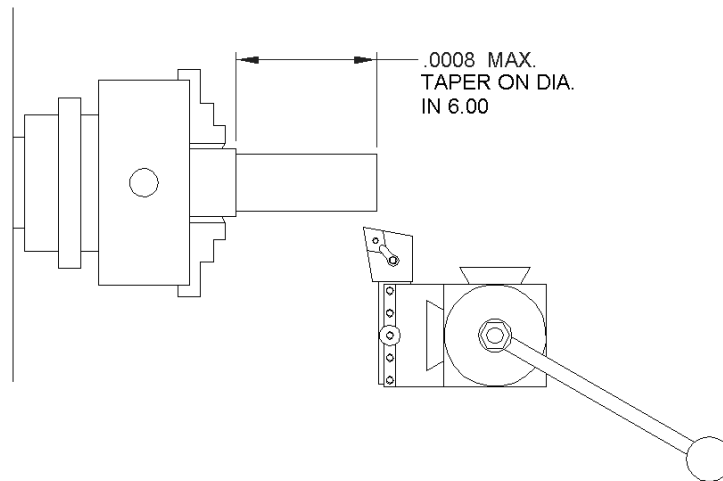
Figure 2-7 - Test Part   i00196

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3.0 Troubleshooting by Symptom

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

3.1 Problems Relating to Machining Results

3.1.1 Poor Finish

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

Perform the following Service Codes:

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

Possible Cause	Check This
Inadequate or no Lubrication to Ballscrews and Way surfaces	Make sure all the Way surfaces are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines.
X & Z-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Z), Section 4.2
Way surfaces are pocked, scarred, or excessively worn	Visually check the condition of all the Way surfaces. For machines that may have excessively worn Way surfaces you may need to adjust the Gibs in this area. This will affect performance when using the machine outside of this area. Check lubrication to affected areas.
Machine set-up problem	Machine's feet are not equally supporting weight. See Leveling, Section 2.8.
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 5.1.14

3.1.2 Turning Diameters Out of Round

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

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

Perform 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 Adjust Spindle Bearing Preload, Section 5.1.14

3.1.3 Cutting Taper

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

Perform the following service code and procedure:

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

Possible Cause	Check This
Machine set-up problem	Machine not leveled properly See Leveling, Section 2.8.
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 Ballscrew Alignment, Section 5.1.12.
Loose bearing problem	Looseness in the spindle bearings. See Mechanical Drive Train (X, Z), 4.2. See Spindle Bearing Preload, Section 5.1.13.
Headstock and/or tailstock not aligned	See Adjust Headstock for Taper, Section 5.1.12. To adjust tailstock from side to side, adjust grub screw. See Section 5.1.15.

3.1.4 Parts Have Incorrect Dimensions

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

- Parts should be round within .0004" TIR.
- The acceptable measurement of parallelism of spindle axis to carriage movement is .0008" over 6 inches.

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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, Section 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, Section 4.1.
Looseness in the Drive Train, ball nut loose in yoke, split nut loose, yoke loose	See Mechanical Drive Train (X, Z), Section 4.2.

3.1.5 Threading Problems

Threads can be cut with and an unlimited number of pitches.

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.

Perform 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.
Failure of the spindle proximity sensor Run service code 133 to check if the sensor counts.	Replace spindle proximity sensor See Spindle Encoder replacement, Section 5.1.7.

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 proximity sensor Run service code 133 to check if the sensor counts.	Replace spindle proximity sensor See Spindle Encoder replacement, Section 5.1.7.

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.

Perform the following Service Codes:

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

- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting.

Possible Cause	Check This
The home position 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.

Perform the following Service Codes:

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

- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting.

- **Code 129** Set's the maximum allowable arc accuracy error. This applies to arcs only.

Possible Cause	Check This
The maximum allowable Arc Accuracy is set too low.	This value will only slow down the machine during arc moves. The factory default is set at 0.005". Perform Code 129 to check or change this value. See Service Codes, Section 4.8. Values lower than 0.005" may reduce the feedrate.
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 4.1.3.
X and Z-axis Gibs are not adjusted properly	Check the adjustment of the X and Z-axis Gibs using the X and Z-axis Gib adjustment procedures.
Binding in the Drive Train	Check Repeatability using the Repeatability and Positional Accuracy procedure. Check the torque reading of the Drive Train. Step by step, carefully inspect the Drive Train for any binding. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Z), Section 4.2.
Servo Drive failure	See Servo Drive, Section 4.5.
Motor failure	See Motor, Section 4.4.

3.2.3 Axis Motor Motion Is Not Smooth

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

Perform the following Service Codes and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 12** Feed Forward Constant.
- **Code 127** Measure's the backlash in the system.
- **Code 128** Enter backlash compensation.
- **Code 100**   Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting.

Possible Cause	Check This
X and Z-axis Gibs are not adjusted properly	Check the adjustment of the X and Z-axis Gibs using the X and Z-axis Gib adjustment procedures.
Calibration or Backlash problem	Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy. See Calibration & Backlash Constants, Section 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.

3.2.4 Vibration in Motion

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

Perform the following Service Codes and procedures:

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

Possible Cause	Check This
Too much backlash entered in Code 128.	Recheck the machines backlash.
Inadequate or no Lubrication to Ballscrews and Way surfaces	Make sure all the Way surfaces are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines. See Lubrication, Section 2.12.
X Gib is not making good contact.	Pull gibs out and mark with a blue die to check where the gibs are making contact. It is recommended that the gibs uniformly contact at least 80% of the surface.
Binding or looseness in the Drive Train	Check Repeatability using the Repeatability and Positional Accuracy procedure. Check the torque reading of the Drive Train. Step by step, carefully inspect the Drive Train for any binding or looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Z), Section 4.2.
Axis Motor belt too tight.	Loosen belt.
Misalignment of ball screw	See Mechanical Drive Train (X, Z), Section 4.2.

3.3 Problems Relating to the Operation of the Control

3.3.1 Display Blanks

The display is completely blank.

Possible Cause	Check This
Screen saver has been activated	Press any key to turn back on. Hitting this key will not activate any feature on the control.
The system has shut down	Turn off 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.
Fuse blown in pendant	Remove fuse and check continuity
Computer/Pendant failed	See Computer/Pendant, Section 4.3.

3.3.2 Bad Picture on the Display

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

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

3.3.3 Keyboard Lockup

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

Perform the following Service Code 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.
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.

Perform the following Service Codes and procedures:

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

- **Code 12** Feed Forward Constant

- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting.

Possible Cause	Check This
Motor cables at pendant switched around.	Make sure during an installation the X and Z motor cables at the pendant are in the correct ports.
X and Z-axis Gibs are adjusted extremely tight	Check the adjustment of the X and Z-axis Gibs using the X and Z-axis Gib adjustment procedures. See X and Z-axis Gib Adjustments, Section 5.2.1.
Excessive friction in the slideways	See Machine Tool & Setup, Section 4.1.
Binding or looseness in the Drive Train	See Mechanical Drive Train (X, Z), Section 4.2.
Incoming electrical power	Incoming voltage. See Electrical, Section 4.6.
Servo Drive failure	See Servo Driver, Section 4.5.
Motor failure	See Motor diagnostics, Section 4.4.
Computer/Pendant failure	See Computer/Pendant diagnostics, Section 4.3.

3.3.5 Problems Reading the USB Drive; Programs Not Saved Properly

The USB 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.
USB thumb drive failure	The USB thumb drive may be bad. See if the USB drive can be read by a Personal Computer.
USB thumb drive is full	Put the USB drive into a Personal Computer to see how many bytes remain. The size varies.
USB thumb drive is incompatible with the ProtoTRAK ELX	See the programming manual (P/N 26010) for the brands compatible with the ProtoTRAK ELX.

3.3.6 System Will Not Turn On

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

Possible Cause	Check This
110 V line is not plugged in	Check incoming 110 V power source to black 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.
IDE Flash Drive	If Boot Failure message appears, then check that the IDE Flash is properly installed. See Section 5.1.5.
Computer/Pendant has failed	See Computer/Pendant Diagnostics, Section 4.3.

3.3.7 System Reboots by Itself

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

Possible Cause	Check This
Interruption of 110 V power to pendant	Using a Voltmeter, check the incoming 110VAC to the pendant.
Poor wiring and cable connections	Check for any loose wiring or cables.
Computer/Pendant failed	See Computer/Pendant Diagnostics, Section 4.3.

3.3.8 System Shuts Off

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

Possible Cause	Check This
Fuse blown in pendant	Remove fuse and check continuity
Poor wiring and cable connections	Check for any loose wiring. Also, check the 110VAC Power Cable connection from the electrical box to the Pendant. See Electrical, Section 4.6.
Computer/Pendant has failed	See Computer/Pendant diagnostics, Section 4.3.

3.3.9 Will Not Hold Calibration

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

Do the following service codes and procedures:

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

- **Code 313** Configuration Values

- **Code 123** Calibration using a measurement standard, or

Possible Cause	Check This
Configuration file corrupt	Load default configuration by going to code 313.
Not saving Calibration values	Replace Computer/Pendant module. See Computer/Pendant.

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

- See Measurements Are Not Repeating – see section 3.4.1

- See Measurements Are Not Accurate – see section 3.4.2

3.3.10 E-Stop Error

The E-Stop turns the power off to the axis and spindle motors. This is done by stopping 110V power from reaching the electrical box through the use of a relay in the pendant.

110V Power reaches the electrical box through the AC E-stop cable. It is used to energize the spindle motor contactor. If this contactor is not energized the spindle will not turn on. See Figure 2-6 and 4-2.

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

Possible Cause	Check This
Faulty E-Stop switch	Check the cable connections from the computer module to the E-Stop switch. Check the E-Stop switch for functionality.
Bad Computer Module	Does 110 V power come out of the pendant through the E-stop connector? If yes, and the screen has an E-stop message, replace the computer module.

3.4 Problem with the Measurements

3.4.1 X & Z-Axis Measurements Do Not Repeat

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

Expected repeatability numbers should be 0.0005" or less.

Possible Cause	Check This
Machine Tool & Setup problem	Check for any looseness in the setup. See Machine Tool & Setup, Section 4.1.
X and Z-axis Gibs are loose	Check the adjustment of the X and Z-axis Gibs using the X and Z-axis Gib adjustment procedures.
X and Z-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Z), Section 4.2.
Encoder Disk or Reader Head on motor are loose	Swap the motor in question with a known good motor. If the symptom stays with the motor in question, then replace the motor. If not, then the motor is not at fault and something else is causing the problem.

3.4.2 X & Z-Axis Measurements Are Not Accurate

Measurements repeat, but with a dial indicator mounted to the spindle, traversing the length of a gage block or some other measurement standard, the measurement is not accurate.

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

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

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

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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.

Perform the following Service Codes:

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

- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting.

- **Code 132** Electronic handwheel test.

- **Code 131** Manual DRO test.

Possible Cause	Check This
Electronic handwheel failure	Each handwheel should count 0.100" for Z and X in fine mode, and count 0.400" in course mode.
Motor Encoder not counting	See Motor diagnostics.
Computer/Pendant failure	See Computer/Pendant diagnostics.

3.4.4 X & Z-Axis DRO Counting in Wrong Direction

The DRO is counting in the wrong direction.

The positive directions for each axis are:

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

- **Z-axis** – carriage moves toward tailstock.

Perform the following service codes and procedures:

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

- **Code 97** Sets positive motor encoder direction.

- **Code 313** Check the line that specifies the product.

3.4.5 X & Z-Axis Electronic Handwheels Count in Wrong Direction

The Electronic Handwheels count in the wrong direction.

The positive directions for each Electronic Handwheel are:

- **X-axis** - Electronic Handwheel turns counterclockwise

- **Z-axis** - Electronic Handwheel turns clockwise

Perform the following service codes 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.
Overload has tripped or is not set correctly	The harder the Spindle Motor works trying to make heavy cuts, the more current the Spindle Motor utilizes. This can be caused by a cut so large that it exceeds the machine capability, or a problem with the spindle motor. The overload is set to 14 amps for 220V and to 7 amps for 440V. See figure 4-1.
Spindle Drive parameters are not correct	May need to re-download the Spindle Drive parameters. Contact Customer Service for assistance at 800.367.3165.

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 220V or 440V voltage to the machine.
Missing a phase	Check each phase to make sure you have the correct voltage.
Poor wiring connections	Check all the wiring connections to the electrics box. Make sure the motor is wired for the correct voltage.
Defective cable connections	Check all cable connections.
Spindle Motor is faulty	Check the resistance of the spindle motor windings on the spindle motor between L1 (U) and L2 (V), L2 (V) and L3 (W), then L1 (U) and L3 (W) using a digital ohmmeter. If the ohmmeter reads more than one (1) ohm difference or "OL" (infinite) between any pair, replace the motor. The next check is for resistance to ground using a digital ohmmeter. Check L1 (U) to ground, L2 (V) to ground, and L3 (W) to ground. The meter reading in the display window should be "OL" (infinite) with reference to ground. Any other reading indicates a problem, and the motor should be replaced.

3.5.3 Spindle Runs Backwards

The spindle motor runs in the opposite direction. The spindle should always spin in the counterclockwise direction when the spindle on/off switch is turned to forward.

Possible Cause	Check This
3-Phase wires backwards	Need to switch any 2 of the 3 wires coming into the machine (T1, T2, and T3).

3.5.4 Excess Gearbox Noise

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

See figure 6-11 to troubleshoot gear noise.

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

3.5.5 Tailstock Barrel is Stiff

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

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

4.0 Diagnostics

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

4.1 The Machine Tool & Set-Up

4.1.1 Leveling

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

The machine should be level to within .0008" longitudinally and .0005" transversely. See Leveling Procedures, Section 2.8.

4.1.2 A Special Word About the X & Z Gib

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

Gibs should be:
- flat
- free of twist
- free of burrs
- free of blockages in the oil passages and channels

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

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

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

See Gib Adjustments, Section 5.2.1.

4.1.3 Lubrication

Lubrication is one of the single, most important maintenance issues and plays a key role in assuring the performance and durability of the lathe. At the beginning of each day manually supply oil to the way surfaces by pumping the lube pump 5-10 times.

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

Make sure the oil splash system for the headstock is working properly at the start of each day. Check periodically the site glass for the headstock oil. The site glass is located on the headstock. 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.

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
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 2.8.

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 ballscrew 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 to 15 in-lbs. These values should be consistent in both directions and along all areas of the axis travel. Values that differ from that of above may correspond to misaligned ballscrews.

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

See Figures 5-2 through 5-3 in Section 5.0.

1. Ensure that the screws that hold the bearing housing in place are tight.

2. Ensure that the clamp nut is secured to 50 ft-lb. The following applies to the clamp nut: When loosening, make sure to back out the 10-32 screw from the clamp nut.

3. When tightening, snug the 10-32 screw to keep the clamp nut from spreading, tighten it again after the clamp nut is tight.

4. Take out the angular contact bearings in the X & Z-axis and inspect them. They should roll smoothly and be lightly greased. If not, replace them.

NOTE: The bearing housing and spacer rings are matched sets - keep them together.

5. With the motor and drives removed, inspect the ballscrew, ball nut and yoke for the potential problems shown in the chart below.

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

Potential Problem:	Check By:
Bad ballscrew	• 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 ballscrew. • Cranking the ballscrew through a significant part of its travel. If it jams, feel loose or has rough spots, replace the ballscrew. • Dial indicator on a vertical flat of the ballscrew indicates backlash between the ballscrew 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, ballscrews and cross-slide.
Z Ballscrews not aligned properly	• Manually turn the ballscrew through the length of its travel. Pay particular attention to the movement near the headstock, the middle and the tailstock.

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

See: *Z Ballscrew Removal,* Section 5.1.14
         X Ballscrew Removal, Section 5.1.12
         Aligning Z Ballscrew, Section 5.1.15

4.3   Computer/Pendant Diagnostics

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 several cable connections on the rear of the pendant. Make sure all cables are properly fastened. **Warning: do not unplug and plug cables with the control on. This will destroy the computer.**
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.
IDE flash drive failure	If the IDE flash drive fails, the system will not boot up or operate. It will need to be replaced. All programs and machine configurations will be lost. Make sure to back up your flash disk from time to time.
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.
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	10 or 8 amp fuse in pendant blows. Pendant will not turn on if the 10 amp fuse in the on/off switch is blown.

The following is the list of diagnostic LEDs found on the back of the applications board. Remove the black cover on the rear of the pendant to access them.

LED lights – the applications board has 10 LED lights with LED 1 found on the left of the LED segment.
1. 5 volt power LED – signifies that 5 volts are present on the applications board which is being supplied from the power supply.
2. Overlay Key LED – this LED will flash each time a key is pressed on our overlay.
3. Not used
4. Spindle Encoder Zero LED – When a spindle encoder is used not a proximity switch
5. Z Electronic Handwheel Zero LED.
6. X Electronic Handwheel Zero LED.
7. Z Motor Encoder Zero LED.
8. X Motor Encoder Zero LED.
9. 110 volt power LED – this light will be on when the applications board is seeing 110 volts. Check the 8 amp fuse on the applications board if this light is not on.
10. Spindle Enable Output LED – This LED will indicate when the spindle enable function is activated.

4.4   Motor Diagnostics
The Motor subsystem is comprised of 2 parts: The motor and the servo driver. The motors are powered by 110 VAC voltage.

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 back of the ELX pendant. 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 number does not count approximately the same amount as physical movement, the motor assembly needs to be replaced. If the encoder has failed the motor must be replaced.

4.4.3 Diagnosing a Brush Problem

Each of the axis motors on the machine contains 4 brushes. These are a wear item and may need to be replaced during the life of the control system.   When the brushes begin to wear out, you may start to see intermittent faulting of an axis. Please note your brushes will last for a number of years before they need replacement so if you are seeing this symptom in the 1st year or 2 of your product, this is probably not the cause.

See Section 5.1.2 for the procedure for replacing motor brushes.

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 Y-axis has no problems. Lets also assume it is not an obvious problem like a loose connection.

Swap these components	Results
Physically switch the X and Z motors **Warning – turn off the power before plugging or unplugging motors, or you will destroy the computer**	Has problem moved to Z-axis? If yes, replace motor. If no, the motor is not the problem.

4.5 Servo Drivers

Note: the Servo Driver is located in the black box on the side of each motor.

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 run each axis very long when swapping servos. They are not rated to run each other's motor for long periods of time.

4.6   Electrical

4.6.1 Checking A/C Voltage

This procedure tests for the 110V power for the control. Check the 110 VAC at the e-stop AC out connector on the pendant.

- Use a Voltmeter, reading A/C volts

- Acceptable range is 100V 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.

4.6.2 Checking Fuses

CAUTION!
Turn off power before removing and replacing fuses.

There are 5 fuses to check in the system. There are 2 in the pendant and 3 in the electrical cabinet. The bottom fuse in the electrical cabinet on the power strip is 10 amps and fuses power to the pendant. The top fuse is 5 amps and fuses power to the coolant pump, worklamp, and spare. The third fuse in the electrical cabinet is item 8 on figure 4-1. The 2 fuses in the pendant are 10 amp and 8 amps. The 10-amp fuse in the pendant is found in the on/off switch. The 8-amp fuse is found on the applications board inside the pendant.

