TRAK® EMX KNEE & BED MILLS

ProtoTRAK® EMX CNC

Service, Safety, Installation, Maintenance & Parts

Document: P/N 26109
Version: 021220

Covers Current Models:

- **ProtoTRAK EMX Retrofits**
- **TRAK KEMX Knee Mill**
- **TRAK K3 EMX Knee Mill**
- **TRAK K4 EMX Knee Mill**
- **TRAK DPM EX2 Bed Mill**

TRAK MACHINE TOOLS

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1.0 Safety

The safe operation of the TRAK Mills and the ProtoTRAK CNC depends on their proper use and the precautions taken by each operator.

- Read and study this manual and the ProtoTRAK EMX Programming, Operating, and Care Manual. Be certain every operator understands the operation and safety requirements of this machine *before* its use.
- Always wear safety glasses and safety shoes.
- Always stop the spindle and check to ensure the CNC control is in the stop mode before changing or adjusting the tool or workpiece.
- Never wear gloves, rings, watches, long sleeves, neckties, jewelry, or other loose items when operating or around the machine.
- Use adequate point of operation safeguarding. It is the responsibility of the employer to provide and ensure point of operation safeguarding per OSHA 1910.212 - Milling Machine.

1.1 Safety Publications

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

Safety Requirements for Manual Milling, Drilling and Boring Machines with or without Automatic Control (ANSI B11.8-2001). Available from The American National Standards Institute, 1819 L Street N.W., Washington D.C. 20036

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

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

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

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

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

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

NOTICE: The manufacture is not liable (responsible) for any damages or injury of any kind to persons or property caused by or resulting from the improper or unauthorized use, operation, maintenance, alteration, modification, change in configuration of this machine or any of its component parts, or the use of this unit with any third party accessories or parts.

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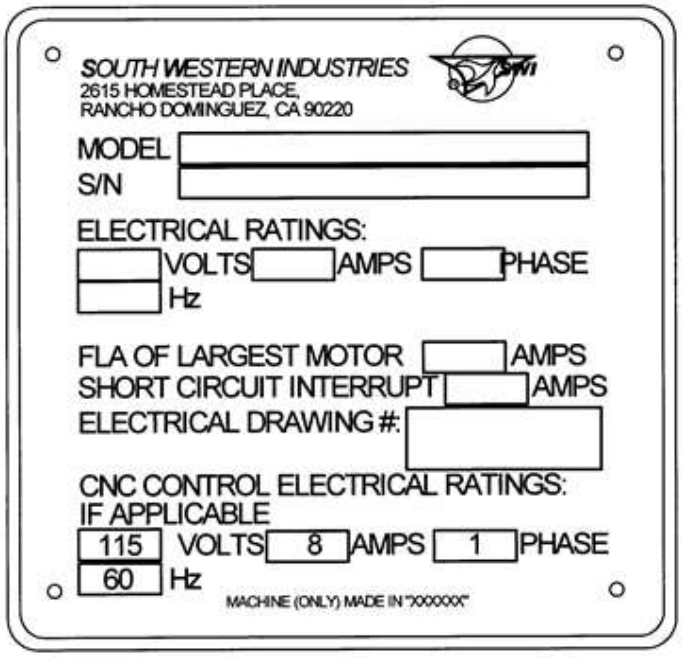
Safety & Information Labels Used On TRAK Milling Machines

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



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Safety & Information Labels Used On The TRAK Milling Machines

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

Power Requirements at 220 and 440 Volts, 3-phase 60 Hz	
	KEMX & DPMEX2
Overload Setting 220 V	8.5 A
Overload Setting 440 V	4.25 A
FLA of Largest Motor at 220 V	8.5 A
FLA of Largest Motor at 440 V	4.25 A
FLA of Machine at 220 V	8.5 A
FLA of Machine at 440 V	4.25 A

1.3 Safety Precautions

1. Do not operate this machine before the TRAK Mill Installation, Maintenance, Service and Parts List Manual, and ProtoTRAK EMX Programming, Operating & Care Manual have been studied and understood.
2. Do not run this machine without knowing the function of every control key, button, knob, or handle. Ask your supervisor or a qualified instructor for help when needed.
3. Protect your eyes. Wear approved safety glasses (with side shields) at all times.
4. Don't get caught in moving parts. Before operating this machine remove all jewelry including watches and rings, neckties, and any loose-fitting clothing.
5. Keep your hair away from moving parts. Wear adequate safety headgear.
6. Protect your feet. Wear safety shoes with oil-resistant, anti-skid soles, and steel toes.
7. Take off gloves before you start the machine. Gloves are easily caught in moving parts.
8. Remove all tools (wrenches, chuck keys, etc.) from the machine before you start. Loose items can become dangerous flying projectiles.
9. Never operate a milling machine after consuming alcoholic beverages, or taking strong medication, or while using non-prescription drugs.
10. Protect your hands. Stop the machine spindle and ensure that the CNC control is in the stop mode:
    - Before changing tools
    - Before changing parts
    - Before you clear away the chips, oil or coolant. Always use a chip scraper or brush
    - Before you make an adjustment to the part, fixture, coolant nozzle or take measurements
    - Before you open safeguards (protective shields, etc.). Never reach for the part, tool, or fixture around a safeguard.
11. Protect your eyes and the machine as well. Don't use compressed air to remove the chips or clean the machine.
12. Disconnect power to the machine before you change belts, pulley, and gears.
13. Keep work areas well lighted. Ask for additional light if needed.
14. Do not lean on the machine while it is running.
15. Prevent slippage. Keep the work area dry and clean. Remove the chips, oil, coolant and obstacles of any kind around the machine.
16. Avoid getting pinched in places where the table, saddle or spindle head create "pinch points" while in motion.
17. Securely clamp and properly locate the workpiece in the vise, on the table, or in the fixture. Use stop blocks to prevent objects from flying loose. Use proper holding clamping attachments and position them clear of the tool path.
18. Use correct cutting parameters (speed, feed, depth, and width of cut) in order to prevent tool breakage.
19. Use proper cutting tools for the job. Pay attention to the rotation of the spindle: Left hand tool for counterclockwise rotation of spindle, and right hand tool for clockwise rotation of spindle.

20. After an emergency stop, always turn the FORWARD/REVERSE switch to "Off" (STOP) before releasing or resetting the E-Stop.
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. Check the direction (+ or -) of movement of the table, saddle and ram when using the jog or power feed.
23. Don't use dull or damaged cutting tools. They break easily and become airborne. Inspect the sharpness of the edges, and the integrity of cutting tools and their holders. Use proper length for the tool.
24. Large overhang on cutting tools when not required result in accidents and damaged parts.
25. Handwheels must have the crank folded inside when using CNC programmed machining or rapid feeds, power feed or jog.
26. Prevent fires. When machining certain materials (magnesium, etc.) the chips and dust are highly flammable. Obtain special instruction from you supervisor before machining these materials. Keep flammable materials and fluids away from the machine and hot, flying chips.
27. Changing the speed of rotation of the spindle must be done while the rotation is on. It is recommended to stop and start the spindle at a low rate of speed.
28. Interlocked table guards may be purchased from Southwestern Industries, Inc., if deemed necessary by the user.

2.0 Machine Installation

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

2.1 Floor Plan, Layout & Space Requirements

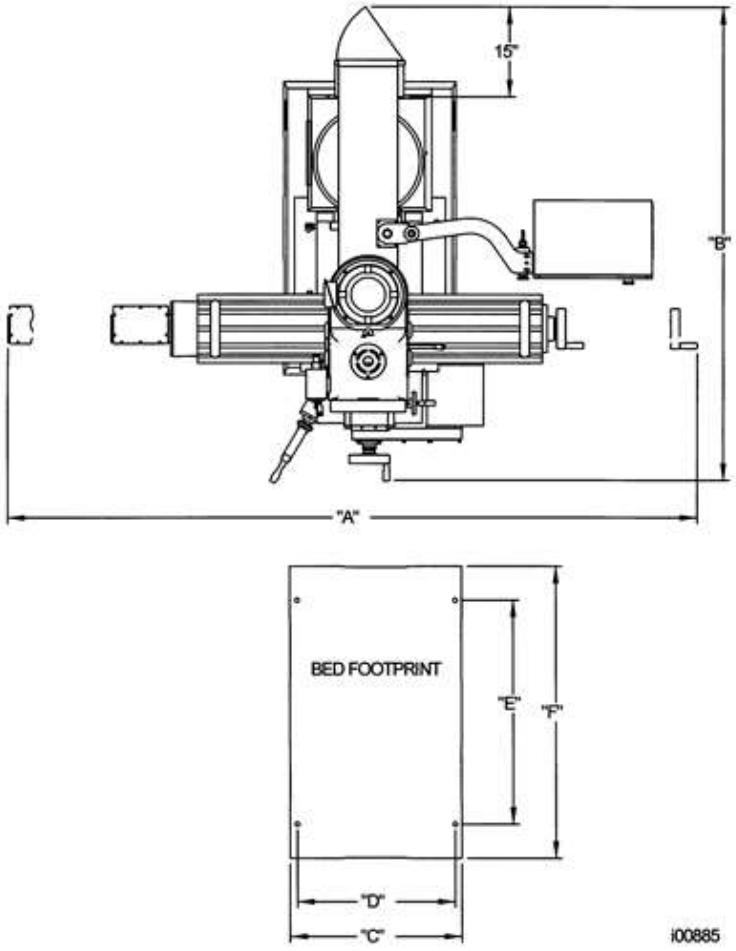


Figure 1 – KEMX – Machine Footprints

	KEMX	
	Weight (approximate) net	2800 lbs
	Weight (approximate) shipping	3100 lbs
	Pallet Size	6′ x 6′
A	Overall width	103″
B	Overall length	70″
C	Base width	24.2″
D	Width between leveling screws	21.9″
E	Distance between leveling screws	29.7″
F	Base length	38.8″

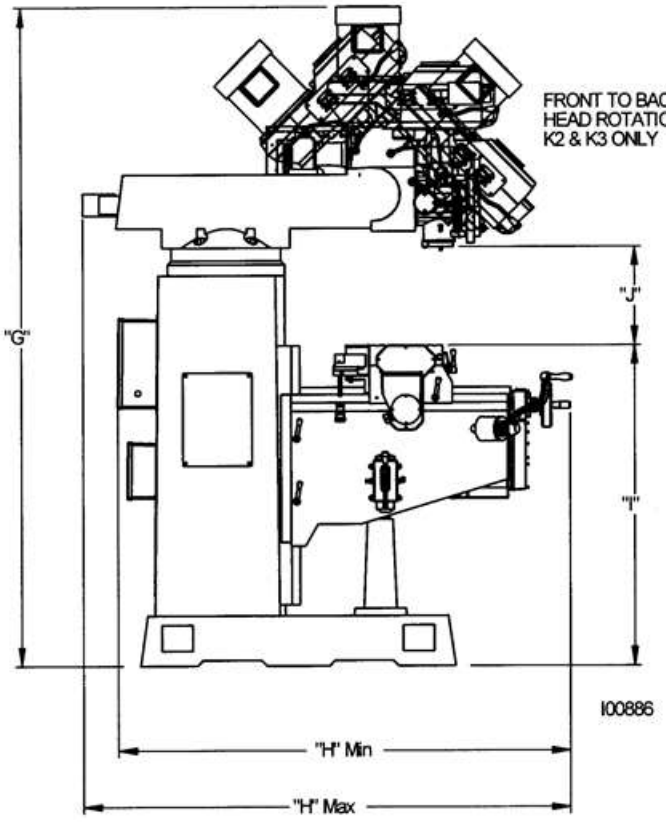


Figure 2 - KEMX - Overall Dimensions

KEMX	
Table Size	10″ x 50″
Dimension G	87″
Dimension G Min	65″
Dimension H Min	64″
Dimension H Max	78″
Dimension I Min	38″
Dimension I Max	49′
Dimension J Max	17″

Floor Plan, Layout & Space Requirements – DPMEX2

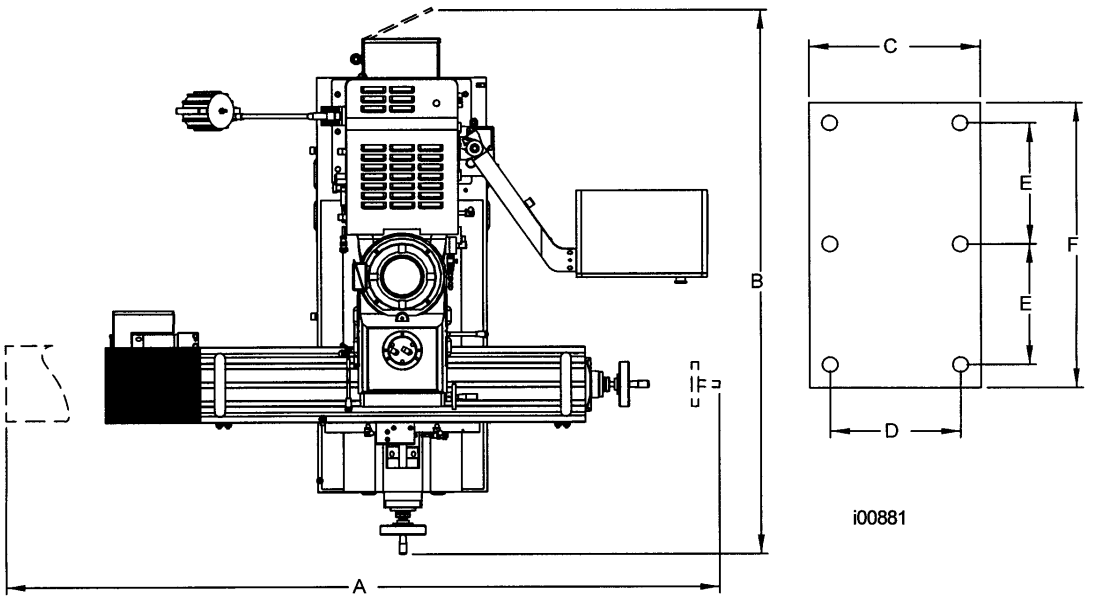


Figure 2.1 - DPMEX2 - Machine Footprints

DPMEX2	
Footprint of Machine	23.1″ x 40.5″
Weight (approximate) net	3200 lbs.
Weight (approximate) shipping	3500 lbs.
Pallet Size	70″ x 70″
A Overall width	101″
B Overall length w/ electric box door open	72″
C Bed width	23.125″
D Bed width between leveling screws	20.5″
E Distance between leveling screws	32.5″
F Bed length	40.5″

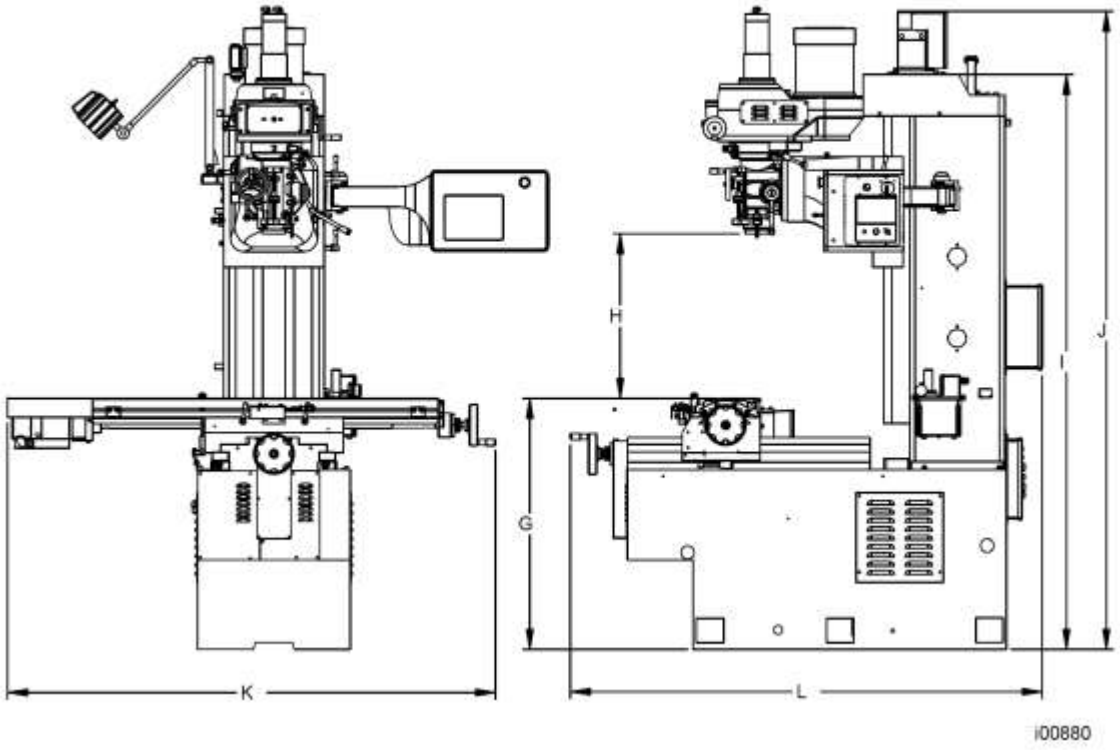


Figure 2.2 - Overall Dimensions

DPMEX2		
G	Height of table from bottom of bed	34″
H	Maximum distance from spindle nose to table	23.5″
I	Maximum height of machine from bottom of bed to top of column cover.	78″
J	Height of machine from bottom of bed to top of spindle motor	89″
K	Width of machine including table	70″
L	Length of machine with electric box door closed	64″

2.2 Uncrating

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

Remove the cardboard box containing the TOOL BOX. The leveling pads and screws for the machine can be found in the toolbox. The Y way covers are shipped in a separate tube.

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

2.3 Shortages: Inventory Checklist

_____ Machine (check model and serial number)

_____ Manual drawbar with washer

_____ Leveling pads (B239) and screws (B240) (4 each)

_____ Pendant Display (installed on machine)

_____ Pendant Arm assembled to the column

_____ Toolbox with various tools

_____ ProtoTRAK EMX Safety, Operation & Programming Manual (P/N 26056)

_____ TRAK KEMX & Retrofit Safety, Installation, Maintenance, Service & Parts List Manual (P/N 26109)

_____ Way covers – front & rear of saddle

_____ Way covers DPMEX2 – front (23676) and rear (23677) of saddle

_____ Way covers DPMEX2 - bottom on column (23675), top on column (23675)

2.4 Installation Instructions & Checklist

Installer: Use this checklist to assure a complete set-up of the KE, DPMEX2 or EMX retrofit.

☐	1.	Shut off power to the machine.
☐	2.	Visually inspect the 220 or 440V 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.
☐	3.	Use a 10mm socket to turn the Z-axis ball screw at the top of the column in order to lower the head until the counterweight is raised off of the counterweight support rods. (DPMEX2 only)
☐	4.	Remove the 2 bottom head supports and also remove the 2 zip ties from the counterweight chain. DPMEX2 only.
☐	5.	Remove the two (2) counterweight support rods.
☐	6.	Clean the machine if needed and remove any remaining grease.
☐	7.	Unlock the table, saddle, knee or column gib locks.
☐	8.	Make and check all the proper electrical connections from the pendant to the electric box. See the pendant and electric box wiring diagrams.
☐	9.	Turn on the power to the machine and to the pendant.
☐	10.	Lubricate all the way surfaces and the ball screws.
☐	11.	Jog the table and saddle or Z axis back and forth until the way surfaces are well lubricated. Oil should be visible on all the way surfaces.
☐	12.	Check the level of the machine. The machine should be level to within 0.0005" front to back and 0.0005" side to side.
☐	13.	Check to make sure that the E-Stop button is functioning correctly.
☐	14.	Perform Service Code 12, Feed Forward Constant.
☐	15.	Perform Service Code 123 to calibrate the X and Y-axis using a 150mm standard.
☐	16.	Perform Service Code 127 and 128 to manually calculate the backlash for the X and Y-axis.
☐	17.	Assure the Z-axis quill glass scale is working and the Z axis DRO is functioning. Use Service Code 15 to turn on the Z axis readout. (Z axis quill scale is optional, knee mills only.)
☐	18.	Perform Service Code 123 and press QUILL softkey to calibrate the Z-axis quill using a 75mm standard. For bed mill, calibrate the Z axis with the 75 mm standard.
☐	19.	Perform Service Code 100 in both directions for the X, Y and/or Z-axes, to verify that the feed rate shown on the display is at least 120 ipm.
☐	20.	Run the spindle at various speeds in both high and low gear for 15 minutes. Verify head shifts from high to low gear smoothly. Test quill feed and spindle brake. N/A to retrofits.
☐	21.	Install the Y-axis front and rear way covers.
☐	22.	Install the top and bottom column way covers. Bed mill only.
☐	23.	If the machine has a power drawbar option, check to make sure that the tools load and unload properly. N/A to retrofits.
☐	24.	Wipe down the machine.

2.5 Machine Specifications

	KEMX	DPMEX2
Table size	50″ x 10″	49″ x 9″
Movement and ranges (X, Y, Z axis)	32″ x 16″ x 16″	31 x 16 x 23.5″
Quill Travel (maximum)	5″	5″
Quill Diameter	86 mm	86 mm
Spindle Taper	R8	R8
Speed Range	60-4200 RPM	60-4200 RPM
Spindle to Column	8″ to 32″	18″
Quill Feeds Per Revolution of Spindle	.0015/.003/.006″	.0015/.003/.006″
Head Tilt	+/- 90°	+/- 90°
Head Swivel	+/- 45°	n/a
Spindle Motor Power	3 HP	3 HP
Voltage	220/440 V	220/440 V
Phase/Cycle	3 phase/60 Hz	3 phase/60 Hz
Current	8.5/4.3 amps	8.5/4.3 amps
Maximum Weight of Workpiece	850 lbs	1320 lbs

2.6 Maximum Work Capacities

Drilling Mild Steel (2-axis manual feed)	1 ¼″
Tapping Mild Steel	1″
Milling (metal removal rate/mild steel)	1 ½ $inch^3$/min

Maximum work capacities are dependent on a lot of variables that cannot be controlled by the machine manufacturer. Each one of the following will have an impact on the above numbers: speeds, feeds, cutter, cutter sharpness, material, setup, coolant and machine adjustments. The numbers above assume all conditions are optimal and may be higher or lower depending on material composition.

2.7 ProtoTRAK EMX Control Hardware

- Digital Servo Amplifiers – custom designed for ProtoTRAK operation
- D.C. Servo Motors – rated at 280 in-oz. continuous torque are twice that required
- Precision Ball Screws – in the table and saddle
- Modular Design – simplifies service and maximized uptime
- 115V/60HZ/10 amps

- Feedrate Override of programmed feedrate and rapid
- Polycarbonate Sealed Membrane Keypad to lock out contamination
- 7.0" Color LCD
- On board IDE flash memory storage for part programs
- USB port for interface with a storage device
- Rugged Industrial PC
- Glass Scale on quill for Z-axis readout (Optional on knee mill)

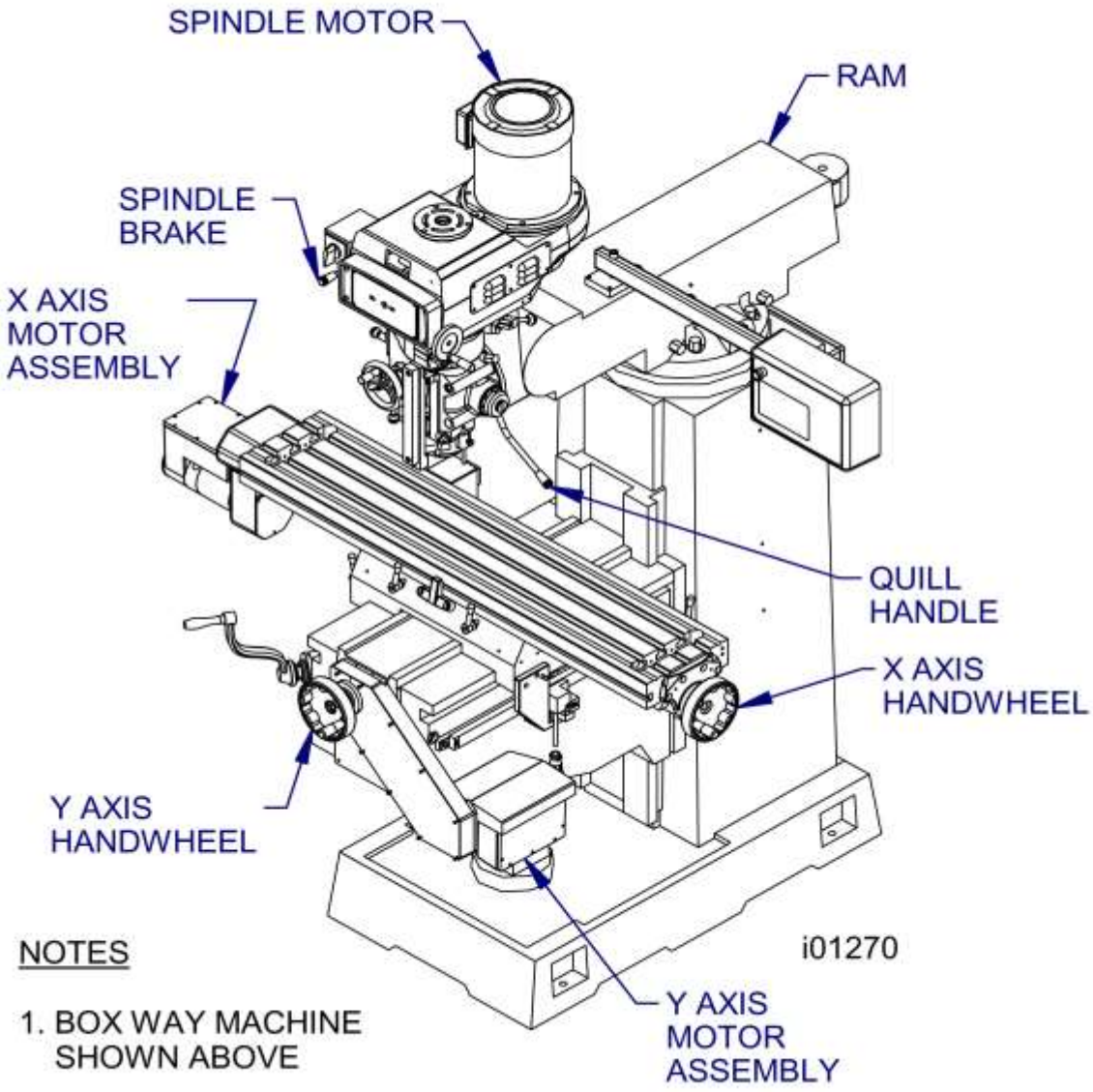


Figure 3 & Parts List Shown - Knee Mill Component Identification

Part Number	Description
20819	Spindle Motor
26015-1 26015-7	EMX Pendant EMX Pendant 3
15616	Y Axis Handwheel (Saddle)
15616	X Axis Handwheel (Table)
20296	X Axis Motor
20296-1	Y Axis Motor

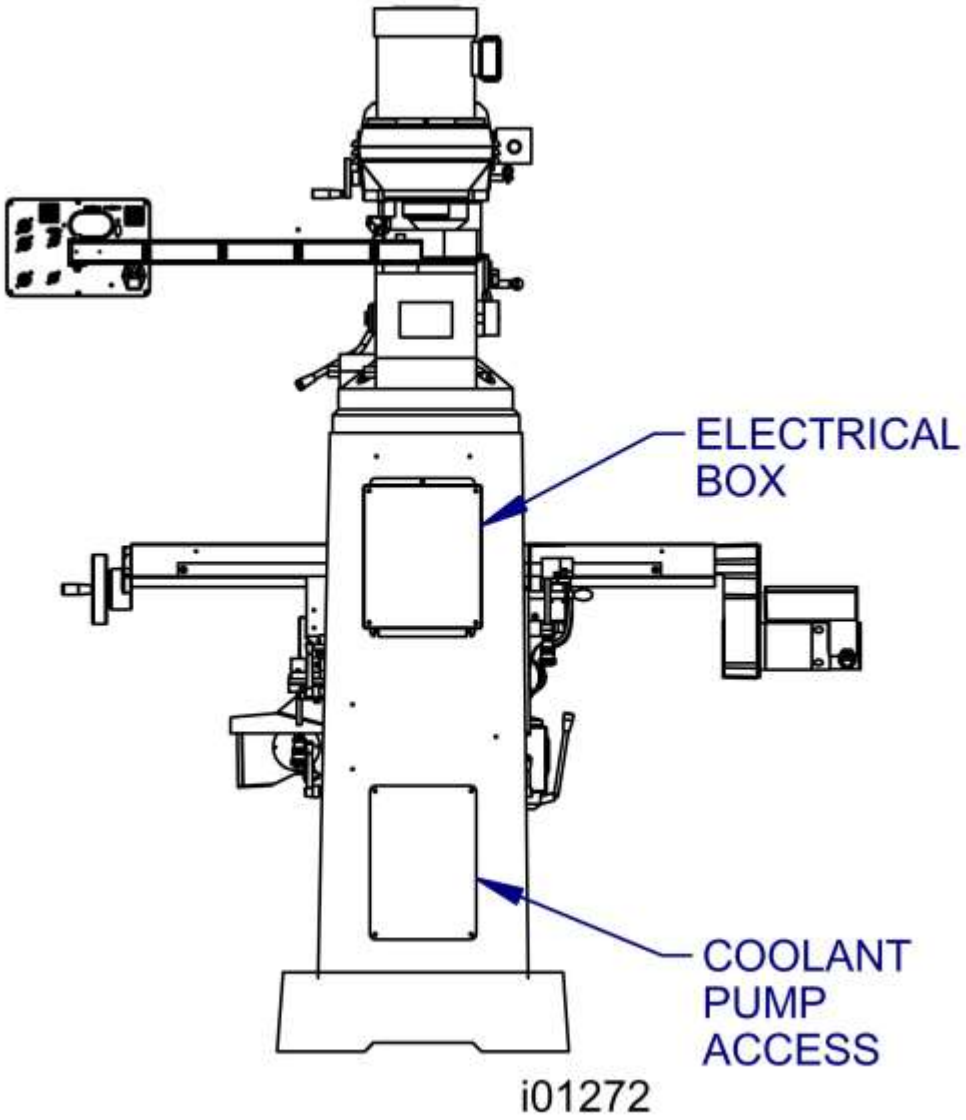


Figure 4 & Parts List Shown - Knee Mill Rear View

Part Number	Description
220V=20676 440V=20676	**Electrical Box – used on knee and bed mills
9001	Lube Pump

If the machine was sold with a table guard option, the electrical box part number is 20676-2.

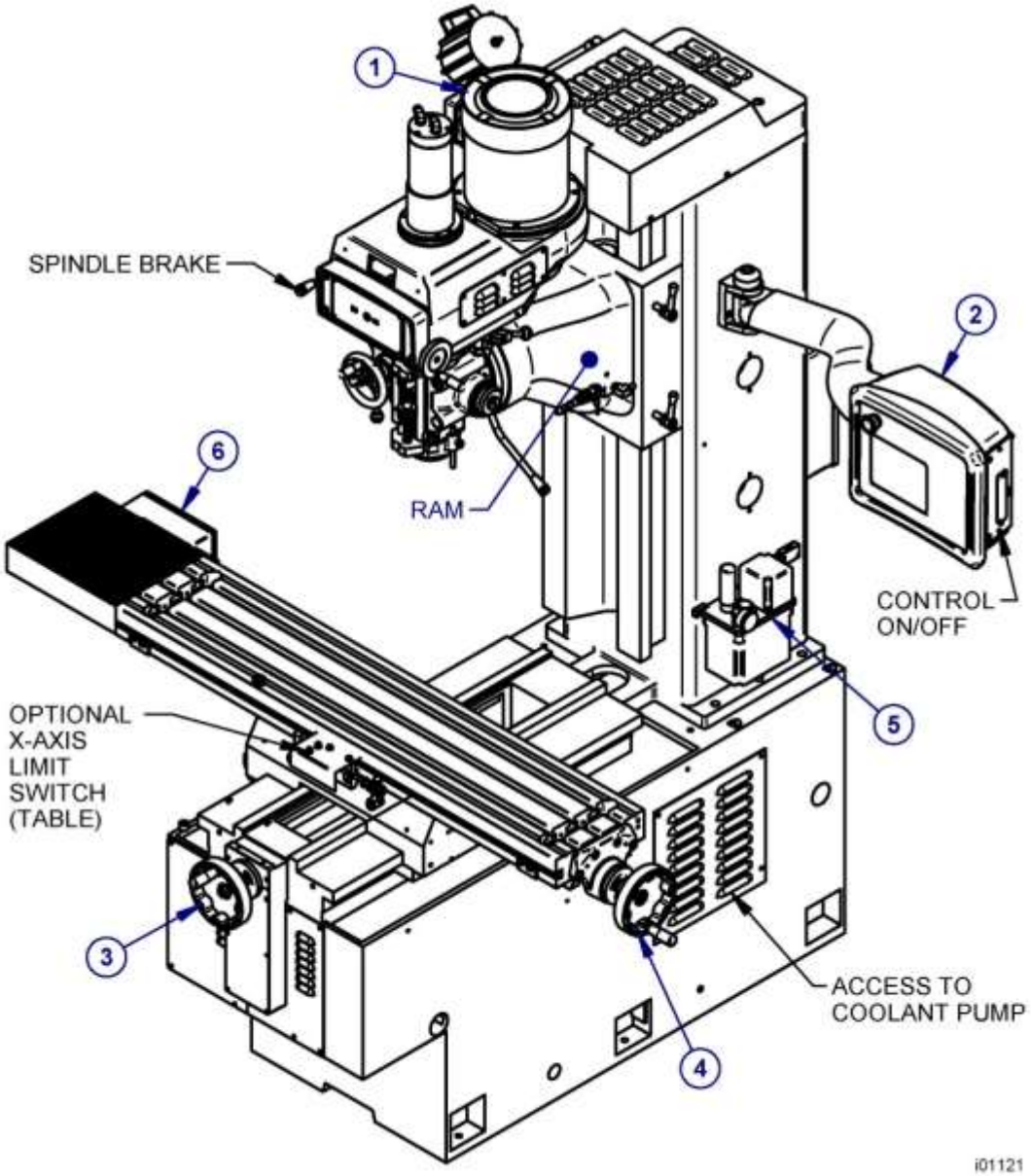


Figure 4.1 & Parts List Shown - DPMEX2 - Component Identification

Item	Part Number	Description
1	20819-1	Spindle Motor
2	26015-7	EMX Pendant – 2 ½ axis
3	15616	Y-Axis Handwheel (Saddle)
4	15616	X-Axis Handwheel (Table)
5	21157-1	Lube Pump
6	20296	X & Z Axis Motor
	20296-1	Y Axis Motor

2.8 Lifting and/or Moving the Machine - KEMX

CAUTION!

The K machine weighs approximately 2800 lbs. Proper equipment of sufficient capacity must be used when lifting and/or moving the machine.

(See Figure 5 To Prepare the Mill before Lifting):

1. Using a steel cable with protective sleeving (min 3/4" diameter) or a 3-ton sling, position sling loops on machine as shown in Figure 5.
2. Use cardboard pieces or other suitable protective sheets on both sides of the machine to prevent scratching.
3. Remove the 4 nuts and screws holding the machine to the wood skid.
4. Lift the machine (the machine should lift approximately level).
5. Insert the 4 screws for leveling pads in their place in the bed.
6. Place the machine in its location (see floor plan and bed footprint drawing). Carefully positioning each leveling pad under each leveling screw.
7. Remove the lifting cable or sling and all protective cardboard.

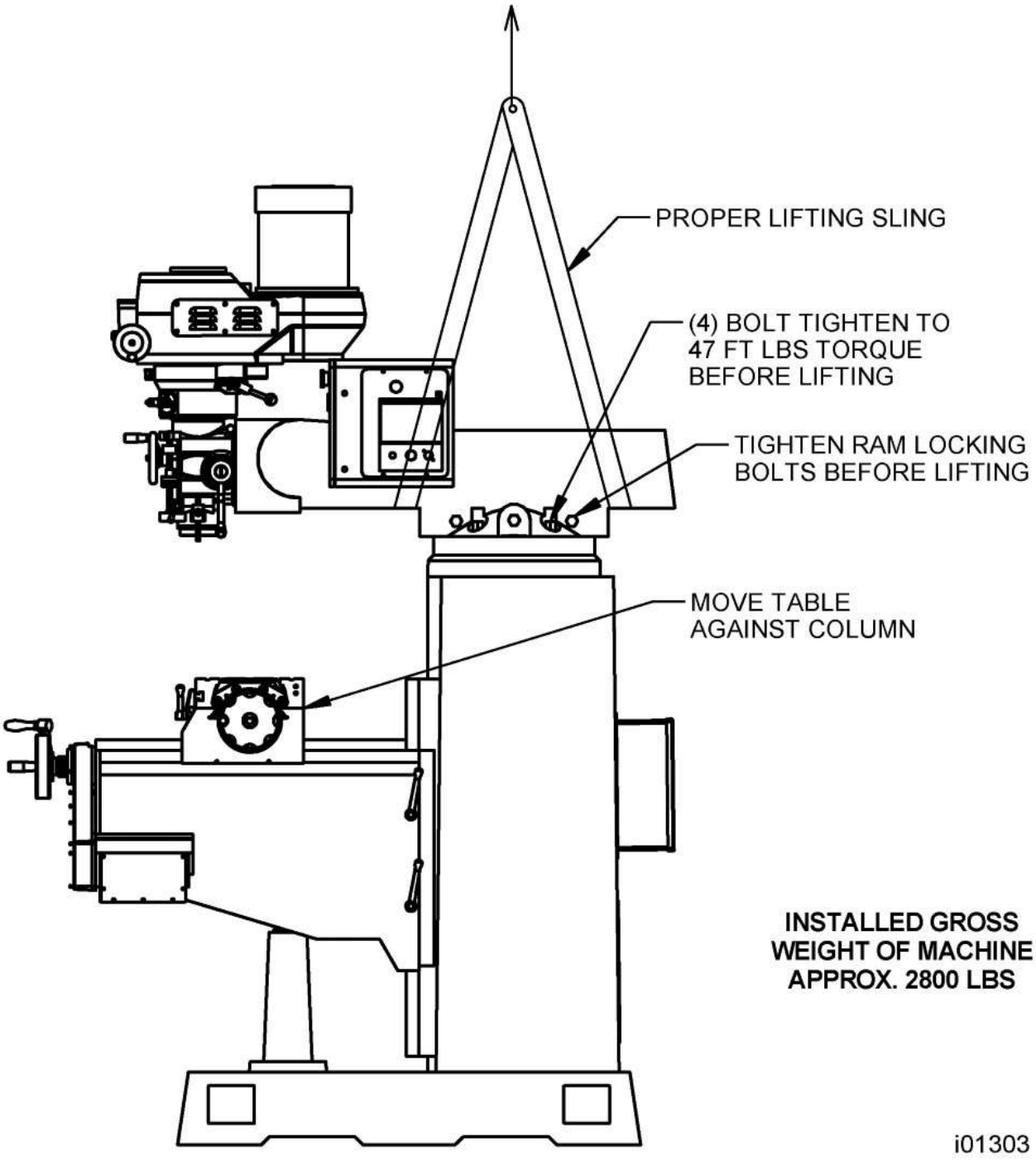


Figure 5 - Lifting the Machine

Lifting and/or Moving the Machine – DPMEX2

CAUTION!

The DPMEX2 machines weigh approximately 3200 lbs. Proper equipment of sufficient capacity must be used when lifting and/or moving the machine.

Method 1 (see Figure 5.1):

1. Insert a steel bar 1.0" dia x 36" long through the rear side holes of the bed (under column).
2. Use a steel cable (with protective sleeving) min. 3/4" dia. or a 3 ton sling.
3. Use cardboard pieces or other suitable protective sheets on both sides of the machine to prevent scratching.
4. Remove the 4 nuts and screws holding the machine to the wood skid.
5. Lift the machine (the front side of the machine should be lower than the back side).
6. Insert the 6 screws for leveling pads in their place in the bed. 4 screws for DPMEX2.
7. Place the machine in its location (see floor plan and bed footprint drawing) carefully positioning each leveling pad under each leveling screw.
8. Remove the lifting cable or sling, the steel bar and all protective cardboard.

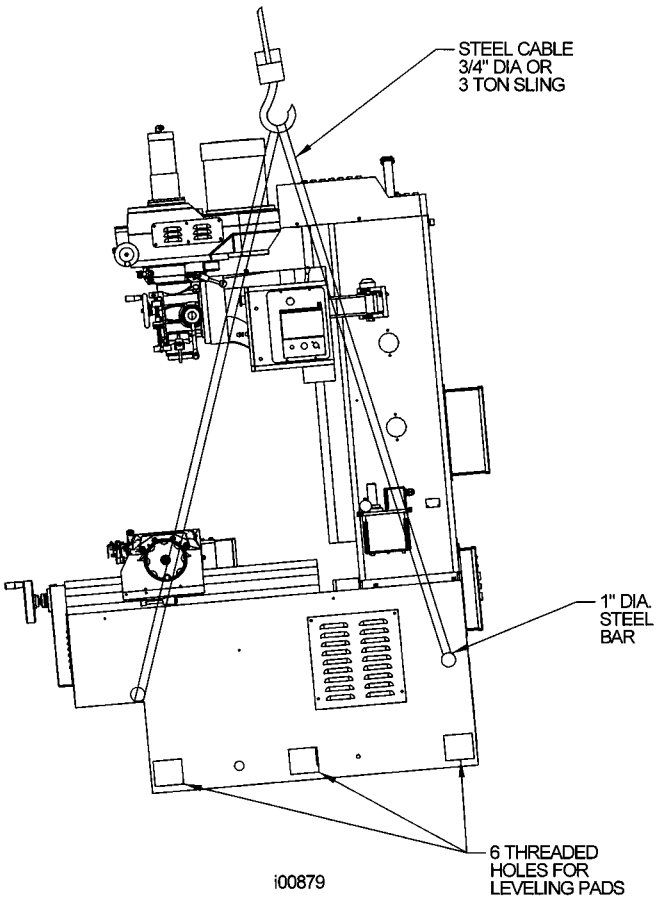


Figure 5.1 - Lifting the Machine - Method 1

Method 2 (see Figure 5.2):

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

WARNING!

The lift truck must have sufficient lifting capacity (3 tons) and be equipped with suitably long forks.

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

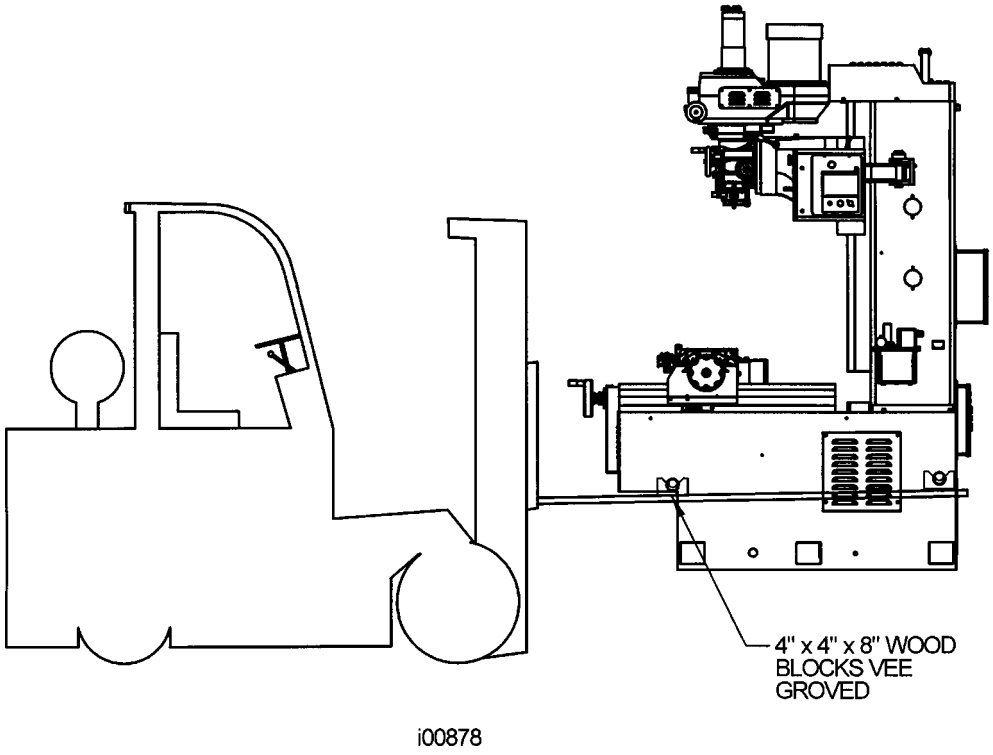


Figure 5.2 - Lifting the Machine - Method 2

2.8.1 Releasing the Head Counterweight Supports – DPMEX2 only

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

1. Release ram gib locks.
2. DPMEX2 – Lower the head slowly with a 10mm socket on the top end of the Z-axis ball screw until the chain between the ram and the counterweight is tight.
3. Lower a little further until the 2 support steel rods are loose. Remove the 2 steel rods and store them for future machine moves or transportation.
4. Do not continue to move the ram until all ways have been cleaned.

CAUTION!

Do not remove the steel rods unless they are loose.

2.9 Cleaning

1. Remove rust protective coating from the machine before moving any slideways (table, saddle, knee, column, etc.).
2. The coating is best removed with clean, dry shop towels. Do not use a cleaning solution that may damage the rubber way scrapers, plastic parts, or pain

WARNING!

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

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

CAUTION!

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

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

2.10 Leveling: Leveling Tolerance is .0005”/10”

1. Set the machine on its 4 leveling pads on a solid, level floor prepared in accordance with the state and local rules for machine tool installation.
2. Put one or two precision Spirit Levels or Electronic Levels in the center of the table in the positions illustrated in Figure 6.
3. Adjust the 4 corner leveling screws on their pads until the machine is level to .0005 in/10 in.
4. If the machine must be anchored to the floor, follow the general instruction for installing machine tools and use for leveling any well-known methods: shims, etc.).
5. If the machine must be installed on vibration mounts/pads (rubber, commercially available leveling and vibration mounts, etc.) follow the instructions delivered with the mounts/pads, ordering them to satisfy the load of the machine and the maximum weight of the workpiece.
6. When machine is correctly level, lock the adjusting screws in place with their hex nuts.

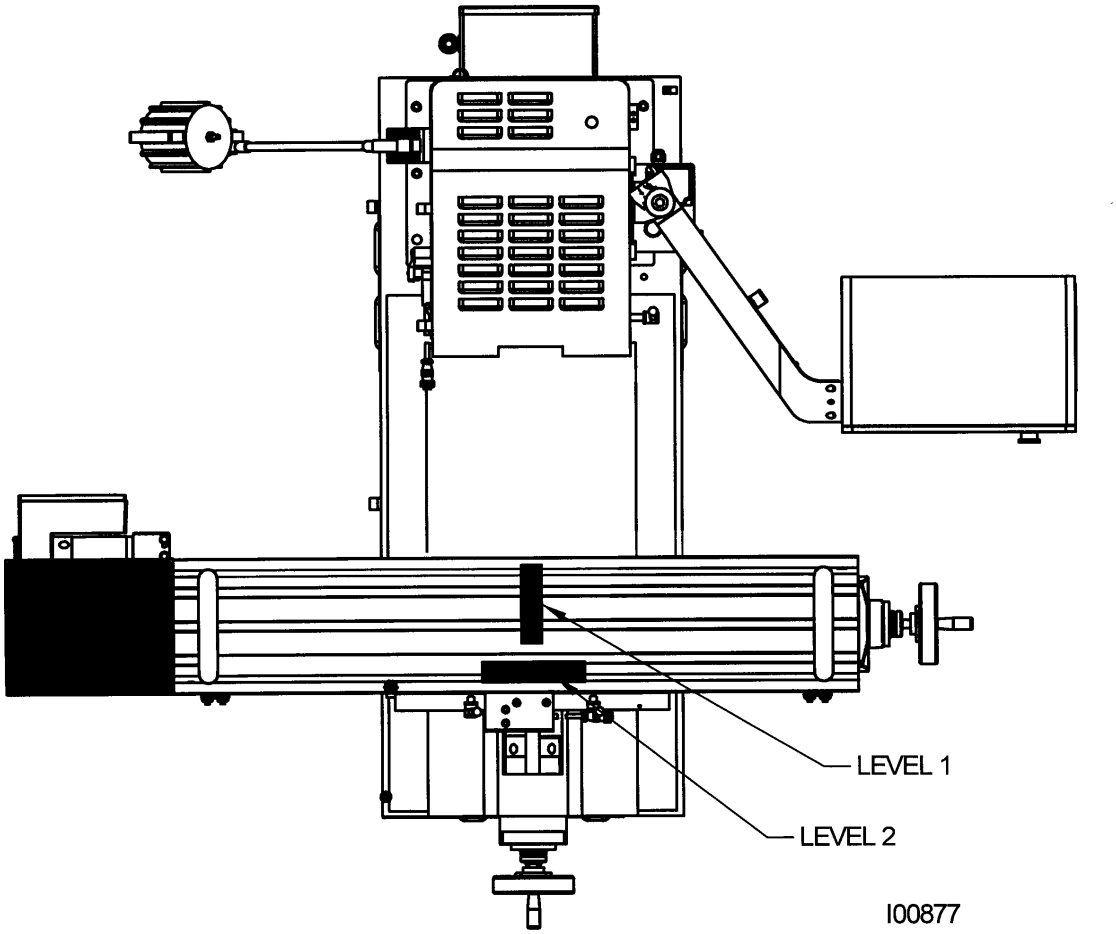


Figure 6 - Placement of Levels

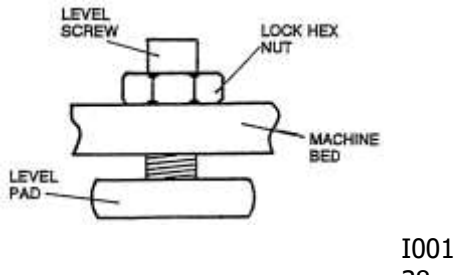


Figure 7 - Leveling Screws

2.11 Pendant Connections

The follow diagram shows the cable connections to the pendant. The Z motor port refers to DPMEX2 machines only. This connector is not found on 2 axis EMX controls. See section 3 for more information on routing cables. See steps 7 and 9.

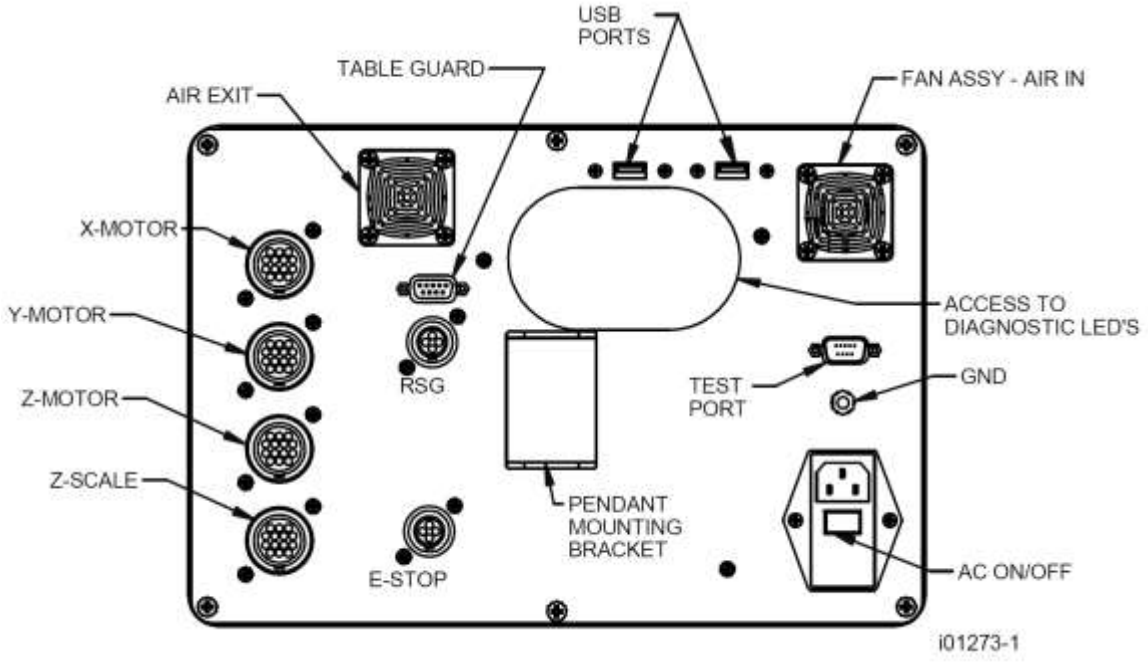


Figure 7-1 - Pendant Connections

2.12 Electrical Connection

The TRAK Mills can be configured for 220 or 440 volt 3 phase electricity. These machines also require a 110V power source to power the control.

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. Be certain that 400-volt electricity (typical range 415 - 460V) is used only with a machine labeled 440 volts at the motor and at the electrics box on the back of the column.

DANGER!

The 220 or 440-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.

Incoming 220 or 440-volt power connects to the machine through the electrical box located on the back of the column. The power cable enters the black box through a hole on the top of the box.

DANGER!

Only a qualified electrician should wire the 220 or 440-volt 3-phase electricity.

To convert a machine from 220 to 440 volt power or vice versa 3 things must happen: spindle motor must be rewired, overload relay must be set to 8.5 amps for 220 V and 4.25 for 440 volts and the voltage stickers on the electric's box must be replaced.

See Section 6.1.11 for a diagram of how to rewire the spindle motor.

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.