To check fuses:

1. Use a Volt/Ohmmeter; select "OHM" or "Ω".
2. Remove the fuses completely from the pendant or electrics box for TRAK Knee mills.
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.

4.6.3 Cable Connections

The TRAK lathe uses several 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.

CAUTION!
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.

5. Make sure to tighten up the screws or locking ring on each of the connectors.
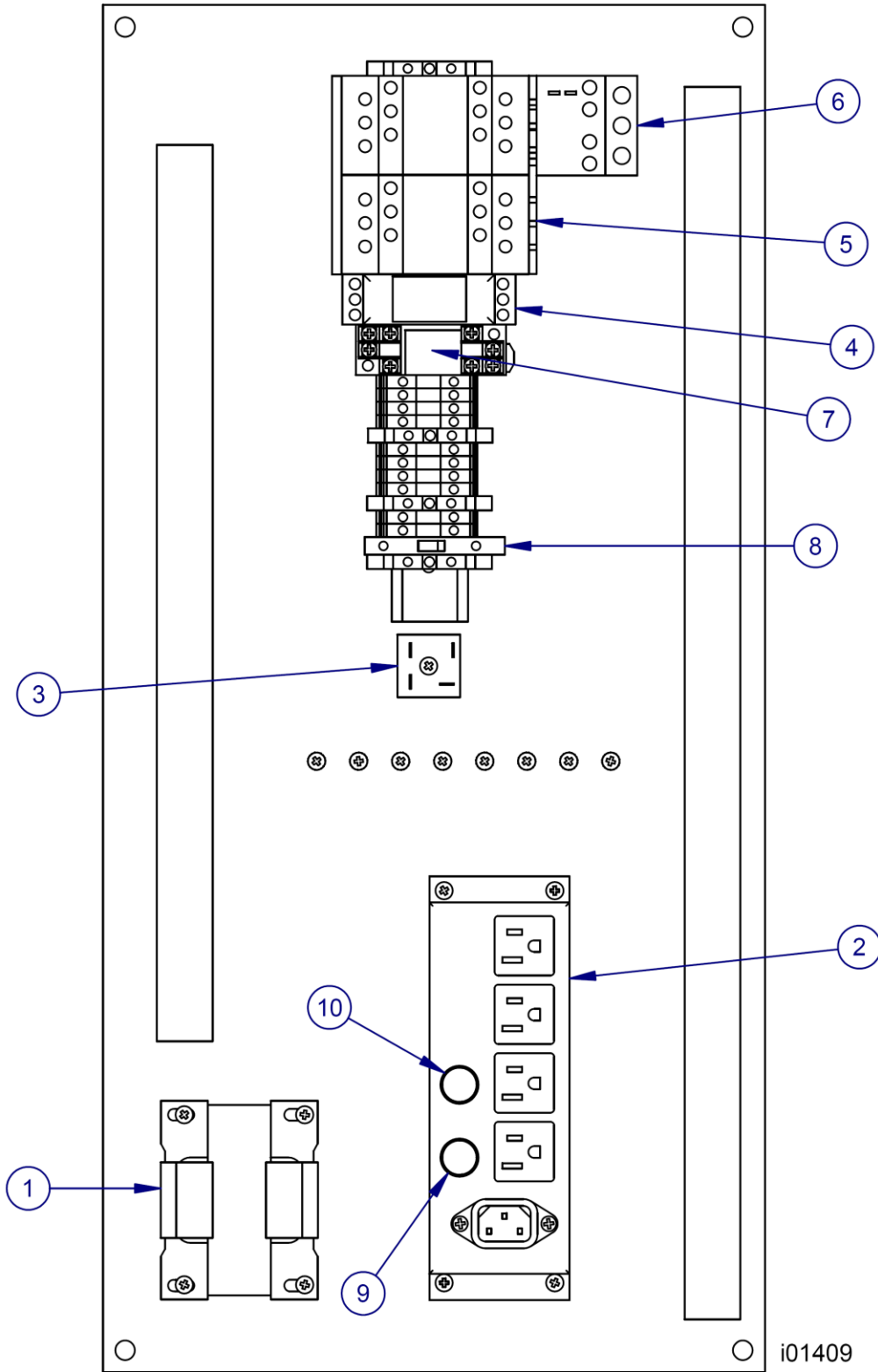
**Figure 4-1 -
Electrical Cabinet**

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Southwestern Industries, Inc.
TRAK TRL Lathe, ProtoTRAK ELX CNC Safety, Installation, Maintenance, Service & Parts List

Parts List - Electrical Cabinet (Figure 4-1)

Item	P/N	Title	Qty
1	26088	TRANSFORMER-100VA	1
2	26091	POWER STRIP ASSY	1
3	23037	DIODE-BRIDGE RECTIFIER-HIGH CURRENT-25 WATT	1
4	24483-1	RELAY- TIMER, OFF DELAY (brake timer)	1
5	26092	CONTACTOR- 3 PHASE REVERSING CONTACTOR	1
6	23821	OVERLOAD RELAY - 220 volt	1
6	23821-4	OVERLOAD RELAY - 440 volt	1
7	23435	RELAY-POWER-100-120 VAC-DPDT	1
8	24126-004	FUSE-5x20mm SERIES 195 - 4 amp	1
9	21824-5	FUSE-3AG-SLOW BLOW, 5 AMP	1
10	21824-10	FUSE-3AG-SLOW BLOW, 10 AMP	1
			i01409

Figure 4-2 - Electrical Cabinet Schematic

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Southwestern Industries, Inc.
TRAK TRL Lathe, ProtoTRAK ELX CNC Safety, Installation, Maintenance, Service & Parts List
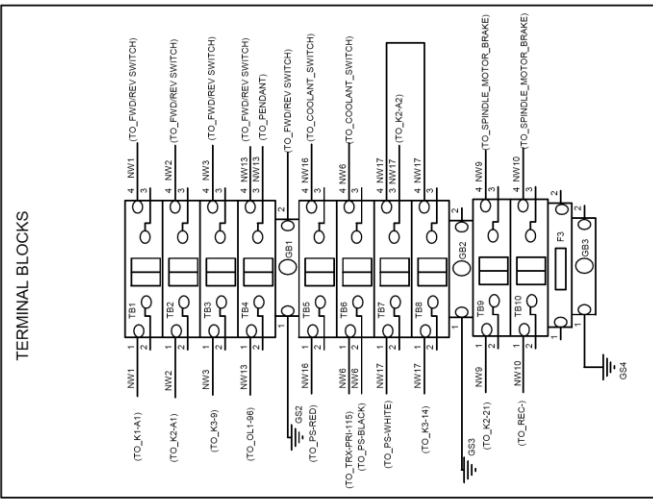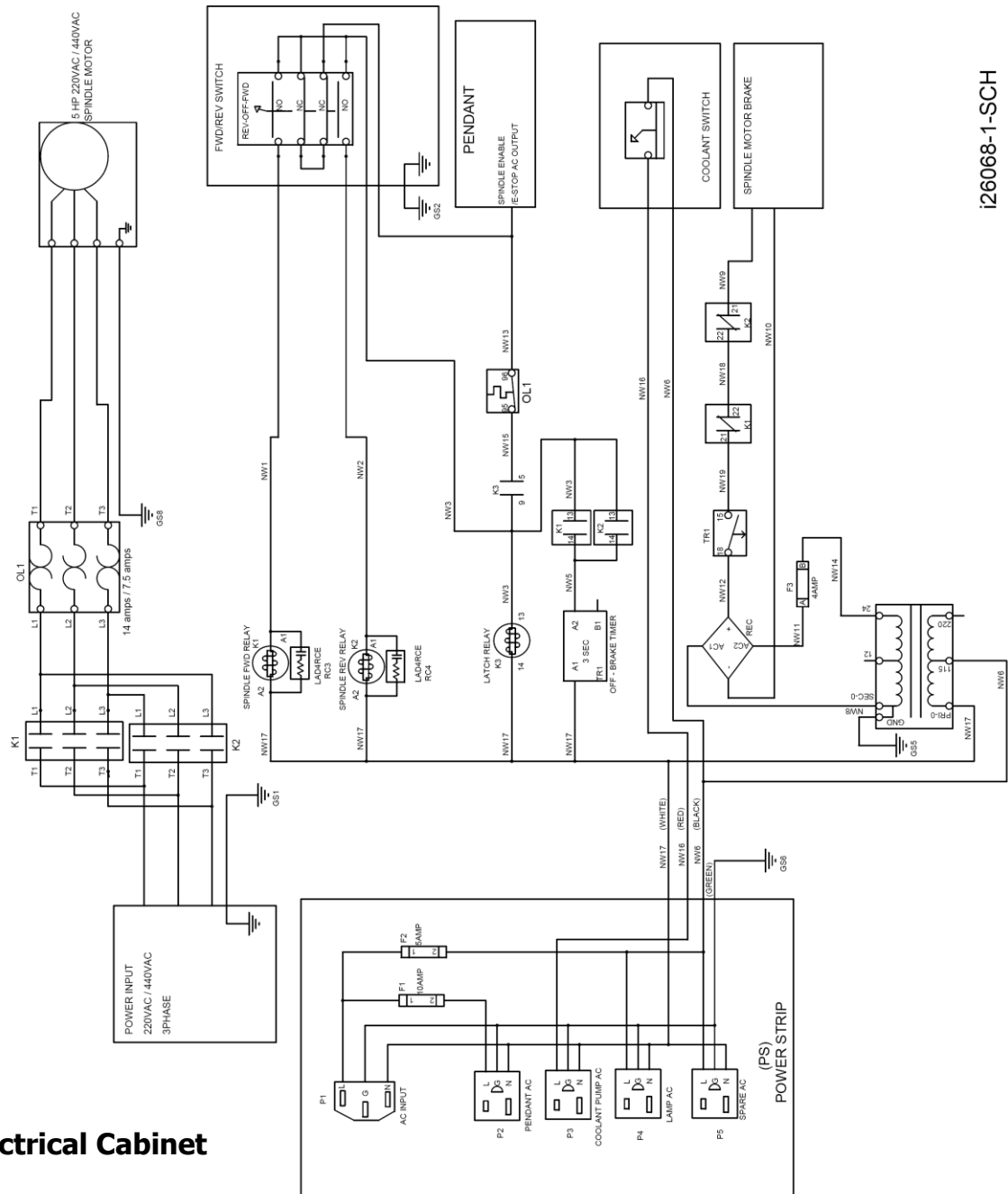
4.7   Door Switch

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

4.8   Service Codes

Service codes are broken down into 4 categories: Software, Machine Setup, Diagnostic, Operator Defaults/Options.

All Service Codes are accessed in the SET-UP Mode by pressing the soft key for "SERV CODES". The service codes can be found under one of the headings listed on the main screen. Press the heading you want to access and enter the code number.

4.8.1   Software Codes

The following codes pertain to software functions in the control.

Note - If you are working with the SWI Customer Service Group, write the values down for Code 33 or Code 313. These values will be valuable for troubleshooting.

4.8.1.1   CODE 33: Software ID

The Code 33 is the software identification procedure. The software ID will display the various software modules. The two that are important for resolving problems are:

- **User Interface/Tool Path** – write down the numbers if service support is needed.

- **Motion Control** – write down the numbers if service support is needed.

Other software information displayed on this screen is rarely needed. You should provide it on request of a service technician.

4.8.1.2   CODE 141: Load Configuration file from USB thumb drive

This code allows you to load your configuration file from the USB thumb drive to the ProtoTRAK's internal IDE Flash drive. The configuration file consists of items such as calibration and backlash constants. This code is used when a computer module or IDE Flash Drive has been replaced and you already loaded the information on the thumb drive using code 142.

4.8.1.3   CODE 142: Save Configuration file to USB thumb drive

This code allows you to save your configuration file to a USB thumb drive. The configuration file consists of items such as calibration and backlash constants. Use this process before a computer module or IDE Flash Drive needs to be replaced. It stores the configuration file from the ProtoTRAK's internal IDE Flash Drive to the USB thumb drive. It is a good idea to do this code after the machine is initially setup so these values can be saved and used in the future. If the computer or IDE flash 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 IDE flash drive is replaced.

4.8.1.4 CODE 313: Display Configuration File

This code displays the configuration file. This file contains pertinent information about the machine. Some of the common service code values are displayed on this page as

well, such as code 12, 100, 128, and 129. Press the Load Default if you wish to load factory defaults for all of the control's settings and configurations.

4.8.1.5 CODE 316: Update Software

Load in USB thumb drive and enter this service code. New software will automatically download and control will reboot.

4.8.1.6 CODE 340: copy part programs to USB Thumb drive

Load in USB thumb drive and enter this service code. All the part programs that are stored in the ProtoTRAK's internal storage will be copied to the USB Thumb Drive.

4.8.1.7 CODE 341: copy part programs from the USB Thumb drive

Load in USB thumb drive and enter this service code. All the part programs that are stored on the USB Thumb Drive will be copied to the ProtoTRAK's internal storage.

4.8.2 Machine Set-up Codes

The following codes are used primarily when setting up a new machine.

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 saddle 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.

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 97 set positive motor encoder direction.

This procedure sets the Plus and Minus motion for the Motor encoders.

It may be necessary to perform this procedure after a new installation or after installing a new Computer Module.

STEPS:
1. Center the table and saddle and position the quill about halfway down.

2. Go into Service Codes and input Code 97.

3. Very carefully, move the table, the saddle and the quill in the positive direction, less than 2 inches for each axis. Positive motion is:

    - X – cross slide moves toward the operator
    - Z – saddle moves along the bed ways away from the spindle.

If you do not move correctly from the beginning, repeat the procedure.

4. Press INC SET to signal the procedure is complete.

4.8.2.3   CODE 100: Axis Open Loop Test

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

CAUTION!
During this procedure, the designated axis will be given a command to move at maximum speed for 1 second in the direction you choose.   Avoid crashes by making sure the table and saddle are centered. MAKE SURE THAT NO ONE IS STANDING IN THE WAY OF THE 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. Make sure the gib locks are released.

2. On the Pendant display, go into the Service Codes and input the Code 100.

3. The conversation line will say: "SELECT AXIS".   Input the axis. Either X or Z.

4. In the conversation line it will say "WHICH DIRECTION? PLUS".

    - If you want to run in the plus direction, press INC SET.

    - If you want to run in the minus direction, press +/-, then INC SET

5. In the conversation line it will say "PRESS GO". Press Go after you are sure that the machine will not crash in the direction and axis that you have specified.

6. Afterward the screen will display values next to the DRO position axes. The DRO value should match actual travel distance.

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 3.0000" to 5.0000".

- If the motor encoder is not within this value, then the one that is out of specification may be the problem.

- The feedrate should be a minimum of 120 ipm.

- If the feedrate is less than 120 ipm and inconsistent in both directions, check the incoming AC voltage and mechanics of the drive train.

4.8.2.4 CODE 123: Calibration
See Section 5.2.2.1 for a further explanation of this code.

4.8.2.5 CODE 127 - Set X or Y Backlash Constant
See Section 5.2.2.2 for a further explanation of this code.

4.8.2.6 CODE 128: Input Backlash Constant
Code 128 allows you to enter the backlash values for each axis. It displays the value after it enters.

4.8.2.7 CODE 308: Reverse X Hand Wheel Direction

This code reverses the direction of the X-axis hand wheel

4.8.2.8 CODE 310: Reverse Z Hand Wheel Direction

This code reverses the direction of the Z-axis hand wheel

4.8.3 Diagnostic Codes
The following codes are used primarily when diagnosing a problem with the machine.

4.8.3.1 CODE 54: Program Continuous Run

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

2. Press **MODE**, **SET UP**, **"C"**, **Code 54**, **INC SET**. The program run will start automatically.

3. Press **STOP** to stop, and **GO** to continue.

4.8.3.2 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.

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 Handwheel is being turned. There should be no skipping and is should count smoothly while the hand wheel is being turned. One revolution of the hand wheel should read 0.4000" for X and Z in course, and 0.100" in fine mode.

4.8.3.5 CODE 133: Spindle Encoder Test

This code ensures that the proximity sensor on the spindle is counting correctly. After entering this code, the spindle can either be turned on or can be turned manually. Every full revolution of the spindle will cause the X value on screen to increase by one. If the spindle is turned on, then the Z value on screen will calculate the actual RPM by the proximity sensor count.

4.8.3.6 CODE 319: Error Log

This service code keeps track of all commands being sent to the servo system. This may be asked for when troubleshooting a problem specific to motion of the ProtoTRAK.

4.8.3.7 CODE 320: History Log

This code keeps track of incidents such as servo faults and software updates, and allows for it to be saved onto a USB drive. This is useful for keeping track how often an error occurs. You may be asked by a customer service representative to send in for evaluation.

4.8.3.8 CODE 326: Error Message Display

This code describes the various error messages.

4.8.3.9 CODE 327: Check Available Memory

This code monitors how much memory (RAM) is available within the system, as well as much space is available within our internal storage device.

4.8.3.10 CODE 329: Test Front Panel Backlight

This code tests the backlight on/off function. After entering this code, the backlight will turn off for three seconds and then turn back on.

4.8.3.11 CODE 332: Load/Save Tool Table

This code allows the user to save a tool table from the control onto a USB drive, or load a tool table from a USB drive to the control.

4.8.3.12 CODE 342: Toggle test lights on or off

Use this service code to toggle a set of test lights visible on screen. The top green light will blink indicating that our operating system and User Interface software is responding properly. The middle orange light is to indicate that commands are being sent to our servo system. The bottom turns red when our servos are in position, and green when they are not.

4.8.4 Operator Defaults/Options Codes

The following codes allow the user to set programming defaults or turn features on or off.

4.8.4.1 CODE 22: Turn on Simulation Mode

This code allows the ProtoTRAK to emulate RUN, POWER FEED, and JOG modes without having to move the servos.

4.8.4.2 CODE 66: Metric Mode

This code gives you the choice of switching to Metric Measurements for temporary use or setting Metric as the default, which means it will not change unless you change it with code 67.

4.8.4.3 CODE 67: English Mode

This code gives you the choice of switching to English (inch) Measurements for temporary use or setting English as the default, which means it will not change unless you change it with code 66.

4.8.4.4 CODE 79: Beeper On

This turns on the beeper to the control keys.

4.8.4.5 CODE 80: Beeper Off

This turns off the beeper to the control keys.

4.8.4.6 CODE 89: Turn off Simulation Mode

Use this code to turn off the simulation mode and return to normal operation.

4.8.4.7 CODE 129: Arc Accuracy

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

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

To input a new Following Error use the following procedure:

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

5.0 Procedures for Replacements & Maintenance

5.1 Replacements

5.1.1 Servo 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.

> **WARNING!**
> **Do not work with the Servo Motors unless the power is disconnected from the machine. The servo motors are run by 110 VAC. There is possibility of death by electrocution!**

5.1.2 Motor brush replacement

1. This procedure assumes the motor assembly has either been removed from the machine and/or no power is applied to the machine.

2. When the motor is mounted to the casting that holds the Servo Driver, it is necessary to remove the four Phillips head bolts at the shaft end of the motor, which hold the motor to the housing to access all four brush assemblies. DO NOT Remove/Disconnect any wires, it is not necessary.

3. Before removing caps, please note they are made of plastic and care must be taken when removing them to not damage the screw slots. To this end, apply firm downward force while gently turning the caps counter clockwise.

4. Note there are four (4) caps to be removed to access and replace all of the brush assemblies. When the caps are loose and before removing it, hold your finger over the top of the cap/hole to contain the parts

5. Remove the O-ring, Keeper and brush assembly.

6. Insert new brush assembly, re-insert keeper (Note: No Keeper is used on the Hathaway/EmoteQ Motor) and install new O-Ring taking care to use the edge of a small screw driver to gently force the O-Ring into the hole down onto the Washer/Keeper. If the O-ring is installed properly, it will hold the brush assembly in place while you install the cap.

7. Install Cap to complete installation and repeat this process for the remaining three (3) brush assemblies.

8. Re-assemble motor to housing while pushing wiring back into housing taking care to not pinch it.

9. Re-install the assembly to the machine.

5.1.3 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 integrated into the servo motor casting.

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

1. Press in the Emergency Stop.

2. Remove the servo motor/driver assembly from its mounting bracket.

3. Remove the 10 cap screws that hold the servo driver and its heat sink plate to the motor casting.

4. Disconnect the cable connector. Do not pull on the wires.

5. Reinstall the new servo driver with its heat sink plate. Be certain the gasket properly seals the assembly.

6. Reinstall the motor/driver assembly. Make certain the belt is tight so that there is little play if pinched in the middle.

5.1.4 Computer Module and LCD Enclosure Replacement (figure 5-1)

If it is determined that these components are faulty, it will be necessary to exchange the entire pendant.

1. Turn off power to the machine and control.

2. Unplug all the connectors from the rear of the pendant.

3. Remove the pendant from the pendant arm by removing the 3/8 – 16 bolt and nut that secures 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) 8-32 x 3/8" Pan Phillips head screws 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. Reach from the top and remove the overlay cable and LCD cable from the computer module. The LCD cable will have some RTV holding it in place.

8. Remove the two E-stop wires, LCD inverter cable, and the ground wire from the LCD/ enclosure side.

9. Replace the computer module or LCD/enclosure.

10. Follow the instructions in reverse order when reinstalling the new computer module or LCD/enclosure. Make sure that all connectors are properly seated before fastening the unit back in place.
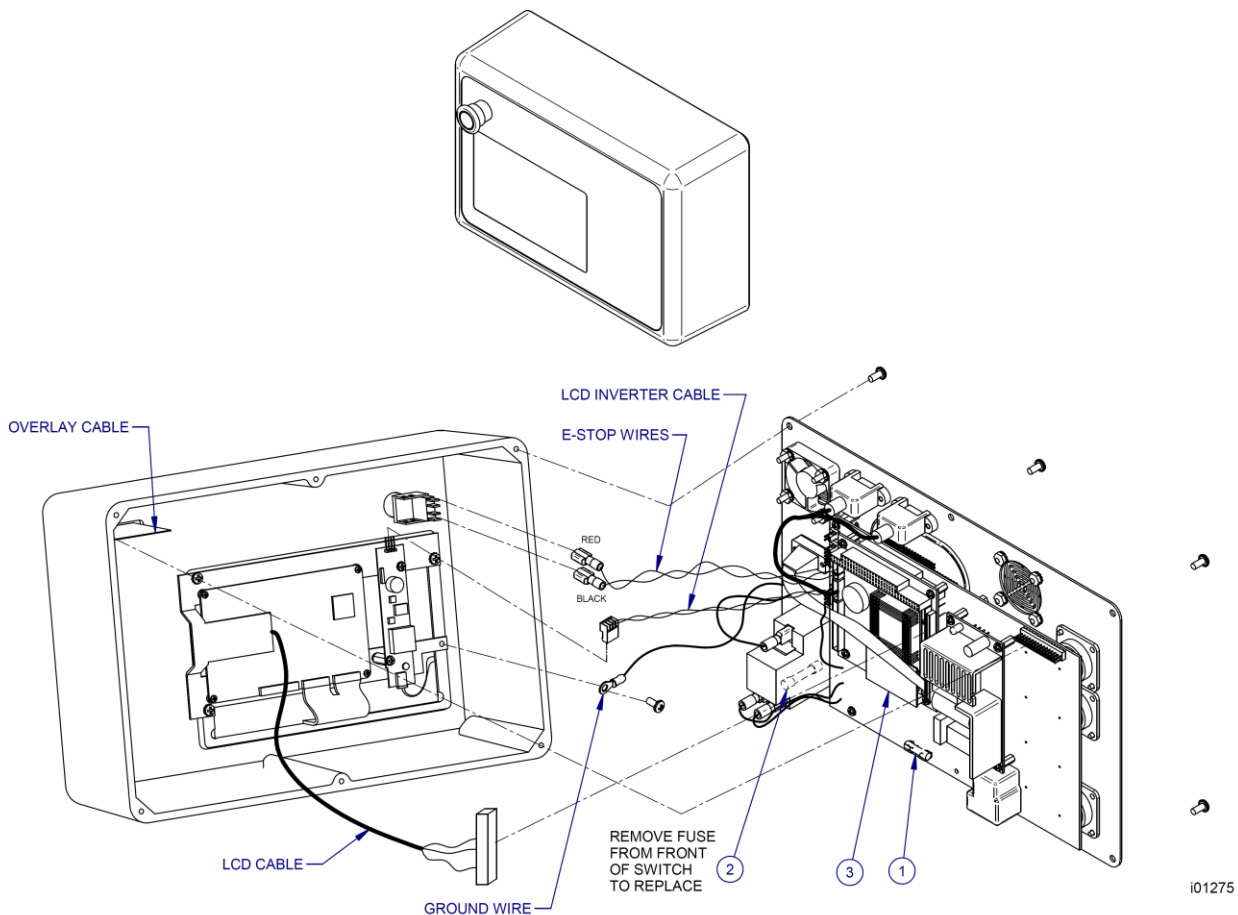
Figure 5-1 & Parts List Shown -

Computer Module and LCD/Enclosure Replacement

| Item	P/N	Title	Use	Qty
1	21824-8	Fuse – 8 Amp Slow Blow	EA	1
2	21824-10	Fuse – 10 Amp Slow Blow	EA	1
3	26027-32	Memory – IDE Flash	EA	1

5.1.5 IDE Flash Disk Replacement

1. From the control, go the SETUP, SERV CODES, SECTION A, and then code 142, and save your Configuration file (calibration values, etc.) to a USB thumb drive. Run code 340 to save your parts programs.

2. Turn off the power to the machine and control.

3. Unplug all the connectors from the rear of the pendant.

4. Remove the pendant from the pendant arm by removing the 3/8 – 16 bolt and nut that secures it in place.

5. Place the pendant assembly on a clean and secured table with the display facing away from you.

6. Remove the (6) 8-32 x 3/8" Pan Phillips head screws securing the computer module to the LCD/enclosure.

7. Pull the computer module a few inches and stop. Pulling the computer module too far will damage the ribbon cables.

8. Reach from the top and remove the overlay cable.

9. Remove the IDE flash drive from the motherboard. Remove the extra adhesive from the motherboard.

10. Firmly insert the replacement IDE flash drive into the motherboard. While pressing in the replacement, be sure the pins line up correctly. Secure the connector with RTV adhesive such as REP Fast Gasket adhesive, P/N 1430.

11. Secure the computer module back to the LCD/enclosure by following the instructions in reverse order.

12. Make sure that the overlay cable is properly seated before fastening the unit back in place.

13. Turn on the power to the machine and control.

14. Update the system software by inserting a thumb drive that contains updated system software from our website (www.southwesternindustries.com). Use service code 316 found in section A to update the software.

15. Use service code 141 to restore the configuration file saved on your USB thumb drive if you were able to save it using code 142. Otherwise, do the calibration and backlash procedures described in 5.2.2

5.1.6 Electronic Handwheels

There are 2 electronic handwheels. Each unit is replaced as an assembly. Disconnect the handwheels from the apron cable. (See figure 6-1)
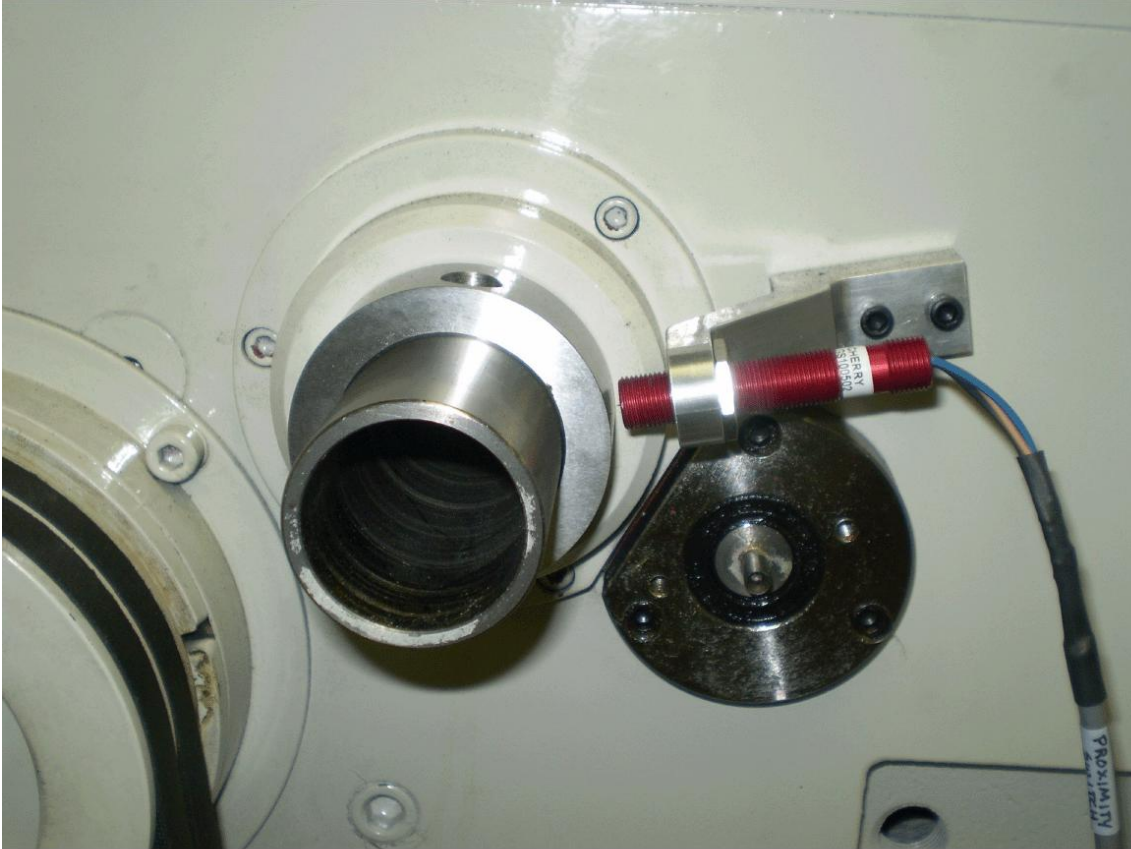
i01407

**Figure 5-2 -
1440EX Proximity Sensor**

5.1.7 Spindle Proximity Sensor Replacement

The proximity sensor must line up with the hole in the sensor ring on the spindle. The sensor ring is held onto the spindle by set screws and can be repositioned to line up with the proximity sensor.

1. Disconnect all power to the lathe.

2. Remove the belt guard to gain access to the spindle proximity sensor.

3. Loosen the locknut on the sensor.

4. Disconnect the sensor's cable from the pendant and remove sensor.

5. Reverse procedure and set the gap between the sensor and the sensor ring to .100" +/- .010"

5.1.8 Spindle Drive Belt Tightening/Replacement

The spindle drive motor is located inside the base pedestal, underneath the headstock. Open the belt cover on the headstock and remove the lower access panel on the pedestal.

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

To tighten the spindle belt, loosen the bottom nut "A" under the motor bracket and use the top nut "B" to tighten the belt. See figure 5-1. Make sure the tension on the belt is such that there is no slippage when the lathe is started at its maximum speed. Check the belt tension by pulling on one of the belts in the mid-span of its travel with a scale until you reach 15 lbs. on the scale. At this point the deflection of the belt relative to the other belt should be no more than 1/2". If the deflection is more than 1/2" tighten the belt.

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

i00491
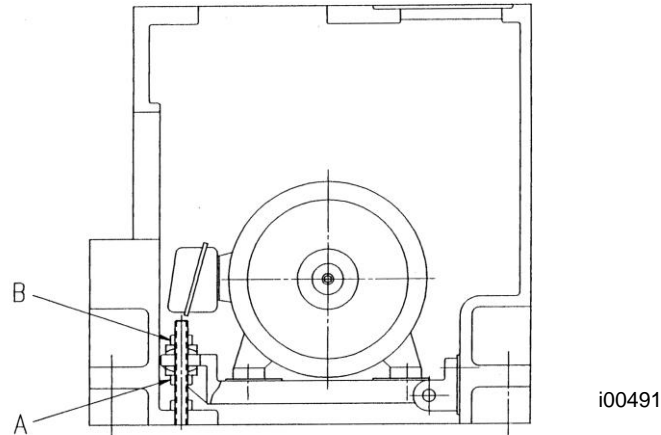
Figure 5-3 -
Spindle Motor Belt Adjustment

5.1.9 Spindle Motor Removal

1. Disconnect all power to the lathe.

2. Loosen the belt tension. See section 5.1.7.

3. Mark and remove motor electrical leads.

4. The motor is secured with four screws to the motor mounting plate. See figure 5-1.

5. 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.

5.1.10 X-Axis Ballscrew Removal

1. Disconnect all power to the lathe.

2. Access the X-axis ballscrew by removing the back cover on the rear splashguard and removing the X-axis belt guard.

3. Remove the 4 ¼-20 Cap Screws.

4. Remove the motor.

5. Remove the belt pulley, 2 bearings, and the bearing housing.

6. Remove the cross slide

7. Remove the ballscrew and X-axis yoke in one piece.

8. Unbolt the ballscrew nut from the yoke.
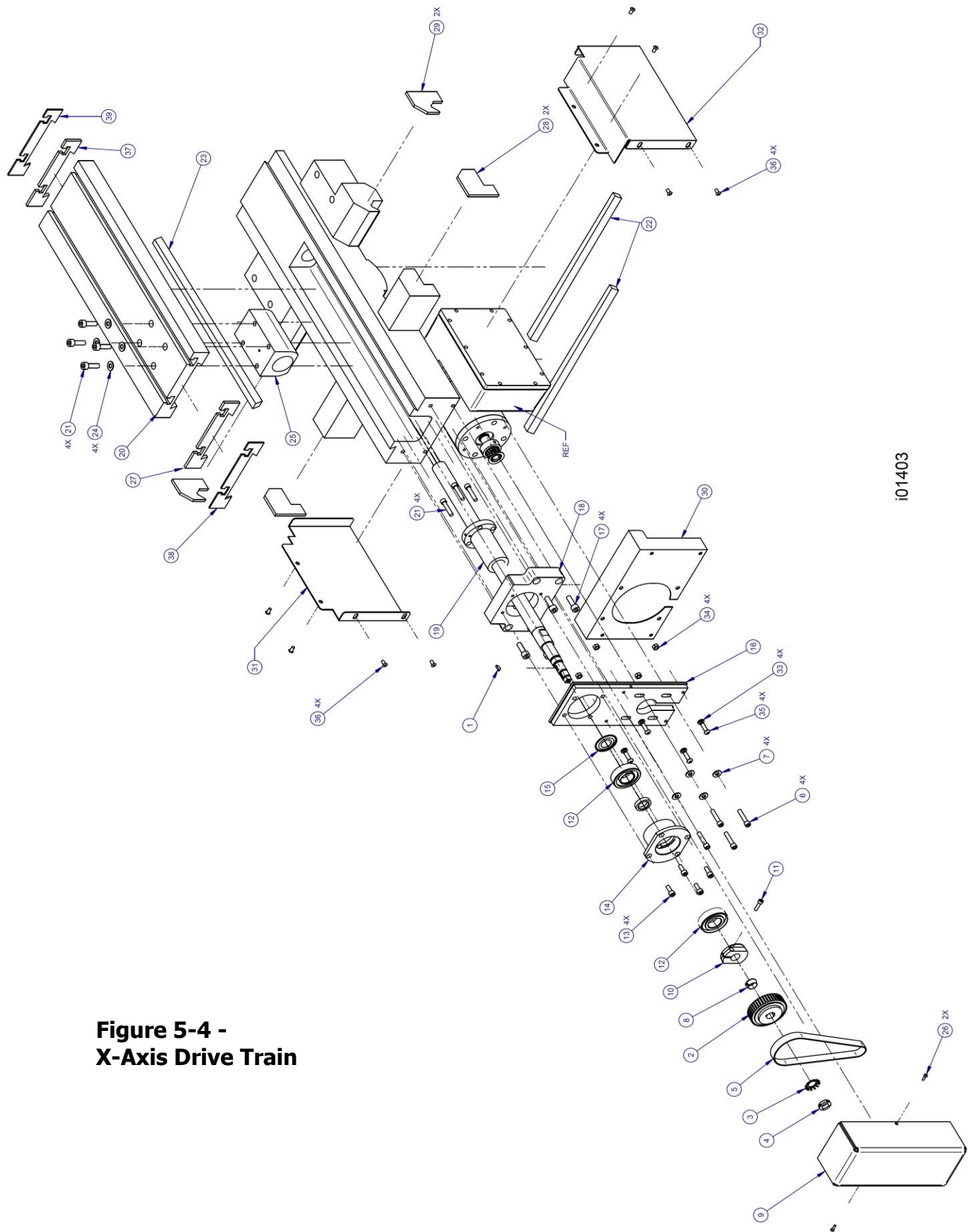
Figure 5-4 -
X-Axis Drive Train

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Parts List - X-Axis Drive Train (Figure 5-4)