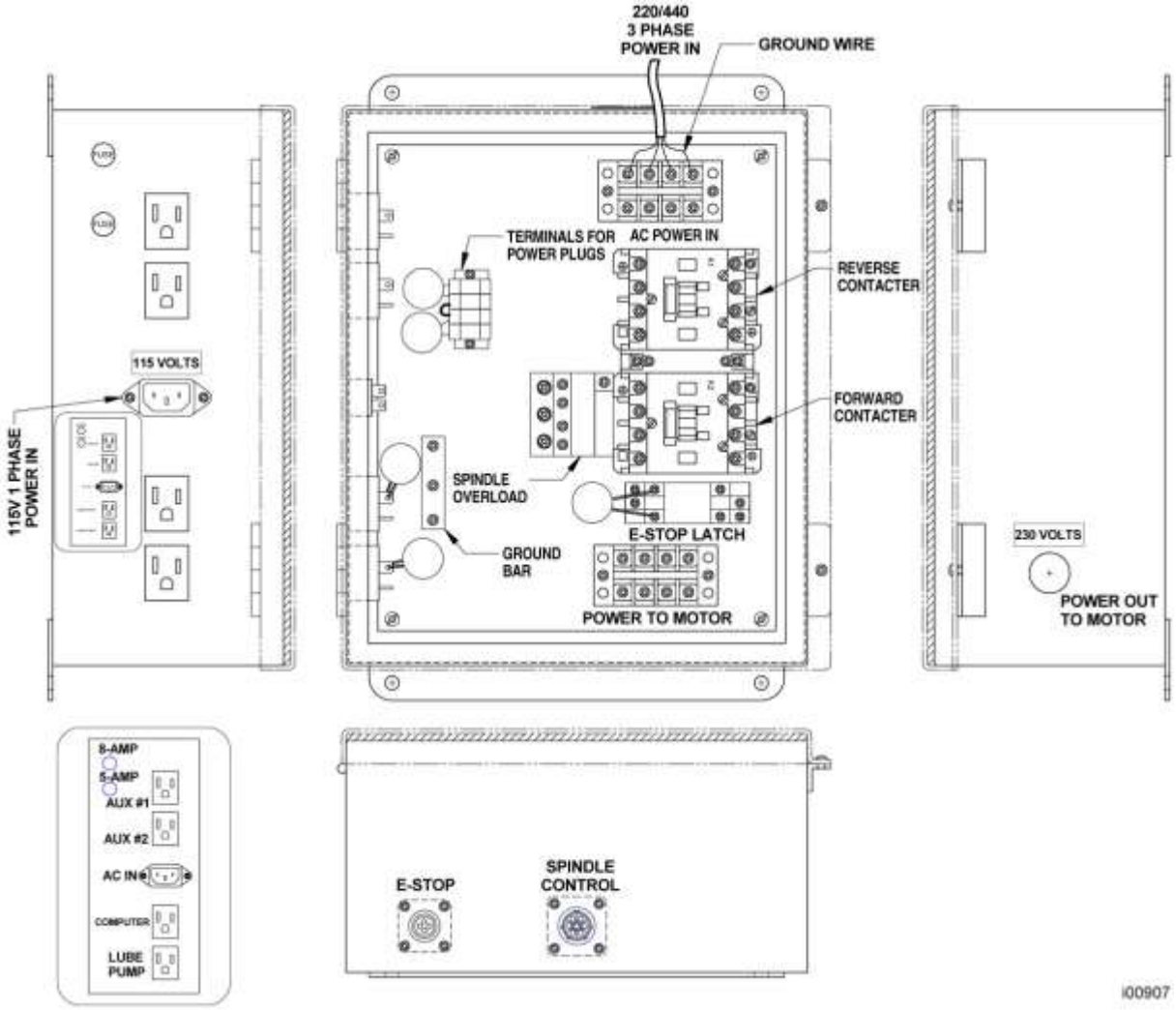


Figure 8 - Wiring - Not for retrofit

Part Number	Description
220V = 20676 440V = 20676	Electrical Box
220V = 23438-3 440V = 23438-3	Overload
23436	Contactor (Qty = 2) (Reverse or Forward)
20676-2	Electrical Box Replacement if machine has table guard option.

2.13 Air Connection - Optional

The machine has an air hookup in the rear of the machine if the machine has a power drawbar

If the machine has a power drawbar option then the machine will include an air regulator, air manifold and an oiler. The air fitting is ¼" NPT. Within the manifold there is an additional air line port in case the user wants to hook up an air line to clean chips. Remove the plug to gain access to this port

2.14 Lubrication

CAUTION!

Failure to properly lubricate the mill will result in the premature failure of bearings, sliding surfaces & ball screws.

2.14.1 Manual Lubrication - KEMX

The TRAK EMX mill X & Y way surfaces and ball screws need to be manually lubricated. The Manual Lube automatically discharges about 4ml of oil every plunge.

1. At the beginning of each day, manually pull the pump handle.

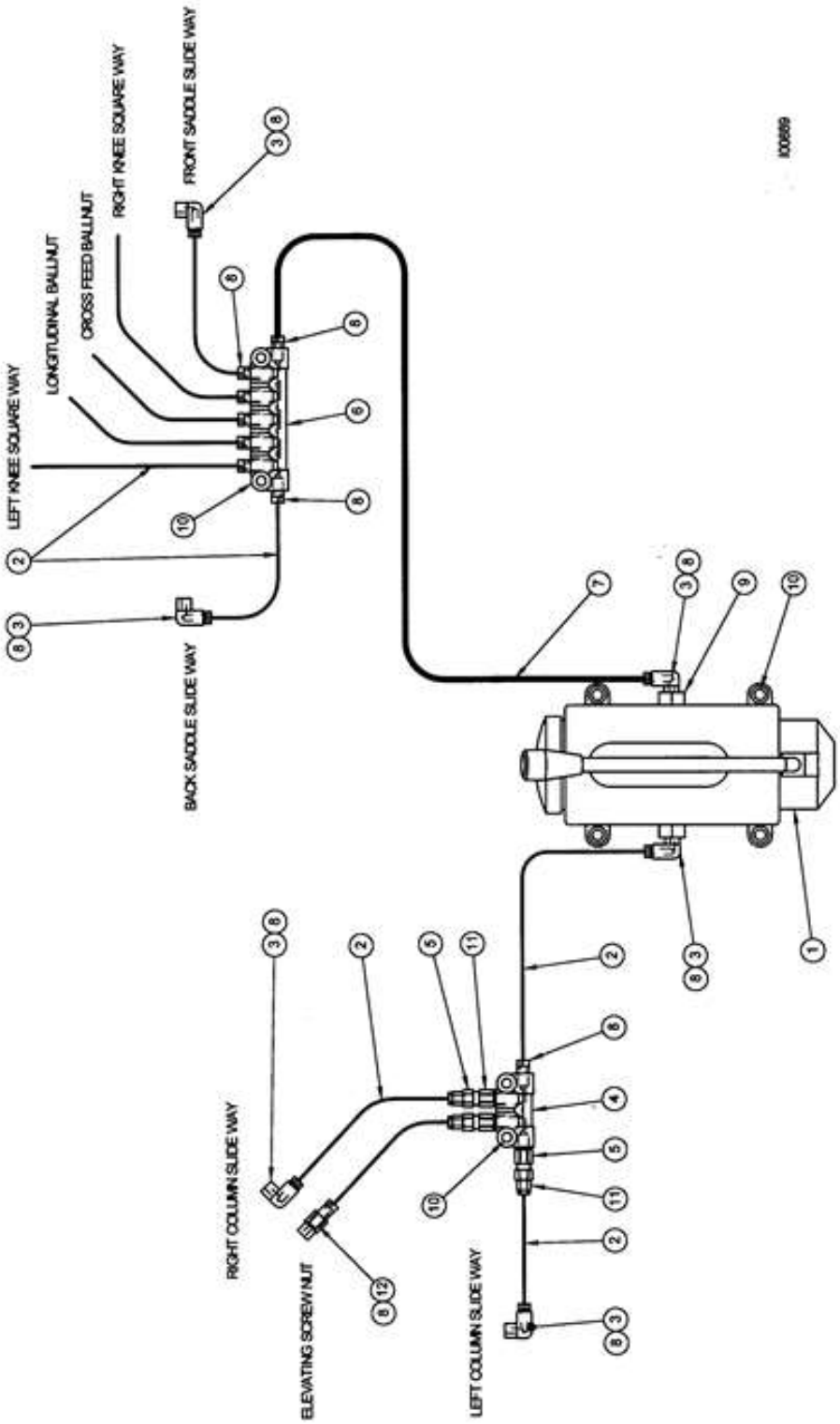
   Note: If the machine has been sitting for a long while, run the machine through the full length of its travel to ensure lubrication reaches all surfaces.

2. At the beginning of each day, check the oil level in the system. If low, fill with Mobil Vactra Oil No. 2 or equivalent.

CAUTION!

Failure to manually activate the pump at the beginning of each day and allowing the pump to run dry may cause severe damage to the TRAK mill way surfaces and ball screws.

Figure 17 – Knee Mill Lubrication



Parts List - Knee Mill Lubrication (Figure 17)

Item	P/N	Description	Qty
1	9001	FRU-K3-HAND OILER	1
2	9002	FRU-K3-ALUMINUM PIPE	6
3	9003	FRU-K3-ELBOW	6
4	9004	FRU-K3-T-JOINT - 4 HOLES- M8 X 1.0	1
5	9005	FRU-K3-CONNECTOR	3
6	9006	FRU-K3-REGULATING DISTRIBUTOR	1
7	9007	FRU-K3-FLEXIBLE TUBE	1
8	9008	FRU-K3-SCREW NUT - M8 X 1.0 MALE	15
9	9009	FRU-K3-SCREW NUT - PD 1/8- 19MM	2
10	9010	FRU-K3-SCREW - M5 X 20 mm LG	8
11	9011	FRU-K3-SCREW NUT - M8 X 1.0 FEMALE	3
12	9012	FRU-K3-ADAPTER	1
13	9013	FRU-K3-SLEEVE - 4.1 mm I.D.	18

i00889

2.14.2 Way Lubrication – DPMEX2

The auto lube system provides centralized automatic lubrication for the ways and ballscrews. The lube pumps 2-liter reservoir is serviced with Mobil Vactra Oil No. 2 or equivalent. The pump is factory set to pump oil for 15 seconds for every 60 minutes of spindle time. There is an internal memory on the pump so that the pump will not reset every time the spindle is turned off.

The pumping output can be regulated electronically to control the pause time between pumping cycles, and the duration of the pumping cycle. The following describes the buttons used to program the lube pump. In order to modify any of the settings the spindle must be on.

The pump has an alarm that will sound if any of the following problems arise:

Oil line breakage

Oil filter blockage

Bad motor

Low oil pressure

No oil in tank

INT (Interval) - this button programs the interval between pumping cycles. Each press of the button increases the interval by one minute.

DIS (Discharge) - this button programs the amount of time the pump will discharge each pumping cycle. Each press of the button increases the discharge time
by one minute.

FEED - this button is used to manually feed the ways and ballscrews.

RST - this button tells the pump to discharge for the time programmed.

Factory Default Values

Interval Time - 60 min.

Discharge Time - 15 sec

Discharge Pressure - Approximately 100 - 150psi

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

At the beginning of each day, check the oil level in the Auto Lube system. If low, fill with Mobil Vactra Oil No. 2 or equivalent (SAE 30 or ISO 68).

CAUTION!
Failure to manually activate the pump at the beginning of each day, or allowing the Auto Lube to run dry may cause severe damage to the TRAK DPMEX2 way surfaces and ballscrews.

2.14.3 Head Lubrication – TRAK Mills

Once Each Week:

1. Fill the oil cup on the front of the head with SAE 30 or 30 W oil. This oil lubricates the Hi/Lo range shifter.

2. Fill the ball oiler located in the front lower right corner of the speed changer housing. This oil lubricates the speed changer shaft.

3. Extend the quill fully and apply a coating of SAE 30 or 30W oil to the outside diameter of the quill.

Every Four Months:

Apply a good grade of general-purpose grease through the grease fittings on the back of the head and on the left side of the head. This grease lubricates the Low range gear set and the feed change gears respectively. Also lubricate vari-disk on spindle motor by means of grease fitting on motor shaft.

3.0 ProtoTRAK EMX Retrofit Installation

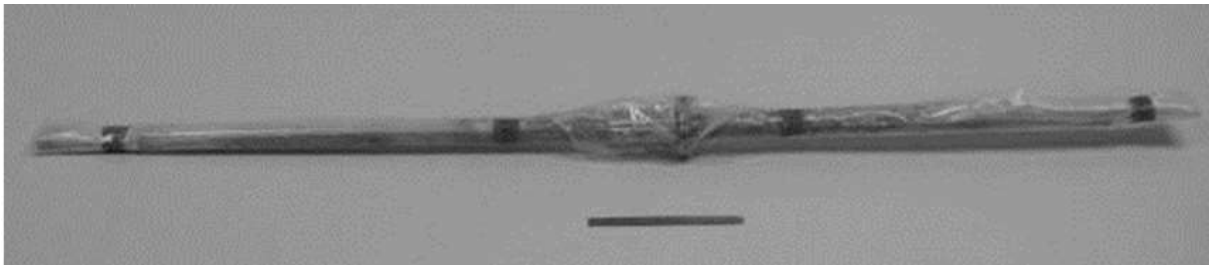
3.1 Recommended Tools

- Allen wrenches, set, inch and metric
- Drill motor
- Drills, set
- Taps, set, and tap handle
- Machinist square
- Bubble level
- Crescent wrench, 10”
- Torque wrench, up to 60 ft/lbs. - Optional, better if you have it
- Crowfoot wrench, 1 1/4” open end to fit torque wrench
- Socket set with 3” and 6” extension and ratchet wrench
- Dial calipers
- Flat blade screwdriver set
- Phillips screwdriver set
- Gauge block, 6” or 150mm - Calibrate X, Y
- Gauge block, 3” or 75mm - Calibrate optional Z scale
- .0001” dial indicator and magnetic base
- Center punch
- Hammer, small
- Combination wrenches, set, 3/8” to 15/16”
- Counterbores or step drills set
- Combination wrench, 10mm
- Transfer punch set
- Transfer screw set
- Feeler gage - Z glass scales option
- Pliers set
- File set
- Xacto knife with flat blade
- 3/4” 2 flute end mill - For machining test
- Safety glasses

3.2 Kit parts

3.2.1 Ballscrews

Warning: never unscrew a ballscrew from its ball nut. This will destroy the ballscrew. This is especially important with the Y-axis ballscrew. Before installing, be sure that the ballscrew is long enough for the saddle travel of your machine.



1 - BALLSCREW-XAXIS

(P/N 26031-42), (P/N 26031-48), (P/N 15608-36) or (P/N 15608-54)

This item will have one of these part numbers based on the kit that is shipped.

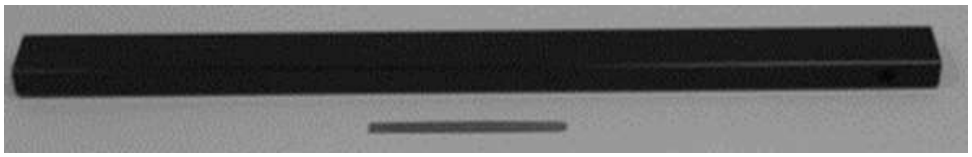
1 - BALLSCREW-YAXIS

(P/N 26032-12), (P/N 26032-16) or (P/N 15609-19)

This item will have one of these part numbers based on the kit that is shipped.

3.2.2 Pendant Arm Assembly – P/N 26034-2, -3 or –4

This assembly will vary depending on the machine it is installed on.



1 ea - PENDANT ARM (P/N 26037)

1 ea - NAMEPLATE-SYSTEM S/N(P/N 21934)

3.2.3 Motors

X & Z MOTOR ASSY ENCODER/DRIVER 4020 (P/N 20296 Qty 2)

Y MOTOR ASSY ENCODER/DRIVER 4020 (P/N 20296)

3.2.4 Options

Z Glass scale and glass scale mounting bracket

The Z Glass Scale and hardware are packaged in two separate boxes. One box contains the scale and the other contains all hardware. See the instructions that came with your glass scale kit for the listing of parts.

1 – Z GLASS SCALE

(P/N 22800-4)

Remote Stop-Go switch Option

1 – REMOTE STOP/GO SWITCH

(P/N P-TRAK RSG)

USB Thumb Drive Option

1 – USB-FLASH DRIVE-512MB

(P/N 24671-512)

3.2.5 Pendant and pendant hardware

1 ea - PENDANT ASSY – PROTOTRAK EMX

(P/N 26015-2)

3.2.6 X Axis Drive Kit – P/N 20255-1,-2,-3,-5 or –6

This assembly will vary depending on the machine it is installed on.

See drawings located at rear of manual.

3.2.7 Y Axis Drive Kit – P/N 23083-1,-2,-3 or -4

This assembly will vary depending on the machine it is installed on.

See drawings located at rear of manual.

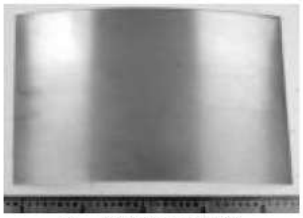
3.2.8 Yoke Kit – P/N 15844-1,-2,-3,-5,-6 or -13

This assembly will vary depending on the machine it is installed on.

See drawings located at rear of manual.

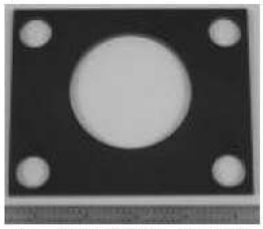
3.2.9 Other parts

The parts in this section are not needed for all machine models and do not appear in some kits. Even if they are in your kit, you may not need to use them. See the instructions.



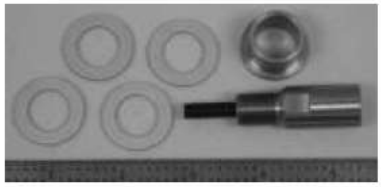
1 – YOKE SHIM
(P/N 16568)
Needed if the ballscrew bore is too small relative to the yoke bore.

1 – END CAP
(P/N 22007)
Needed when the original end cap is not usable.



1 – BACKING PLATE
(P/N 16029)
Needed to support the Y-axis bearing assembly when the hole in the machine casting is too large.

1 – BEARING
(P/N 22008)
Needed when the original floating bearing is not usable.



1 – BALLSCREW EXTENSION ASSEMBLY
(P/N 15181)
Needed for the X-axis ballscrew for tables that are 49″ long.

1 – BALLSCREW EXTENSIVE SUB ASSEMBLY
(P/N 14975)
Needed the X-axis ballscrew for tables that are 50″ long.

3.3 Installation Steps

The following steps suggest the best way to install the ProtoTRAK EMX retrofit. We recommend you proceed with the installation by doing the following.

- Follow the order of the steps.
- Read the Warnings and Cautions to avoid injury and damage.
- Refer to the drawings for the order of assembly of parts.
- Use the photos and tips to save yourself some time.

Step 1. Remove the table and lead screws

DANGER!

Crushing, slicing and pinching hazards are present with this step. Use extreme caution when removing the table. Ensure you have adequate working area and support before you remove the table. Don't work alone.

We suggest you remove the items in the following order:

1. Left and right hand wheel and bearing assemblies from the table
2. Table gib (easiest with table centered)
3. Table
4. Saddle hand wheel and bearing assembly (with saddle cranked all the way forward)
5. Table and saddle lead screws
6. Yoke, or lead screw nut retainer
7. Nut, bushing, key and pins from the yoke (if a new yoke came with the kit, you don't have to do this)

Tips:

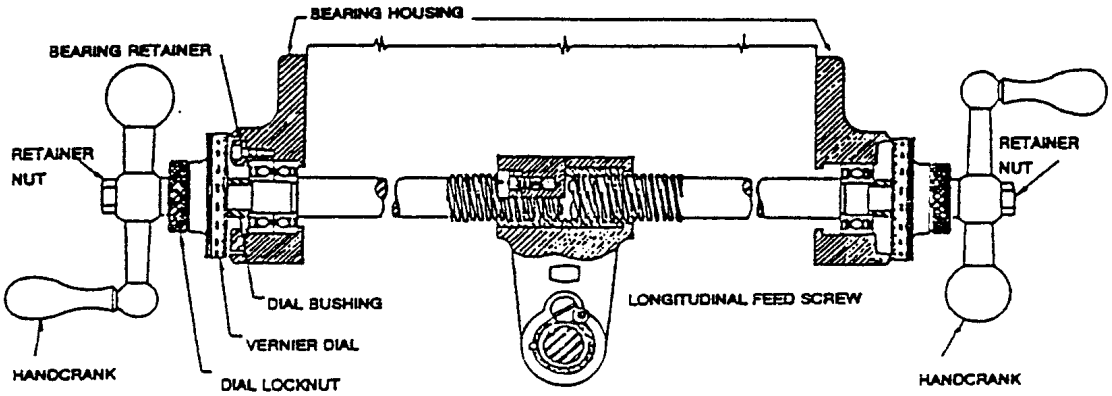
- Keep the original machine hardware organized as you remove it. You will need some of it later.
- Before removing any of the hardware from the machine, crank the table all the way to the right or left in order to be able to position the lift table next to the machine.
- With the machine disassembled, do a good job of cleaning the gibs, oil grooves and slideways. This will help ensure smooth operation of your ProtoTRAK.
- Assure that the lubrication system is working properly.

CAUTION!

When removing the table, make sure it does not cock or it may break the dovetails as it slides out.

Left Assembly

Right Assembly



X AXIS

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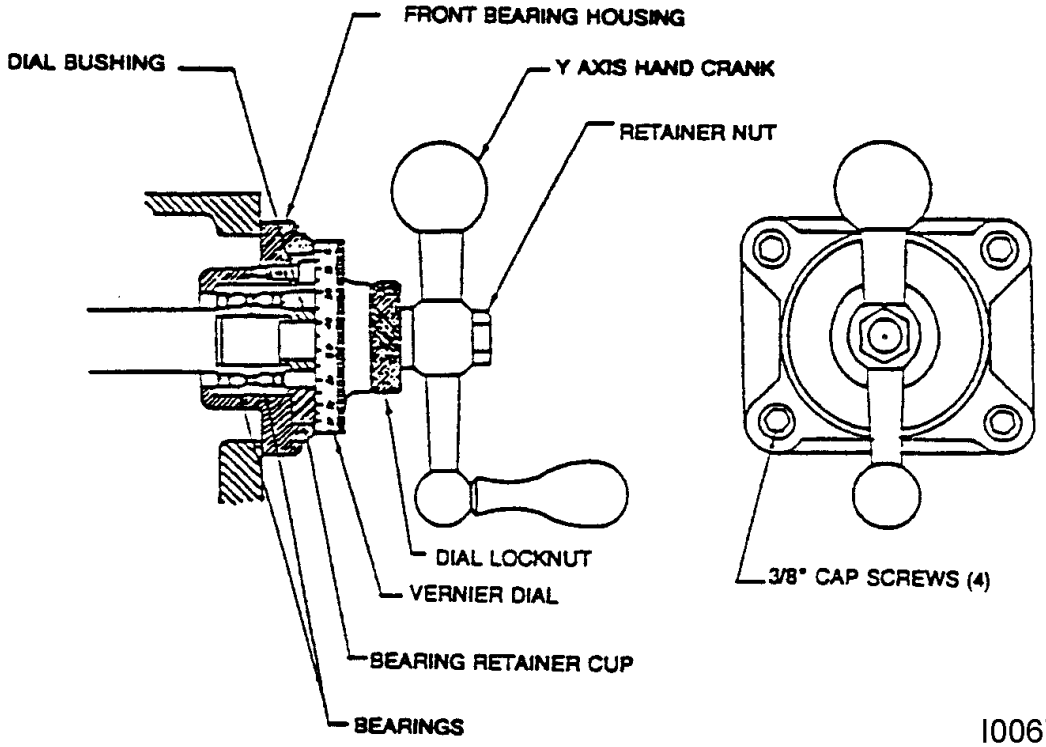
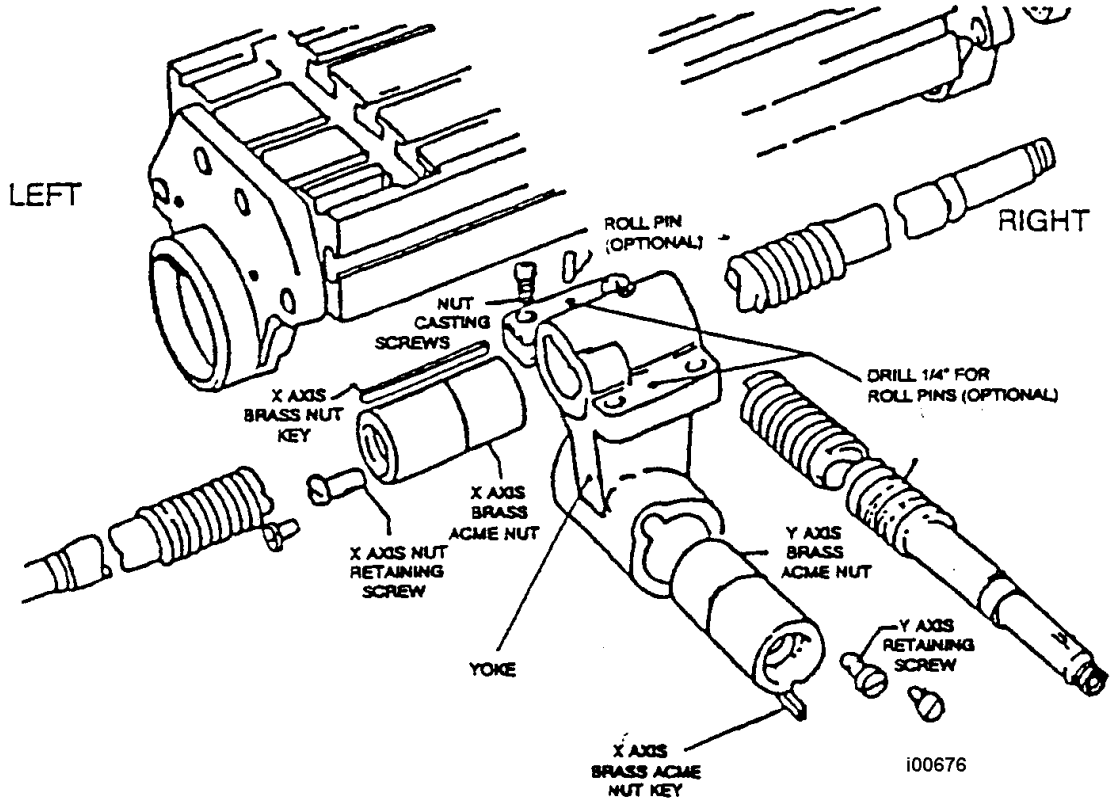
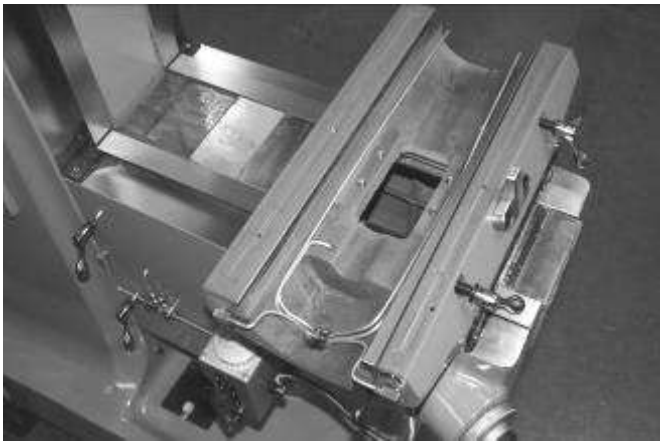


I00671



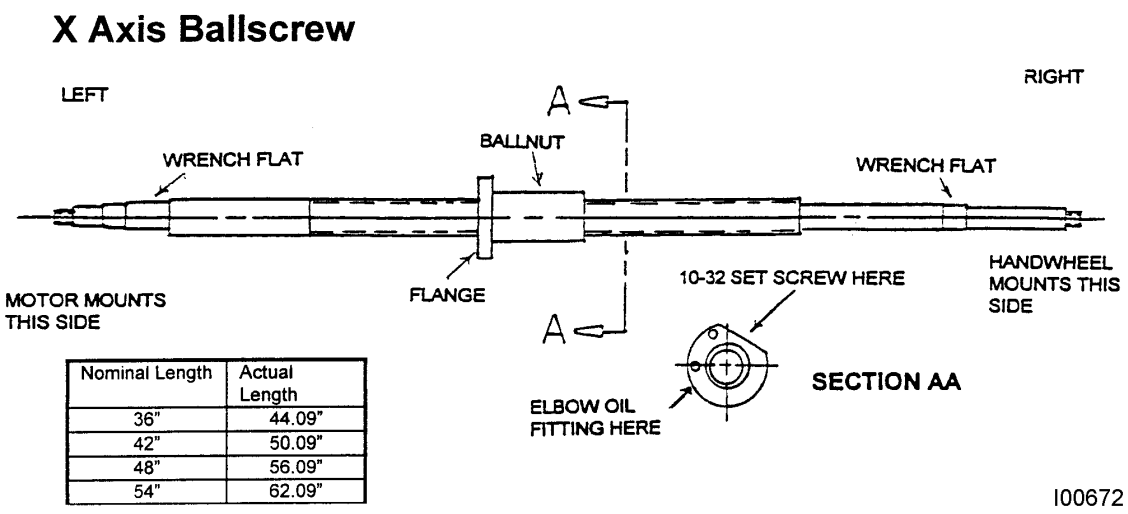
WARNING! Use proper support for the table



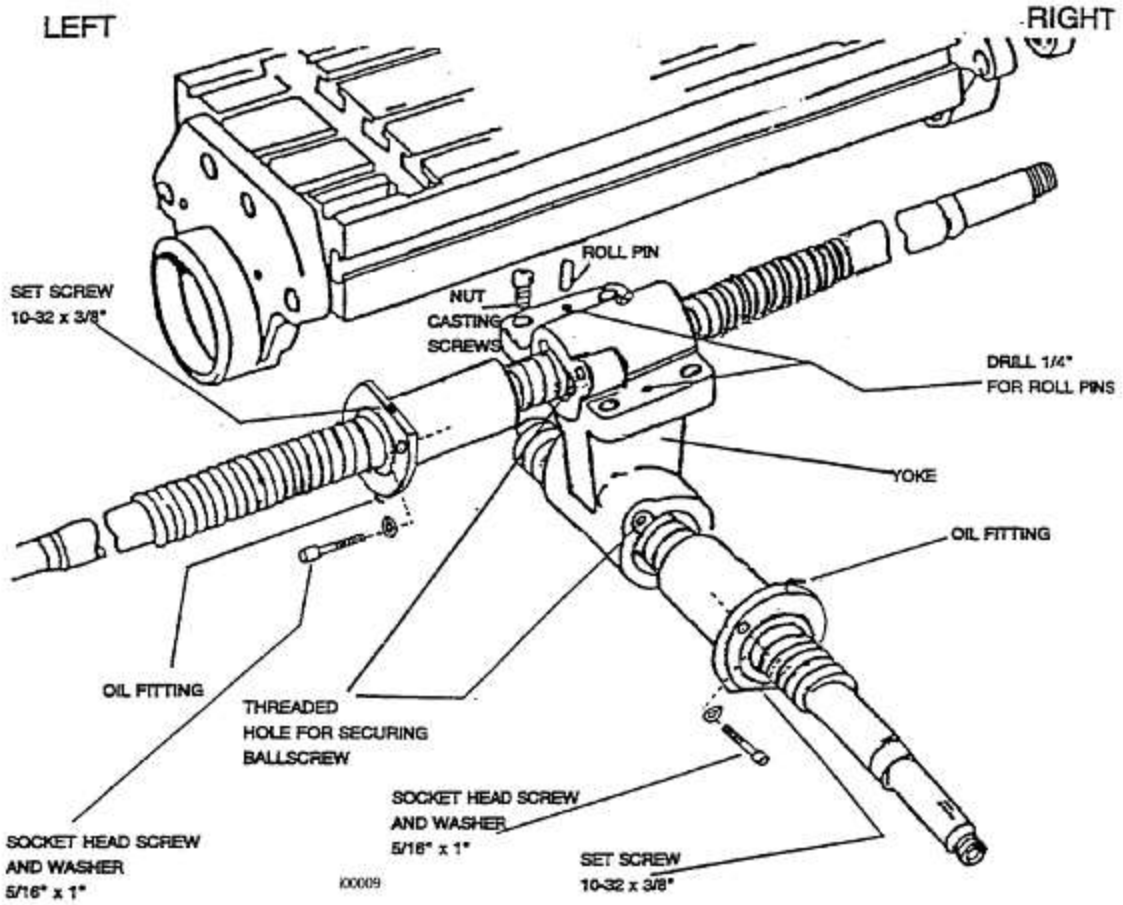
Ready for Step 2

This step is completed when: the table is removed, the casting is cleaned and the parts are organized for later.

Step 2. Install the X (Table) Ballscrew



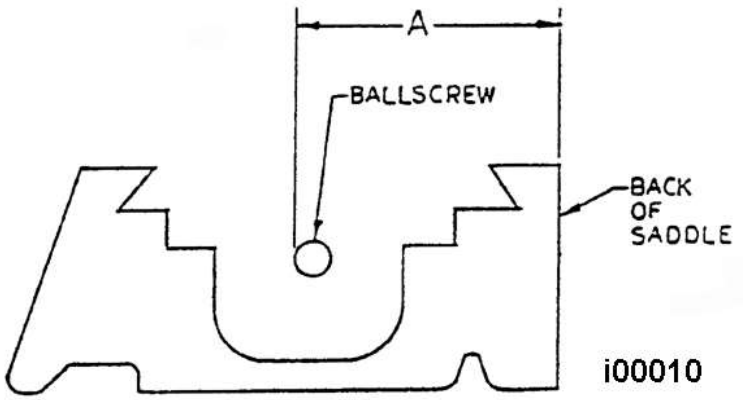
Nominal Length	Actual Length
36"	44.09"
42"	50.09"
48"	56.09"
54"	62.09"



Caution: Never unscrew the ballscrew from the nut. This will destroy the ballscrew.

Tips:

- Install the elbow oil fitting and 10-32 set screws on the ball nut. The set screw goes in flush to the surface to prevent oil from draining out of the hole. Don't tighten too much or it will damage the ballnut.
- First position the yoke in the saddle without the casting screws, then slide the ballscrew into the yoke. Once the ballscrew is in you can screw in the screws that go through the yoke and into the saddle casting, although you should not tighten them until the ballscrew is aligned.
- If you are using the original machine yoke and it was pinned to the casting, simply replace the pins. If not, it will be necessary to align the ballscrew.
- Align the X ballscrew either to the back of the saddle or to a piece of round stock you clamp into the back dovetail. The ballscrew should be aligned within +/- 0.005" end-to-end.



- Trim excess oil line tubing to get it out of your way.
- T-fittings are provided in case they are needed. Use provided restrictors in the oil lines to both the x and y ball nuts so that there will be enough pressure to force oil to the ways.

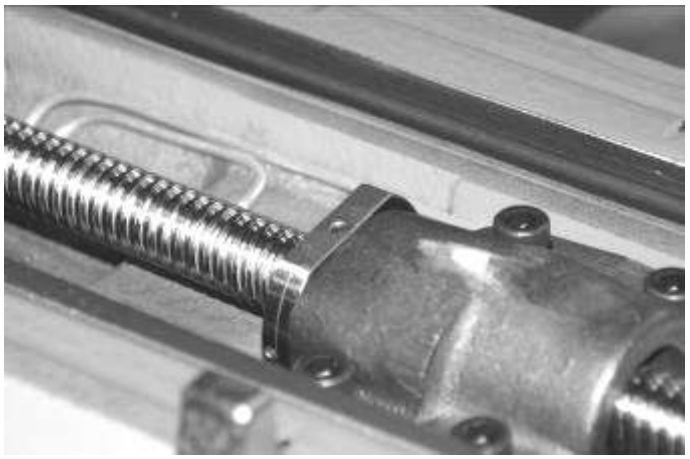
Caution!

Ballscrews must be aligned. Damage to the ballscrew and drive assemblies will occur if the ballscrews are not aligned properly.

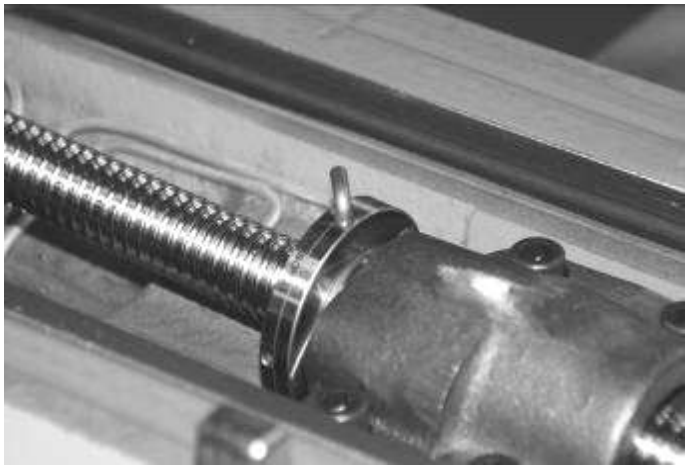
Caution!

Assure that the oil line will provide for proper oil flow to the ball nut. The ballscrew must have oil.

Position ballscrew with yoke still loose



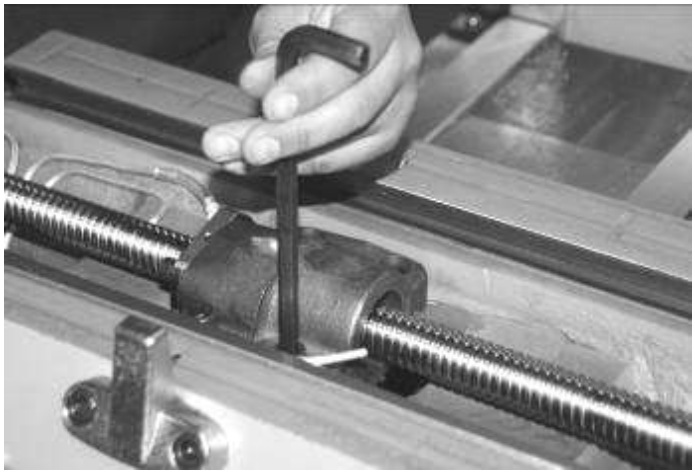
Install set screw flush, not tight



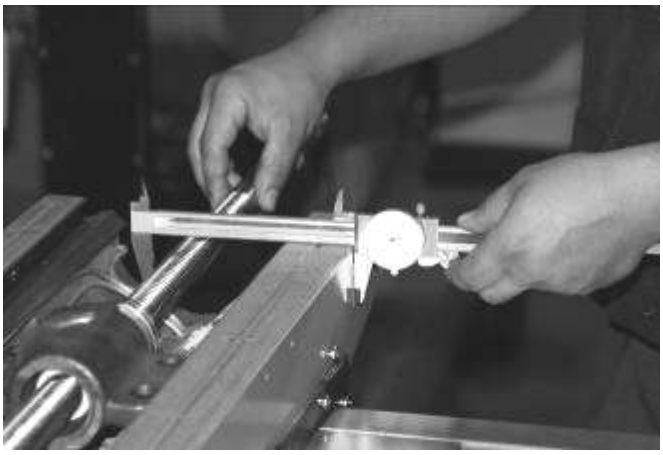
Elbow fitting

Oil line installed with restrictor

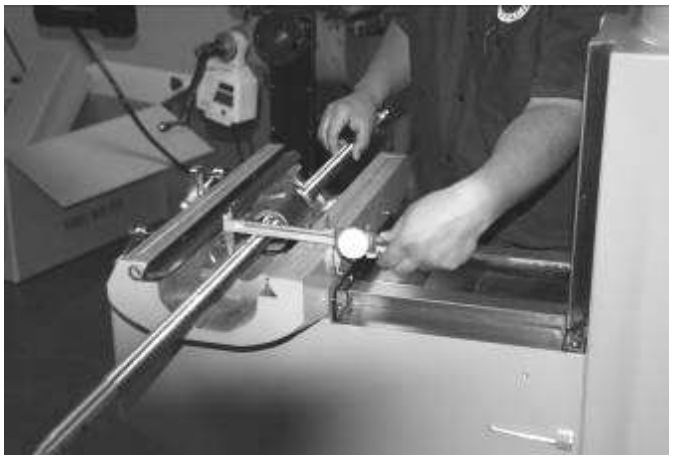
Tighten ball nut retaining screw



Install casting screws snugly, not tight yet



Align to back of the saddle…

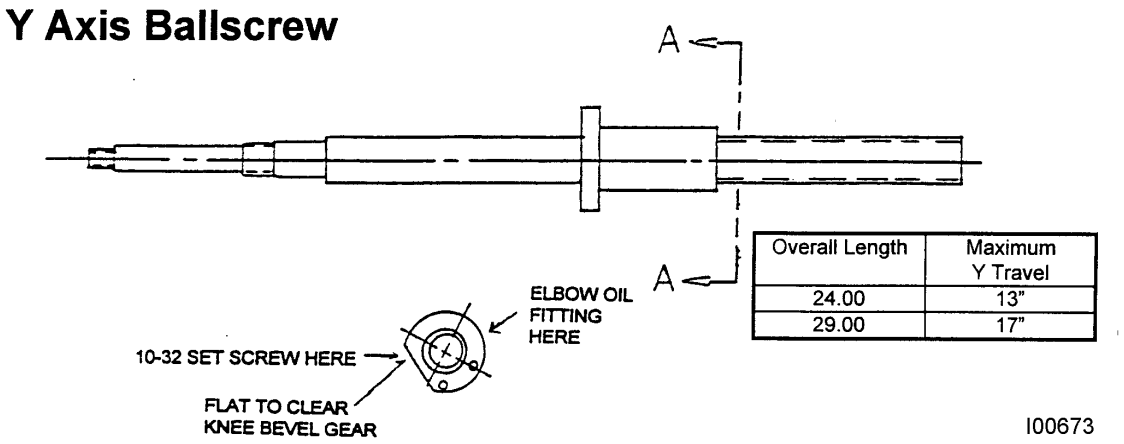


…within ± 0.005”

Now tighten. Check alignment again.

This step is completed when: the X ballscrew is tightly attached to the saddle casting and is aligned within +/- 0.005” from end-to-end.

Step 3. Install the Y Axis (Saddle) Ballscrew



Overall Length	Maximum Y Travel
24.00	13"
29.00	17"

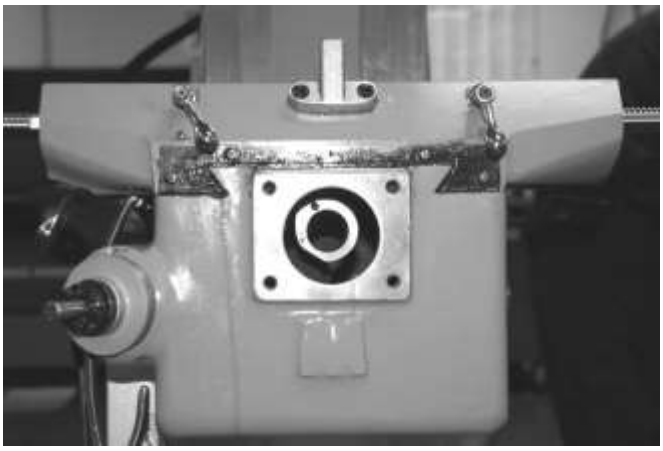
Caution: never unscrew the ballscrew from its ball nut. This will destroy the ballscrew.

Tips:

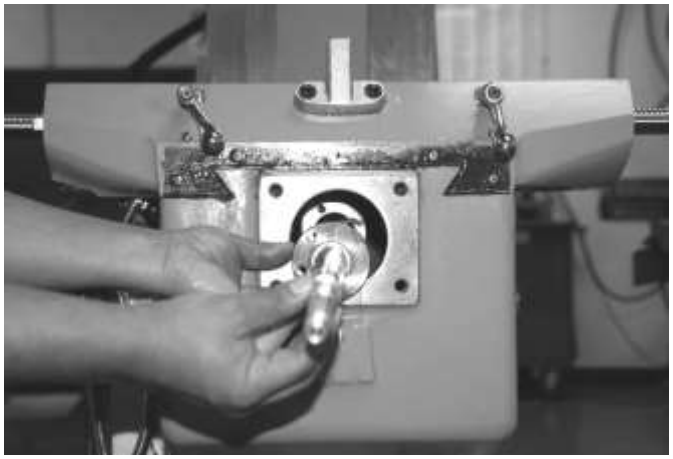
- Note that the oil fitting and set screw for the Y-axis ballscrew are in different positions than for the X ballscrew.
- Make sure the oil fitting clears the machine casting at the front. If it doesn't, you will have to grind away some of the casting for it to clear.
- Pull the saddle all the way forward to make it easier to slide the ballscrew into the yoke.
- The flat of the ball nut should match the flat of the yoke. These flats are there in order to clear the beveled gear of the knee crank.
- If you are using a yoke provided in the kit (and not the original yoke), make sure the flat of the new yoke clears the beveled gear. If it does not, you will have to grind some of the yoke away.
- Run the oil line for the ballscrew to the right and rear of the yoke. Don't trim it too short – having it longer will make maintenance easier in the future. Make sure to install an oil line restrictor.
- Leave the oil line to the ballscrew long – for easier maintenance access

CAUTION!

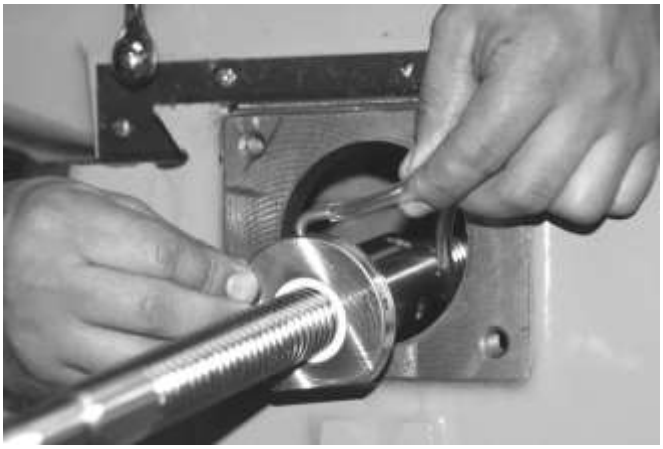
Make sure the sliding way covers will not shear the oil line when the saddle moves. The ballscrew must have oil.



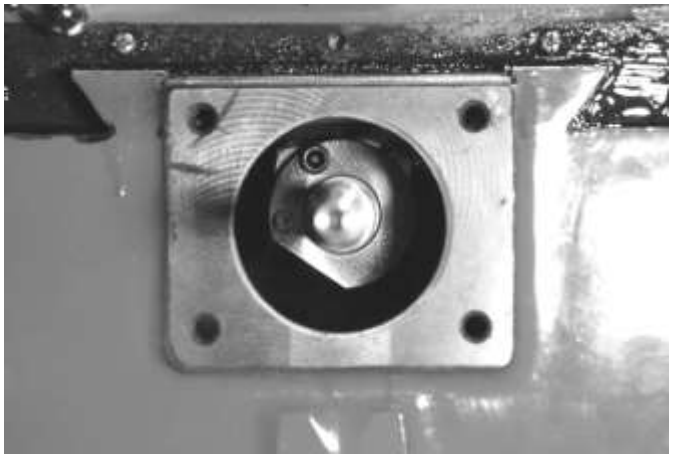
Note the flat on the yoke



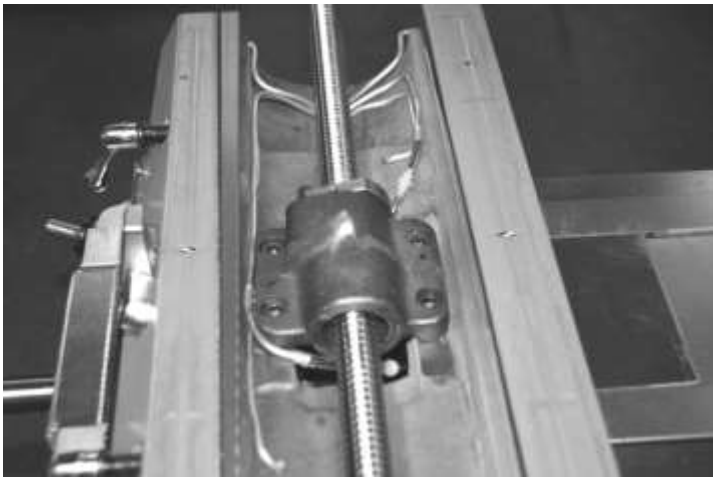
Align ball nut flat with yoke flat



Attach oil line and routed



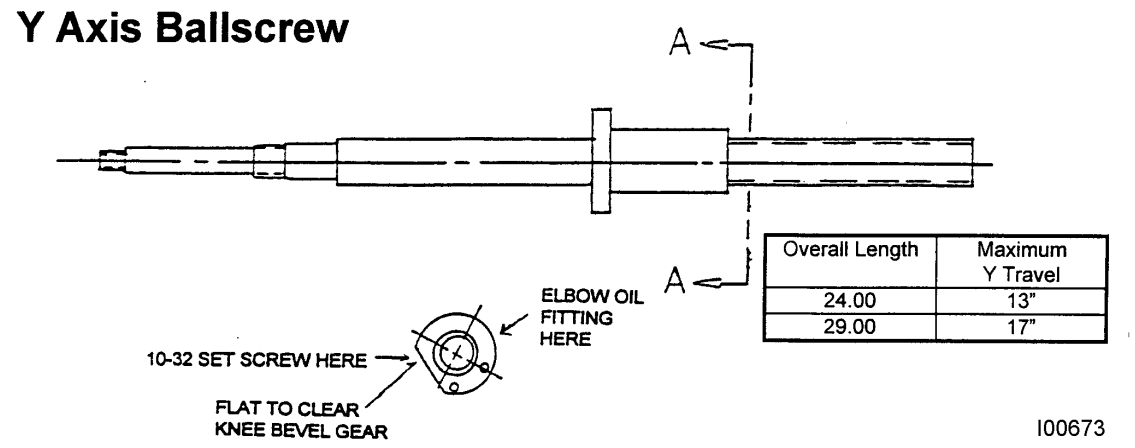
Ball nut and yoke must clear the bevel gear



Oil lines routed

This step is completed when: The Y-axis ballscrew is installed and it clears the bevel gear inside the saddle casting when the saddle is pushed back. Both oil lines are attached to both ball nuts and oil is flowing to the ball nuts and all the ways.

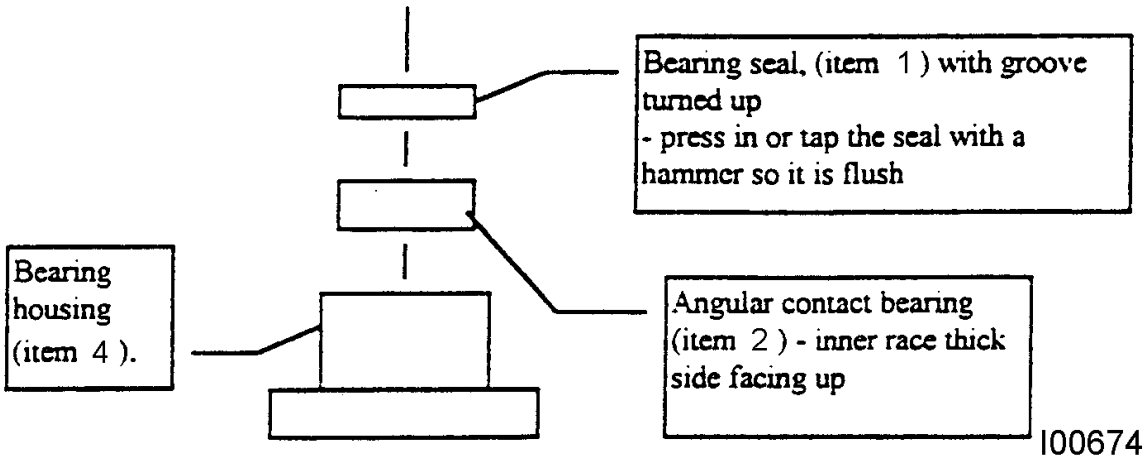
Step 4. Install the Y Axis Drive Train



Overall Length	Maximum Y Travel
24.00	13"
29.00	17"

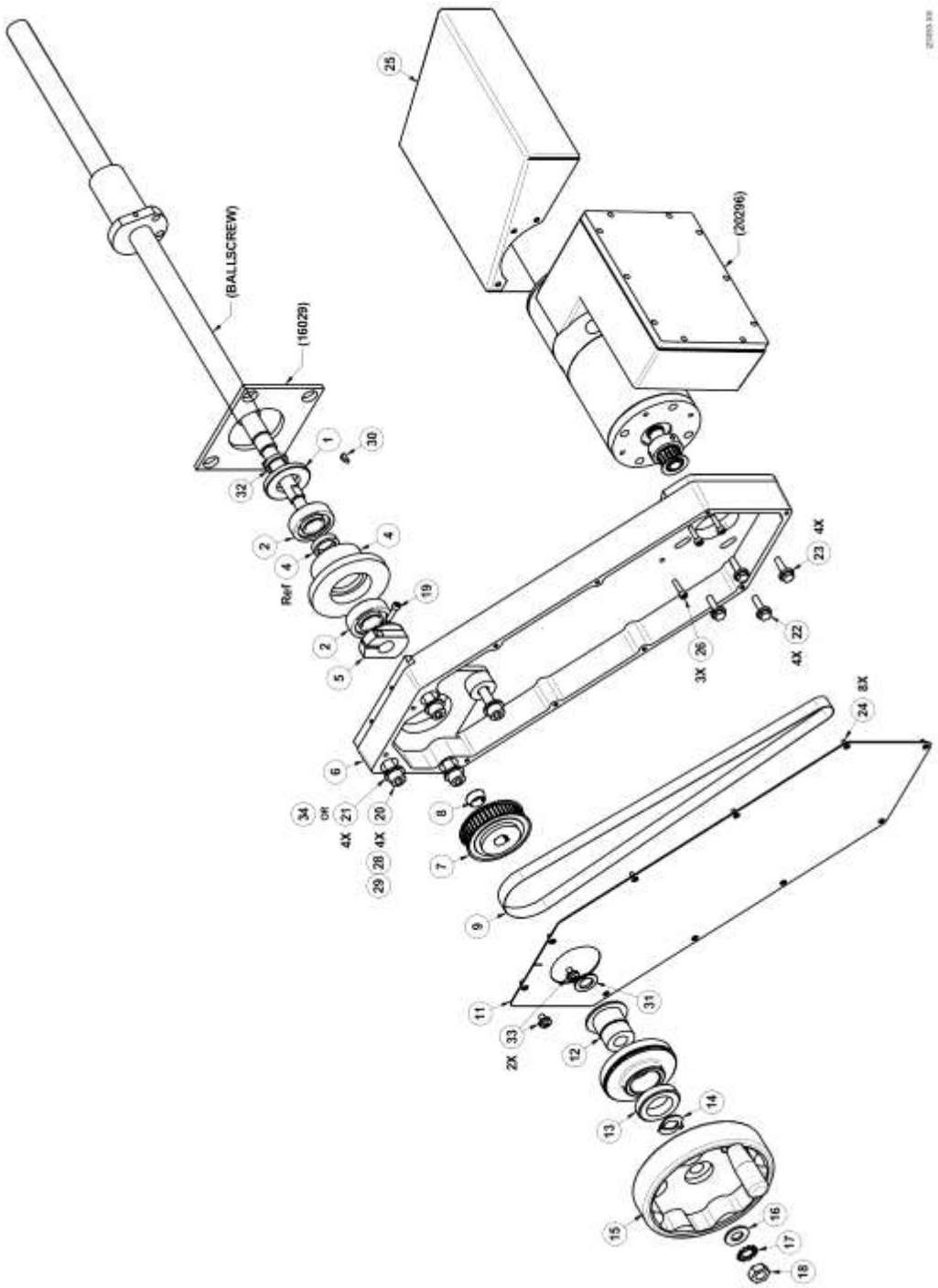
Tips:

- Assemble bearing housing assembly on a flat surface before you assemble it onto the ballscrew.



- There are two sets of bearing housings and bearing rings (one for Y and one for X); they are matched sets, don't mix them.
- The bearing seal should fit flush into the bearing housing with the groove side out. Press or gently tap it in with a hammer.
- The angular contact bearings must be oriented properly. The thick part of the inner races should face away from each other and be separated by the bearing ring.