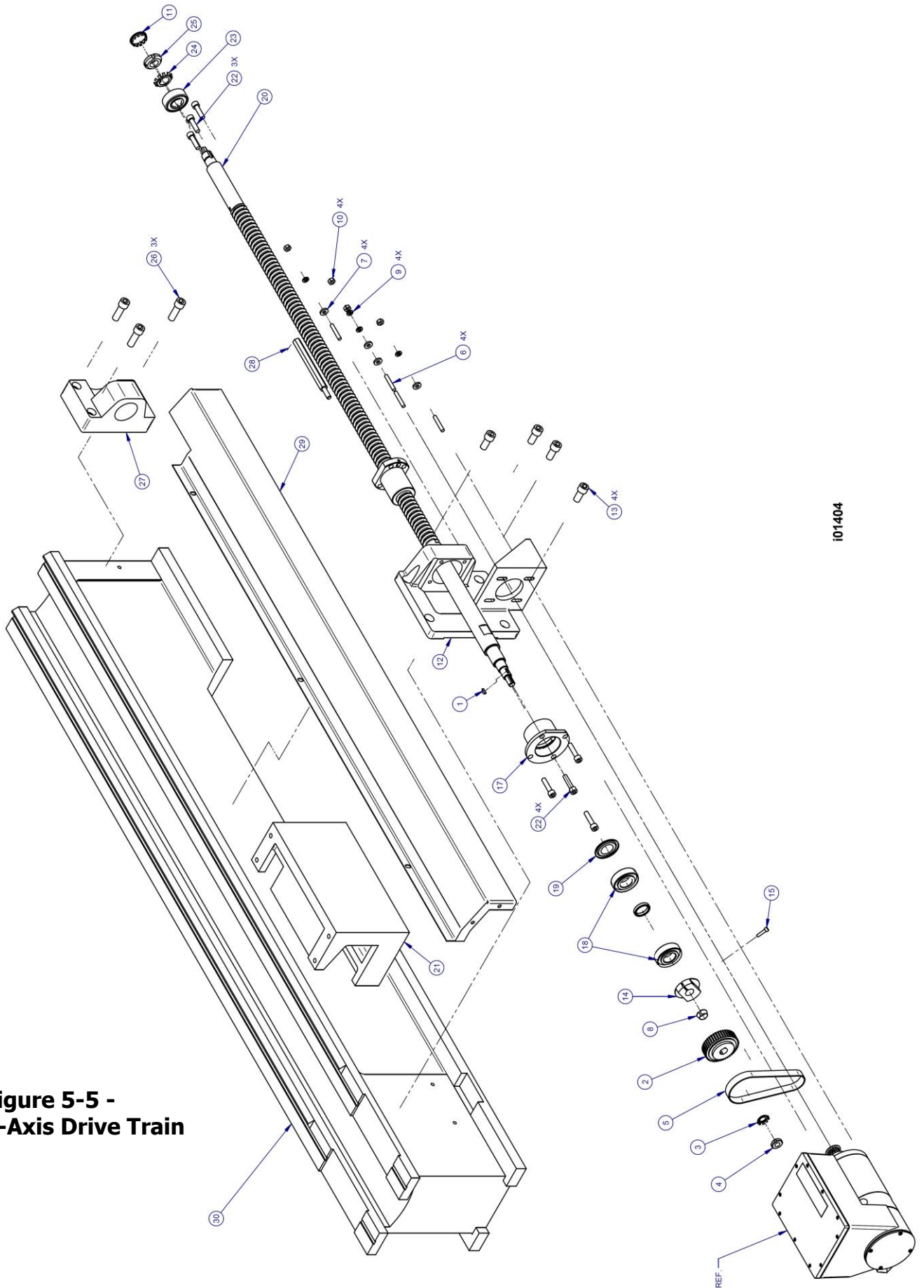| Item	P/N	Title	Qty
1	98481A090	KEY WOODRUFF #404-1/8 X 1/2	1
2	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES	1
3	W02	LOCKWASHER	1
4	NT02	NUT-LOCK	1
5	425-5M-15	BELT-TIMING 5MM POWERGRIP	1
6	1/4-20X1 1/4 25B	SCREW-SHCS-STL-BO	4
7	15759	WASHER-1/4 HARD BLK OX 1/8 THK	4
8	16350	FERRULE-SPROCKET	1
9	34263	COVER-X AXIS MOTOR PULLEY	1
10	16314	NUT CLAMP-X AXIS	1
11	10-32X3/4 25B	SCREW-SHCS-STL-BO	1
12	23930	BEARING SET(2)-ANGULAR CONTACT- 7204 BECBP	1
13	M6-1.0X30 25B	SCREW-SHCS-STL-BO	4
14	16300	BEARING HOUSING	1
15	7204-AVH	NILOS RING-7204	1
16	34261	PLATE-MOTOR	1
17	M5-0.8X6 25B	SCREW-SHCS-STL-BO	4
18	34262	CLAMPING BLOCK	1
19	20984	BALLSCREW-LX X-AXIS	1
20	34051	CROSS SLIDE	1
21	M8-1.25X25 25B	SCREW-SHCS-STL-BO	8
22	26122	GIB-Z AXIS(34018)	2
23	26123	GIB-X AXIS (34052)	1
24	24009-1	WASHER - BELLEVILLE SPRING LOCK	4
25	34061	YOKE	1
26	M5-0.8X12 25B	SCREW-SHCS-STL-BO	2
27	26169	CHIP WIPER CROSS SLIDE(2445 FRONT)	1
28	26170	CHIP-WIPER-SADDLE FRONT	2
29	26171	CHIP-WIPER-SADDLE REAR	2
30	26226	COVER-X-AXIS MOTOR-1440ELX	1
31	26226-1	COVER-X-AXIS MOTOR-1440ELX	1
32	26226-2	COVER-X-AXIS MOTOR-1440ELX	1
33	M6 73B	WASHER-SPLIT LOCK-STL-BO	4
34	M6-1.0 50B	NUT-HEX-STL-BO	4
35	M6-1.0X20 25B	SCREW-SHCS-STL-BO	4
36	M6-1.0X12 27B	SCREW-BHCS-STL-BO	8
37	26169-1	CHIP WIPER CROSS SLIDE(2448 REAR)	1
38	26230	CHIP WIPER CROSS SLIDE PLATE	1
39	26230-1	CHIP WIPER CROSS SLIDE PLATE	1

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5.1.11 Z-Axis Ballscrew Removal

1. Disconnect all power to the lathe.

2. Remove Z-axis motor belt.

3. Remove ballscrew pulley, bearing, and bearing housing on left end of ballscrew.

4. Remove bearing housing, locknut, and bearings from right side of ballscrew.

5. Disconnect ball nut from Z-axis yoke.

6. Disconnect oil line.

7. Remove ballscrew

**Figure 5-5 -
Z-Axis Drive Train**

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Southwestern Industries, Inc.
TRAK TRL Lathe, ProtoTRAK ELX CNC Safety, Installation, Maintenance, Service & Parts List

Parts List - Z-Axis Drive Train (Figure 5-5)

Item	P/N	Title	Qty
1	98481A090	KEY WOODRUFF #404-1/8 X 1/2	1
2	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES	1
3	W01	LOCKWASHER	1
4	N01	LOCKNUT	1
5	375-5M-15	BELT- TIMING	1
6	23053	STUD-1/4-20X1 1/2-FULLY THREADED-GRADE 2	4
7	15759	WASHER-1/4 HARD BLK OX 1/8 THK	4
8	16350	FERRULE-SPROCKET	1
9	1/4 73B	WASHER-SPLIT LOCK-STL-BO	4
10	1/4-20 50B	NUT-HEX-STL-BO	4
11	21155	PLUG-Z-AXIS COVER	1
12	26150	BRACKET-Z-AXIS MOTOR	1
13	M12-1.75X25 25B	SCREW-SHCS-STL-BO	4
14	16452	NUT CLAMP-X ,Y, & Z-AXIS	1
15	10-32X3/4 25B	SCREW-SHCS-STL-BO	1
17	16295-1	HOUSING- BEARING Z-AXIS	1
18	23940	BEARING SET (2) -ANGULAR CONTACT-7205 BECBP	1
19	7205-AVH	NILOS RING-7205	1
20	24704	BALLSCREW - Z-AXIS	1
21	26151	YOKE-Z-AXIS	1
22	M8-1.25X30 25B	SCREW-SHCS-STL-BO	7
23	22446	BEARING-SELF ALIGNING	1
24	W04	LOCKWASHER	1
25	N04	LOCKNUT	1
26	M12-1.75X45 25B	SCREW-SHCS-STL-BO	3
27	26152	HOUSING-TAILSTOCK BEARING	1
28	26153	STOP	1
29	26154	COVER-Z-AXIS	1
30	93501	BED-1440 LATHE	1

i01404

5.1.12 Z-Axis Ballscrew Alignment

See figure 5-3.

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 ballscrew manually and move the carriage to the tail stock end.

6. Tighten the yoke; this will align it vertically.

7. Tighten the tailstock bearing housing.

8. Loosen the yoke and retighten to realign ball horizontally.

9. Using a 3/8" socket extension, move the carriage to the headstock.

10. Tighten the Z-axis housing.

11. Tighten the bearing housing.

12. Turn the ballscrew manually with the 3/8" socket extension and move the carriage to the middle of the travel.

13. Loosen the yoke mounting bolts to readjust the apron plate after the bearings have been tightened.

14. Retighten the yoke.

15. Move the ballscrew manually and move the carriage through the entire length of the Z-axis. Pay special attention to the areas near the headstock, tailstock, and in the middle of the travel. If there is any binding or rough spots, the alignment procedure must be repeated. The axis should feel equally free throughout the entire range.

16. Using a torque wrench, measure the torque to move the Z-axis at each end, and in the middle of the axis travel. The torque reading should be a maximum of 10-15 in-lb.

5.1.13 Headstock Taper Adjustment

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

To adjust the headstock alignment, loosen the four socket head cap screws that attach the headstock housing to the bed. Using the adjusting screw located at the rear of the headstock, (see figure 5-4) 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.

Adjusting screw

Headstock fixing screw

Headstock fixing screw
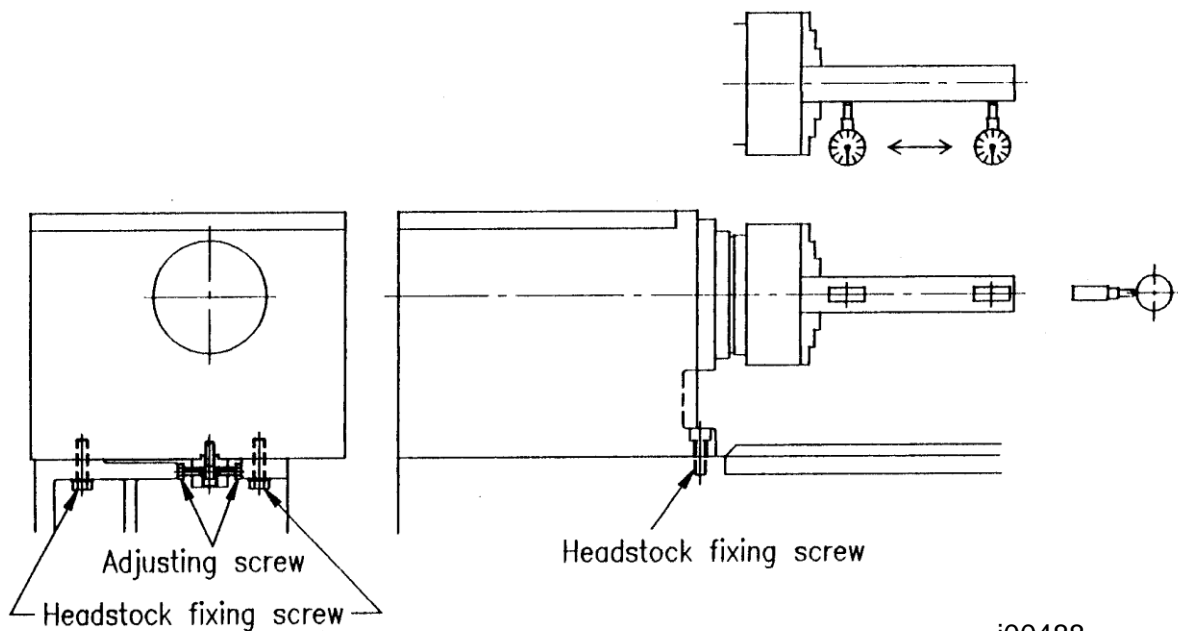
i00488

**Figure 5-6 -
Headstock Taper Adjustment**

5.1.14 Spindle Bearing Preload

1. Run the lathe for 10 minutes to insure the bearing are lubricated and slightly warmed. Run the lathe at 450 RPM.

2. Place lathe in neutral by positioning left shift lever between low and medium range. With a rolling torque meter, check the rolling torque on the spindle. The acceptable range of rolling torque is 10-15 in-lb.

3. If torque is out of tolerance, remove the spindle belt guard and the rear bearing cover to gain access to the spindle-adjusting nut. Loosen the three setscrews on the spindle-adjusting nut before tightening or loosening (figure 6-6). The spindle-adjusting nut is outside the gearbox, so the headstock access cover will not need to be removed.

4. Torque too low: Lock the spindle in low gear. With a spanner wrench tighten the adjusting nut. Return the speed selection lever to the neutral position. Measure the rolling torque and repeat until 10 – 15 in -lb. of rolling torque is achieved. Tighten the three setscrews to retain the adjustment.

5. Torque too high: Lock the spindle in low gear. With a spanner wrench loosen the adjusting nut two full turns. Place an aluminum block over the end of the spindle and with a hammer drive the spindle forward until it is loose. (Near zero rolling torque) With a spanner wrench tighten the adjusting nut. Return the speed selection lever to the neutral position. Measure the rolling torque and repeat until 10 - 15 in -lb. of rolling torque is achieved. Tighten the three setscrews to retain the adjustment.

5.1.15 Aligning Tailstock to Spindle

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

1. Insert a gauge mandrel between centers in both the spindle and tailstock with the tailstock quill retracted as much as possible. Attach a magnetic base indicator to the cross slide and contact the side of the mandrel with the indicators stylus. Move the carriage in the Z-axis direction from end to end of the mandrel and record the indicator reading.

2. Release the tailstock clamping lever holding the tailstock to the bed.

3. Adjust screws A on both sides of the tailstock to move the tailstock laterally across the tailstock base until desired alignment is achieved. Lock both screws to retain alignment.

4. Lock the tailstock clamping lever and indicate the mandrel to confirm desired alignment.

i01429
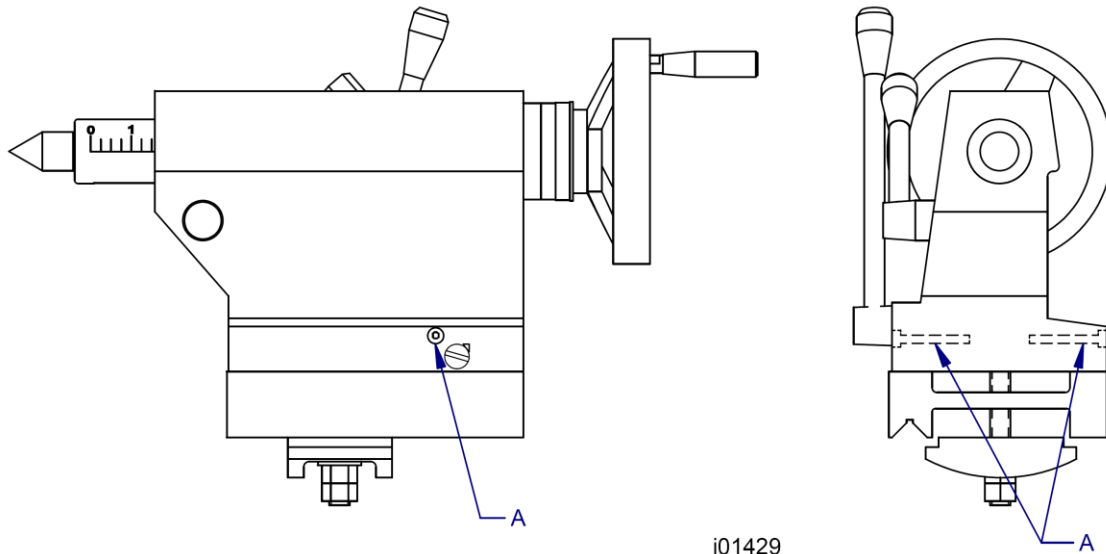
Figure 5-7 - Tailstock Adjustment

5.1.16 Spindle Motor Wiring

The TRAK TRL 1440 spindle motor can be wired for 220 or 440 volts. The wiring consists of 3-phase power for the motor and 110 V power for the spindle motor fan. Please see the motor junction box diagram for wiring information.

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

The spindle motor fan wires are also found in the junction box. There is 1 hot wire, 1 neutral wire and 1 ground wire. It does not matter which wires are connected to the hot and neutral wires. The ground screw in the box is identified on the block diagram in the junction box lid. Any wire there should be green or green/yellow.

5.1.17 Spindle Removal (See figures 6-7 and 6-11)

The following procedure is to remove the spindle for the 1440EX lathe.