Figure 18 - Y - Axis Drive Assembly – P/N 23083-3



Parts List - Y-Axis Drive Assembly - P/N: 23083-3

(Figure 18)

Item	P/N	Title	Qty
1	15626	SEAL-BEARING HOUSING	1
2	23930	BEARING SET (2)-ANGULAR CONTACT- 7204 BECBP	1 Set
4	15980	BEARING HOUSING ASSY-LARGE FLANGE-Y AXIS	1
5	16452	NUT CLAMP-X ,Y, & Z AXIS	1
6	20623	MOTOR BRACKET-KNEE MILLS-40 DEGR	1
7	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES	1
8	16350	FERRULE-SPROCKET	1
9	890-5M-15	BELT - TIMING 5MM POWERGRIP (Y AXIS)	1
11	20621	COVER-SPORT 40 DEGREE	1
12	15627-2	DIAL HOLDER	1
13	15836	DIAL NUT	1
14	15614	TAB WASHER	1
15	15616	HANDWHEEL ASSY-MX	1
16	1/2 71Z	WASHER-FLAT SAE-STL-ZINC	1
17	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	1
18	1/2-20 51Z	NUT-HEX JAM-STL-ZINC	1
19	10-32X3/4 25B	SCREW-SHCS-STL-BO	4
20	M10-1.5X60 25B	SCREW-SHCS-STL-BO	4
21	23082	WASHER-.75X.394X.10-STL	4
22	1/4-20X1 24B	SCREW-HEX HD-STL-BO	4
23	15759	WASHER-1/4 HARD BLK OX 1/8 THK	4
24	6-32X3/8 10B	SCREW-PH-PHIL-STL-BO	8
25	23141	SHEET METAL-PT4-COOLANT MOTOR COVER ASSY	1
26	10-32X1 25B	SCREW-SHCS-STL-BO	3
27	10 73B	WASHER-SPLIT LOCK-STL-BO	3
30	98481A090	KEY WOODRUFF #404-1/8 X 1/2	1
31	14772-2	SPACER - .020" THICK	1
32	20322	SPACER Y-AXIS- BALLSCREW	1
33	1/4-20X3/8 10B	SCREW-PH-PHIL-STL-BO	2
	20296	MOTOR/ENCODER/SERVO ASSY-DRIVER	1
	26032-12	BALLSCREW - Y AXIS	1
	26032-16	BALLSCREW - Y AXIS	1

i23083-3

The clamp nut is designed to trap the bearing against the ballscrew journal with the correct preload:

- Thread the clamp nut onto the ball screw and tighten the #10-32 clamp screw until you feel the clamp nut contact the ball screw threads. It should drag as you tighten the clamp nut.
- Tighten the clamp nut to 50 ft/lb.
- Tighten the 10-32 clamp screw.

The bearing housing is designed to float to find its own center. If it does not contact the saddle casting (because the hole is too large) use the backing plate (PN 16029) that is provided for the machine models that need them.

Once the clamp nut is installed, turn it until the bearing housing contacts the knee casting (or backing plate) and the saddle begins to move forward. Then install the motor mounting casting.

Bring the saddle forward until it is about an inch away from the front of its travel. Having the ball nut retainer (yoke) close to the mounting bracket will help to align it properly.

Put the Y axis drive belt on the pulley before installing the vernier dial. Install the motor next. Position the motor so the cable can be routed to the left and around the machine.

Use the machine's original vernier dial.

Install the top cover of the motor mounting bracket and check for clearance between the vernier dial and cover. Add shims to the vernier dial holder if needed.

Tighten the 1/2-20 hex head nut to 20 ft/lb.

WARNING!

Don't push down on the ballscrew as you are tightening – this may bend the ballscrew.

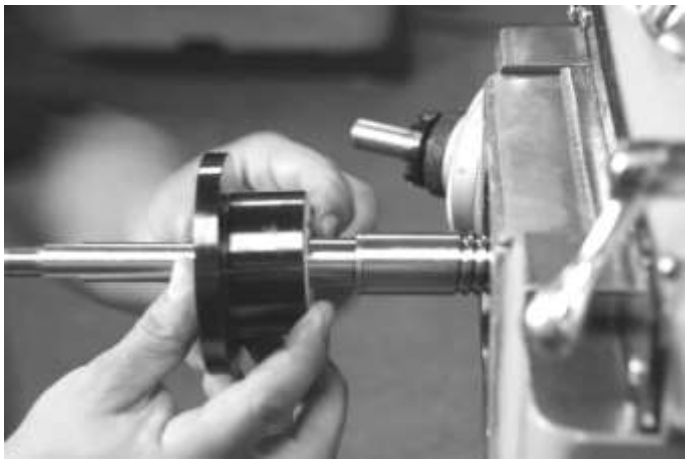
Bearing letters face in

Bearing ring

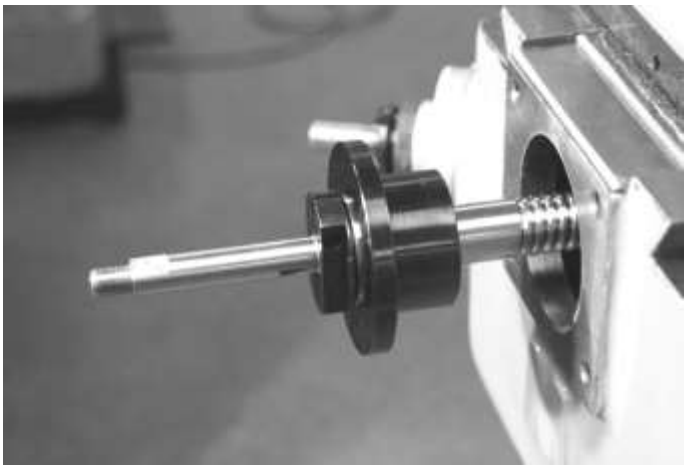
Facing in

Groove side out

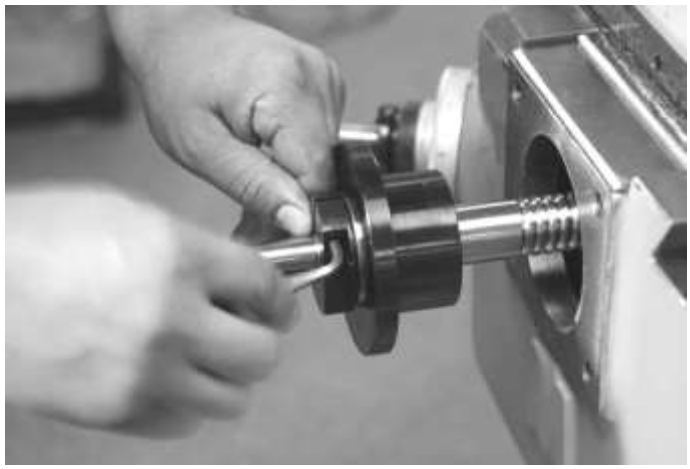
Bearing housing complete assembly



Bearing housing assembly next



Clamp nut pins bearings

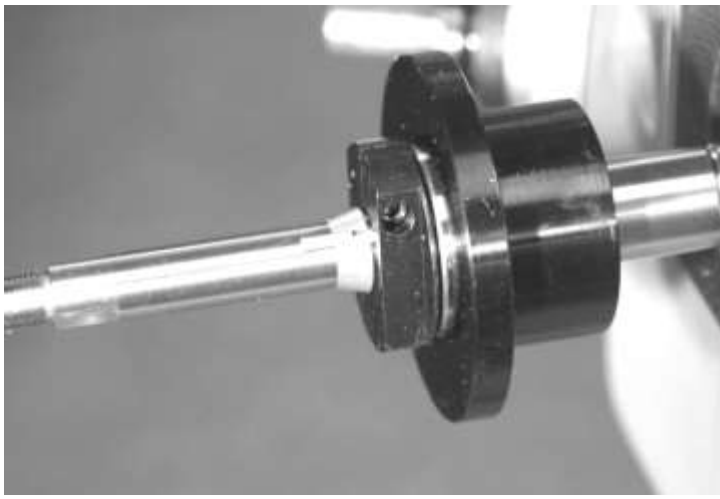


10-32 socket head cap screw, but not tight yet

Torque clamp nut to 50 ft/lb.

Torque socket head cap screw to 90 in/lb.

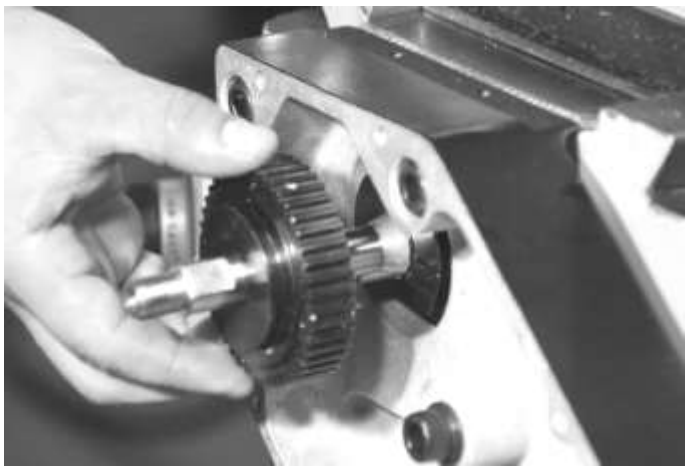
Woodruff key



Brass ferrule

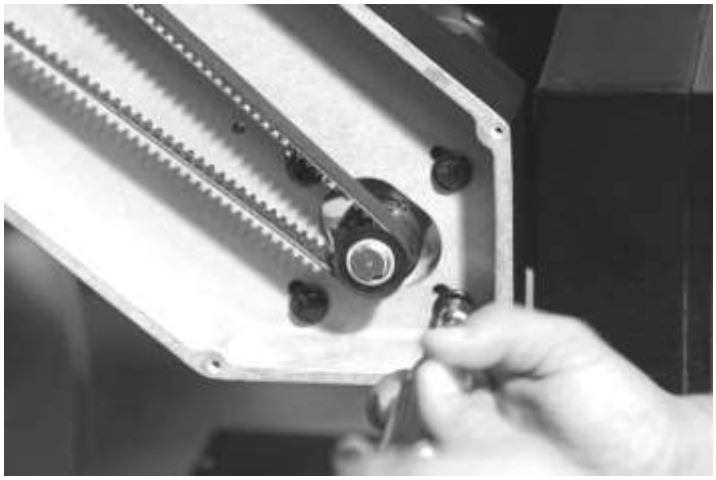
Flat against casting

Motor bracket

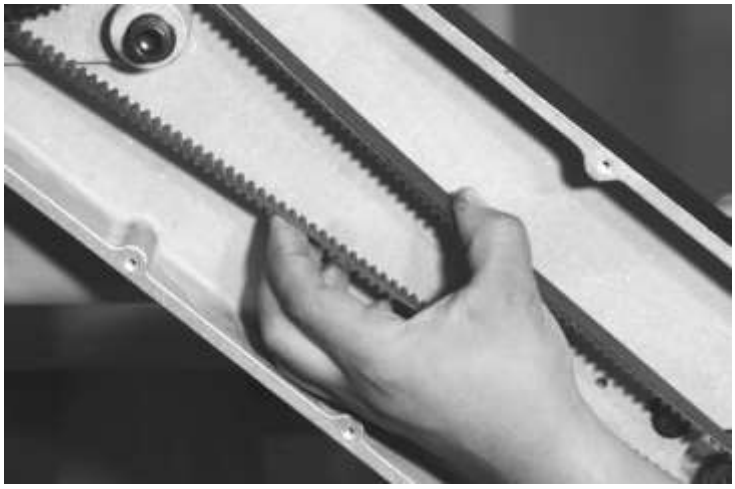


Pulley

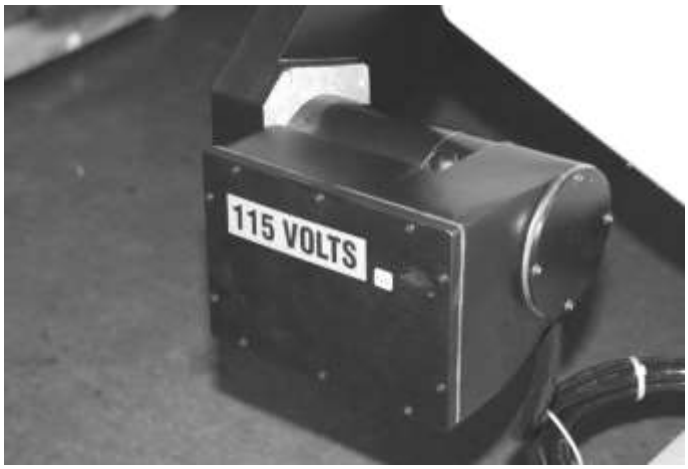
Belt



Motor

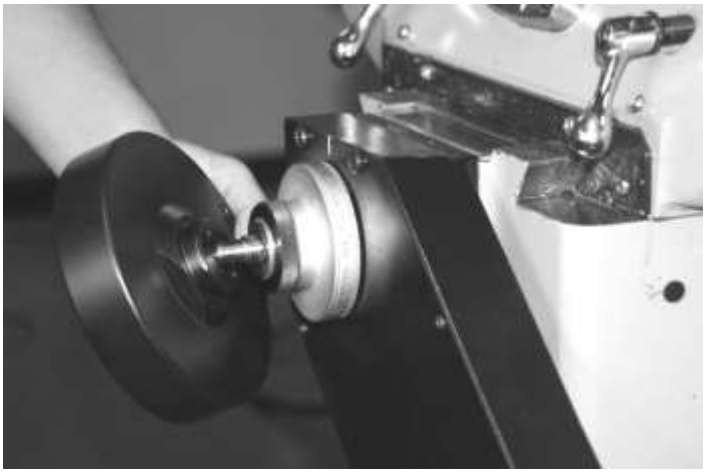


Proper tightness



Motor, proper orientation

Vernier and spacer



Dial nut, tab washer and handwheel

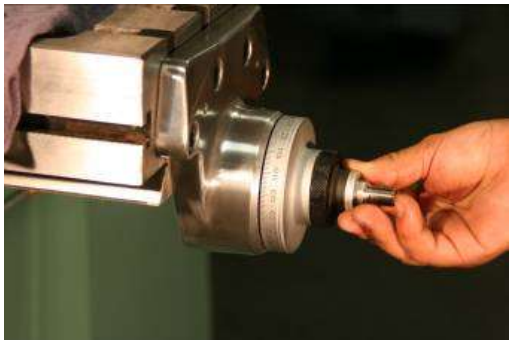
Tighten, don't push down

Torque to 20 ft/lbs

Y-axis drive completed

This step is completed when: The drive train feels smooth as you crank the Y-axis hand wheel through the entire travel. You will feel the belt cogs engage and the balls move through the ball nut, but it should be consistent and smooth.

Spacers as needed



Vernier dial, lock nut, spacers as needed

Handwheel, washer, star washer, nut

Tighten, don't push down

Torque to 20 ft/lbs

Step 5. Replace the table & install the X drive train (left side) & motor.

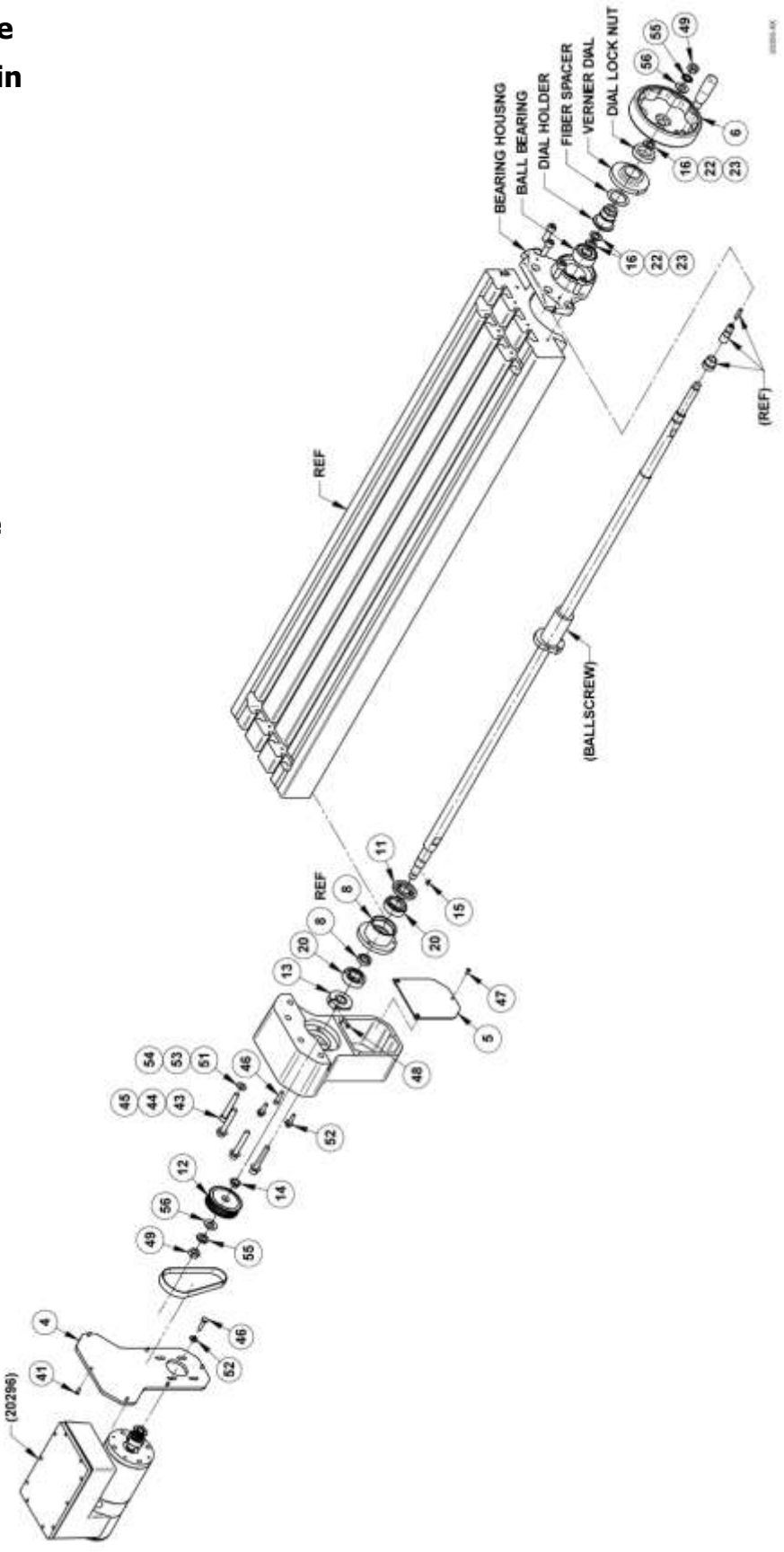


Figure 18.1 - X-Axis Drive Assembly - P/N: 20255-2

Parts List - X-Axis Drive Assembly (Figure 18.1)

Item	P/N	Title	Qty
1	15621	DRIVE HOUSING	1
4	15624	COVER - X-AXIS - DRIVE - HOUSING-MX	1
5	15622	BACK COVER	1
6	15616	HANDWHEEL ASSY-MX	1
8	15612	BEARING HOUSING ASSY-X AXIS	1
10	15638	STOP - X-AXIS	1
11	15626	SEAL-BEARING HOUSING	1
12	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES	1
13	16452	NUT CLAMP-X ,Y, & Z AXIS	1
14	16350	FERRULE-SPROCKET	1
15	98481A090	KEY WOODRUFF #404-1/8 X 1/2	1
16	14772	SPACER - .100" THICK	5
19	400-5M-15	BELT - TIMING 5MM POWERGRIP	1
20	23930	BEARING SET (2)-ANGULAR CONTACT-7204 BECBP	1Set
22	14772-2	SPACER - .020" THICK	2
23	14772-5	SPACER - .050" THICK	2
41	8-32X3/8 25B	SCREW-SHCS-STL-BO	6
42	5/16-18X1 25B	SCREW-SHCS-STL-BO	1
45	M10-1.5X65 25B	SCREW-SHCS-STL-BO	4
46	1/4-20X1 24B	SCREW-HEX HD-STL-BO	7
47	8-32X3/8 20B	SCREW-RH-PHIL-STL-BO	3
48	10-32X3/4 25B	SCREW-SHCS-STL-BO	1
49	1/2-20 51Z	NUT-HEX JAM-STL-ZINC	2
52	15759	WASHER-1/4 HARD BLK OX 1/8 THK	7
54	M10 70P	WASHER-FLAT USS-STL-PLAIN	4
55	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	2
56	1/2 71Z	WASHER-FLAT SAE-STL-ZINC	2
57	22008	BEARING-204KTT	1
	26031-42	BALLSCREW - X AXIS	1
	26031-48	BALLSCREW - X AXIS	1

i20255-2

Danger!

Crushing, slicing and pinching hazard. Use extreme caution when replacing the table. Don't work alone.

Tips:

- Screw the X ballscrew to the opposite side to make it easier to slide the table back on.
- Temporarily install the 1/2-20 hex head nut on the ballscrew and use a wrench to turn it.
- Before you slide the table back on attach the oil lines and test the oil flow. Liberally lubricate the ways.
- Make sure the gib locks have not fallen out of their holes and into the saddle.
- Reinstall the table gib after the table is back on the machine.
- Unlike the Y-axis drive, the X-axis bearing housing attaches to the drive housing.
- See Step 4 for tips about the assembly of bearing housing and the clamp nut.
- Position the left end of the table almost flush with the left side of the saddle to install the left side drive train and motor.
- Make sure the belt is tight on the pulleys.
- Position the motor so the cable can be routed to the left (your left, facing the machine) and around the machine.
- When more than one fastener is called out in the drawing, use the ones that work for your machine.
- Item 10 in the list above may be installed on the saddle if needed to prevent the X motor casting from damaging the oil manifold. Use the 5/16-18 X 1 SHCS to fasten the stop.

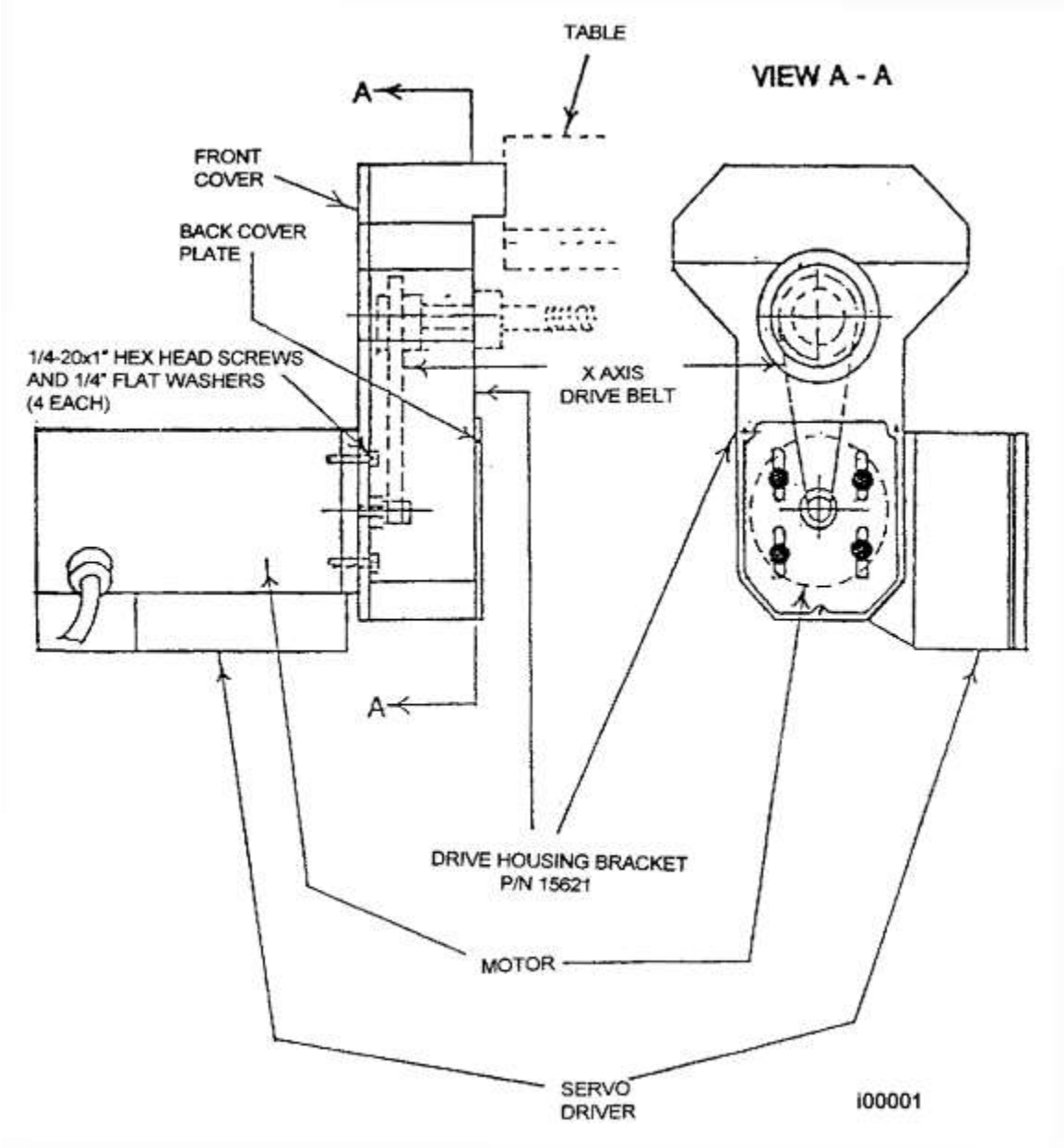
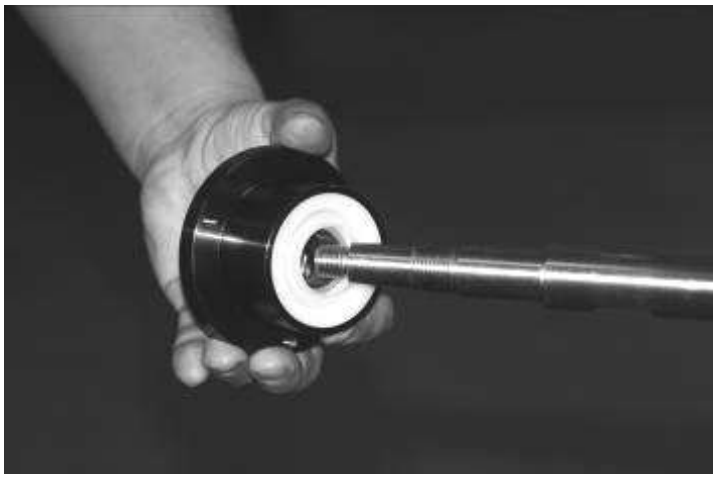


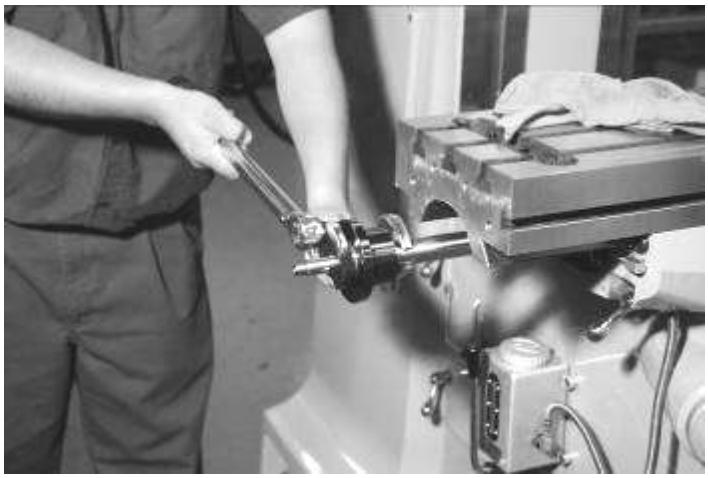
TABLE
VIEW A - A
A
FRONT COVER
BACK COVER PLATE
1/4-20x1" HEX HEAD SCREWS AND 1/4" FLAT WASHERS (4 EACH)
X AXIS DRIVE BELT
A
DRIVE HOUSING BRACKET P/N 15621
MOTOR
SERVO DRIVER
I00001

Table back on

X gib back in

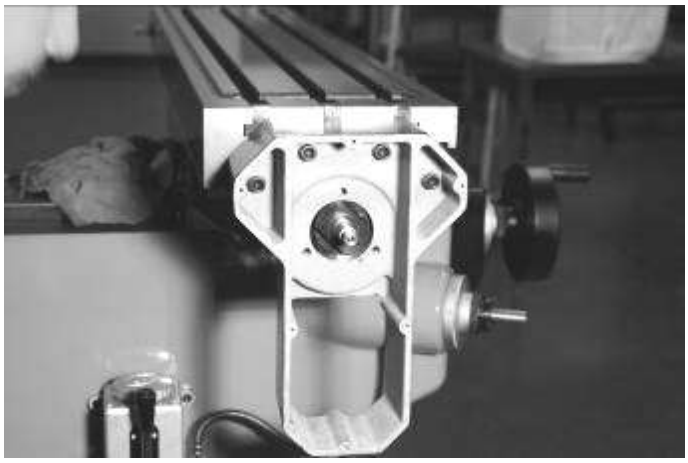


Bearing housing assembly

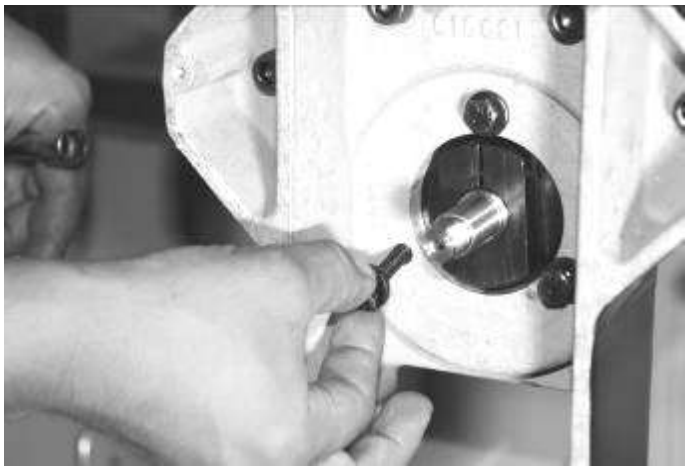


Tighten, don't push down, to 50 ft-lbs

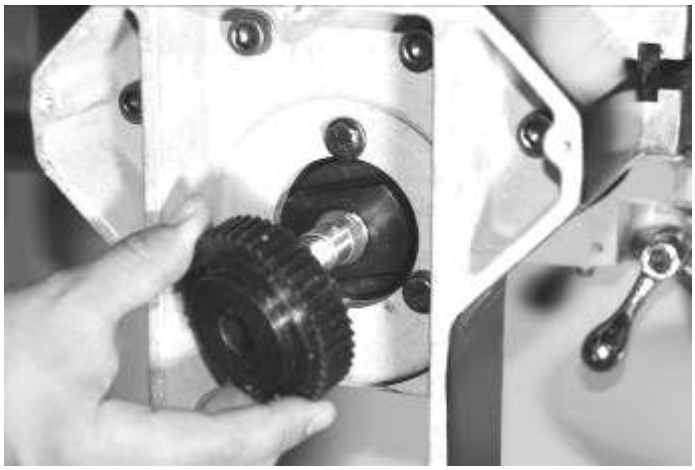
Ready for drive housing



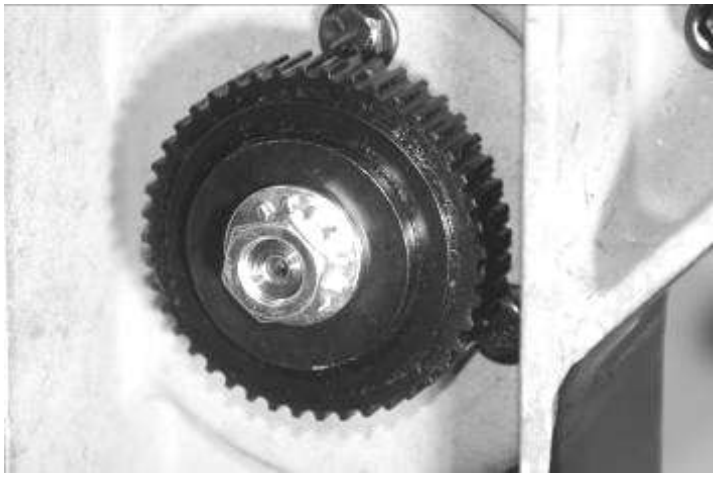
Drive housing installed on table



Securing the bearing housing assembly

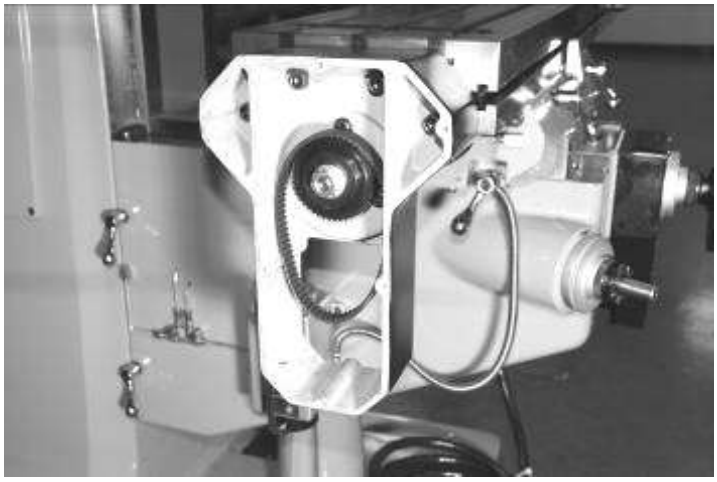


Key, ferrule, pulley



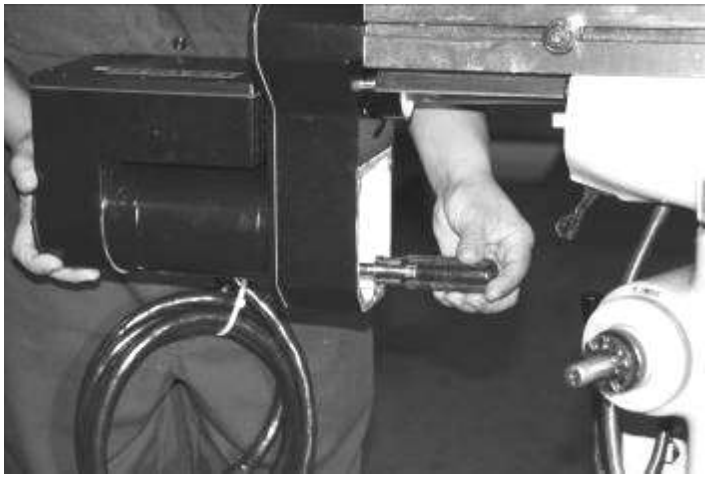
Washer, star washer, ½ hex nut

Tighten to 20 ft-lbs

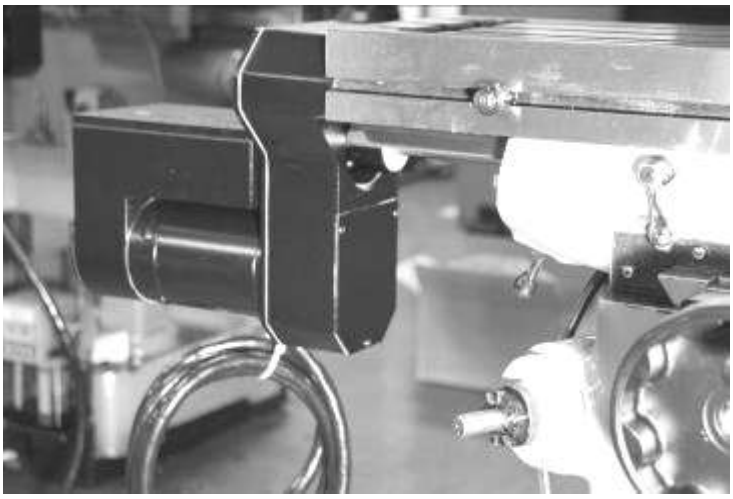


Belt

Front cover



Motor



Complete. Note motor orientation.

This step is completed when: The motor is installed with the cable pointing down and toward the rear of the machine.

Step 6. Install the right side end cap and hand wheel assembly.

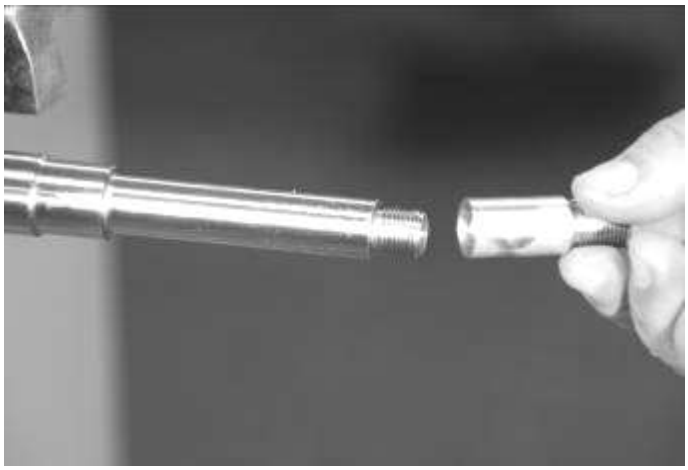
See the figure from Step 5 above.

Tips:

- Use the original right or left side hardware from the machine.
- Position the table (by screwing the ballscrew) so that the right end is almost flush with the right side of the saddle to install the hardware.
- Some installations require a ballscrew extension (included in the kit). If you use the ballscrew extension, note that there is a setscrew inside the extension. First install the extension; use two wrenches to tighten it securely. Then install and tighten the setscrew (lock tight is recommended). Use the bushing to seat the floating bearing (that came with the machine.
- Once the handwheels are installed on both sides, crank the table back and forth. It should move smoothly throughout the entire travel with no binding.
- Adjust the table and saddle gibs to be snug but allow smooth motion.

Warning!
Don't push down on the ballscrew as you are tightening – this may bend the ballscrew.

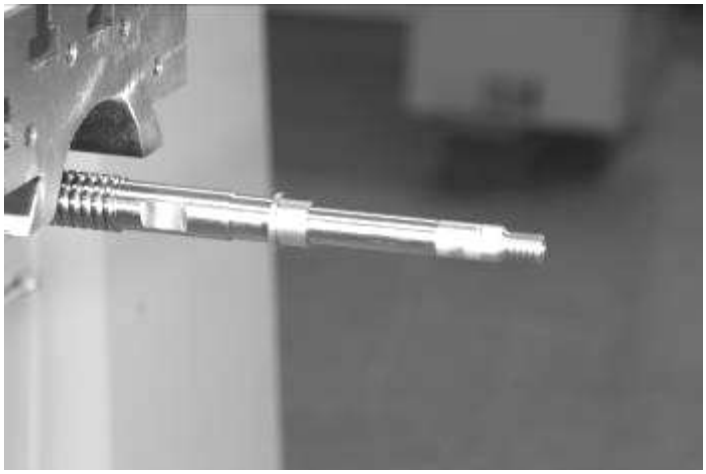
This step is completed when: The drive train feels smooth as you crank the X-axis hand wheel through the entire travel. You will feel the belt cogs engage and the balls move through the ball nut, but it should be consistent and smooth.



Extension, only if needed

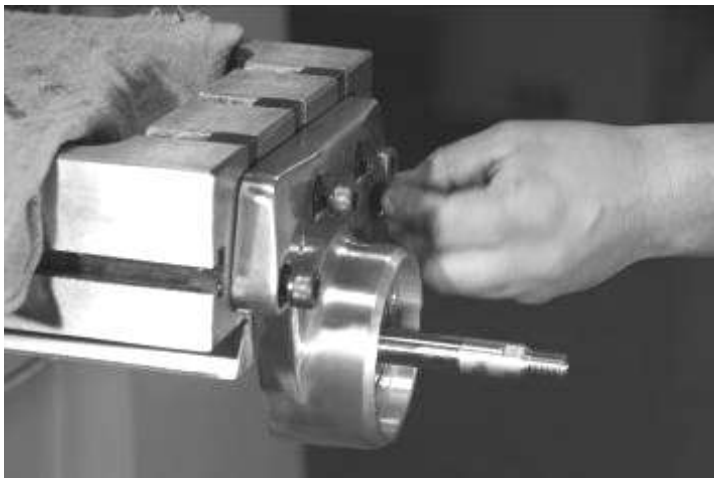
Tighten extension

Set screw to tighten extension



Bushing

Original bearing in original housing



Housing on table

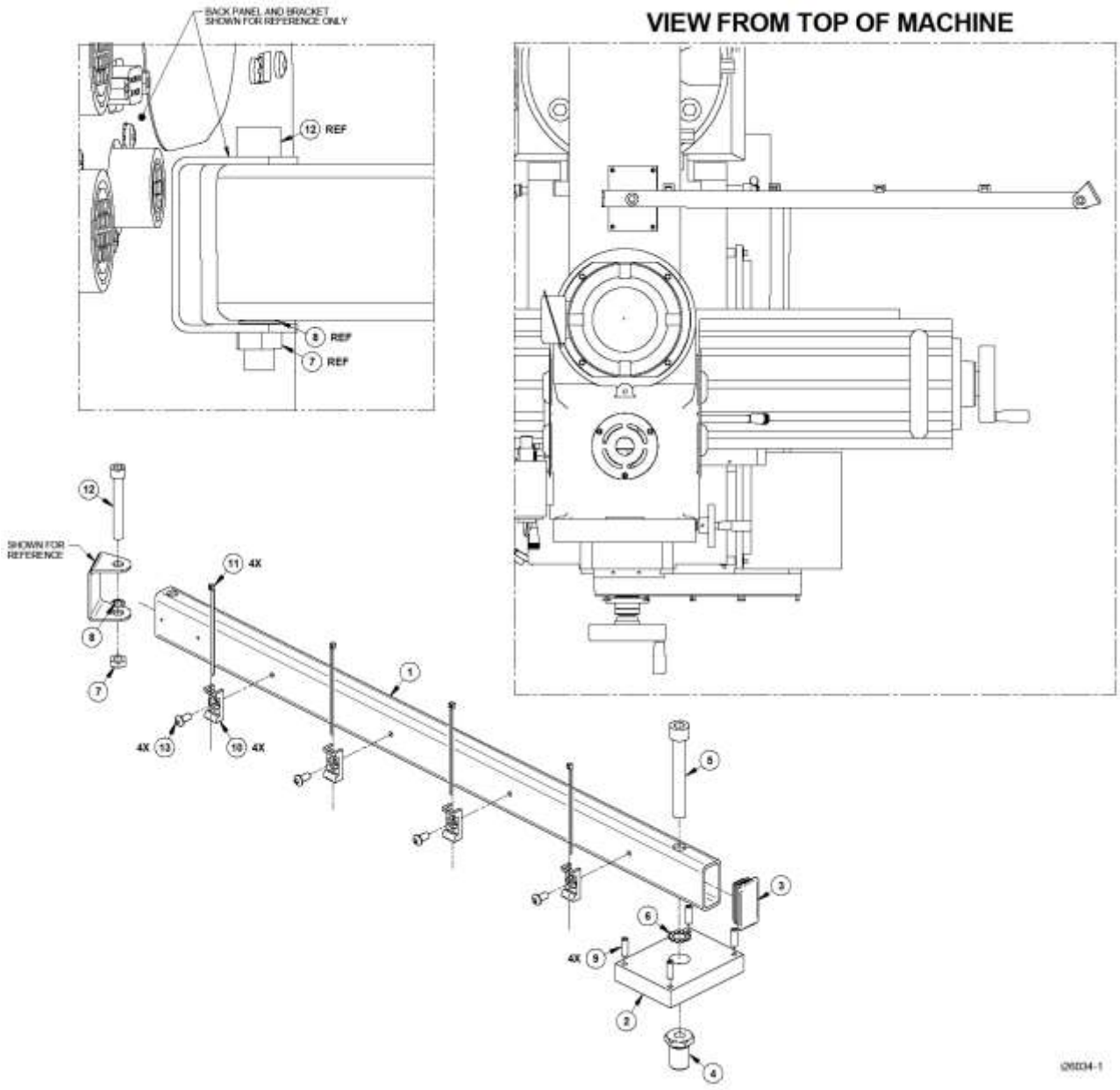
Use cable ties to secure the cables to the pendant-mounting arm. You may want to do this after the system check out in step 10. Just don't forget to come back to it because the machine will look a lot nicer with the cables all tied up.

Note: The tableguard port is not used for retrofits.

Step 7. Installing the Pendant (26034-1 thru -4)

Pendant Arm Assy-Top Mount- K4EMX

P/N 26034-1



Parts List-Pendant Arm Assy-Top Mount- K4EMX

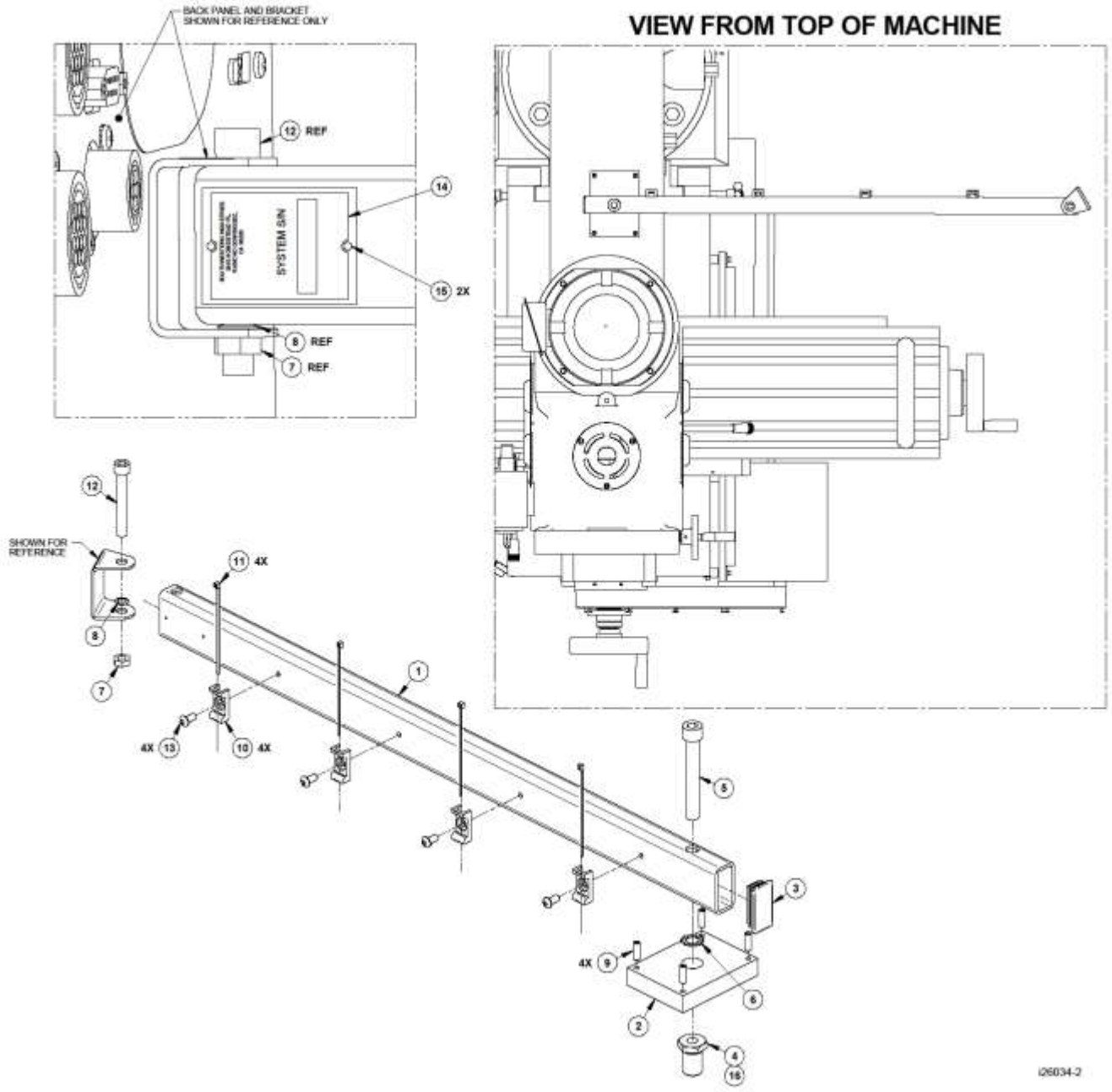
P/N 26034-1

Item	P/N	Title	Qty
1	26037	PENDANT ARM	1
2	16919	PLATE-LEVELING	1
3	26038	CAP PLUG	1
4	26016-2	BUSHING - THREADED - M20X2.5	1
5	1/2-13X3 1/2 25B	SCREW-SHCS-STL-BO	1
6	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	1
7	3/8-16 50B	NUT-HEX-STL-BO	1
8	24009-2	WASHER - BELLEVILLE SPRING LOCK	1
9	1/4-20X3/4 40B	SCREW-SOC SET-STL-BO-CUP	4
10	26050	CABLE MOUNT	4
11	22475	TIE WRAP-4 IN-PLASTIC	4
12	3/8-16X2 3/4 25B	SCREW-SHCS-STL-BO	1
13	1/4-20 X 1/2 27B	SCREW-BHCS-STL-BO	4

i26034-1

Pendant Arm Assy-Top Mount- Retrofit/EMX

P/N 26034-2



Parts List-Pendant Arm Assy-Top Mount- Retrofit/EMX

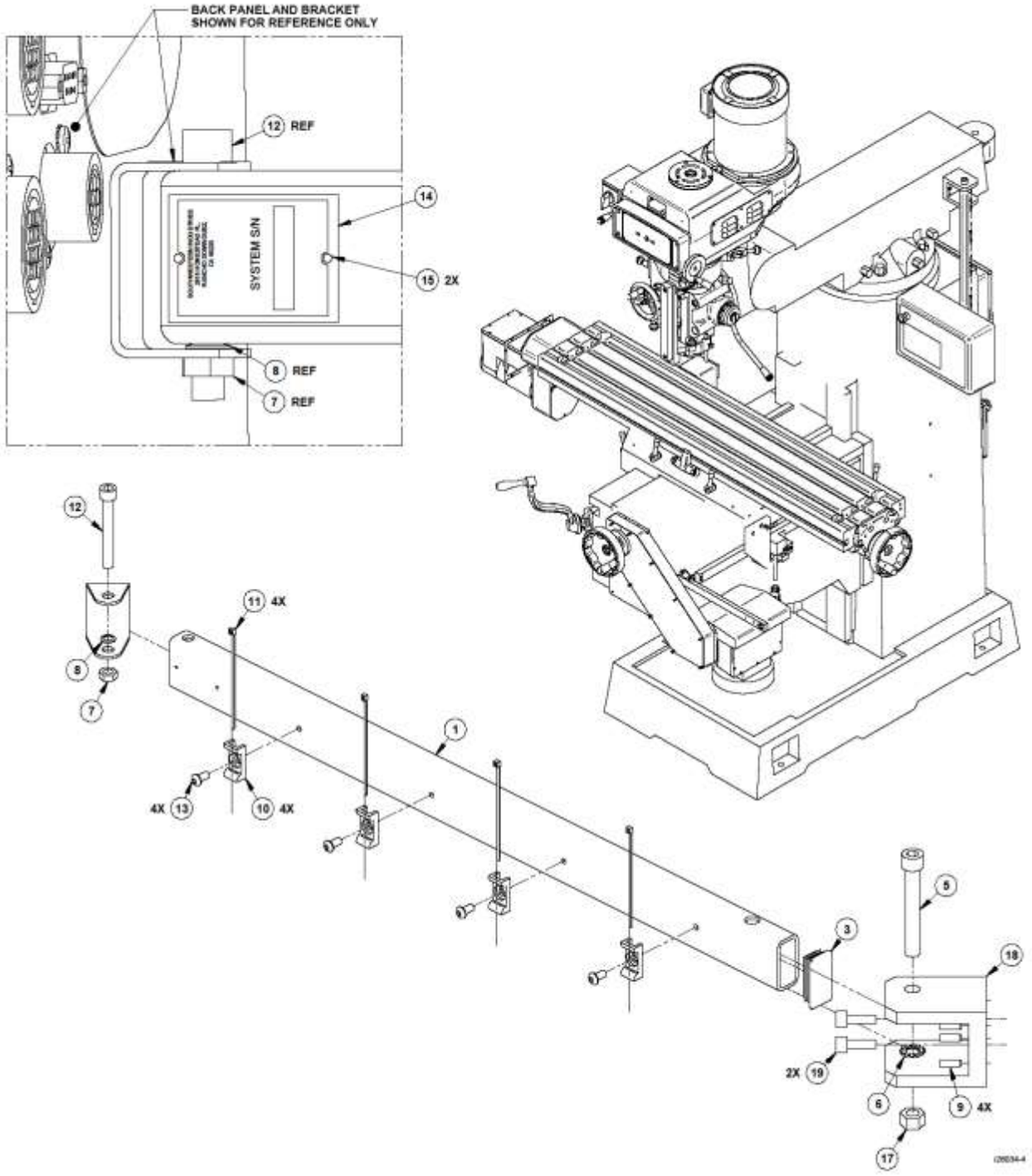
P/N 26034-2

Item	P/N	Title	Qty
1	26037	PENDANT ARM	1
2	16919	PLATE-LEVELING	1
3	26038	CAP PLUG	1
4	26016-2	BUSHING - THREADED - M20X2.5	1
5	1/2-13X3 1/2 25B	SCREW-SHCS-STL-BO	1
6	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	1
7	3/8-16 50B	NUT-HEX-STL-BO	1
8	24009-2	WASHER - BELLEVILLE SPRING LOCK	1
9	1/4-20X3/4 40B	SCREW-SOC SET-STL-BO-CUP	4
10	26050	CABLE MOUNT	4
11	22475	TIE WRAP-4 IN-PLASTIC	4
12	3/8-16X2 3/4 25B	SCREW-SHCS-STL-BO	1
13	1/4-20 X 1/2 27B	SCREW-BHCS-STL-BO	4
14	21934	NAMEPLATE-SYSTEM S/N	1
15	4X3/8 34J	SCREW-DRIVE-4-SS	2
16	26016-1	BUSHING - THREADED - 3/4-10	1
20	26034-2-DOC	PENDANT ARM ASSY-TOP MOUNT	1

i26034-2

Pendant Arm Assy-Side Mount-Retrofit/K4

P/N 26034-4



Parts List-Pendant Arm Assy-Side Mount-Retrofit/K4

P/N 26034-4

Item	P/N	Title	Qty
1	26037	PENDANT ARM	1
3	26038	CAP PLUG	1
5	1/2-13X3 1/2 25B	SCREW-SHCS-STL-BO	1
6	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	1
7	3/8-16 50B	NUT-HEX-STL-BO	1
8	24009-2	WASHER - BELLEVILLE SPRING LOCK	1
9	1/4-20X3/4 40B	SCREW-SOC SET-STL-BO-CUP	4
10	26050	CABLE MOUNT	4
11	22475	TIE WRAP-4 IN-PLASTIC	4
12	3/8-16X2 3/4 25B	SCREW-SHCS-STL-BO	1
13	1/4-20X1/2 27B	SCREW-BHCS-STL-BO	4
14	21934	NAMEPLATE-SYSTEM S/N	1
15	4X3/8 34J	SCREW-DRIVE-4-SS	2
17	1/2-13 50Z	NUT-HEX-STL-ZINC	1
18	26066	BRACKET-PENDANT ARM	1
19	5/16-18X1 25B	SCREW-SHCS-STL-BO	2
20	26034-4-DOC	PENDANT ARM ASSY-SIDE MT-RETROFIT/K4	1

i26034-4

The drawing illustrates the two ways of mounting the pendant arm to the machine. Your kit will include one of the two sets of hardware depending on the model of your machine. For Bridgeport models, if it is necessary to use the 5/8" bolt supplied, you will have to open up the through-hole in the pendant arm.

Attach the nameplate serial number plate (21934) on the pendant arm. This serial number plate is the serial number that you will need to reference for service parts and other support in the future. The Service Department will not be able to help you efficiently without the serial number.

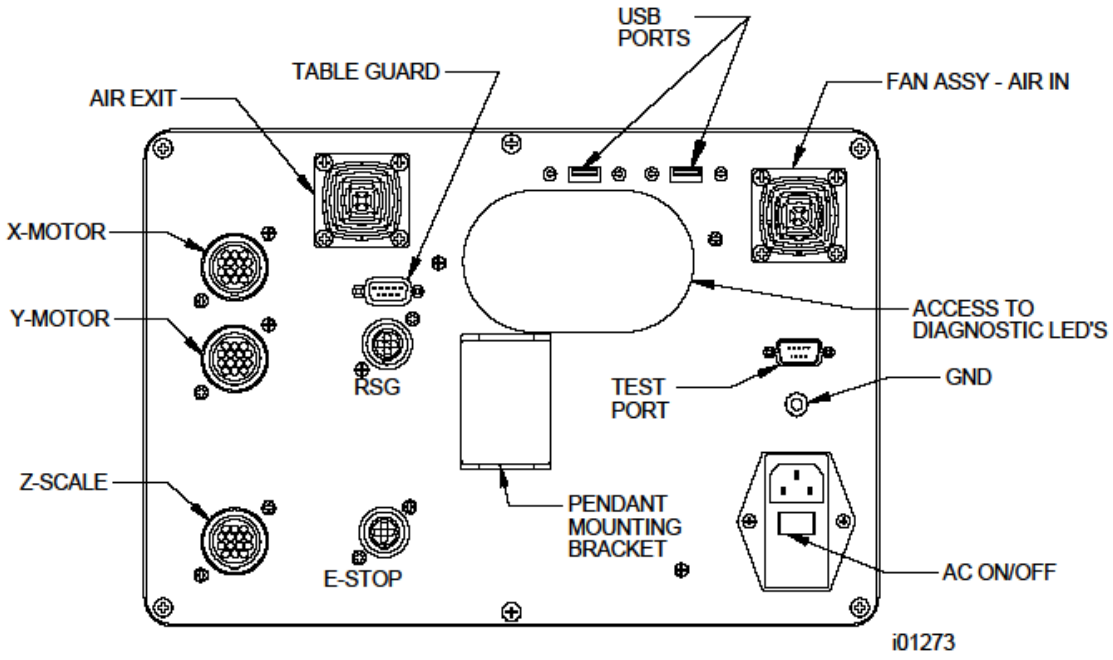
This step is completed when: The display pendant is mounted securely to the machine ram and the serial number name plate is attached to the pendant arm.

Step 8. Install the Z Glass Scale

There are several different brackets that come with the Z-axis glass scale kit, depending on the machine model. Illustrated instructions will come with the scale kit.

This step is completed when: the glass scale is mounted securely to the machine quill and moves smoothly with quill travel.

Step 9. Connect the cables and the power.



CAUTION

Do not turn the power on to the pendant until all cables are plugged in properly. Plugging or unplugging with power on will destroy the computer.

Tips:

- Loosely route the cables and check that there will be enough slack to accommodate full table and saddle traverse.
- Use cable ties to secure the cables to the pendant-mounting arm. You may want to do this after the system check out in step 10. Just don't forget to come back to it because the machine will look a lot nicer with the cables all tied up.
- **Note:** The tableguard port is not used for retrofits.

This step is completed when: The cables are plugged into the display.

	
Pendant Arm & Cables	**Plug in all cables with System off**

Step 10. Check out

Do the following:

1. Plug the ProtoTRAK EMX into a 110 volt outlet.
2. Turn the ProtoTRAK EMX on.
3. Go into DRO mode, press Jog.
4. Push the X, the table should move under power. Press the +/- key and press the X again. It should move the opposite direction.
5. Note: The table should move to the left for positive X counting and the saddle should move towards the operator for positive Y counting. Moving the quill up should result in positive Z counting. Use Service Code 97 to change if needed.
6. Do the same with the Y key and observe the saddle.
7. Press Return to get out of Jog.
8. Move the quill handle. There should be a readout on the Z. If the Z isn't activated, see section 5.7 for instructions on how to do service code 15.

If the system is jogging we recommend that you calibrate and set backlash constants now. See section 6.2.2. Also run service code 12, see Section 5.7.2.1.

If you have any problems, see the troubleshooting section in this manual for what to do. Don't worry, there isn't anything too tough. You may just have to reinstall something.

Congratulations! See your ProtoTRAK EMX Safety, Programming, Operating and Care Manual for instructions for using the ProtoTRAK EMX, a tutorial and some sample programs.

Now you can machine!

4.0 Troubleshooting by Symptom

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

4.1 Problems Relating to Machining Results

4.1.1 Poor Finish

The part finish is marred with scallops or is very rough.

Do the following Service Codes and document values:

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

Possible Cause	Check This
Too much backlash entered for code 128	Verify nothing is mechanically loose and the backlash values are not higher than what physically is in the system.
Machine Tool & Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). Check the condition and type of cutter being used, type of material, RPM and Feedrate, etc. See Machine Tool & Setup Section 5.1
Table, Saddle, or Knee Locks are locked	Make sure the Table and Saddle Locks are unlocked. Never use gib locks with a CNC machine.
Inadequate or no Lubrication to Ballscrews and Way surfaces	Make sure all the Way surfaces are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines. See Lubrication Section 5.1.3
X, Y, Z and knee Gibs are not adjusted properly	Check the adjustment of the X, Y and Z gibs. See Gib Adjustments in Section 6.2.1.
X, Y & 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, Y) Section 5.2
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.

4.1.2 Circles Out of Round

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

Note: The typical slideway-milling machine is not capable of achieving more precise results although careful adjustments to a new milling machine may produce better results. If more precise circles are required, then it is recommended to use a precision boring head/boring bar.

Do the following Service Codes and document values:

- **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
Torque values on X and Y-axis are too high.	Make sure torque is lower than 20 in-lbs. Normal values for a machine that is aligned and adjusted properly should be between 10 and 15 in-lbs. Make sure torque is consistent across axis travel.
Machine Tool and Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). See Machine Tool & Setup - Section 5.1
Machine not level	Verify that the machine is level to specification.
Head is not Trammed	Verify that the Head is Trammed to specification. See Tramming the Head Sec 6.2.3
X and Y Gibs are not adjusted properly	Check the adjustment of the X and Y Gibs using the X and Y Gib adjustment procedures.
Calibration or Backlash problem	Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy. See Calibration & Backlash Constants Section 6.2.2
X & Y-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 5.2
Head Bolts are loose	Verify that all the head bolts are tight.

4.1.3 Taper Cut on a Programmed Straight Line Move

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

Explanation: For straight line cuts along the X or Y-axis, the control is designed to lock the motor of the axis that is not moving. A taper is created when there is play in the system. The force of the tool shoves the table or saddle out of position.

The system will respond to being pushed out of position by making an adjustment at the end of the move.

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

Do the following Service Codes and document values:

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

Possible Cause	Check This
Machine Tool & Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). See Machine Tool & Setup Section 5.1
X and Y Gibs are loose	Check the adjustment of the X and Y Gibs using the X and Y Gib adjustment procedures. See Section 6.2.1
X and Y-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 5.2

4.1.4 Parts Have Incorrect Dimensions

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

- **Circles:** 0.002" TIR over 3.00" DIA
- Positional Accuracy: +/- 0.0005"
- Repeatability: 0.0005"

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

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

Do the following Service Code:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 123** Calibration using a measurement standard, or
- **Code 122** Calibration using work piece measurements.
- **Code 12** Feed Forward Constant.
- **Code 127** Measures the backlash in the system.
- **Code 128** Enter backlash compensation.

4.1.4.1 Every Part Has the Same Error

Possible Cause	Check This
Machine Tool & Setup problem	See Machine Tool & Setup Section 5.1
Programming Error	In the program, look for common errors in programming such as transposing numbers, tool diameters, and pressing INC SET when ABS SET is meant. This is especially suspected if the dimensional errors are larger than a few thousandths. See the Controls Programming, Operations and Care manual.
Calibration or Backlash problem	Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy. See Calibration & Backlash Constants

4.1.4.2 The Dimensional Errors Are Random or Accumulate in Size Over the Part Program Run

Possible Cause	Check This
Machine Tool & Setup problem	See Machine Tool & Setup Section 5.1
X and Y-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 5.2

4.2 Problems Regarding the Motion of the Machine

4.2.1 Run Away Axis

The axis makes an unwanted move at rapid speed in one direction and faults out. This is usually caused by an encoder signal being interrupted.

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting properly.
- **Code 131** Motor encoder operation test.

Possible Cause	Check This
The home positions or tools are not set correctly	See the Controls Programming, Operations and Care manual.
Bad Motor Encoder	See Motor diagnostics Section 5.4

4.2.2 Slow Down Axis

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

Do the following Service Codes:

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

Possible Cause	Check This
The maximum allowable Arc Accuracy is set too low.	This value will only slow down the machine during arc moves. The factory default is set at 0.001". Perform Code 129 to check or change this value. See Service Codes section
Incoming AC voltage is inadequate	Perform Code 100. See Service Codes - Section 5.9 and Electrical Section 5.8
Table and Saddle Locks are locked	Make sure the Table and Saddle Locks are unlocked.
Inadequate or no Lubrication to Ballscrews and Way surfaces	Make sure all the Way surfaces are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines. See Lubrication Section 5.1.3
X and Y Gibs are not adjusted properly	Check the adjustment of the X and Y Gibs using the X and Y 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, Y) Section 5.2
Servo Drive failure	See Servo Drive Section 5.5
Motor failure	See Motor Section 5.4

4.2.3 Axis Will Not Jog

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

Do the following Service Codes and procedures:

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

Possible Cause	Check This
Improper Boot-up	Shut down the system and wait 10 seconds before rebooting
E-Stop is pressed in	Check E-Stop. Especially if both axes will not jog
Servo Drive failure	Especially, if only one axis will not jog; See Servo Driver Section 5.5
Shorted motor	See Motor Section 5.4
Poor cable or wiring connections	See Electrical Connection Section 5.8
Computer/Pendant failed	See Computer/Pendant diagnostics Section 5.3

4.2.4 Axis Motor Motion Is Not Smooth

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

Do the following Service Codes and procedures:

- **Code 33 Software Identification. This is needed if you call SWI Customer Service.**
- **Code 12 Feed Forward Constant. High feed forward constants will cause an unstable servo system.**
- **Code 127 Measures 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 Y Gibs are not adjusted properly	Check the adjustment of the X and Y Gibs using the X and Y Gib adjustment procedures.
Calibration or Backlash problem	Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy. See Calibration & Backlash Constants section.
Binding in the Drive Train	Check Repeatability using the Repeatability and Positional Accuracy procedure. Check the torque reading of the Drive Train. Step by step, carefully inspect the Drive Train for any binding. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 5.2

4.2.5 Searching Axis

The handwheels are slowly turning back and forth when the servos are engaged. Several thousandths of motion are observed on the vernier dial and the frequency is one cycle every couple of seconds.

Do the following Service Code and procedures:

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

Possible Cause	Check This
Most often causes by excess backlash compensation	Use code 127. Check physical backlash in system and re-enter in code 128.
High feed forward values	Check ball screw torque. Typical values should be between 10 to 15 in-lbs.
Excessive friction in the sliding ways	Lubrication, gib adjustments, gib locks. See Machine Tool & Setup - Section 5.1
Looseness in the drive train	Especially the tightness of the drive assembly. See Mechanical Drive Train (X, Y) - Section 5.2

4.3 Problems Relating to the Operation of the Control

4.3.1 Display Blanks

The display is completely blank.

Possible Cause	Check This
Screen saver has been activated	Press any key to turn back on.
The system has shut down	Turn the power switch off, check the computer/ pendant fuses and cable connections. See Electrical Section 5.8
Poor cable connection from Computer Module to LCD (Liquid Crystal Display)	Double-check the connection from the computer module to the LCD.
Computer/Pendant failed	See Computer/Pendant Section 5.3

4.3.2 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
Computer/Pendant failed	See Computer/Pendant Section 5.3
Poor cable connection from Computer Module to LCD (Liquid Crystal Display)	Double-check the connection from the computer module to the LCD.

4.3.3 Keyboard Lockup

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

Do the following Service Codes and procedures:

- **Code 81** To check if the pendant keys are working properly, press each key. If a key is working properly, the corresponding key on the screen will light. 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 5.3

4.3.4 Fault X or Y

The program run or jogging operation is interrupted with a Fault Message on the display.

Do the following Service Codes and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 12 Feed Forward Constant.**
- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting.

Possible Cause	Check This
Table and Saddle Locks are locked	Make sure the Table and Saddle Locks are unlocked. High torque on any axis may cause faulting problems during alignment routine.
X and Y Gibs are adjusted extremely tight	Check the adjustment of the X and Y Gibs using the X and Y Gib adjustment procedures. See X and Y Gib Adjustments Section 6.2.1
Excessive friction in the slideways	See Machine Tool & Setup Section 5.1
Binding or looseness in the Drive Train	See Mechanical Drive Train (X, Y) Section 5.2
Incoming electrical power	Incoming voltage. See Electrical Section 5.8
Servo Drive failure	See Servo Driver - Section 5.5
Motor failure	See Motor diagnostics, Section 5.4
Computer/Pendant failure	See Computer/Pendant diagnostics, Section 5.3

4.3.5 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 5.3.
Computer/Pendant has failed	See Computer/Pendant diagnostics Section 5.3

4.3.6 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 5.3

4.3.7 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 5.8
Computer/Pendant has failed	See Computer/Pendant diagnostics Section 5.3

4.3.8 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
- **Code 122** Calibration using work piece measurements.

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 Measurements Are Not Accurate

4.3.9 E-Stop Error

For TRAK Knee mills, the E-Stop turns the power off to the axis and spindle motors (for retrofits, the e-stop does not cut power to the spindle motor). For the machine 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 19.

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.

4.4 Problem with the Measurements

4.4.1 X, Y and Z-Axis Measurements Do Not Repeat

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

Test for accumulative error by moving the axis a number of times to see if the error

gradually grows by a small amount or if the error abruptly changes by a large amount, it may be caused by a bad encoder.

Expected repeatability numbers should be 0.0005" or less

Possible Cause	Check This
Machine Tool & Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). Make sure there is sufficient contact between the tool holder and the spindle. See Machine Tool & Setup Section 5.1
X and Y Gibs are loose	Check the adjustment of the X and Y Gibs using the X and Y Gib adjustment procedures.

Possible Cause	Check This
X and Y-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 5.2
Spindle and/or Quill are loose	Use a Dial Indicator and check for side-to-side movement between the Spindle and the Head. Next, check for side-to-side movement between the Quill and the Head. There should be no more than 0.0003" of side-to-side movement. Make sure that there is a few thousandths gap between the Spindle Collar and the Quill after tightening.
Head bolts are loose	Tighten Ram bolts

4.4.2 X, Y, and Z-Axis Measurements Are Not Accurate

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

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.

4.4.3 The DRO Is Not Counting

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

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting.
    - **Code 131** Motor encoder operation test.

Possible Cause	Check This
Motor Encoder not counting	See Motor diagnostics section 5.4
Computer/Pendant failure	See Computer/Pendant diagnostics 5.3

4.4.4 X, Y, and Z-Axis DRO Counting in Wrong Direction

The DRO is counting in the wrong direction.

The positive directions for each axis are:

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

Do the following service code and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 97** set positive motor encoder direction.
- **Code 313** Check the line that specifies the product.

4.5 Problems with the Machine Tool

4.5.1 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 5.1
Drive Belt in the head is slipping	Check the alignment, condition, and tension of the Drive Belt.
Cut more than the machine is capable	Check width and depth of cut
Insufficient voltage, excessive amp load	Check incoming power. Check overload setting.

4.5.2 Spindle Motor Hums or Will Not Run

If the spindle will not run, you must ensure that 110V power is reaching the spindle motor contactors in the electrics box. Check your 110V power across terminals wire 3 and ground. If power has reached the electrical box, use the schematic in Section 5.8 to see how the power is routed.

If the spindle motor makes a constant humming noise during operation, check the 3-phase power to the machine by checking line to line.

Possible Cause	Check This
Wrong voltage	Check the 220V/440V voltage to the machine
Poor wiring connections	Check all the wiring connections to the electric's box.
Defective cables or poor cable connections	Check all cable connections
Spindle Motor is bad	Check the resistance of the Spindle Motor windings on the Spindle Motor between L1 & L2, L2 & L3, and L1 & L3, using an Ohmmeter. The resistance should range from ".7 to 1.2 Ohm". If the Ohmmeter reads "0 Ohms" or "OL", then replace Spindle Motor. Next, check the resistance between L1 & Ground, L2 & Ground, and L3 & Ground, using an Ohmmeter. The resistance should read "OL". If not then replace Spindle Motor.
Spindle will not run because 110 V power is not reaching the spindle contactor	Check 110 V coming out of the AC e-stop port on the pendant. If no voltage replace or repair the pendant.

4.5.3 Spindle Runs Backwards

The spindle motor runs in the opposite direction. The spindle will run in opposite directions from high to low gear.

Possible Cause	Check This
3-Phase wires backwards	Need to switch any 2 of the 3 wires either coming into the machine or motor. Warning: Be sure to shut off all power to the machine before attempting to switch any wires.

4.5.4 Head Noise

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

Use the table below to try to pinpoint the possible cause. Also try to pinpoint the noise by seeing if it exists in high, low or neutral. For example, if the noise is evident in neutral then this eliminates the spindle bearings.

Possible Cause	Check This
Machine setup or tooling problem	If the noise is most evident under load (cutting situations) then it is important to look at setup and tooling being used. Ask the following questions. Is the cutter dull? Is the tool loose in the holder? Am I taking a bigger cut then is possible on the machine? Is the part moving in the vice? Am I using realistic speeds and feeds? Any one of these can have a significant impact.
Upper spindle bearing is worn out.	Remove the upper bearing plate above the spindle. This will unload the bearing. If the noise goes away then this bearing should be replaced.
Verify nosepiece is tight on bottom of spindle.	To check if the nosepiece is bottomed out try to insert a piece of paper in between the nosepiece and the quill. If a piece of paper does fit then this may be the problem. Before tightening or loosening the nosepiece make sure to loosen the setscrew that holds it in place.
Spindle bearings are worn out	This is categorized by a high pitch sound and is most evident at high RPM's. It should also cause chatter under load. Replace the spindle if this is the case. See spindle replacement in Section 5.

5.0 Diagnostics

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

5.1 The Machine Tool & Set-Up

5.1.1 The Milling Machine Checklist

The following is a quick reference for the types of problems that may arise if problems are noticed in these areas.

Problems With:	Can Contribute To:	Most Suspect When (and why):
Spindle bearings See Spindle Replacement	Noisy head Parts incorrect Circles out of round	Older machines, machines that are pushed hard
Lubrication system	Premature wear of ball screws, wear surfaces. Faulting Poor finish	New installations (may not be hooked up or line sheared)
Inadequate lubrication habits	Premature wear of ball screws, wear surfaces	New installations (more motion than the machinist is used to with a manual mill) Lubricate

	Poor finish Faulting	machine every morning before use.
Gib locks - on X, Y and Z axis	If locked can lead to axis faults.	Note: when using the CNC to machine, never tighten the gib locks!
X and Y gibs loose See Gib Adjustment - Section 5.2.1	Taper on straight Y moves Poor finish Circle out of round	When machine hasn't been serviced in a long while.
Gibs too tight	Not getting to position, does not repeat, axis faults Poor finish	N/A
Gibs floating	Not getting to position, does not repeat, axis faults Poor finish	Contact area of gibs. May need to be scraped. Very old machines may not have any more adjustments on gib. A new gib will need to be fit on the machine.
Gibs defective - bowed, scarred	Excess play when gib is checked side to side	Inadequate gib contact
Way surfaces pocked, scarred, or excessively worn	Poor finish Out of round circles Faulting	Inadequate lubrication
Machine not level Weight not distributed evenly on all four screws See Leveling procedures	Parts incorrect Machine geometry off, i.e. tram.	New installation or heavy crash. Relocation of mill.
Head out of tram See Tramming Head - Section 5.2.3	Leaves uneven surfaces on bottom of pockets.	Machine not level

5.1.2 A Special Word About X, Y & Z Gibs

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

Gibs should be:

- flat
- free of twist
- free of burrs
- free of blockages in the oil passages and channels
  Defective or scarred gibs must be replaced. Shimming of gibs may not yield acceptable results.

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

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

See Gib Adjustments Section 5.2.1.

5.1.3 Lubrication

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

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

5.1.4 Machining Set-Up

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

Problems With	Can Contribute To:
Feed and Speeds (spindle rpm) See below	Poor finish Machine chatter Excessive speeds and feeds can break cutting tools or wear tools prematurely.
Tooling Using the wrong cutter for an application Entering the wrong size diameter and programming with tool compensation.	Poor finish Parts incorrect size
Cutting too deep	Part dimensions incorrect Driving and cutting forces cause deflections, since no material is totally rigid Machine chatter
No coolant	Poor finish, decrease the life of the cutter

5.1.4.1 Spindle Speeds

Spindle speeds are influenced by a number of variables:

- Material
- Rigidity of the Machine Setup
- Coolant
- Cutter type, material and diameter
- Cutting Depth

As a general rule:

- Lower spindle speeds are used to machine hard or tough material or where heavy cuts are taken.
- Higher spindle speeds are used to machine softer materials in order to achieve better surface finishes. Higher speeds also apply when using small diameter cutters for light cuts on frail work pieces and delicate setups.

Note: Cutter diameter greatly affects spindle speeds. The larger the diameter, the lower the spindle speed.

5.1.4.2 Feedrates

Factors that affect feedrates:

- Depth and width of cut
- Design or type of cutter
- Sharpness of the cutter
- Workpiece material
- Type of finish or accuracy required
- Climb or conventional milling

If a fine finish is required, reduce the feed rather than increase the spindle speed. Cutters are dulled by higher spindle speeds rather than high feedrates.

5.2 The Mechanical Drive Train (X, Y)

Indications:

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

1. Check for machine considerations, especially gib locks and gib adjustments.
   See Gib Adjustments section
2. Check the torque of the axis in three places (both ends and center of ball screw) along the length of the ball screw. The torque should be within 2 or 3 in-lbs across the length of the ball screw. If it is not, chances are the ball screw is misaligned. A misaligned ball screw can lead to parts being out of round and servo problems at low feedrates. A bad ball screw can also cause high torque, although this is highly unlikely. See Sections 5.2.1 and 5.2.2 for more information.

The following steps take you in logical sequence through the assemblies for the knee mills. For drawings of these assemblies see figures. These instructions break the machine down from fully assembled and point out the areas to look at specifically.

3. Check that the belt is properly tightened. A loose belt can lead to excessive backlash compensation values on motor encoder only machines.
4. Check that the nut that tightens up against the ball screw pulley is tight. If this is loose the pulley may not run true on the ball screw.
5. Check that the tapered sleeve that seats the pulley has not clamped to the ball screw prematurely. It should be seated firmly against the pulley. Tightening the nut may not have ensured this. Also make sure the pulley is keyed to the ball screw.
6. Ensure that the screws that hold the bearing housing in place to the bracket are not loose.
7. Ensure that the Clamp Nut is secured. The following applies to the clamp nut:
    - When loosening, make sure to back out the 10-32 screw from the clamp nut.
    - When tightening, snug the 10-32 screw so the clamp goes onto the ball screw thread with some drag. Thread it onto the ball screw and torque the clamp nut to 50 ft/lbs and then tighten the screw down.
8. Take out the angular contact bearings and inspect them. They should roll smoothly and be lightly greased. If not, replace them. When putting the bearings back into the housing make sure to put them in correctly. Failure to do this will cause problems. The thin race of each bearing should be facing inward toward the spacer ring.

    Note: the bearing housing and spacer ring are matched sets - keep them together.
9. Check the ball screw mounting to the yoke. Make sure the SHCS are tight.
10. Inspect the ball screw, ball nut and yoke for the potential problems shown in the chart on the next page.

CAUTION!

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

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

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

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

5.2.1 Keys to Ball Screw Alignment

- **X-axis** – there are 3 components that can cause misalignment: the yoke, the left side bearing housing bracket, and the right side bearing housing.
- **Yoke** – the yoke is aligned at the factory and pinned in place. It is aligned to within +/-0.0005" with a precise alignment tool. The yoke most likely is not causing the problem. If this were the problem you would need to remove the pins and align the X ball screw with the back of the saddle. Drill new holes and pin the yoke in place. The Y-axis ball screw bore is machined perpendicular to the X bore. If the X-axis is aligned the Y-axis will also be aligned.
- **Left side table bearing housing** – this is most likely the cause of the misalignment. To align the bracket and bearing housing, move them as close to the yoke as possible. Loosen the bracket bolts and bearing housing bolts and then retighten. This should allow the bearing housing to align itself up with the yoke.
- **Right side table bearing housing** – once again move the bearing housing as close to the yoke as possible. Loosen the bearing housing and retighten. This should allow the bracket to align itself. If you do not move the table toward the yoke the ball screw will tend to bend down slightly and cause misalignment.
- **Y-axis** – the only component that can cause a misalignment problem is the motor mounting bracket. To align this bracket, move the saddle as close to the front of the machine as possible. Loosen the bracket and then retighten it. Once again moving the saddle forward allows the yoke to be as close to the bearing housing as possible.

5.3 Computer/Pendant Diagnostics

The pendant consists of 2 separate modules: the computer module, and LCD screen/enclosure.

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 4 or 5 cable connections to 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 LED's found on the back of the applications board. Remove the black cover on the rear of the pendant to access them.

See figure 23.

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 is 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. Watchdog timer – not used
4. Not used

5. Z absolute zero LED – this LED will be lit when the Z axis counter is set to zero. This light should come on when you are + or – 0.001" from your zero.
6. Not used - will be used on future products with more axes.
7. Y absolute zero LED - this LED will be lit when the Y axis counter is set to zero. This light should come on when you are + or – 0.001" from your zero.
8. X absolute zero LED - this LED will be lit when the X axis counter is set to zero. This light should come on when you are + or – 0.001" from your zero.
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. Not used.

5.4 Motor Diagnostics

The Motor subsystem is comprised of 3 parts: The Motor Encoder and the Motor and Servo Driver. The motors are powered by 110 VAC voltage. The servo driver is also an integral part of servo system, which is discussed in detail in the next section.

WARNING!

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

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

5.4.1 Cable Connections

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

5.4.2 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 Codes 100 or 131. This will display on the DRO if the motor encoder is counting. If the axis does not count, the encoder is not counting. This means either the encoder or the cable is the problem. Visually check the cable for any problems. If the encoder has failed the motor must be replaced.

5.4.3 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 of 2 of your product, this is probably not the cause.

Motor Identification

Before ordering your brush replacement kit, you 1st will need to identify the type of motor you have on your machine. This can be done by identifying the diameter of the cap that holds the brushes in place. Each motor has 4 caps spaced 90˚ apart. They are found at the end of the motor furthest away from the motor pulley. If the diameter of the cap holding the brush in place is ¾" in diameter then the motor is a Hathaway motor. If the diameter of the cap is ½" in diameter then the motor is an AO Smith motor. You can also identify the type of motor by removing the brush and measuring its

cross sectional size. If the brush measures 3/8" x 1/8" then it is a Hathaway motor and if it measures 3/8" x ¼" it is an AO Smith motor.

On Hathaway motors it will be time to replace the brushes when the brush reaches a length of approximately ¼".

On AO Smith motors it will be time to replace the brushes when the brush reaches a length of approximately 3/16".

See Section 6.1.2 for the procedure for replacing motor brushes.

5.4.4 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, or computer module. In some cases it is not 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. Let's also assume it is not an obvious problem like a loose connection.

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

5.5 Servo Driver

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

Indications:

- Problems moving just one axis, including hard turning in one or both directions.

Servo Types:

- X and Y servos are identical

Objective:

- Isolate the problem to the particular Servo Driver

Steps:

1. Turn off and unplug the system.

WARNING!

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

2. Physically swap the servo module from the axis that is not working to one that is.

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.

5.6 Electrical

5.6.1 Checking A/C Voltage

This procedure tests for the 110V power for the control.

- Use a Voltmeter, reading A/C volts.
- Acceptable range is 100V to 130V.

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

Test the following in the order presented:

Problems Here:	May Indicate:
1. The wall outlet.	• Fuse blown in the shop electrical panel. • Incoming service from local utility is bad. Call the electric company.
2. The control power cord from the wall. For TRAK mills, check the end that goes to the electrics box.	• Power cord defective.
3. Check the top fuse on the electrical cabinet. It should be a 10-amp fuse.	• If this is blown then power will not reach the 4 outlets on the electrical box.
4. Check the 110-power cord to the pendant.	• Power cord defective

5.6.2 Checking Fuses

CAUTION!

Turn off power before removing and replacing fuses.

There are 4 fuses to check in the system. There are 2 in the pendant and, for TRAK mills, 2 in the electrical cabinet. The top fuse in the electrical cabinet is 10 amps and fuses power to the pendant. The bottom fuse is 5 amps and fuses power to the lube pump outlets. 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".
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.

5.6.3 Cable Connections

The TRAK knee mill machines use 5+ 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 on each of the connectors.

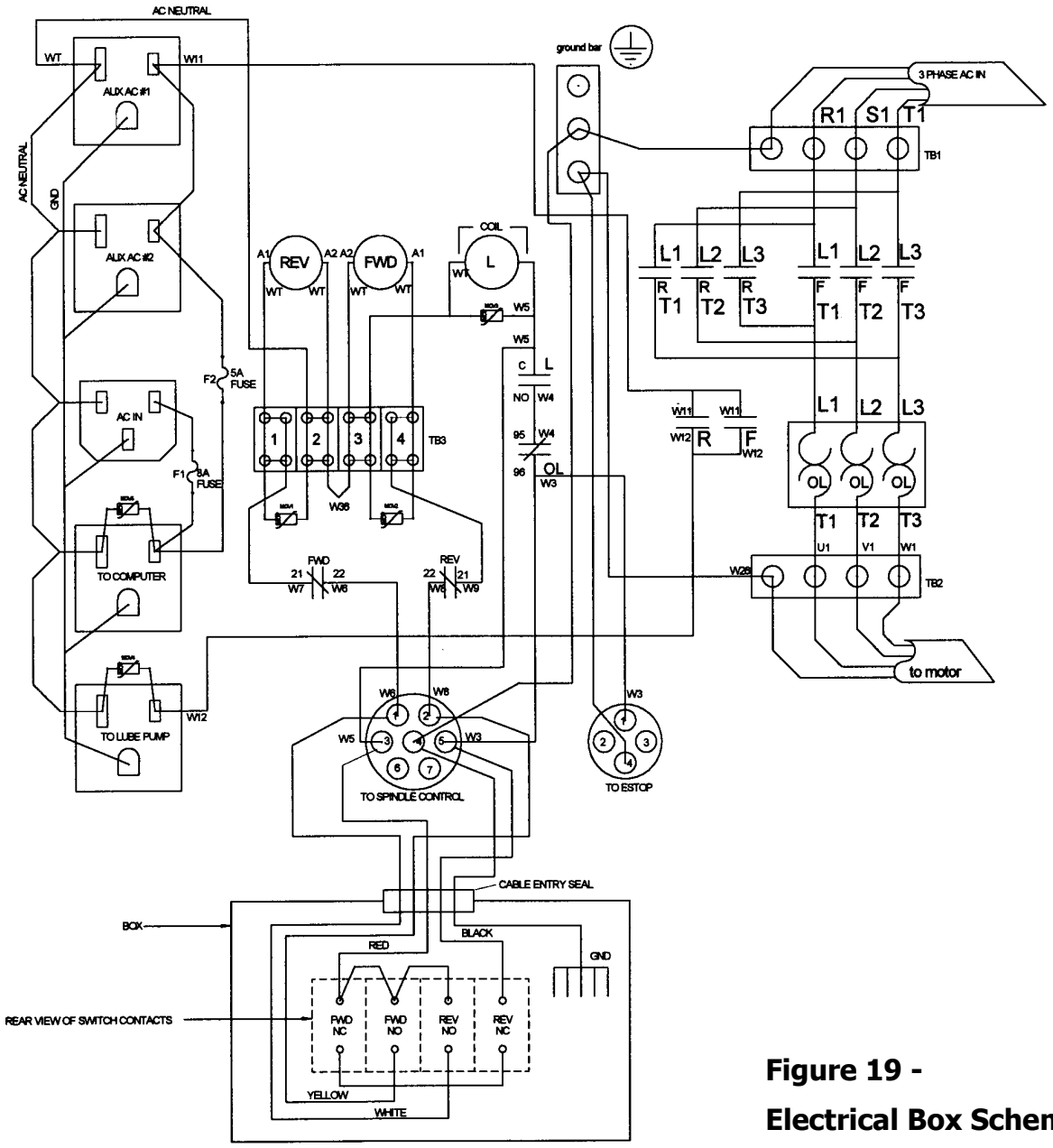


Figure 19 -

Electrical Box Schematic

5.7 Service Codes

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

Figure 21

LEDs on Spindle

Control Board

the DRO Mode by pressing the soft key for "SERV CODES". The one of the headings listed on the main screen. Press the heading estion. Press CODE #, enter the number you want, press SET.

5.7.1 Software Codes

The following codes pertain to software functions in the control. To get to any of these codes go to Service Codes, press "A" and press the code you wish to view.

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

5.7.1.1 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.

5.7.1.2 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.

5.7.1.3 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.

5.7.1.4 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.

5.7.1.5 Code 316: Update Software

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

5.7.1.6 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.

5.7.1.7 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.

5.7.2 Machine Set-up Codes

The following codes are used primarily when setting up a new machine. To get to any of these codes go to Service Codes, press "B" and press the code you wish to view.

5.7.2.1 Code 12: Feed Forward Constant

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

The Code 12 is used for diagnosing and resolving:

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

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

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

Explanation

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

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.

5.7.2.2 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 - table moves to the left (so the tool moves to the right relative to the workpiece)
    - Y - saddle moves toward the front (so the tool moves up relative to the workpiece).
    - Z - the quill moves up.

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

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

5.7.2.4 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 quill is out of the way and by starting with the table and saddle centered. MAKE SURE THAT NO ONE IS STANDING IN THE WAY OF THE TABLE OR SADDLE!

Note: You will lose the DRO reference position.

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

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

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

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

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

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

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

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

Interpretation of the resulting values displayed:

The values for the encoder displays should be in the range of 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.

5.7.2.4 Code 122: Calibration using part measurements

See Section 6.2.2.2 for a further explanation of this code.

5.7.2.5 Code 123: Calibration

See Section 6.2.2.1 for a further explanation of this code.

5.7.2.6 Code 127 - Set X or Y Backlash Constant

See Section 6.2.2.3 for a further explanation of this code.

5.7.2.7 Code 128: Input Backlash Constant

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

5.7.3 Diagnostic Codes

The following codes are used primarily when diagnosing a problem with the machine. To get to any of these codes go to Service Codes, press "C" and press the code you wish to view.

5.7.3.1 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.

5.7.3.2 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.

5.7.3.3 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.

5.7.3.4 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.

5.7.3.5 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.

5.7.3.6 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.

5.7.3.7 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.

5.7.4 Operator Defaults/Options Codes

The following codes allow the user to set programming defaults or turn features on or off. To get to any of these codes go to Service Codes, press "D" and press the code you wish to view.

5.7.4.1 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.

5.7.4.2 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.

5.7.4.3 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.

5.7.4.4 Code 79: Beeper On

This turns on the beeper to the control keys.

5.7.4.5 Code 80: Beeper Off

This turns off the beeper to the control keys.

5.7.4.6 Code 89: Turn off Simulation Mode

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

5.7.4.7 Code 129: Arc Accuracy

When the EMX 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**.

5.7.4.8 Code 130: Toggle between 2 and 3 axis

Allows the user to switch between 2 and 3 axis mode.

6.0 Procedures for Replacements & Maintenance

6.1 Replacements

6.1.1 Servo Motor Replacement

WARNING!

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

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.

6.1.2 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 is 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.

6.1.3 Servo Driver Replacement (figure 22)

DANGER!

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.

WARNING!

Always engage (push in) the Emergency Stop switch, turn the ProtoTRAK SM Control off, and disconnect the servo motor/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.

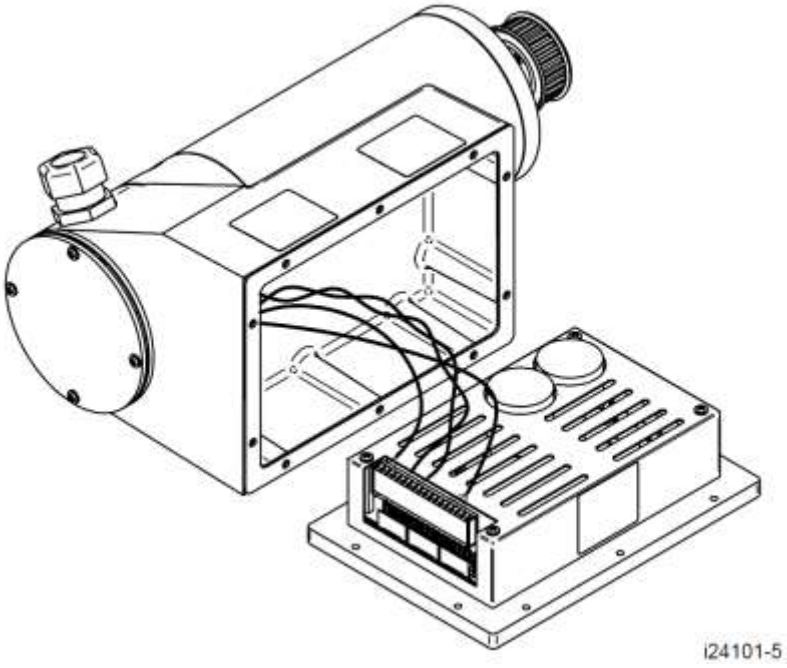


Figure 22

Part #	Description
20201	X, Y or Z Servo Driver

6.1.4 Computer Module and LCD/Enclosure Replacement (Figure 23).

1. Turn off power to the machine and control.
2. Unplug all the connectors from the rear of 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. Now reach from the top and remove the overlay cable and LCD cable from the computer module. The LCD cable will have some RTU 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 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.

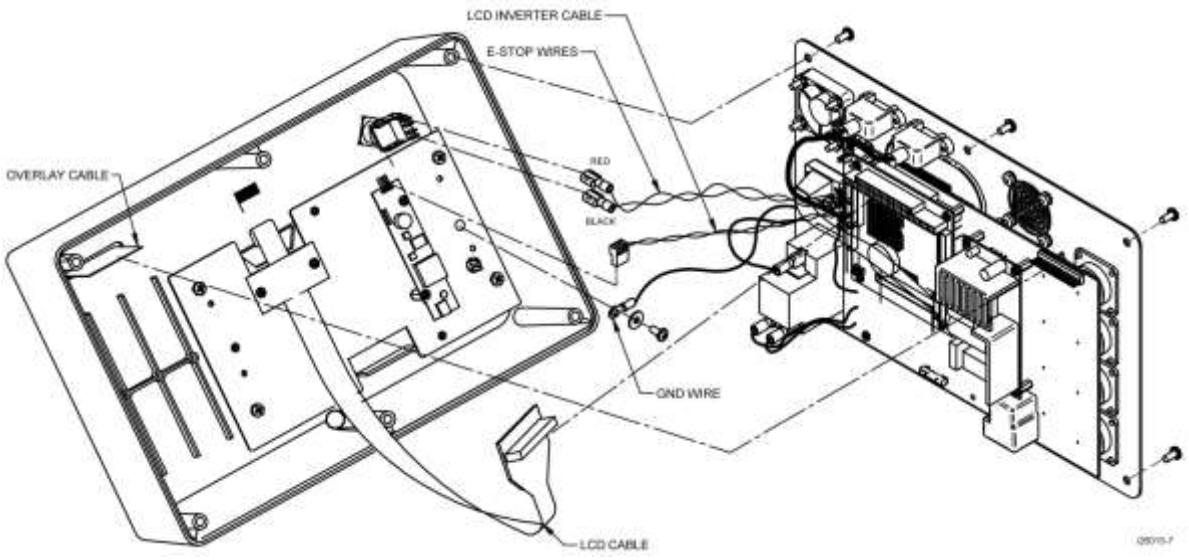


Figure 23 - Computer Module and LCD/Enclosure Replacement

Item	P/N	Title	Use As	Qty
1	21824-8	FUSE-8 AMP SLOW BLOW	EA	1
2	21824-10	FUSE-10 AMP SLOW BLOW	EA	1

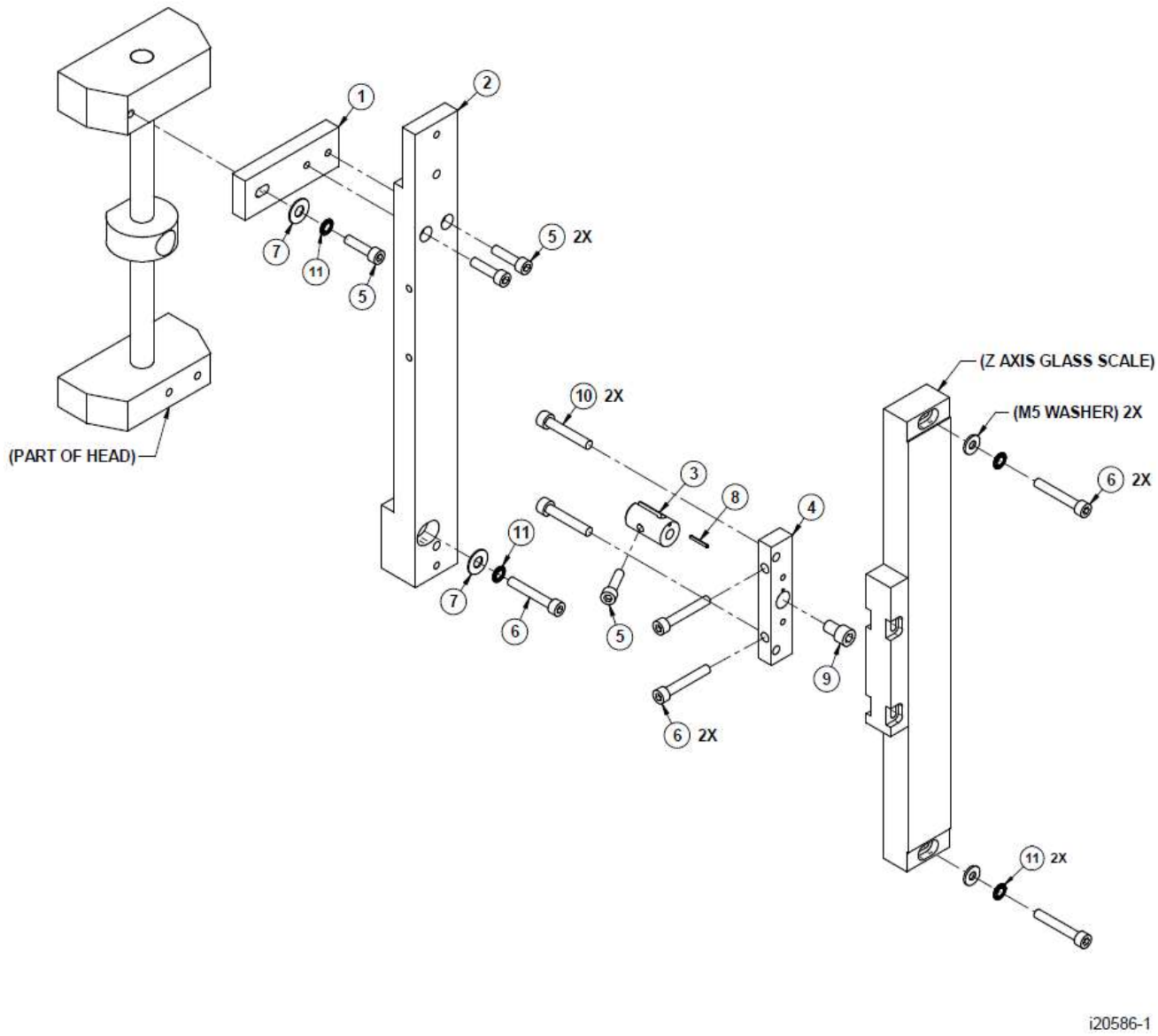
6.1.5 Cable Routing on Machine

Whenever you replace a cable or reroute a cable it is very important to keep the high voltage power cables and glass scale cable separated from each other. The power cables consist of the (2 or 3) 110-volt motor cables and (1) 110-volt power cable for the pendant, and the 220 or 440 Volt power cables for the spindle motor. The glass scale cable should not be tied to the 220 or 440 volt cable. Mixing of the power and scale cables may cause noise from the power cable to interrupt the signals in the scale cable. This can lead to measurement repeatability problems.

6.1.6 Replacement of the Optional Z-Axis Glass Scale

See Figure 28.

1. Check the tram of the head in the X direction. If it is within a few thousands then continue on. If not, tram per Figure 28 per instructions (see 28100 Installation Instructions) that come with the Glass Scale.



Part #	Description
28066-150	Z Glass Scale

Figure 28 Z Axis - Glass Scale Assembly

P/N 20586-1

Parts List – Z Axis - Glass Scale Assembly-

P/N 20586-1 (Figure 28)

Item	P/N	Title	Detail	Qty
1	20550	PLATE-MOUNTING-Z-AXIS ARM		1
2	20551-1	MOUNTING PLATE- Z AXIS GLASS SCALE		1
3	20548	ADAPTER-Z-AXIS GLASS SCALE		1
4	20549-1	ADAPTER PLATE- Z AXIS GLASS SCALE		1
5	10-32X3/4 25B	SCREW-SHCS-STL-BO		4
6	10-32X1 1/4 25B	SCREW-SHCS-STL-BO		5
7	10 70B	WASHER-FLAT USS-STL-BO		2
8	1/16X1/2 81B	SPRING PIN		1
9	1/4-28X3/8 25B	SCREW-SHCS-STL-BO		1
10	M5-0.8X30 25B	SCREW-SHCS-STL-BO	NON STOCKABLE	2
11	24009-4	WASHER - BELLEVILLE SPRING LOCK	10 OR M5 - SERRATED	4

i20586-1

6.1.7 Power Drawbar

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

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

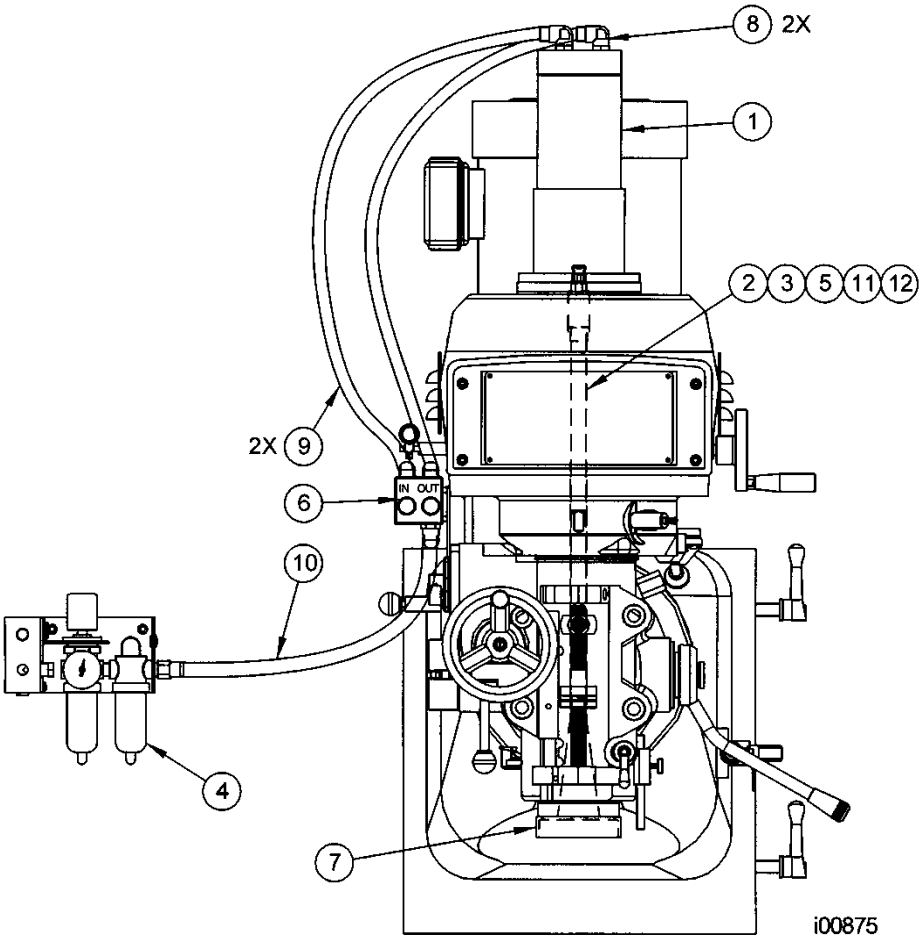


Figure 30 & Parts List Shown - Power Drawbar Assembly

Item	P/N	Title
1	22581-1	AIR GUN ASSY ONLY- TORQUE RITE
2	22605	TOP WASHER QUILL/SPINDLE
3	20893	SPACER - DRAWBAR - R8 SPINDLE
4	22380-1	AIR REGULATOR ASSY
5	23888	SPACER - DRAWBAR - 40 TAPER SPINDLE
6	22581-2	SWITCH - CONTROL HEAD - TORQUE RITE
8		1/4" NPT AIR FITTING 90°
9		3/8 O.D. TUBING 132" LG.
10		3/8 O.D. TUBING 27" LG.
13	TR220	SOCKET - AIR GUN REPLACEMENT (not shown on drawing)

i00875-1

6.1.8 Ball Screw Replacement, X-Axis (Table)

CAUTION!

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

1. Y-axis motor mounting bracket and hardware must be removed to remove X yoke.
2. Position the table in the center of travel.
3. Remove the left side table tray by pulling it up, and remove the X motor (If machine has tray).
4. Remove the motor mounting bracket and bearing housing.
5. Remove the right side bearing housing.
6. Loosen the table gibs. Slide the table to the right and on to a lift that will support the table's weight. Slide the table until the yoke is exposed.

CAUTION!

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

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

Important: The clamp nut must be reassembled as follows:

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

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

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

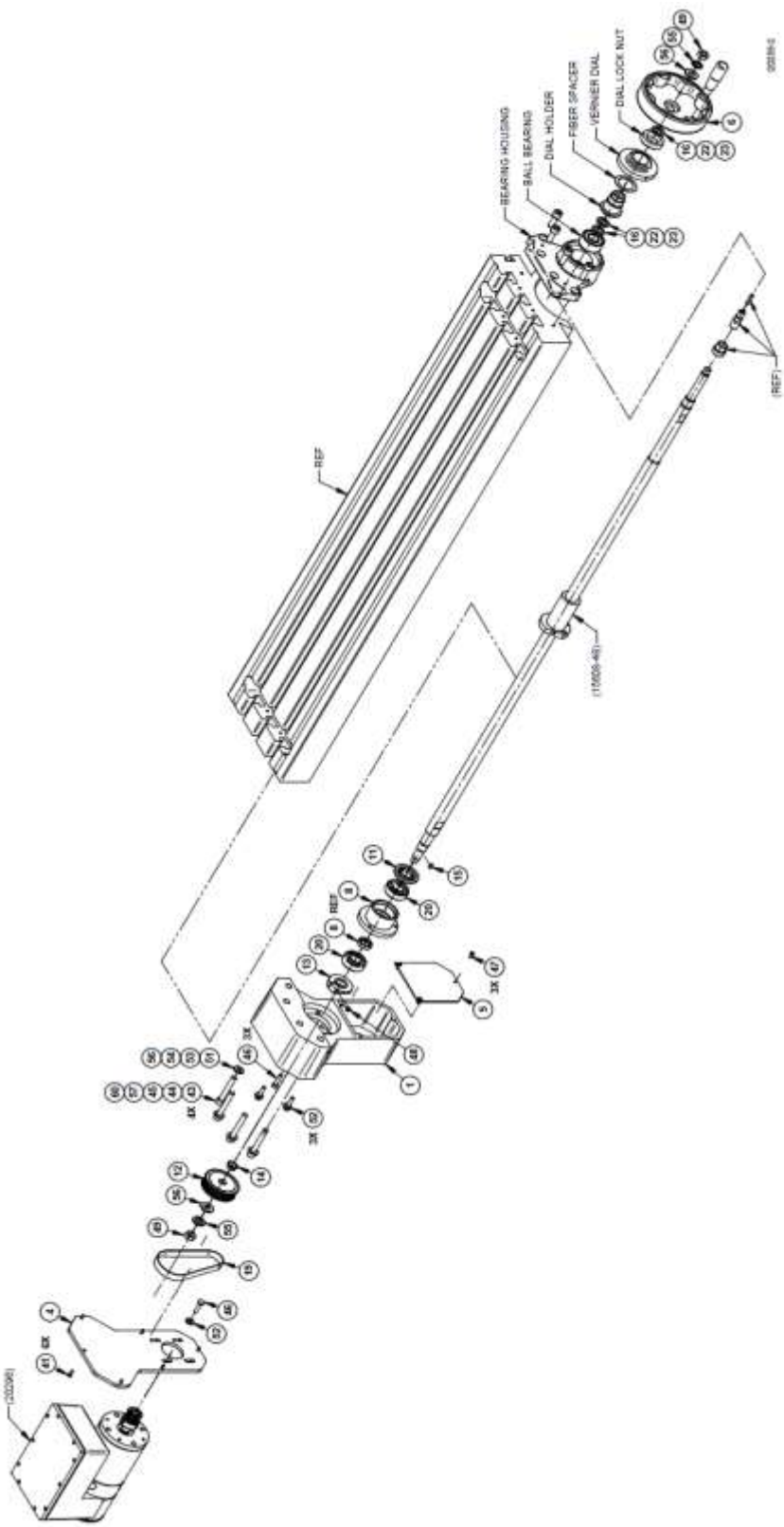


Figure 31 - X-Axis Drive Assembly -P/N 20255-2

Parts List - X-Axis Drive Assembly - P/N 20255-2 (Figure 31)

Item	P/N	Title	Qty
1	15621	DRIVE HOUSING	1
4	15624	COVER - X-AXIS - DRIVE - HOUSING-MX	1
5	15622	BACK COVER	1
6	15616	HANDWHEEL ASSY-MX	1
8	15612	BEARING HOUSING ASSY-X AXIS	1
10	15638	STOP - X-AXIS	1
11	15626	SEAL-BEARING HOUSING	1
12	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES	1
13	16452	NUT CLAMP-X ,Y, & Z AXIS	1
14	16350	FERRULE-SPROCKET	1
15	98481A090	KEY WOODRUFF #404-1/8 X 1/2	1
16	14772	SPACER - .100" THICK	5
19	400-5M-15	BELT - TIMING 5MM POWERGRIP	1
20	23930	BEARING SET (2)-ANGULAR CONTACT-7204 BECBP	1Set
22	14772-2	SPACER - .020" THICK	2
23	14772-5	SPACER - .050" THICK	2
41	8-32X3/8 25B	SCREW-SHCS-STL-BO	6
42	5/16-18X1 25B	SCREW-SHCS-STL-BO	1
45	M10-1.5X65 25B	SCREW-SHCS-STL-BO	4
46	1/4-20X1 24B	SCREW-HEX HD-STL-BO	7
47	8-32X3/8 20B	SCREW-RH-PHIL-STL-BO	3
48	10-32X3/4 25B	SCREW-SHCS-STL-BO	1
49	1/2-20 51Z	NUT-HEX JAM-STL-ZINC	2
52	15759	WASHER-1/4 HARD BLK OX 1/8 THK	7
54	M10 70P	WASHER-FLAT USS-STL-PLAIN	4
55	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	2
56	1/2 71Z	WASHER-FLAT SAE-STL-ZINC	2
57	22008	BEARING-204KTT	1
	26031-42	BALLSCREW - X AXIS	1
	26031-48	BALLSCREW - X AXIS	1

i20255-2

6.1.9 Ball Screw Replacement, Y-Axis (Saddle)

CAUTION!