1. Remove Z-axis servomotor cover to gain access to two screws that hold belt guard sheet metal.

2. Remove headstock nameplate attaching screws.

3. Remove belt guard.

4. Remove headstock cover, item 2 on figure 6-6.

5. Remove proximity sensor and its mounting bracket. See figure 5-2.

6. Remove proximity ring from the spindle.

7. Remove cover item #17. See figure 6-10 for the items mentioned below.

8. Remove locknut item #15

9. Remove chuck guard assembly

10. Remove socket head cap screws item #6

11. Remove snap ring item #13

12. Cover end of the spindle with an aluminum drift.

13. Using a mallet to drift the spindle forward to remove.

14. Slide gears item #10 and #11 off of the spindle as it is moved forward.

15. Spindle will remove with item #4 and bearing cone from item #5.

5.1.18 Gear Shifting Lever Removal

In order to remove the gear shifting lever, it is necessary to use an M6 tap to remove the detent plunger as shown in figure 5-7. The detent plunger holds the gear shifting lever in place on the 3.5 mm groove.
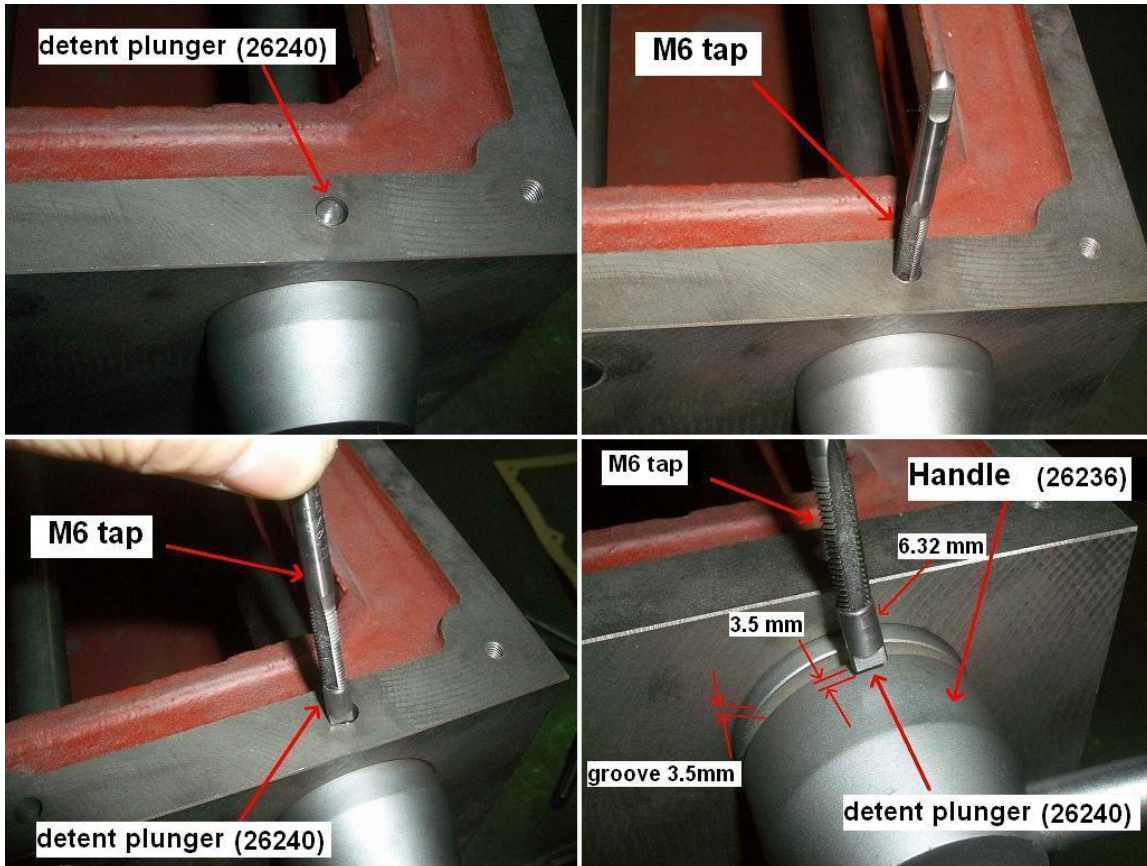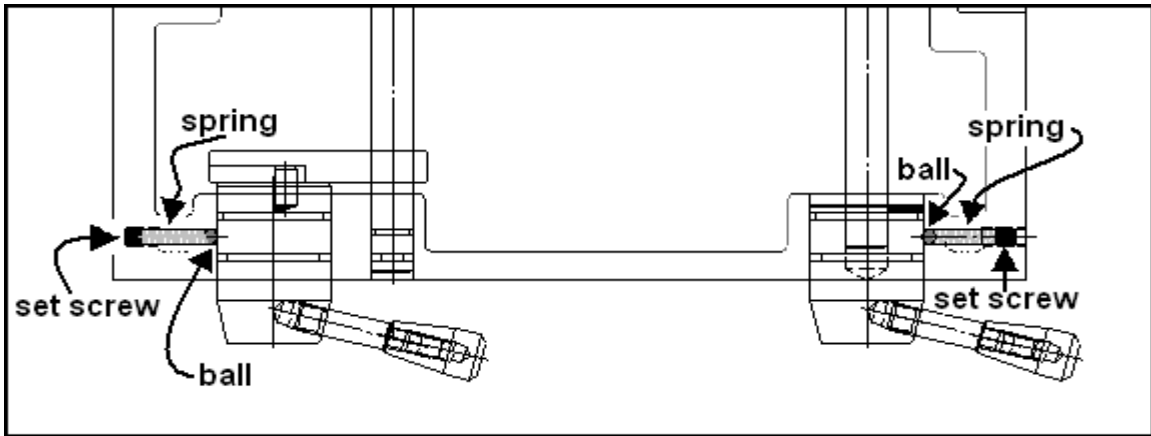

**Figure 5-8 -
Gear Shifting Lever Removal**

5.1.19 Shift Lever Detent Adjustment

The shift levers should firmly lock into place. If they feel loose, then it may be necessary to adjust the pressure the ball bearing has in the detent of the shift lever.
See figure 5-9.

1. Remove the sheet metal on both sides of the headstock.

2. Locate the set screws as shown in figure 5-8.

3. Tighten the set screw to tighten the shift lever, loosen the set screw to loosen the shift lever.

Figure 5-9 -
**Shift Lever Detent Adjustment**

5.2 Maintenance

5.2.1 Gib Adjustments

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

5.2.1.1 Cross Slide Gib Adjustment

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

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

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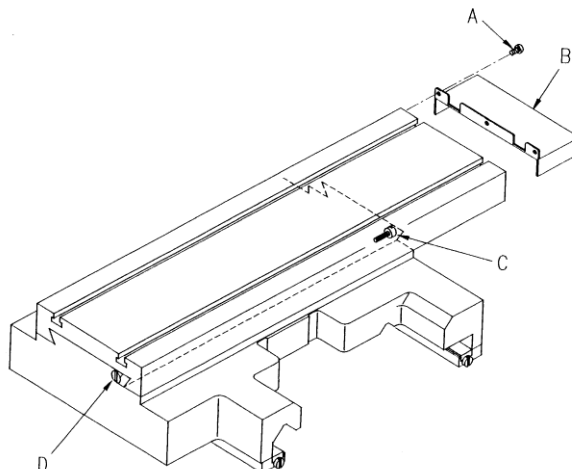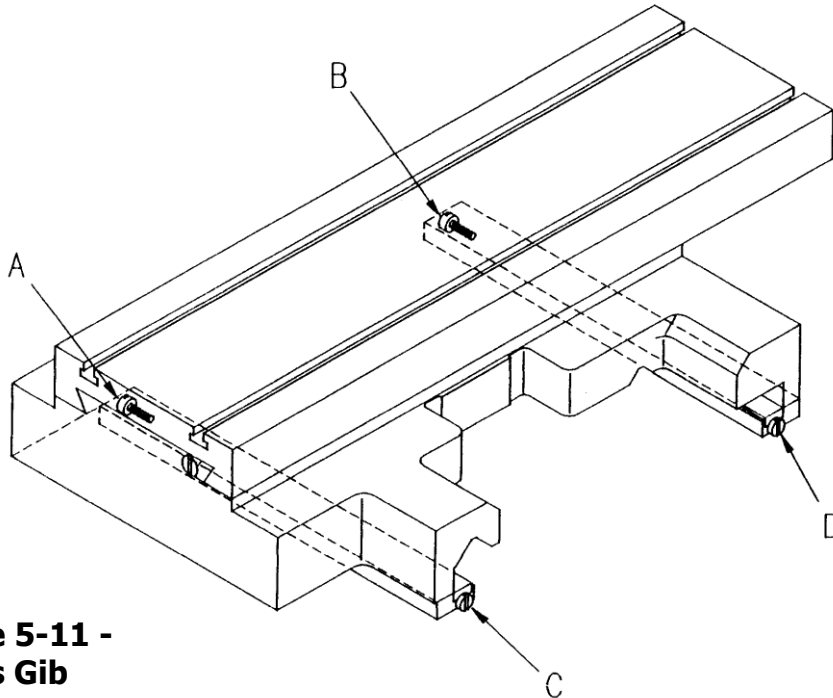

Figure 5-10 -
X-Axis Gib

5.2.1.2   Z-Axis Gib Adjustment

1. Mount a dial indicator on the Z-axis ways and locate on top of the carriage.

2. Lift the carriage up to measure the amount of play. The dial indicator should not move more than 0.001". If it moves more, tighten the gibs. Make sure not to over tighten the gibs.

3. This procedure with the dial indicator will need to be done in the front and rear of the saddle.

Note: The two Z-axis gibs are in opposite configuration with respect to one another. In other words, the thick and thin ends are on opposite sides.

**Figure 5-11 -
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 to teach the machine a known distance. We typically calibrate our machines over a 150 mm distance. There is no limit to how far you can calibrate the machine.

5.2.2.1   Calibration

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

1. Recheck machine level and adjust as necessary.

2. Press the "SERV CODE" soft key.

3. Input 123 on the keyboard, then press the "INC SET" key.

4. Input the "X" key to tell the control the X-axis is being calibrated.

5. Place the .0001 indicator in the spindle and set up the metric standard on the cross slide. Make sure the standard is parallel to the cross slide by using a combination square. Ensure that the standard is set up so that the readings will be taken with the cross slide extended towards the operator and moving in towards the motor end of the X-axis.

6. When the indicator is zeroed at the beginning of the standard press the "INC SET" key.

7. Move the cross slide towards the motor side of the X-axis until the indicator zeros on the end of the standard. Input 300 on the keyboard.

8. If the calibration was successful the screen will return to the set up screen.

9. Press the "SERV CODE" soft key.

10. Input 123 on the keyboard, then press the "INC SET" key.

11. Press the "Z" key to tell the control that the Z-axis is being calibrated.

12. Set up the metric standard on the Z-axis ways.

13. Set up the magnetic base and .0001 indicator on the cross slide.

14. When the indicator is zeroed at the beginning of the standard press the "INC SET" key.

15. Move the saddle towards the chuck until the indicator zeros on the end of the standard, then press the "INC SET" key.

16. Input 150 on the keyboard.

17. If the calibration is successful the screen will change to the set up screen.
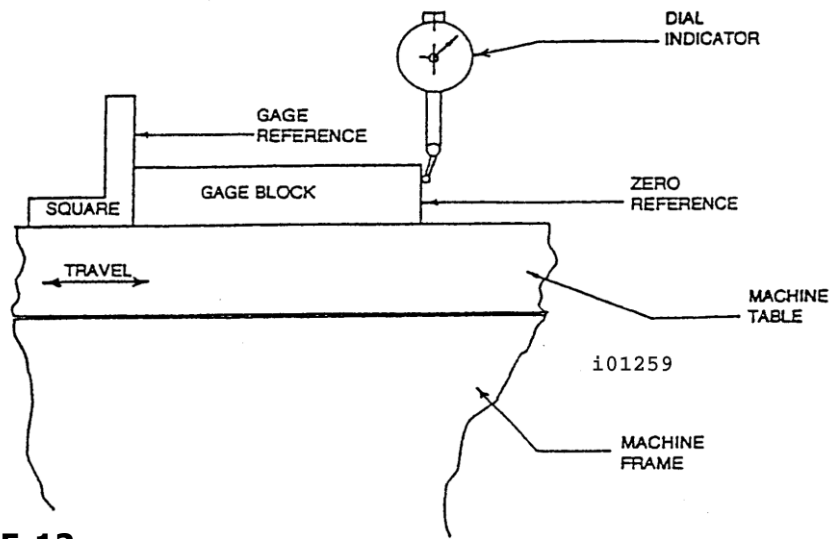
**Figure 5-12 -
Calibration Set-Up**

5.2.2.2 Backlash Compensation

Code 127: Calculate X or Z Backlash Constant

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

1. Set a .0001-inch dial indicator in the spindle, and touch off on a block 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 press of INCR VALUE or DECR VALUE.
g. The following is an example of what you might see when running this code.	For example, if the up and down "Oscillation Value" shown in the conversation line is .00278 inch, and the dial indicator is moving back and forth .0012, then the true backlash value is .00278 -.0012 = .00158 inch. Input this by pressing MODE, SET UP, SERV CODE, 128, SET and then .00158, SET, RETURN.

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

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

- Load the indicator to zero from one direction and zero out the DRO.

- Move the indicator to 0.002" and then back to zero. Do not over shoot 0, otherwise start over.

- Whatever number appears on the screen is the backlash value.

- Enter this value into service code 128.

- After entering this number redo the process. The DRO and indicator should now both read 0.

CODE 128: Input Backlash Constant

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

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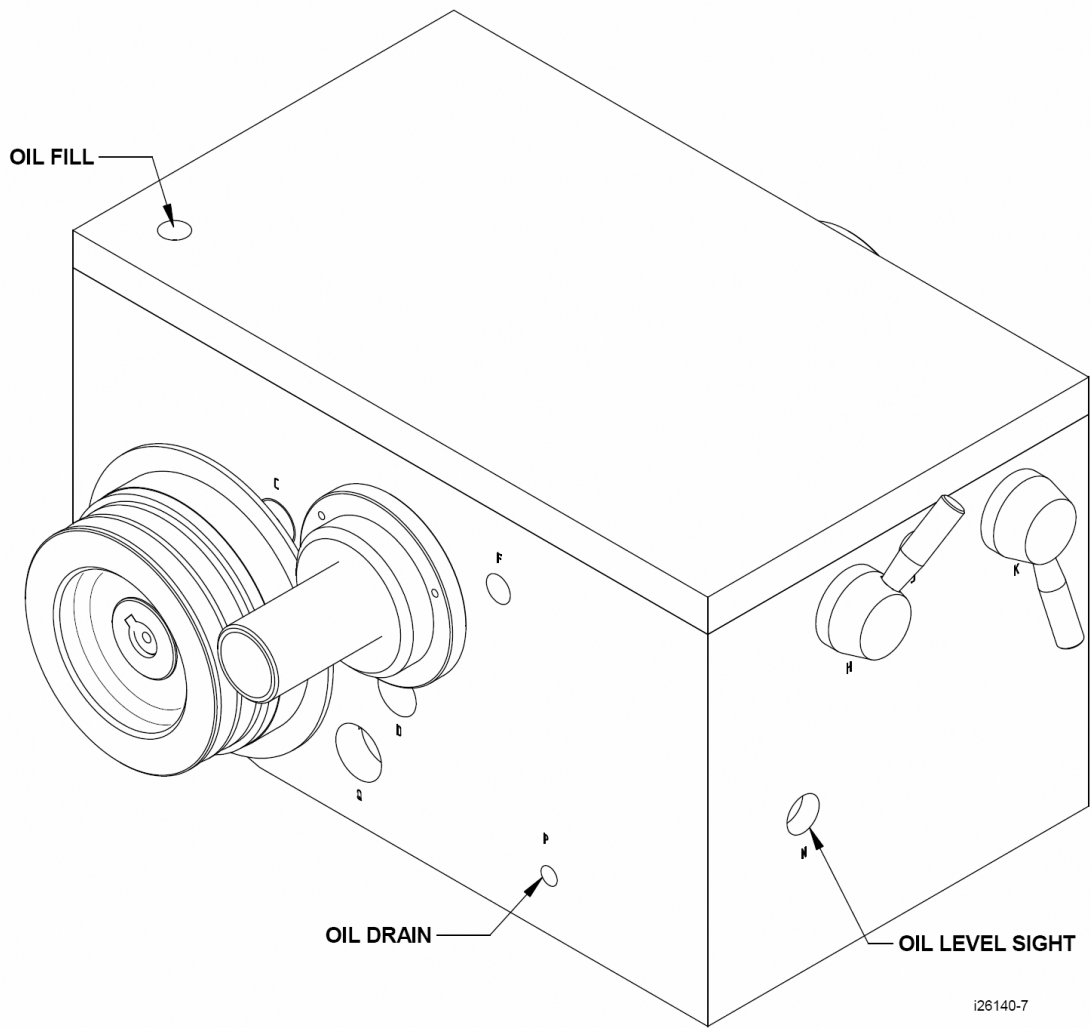
5.2.3 Lubrication

5.2.3.1 Headstock Lubrication

A splash system provides lubrication for an even distribution of oil to all the gears and bearings in the headstock. A site glass on the front of the headstock displays the oil lever. Periodically check to see that oil is present.

The plug to drain the headstock is located under the spindle cover towards the bottom of the casting. See figure 5-12. Oil can be added through the cover on top of the headstock. The headstock reservoir holds approximately 3 gallons. Fill the headstock with SAE 30 weight 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, as that will soften the paint. Thereafter, the oil should be flushed and drained every 1500-2000 hours of operation.

OIL FILL

OIL DRAIN

OIL LEVEL SIGHT

i26140-7

**Figure 5-13 -
Headstock Oil Fill and Removal**

5.2.3.2 Way Lubrication

The TRAK Lathe lube system provides centralized lubrication for the carriage, cross slide and ballscrews. The lube pump has a ½ quart reservoir filled with Mobil Vactra Oil No. 2 or non-detergent 30 weight.

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

We recommend that you manually pump the oil 5-10 times at the start of every day and every hour during the day.

CAUTION!
Failure to properly lubricate the lathe will result in the premature failure of ballscrews and sliding surfaces.
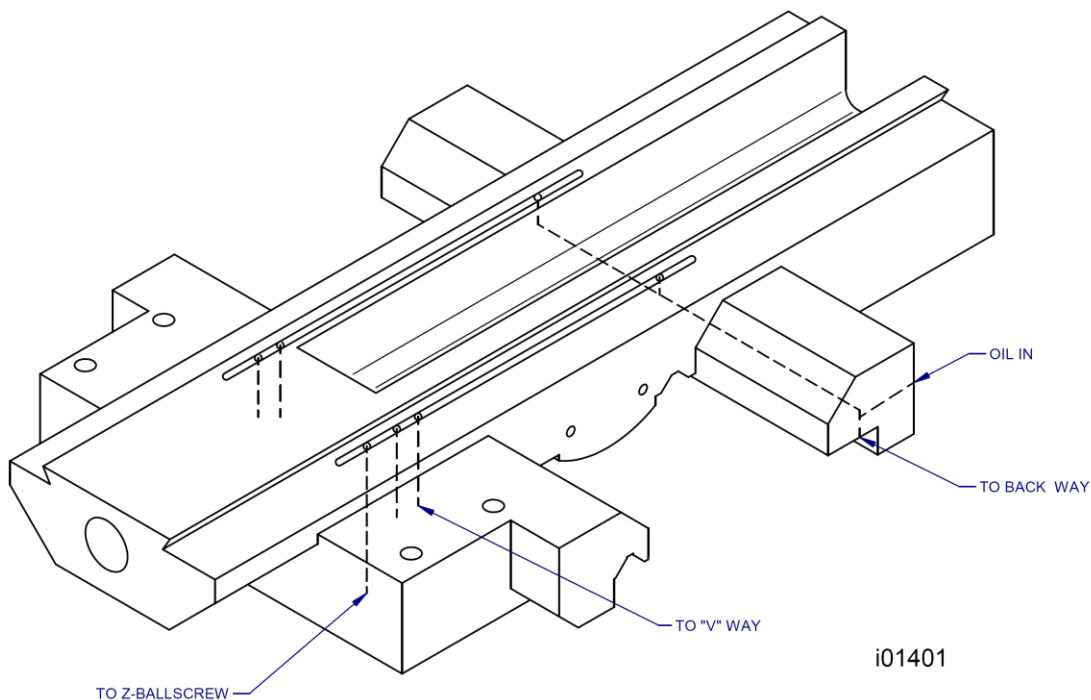
Figure 5-14 -
Way Lubrication

5.2.3.3   Tailstock

Two 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.

OIL

i01411
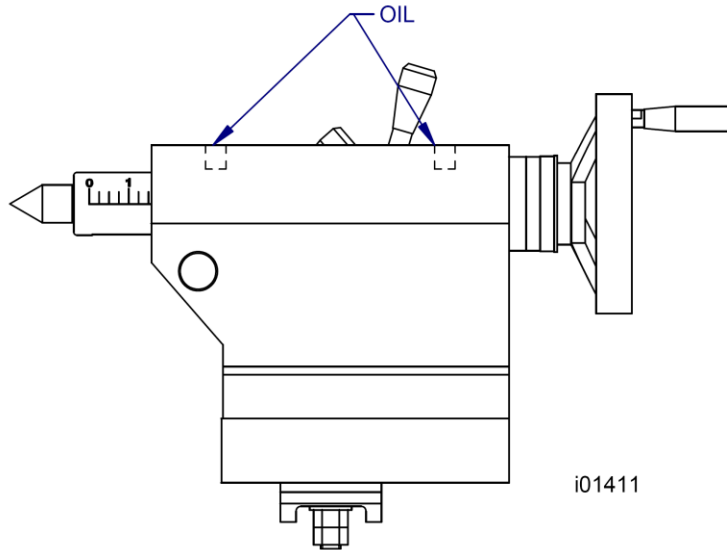
**Figure 5-15 -
Tailstock Lubrication**

5.2.3.4   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 SAE 30 lubricating oil.