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

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

Important: The clamp nut must be reassembled as follows:

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

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

See Figure 32 for an illustration of the Y-axis drive train.

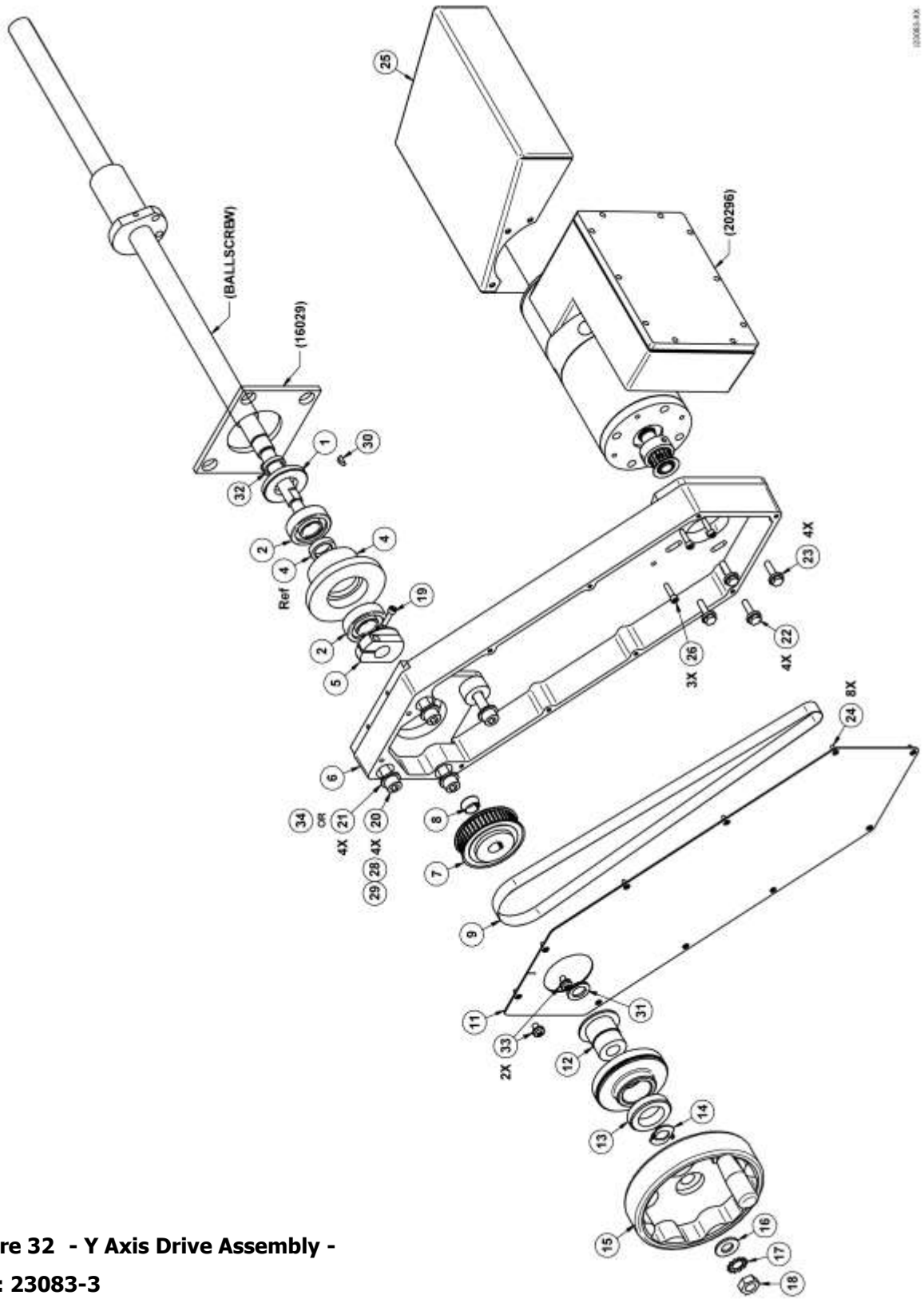


Figure 32 - Y Axis Drive Assembly - P/N: 23083-3

Parts List - Y-Axis Drive Assembly - P/N: 23083-3 (Figure 32)

Item	P/N	Title	Qty
1	15626	SEAL-BEARING HOUSING	1
2	23930	BEARING SET (2)-ANGULAR CONTACT-7204 BECBP	1Set
4	15980	BEARING HOUSING ASSY-LARGE FLANGE-Y AXIS	1
5	16452	NUT CLAMP-X ,Y, & Z AXIS	1
6	20623	MOTOR BRACKET-KNEE MILLS-40 DEGR	1
7	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES	1
8	16350	FERRULE-SPROCKET	1
9	890-5M-15	BELT - TIMING 5MM POWERGRIP (Y AXIS)	1
11	20621	COVER-SPORT 40 DEGREE	1
12	15627-2	DIAL HOLDER	1
13	15836	DIAL NUT	1
14	15614	TAB WASHER	1
15	15616	HANDWHEEL ASSY-MX	1
16	1/2 71Z	WASHER-FLAT SAE-STL-ZINC	1
17	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	1
18	1/2-20 51Z	NUT-HEX JAM-STL-ZINC	1
19	10-32X3/4 25B	SCREW-SHCS-STL-BO	4
20	M10-1.5X60 25B	SCREW-SHCS-STL-BO	4
21	23082	WASHER-.75X.394X.10-STL	4
22	1/4-20X1 24B	SCREW-HEX HD-STL-BO	4
23	15759	WASHER-1/4 HARD BLK OX 1/8 THK	4
24	6-32X3/8 10B	SCREW-PH-PHIL-STL-BO	8
25	23141	SHEET METAL-PT4-COOLANT MOTOR COVER ASSY	1
26	10-32X1 25B	SCREW-SHCS-STL-BO	3
27	10 73B	WASHER-SPLIT LOCK-STL-BO	3
30	98481A090	KEY WOODRUFF #404-1/8 X 1/2	1
31	14772-2	SPACER - .020" THICK	1
32	20322	SPACER Y-AXIS- BALLSCREW	1
33	1/4-20X3/8 10B	SCREW-PH-PHIL-STL-BO	2
	20296	MOTOR ASSY ENCODER/DRIVER 4020	1
	15609-12	BALLSCREW - Y AXIS	1
	15609-16	BALLSCREW - Y AXIS	1

i23083-3

6.1.10 Z-Axis Ball Screw Removal & Replacement

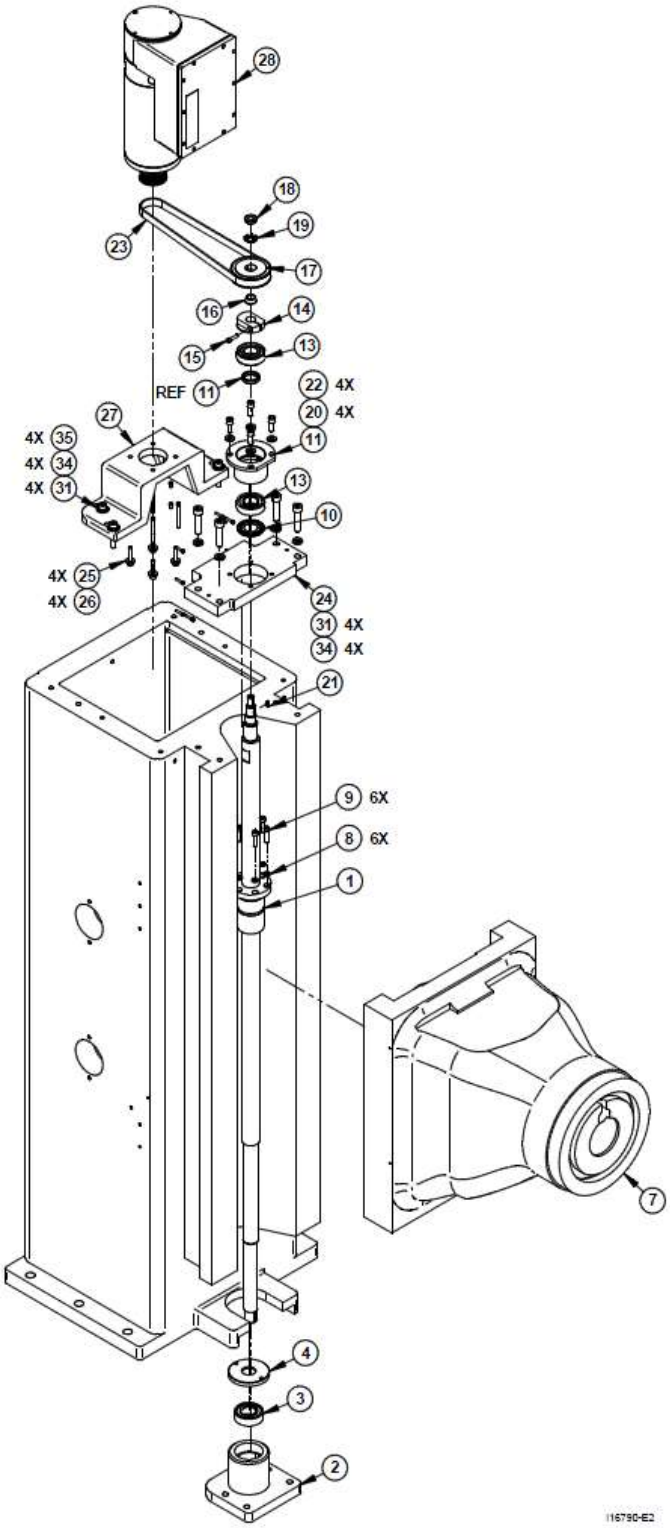
CAUTION!
Never screw a ball screw partially or totally out of its nut. They cannot be reassembled.

1. Ensure that there is sufficient vertical clearance above the top of the machine to remove the ball screw. Minimum clearance required is 32 inches.
2. Remove vertical column top cover.
3. Remove servomotor, belt and Z motor mounting bracket.
4. Remove upper and lower Z-axis way covers.
5. Lower head to table. Place 1 or 2 inch wood board between spindle nose and table to protect.
6. Lower head until weight of head is supported by the table.
7. Tighten both ram locks on the right side of ram.
8. Remove locknut and lock washer from the top of the Z ball screw.
9. Remove pulley and woodruff key.
10. Loosen #10-32 socket screw on clamp nut.
11. Using wrench flats on clamp nut and wrench flats on ball screw remove clamp nut.
12. Remove the four cap screws from bearing housing flange.
13. Remove the clamp nut.
14. Remove bearing, nilos ring and bearing housing with matched spacer from ball screw.
15. Remove (6) M6 cap screws and lock washers from ball nut flange.
16. Extract ball screw assembly from machine until ball nut flange is above the top of the ram. Support ball screw and remove lubrication line from ball nut flange.
17. Raise the ball screw until the bottom end of the ball screw is above the ram. Angle the ball screw out and away from the head. Lower the ball screw on the right side of the machine until the top of the ball screw clears the support plate.
18. Reassemble all components in reverse order as shown above, except leave off the pulley, locknut and lock washer until ball screw is realigned. Torque clamp nut to 50 ft. lb.
19. With the ball screw assembly installed, loosen four 5/16-18 cap screws from bearing housing, raise head to the uppermost position, and re-tighten 5/16-18 cap screws. Note that there is .060 clearance between the bearing housing outside diameter and the inside diameter of the support plate to allow for realignment. Traverse the head to the extreme of the up and down travel manually to check for freedom of movement. Use torque wrench to make sure torque is consistent along length of screw. Use torque wrench to make sure torque is consistent along length of screw.

See Figure 32-1 for an illustration of the Z-axis drive train.

See Section 6.2.2 to properly measure and set the Z Backlash Compensation and calibration.

Figure 32-1 – Drive Assy-Z Axis –DPMEX2 P/N 16790-E2



Parts List - Drive Assy-Z Axis –DPMEX2 (Figure 32-1)

Item	P/N	Title	Detail	Qty
1	23662	BALLSCREW-Z AXIS	LM0010	1
2	SW 0008	BEARING HOUSING LOWER SW 0008	SW 0008	1
3	22583	BEARING-SELF ALIGNING 2205E-2RS1TN9		1
4	16774	PROTECTOR-BEARING		1
7	16770	MODIFICATION OF 3 HP RAM FOR TRAK	PING JENG	1
8	M6 73B	WASHER-SPLIT LOCK-STL-BO		6
9	M6-1.0X25 25B	SCREW-SHCS-STL-BO		6
10	7205-AVH	NILOS RING-7205		1
11	16295-1	HOUSING-BEARING ASSY Z-AXIS DRIVE		1
13	20374	BEARING-ANGULAR CONTACT-7205		2
14	16773	NUT CLAMP-Z AXIS		1
15	10-32X3/4 25B	SCREW-SHCS-STL-BO		1
16	16350	FERRULE-SPROCKET-DRIVE		1
17	16983	PULLEY-SOLID 44 TEETH Z-AXIS		1
18	N01	LOCKNUT		1
19	W01	LOCKWASHER		1
20	M8 73B	WASHER-SPLIT LOCK-STL-BO		4
21	98481A090	KEY WOODRUFF #404-1/8 X 1/2		1
22	M8-1.25X20 25B	SCREW-SHCS-STL-BO		4
23	710-5M-15	BELT - TIMING		1
24	23664	BRACKET-Z AXIS BALLSCREW-DPME2	LM0011	1
25	1/4-20X1 1/4	SCREW-SHCS-STL-BO		4
26	15759	WASHER-1/4 HARD BLK OX 1/8 THK		4
27	23655	BRACKET-Z AXIS MOTOR-DPME2	LM0022	1
28	20296	MOTOR/ENCODER/SERVO ASSY-DRIVER		1
31	M10 73B	WASHER-SPLIT LOCK-STL-BO		8
34	M10-1.5X45 25B	SCREW-SHCS-STL-BO		8
35	M10 71B	WASHER-FLAT SAE-STL-BO		4

i16790-E2

6.1.11 Spindle Motor Wiring

The spindle motor is wired for 220 or 440 volts. See Figure 33 for how to wire the motor.

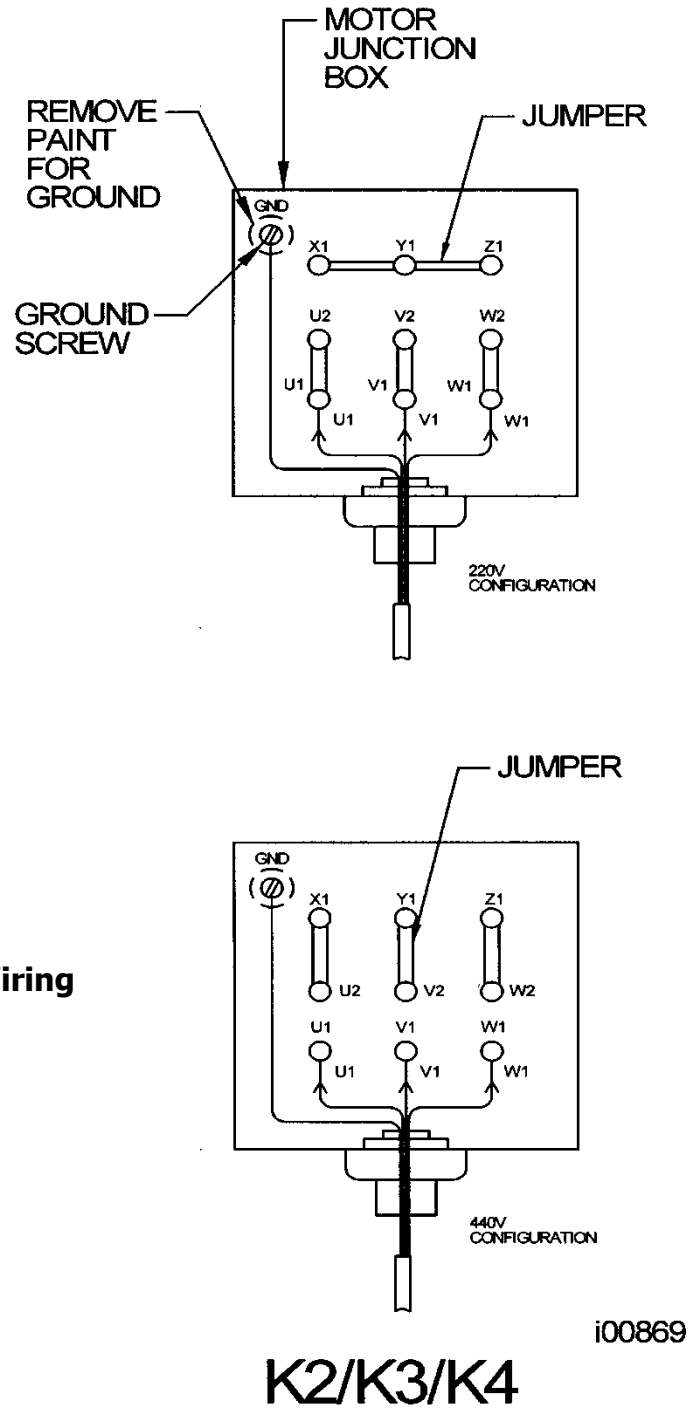


Figure 33

Spindle Motor Wiring

6.1.12 Feed Trip Adjustment

If the feed trip is adjusted too light it will inadvertently trip when drilling. If too heavy, it will not trip accurately and stress the mechanism. The correct adjustment depends on the operation to be performed. To adjust:

1. Release the lock nut.
2. Engage the trip handle--move it left.
3. Adjust the micrometer nut against the quill stop knob.
4. Slowly turn the adjusting screw until the handle trips.
5. Tighten the lock nut.
6. Check the reaction. If too sensitive, lower the adjusting screw slightly. If too heavy, raise it.

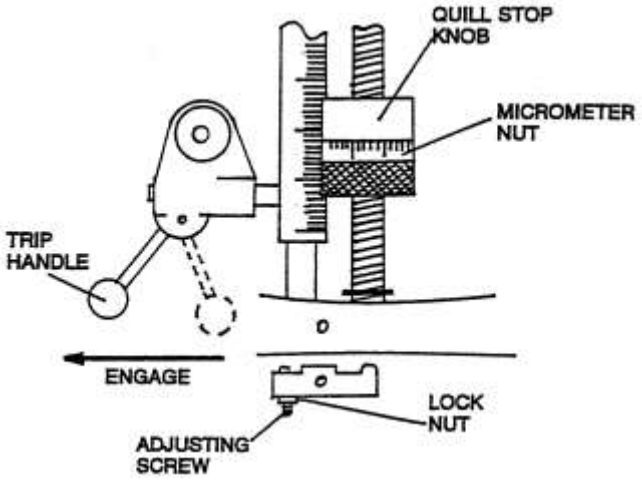


Figure 34 I00153

6.1.13 Quill Clock Spring Replacement and Adjustment

The quill Clock Spring counterbalances the weight of the quill and tool

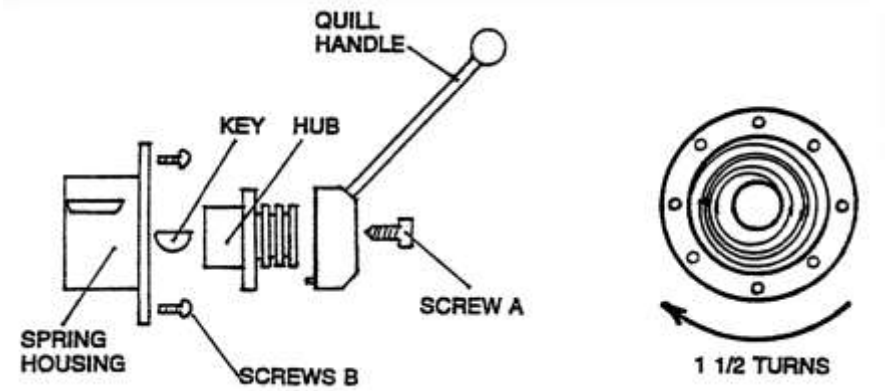


Figure 35

1. Move the quill to its top position and lock it in place.
2. Remove the quill handle, hub (by removing Screw A) and key.
3. Remove Screws B and allow the spring housing to unwind.

4. Remove the spring. It is held by a pin on the shaft and slot in the housing.
5. Replace the spring. Rotate the housing clockwise until the spring catches the shaft pin.
6. Rotate (wind up) the housing 1 1/2 turns, replace Screws B, key hub, Screw A, and handle.

6.1.14 Spindle Motor Removal and Replacement

1. While the spindle is running, change the RPM to its lowest value.
2. Disconnect the power to the motor. It is recommended that the power disconnect be made from the shop feeder box.
3. Disconnect the electrical connection in the conduit box attached to the motor.
4. Crank the speed changer to the highest RPM value.
5. Remove the two screws that fasten the motor to the top of the housing.

CAUTION!

The motor is heavy--about 60 pounds. Be certain you have the proper equipment or assistance.

6. Tilt the motor toward ram and remove the belt from the motor pulley. Remove motor.
7. If the motor is to be replaced, remove the M8 socket head cap screw at the end of the motor shaft. Slide the pulley assembly off the motor shaft and onto the new motor.

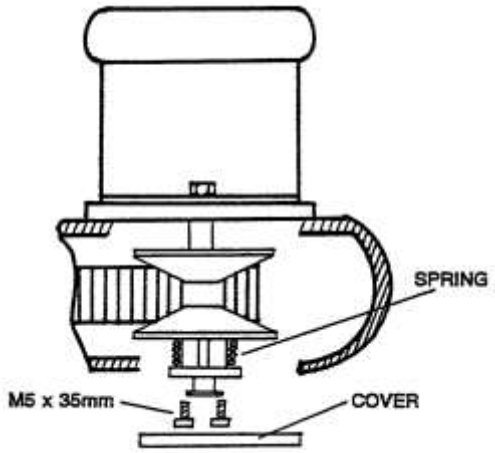


Figure 36 I00155

6.1.15 Drive Belt Replacement

1. Remove the motor.
2. Remove the draw bar and its bushing.
3. Remove the three Screws A and use M6 x 35mm screws in the adjacent tapped holes to remove the Bearing Cap.
4. Remove the nut from the fine speed adjustment Screw B and turn the screw all the way down through the casting. Catch it from the motor hole.
5. Remove six Screws C holding the belt housing to the subplate.
6. Remove the four screws holding the speed changer.
7. Remove the belt housing.
8. Replace the belt by sliding it over the speed changer.
9. In reassembly be certain the fine speed adjustment Screw B goes into the slot of the Speed Change Plate D in the area in which the screw is not threaded.

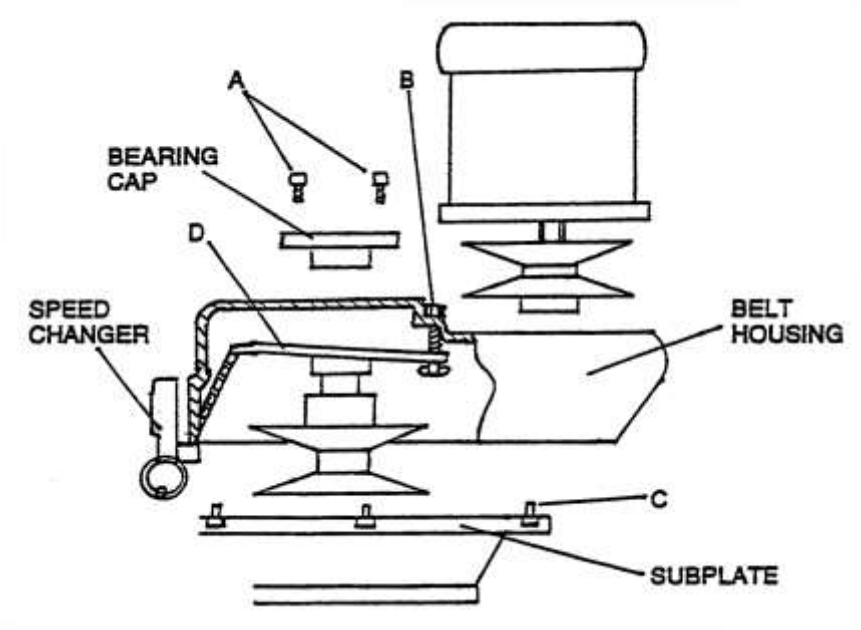


Figure 37 i00156

6.1.16 Timing Belt Replacement

1. Remove the motor and drive belt.
2. Slide the top or adjustable vari-disc pulley assembly off the shaft.
3. Remove the three M8 screws holding the belt housing base to the gear housing.
4. Lower the quill about 4 inches.
5. Remove the belt housing base and lower or stationary vari-disc pulley assembly.
6. Replace the timing belt.

6.1.17 Brake Shoe Replacement

1. Remove the motor, drive belt and complete Steps 1-5 of the timing belt replacement procedure.
2. Remove the two M6 cap screws from the bottom of the belt housing base.
3. Separate the belt housing base from the lower or stationary vari-disc pulley. This is a slight press fit.
4. Remove the 2 springs.
5. Replace the brake shoes.

6.1.18 Spindle Replacement

1. Remove the draw bar and its bushing.
2. Lower the quill about 1 inch and lock.
3. Remove the setscrew from the back of the spindle.
4. Loosen (unscrew) the large black ring (nosepiece) with a spanner wrench.

Note: The nosepiece has a left hand thread-- rotate counterclockwise to loosen.

5. Using a soft bar about 12 inches long, alternately tap on the top of the spindle and loosen a few threads on the nosepiece until fully unscrewed (the nosepiece will remain attached to the spindle).
6. Continue to tap the spindle out of the quill. The spindle bearings will come out with the spindle.

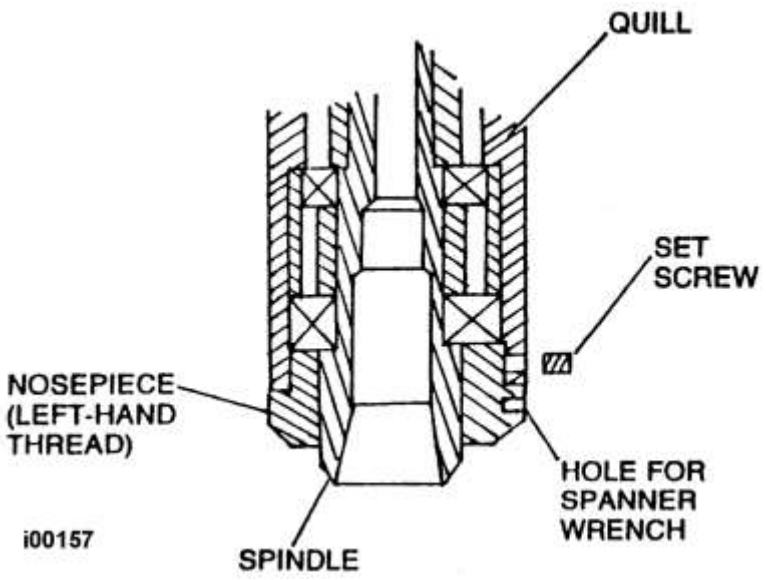


Figure 38

6.2 Maintenance

6.2.1 Gib Adjustments

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

6.2.1.1 Table Gib Adjustment, X-Axis

See Figure 39.

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

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

4. Attach a .0001 dial indicator with a magnetic base to the left front of the saddle. Place the indicator stylus on the front surface of the table as close to the indicator base as possible.

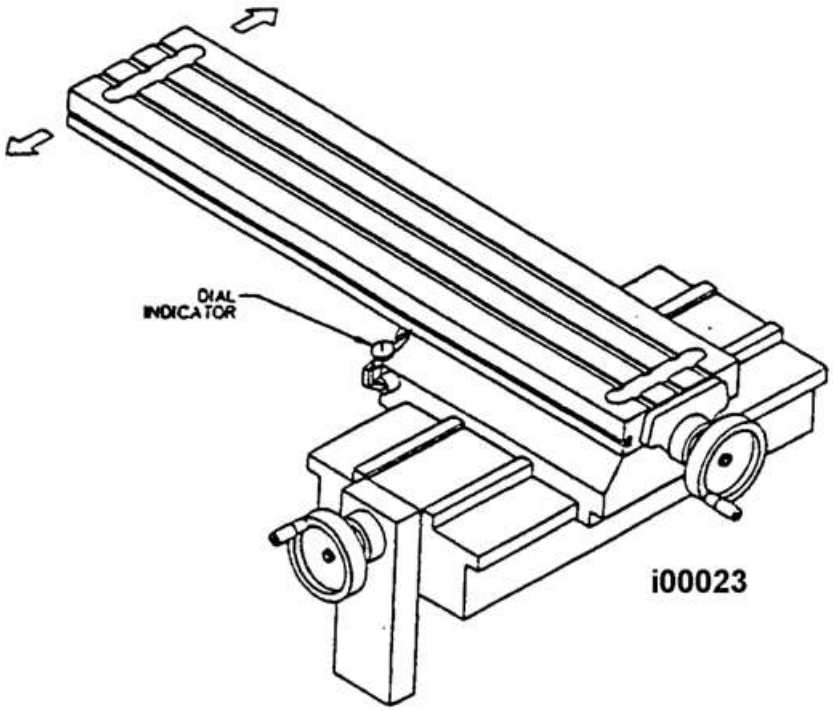


Figure 39 Table Gib Adjustment

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

- To adjust the gib for excessive clearance: Loosen the gib lock screw on the right end of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw

on the left end of the saddle. Tighten the gib lock screw on the right end of the saddle to lock the give in place, and recheck. Repeat as necessary.

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

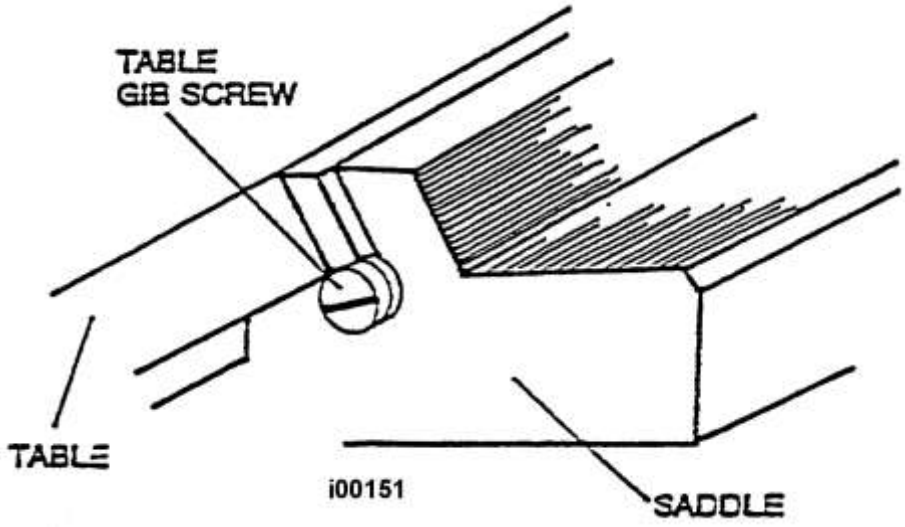


Figure 40 - Table Gib Screw

6.2.1.2 Saddle Side Gib Adjustment, Y-Axis

See Figure 41.

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

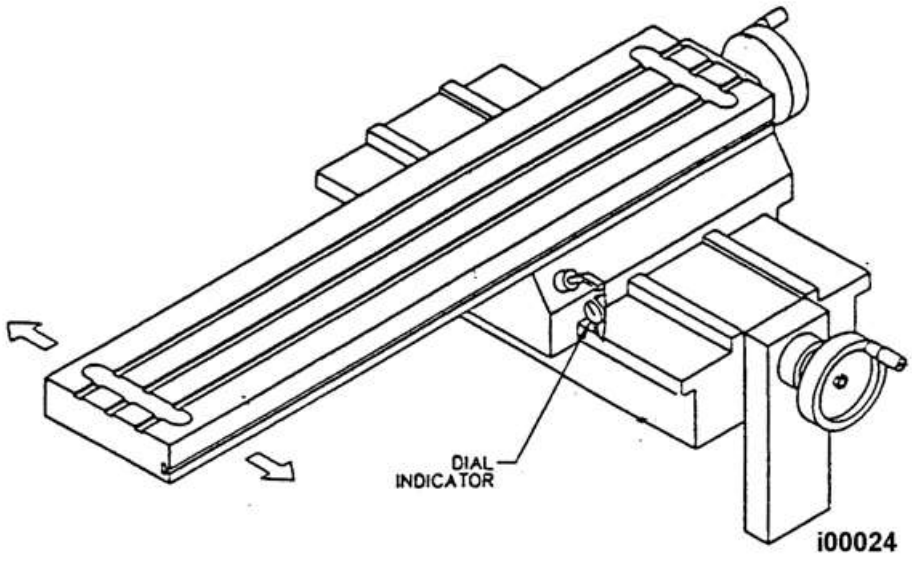


Figure 41 Saddle Side Gib Adjustment

5. Attach a .0001 dial indicator with a magnetic base to the left front of the saddle. Place the indicator stylus on the edge of the large box way.
6. Move the left end of the table back and forth and note the amount of movement on the dial indicator. Adjust the Y-axis side gib until the registered movement is .0010-.0015.
    - To adjust the gib for excessive clearance:

Loosen the gib lock screw on the back of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the front of the saddle. Tighten the gib lock screw on the back end of the saddle to lock the gib in place, and recheck. Repeat as necessary

- To adjust the gib for too small of a clearance:

Loosen the gib lock screw on the front of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the back of the saddle. Tighten the gib lock screw on the front of the saddle to lock the gib in place, and recheck. Repeat as necessary.

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

6.2.1.3 Ram Gib Adjustment - Z Axis

1. Clean all chips, dirt and excess oil from the table and saddle.

2. Disconnect one end of the upper and lower way cover where it is attached to the ram.
3. Position the milling head such that the table can be reached by extending the quill approximately 3/4 of its travel.
4. Place a wood block on the table underneath the spindle.
5. Attach a .0001 dial indicator with a magnetic base to the column near the base of the ram on the left side of the machine. Place the indicator stylus on the rear surface of the ram near the bottom.

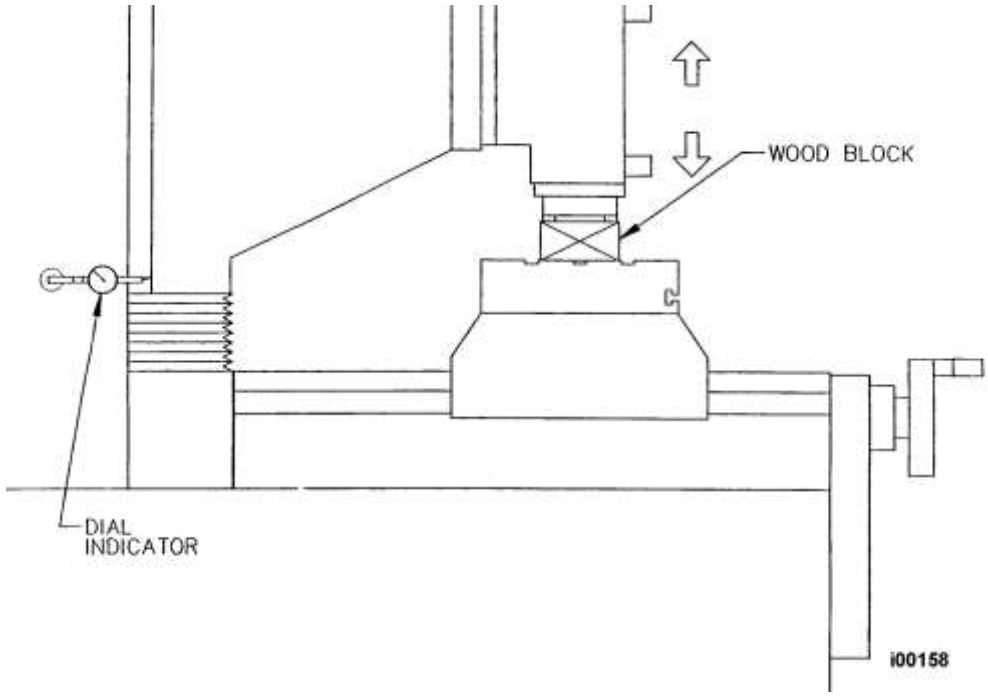


Figure 41-1 - Ram Gib

6. Extend the quill until it touches the wood block. Using the quill handle, push the spindle nose against the wood block and note the amount of movement on the dial indicator. Adjust the gib until the registered movement is .001-.0015.

   To adjust the gib for excessive clearance: Loosen the gib lock screw

on the bottom of the ram. Estimate the amount of gib lock screw adjustment required and tighten the gib lock screw on the top of the ram. Tighten the gib lock screw on the bottom of the ram to lock the gib in place, and recheck. Repeat as necessary.

To adjust the gib for too small of a clearance: Loosen the gib lock screw on the top of the ram. Estimate the amount of gib lock screw adjustment required and tighten the gib lock screw on the bottom of the ram. Tighten the gib lock screw on the bottom of the ram. Tighten the gib lock screw on the top of the ram to lock the gib in place, and recheck. Repeat as necessary.

7. Run Service Code 12 to set the feed forward constant.
8. Repeat the procedure for the gib on the right side of the machine.
9. Reattach the upper and lower way cover to the ram.

CAUTION!

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

6.2.2 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.

6.2.2.1 X, Y, Z and Quill Calibration using a standard.

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

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

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

- X and Y -- 150mm or 6”
- Z -- 75 mm or 3”

3. Set a 0.0001” indicator in the spindle and move it up to one side of the gage block or standard.
4. Go to setup mode, go to section “B” and press CODE 123.
5. Select the axis you want to calibrate X, Y or Z. For the quill press the F1 key labeled QUILL. The Z key is used to calibrate 3 axis machines only.
6. Follow the instructions on the screen to complete calibration.

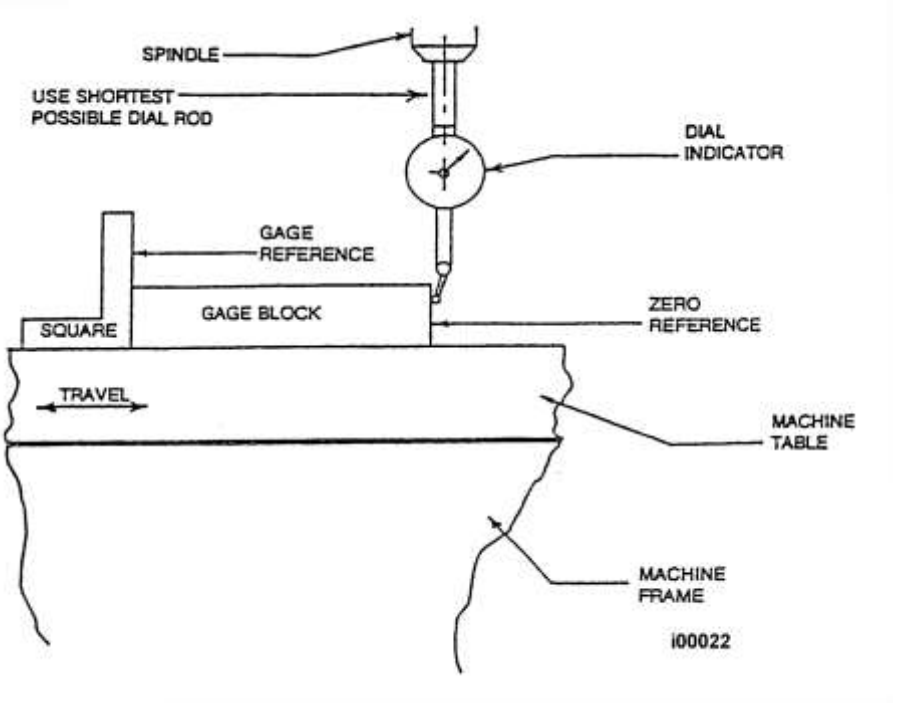


Figure 43 - Calibration Set-Up

6.2.2.2 X, Y , Z Calibration using part measurements.

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

X dimension = 3.003

Y dimension = 2.995

To calculate your offset, do the following:

X calibration offset = programmed ÷ actual = 3.000 ÷ 3.003 = 0.9990

Y calibration offset = programmed ÷ actual = 3.000 ÷ 2.995 = 1.0017

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

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

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

Z calibration offset = DRO ÷ actual = 1.000 ÷ 0.985 = 1.0152

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

6.2.2.3 Backlash Compensation

Code 127: Set X, Y or Z Backlash Constant

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

1. Set a .0001-inch dial indicator in the spindle, and touch off on a block or the vise along the direction (X, Y or Z) you wish to check, or set the backlash constant.
2. Turn on the ProtoTRAK and at the Main Menu and follow the procedure below precisely. It is recommended to have zero values in code 128 before proceeding.

Conversation Says	You Do
a. ---	a. Press MODE
b. Select Mode	b. Press DRO
c. DRO	c. Press SERV CODES
d. Service Code #	d. Press 127 and then ABS SET
e. Select Axis	e. Press X or Y
f. Travel = _ _ _ _	f. This shows the amount of travel for oscillation. Follow the instructions on the screen, press GO, and then press the appropriate soft keys (INC or DEC) to increase or decrease the amount of travel. Wait a few seconds for the amount to take effect. The value can also be manually input by pressing the TRAVEL button. To change the speed of oscillation, use the up and down arrow keys.
g. The following is an example of what you might see when running this code.	For example, if we were running this code for the X axis, and the "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, DRO, SERV CODE, 128, SET, OK, and then X, .00158, SET, RETURN.

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

   The backlash can also be found manually with a 0.0001" indicator with the following method (assuming once again that code 128 has zero value):

- 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.

6.2.2.4 CODE 128: Input Backlash Constant

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

6.2.3 Head Rotation and Tramming

The TRAK knee head is free to rotate up to 90 degrees to the right or left. The K2 and K3 can also rotate 45° front to back. The K4 machine cannot rotate front to back.

6.2.3.1 To Rotate the Head Side to Side:

1. Loosen the four locknuts.

2. Rotate the head with the adjusting worm shaft. When rotating to greater than a 45° angle, support head by hand.

3. Tighten the locknuts. Snug each locknut, then lightly tighten each locknut, then fully tighten each locknut in a crisscross pattern.

4. Use the method shown in the figure below and a parallel bar to square the head to the table.

6.2.3.2 Tramming the Head

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

Side to side tolerance – 0.001"

Side-to-Side Alignment

1. Make sure the machine is level.
2. Make sure the table has been clean and the Z gibs are adjusted properly. Mount a dial indicator in a tool holder and mount in the quill.
3. Adjust the Y-axis so that the spindle is in the center of the table.
4. Adjust the Knee so that the dial indicator will reach the table.
5. Move the dial indicator to 6 o'clock position and adjust the face so the needle is zero.
6. Do a series of sweeps from 9 o'clock to 3 o'clock and check for the repeatability of the setup. The head should be trammed within ± 0.001"
7. If the head is out of tram from side to side then loosen the 4 head bolts and rotate the head with the worm shaft.
8. Once the head has been trammed, tighten the 4 heads bolts. Be careful not to move the head while tightening. Tighten the bolts in a criss-cross pattern.

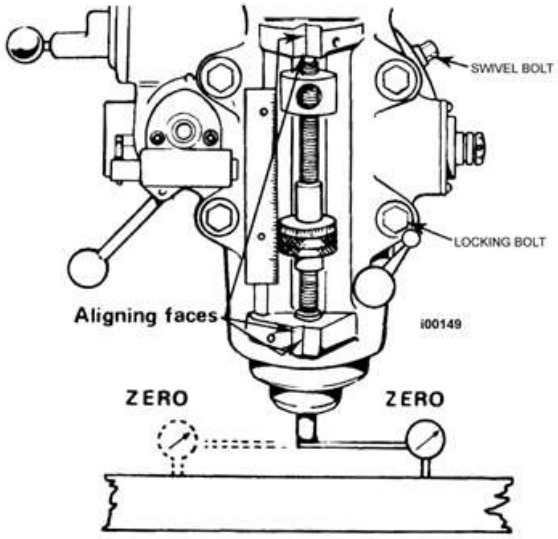


Figure 44

Tramming the Head

Back to Front Adjustment

With the dial indicator sweep the table from 6 o'clock to 12 o'clock. The head should be trammed within ± 0.0005" from front to back.

6.2.3.3 Back to Front Adjustment – only applicable to knee mills

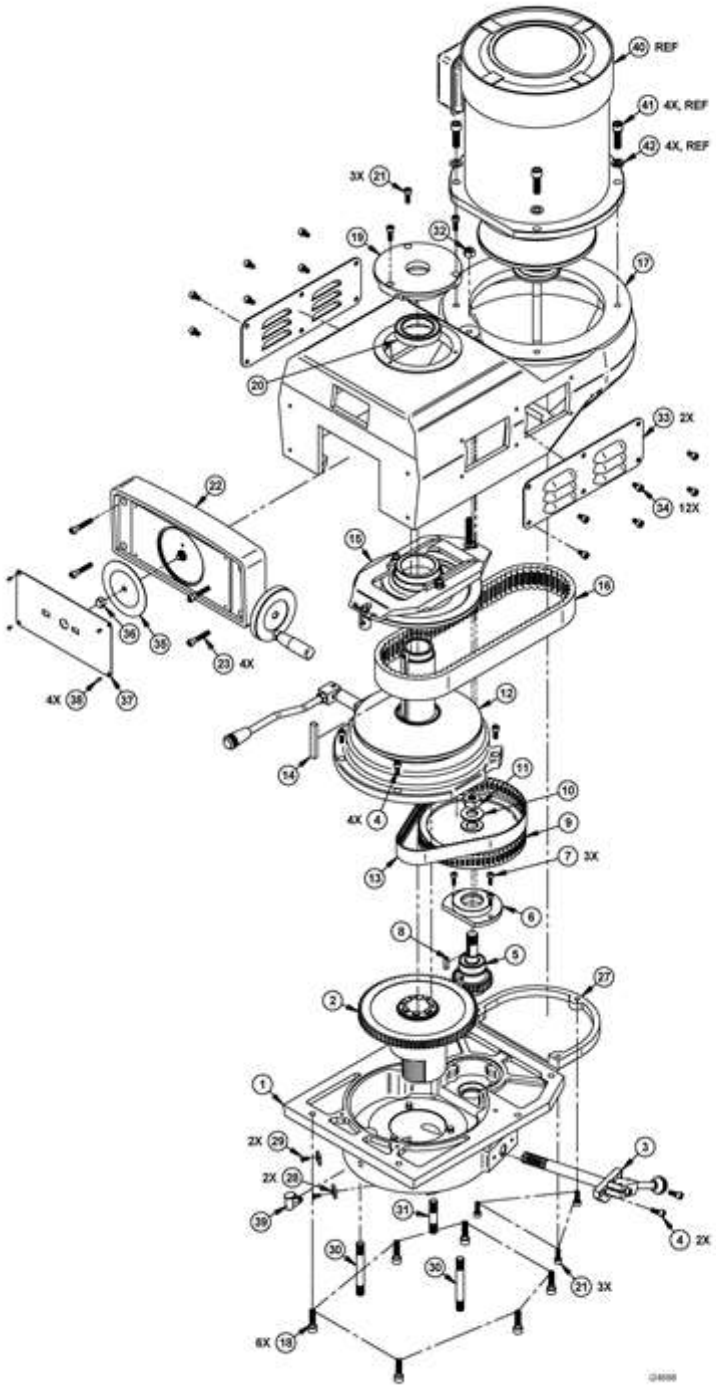
1. Make sure the table has been clean and the gibs are adjusted properly.
2. Mount a dial indicator in a tool holder and mount in the quill.
3. Adjust the Y-axis so that the spindle is in the center of the table.
4. Adjust the knee so that the dial indicator will reach the table and lock the 2 clamps on the knee.
5. Move the dial indicator to 6 o'clock position and adjust the face so the needle is zero.
6. Do a series of sweeps from 6 o'clock to 12 o'clock and check for the repeatability of the setup. The head should be trammed as close as possibility to 0.0005."
7. Loosen the three bolts and adjust the tram with the bolt mounted on the top of the ram.

Once the head has been trammed tighten the three bolts. Be careful not to move the head while tightening. Tighten the bolts a little at a time. (Note: the head must droop down rather than up because tool pressure will take care of the extra 0.0005".)

7.0 Figure & Part Lists

Figure 100 TRAK K4EMX - Upper Head Assy

P/N 24688 Green or P/N 24688-1 White



Parts Lists-TRAK K4EMX-Upper Head Assembly
P/N 24688 Green and P/N 24688-1 White (Figure 100)

Item	P/N	Title	Qty
1	20697-1	GEAR HOUSING ASSY	1
2	20697-2	HI-LOW SHIFT CLUTCH ASSY	1
3	20697-3	HI-LOW SHIFT ASSY	1
4	FVS12	SOCKET CAP SCREW M6-P1.0x15L	6
5	20697-4	PULLEY PINION ASSY	1
6	FVS64	BULL GEAR PINION BEARING CAP	1
7	FVS93	SCREW SOC HD M5-P0.8x15L	3
8	FVS117	KEY 5x520L	1
9	FVS62	TIMING BELT PULLEY	1
10	FVS126	WASHER Ø 5/8	1
11	FVS61	JAM NUT 5/8-11NC	1
12	20697-5	LOWER VARI-DISC DRIVE ASSY	1
13	FVS63	BELT 8YU-600L	1
14	FVS135	KEY 8x7x60L	1
15	20697-6	UPPER VARI-DISC DRIVE ASSY-40T	1
16	FVS4	BELT	1
17	FVS1	BELT HOUSING	1
18	FVS17	SOCKET CAP SCREW M6-P1.0x35L	6
19	FVS13	TOP BEARING CAP	1
20	FVS15	BALL BEARING (6909VV)	1
21	FVS129	SCREW- SOC HD CAP M6-P1.0x18L	6
22	20697-7	SPEED CHANGE HANDWHEEL-ASSY-40T	1
23	FVS10	SCREW- SOC HD CAP M8-P1.25x30L	4
27	FVS11	MOTOR PULLEY COVER	1
28	FVS104	COPPER CHIP(2REQ.)	2
29	FVS131	SCREW- FLAT HD PHILIP M5-P0.8x10L	2
30	FVS132	STUD Ø 7/16-92L	2
31	FVS133	STUD Ø 7/16-56L	1
32	FVS96	JAM NUT 3/8-16NC	1
33	FVS101	VENTILATOR(2REQ.)	2
34	FVS136	SCREW- SOC HD CAP M6-P1.0x10L	12
35	FVS16-1	VARI-SPEED DIAL	1
36	FVS95	NUT-ACORN 5/16-18NC	1
37	FVS16-2	NAME PLATE	1
38	FVS19	DRIVE SCREW	4
39	OIL-1	FRU-K3-OIL CUP	1
40	20820	SPINDLE MOTOR ASSY-5HP-GREEN	(1)
41	FVS130	WASHER- FLAT Ø 10.2	(4)
42	FVS111	SOC HD SCREW- 3/8-16NCx32L	(4)

i24688

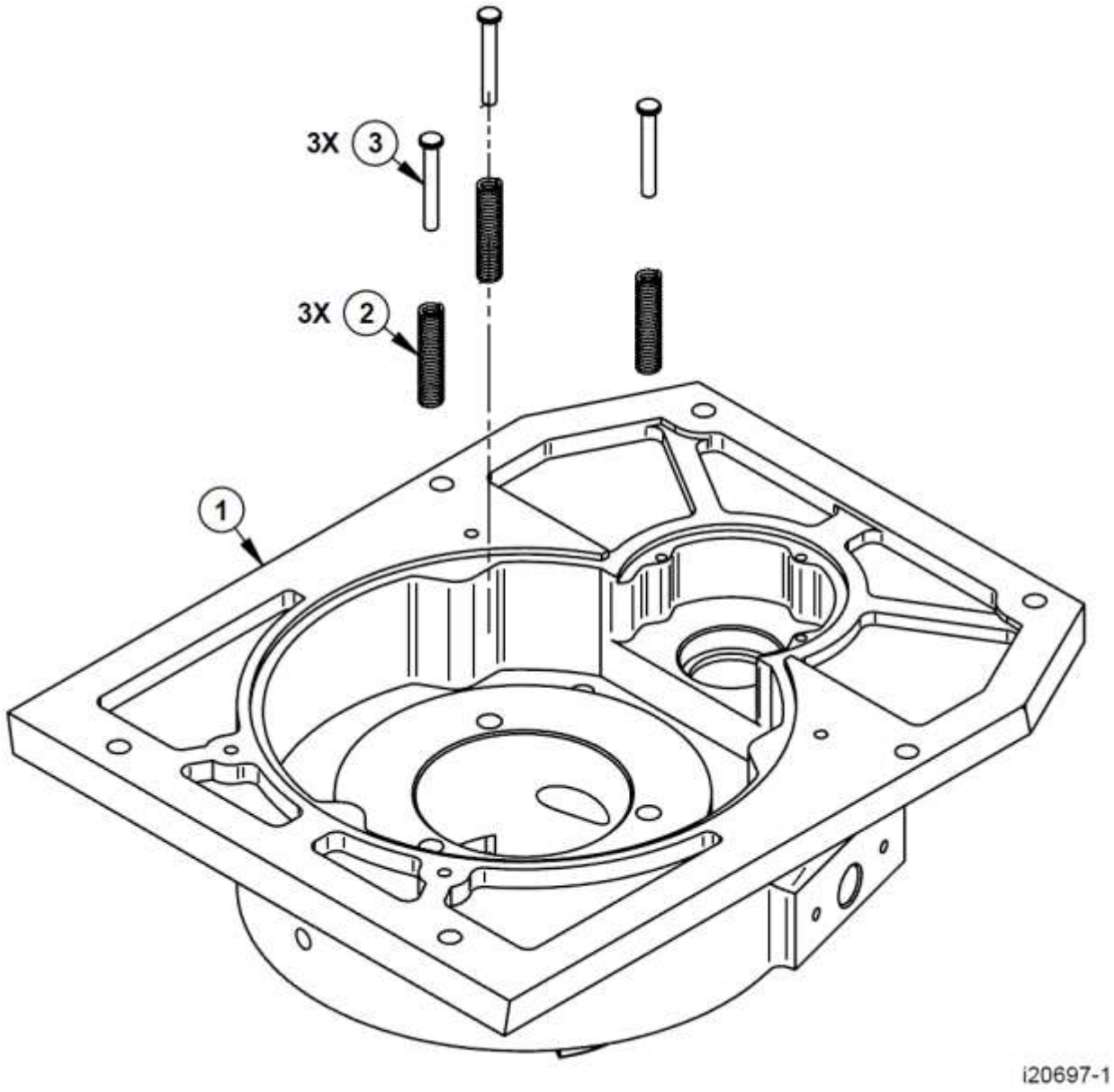


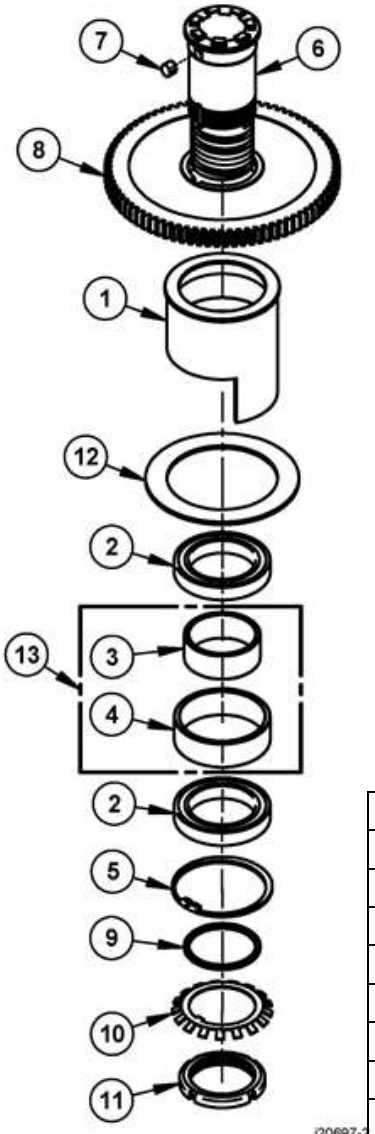
Figure 101 & Parts List Shown - TRAK K4EMX –

Gear Housing Assembly - P/N 20697-1

Item	P/N	Title	Qty
1	FVS82	GEAR HOUSING	1
2	FV112	GUIDE SPRING	3
3	FV113	SPRING GUIDE PIN	3

i20697-1

Figure 102 & Parts List Shown
TRAK K4EMX- Hi-Low Shift Clutch Assy - P/N 20697-2



Item	P/N	Title	Qty
1	FVS75	BULL GEAR BEARING SPACER	1
2	FVS77	BALL BEARING (2 REQ.) 6910ZZ	2
3	FVS78	BEARING SPACER	1
4	FVS79	BEARING SPACER	1
5	FVS80	SNAP RING R-75	1
6	FVS73	SPLIED GEAR HUB	1
7	FVS72	KEY 8x7x10L	1
8	FVS74	SPINDLE BULL GEAR	1
9	FVS11	WASHER	1
10	FVS11	EXTERNAL TOOTH WASHER Ø 50	1
11	FVS81	LOCK WASHER Ø 50-18NC	1
12	FVS76	RING	1
13	20818	BEARING-SPACER	(1)

i20697-2

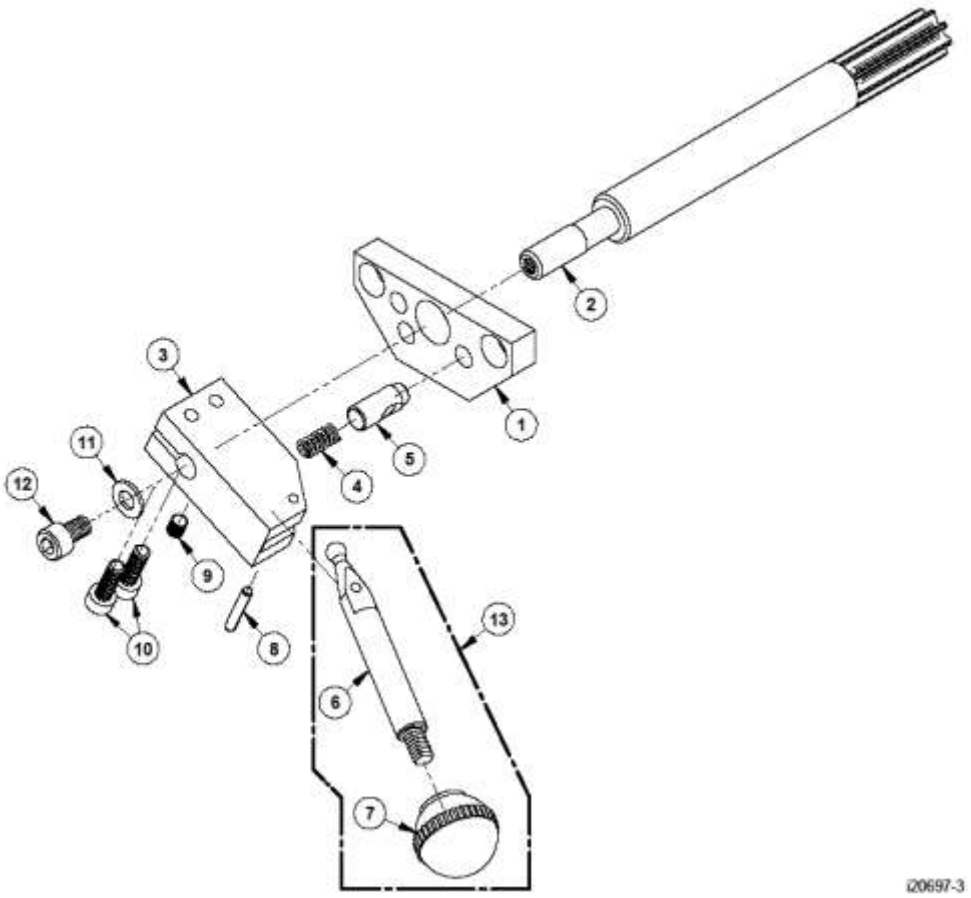


Figure 103 & Parts List Shown – TRAK K4EMX – Hi-Low Shift Assy – P/N 20697-3

Item	P/N	Title	Qty
1	FVS89	HI-LOW DETENT PLATE	1
2	FVS87	CLUTCH GEAR SHAFT	1
3	FVS92	HI-LOW PINION BLOCK	1
4	FVS91	SPRING	1
5	FVS90	HI-LOW DETENT PLUNGER	1
6	FVS94	HI-LOW SHAFT CRANK	1
7	FVS57	BAKELITE BALL HANDLE	1
8	FVS88	PIN Ø 319L	1
9	FVS92-1	SET SCREW M5-P0.8x6L	1
10	FVS93	SCREW SOC HD M5-P0.8x15L	2
11	FVS116	WASHER- FLAT Ø 6	1
12	FVS12	SOCKET CAP SCREW M6-P1.0x15L	1
13	24083	HI/LOW SHAFT ASSEMBLY	(1)

i20697-3

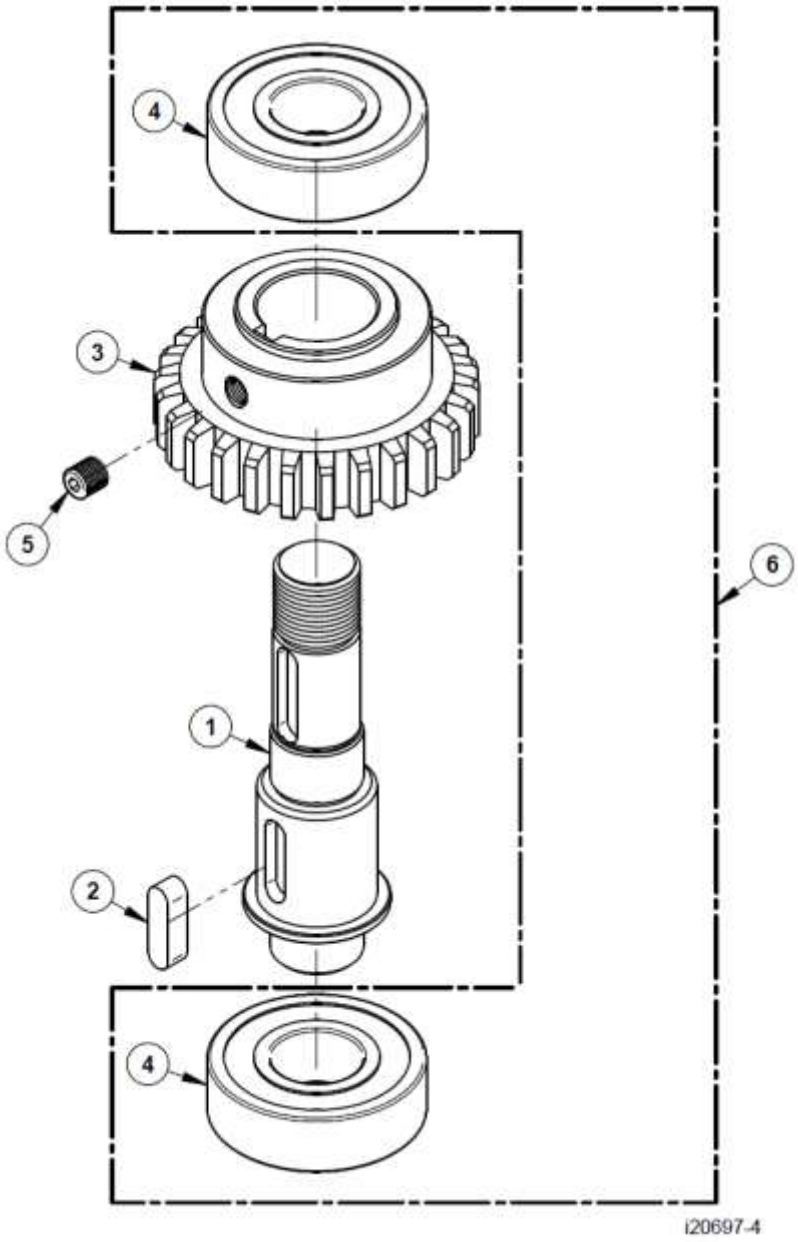
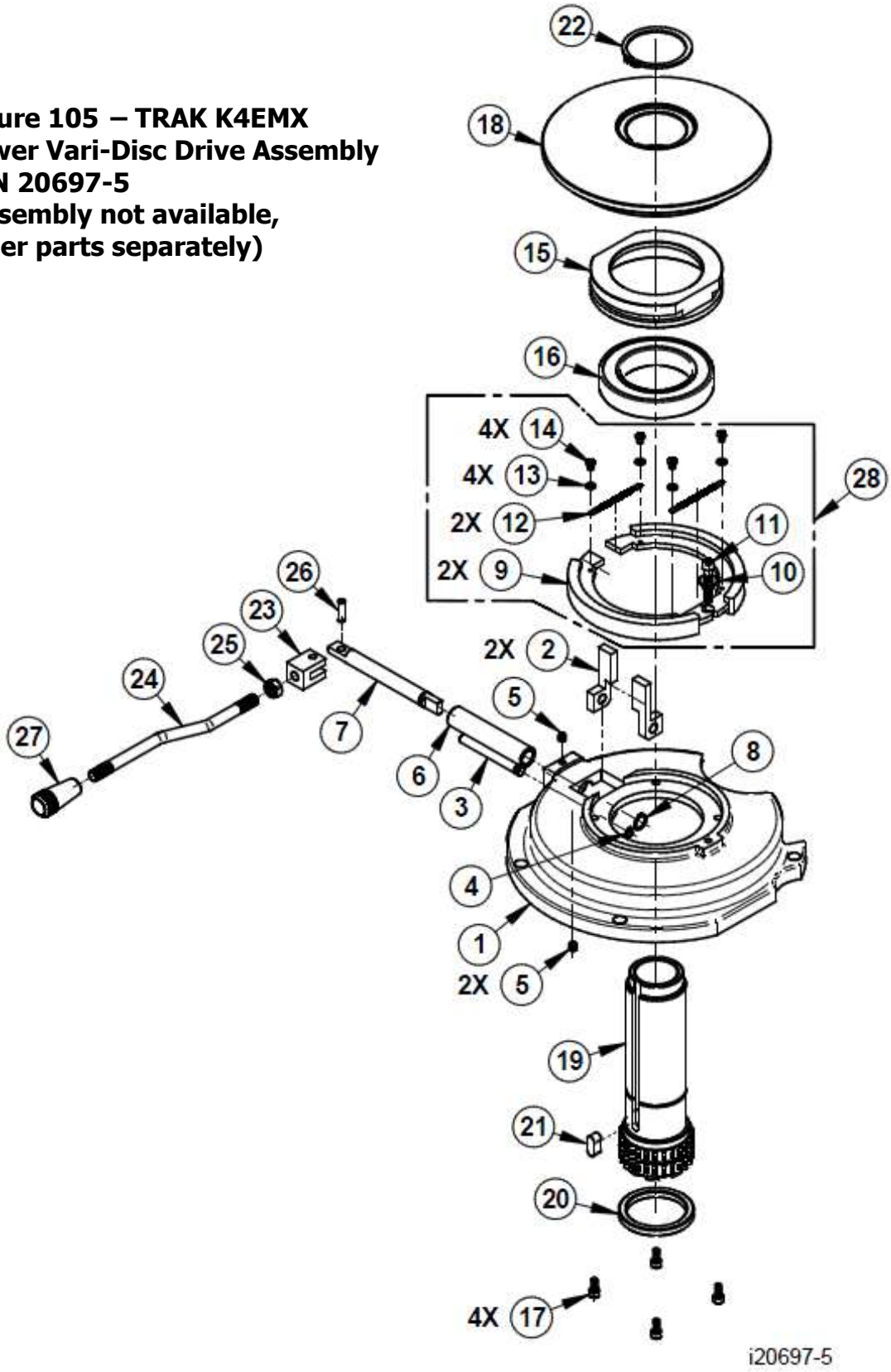


Figure 104 & Parts List – TRAK K4EMX Pinion Assembly - P/N 20697-4

Item	P/N	Title	Qty
1	FVS67	BULL GEAR PINION COUNTER SHAFT	1
2	FVS69	KEY 5518L	1
3	FVS66	BULL GEAR PINION	1
4	AK118	BEARING-DEEP GROOVE-6203ZZ	2
5	FVS3	SOCKET SET SCREW M6-P1.0x6L	1
6	23954	BEARING-DEEP GROOVE-SET (2)-6203ZZ	(1)

i20697-4

Figure 105 – TRAK K4EMX
Lower Vari-Disc Drive Assembly
P/N 20697-5
(assembly not available,
order parts separately)



Parts List - TRAK K4EMX - Lower Vari-Disc Drive Assy –

P/N: 20697-5 (Figure 105)

Item	P/N	Title	Qty
1	FVS50	BELT HOUSING BASE	1
2	FVS59	BRAKE BLOCK	2
3	FVS58	TURNING BLOCK SHAFT	1
4	FVS103	RETAINING RING Ø 7	1
5	FVS51	SET SCREW M6-P1.06L	2
6	FVS53	BRAKE LOCK BUSHING	1
7	FVS52	BRAKE LOCK SHAFT	1
8	FSV119	RETAINING RING Ø 11	1
9	FVS47	BRAKE SHOE	2
10	FVS48	BRAKE SHOE PIVOT SLEEVE	1
11	FVS17	SOCKET CAP SCREW M6-P1.0x35L	1
12	FVS49	BRAKE SPRING	2
13	FVS122	WASHER Ø 6	4
14	FVS120	SCREW- PHILLIP PAN HD 3/16-24NC6L	4
15	FVS46	BRAKE BEARING CAP	1
16	AK048	BALL BEARING (6912ZZ)	1
17	FVS14	SOCKET CAP SCREW M 5-PO.8x12L	4
18	FVS45	STATIONARY DRIVEN VARIDISC	1
19	FVS70	SPINDLE PULLY ASSY	1
20	FVS100	SPINDLE PULLY SPACER	1
21	FVS71	KEY 8x8x20L	1
22	FVS97	SNAP RING Ø 50	1
23	FVS52-1	BRAKE LOCK SHAFT SWIVEL	1
24	FVS56	BRAKE LOCK HANDLE	1
25	FVS54	HANDLE FIX BLOCK 3/8-16NC	1
26	FVS55	SPRING PIN Ø 6x20L	1
27	FVS57-1	BAKELITE BALL HANDLE 3/8-16NC	1
28	24055	BRAKE SHOE ASSY	(1)

i20697-5

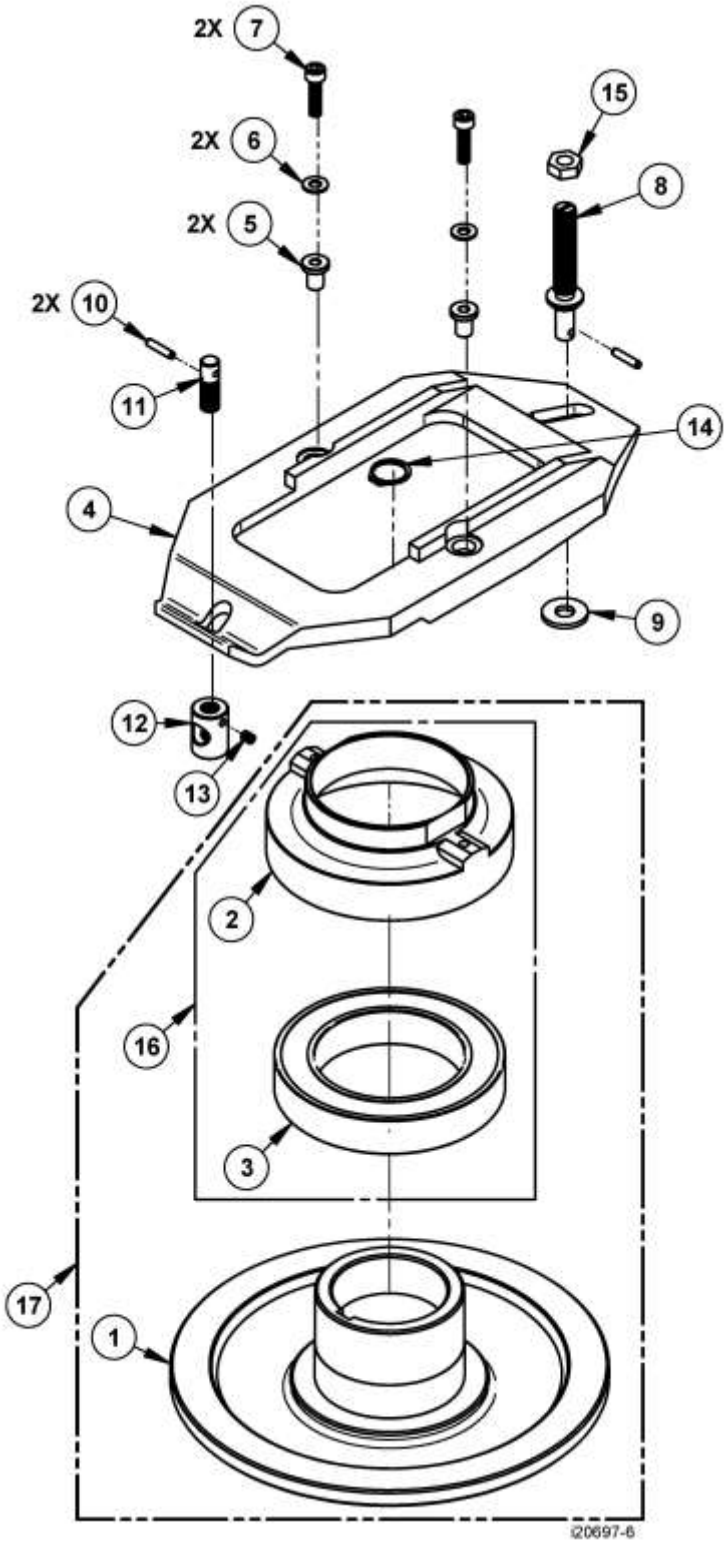


Figure 106 - TRAK K4EMX - Upper Vari-Disc Drive Assy - P/N 20697-6

Parts List - TRAK K4EMX - Upper Vari-Disc Drive Assy – P/N 20697-6 (Figure 106)

Item	P/N	Title	Qty
1	FVS44	ADJUSTABLE-DRIVEN VARIDISC W/ KEY	1
2	FVS42	SPINDLE PULLEY BEARING HOUSING	1
3	24641	BEARING-DEEP GROVE-6013ZZ	1
4	FVS36	SPEED CHANGE PLATE	1
5	FVS38	PIVOT SLEEVE Ø 5	2
6	FVS37	WASHER M5-P0.8X20L	2
7	FVS123	SOCKET CAP SCREW	2
8	FVS39	SPEED CHANGE PLATE PIVOT STUD	1
9	FVS41	WASHER Ø 8.2	1
10	FVS40	ROLL PIN Ø3x15L	2
11	FVS35	CHAIN END STUD	1
12	FVS34	ADJUSTMENT NUT	1
13	FVS33	CHAIN FRONT SCREW M4-P0.7x5L	1
14	FVS97	SNAP RING Ø 50	1
15	FVS96	JAM NUT 3/8-16NC	1
16	24599	BEARING HOUSING ASSY-K4	(1)
17	24603	VARIDISC ASSY-ADJUSTABLE	(1)

i20697-6

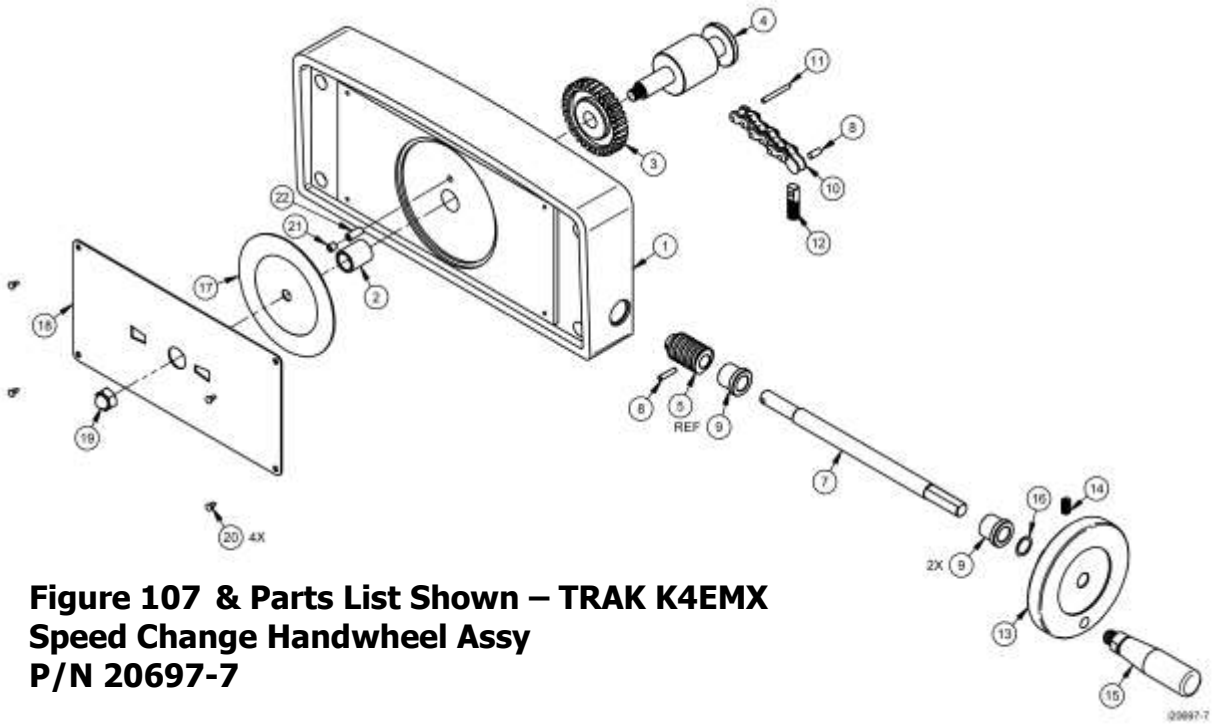


Figure 107 & Parts List Shown – TRAK K4EMX
Speed Change Handwheel Assy
P/N 20697-7

Item	P/N	Title	Qty
1	FVS16	SPEED CHANGE HOUSING	1
2	FVS20	BUSHING SELF LUBRICATING	1
3	FVS22	SPEED CHANGER GEAR	1
4	FVS31	SPEED CHANGE CHAIN DRUM	1
5	FVS21	WORM	1
7	FVS25	SPEED CHANGE SHAFT	1
8	FVS40	ROLL PIN Ø3x15L	2
9	FVS24	COPPER BUSHING	2
10	FVS32	CHAIN #3109.525	1
11	FVS31-1	DOWEL PIN Ø3x25L	1
12	FVS30	SPEED CHANGE STUD	1
13	FVS27	SPEED CHANGE HANDWHEEL	1
14	FVS18	FULL DOG SOCKET SET SCREW M6-	1
15	FVS28	HANDLE 3/8-16NC	1
16	VS24-1	FRU-K3-WASHER-WAVE	1
17	FVS16-1	VARI-SPEED DIAL	1
18	FVS16-2	NAME PLATE	1
19	FVS95	NUT-ACORN 5/16-18NC	1
20	FVS19	DRIVE SCREW	4
21	M5-0.8X14 40B	SCREW-SOC SET-STL-BO-CUP	1
22	M5-0.8X5 40B	SCREW-SOC SET-STL-BO-CUP	1

i20697-7

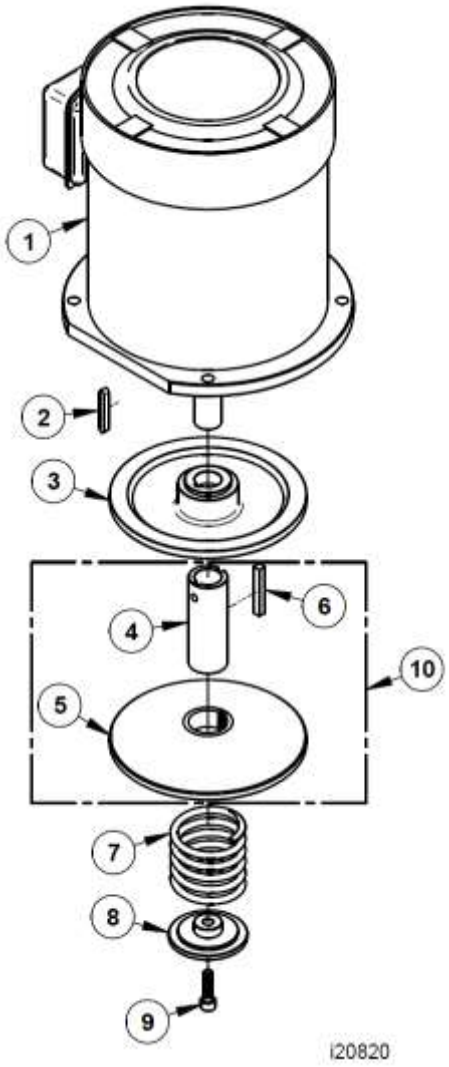


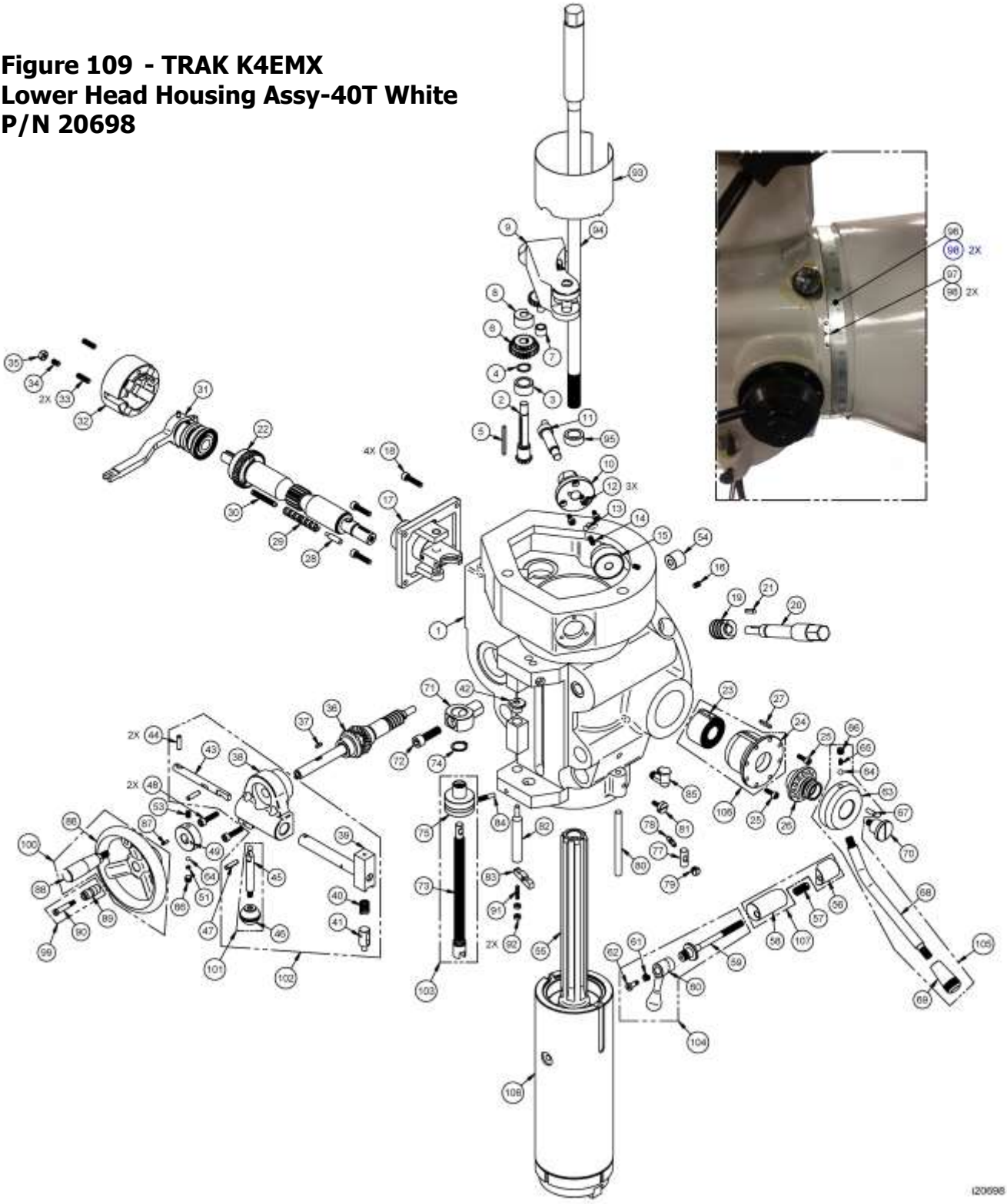
Figure 108 & Parts List Shown - TRAK K4EMX –

Spindle Motor Assembly - P/N 20820

Item	P/N	Title	Qty
1	FVS110	MOTOR 5 HP	1
2	FVS3-1	KEY 6x6x45L	1
3	FVS2	STATIONARY MOTOR VARIDISC	1
4	FVS6	BUSHING	1
5	FVS5	ADJUSTABLE MOTOR VARIDISC	1
6	FVS6-1	KEY 7x7x50L	1
7	FVS8	SPRING FOR VARIDISC MOTOR SHAFT	1
8	FVS9	ADJUSTABLE VARIDISC SPRING COLLAR	1
9	FVS10	SCREW- SOC HD CAP M8-P1.25x30L	1
10	24054	ADJUSTABLE MOTOR VARIDISC ASSY	(1)

i20820

Figure 109 - TRAK K4EMX
Lower Head Housing Assy-40T White
P/N 20698



Parts List - TRAK K4EMX - Lower Head Housing Assy-40T -White P/N 20698 (Figure 109)

Item	P/N	Title	Qty
1	FB192	QUILL HOUSING	1
2	FB31	CLUSTER GEAR SHAFT	1
3	FB33	BEVEL GEAR BEARING	1
4	FB94	SNAP RING 95 DOWEL PIN Ø 14	1
5	FB29	CLUSTER GEAR KEY 3x3x45L	1
6	FB28	CLUSTER GEARS ASSEMBLY	1
7	FB41	NEEDLE BEARING KO-BA66Z	1
8	FB27	CLUSTER GEAR SHAFT UPPER BEARING	1
9	20698-1	FRU-SK4-4VK-H1 WORM GEAR CRADLE SUB-ASSY	1
10	FB19	SHIFT SLEEVE	1
11	FB18	WORM GEAR CRADLE THROW-OUT	1
12	FB20	CAP SCREW M5-P0.8x12L	3
13	FB24	STEEL BALL	1
14	FB25-A	SPRING	1
15	FB23	SHIFT CRANK	1
16	FB68	SET SCREW M6-P1.0x8L	1
17	20698-2	QUILL FEED SELECTOR ASSY	1
18	FB67	CAP SCREW M6-P1.0x18L	4
19	FB186	WORM GEAR	1
20	FB189	ADJ WORM SHAFT	1
21	FB187	KEY 4x4x18L	1
22	20698-3	QUILL PINION SHAFT ASSY-40 TAPER	1
23	FB178	CLOCK SPRING (CLOCK SPRING ASSY.)	1
24	FB177	SPRING COVER	1
25	M8-1.25X20	SCREW-SHCS-STL-BO	2
26	FB176	PINION SHAFT HUB SLEEVE	1
27	FB171	KEY 3x3x20L	1
28	FB89	OVERLOAD CLUTCH LEVER SPRING PLUNGER	1
29	FB88	COMPRESSION SPRING	1
30	FB88-1	INTERNAL COMPRESSION SPRING	1
31	20698-4	OVERLOAD CLUTCH TRIP ASSY	1
32	FB99	CLUTCH ARM COVER	1
33	FB73	CAP SCREW M5-P0.8x40L	2
34	FB100	SOCKET SET SCREW M6-P1.0x20L	1
35	FB101	CHEM BLACKED LOCKNUT M6-P1.0	1
36	20698-5	FEED REVERSE CLUTCH ASSY	1
37	FB109	KEY 3x3x20L	1

Parts List - TRAK K4EMX - Lower Head Housing Assy-40T -White - P/N 20698 (Figure 109)			
38	FB106	FEED TRIP BRACKET	1
39	FB118	CAM ROD SLEEVE ASSY.	1
40	FB120	COMPRESSION SPRING	1
41	FB121	TRIP PLUNGER	1
42	FB123	TRIP PLUNGER BUSHING	1
43	FB103	CAM ROD	1
44	FB117	ROLL PIN Ø 3x15L	2
45	FB104	TRIP HANDLE	1
46	FB105	BLACK PLASTIC BALL	1
47	FB119-1	ROLL PIN Ø 3x20L	1
48	FB107	CAP SCREW M6-P1.0x25L	2
49	FB113	HAND WHEEL CLUTCH	1
51	FB115	COMPRESSION SPRING	1
53	FB108	SET SCREW M6-P1.0x8L	1
54	FB42	BUSHING	1
55	20836-1	SPINDLE ASSY-K4	1
56	FB148	QUILL LOCK SLEEVE TAPPED	1
57	FB148-1A	COMPRESSION SPRING	1
58	FB153	QUILL LOCK SLEEVE	1
59	FB152	QUILL LOCK BOLT	1
60	FB149	LOCK HANDLE	1
61	FB149-1	CONICAL COMPRESSIONAL SPRING	1
62	FB149-2	SCREW- PHILLIP HD	1
63	FB175	RACK FEED HANDLE HUB	1
64	FB114	STEEL BALL	2
65	FB175-2A	COMPRESSION SPRING	1
66	FB116	HANDWHEEL CLUTCH SPRING SCREW M8-P1.25x6L	1
67	FB175-3	DOWEL PIN	1
68	FB190	PINION SHAFT HUB HANDLE	1
69	FB191	PLASTIC BALL HANDLES	1
70	FB169	PINION SHAFT HUB SCREW	1
71	FB163	QUILL STOP KNOB	1
72	FB200	SCREW- SOC HD 3/8-24NF x 1 1/4	1
73	FB164	QUILL STOP MICRO-SCREW	1
74	FB160	SNAP RING Ø16	1
75	FB161	QUILL MICRO-STOP NUT	1
76	FB162	MICROMETER NUT	1
77	FB184	FEED REVERSE TRIP PLUNGER	1
78	FB183	REVERSE TRIP BALL LEVER	1
79	FB185	REVERSE TRIP BALL LEVER SCREW	1

Parts List - TRAK K4EMX - Lower Head Housing Assy-40T -White - P/N 20698 (Figure 109)			
80	FB202	INDICATOR ROD	1
81	FB201	INDICATOR ROD SCREW	1
82	FB124	FEED TRIP PLUNGER	1
83	FB145	FEED TRIP LEVER	1
84	FB144	SOCKET SET SCREW	1
85	OIL-1	FRU-K3-OIL CUP	1
86	FB125	HANDWHEEL	1
87	FB125-1	HANDWHEEL SPRING PIN - Ø 3x3x10L	1
88	FB125-2	HANDWHEEL HANDLE	1
89	FB111	REVERSE KNOB	1
90	FB126	CAP SCREW M6-P1.0x35L	1
91	FB124-1	FEED TRIP PLUNGER SOC SET SCREW M4-P0.7x20L	1
92	FB124-2	FEED TRIP PLUNGER NUT M4-P0.7x20L	2
93	FB128	QUILL SKIRT	1
94	FVS109	DRAWBAR-MANUAL-K4, DPM3/DPM5 (TOP ONE)	1
95	FVS109-1	SPACER	1
96	25041	SCALE-HEAD ROTATION-NT40	1
97	25043	POINTER SCALE	1
98	25044	DRIVE SCREW-SCALE	4
99	20834	FRU-SK2/SK3-FEED REVERSE KNOB ASSY	1
100	20835	FRU-SK2/SK3-HANDWHEEL ASSY	(1)
101	24099	TRIP HANDLE ASS'Y (INCLUDES PLASTIC BALL)	(1)
102	20833	FRU-K4-FEED TRIP ASSY	(1)
103	20847	QUILL MICRO NUT & SCREW ASSY	(1)
104	20846	FRU-SK2/SK3-QUILL LOCK HANDLE ASSY	(1)
105	20850	FRU-SK4-FEED HANDLE ASSY	(1)
106	24095	CLOCK SPRING ASSEMBLY (SPRING & COVER)	(1)
107	20844	FRU-SK2/SK3-QUILL LOCK SLEVE ASSY	(1)
108	FB142	QUILL	(1)
109	A071	T-BOLT ASSY	(1)

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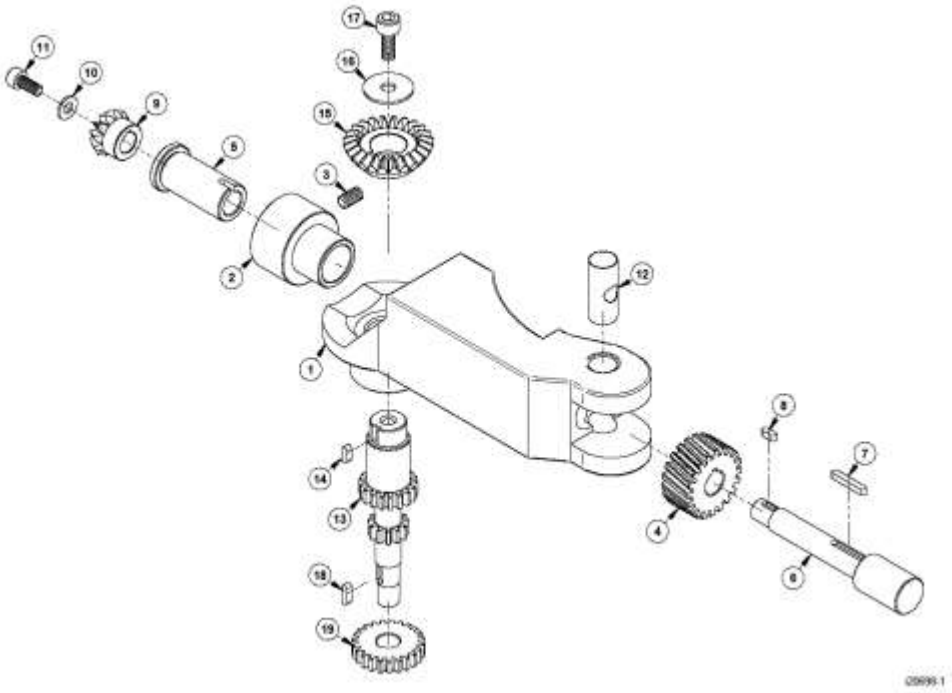
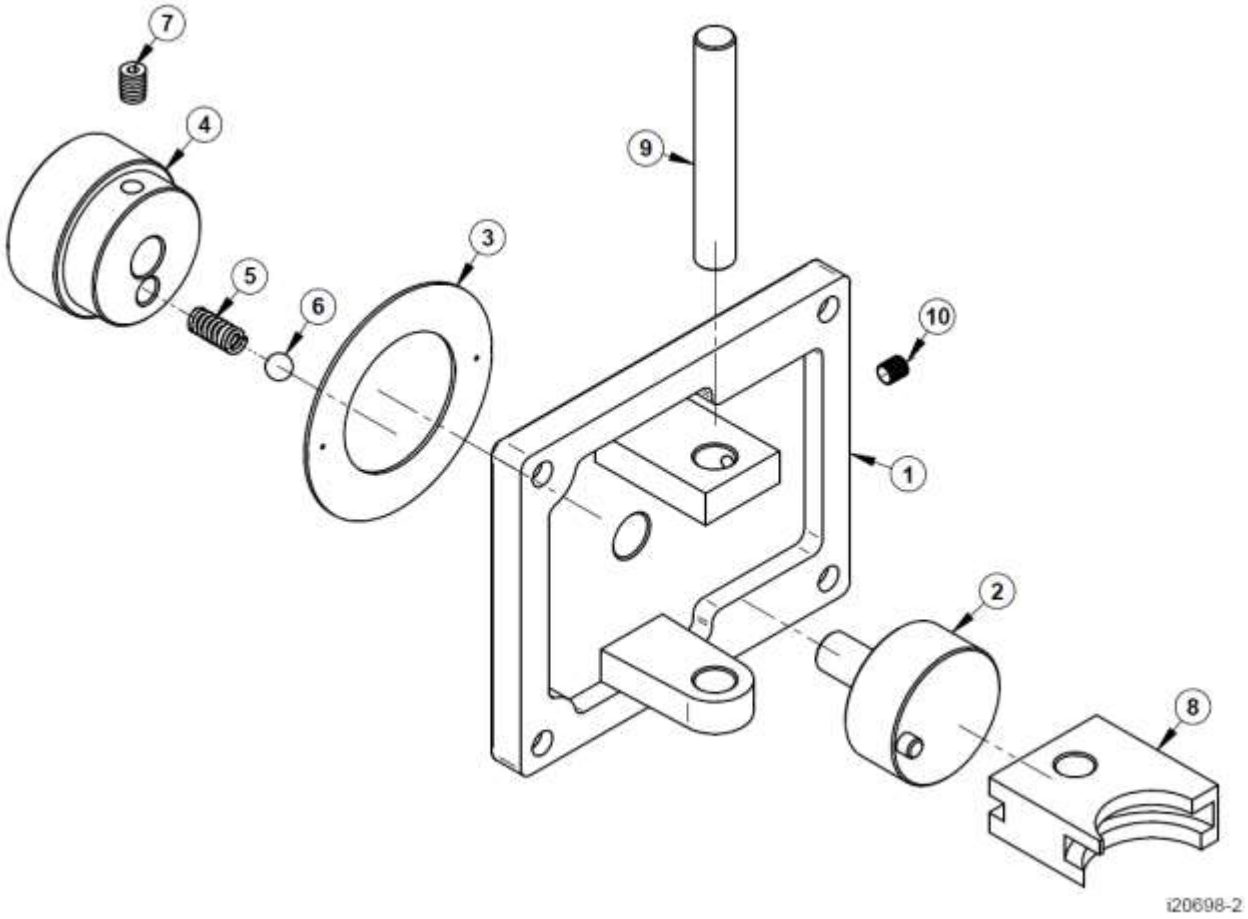


Figure 110 & Parts List Shown - TRAK K4EMX Worm Gear Cradle Assy- P/N 20698-1

Item	P/N	Title	Qty
1	FB17	WORM GEAR CRADLE	1
2	FB5	WORM CRADLE BUSHING	1
3	FB6	SETSCREW M6-PP1.0x10L	1
4	FB8	FEED DRIVEWORM GEAR	1
5	FB4	FEED WORM GEAR SHAFT SLEEVE	1
6	FB9	FEED DRIVE WORM GEAR SHAFT	1
7	FB11	KEY 3x3x20L	1
8	FB10	WORM SHAFT KEY 3x3x8L	1
9	FB3	FEED BEVEL PINION	1
10	FB2	BEVEL PINION WASHER Ø 5	1
11	FB1	SOC.HD.SCREW M5-P0.8x10L	1
12	FB16	FEED ENGAGE PIN	1
13	FB36	FEED DRIVING GEAR	1
14	FB36-1	KEY 3x3x8L	1
15	FB15	FEED REVERSE BEVEL GEAR	1
16	FB13	WASHER Ø 6 Ø 22	1
17	FB14	SOC HD SCREW M6-P1.0x15L	1
18	FB37	KEY 3x3x10L	1
19	FB40	FEED DRIVE GEAR	1

i20698-1



Item	P/N	Title	Qty
1	FB66	CLUSTER GEAR COVER	1
2	FB64	CLUSTER GEAR SHIFT CRANK	1
3	FB69-	DIAL	1
4	FB69	SHIFT KNOB	1
5	FB71	SPRING	1
6	FB70	STEEL BALL	1
7	FB68	SET SCREW M6-P1.0x8L	1
8	FB63	FEED GEAR SHIFT FORK	1
9	FB60	FEED SHIFT ROD	1
10	FB61	KP.SET SCREW M5-P0.8x6L	1

i20698-2

Figure 111 & Parts List Shown - TRAK K4EMX –

Quill Feed Selector Assembly - P/N 20698-2

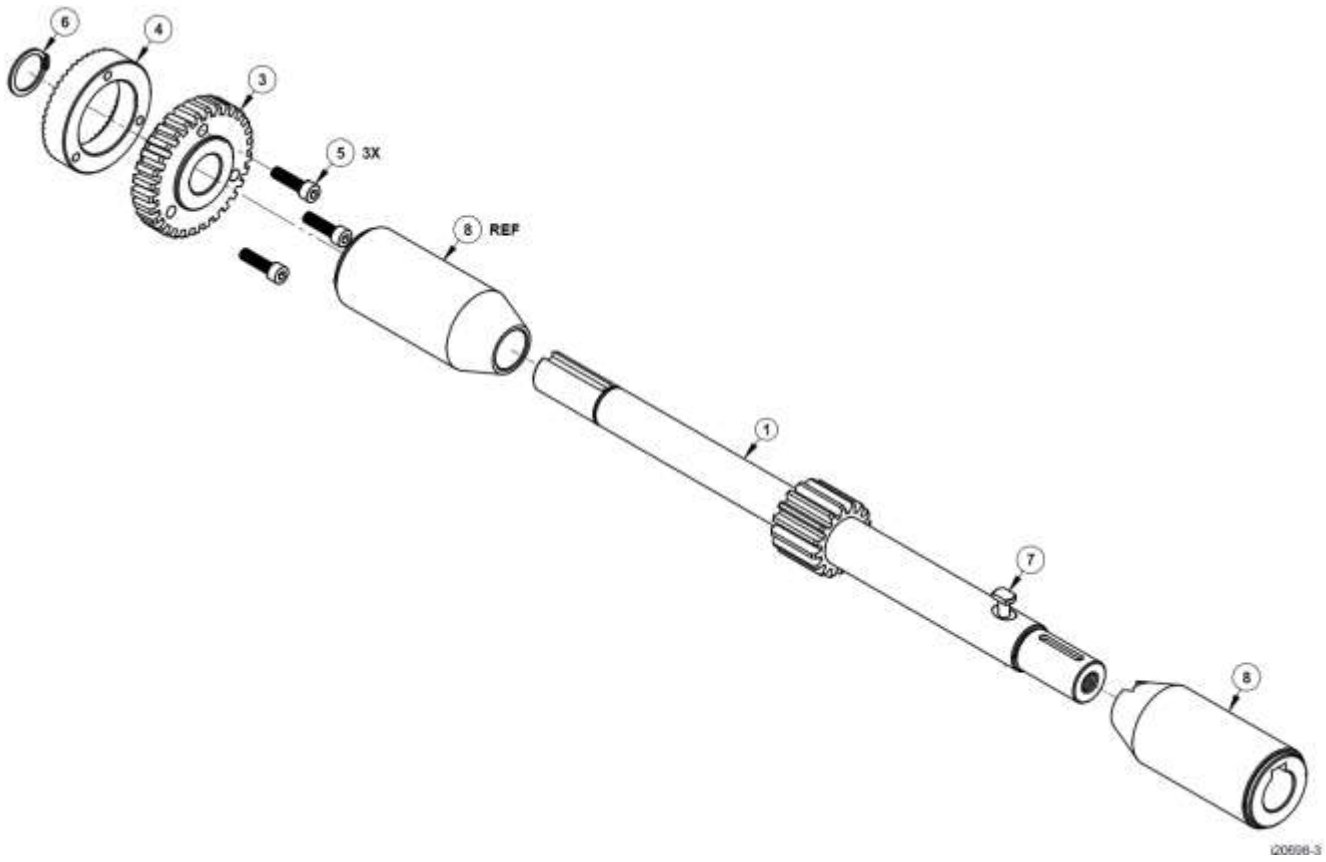


Figure 112 & Parts List Shown - TRAK K4EMX - Quill Pinion Shaft Assy - P/N: 20698-3

Item	P/N	Title	Use As	Qty
1	FB166	QUILL PINION SHAFT	EA	1
3	K-B92	OVERLOAD CLUTCH WORM GEAR	EA	1
4	K-B93	OVERLOAD CLUTCH RING	EA	1
5	K-B92-1	SCREW SOC HD CAP M4-P0.7x15L	EA	3
6	K-B94	SNAP RING 95 DOWEL PIN Ø 14	EA	1
7	K-B168	SCREW PIN	EA	(1)
8	25707	BUSHING KIT-PINION SHAFT-40 TAPER	EA	1

i20698-3

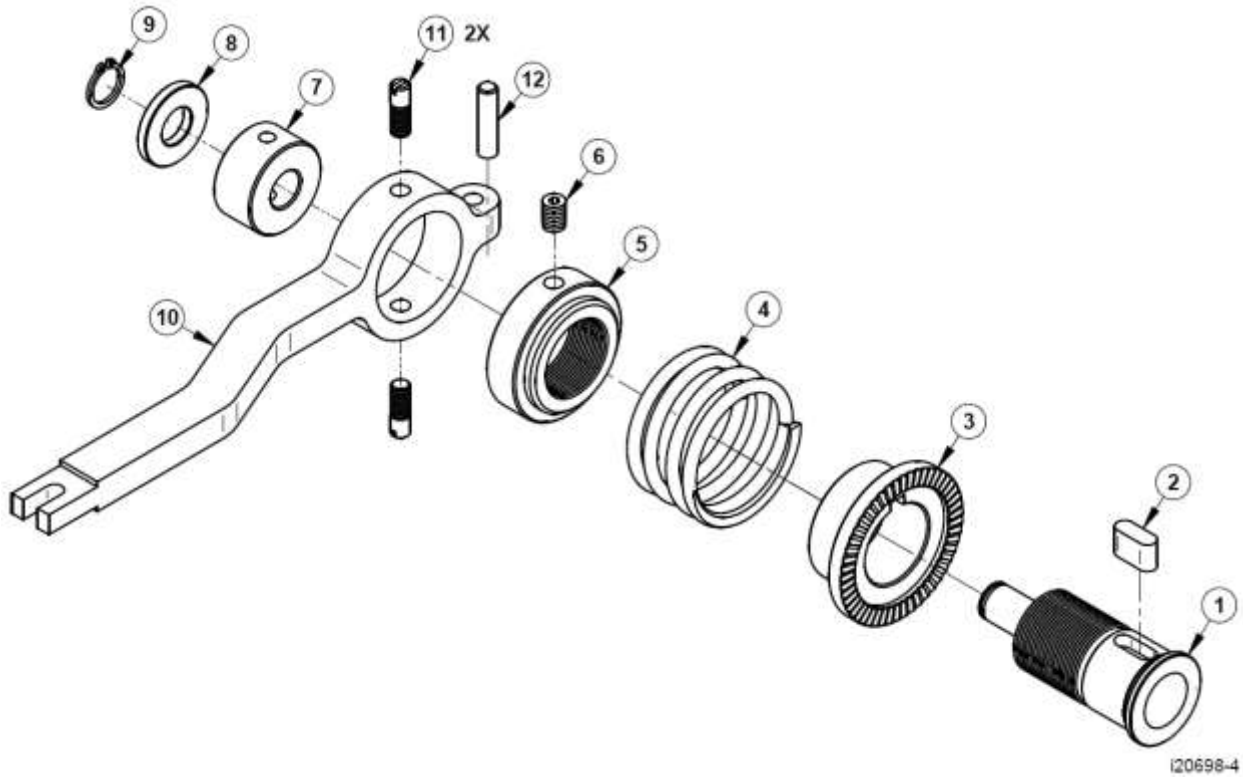


Figure 113 & Parts List Shown - TRAK K4EMX

Overload Clutch Trip Assy – P/N 20698-4

Item	P/N	Title	Qty
1	FB81	OVERLOAD CLUTCH SLEEVE	1
2	FB81-1	KEY 5x8x13L	1
3	FB80	OVERLOAD CLUTCH	1
4	FB79	SAFETY CLUTCH SPRING	1
5	FB78	OVERLOAD CLUTCH LOCKNUT	1
6	FB76	SOCKET SET SCREW M6-P1.0x8L	1
7	FB75	CLUTCH RING	1
8	FB97	OVERLOAD CLUTCH WASHER	1
9	FB98	SNAP RING Ø 10	1
10	FB96	OVERLOAD CLUTCH TRIP LEVER	1
11	FB74	CLUTCH RING PIN (2REQ.)	2
12	FB77	BRASS PLUG	1

i20698-4

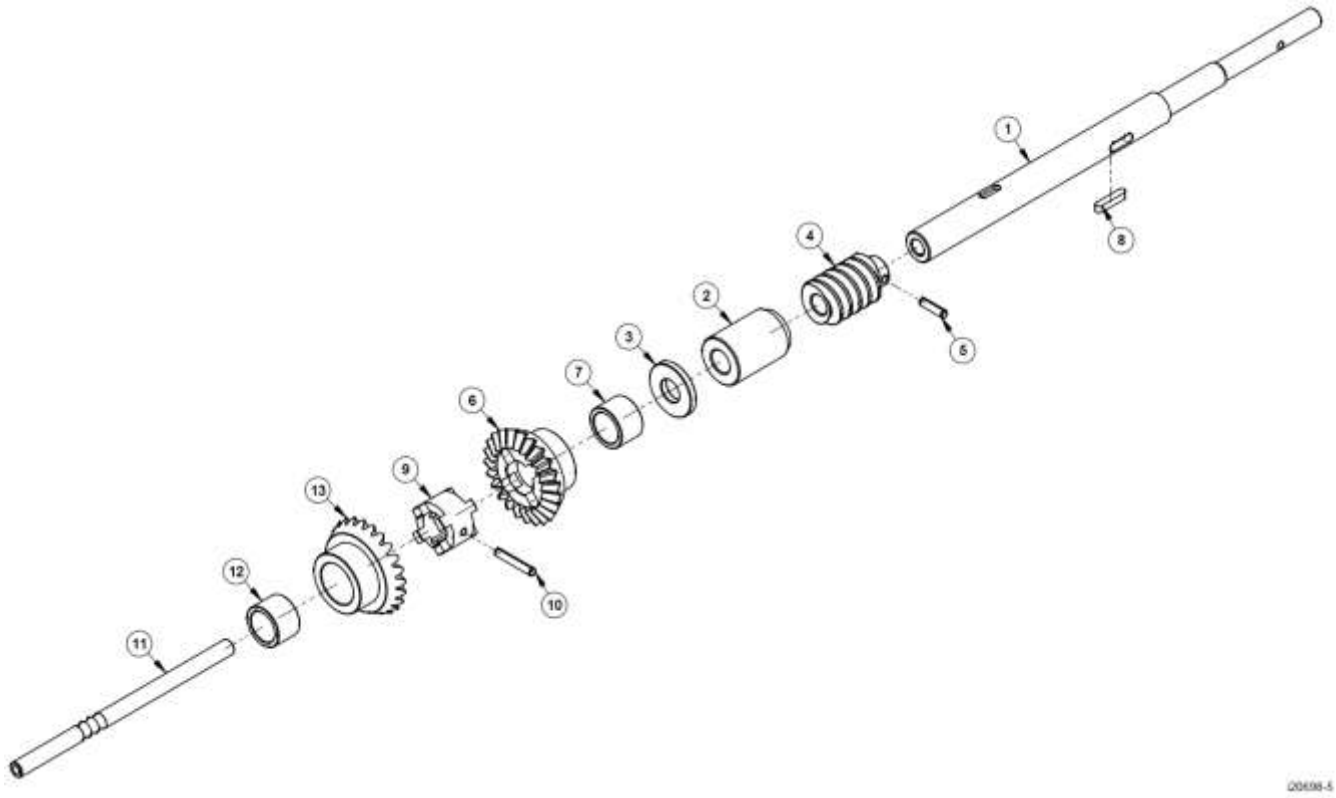


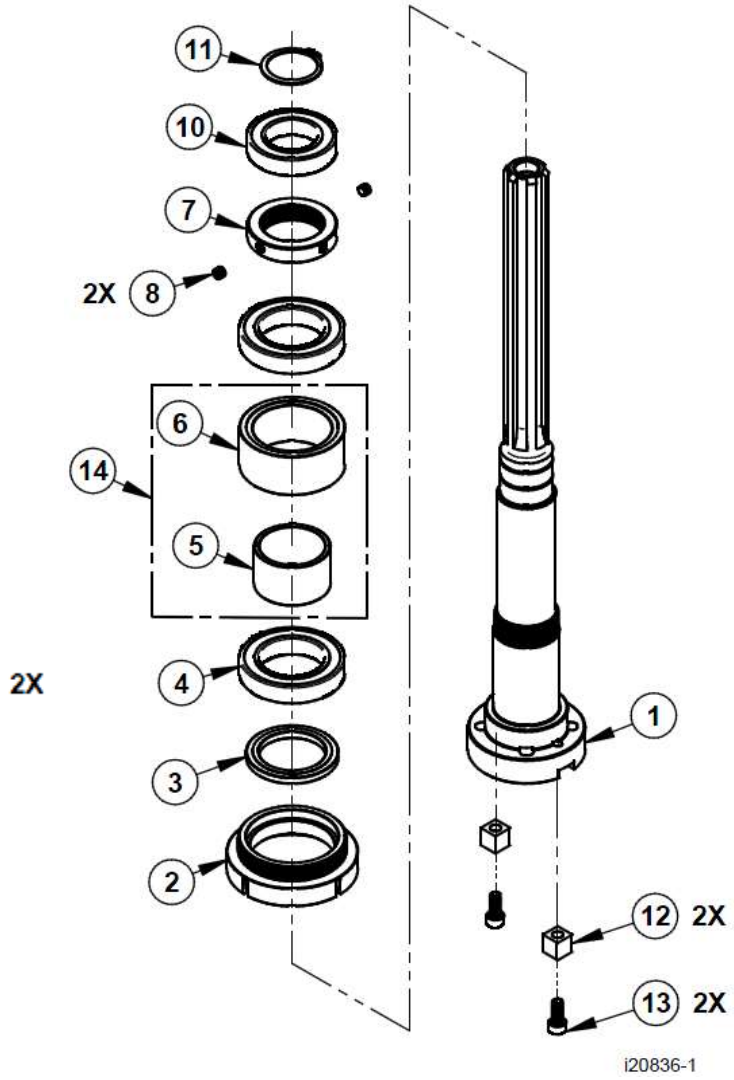
Figure 114 & Parts List Shown - TRAK K4EMX –
Feed Reverse Clutch Assembly – P/N 20698-5