6.0 Drawings & Parts Lists
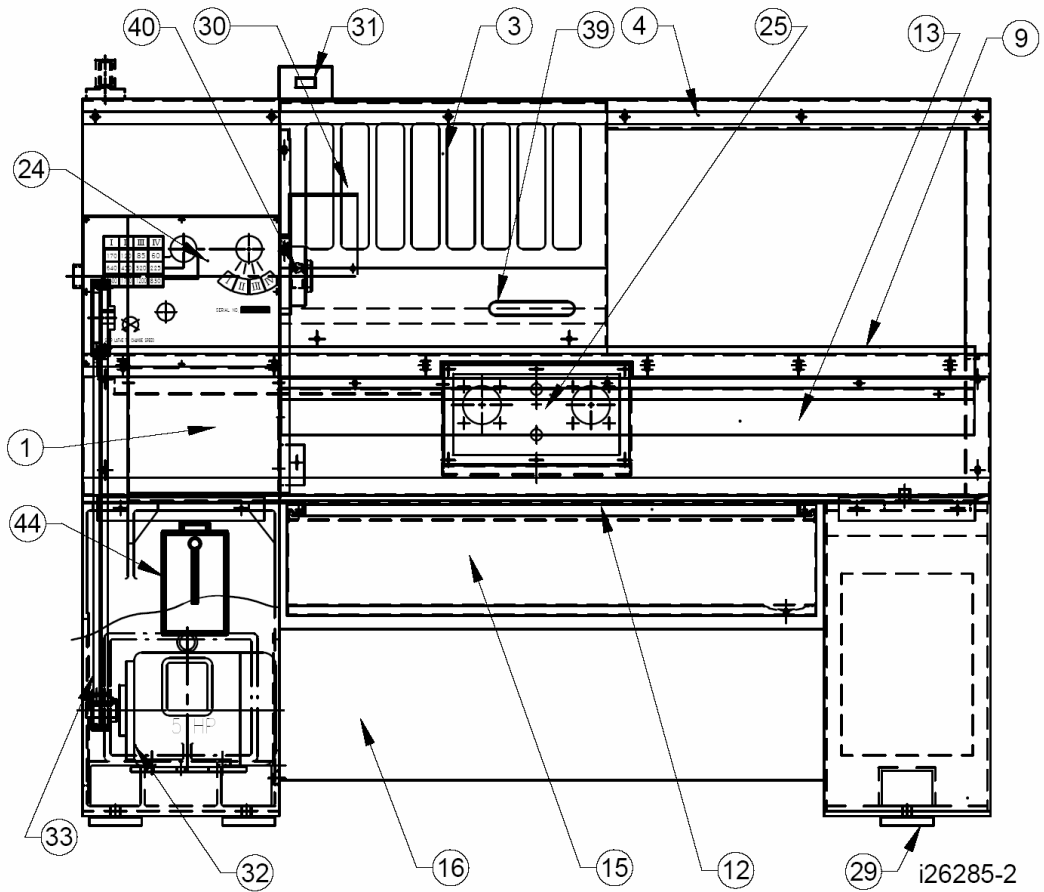
**Figure 6-1 - 1440EX -
Overall Machine Drawing - Front View**
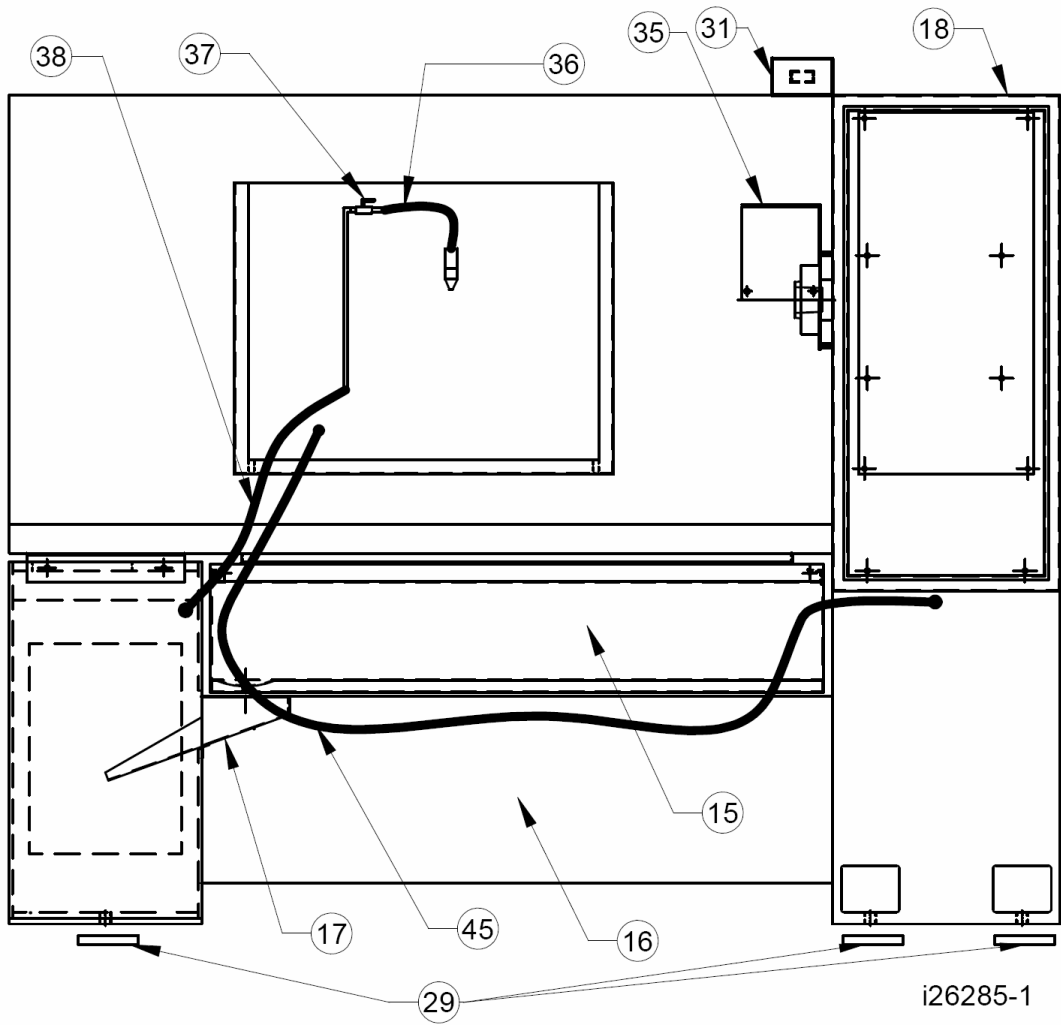
**Figure 6-2 - 1440EX -
Overall Machine Drawing - Rear View**

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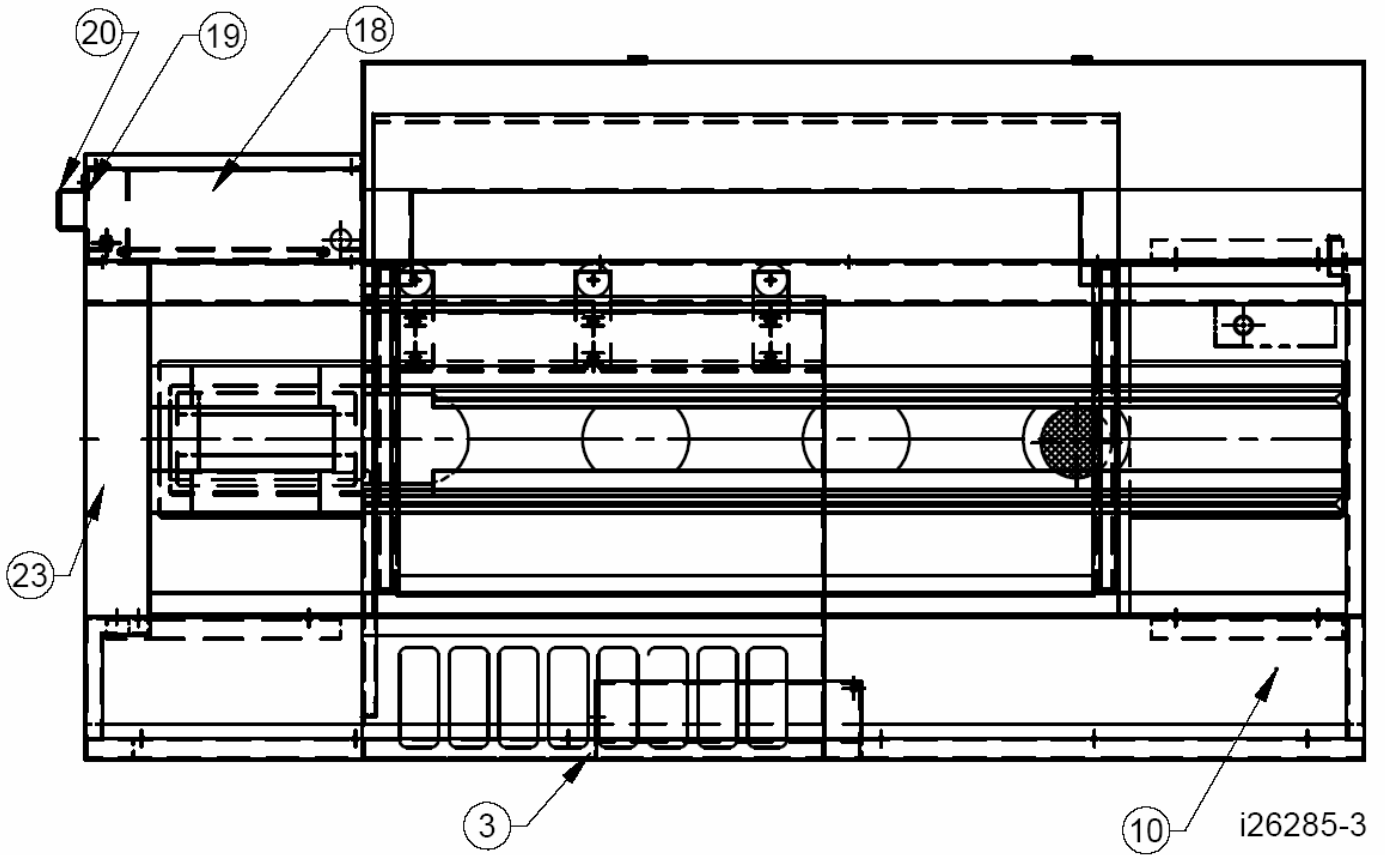
**Figure 6-3 - 1440EX -
Overall Machine Drawing - Top View**
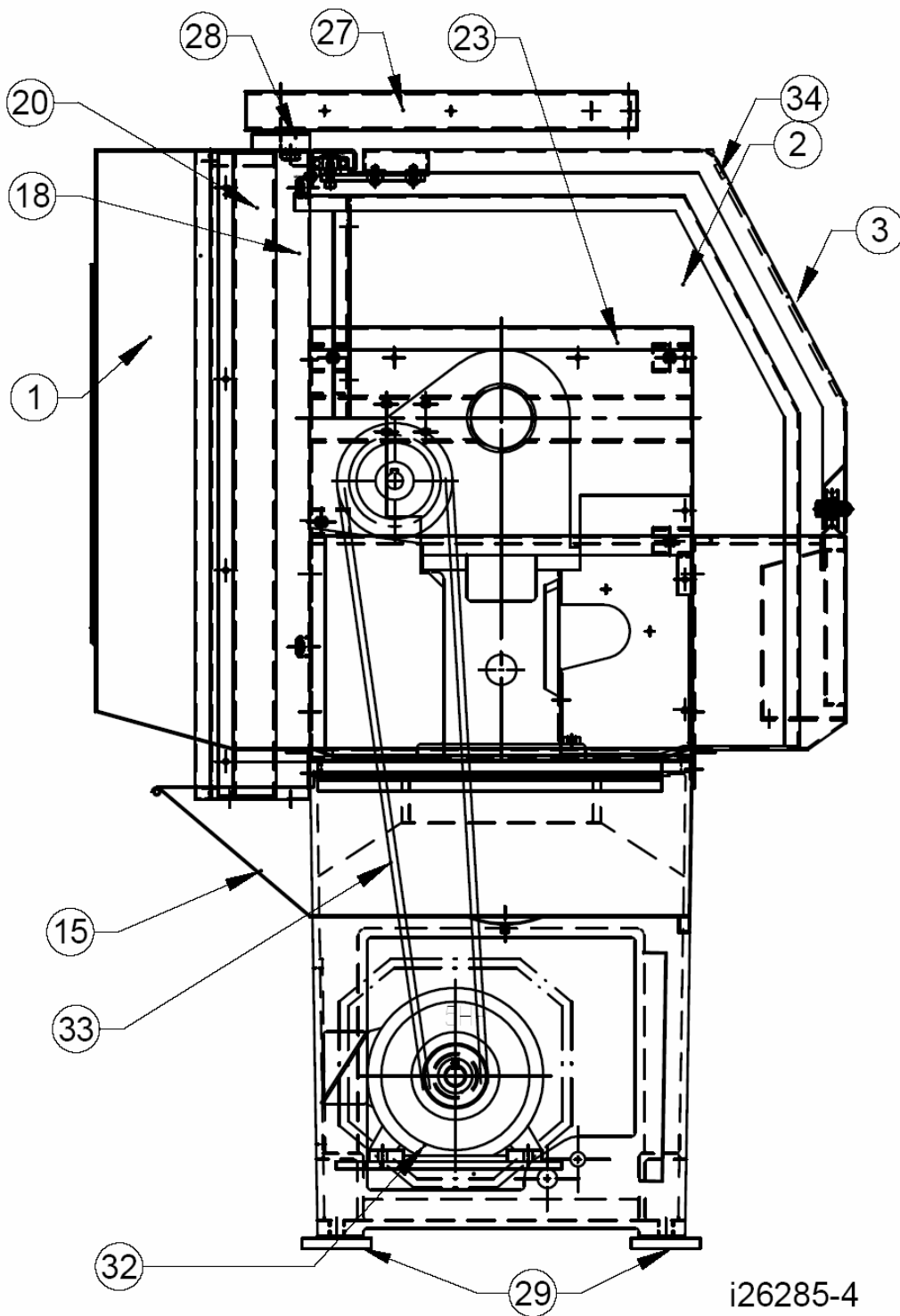
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i26285-4

Figure 6-4 - 1440EX -
Overall Machine Drawing - Left Side View

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i26285-5

**Figure 6-5 - 1440EX -
Overall Machine Drawing - Right Side View**

Parts List - 1440EX - Overall Machine (Figures 6-1 to 6-5)

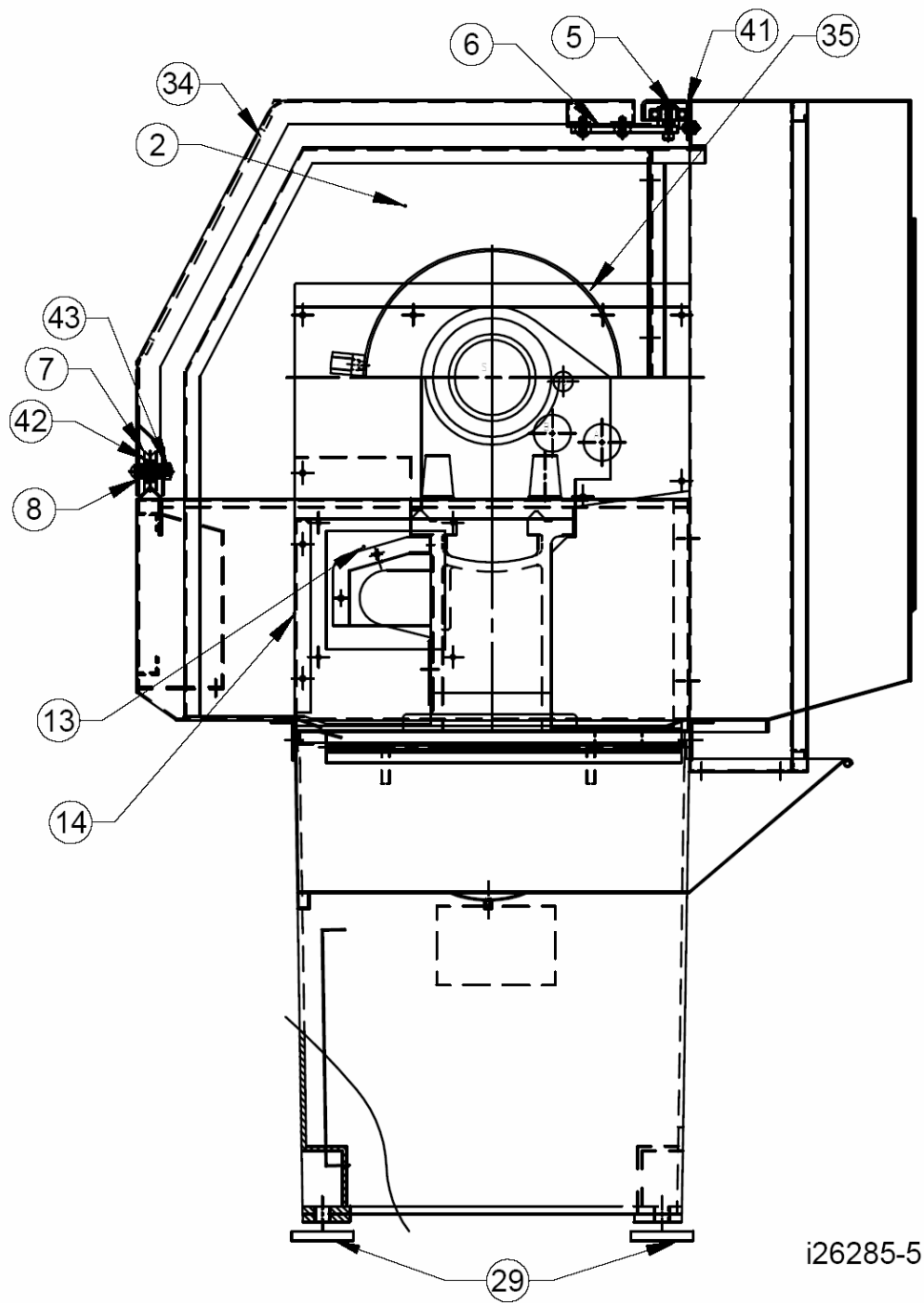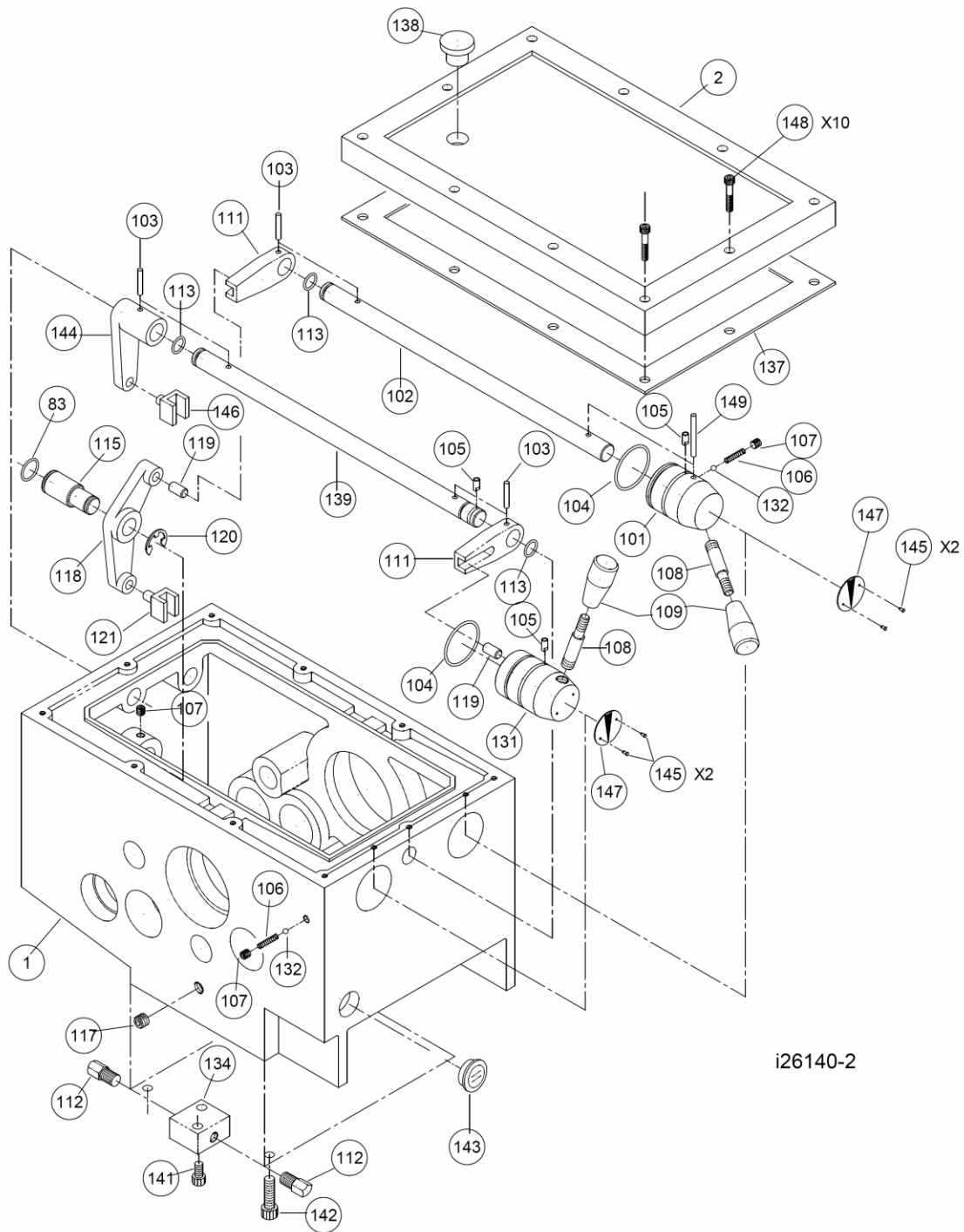| Item	P/N	Title	Qty
1	26286	Guard - Splash	1
2	26287	Plate - Front - Headstock	1
3	26288	Door - Front	1
4	26289	Guide - Upper	1
5	26290	Shaft - Bearing - Door - Upper	2
6	26291	Plate - Support	2
7	26292	Roller - Door	2
8	26293	Collar	2
9	26294	Guide - Track	1
10	26295	Tray - Chip	1
12	26297	Tray - Chip - Bottom	1
13	26298	Cover - Z-Axis - Ballscrew	1
14	26299	Cover - Z-Axis - Motor	1
15	26300	Tank - Chip	1
16	26301	Plate - Front	1
17	26302	Chute	1
18	26303	Enclosure - Electrical	1
19	26304	Cover - Cable Way	1
20	26305	Cable Way	1
22	26068-1	Electrical Panel Assy – 1440EX	1
23	26307	Cover - End	1
24	26308	Name Plate - Headstock	1
25	26309	Plate - Cover - Handwheel	1
27	26311	Arm - Display	1
28	26312	Pad - Pendant Leveling	1
29	26331	Pad - Leveling	6
30	26322 26322-1	Safety Glass – Door (old style) Safety Glass – Door (new style)	1
31	22684	Cable Assy-Door Switch	1
32	26329	Motor - Spindle	1
33	26330	Belt - Spindle Motor	2
34	26320	Frame - Window	1
35	26324	Guard - Chuck	1
36	26161	Nozzle - Coolant	1
37	26162	Valve - Coolant	1
38	26166	Hose - Flexible	1
39	26323	Handle - Door	1
40	26325	Knob - Guard - Chuck	1
41	26198-1	Bearing – Deep Groove – 6204ZZ	3
42	26327	Bearing – Deep Groove – 6000ZZ	2
43	26328	Shaft - Bearing - Lower - Door	1
44	26332	Pump - Oil	1
45	26333	Hose - Oil - Flexible	1

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Figure 6-6 - 1440EX -
Headstock Drawing - Controller Box

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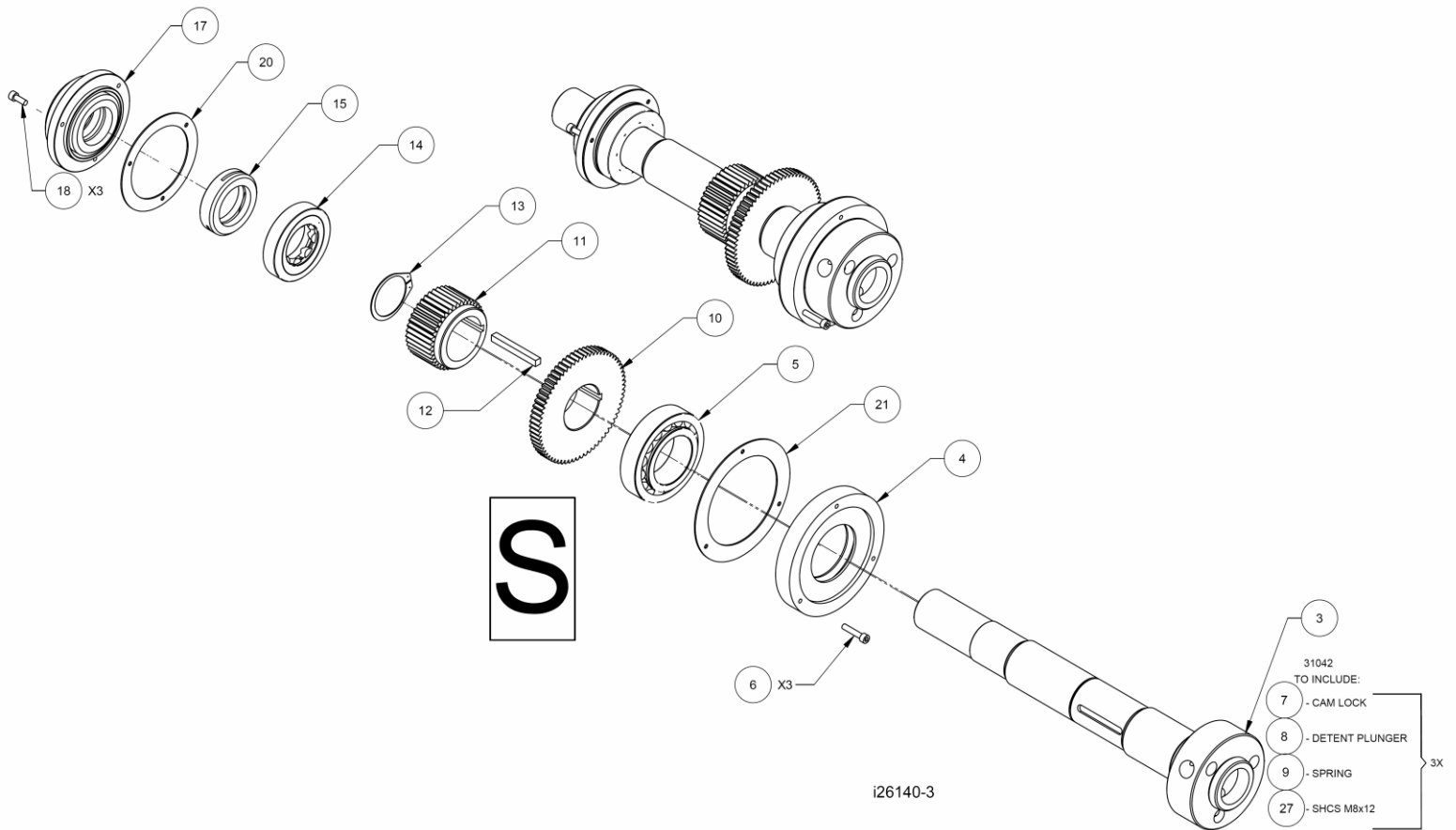
**Figure 6-7 - 1440EX -
Headstock Components - Spindle Assembly**

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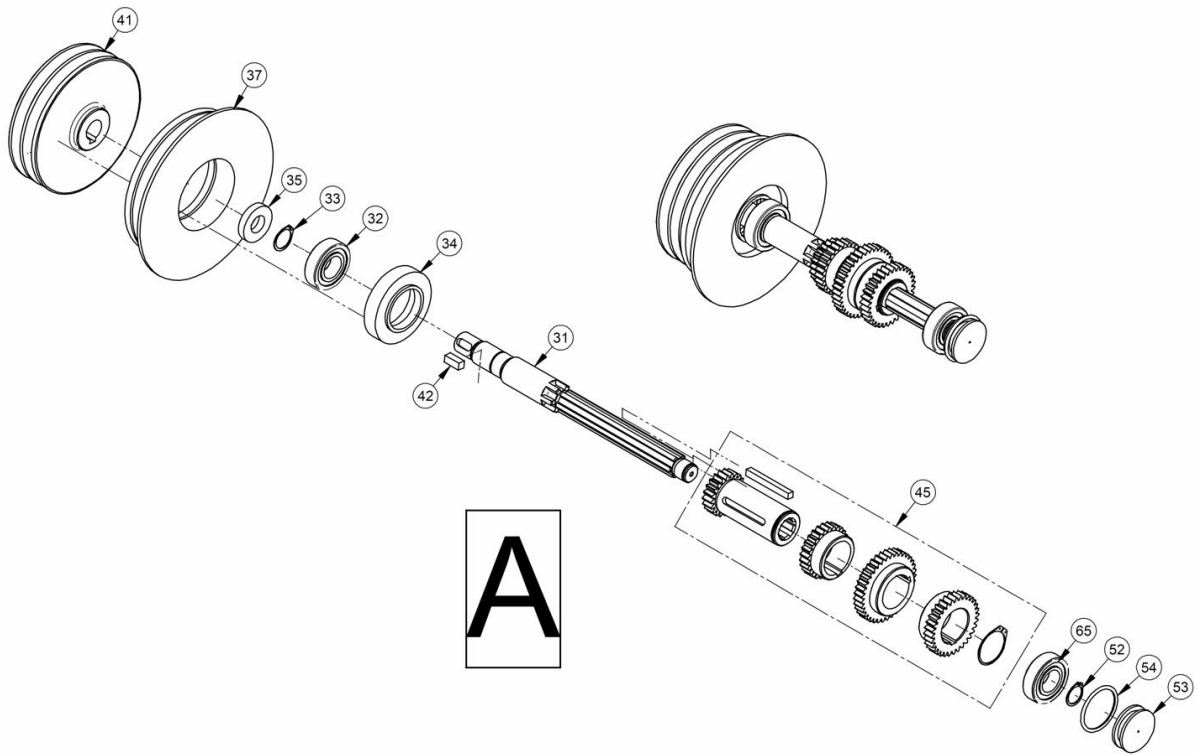
PULLEY SHAFT "A" ASSEMBLY

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Figure 6-8 - 1440EX -
Headstock Components - Pulley Shaft
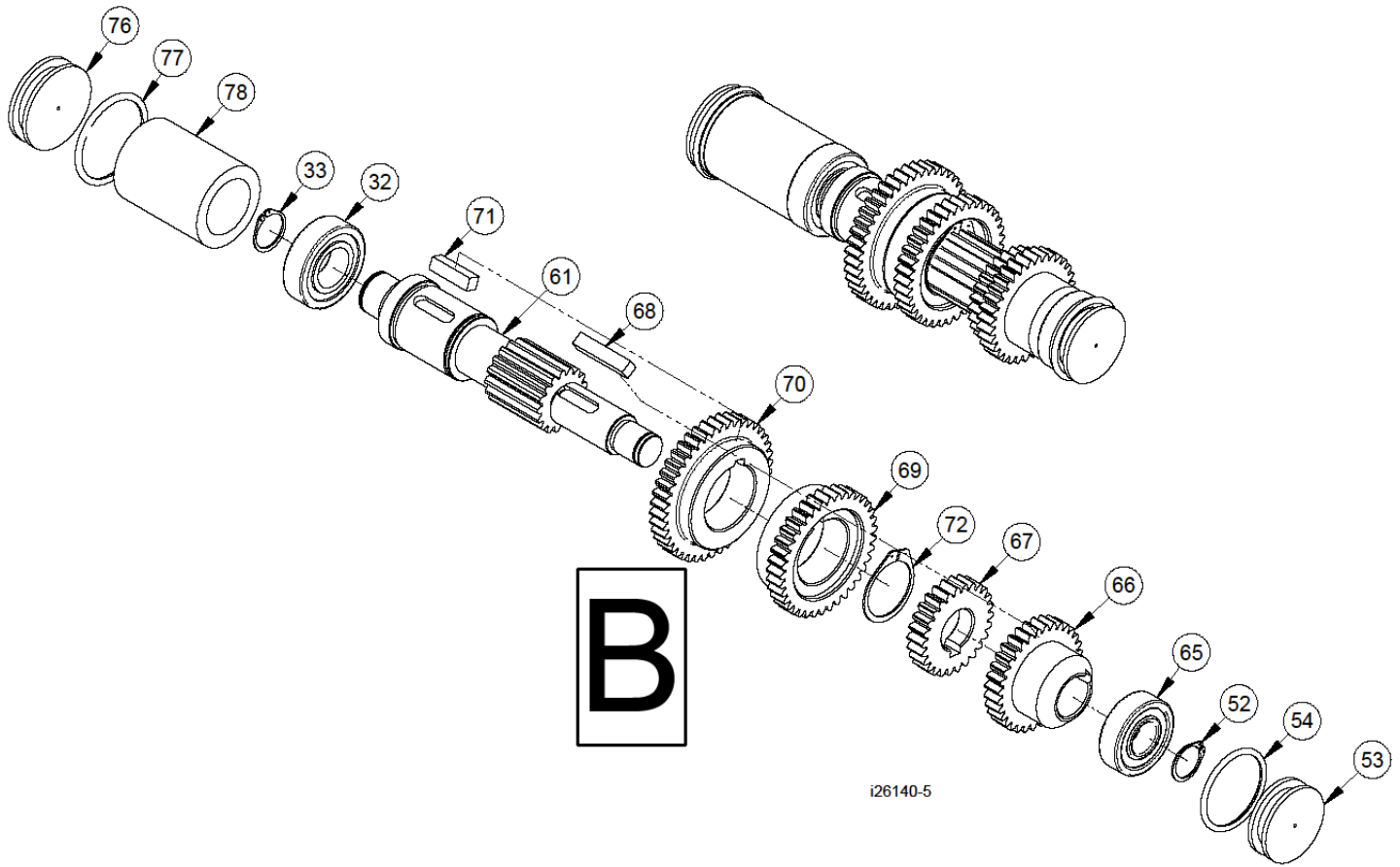
**Figure 6-9 - 1440EX -
Headstock Components - Intermediate B Shaft**

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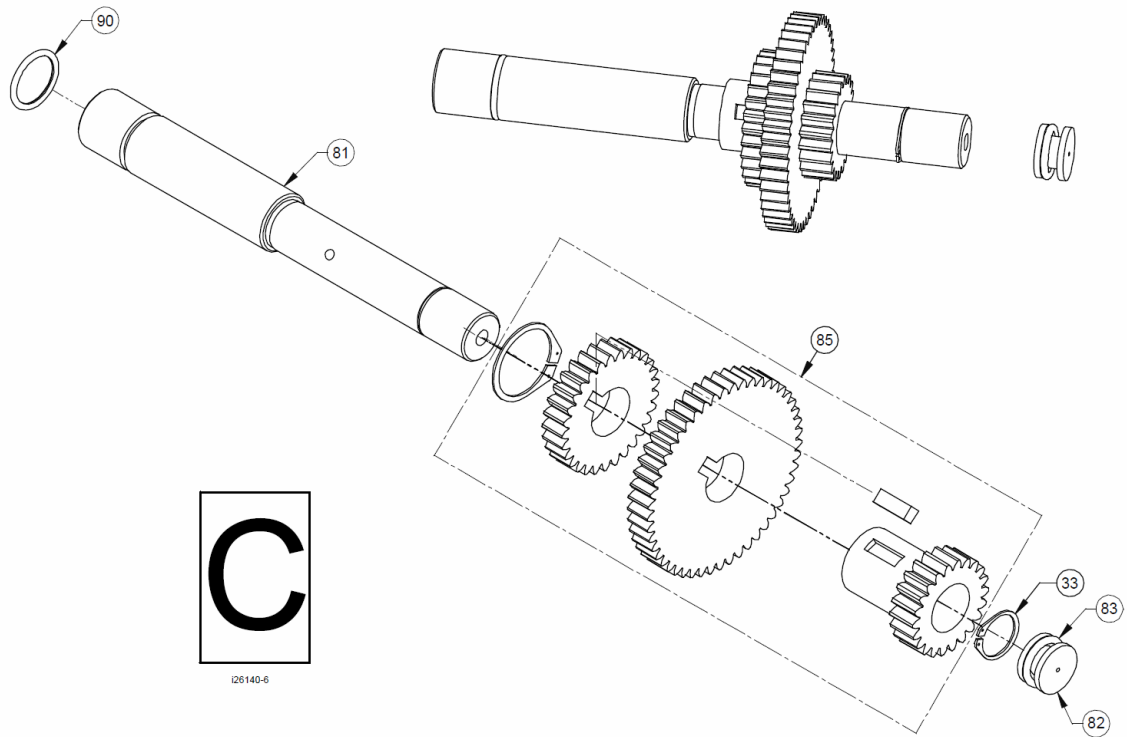
**Figure 6-10 - 1440EX -
Headstock Components - Intermediate C Shaft**