Item	P/N	Title	Qty
1	FB57	FEED WORM SHAFT	1
2	FB44	FEED WORM SHAFT BUSHING	1
3	FB47	FEED WORM SHAFT THRUST WASHER	1
4	FB43	WORM	1
5	FB59	PIN Ø 3x12L	1
6	FB49	FEED REVERSE BEVEL GEAR	1
7	FB48	BUSHING	1
8	FB62	KEY 3x3x15L	1
9	FB50	FEED REVERSE CLUTCH	1
10	FB50-	PIN Ø 3x19L	1
11	FB55	REVERSE CLUTCH ROD	1
12	FB52	BUSHING	1
13	FB51	FEED REVERSE BEVEL GEAR	1

i20698-5

Figure 115 & Parts List Shown –

TRAK K4EMX Spindle Assy
P/N 20836-1

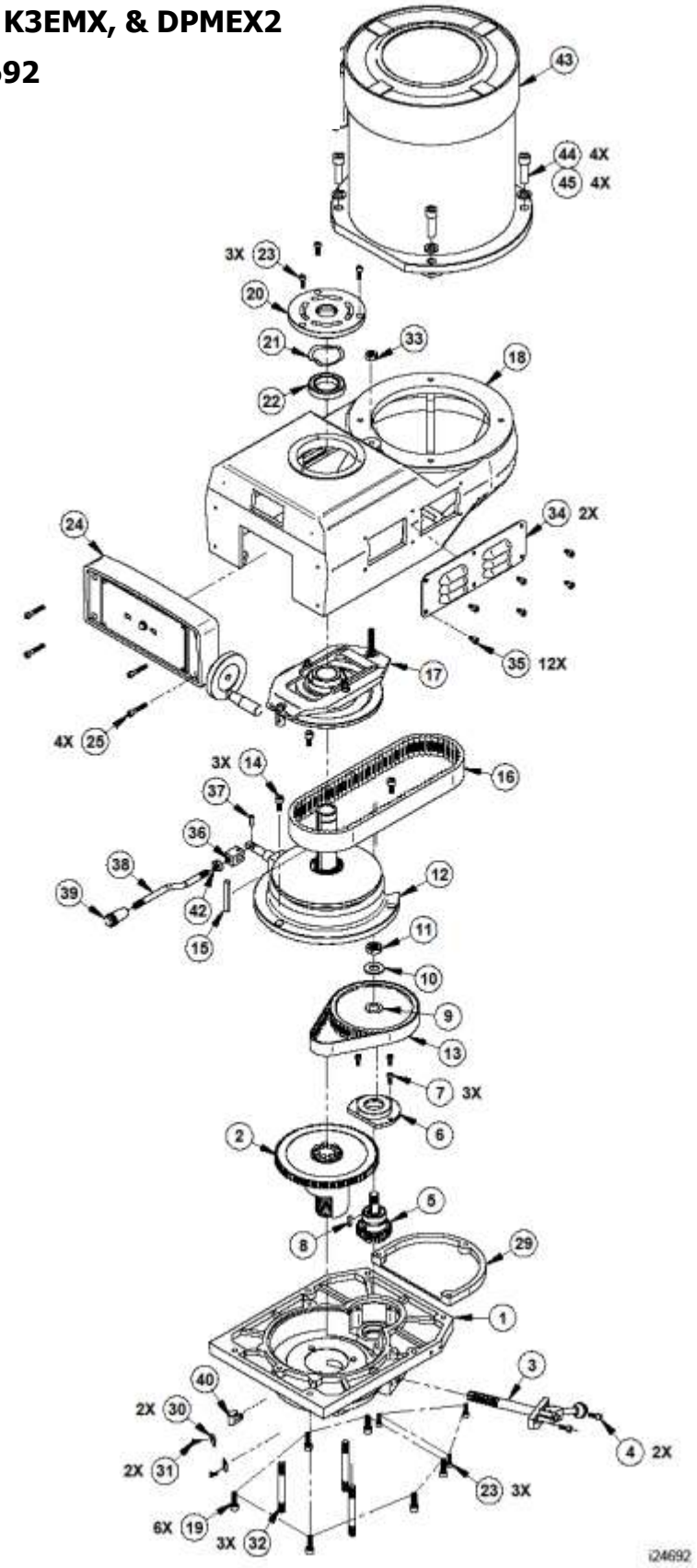


Item	P/N	Title	Qty
1	FB127	SPINDLE BT-40	1
2	FB133	NOSE-PIECE	1
3	FB134	SPINDLE DIRT SHIELD	1
4	20839	BEARING-ANGULAR CONTACT U/ SET (2)-	1
5	FB136	BEARING SPACER-LARGE	1
6	FB137	BEARING SPACER-SMALL	1
7	FB139	SPINDLE BEARING LOCK NUT	1
8	FB139-	SET SCREW M8-P1.25x6L	2
10	26392	BEARING-DEEP GROOVE-6008ZZ	1
11	FB143	LOCK RING Ø 40	1
12	FB140	SPINDLE FIXED NUT	2
13	FB141	COLLET ALIGNMENT SCREW M8-P1.25x20L	2
14	20841	BEARING SPACER SET	(1)

i20836-1

Figure 118 – TRAK K2EMX, K3EMX, & DPMEX2

Upper Head Assy - P/N 24692



Parts List – K2EMX, K3EMX & DPMEX2 – Top Housing Assy - P/N 24692 (Figure 118)

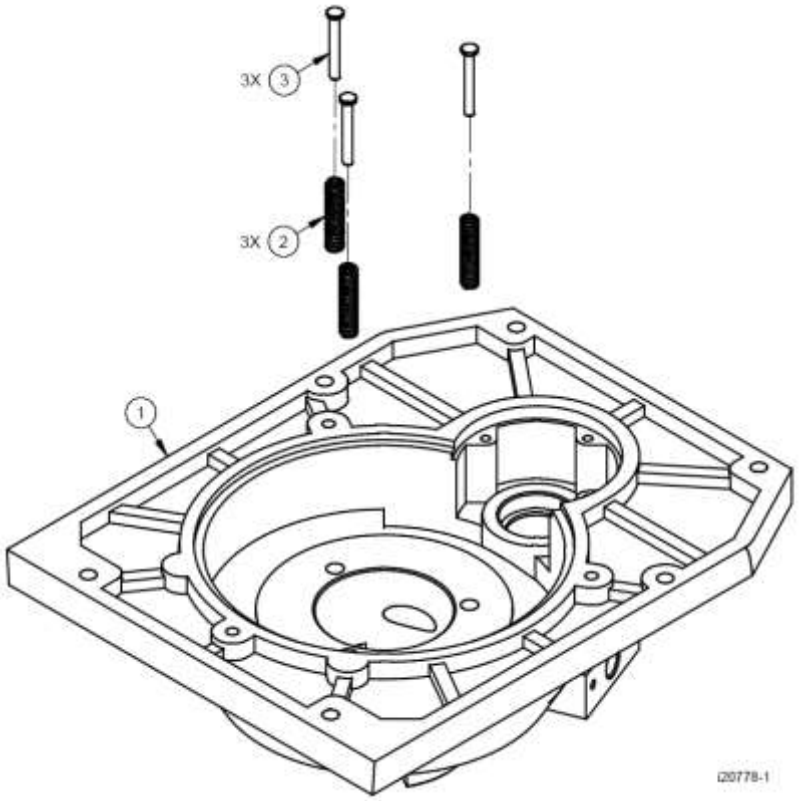
Item	P/N	Title	Qty
1	20778-1	FRU-SK3 3VK-VS1 GEAR HOUSING SUB-ASSY	1
2	20778-2	FRU-SK3-3VK-VS2 HI-LOW SHIFT CLUTCH SUB-ASSY	1
3	20778-3	HI-LOW SHIFT ASSY	1
4	VS12	FRU-K3-SOCKET CAP SCREW M6-P1.0x15L	2
5	20778-4	FRU-SK3-PULLY PINION SUB-ASSY (3VK-A4)	1
6	VS64	FRU-K3-BULL GEAR PINION BEARING CAP	1
7	VS93	FRU-K3-SCREW M5-P0.8x15L	3
8	VS117	FRU-K3-KEY 5x525L	1
9	VS62	FRU-K3-TIMING BELT PULLEY	1
10	VS126	FRU-K3-WASHER Ø 5/8	1
11	VS61	FRU-K3-JAM NUT 5/8-11NC	1
12	20778-5	FRU-SK3-LOWER VARI-DISC DRIVE SUB-ASSY (3VK-A5)	1
13	VS63	FRU-K3-BELT 3/8"-#225	1
14	VS14-1	FRU-K3-SCREW M8-P1.25x18L	3
15	VS135	FRU-K3-KEY 8x7x60L	1
16	VS4	FRU-K3-BELT	1
17	20778-6	UPPER VARI ASSY-DISC DRIVE-R8	1
18	VS1	FRU-K3-BELT HOUSING	1
19	VS137	FRU-K3-SOCKET CAP SCREW M8-P1.25x25L	6
20	VS13	FRU-K3-TOP BEARING CAP	1
21	VS13-1	FRU-K3-WAVE WASHER	1
22	VS15	BEARING-DEEP GROVE-6007V	1
23	VS129	FRU-K3-SCREW- SOC HD CAP M6-P1.0x18L	6
24	20778-7	SPEED CHANGE HANDWHEEL-ASSY-R8	1
25	VS07	FRU-K3-SCREW- SOC HD CAP M6-P1.0x35L	4
29	VS11	FRU-K3-MOTOR PULLEY COVER	1
30	VS104	FRU-K3-COPPER CHIP(2REQ.)	2
31	VS131	FRU-K3-SCREW- FLAT HD PHILIP M5-P0.8x10L	2
32	VS132	FRU-K3-STUD Ø 7/16-100L	3
33	VS96	FRU-K3-JAM NUT 3/8"-16NC	1
34	VS101	FRU-K3-VENTILATOR(2REQ.)	2
35	VS136	FRU-K3-SCREW- SOC HD CAP M6-P1.0x10L	12
36	VS54	FRU-K3-HANDLE FIX BLOCK	1
37	VS55	FRU-K3-SET SCREW	1
38	VS56	FRU-K3-BRAKE LOCK HANDLE	1
39	VS57	FRU-K3-BAKELITE BALL HANDLE	1
40	OIL-1	FRU-K3-OIL CUP	1
41	20817	FRU-SK2/SK3-BEARING SPACER	1

42	VS52-1	FRU-K3-NUT	1
43	20819	MOTOR ASSY-K2 & K3-3HP	(1)
44	VS130	FRU-K3-WASHER- FLAT Ø 10.2	(4)
45	VS111	FRU-K3-SOC HD SCREW- 3/8-16NCx32L	(4)

i24692

Figure 119 & Parts List Shown –

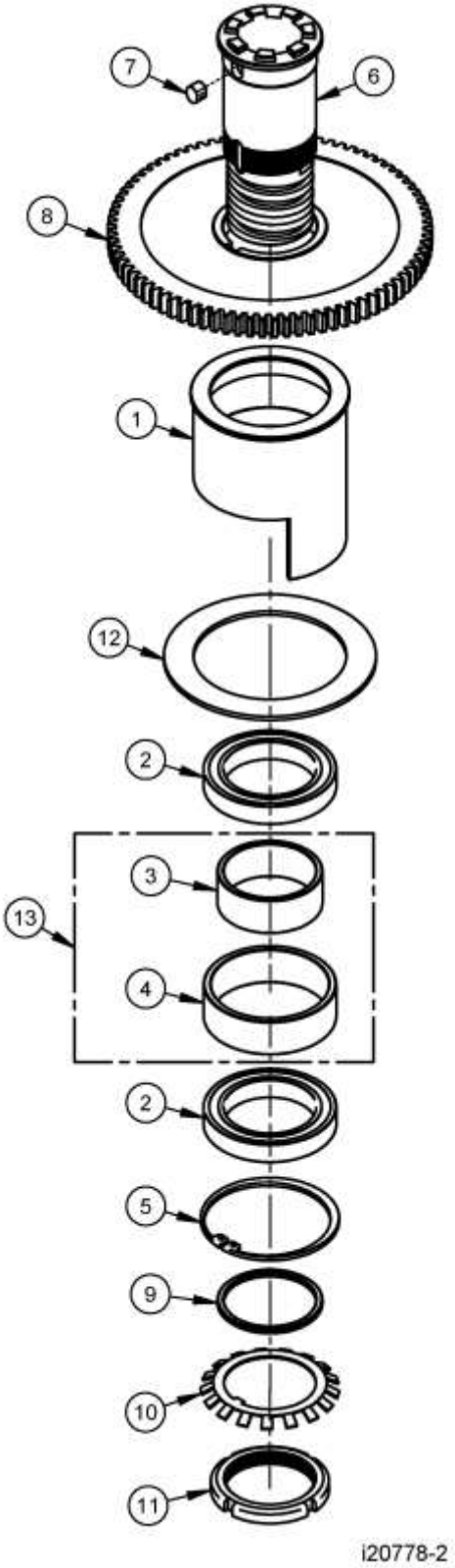
K2EMX, K3EMX & DPMEX2 – Gear Housing Assy - P/N: 20778-1



Item	P/N	Title	Qty
1	VS82	FRU-K3-GEAR HOUSING	1
2	VS112	FRU-K3-GUIDE SPRING	3
3	VS113	FRU-K3-SPRING GUIDE PIN	3

I20778-1

Figure 120 – K2EMX, K3EMX & DPMEX2 – Hi-Low Shift Clutch Assy – P/N 20778-2



Parts List – K2EMX, K3EMX & DPMEX2 –

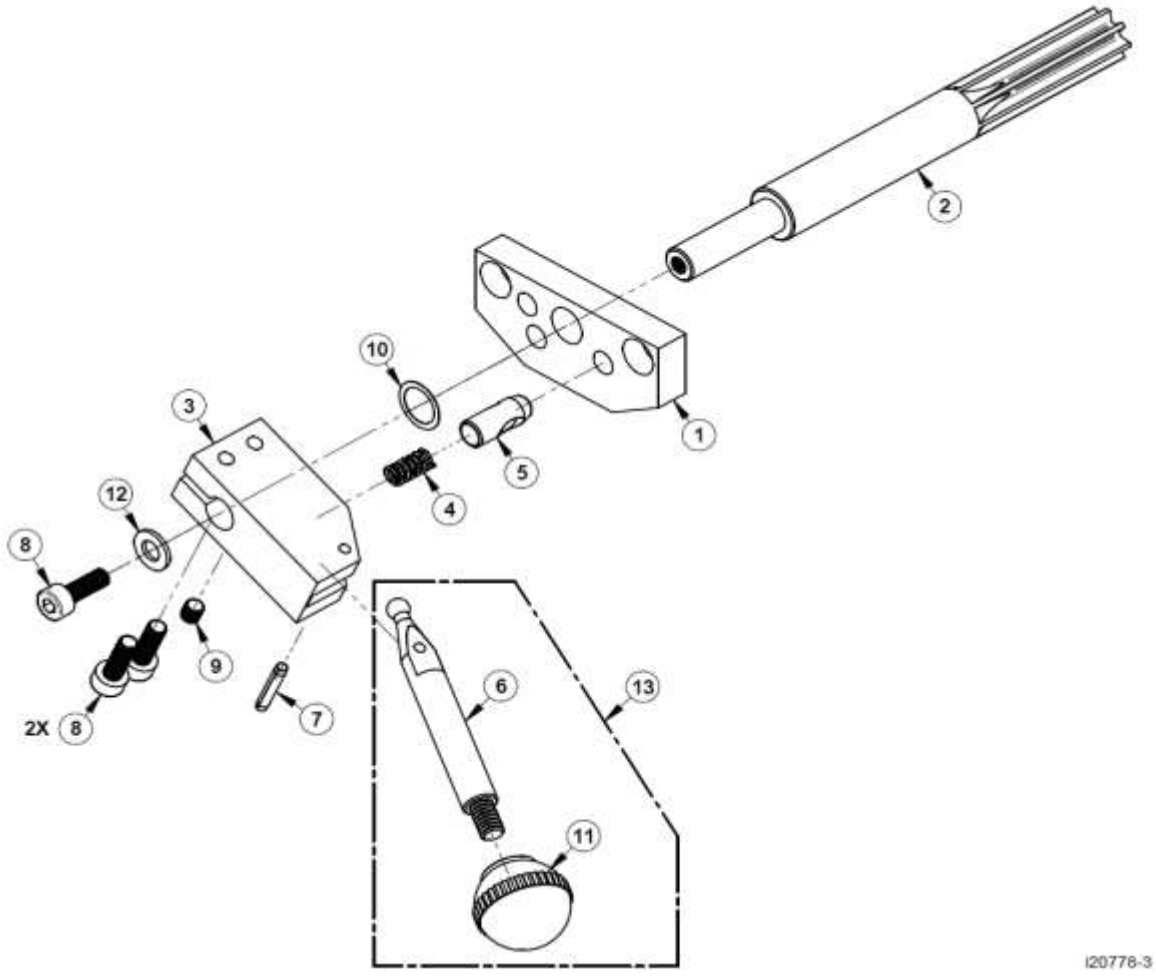
High-Low Shift Clutch Assy - P/N: 20778-2 (Figure 120)

Item	P/N	Title	Qty
1	VS75	FRU-K3-BEARING SLEEVE	1
2	VS77	FRU-K3-BALL BEARING (2 REQ.) 6908ZZ	2
3	VS78	FRU-K3-BEARING SPACER	1
4	VS79	FRU-K3-BEARING SPACER	1
5	VS80	FRU-K3-SNAP RING R-65	1
6	VS73	FRU-K3-SPLINED GEAR HUB	1
7	VS72	FRU-K3-KEY 8x7x10L	1
8	VS74	FRU-K3-SPINDLE BULL GEAR	1
9	VS114	FRU-K3-WASHER	1
10	VS115	FRU-K3-EXTERNAL TOOTH WASHER Ø 40	1
11	VS81	FRU-K3-LOCK WASHER Ø 9/16-18NC	1
12	VS76	FRU-K3-RING	1
13	20817	BEARING SPACER ASSY	(1)

i20778-2

Figure 121 & Parts List Shown – K2EMX, K3EMX & DPMEX2 –

Hi-Low Shift Assy - P/N: 20778-3



Item	P/N	Title	Qty
1	VS89	FRU-K3-HI-LOW DETENT PLATE	1
2	VS87	FRU-K3-CLUTCH GEAR SHAFT	1
3	VS92	FRU-K3-HI-LOW PINION BLOCK	1
4	VS91	FRU-K3-SPRING	1
5	VS90	FRU-K3-HI-LOW DETENT PLUNGER	1
6	VS94	FRU-K3-HI-LOW SHAFT CRANK	1
7	VS88	FRU-K3-PIN Ø 3X19L	1
8	VS93	FRU-K3-SCREW M5-P0.8x15L	3
9	VS92-1	FRU-K3-SET SCREW M5-P0.8x5L	1
10	VS92-2	FRU-K3-WASHER- FLAT Ø 11	1
11	VS57	FRU-K3-BAKELITE BALL HANDLE	1
12	VS116	FRU-K3-WASHER- FLAT Ø M5	1
13	24083	SHAFT-HI/LOW SHAFT ASSY	(1)

i20778-3

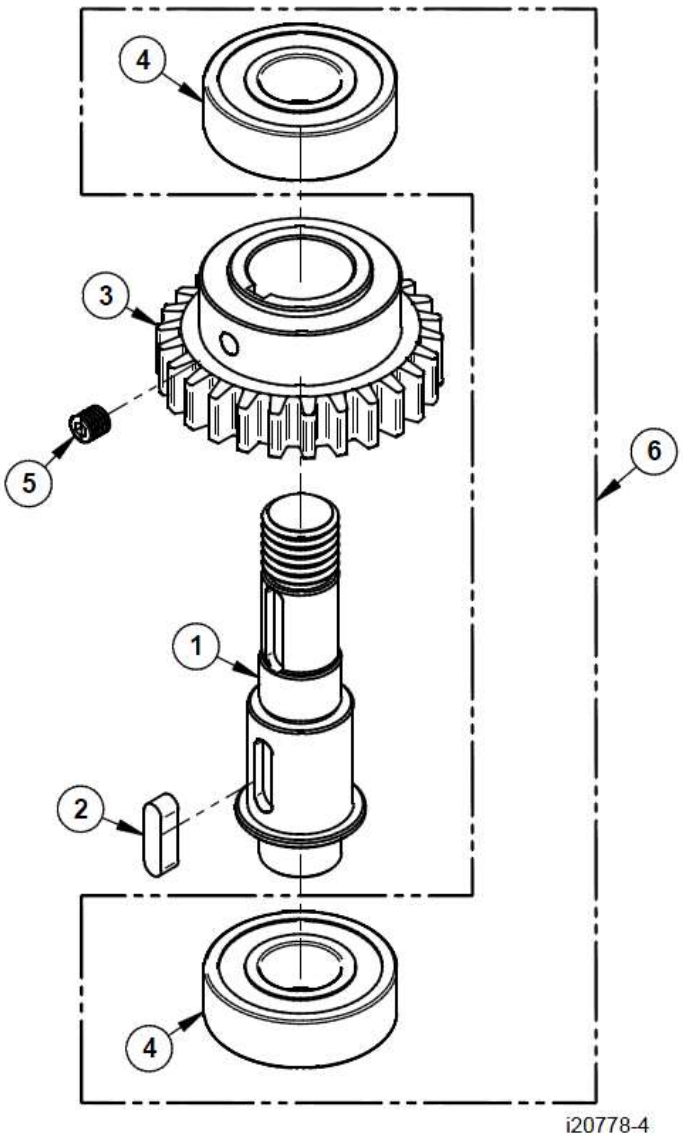
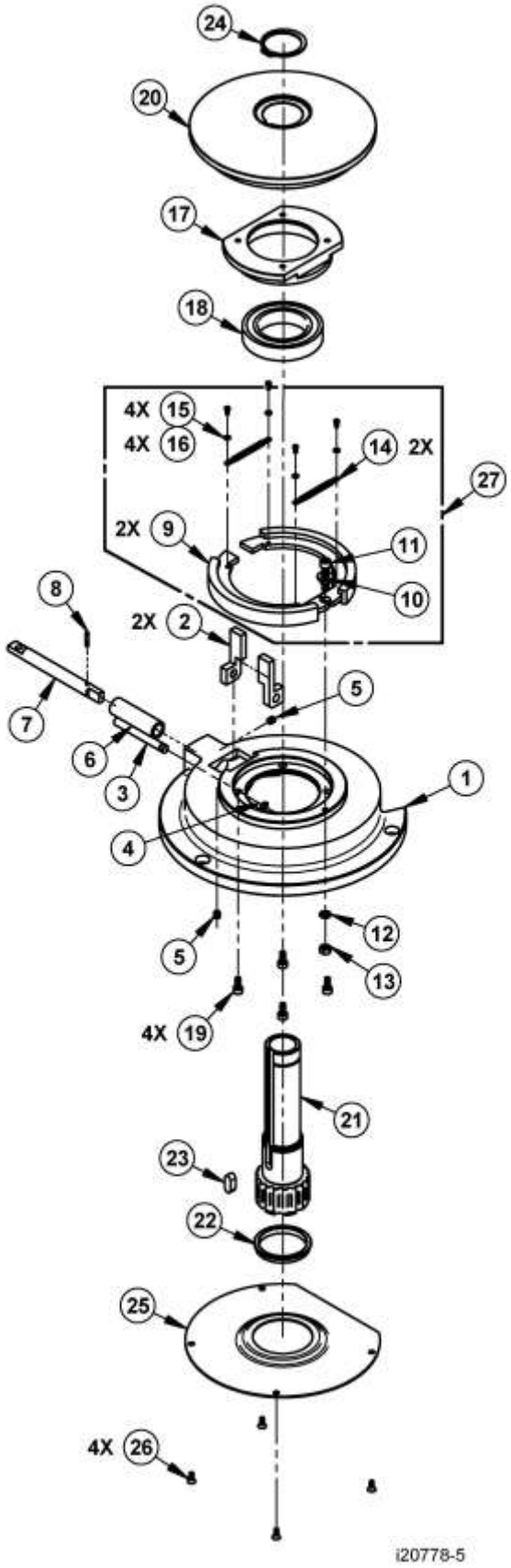


Figure 122 & Parts List Shown – K2EMX, K3EMX & DPMEX2 – Pulley Pinion Assy - P/N 20778-4

Item	P/N	DESCRIPTION	Qty
1	VS67	FRU-K3-BULL GEAR PINION COUNTER SHAFT	1
2	VS69	FRU-K3-KEY 5X5X18L	1
3	VS66	FRU-K3-BULL GEAR PINION	1
4	AK118	BEARING-DEEP GROOVE-6203ZZ	2
5	VS3	FRU-K3-SOCKET SET SCREW M6-P1.0x6L	1
6	23954	BEARING-DEEP GROOVE-SET (2)-6203ZZ	(1)

i20778-4

Figure 123 –
K2EMX, K3EMX & DPMEX2
Lower Vari-Disc Drive
P/N 20778-5 (Assembly not available, order parts separately)



Parts List – K2EMX, K3EMX & DPMEX2 –Lower Vari-Disc Drive Assy – P/N 20778-5 (Figure 123)

Item	P/N	Title	Qty
1	VS50	FRU-K3-BELT HOUSING BASE	1
2	VS59	FRU-K3-BRAKE BLOCK	2
3	VS58	FRU-K3-TURNING BLOCK SHAFT	1
4	VS103	FRU-K3-RETAINING RING Ø 7	1
5	VS51	FRU-K3-SET SCREW M6-1.0X6L	2
6	VS53	FRU-K3-BRAKE LOCK BUSHING	1
7	VS52	FRU-K3-BRAKE LOCK SHAFT	1
8	VS52-	FRU-K3-BRAKE LOCK PIN DIA 3 X 5/8"L	1
9	VS47	FRU-K3-BRAKE SHOE	2
10	VS48	FRU-K3-BRAKE SHOE PIVOT SLEEVE	1
11	VS17	FRU-K3-SOCKET CAP SCREW M6-P1.0x35L	1
12	VS17-	FRU-K3-WASHER Ø 6	1
13	VS17-	FRU-K3-NUT M6-P1.0	1
14	VS49	FRU-K3-BRAKE SPRING	2
15	VS122	FRU-K3-WASHER DIA 3.3	4
16	VS120	FRU-K3-SCREW-PAN HEAD PHILIP 5-40NC	4
17	VS46	FRU-K3-BRAKE BEARING CAP	1
18	VS43-	FRU-K3-BALL BEARING 6010ZZ	1
19	VS14	FRU-K3-SOCKET CAP SCREW M5-0.8x12L	4
20	VS45	FRU-K3-STATIONARY DRIVEN VARIDISC	1
21	VS70	FRU-K3-SPINDLE PULLY ASSY	1
22	VS100	FRU-K3-SPINDLE PULLY SPACER	1
23	VS71	FRU-K3-KEY 8x7x20L	1
24	VS97	FRU-K3-SNAP RING Ø 40	1
25	VS50-	FRU-K3-DUST COVER	1
26	VS50-	FRU-K3-SCREW-FH-PH-STL-BO M6-1.0X6L	4
27	24055	BRAKE SHOE ASSY	(1)

i20778-5

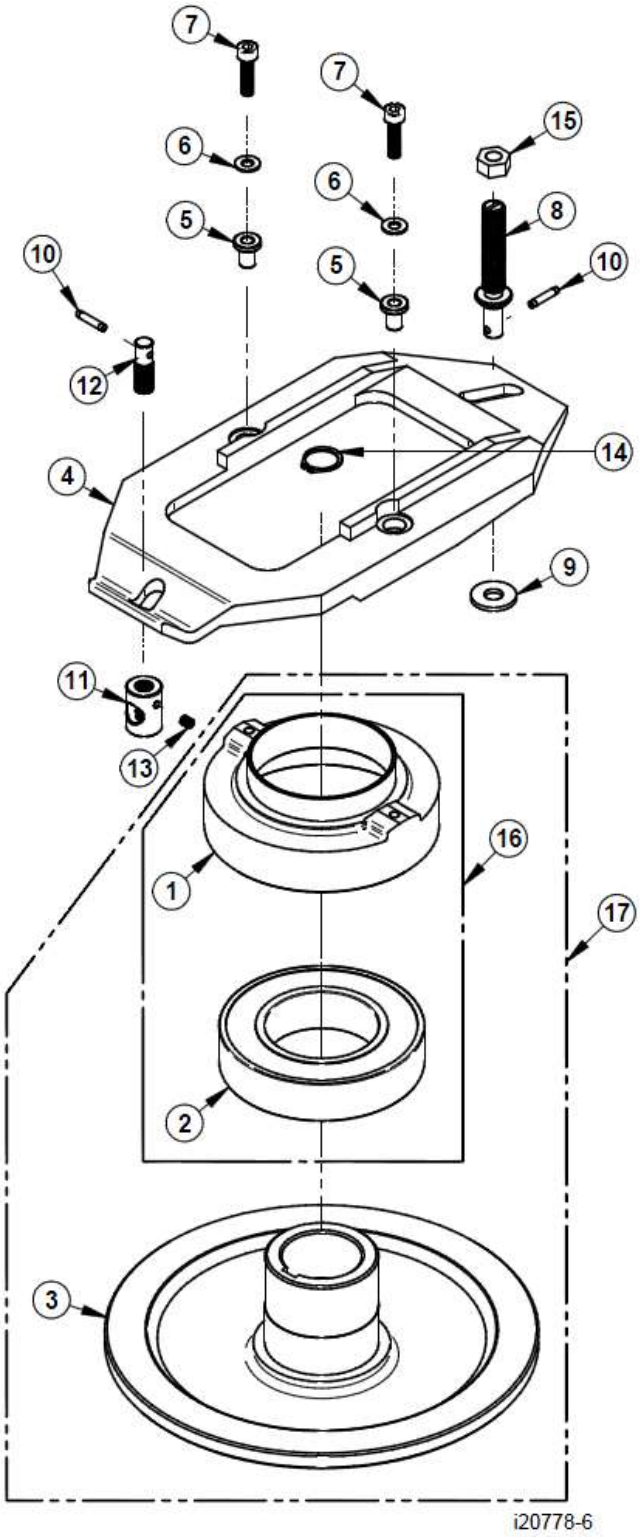


Figure 124 – K2EMX, K3EMX & DPMEX2 –Upper Vari-Disc Drive Assy – P/N 20778-6

Parts List – K2EMX, K3EMX & DPMEX2 – Upper Vari-Disc Drive Assy – P/N 20778-6 (Figure 124)

Item	P/N	Title	Qty
1	VS42	FRU-K3-SPINDLE PULLEY BEARING HOUSING	1
2	24643	BEARING-DEEP GROVE-6210ZZ	1
3	VS44	FRU-K3-ADJUSTABLE-DRIVEN VARIDISC	1
4	VS36	FRU-K3-SPEED CHANGE PLATE	1
5	VS38	FRU-K3-PIVOT SLEEVE Ø 5	2
6	VS37	FRU-K3-WASHER M5 P0.8X20L	2
7	VS123	FRU-K3-SCREW-SHCS M5-0.8X20L	2
8	VS39	FRU-K3-SPEED CHANGE PLATE PIVOT STUD	1
9	VS41	FRU-K3-WASHER Ø 8.2	1
10	VS40	FRU-K3-ROLL PIN Ø3x15L	2
11	VS35	FRU-K3-ADJUSTMENT NUT	1
12	VS34	FRU-K3-CHAIN END STUD	1
13	VS33	FRU-K3-CHAIN FRONT SCREW M4-P0.7x5L	1
14	VS7	FRU-K3-SNAP RING Ø 35	1
15	FVS96	JAM NUT 3/8-16NC	1
16	24564	BEARING HOUSING ASS'Y - K2/K3	(1)
17	24631	VARIDISC ASSY-ADJUSTABLE	(1)

i20778-6

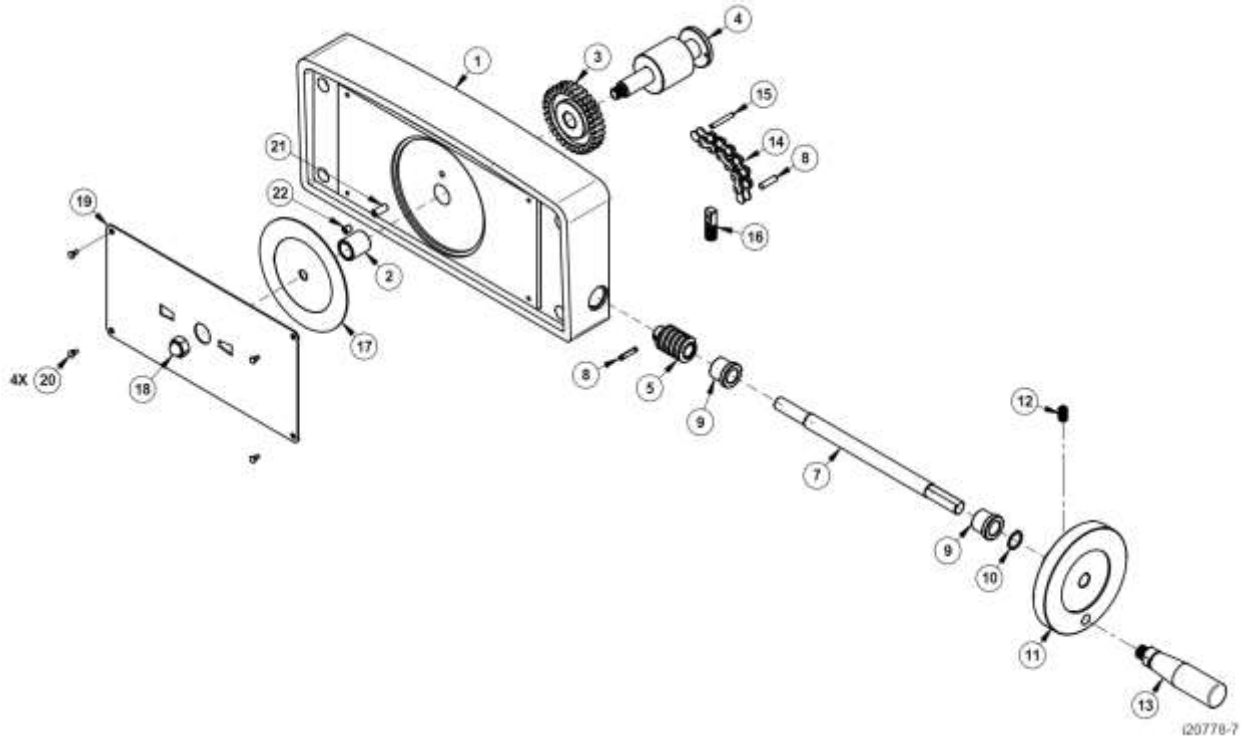


Figure 125 & Parts List Shown

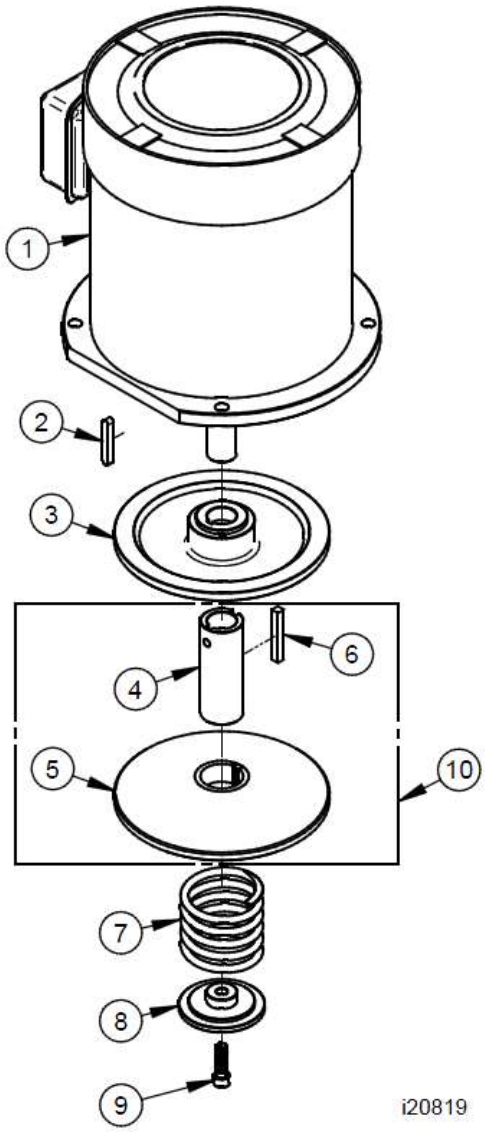
K2EMX, K3EMX & DPMEX2 Speed Change Handwheel – P/N 20778-7

Item	P/N	DESCRIPTION	Qty
1	VS16	SPEED CHANGE HOUSING	1
2	VS20	BEARING SELF LUBRICATING	1
3	VS22	SPEED CHANGER GEAR	1
4	VS31	SPEED CHANGE CHAIN DRUM	1
5	VS21	WORM	1
7	VS25	SPEED CHANGE SHAFT	1
8	VS40	ROLL PIN Ø3x15L	2
9	VS24	COPPER BUSHING	2
10	VS24-1	WASHER-WAVE	1
11	VS27	SPEED CHANGE HANDWHEEL	1
12	VS18	FULL DOG SOCKET SET SCREW M6-P1.0x10L	1
13	VS28	HANDLE 3/8-16NC	1
14	VS32	CHAIN #310X9.525	1
15	VS31-1	DOWEL PIN Ø3x25L	1
16	VS30	SPEED CHANGE STUD	1
17	VS16-1	SPEED DIAL	1
18	VS95	NUT-ACORN 5/16-18 NC	1
19	VS16-2	NAME PLATE	1
20	VS19	SCREW-DRIVE	4
21	M5-0.8X14	SCREW-SOC SET-STL-BO-CUP	1
22	M5-0.8X5	SCREW-SOC SET-STL-BO-CUP	1
		i20778-7	

Figure 126 & Parts List Shown –

K2K3EMX & DPMEX2 –

Spindle Motor - P/N 20819

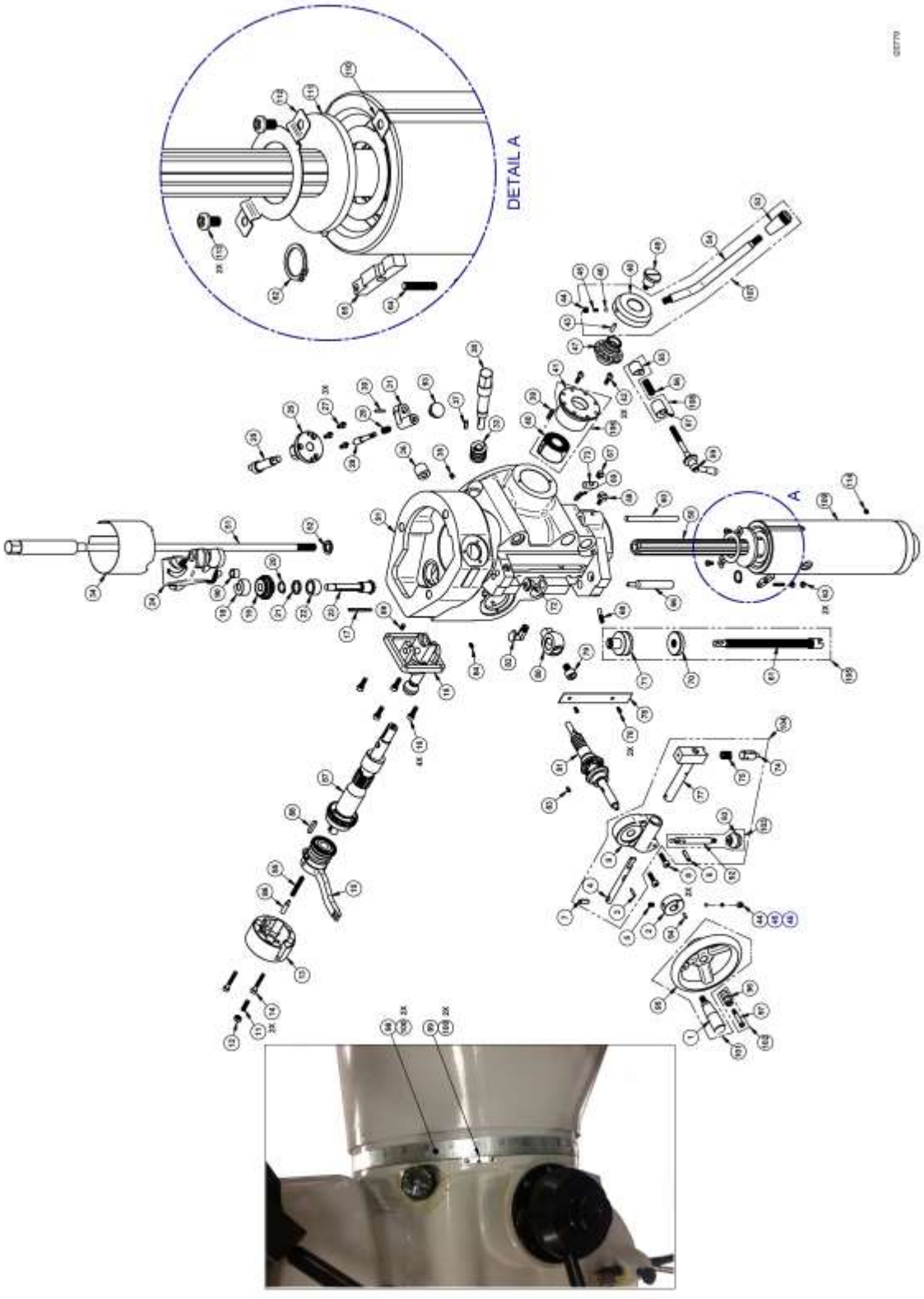


Item	P/N	Title	Qty
1	VS110	FRU-K3-MOTOR 3 HP	1
2	VS3-1	FRU-K3-KEY 6x6x45L	1
3	VS2	FRU-K3-STATIONARY MOTOR VARIDISC	1
4	VS6	FRU-K3-BUSHING	1
5	VS5	FRU-K3-ADJUSTABLE MOTOR VARIDISC ASSY.	1
6	VS6-1	FRU-K3-KEY 7x7x50L	1
7	VS8	FRU-K3-SPRING FOR VARIDISC MOTOR SHAFT	1
8	VS9	FRU-K3-ADJUSTABLE VARIDISC SPRING COLLAR	1
9	VS10	FRU-K3-SCREW- SOC HD CAP M8-P1.25x30L	1
10	23953	VARIDISC ASSY-ADJUSTABLE MOTOR	(1)

i20819

Figure 127 K2EMX, K3EMX & DPMEX2

Lower Head Housing Assy-R8- Green P/N 20779



Parts List–K2EMX, K3EMX, & DPMEX2–
Lower Head Housing Assy–R8-Green (Figure 127) P/N 20779

Item	P/N	Title	Qty
1	K-B125-2	FRU-K3-HANDWHEEL HANDLE (AVAILABLE ONLY IN ASSY. 20835)	1
2	K-B113	FRU-K3-HAND WHEEL CLUTCH	1
3	K-B117	FRU-K3-ROLL PIN Ø3x15L	1
4	K-B103	FRU-K3-CAM ROD	1
5	K-B108	FRU-K3-SOCKET SET SCREW M6-P1.0x8L	1
6	K-B119-1	FRU-K3-ROLL PIN Ø3x20L	1
7	K-B103-1	FRU-K3-CAM ROD PIN Ø6x15L	1
8	K-B107	FRU-K3-CAP SCREW M6-P1.0x25L	2
9	K-B106	FRU-K3-FEED TRIP BRACKET	1
10	20779-4	OVERLOAD CLUTCH TRIP ASSY	1
11	K-B73	FRU-K3-SOCKET SET SCREW M6-P1.0x20L	1
12	K-B101	FRU-K3-CHEM BLACKED LOCKNUT M6-P1.0	1
13	K-B99	FRU-K3-CLUTCH ARM COVER	1
14	M5-0.8X50 25B	SCREW-SHCS-STL-BO	2
15	20779-2	QUILL FEED SELECTOR ASSY	1
16	K-B67	FRU-K3-CAP SCREW M6-P1.0x18L	4
17	K-B29	FRU-K3-CLUSTER GEAR KEY 3x3x45L	1
18	K-B27	FRU-K3-CLUSTER GEAR SHAFT UPPER BEARING	1
19	K-B28	FRU-K3-CLUSTER GEARS ASSEMBLY	1
20	K-B94	FRU-K3-SNAP RING 95 DOWEL PIN Ø 14	1
21	K-B32	FRU-K3-BEVEL GEAR THRUST SPACER	1
22	K-B33	FRU-K3-BEVEL GEAR BEARING	1
23	K-B31	FRU-K3-CLUSTER GEAR SHAFT 6602BB	1
24	20779-1	WORM GEAR CRADLE ASSY	1
25	K-B18	FRU-K3-WORM GEAR CRADLE THROW-OUT	1
26	K-B19	FRU-K3-SHIFT SLEEVE	1
27	K-B25	FRU-K3-CAP SCREW(3REQ.) M5-P0.8x12L	3
28	K-B20	FRU-K3-GEAR SHIFT PLUNGER	1
29	K-B21	FRU-K3-COMPRESSION SPRING	1
30	K-B22	FRU-K3-ROLL PIN Ø3x20L	1
31	K-B23	FRU-K3-SHIFT CRANK	1
33	K-B186	FRU-K3-WORM GEAR	1
34	K-B128	FRU-K3-QUILL SKIRT	1
35	K-B189-1	FRU-K3-ADJ WORM SHAFT SET SCREW M6-P1.0x6L	1
36	K-B42	FRU-K3-BUSHING	1
37	K-B187	FRU-K3-KEY 4x4x18L	1

Parts List–K2EMX, K3EMX, & DPMEX2–
Lower Head Housing Assy–R8-Green (Figure 127) P/N 20779

Item	P/N	Title	Qty
39	K-B171	FRU-K3-KEY 3x3x20L	1
40	K-B178	FRU-K3-CLOCK SPRING(CLOCK SPRING ASSY.)	1
41	K-B177	FRU-K3-SPRING COVER	1
42	K-B169	FRU-K3-RD.HEAD SCREW(2REQ.) M5-P0.8x15L	2
43	K-B170	FRU-K3-ROLL PIN	1
44	K-B175-3	FRU-K3-SET SCREW M8-P1.25x6L	2
45	K-B175-2	FRU-K3-COMPRESSION SPRING	2
46	K-B175-1	FRU-K3-STEEL BALL	2
47	K-B176	FRU-K3-PINION SHAFT HUB SLEEVE	1
48	K-B175	FRU-K3-RACK FEED HANDLE HUB	1
49	K-B172	FRU-K3-PINION SHAFT HUB SCREW	1
50	20836	SPINDLE ASSY-K2/K3	1
51	VS109	DRAWBAR-R8-MANUAL	1
52	VS109-1	FRU-K3-SPACER	1
53	K-B191	FRU-K3-BLACK PLASTIC BALL HANDLES	1
54	K-B190	FRU-K3-PINION SHAFT HUB HANDLE	1
55	K-B148	FRU-K3-QUILL LOCK SLEEVE	1
56	K-B148-1	FRU-K3-COMPRESSION SPRING	1
57	K-B153	FRU-K3-QUILL LOCK SLEEVE TAPPED	1
58	KB-201	FRU-K3-INDICATOR ROD SCREW	1
59	K-B149	FRU-K3-LOCK HANDLE	1
60	KB-202	FRU-K3-INDICATOR ROD	1
61	K-B164	FRU-K3-QUILL STOP MICRO-SCREW	1
62	K-B160	FRU-K3-SNAP RING Ø16	1
63	K-B124-2	FRU-K3-FEED TRIP PLUNGER NUT M40-P0.7	2
64	K-B124-1	FRU-K3-FEED TRIP PLUNGER SOC SET SCREW M4-P0.7x20L	1
65	K-B145	FRU-K3-FEED TRIP LEVER	1
66	K-B124	FRU-K3-FEED TRIP PLUNGER	1
67	K-B185	FRU-K3-REVERSE TRIP BALL LEVER SCREW	1
68	K-B144	FRU-K3-SOCKET SET SCREW	1
69	K-B183	FRU-K3-REVERSE TRIP BALL LEVER	1
70	K-B161	FRU-K3-QUILL MICRO-STOP NUT	1
71	K-B162	FRU-K3-MICROMETER NUT	1
72	K-B123	FRU-K3-TRIP PLUNGER BUSHING	1
73	K-B184	FRU-K3-FEED REVERSE TRIP PLUNGER	1
74	K-B121	FRU-K3-TRIP PLUNGER	1
75	K-B120	FRU-K3-COMPRESSION SPRING	1
76	K-B158	FRU-K3-CHEM BLACKED RD.HD.SCREWS(2 REQ.) M5-P0.8x8L	2

Parts List–K2EMX, K3EMX, & DPMEX2–
Lower Head Housing Assy–R8-Green (Figure 127) P/N 20779

Item	P/N	Title	Qty
77	K-B118	FRU-K3-CAM ROD SLEEVE ASSY	1
78	K-B159	FRU-K3-MICROMETER SCALE	1
79	KB-200	FRU-K3-SCREW- SOC HD 3/8-24NFx15L	1
80	K-B163	FRU-K3-QUILL STOP KNOB	1
81	20779-5	FEED REVERSE CLUTCH ASSY	1
82	OIL-1	FRU-K3-OIL CUP	1
83	K-B109	FRU-K3-KEY 3x3x20L	1
84	K-B17-1	FRU-K3-WORM GEAR SET SCREW M6-P1.0x8L	1
85	K-B88-1	FRU-K3-COMPRESSION SPRING	1
86	K-B89	FRU-K3-OVERLOAD CLUTCH LEVER SPRING PLUNGER	1
87	20779-3	QUILL PINION SHAFT ASSY-R8	1
88	K-B167	FRU-K3-KEY 5x5x25L	1
89	K-B27-1	FRU-K3-SET SCREW M6-P1.0x8L	1
90	K-B41	FRU-K3-NEEDLE BEARING BA66 BEARING SIZE KO-BA66Z	1
91	K-B192	FRU-K3-QUILL HOUSING	1
92	K-B104	FRU-K3-TRIP HANDLE	1
93	K-B105	FRU-K3-BLACK PLASTIC BALL	2
94	K-B125-1	FRU-K3-HANDWHEEL SPRING PIN Ø3x3x10L	1
95	K-B125	FRU-K3-HANDWHEEL	1
96	K-B111	FRU-K3-REVERSE KNOB	1
97	K-B100	FRU-K3-CAP SET SCREW M5-P0.8x35L	1
98	25042	SCALE-HEAD ROTATION-R8	1
99	25043	POINTER SCALE	1
100	25044	DRIVE SCREW-SCALE	4
101	20835	FRU-SK2/SK3-HANDWHEEL ASSY	(1)
102	20834	FRU-SK2/SK3-FEED REVERSE KNOB ASSY	(1)
103	24052	TRIP HANDLE ASSEMBLY (INCLUDES PLASTIC BALL)	(1)
104	20832	FRU-SK2/SK3-FEED TRIP ASSY	(1)
105	20847	QUILL MICRO NUT & SCREW ASSY	(1)
106	24051	CLOCK SPRING ASSEMBLY (SPRING & COVER)	(1)
107	20849	FRU-SK2/SK3-FEED HANDLE ASSY (QUILL HANDLE)	(1)
108	20843	FRU-SK2/SK3-QUILL LOCK SLEEVE ASSY	(1)
109	K-B142	FRU-K3-QUILL	1
110	K-B150-1	STRAIGHT LOWER CLAMP	1
111	K-B151	FELT OIL STRAINER	1
112	K-B150-2	STRAINER UPPER CLAMP	1
113	K-B139	SCREW-PH-HD-M5-0.8X8L	2
114	M5-0.8X5 40B	SCREW-SOC SET-STL-BO-CUP	1