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TRAK TRL Lathe, ProtoTRAK ELX CNC Safety, Installation, Maintenance, Service & Parts List
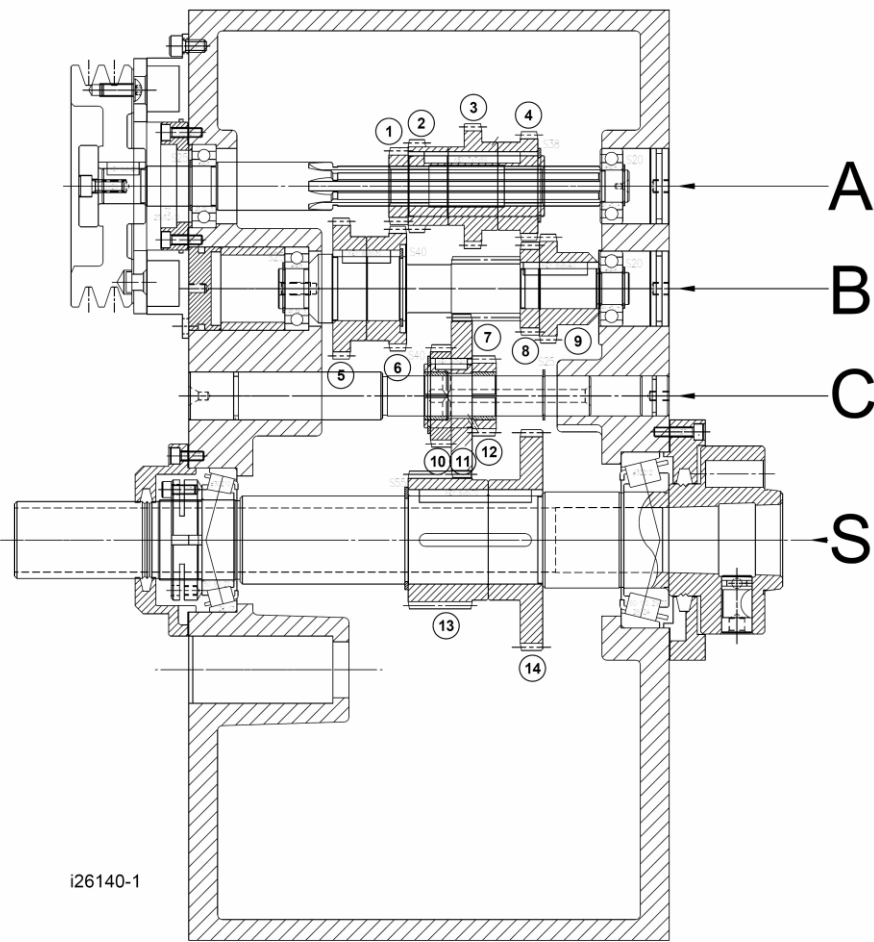
1440 ELX Gear Mesh Matrix

Spindle RPM	Shaft A to Shaft B	Shaft B to Shaft C	Shaft C to Spindle S
60	1-5	7-11	12-14
85	2-6	7-11	12-14
120	4-9	7-11	12-14
170	3-8	7-11	12-14
225	1-5	7-11	11-13
320	2-6	7-11	11-13
450	4-9	7-11	11-13
640	3-8	7-11	11-13
830	1-5	6-10	11-13
1200	2-6	6-10	11-13
1700	4-9	6-10	11-13
2400	3-8	6-10	11-13

Figure 6-11 - 1440EX - Gear Mesh Matrix

Parts List - 1440EX - Headstock (Figures 6-6 to 6-11)

Item	P/N	Title	Qty
1	26282	CASTING - HEADSTOCK	1
2	26283	COVER - HEADSTOCK	1
3	26141	SPINDLE	1
4	26217	COVER - FRONT	1
5	26142	BEARING - ROLLER	1
6	M6-1.0X25 25B	SCREW-SHCS-STL-BO	3
7	26143	CAM LOCK	3
8	26233	PLUNGER DETENT	3
9	26234	SPRING	3
10	26144	GEAR - 2MX67T	1
11	26145	GEAR - 2MX40T	1
12	26146	KEY 8X8X70	1
13	26147	RING - RETAINING	1
14	26148	BEARING - ROLLER	1
15	26149	NUT - LOCK	1
17	26235	COVER - BACK	1
18	M6-1.0X16 25B	SCREW-SHCS-STL-BO	3
20	26232	GASKET	1
21	26231	GASKET	1
27	M8-1.25X12 25B	SCREW-SHCS-STL-BO	3
31	26278	SHAFT - GEAR	1
32	21234-038	BALLBEARING-DEEP GROOVE #6205	2
33	26178	RING - RETAINING	2
34	26181	COVER	1
35	26179	SEAL - OIL	1
37	26180	BRAKE - MAGNETIC	1
41	26182	PULLEY	1
42	26183	KEY 8X8X20	1
45	24663	CLUSTER GEAR INPUT SHAFT ASSY	1
52	26191	RING - RETAINING	2
53	26192	PLUG - BORE	2
54	26193	O-RING 38X45X3.5	2
61	26194	SHAFT - GEAR - 2MX17T	1
65	26198	BALLBEARING-DEEP GROOVE #6204	2
66	26199	GEAR - 2MX32T	1
67	26200	GEAR - 2MX26T	1
68	26201	KEY 8X8X40	1
69	26202	GEAR - 2MX37T	1
70	26204	GEAR - 2MX42T	1

Parts List - 1440EX - Headstock (Figures 6-6 to 6-11)

71	26205	KEY 8X8X30	1
72	26206	RING - RETAINING	2
76	26209	PLUG - BORE	1
77	26210	O-RING 43X51X4	1
78	24562-1	SPACER	1
81	26211	SHAFT - 30 MM	1
82	26212	PLUG - BORE	1
83	26213	O-RING 20X25X2.5	2
85	24664	CLUSTER GEAR INTERMEDIATE SHAFT ASSY	1
90	26222	O-RING 24X30X3	1
101	26236	HANDLE	1
102	26237	SHAFT	1
103	26238	PIN 5X30	3
104	26239	O-RING 44X50X3	2
105	26240	PLUNGER - DETENT	3
106	26241	SPRING 1/4X30	2
107	M8X8	SCREW-SET SHS-STL-BO	2
108	26243	LEVER	2
109	26244	KNOB	2
112	26246	SCREW	2
113	26261	O-RING 14X19X2.5	3
115	26249	SHAFT	1
117	26251	PLUG - 1/2 NPT	1
118	26252	SHIFT LEVER	1
119	26253	PIN	2
120	26254	RING - RETAINING	1
121	26255	SHIFT FORK	1
131	26256	HANDLE	1
132	26257	BALL 1/4	2
134	26259	SET-OVER PAD	1
137	26262	GASKET - HEADSTOCK	1
138	26263	PLUG - 3/4	1
139	26264	SHAFT	1
141	26266	SCREW	1
142	26267	SCREW	1
143	26268	PLUG - 1-1/8 G.P.	1
144	26269	FORK ARM	1
145	26270	SCREW 1/8 X 1/4	4
146	26271	SHIFT FORK	1
147	26272	PLATE - INDEXING	2

Parts List - 1440EX - Headstock (Figures 6-6 to 6-11)

148	M6-1.0X35 25B	SCREW-SHCS-STL-BO	10
149	26284	PIN 5X50	1
150	24666	LEVER	1

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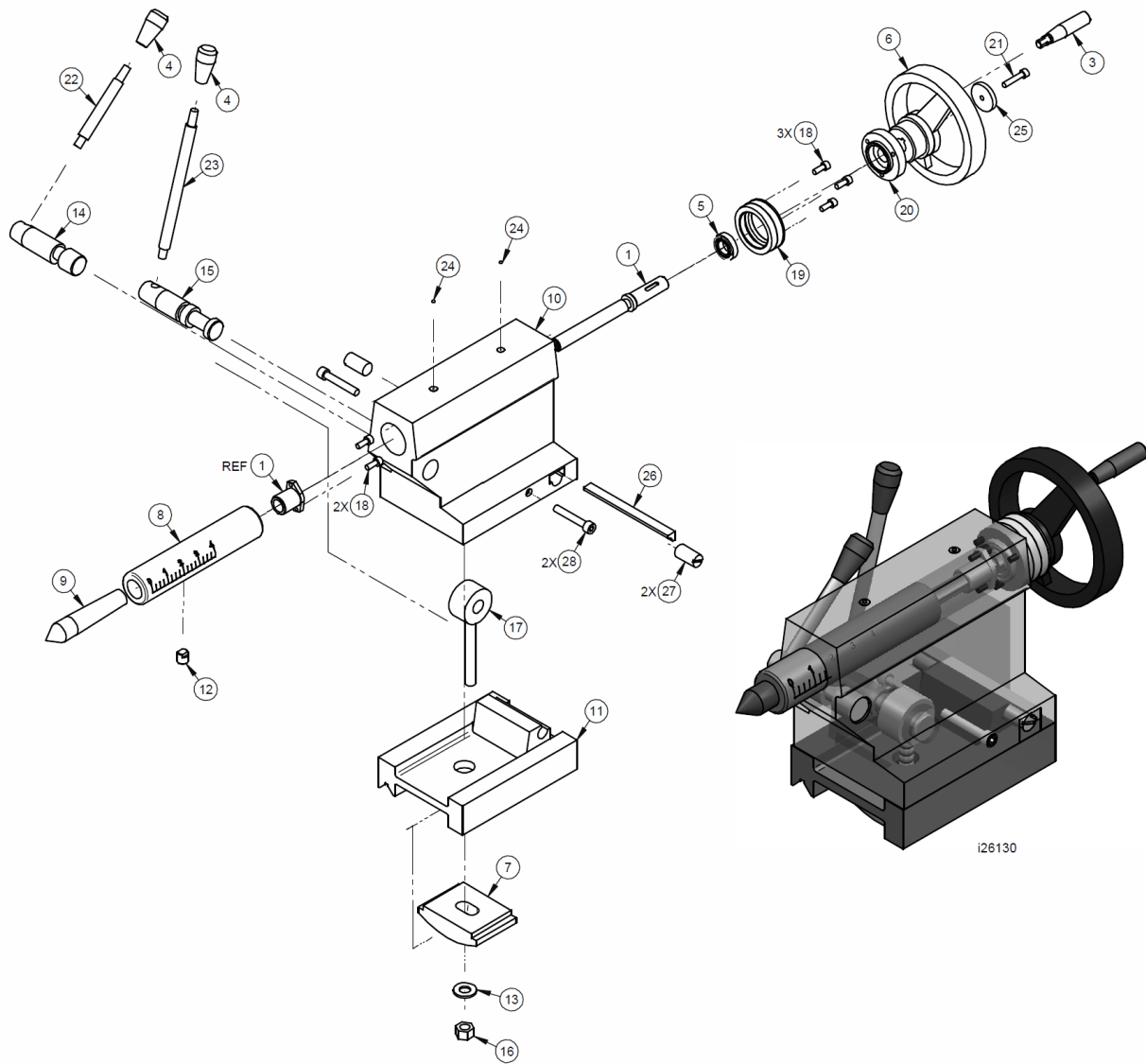
Figure 6-12 - 1440EX - Tailstock Assembly

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TRAK TRL Lathe, ProtoTRAK ELX CNC Safety, Installation, Maintenance, Service & Parts List

Parts List - 1440EX - Tailstock Assembly (Figure 6-12)

Item	P/N	Title	Qty
1	24665	LEADSCREW & NUT ASSY	1
3	26133	HANDLE-NANDWHEEL	1
4	26134	KNOB (3/8")	2
5	26135	BEARING- THRUST(#51103)	1
6	26136	HANDWHEEL	1
7	26137	CLAMP-PLATE	1
8	26138	QUILL-TAILSTOCK	1
9	26139	CENTER (MT#3)	1
10	2601	TAILSTOCK	1
11	2602	BASE	1
12	26242	KEY	1
13	1/2 70B	WASHER-FLAT USS-STL-BO	1
14	26247	SHAFT	1
15	26248	SHAFT	1
16	1/2-13 50P	NUT-HEX-STL-PLAIN	2
17	26250	SCREW-HOIST	1
18	M6-1.0X15 25B	SCREW-SHCS-STL-BO	5
19	26258	ASSY- KEEP	1
20	26260	RING- INDEX	1
21	M6-1.0X25 25B	SCREW-SHCS-STL-BO	1
22	26228	HANDLE-QUILL LOCK	1
23	26229	HANDLE-BASE LOCK	1
24	26265	OILER	2
25	26273	PLUG	1
26	26340	GIB 8X10X136	1
27	26341	SCREW - ADJUSTING	2
28	M8-1.25X50 25B	SCREW-SHCS-STL-BO	2

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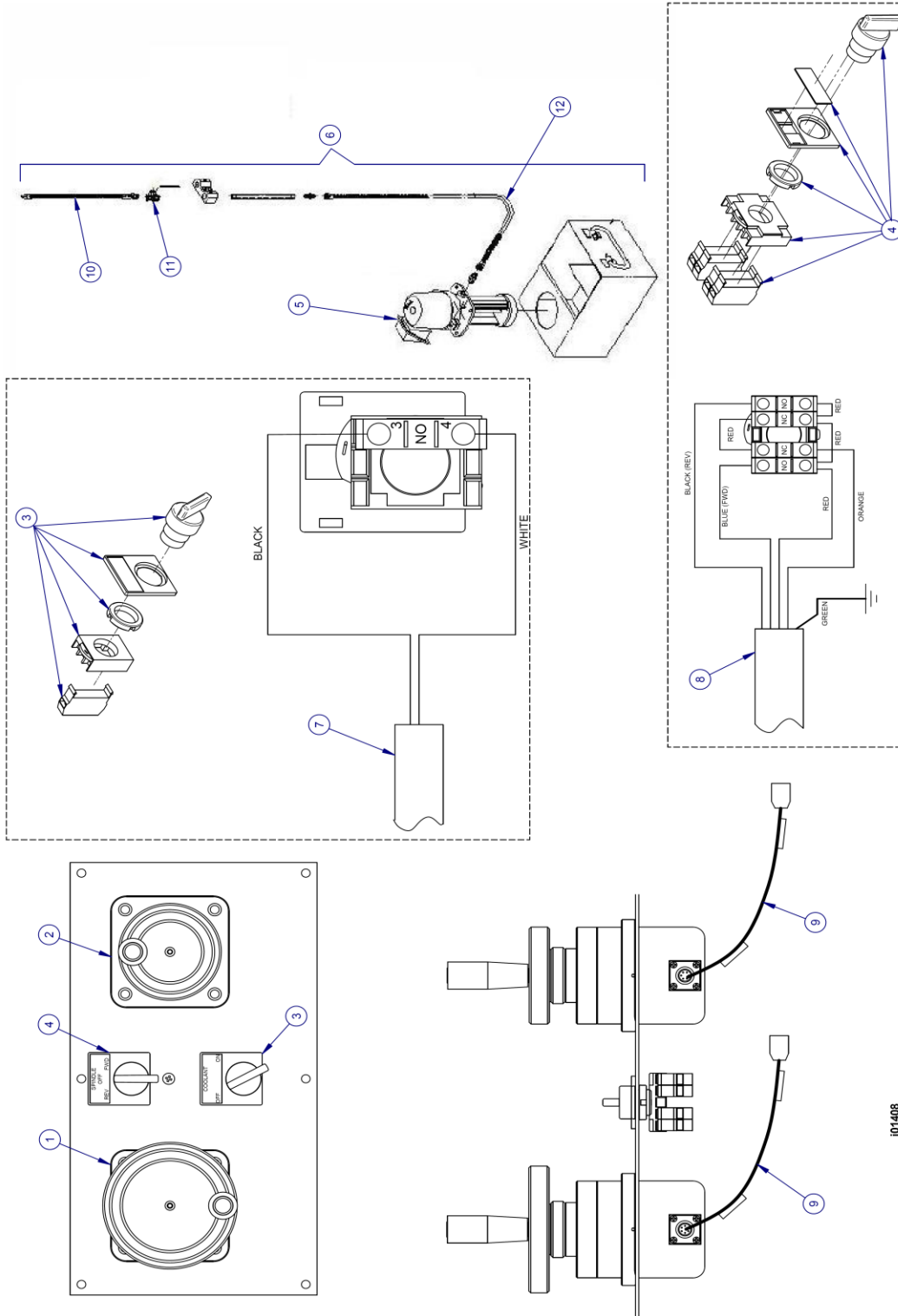
Figure 6-13 - 1440EX -
Apron Assembly/Forward/Reverse/Coolant Switches

Parts List - 1440EX - Apron Assembly/Forward/Reverse/ Coolant Switches (Figure 6-13)

Item	P/N	Title	Qty
1	20082-3	Electronic Handwheel-Z-Axis TRL	1
2	20082-2	Electronic Handwheel-X-Axis TRL	1
3	26155	Switch Assembly - Coolant	1
4	26159	Switch Assembly - Fwd/Rev	1
5	23265	Pump Coolant 1/8 HP	1
6	26160	Coolant Pump Kit	1
7	26070	Cable Assy - Coolant Switch	1
8	26085	Cable Assy - Forward/Reverse Switch	1
9	26072	Cable Assy - Handwheel	2
10	26161	Pipe - Spraying	1
11	26162	Valve - Gate	1
12	26166	Hose - Flexible	1

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TRAK Machine Tools
Southwestern Industries, Inc

TRAK Warranty Policy

Warranty

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

Product	Warranty Period	
	Materials	**Factory Labor**
New TRAK/ProtoTRAK	1 Year	1 Year
Any EXCHANGE Unit	90 Days	90 Days

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

If a product, subsystem or component proves to be defective in workmanship and fails within the warranty period, it will be repaired or exchanged at our option for a properly functioning unit in similar or better condition. Such repairs or exchanges will be made FOB Factory/Los Angeles or the location of our nearest factory representative or authorized distributor.

Warranty Disclaimers

- This warranty is expressly in lieu of any other warranties, express or implied, including any implied warranty of merchantability or fitness for a particular purpose, and of any other obligations or liability on the part of SWI (or any producing entity, if different).

- Warranty repairs/exchanges do not cover incidental costs such as installation, labor, freight, etc.

- SWI is not responsible for consequential damages from use or misuse of any of its products.

- TRAK products are precision mechanical/electromechanical/electronic systems and must be given the reasonable care that these types of products require. Evidence that the product does not receive adequate Preventative Maintenance may invalidate the warranty. Excessive chips built up around ballscrews and way surfaces is an example of this evidence.

- Accidental damage, beyond the control of SWI, is not covered by the warranty. Thus, the warranty does not apply if a product has been abused, dropped, hit or disassembled.

- Improper installation by or at the direction of the customer in such a way that the product consequently fails, is considered to be beyond the control of the manufacturer and outside the scope of the warranty.

- Warranty does not cover wear items that are consumed under normal use of the product. These items include, but are not limited to: windows, bellows, wipers, filters, drawbars and belts.