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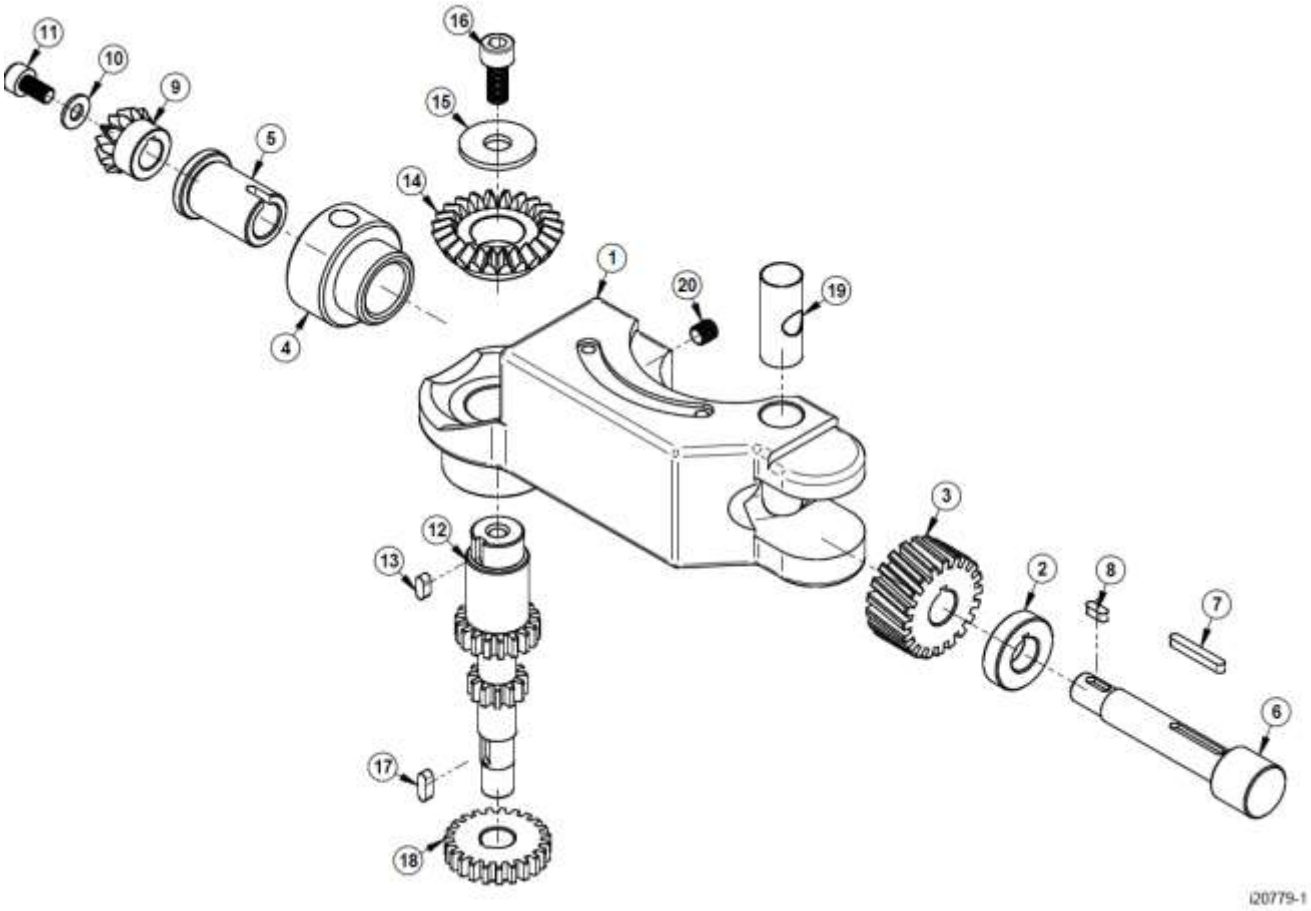
Figure 128 & Parts List Shown – K2EMX, K3EMX, & DPMEX2 – Worm Gear Cradle Assy P/N 20779-1

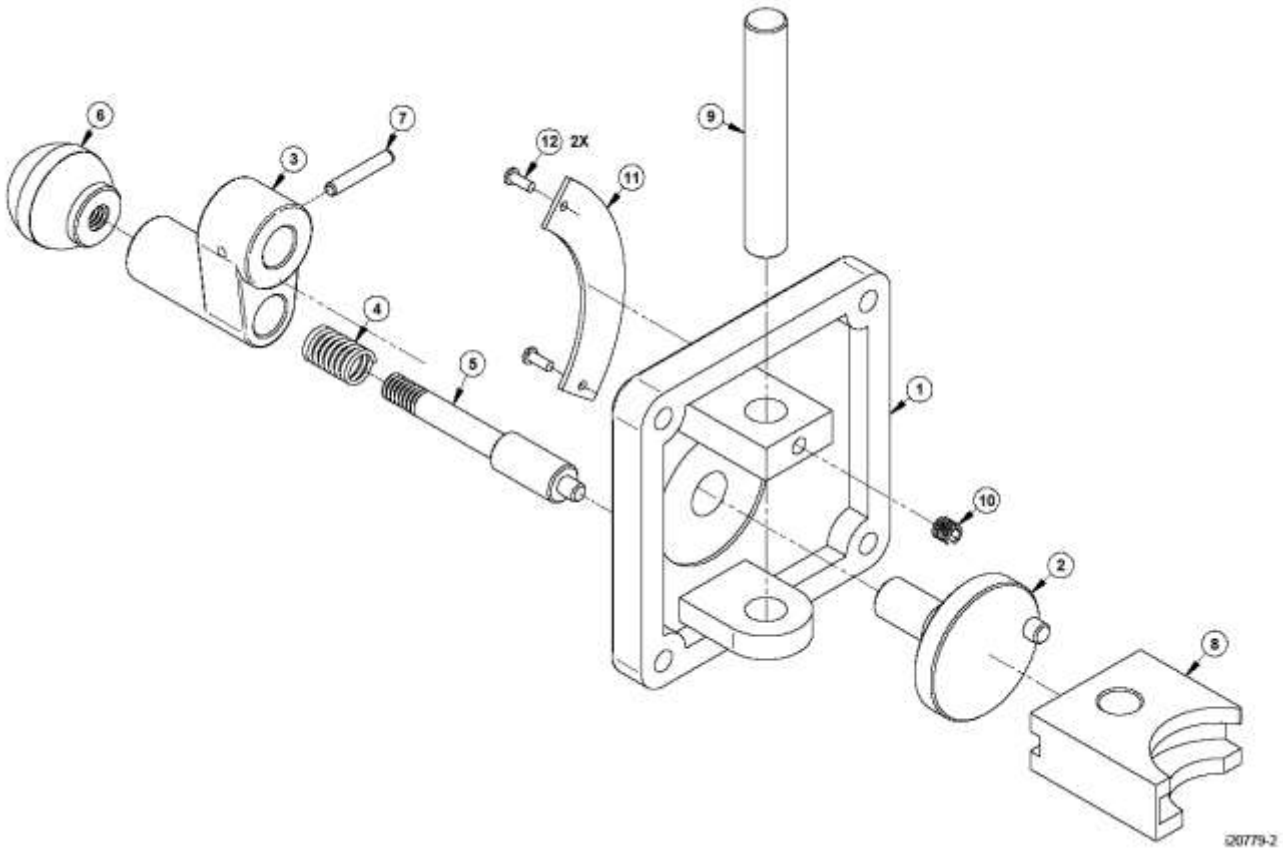


Item	P/N	Title	Qty
1	K-B17	FRU-K3-WORM GEAR CRADLE	1
2	K-B07	FRU-K3-WORM GEAR SPACER	1
3	K-B08	FRU-K3-FEED DRIVEWORM GEAR	1
4	K-B05	FRU-K3-WORM CRADLE BUSHING	1
5	K-B04	FRU-K3-FEED WORM GEAR SHAFT SLEEVE	1
6	K-B09	FRU-K3-FEED DRIVE WORM GEAR SHAFT	1
7	K-B11	FRU-K3-KEY 3x3x25L	1
8	K-B10	FRU-K3-WORM SHAFT KEY 3x3x8L	1
9	K-B03	FRU-K3-FEED BEVEL PINION	1
10	K-B02	FRU-K3-BEVEL PINION WASHER Ø 5	1
11	K-B01	FRU-K3-SOC.HD.SCREW M5-P0.8x10L	1
12	K-B36	FRU-K3-FEED DRIVING GEAR	1
13	K-B36-	FRU-K3-KEY 3x3x8L	1
14	K-B15	FRU-K3-FEED REVERSE BEVEL GEAR	1
15	K-B13	FRU-K3-WASHER Ø 6, 22 OD	1
16	K-B14	FRU-K3-SOC HD SCREW M6-P1.0x15L	1
17	K-B37	FRU-K3-KEY 3x3x10L	1

Figure 128 Parts List– K2EMX, K3EMX, & DPMEX2 – Worm Gear Cradle Assy P/N 20779-1

Item	P/N	Title	Qty
18	K-B40	FRU-K3-FEED DRIVE GEAR	1
19	K-B16	FRU-K3-FEED ENGAGE PIN	1
20	K-B06	FRU-K3-SETSCREW M6-P1.0x6L	1
		i20779-1	

Figure 129 & Parts List Shown – K2EMX, K3EMX & DPMEX2 – Quill Feed Selector Assy P/N 20779-2



Item	P/N	Title	Qty
1	K-B66	FRU-K3-CLUSTER GEAR COVER	1
2	K-B64	FRU-K3-CLUSTER GEAR SHAFT CRANK	1
3	K-B70	FRU-K3-SHIFT CRANK	1
4	K-B69	FRU-K3-SPRING Ø 3 x 20L	1
5	K-B68	FRU-K3-GEAR SHIFT PLUNGER	1
6	K-B72	FRU-K3-SHIFT KNOB-5/16-18NC	1
7	K-B71	FRU-K3-ROLL PIN Ø 3 x 20L	1
8	K-B63	FRU-K3-FEED GEAR SHIFT FORK	1
9	K-B65	FRU-K3-SHAFT	1
10	K-B61	FRU-K3-CAP SET SCREW M5-P0.8x5L	1
11	28072	SCALE-QUILL SELECTOR	1
12	25044-1	DRIVE SCREW-SCALE	2

I20779-2

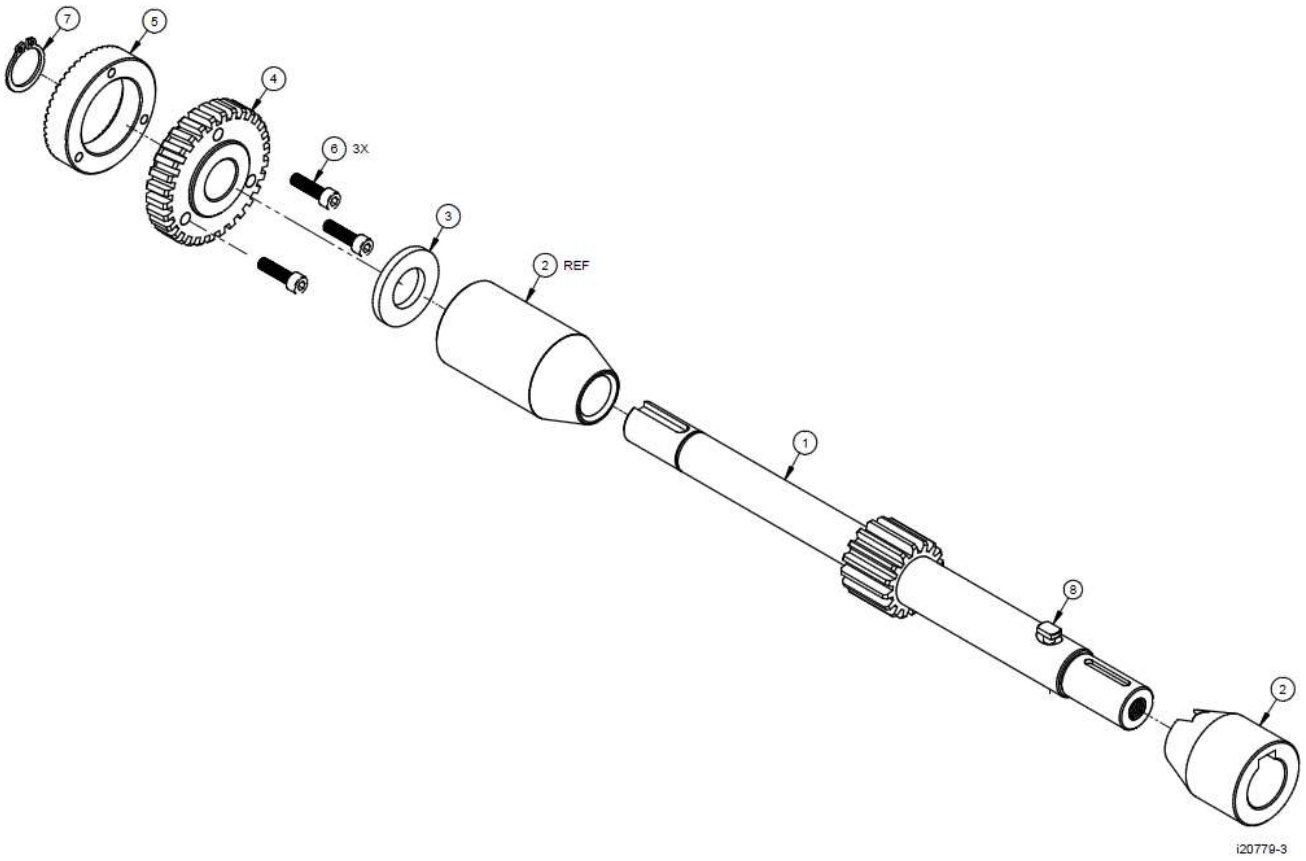


Figure 130 & Parts List Shown – K2EMX, K3EMX & DPMEX2 –

Quill Pinion Shaft - P/N 20779-3

Item	P/N	Title	UseAs	Qty
1	K-B166	QUILL PINION SHAFT	EA	1
2	25706	BUSHING KIT-PINION SHAFT-R8	EA	1
3	K-B91	WASHER	EA	1
4	K-B92	OVERLOAD CLUTCH WORM GEAR	EA	1
5	K-B93	OVERLOAD CLUTCH RING	EA	1
6	K-B92-1	SCREW SOC HD CAP M4-P0.7x15L	EA	3
7	K-B94	SNAP RING 95 DOWEL PIN Ø 14	EA	1
8	K-B168	SCREW PIN	EA	(1)

i20779-3

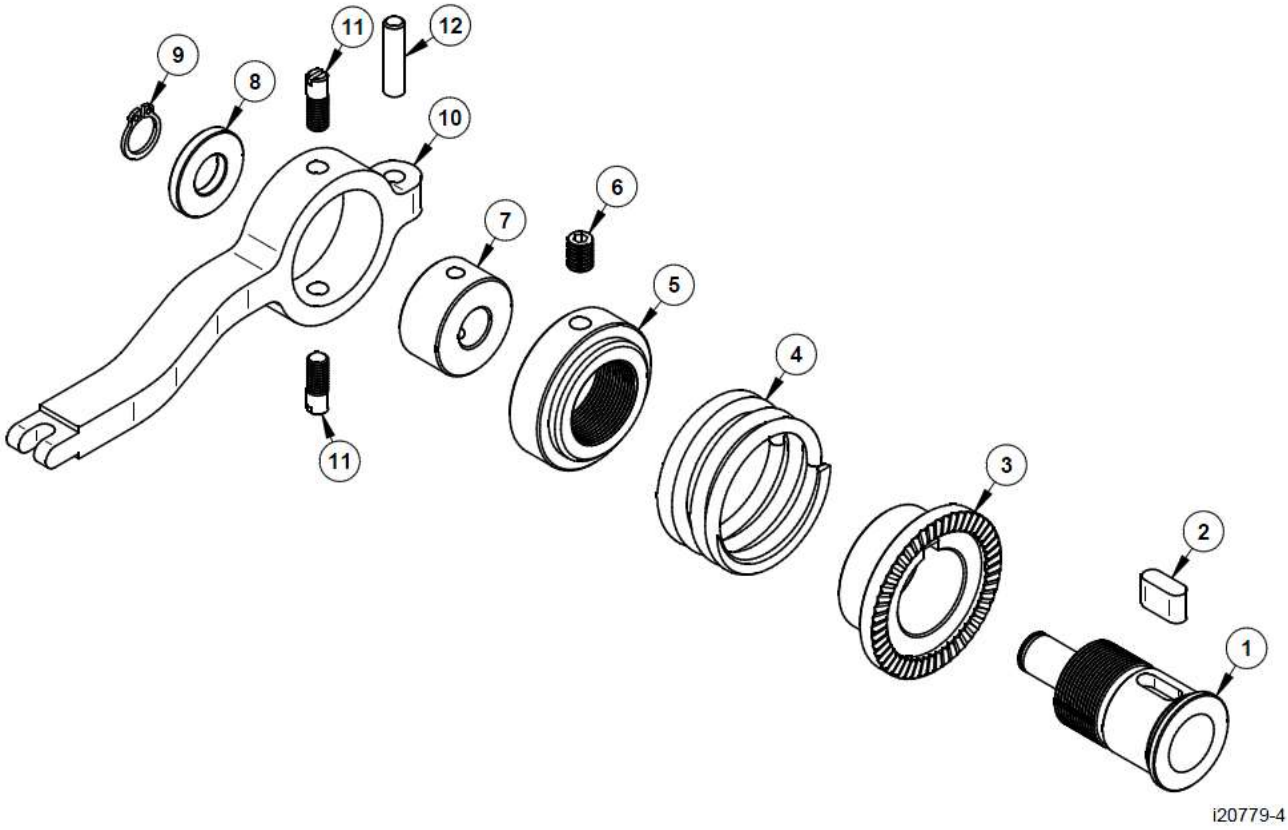


Figure 131 & Parts List Shown – K2EMX, K3EMX & DPMEX2 – Overload Clutch Trip - P/N: 20779-4

Item	P/N	Title	Qty
1	K-B81	FRU-K3-OVERLOAD CLUTCH SLEEVE	1
2	K-B81-1	FRU-K3-KEY 5x8x13L	1
3	K-B80	FRU-K3-OVERLOAD CLUTCH	1
4	K-B79	FRU-K3-SAFETY CLUTCH SPRING	1
5	K-B78	FRU-K3-OVERLOAD CLUTCH LOCKNUT	1
6	K-B76	FRU-K3-SOCKET SET SCREW M6-P1.0x8L	1
7	K-B75	FRU-K3-CLUTCH RING	1
8	K-B97	FRU-K3-OVERLOAD CLUTCH WASHER	1
9	K-B98	FRU-K3-SNAP RING Ø 10	1
10	K-B96	FRU-K3-OVERLOAD CLUTCH TRIP LEVER	1
11	K-B74	FRU-K3-CLUTCH RING PIN (2REQ.)	2
12	K-B77	FRU-K3-BRASS PLUG	1

I20779-4

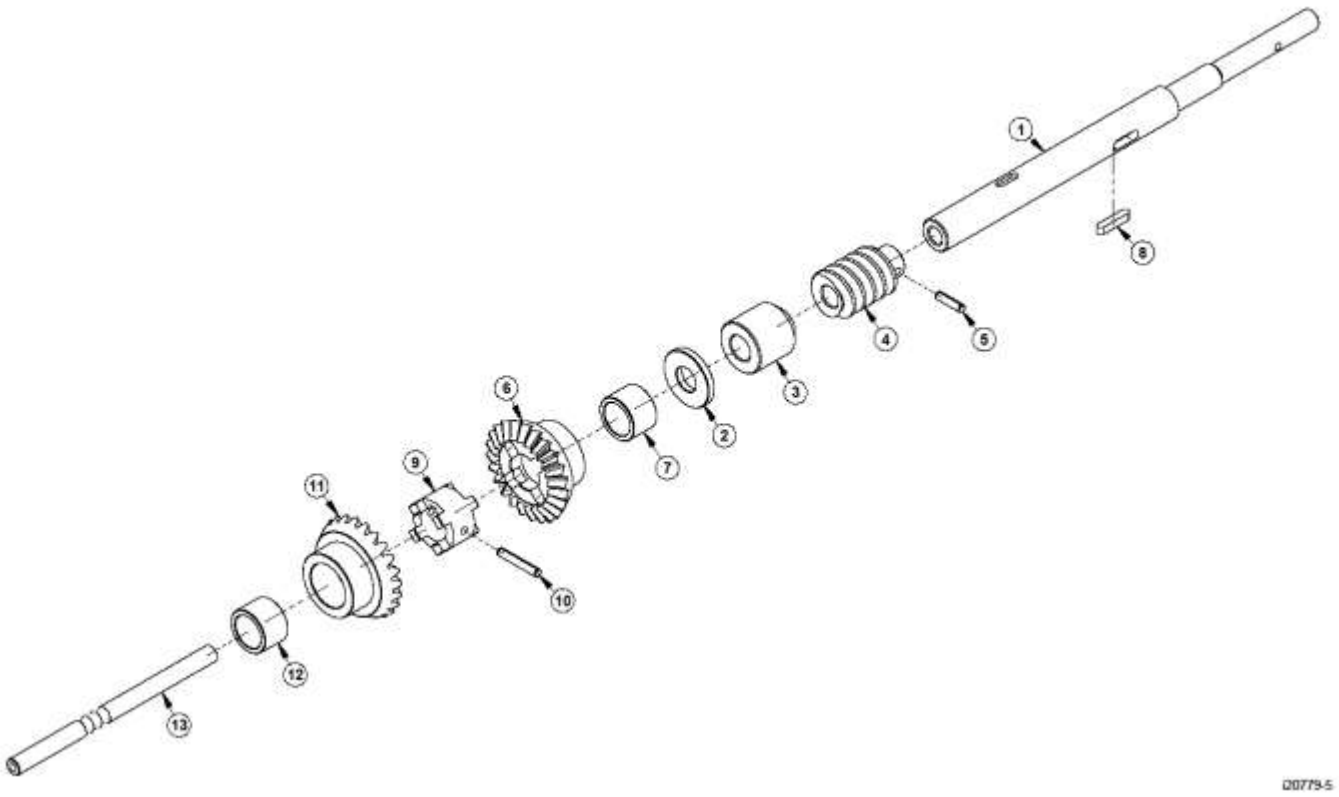


Figure 132 & Parts List Shown – K2EMX, K3EMX & DPMEX2 – Feed Reverse Clutch - P/N 20779-5

Item	P/N	Title	Qty
1	K-B57	FRU-K3-FEED WORM SHAFT	1
2	K-B47	FRU-K3-FEED WORM SHAFT THRUST WASHER	1
3	K-B44	FRU-K3-FEED WORM SHAFT BUSHING	1
4	K-B43	FRU-K3-WORM	1
5	K-B59	FRU-K3-PIN Ø 3x12L	1
6	K-B49	FRU-K3-FEED REVERSE BEVEL GEAR	1
7	K-B48	FRU-K3-BUSHING	1
8	K-B62	FRU-K3-KEY 3x3x15L	1
9	K-B50	FRU-K3-FEED REVERSE CLUTCH	1
10	K-B56	FRU-K3-PIN Ø 3x19L	1
11	K-B51	FRU-K3-FEED REVERSE BEVEL GEAR	1
12	K-B52	FRU-K3-BUSHING	1
13	K-B55	FRU-K3-REVERSE CLUTCH ROD	1

I20779-5

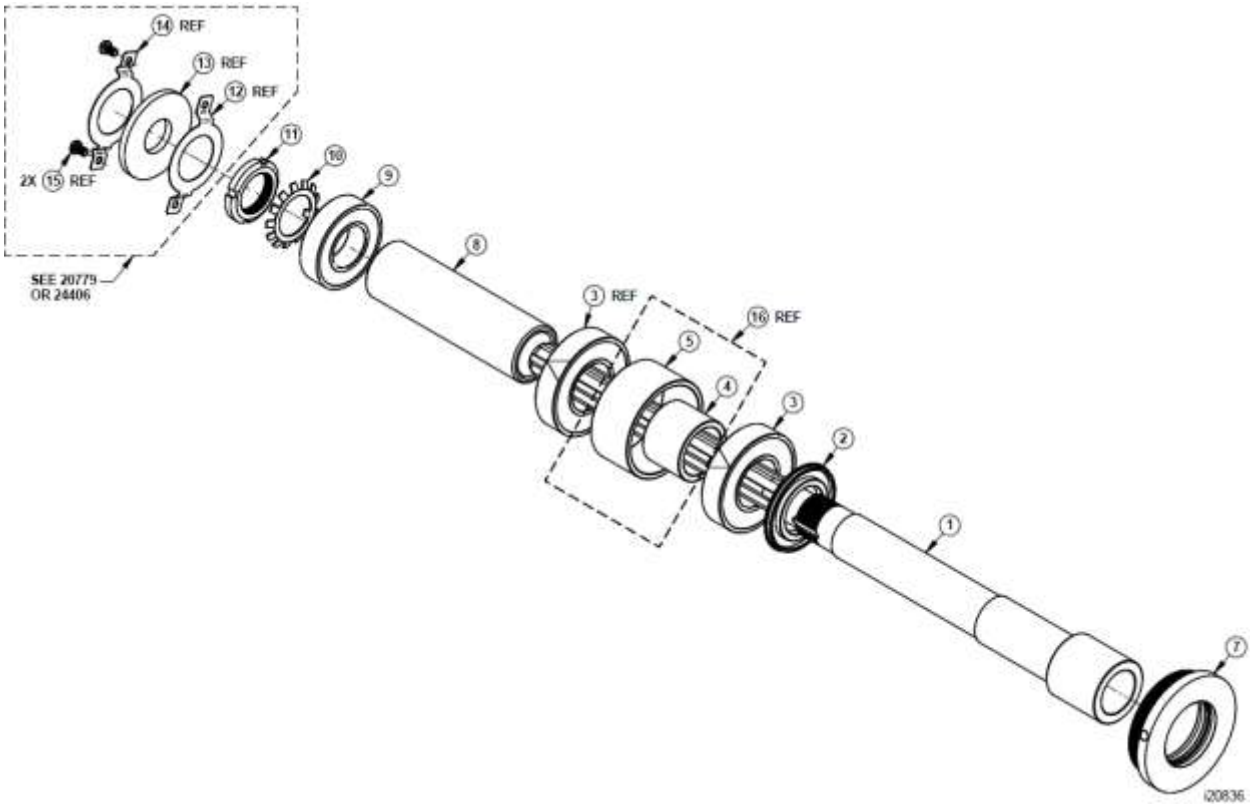


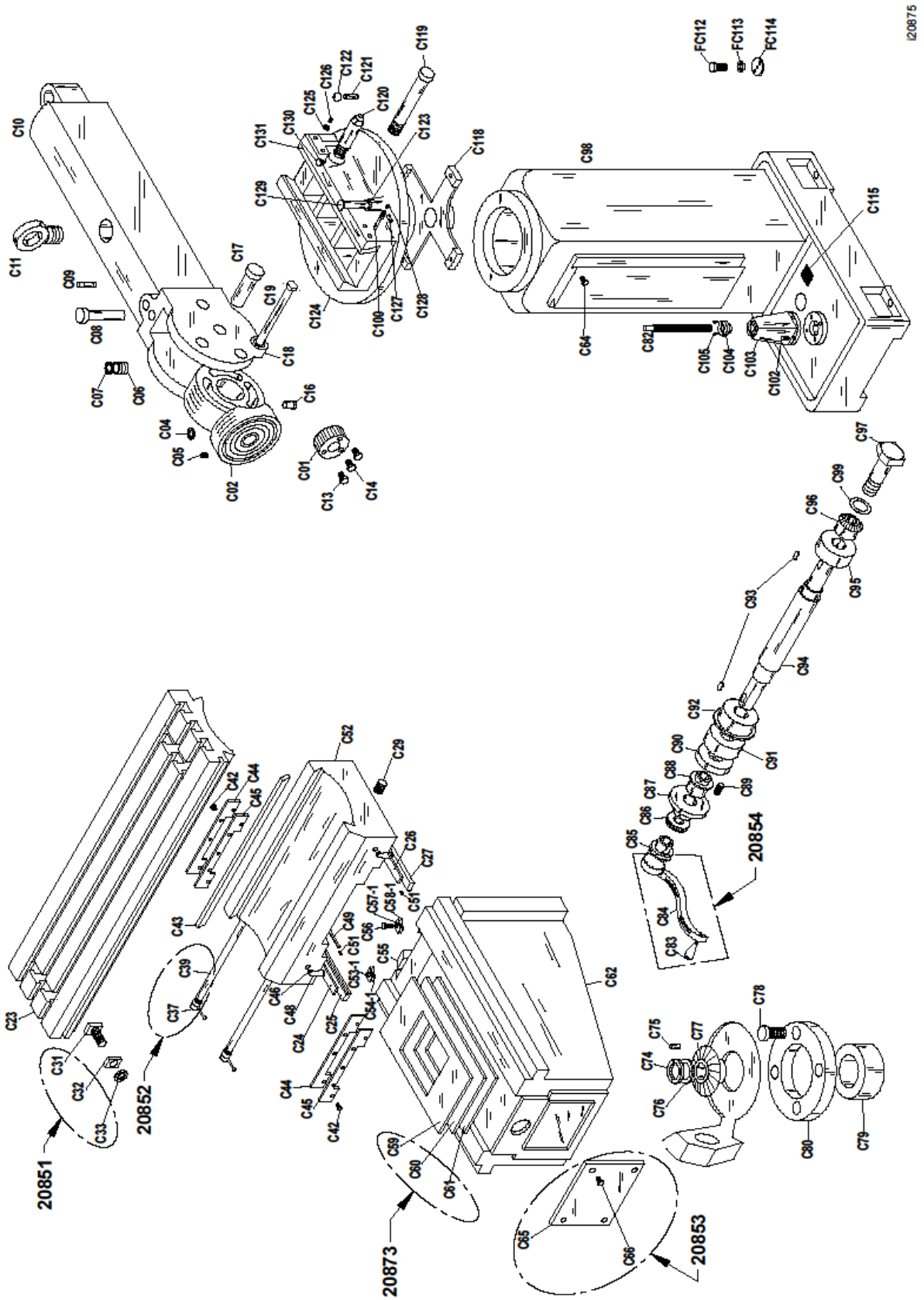
Figure 133 & Parts List Shown –

K2EMX, K3EMX & DPMEX2 – Spindle Assembly - P/N 20836

Item	P/N	Title	Qty
1	K-B127	SPINDLE R8	1
2	K-B134	SPINDLE DIRT SHIELD	1
3	20838	BEARING-ANGULAR CONTACT-U/SET(2)-7207 P4	1
4	K-B136	BEARING SPACER-SMALL	1
5	K-B137	BEARING SPACER-LARGE	1
7	K-B133	NOSE-PIECE	1
8	K-B132	SLEEVE	1
9	K-B131	BEARING-DEEP GROVE-6206ZZ	1
10	K-B130	BEARING LOCK WASHER Ø 30	1
11	K-B129	SPINDLE BEARING LOCK NUT- Ø30-20N	1
12	K-B150-1	STRAIGHT LOWER CLAMP	(1)
13	K-B151	FELT OIL STRAINER	(1)
14	K-B150-2	STRAINER UPPER CLAMP	(1)
15	K-B139	SCREW-PH-HD-M5-0.8X8L	(2)
16	20840	BEARING SPACER SET	(1)

i20836

Figure 134 – K2 & K3 – Base Machine Assy P/N 20785



Parts List – K2 & K3 – Base Machine P/N 20785 (Figure 134)

Item	P/N	Title	Qty
1	C01	FRU-K3-QUILL HOUSING ADJ.GEAR	1
2	C02	FRU-K3-RAM ADAPTER	1
3	C04	FRU-K3-NUT	1
4	C06	FRU-K3-VERTICAL ADJUSTING WORM	1
5	C07	FRU-K3-WORM THRUST WASHER(2REQ.)	2
6	C08	FRU-K3-VERTICAL ADJUSTING WORM SHAFT	1
7	C09	FRU-K3-WORM KEY	1
8	C10	FRU-K3-RAM	1
9	C13	FRU-K3-SOCKET CAP SCREW(2REQ.)	2
10	C14	FRU-K3-ROLL DOWEL PIN	1
11	C15	FRU-K3-ANGLE PLATE (Not Shown)	1
12	C16	FRU-K3-ROUND HD DRIVE SCREW(5REQ.)	5
13	C17	FRU-K3-ADAPTER PIVOT PIN	1
14	C18	FRU-K3-CHAMFERED & HARDENED WASHER(7REQ.)	7
15	C19	FRU-K3-ADAPTER LOCKING BOLT(3REQ.)	3
16	C23	FRU-K3-TABLE 42" OR 48"	1
17	C31	FRU-K3-STOP PIECE T-BOLT(3REQ.)	3
18	C32	FRU-K3-TABLE STOP PIECE(2REQ.)	2
19	C33	FRU-K3-HEX NUT(3REQ.)	3
20	C37	FRU-K3-TABLE LOCK BOLT HANDLE	1
21	C38	FRU-K3-SADDLE LOCK BOLT	1
22	C39	FRU-K3-SADDLE LOCK PLUNGER	1
23	C40	FRU-K3-SOCKET HD CAP SCREW(2REQ.)	2
24	C41	FRU-K3-GIB ADJUSTING SCREW(3REQ.)	3
25	C42	FRU-K3-TABLE STOP BRACKET	1
26	C43	FRU-K3-SADDLE/TABLE GIB	1
27	C44	WIPER-FRONT/REAR-K2	2
28	C46	FRU-K3-TABLE LOCK PLUNGER	1
29	C47	FRU-K3-TABLE LOCK BOLT	1
30	C48	FRU-K3-TABLE LOCK BOLT HANDLE	1
31	C49	FRU-K3-SADDLE/KNEE GIB	1
32	C50	FRU-K3-SADDLE KNEE WIPER PLATE(4REQ.)	4
33	C51	FRU-K3-OVAL HEAD SCREW(8REQ.)	8
34	C53-1	FRU-K3-LEFT HAND COLUMN WIPER HOLDER	1
35	C52	FRU-K3-SADDLE	1
36	C54-1	WIPER-CHIP-LEFT KNEE-K3	1
37	C55	FRU-K3-KNEE/COLUMN GIB	1
38	C56	FRU-K3-ALLEN CAP SCREW(2REQ.)	2
39	C57-1	FRU-K3-RIGHT HAND COLUMN WIPER HOLDER	1
40	C58-1	WIPER-CHIP-RIGHT KNEE-K3	1
41	C59	FRU-K3-CHIP GUARDS-UPPER	1
42	C60	FRU-K3-CHIP GUARDS-MIDDLE	1

Parts List – K2 & K3 – Base Machine P/N 20785 (Figure 134)

Item	P/N	Title	Qty
43	C61	FRU-K3-CHIP GUARDS-LOWER	1
44	C62	FRU-K3-KNEE	1
45	C64	FRU-K3-STOP SCREW	1
46	C65	FRU-K3-KNEE LOCK SHAFT ASSEMBLY	1
47	C69	FRU-K3-KNEE LOCK PLUNGER	1
48	C71	FRU-K3-KNEE BINDER PLUG(PLASTIC)	1
49	C72	FRU-K3-DOG POINT SET SCREW	1
50	C73	FRU-K3-SET SCREW	1
51	C74	FRU-K3-JAM NUT	1
52	C75	FRU-K3-KEY	1
53	C76	FRU-K3-WASHER	1
54	C77	FRU-K3-BEVEL GEAR	1
55	C79	FRU-K3-SEALED BALL BEARING	1
56	C80	FRU-K3-BEARING RETAINER RING	1
57	C81	FRU-K3-SOCKET HEAD CAP SCREW	1
58	C82	FRU-K3-ELEVATING SCREW ASSEMBLY	1
59	C83	FRU-K3-HANDLE	1
60	C84	FRU-K3-ELEVATING CRANK	1
61	C85	FRU-K3-GEARSHAFT CLUTCH INSERT	1
62	C86	FRU-K3-DIAL LOCK NUT	1
63	C87	FRU-K3-DIAL WITH 100 GRADUATIONS	1
64	C88	FRU-K3-DIAL HOLDER	1
65	C89	FRU-K3-SOCKET HEAD CAP SCREW	1
66	C90	FRU-K3-BEARING RETAINING RING	1
67	C91	FRU-K3-GREASE SEALED BEARING	1
68	C92	FRU-K3-BEARING CAP	1
69	C93	FRU-K3-KEY	1
70	C94	FRU-K3-ELEVATING SHAFT FOR 12" KNEE	1
71	C95	FRU-K3-GREASE SEALED BEARING	1
72	C96	FRU-K3-BEVEL PINION	1
73	C97	FRU-K3-SET SCREW	1
74	C98	FRU-K3-COLUMN	1
75	C99	FRU-K3-WASHER	1
76	C102	FRU-K3-SOCKET HEAD CAP SCREW	1
77	C103	FRU-K3-PEDESTAL	1
78	C104	FRU-K3-ELEVATING SCREW NUT	1
79	C105	FRU-K3-SOCKET HEAD CAP SCREW	1
80	C118	FRU-K3-SPIDER	1
82	C120	FRU-K3-RAM PINION	1
83	C121	FRU-K3-RAM PINION HANDLE	1
84	C122	FRU-K3-PLASTIC BALL	1
85	C123	FRU-K3-CHAMFERED HARDENED WASHER	1
86	C124	FRU-K3-TURRET	1

Parts List – K2 & K3 – Base Machine P/N 20785 (Figure 134)

Item	P/N	Title	Qty
87	C125	FRU-K3-GIB SCREW NUT	1
88	C126	FRU-K3-GIB SCREW	1
89	C127	FRU-K3-LOCK BAR	1
90	C128	FRU-K3-SCREW	1
91	C129	FRU-K3-LOCKING BOLT	1
92	C130	FRU-K3-RAM PINION SCREW	1
93	C131	FRU-K3-RAM/TURRET GIB	1
94	20851	FRU-SK2/SK3-STOP PIECE T-BOLT ASSY	(1)
95	20852	FRU-SK2/SK3-TABLE LOCK HANDLE	(1)
96	20853	FRU-SK2/SK3-KNEE LOCK HANDLE & SHAFT	(1)
97	20854	FRU-SK2/SK3-KNEE CRANK HANDLE ASSY	(1)
98	20873	CHIP GUARD SET K2/K3	(1)
99	FC112	CAP SCREW	1
100	FC113	NUT	1
101	FC114	MACHINE MAT	1
102	C11	EYEBOLT	1
103	C05	INTERNAL SET SCREW	1
104	C100	GIB LOCK	1
105	C45	WIPER-FRONT/REAR-K2	2
106	C29	GIB ADJUSTMENT SCREW	1
107	C24	GIB-LEFT	1
108	C25	BRACKET-LEFT	1
109	C26	GIB-RIGHT	1
110	C27	BRACKET-RIGHT	1
111	C66	M6-1.0X16L	4
112	C78	1/4-20X1.0	4

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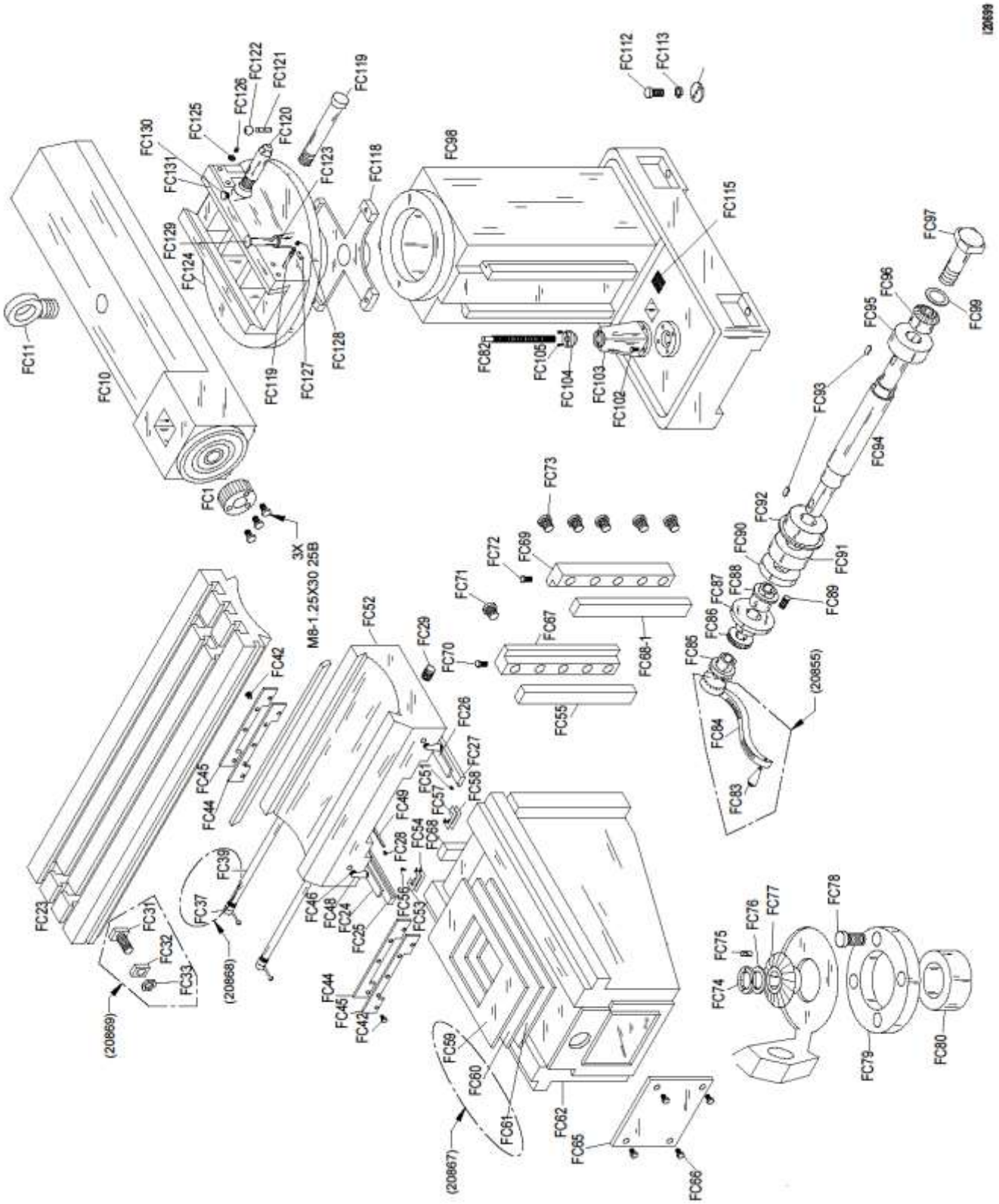
Figure 135 - K4 - Base Machine - P/N 20699



Parts List – K4 – Base Machine P/N 20699 (Figure 135)

Item	P/N	Title	Qty
1	FC1	QUILL HOUSING GEAR	1
2	FC10	RAM	1
3	FC11	LIFTING EYE BOLT	1
5	FC23	TABLE 50"	1
6	FC24	SADDLE BOTTOM GIB	1
7	FC25	GIB BLOCK	1
8	FC26	GIB	1
9	FC27	GIB BLOCK	1
10	FC28	SET SCREW	1
11	FC29	SET SCREW	1
12	FC31	STOP PIECE T-BOLT	1
13	FC32	TABLE STOP PIECE	1
14	FC33	HEX NUT	1
15	FC37	TABLE LOCK HANDLE	1
16	FC39	SADDLE LOCK PLUNGER	1
17	FC42	CAP SCREW	2
18	FC43	GIB-SADDLE/TABLE	1
19	FC44	WIPER-CHIP-SADDLE-FRONT/REAR-K3/K4	2
20	FC45	SADDLE CHIP WIPER PLATE	2
21	FC46	TABLE LOCK PLUNGER	2
22	FC48	TABLE LOCK BOLT HANDLE	2
23	FC49	SADDLE GIB	1
24	FC51	CAP SCREW	1
25	FC52	SADDLE	1
26	FC53	LEFT HAND COLUMN WIPER HOLDER	1
27	FC54	WIPER-CHIP-LEFT KNEE-K4	1
28	FC55	KNEE/COLUMN GIB	1
29	FC56	ALLEN CAP SCREW	2
30	FC57	RIGHT HAND COLUMN WIPER HOLDER	1
31	FC58	WIPER-CHIP-RIGHT KNEE-K4	1
32	FC59	CHIP GUARDS - UPPER	1
33	FC60	CHIP GUARDS - MIDDLE	1
34	FC61	CHIP GUARD LOWER	1
35	FC62	KNEE	1
36	FC65	KNEE PLATE	1
37	FC66	CAP SCREW	4
38	FC67	GIB BLOCK	1
39	FC68	GIB-KNEE-MIDDLE	1
40	FC68-1	GIB-KNEE-RIGHT	1
41	FC69	GIB BLOCK	1
42	FC70	CAP SCREW	1
43	FC71	CAP SCREW	1
44	FC72	CAP SCREW	1

Parts List – K4 – Base Machine P/N 20699 (Figure 135)

Item	P/N	Title	Qty
45	FC73	CAP SCREW	5
46	FC74	JAM NUT	1
47	FC75	KEY	1
48	FC76	WASHER	1
49	FC77	BEVEL GEAR	1
50	FC78	SCREW	1
51	FC79	SEALED BALL BEARING	1
52	FC80	BEARING RETAINER RING	1
53	FC82	ELEVATING SCREW ASSY	1
54	FC83	HANDLE	1
55	FC84	ARM	1
56	FC85	GEARSHAFT CLUTCH INSERT	1
57	FC86	DIAL LOCK NUT	1
58	FC87	DIAL WITH GRADUATIONS	1
59	FC88	DIAL HOLDER	1
60	FC89	SOCKET HEAD CAP SCREW	1
61	FC90	BEARING RETAINING RING	1
62	FC91	GREASE SEALED BEARING	1
63	FC92	BEARING CAP	1
64	FC93	KEY	2
65	FC94	ELAVATING SHAFT	1
66	FC95	GREASE SEALED BEARING	1
67	FC96	BEVEL PINION	1
68	FC97	SET SCREW	1
69	FC98	COLUMN & BASE- K4	1
70	FC99	WASHER	1
71	FC102	SOCKET HEAD CAP SCREW	1
72	FC103	PEDESTAL	1
73	FC104	ELEVATING SCREW NUT	1
74	FC105	SOCKET HEAD CAP SCREW	1
75	FC112	CAP SCREW	1
76	FC113	NUT	1
77	FC114	MACHINE MAT	1
78	FC115	OIL FILTER	1
79	FC118	SPIDER	1
80	FC119	RAM LOCK STUD	1
81	FC120	RAM PINION	1
82	FC121	RAM PINION HANDLE	1
83	FC122	PLASTIC BALL	1
84	FC123	CHAMBERED HARDENED WASHER	1
85	FC124	TURRET	1

Parts List – K4 – Base Machine P/N 20699 (Figure 135)

Item	P/N	Title	Qty
86	FC125	GIB SCREW NUT	1
87	FC126	GIB SCREW	1
88	FC127	LOCK BAR	1
89	FC128	SCREW	1
90	FC129	LOCKING BOLT	1
91	FC130	RAM PINION SCREW	1
92	FC131	RAM/TURRET GIB	1
93	20855	FRU-SK4-KNEE CRANK HANDLE ASSY	(1)
94	20867	FRU-SK4-CHIP COVER ASSY	(1)
95	20868	FRU-SK4-HANDLE & BAR LOCK ASSY	(1)
96	20869	FRU-SK4 FC31,FC32,FC333	(1)
97	M8-1.25X30	SCREW-SHCS-STL-BO	3

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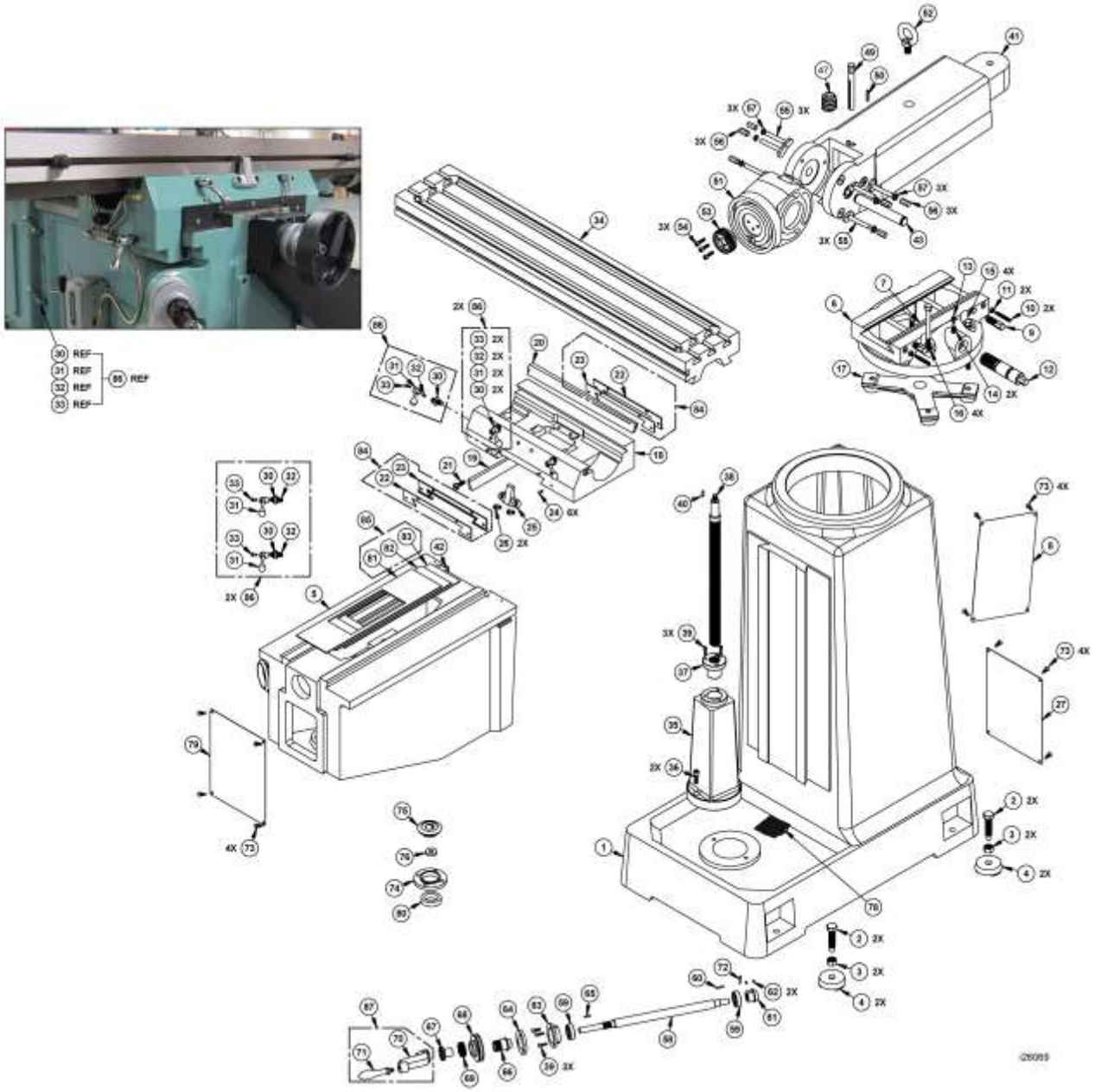
Figure 136 – KE – Base Machine P/N 26069



Item	P/N	Title	Qty
1	FC1	QUILL HOUSING GEAR	1
2	FC10	RAM	1
3	FC11	LIFTING EYE BOLT	1
5	FC23	TABLE 50"	1
6	FC24	SADDLE BOTTOM GIB	1
7	FC25	GIB BLOCK	1
8	FC26	GIB	1
9	FC27	GIB BLOCK	1
10	FC28	SET SCREW	1
11	FC29	SET SCREW	1
12	FC31	STOP PIECE T-BOLT	1
13	FC32	TABLE STOP PIECE	1
14	FC33	HEX NUT	1
15	FC37	TABLE LOCK HANDLE	1
16	FC39	SADDLE LOCK PLUNGER	1
17	FC42	CAP SCREW	2
18	FC43	GIB-SADDLE/TABLE	1
19	FC44	WIPER-CHIP-SADDLE-FRONT/REAR-	2
20	FC45	SADDLE CHIP WIPER PLATE	2
21	FC46	TABLE LOCK PLUNGER	2
22	FC48	TABLE LOCK BOLT HANDLE	2
23	FC49	SADDLE GIB	1
24	FC51	CAP SCREW	1
25	FC52	SADDLE	1
26	FC53	LEFT HAND COLUMN WIPER HOLDER	1
27	FC54	WIPER-CHIP-LEFT KNEE-K4	1
28	FC55	KNEE/COLUMN GIB	1
29	FC56	ALLEN CAP SCREW	2
30	FC57	RIGHT HAND COLUMN WIPER HOLDER	1
31	FC58	WIPER-CHIP-RIGHT KNEE-K4	1
32	FC59	CHIP GUARDS - UPPER	1
33	FC60	CHIP GUARDS - MIDDLE	1
34	FC61	CHIP GUARD LOWER	1
35	FC62	KNEE	1
36	FC65	KNEE PLATE	1
37	FC66	CAP SCREW	4
38	FC67	GIB BLOCK	1
39	FC68	GIB-KNEE-MIDDLE	1
40	FC68-1	GIB-KNEE-RIGHT	1
41	FC69	GIB BLOCK	1
42	FC70	CAP SCREW	1
43	FC71	CAP SCREW	1
44	FC72	CAP SCREW	1

45	FC73	CAP SCREW	5
46	FC74	JAM NUT	1
47	FC75	KEY	1
48	FC76	WASHER	1
49	FC77	BEVEL GEAR	1
50	FC78	SCREW	1
51	FC79	SEALED BALL BEARING	1
52	FC80	BEARING RETAINER RING	1
53	FC82	ELEVATING SCREW ASSY	1
54	FC83	HANDLE	1
55	FC84	ARM	1
56	FC85	GEARSHAFT CLUTCH INSERT	1
57	FC86	DIAL LOCK NUT	1
58	FC87	DIAL WITH GRADUATIONS	1
59	FC88	DIAL HOLDER	1
60	FC89	SOCKET HEAD CAP SCREW	1
61	FC90	BEARING RETAINING RING	1
62	FC91	GREASE SEALED BEARING	1
63	FC92	BEARING CAP	1
64	FC93	KEY	2
65	FC94	ELAVATING SHAFT	1
66	FC95	GREASE SEALED BEARING	1
67	FC96	BEVEL PINION	1
68	FC97	SET SCREW	1
69	FC98	COLUMN & BASE- K4	1
70	FC99	WASHER	1
71	FC102	SOCKET HEAD CAP SCREW	1
72	FC103	PEDESTAL	1
73	FC104	ELEVATING SCREW NUT	1
74	FC105	SOCKET HEAD CAP SCREW	1
75	FC112	CAP SCREW	1
76	FC113	NUT	1
77	FC114	MACHINE MAT	1
78	FC115	OIL FILTER	1
79	FC118	SPIDER	1
80	FC119	RAM LOCK STUD	1
81	FC120	RAM PINION	1
82	FC121	RAM PINION HANDLE	1
83	FC122	PLASTIC BALL	1
84	FC123	CHAMBERED HARDENED WASHER	1
85	FC124	TURRET	1
86	FC125	GIB SCREW NUT	1
87	FC126	GIB SCREW	1
88	FC127	LOCK BAR	1
89	FC128	SCREW	1

90	FC129	LOCKING BOLT	1
91	FC130	RAM PINION SCREW	1
92	FC131	RAM/TURRET GIB	1
93	20855	FRU-SK4-KNEE CRANK HANDLE ASSY	(1)
94	20867	FRU-SK4-CHIP COVER ASSY	(1)
95	20868	FRU-SK4-HANDLE & BAR LOCK ASSY	(1)
96	20869	FRU-SK4 FC31,FC32,FC333	(1)
97	M8-1.25X30	SCREW-SHCS-STL-BO	3

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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.

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