

ProtoTRAK & TRAK[®] CNC

Service and Troubleshooting Manual

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1.0 Installation Tools and Hardware

The following section lists the required tools and hardware for installing a ProtoTRAK/CNC2 control. It also lists the pre-installation requirements needed to complete the retrofit at the customer's shop.

1.1 Required Tools/Hardware

The following tools are necessary for a typical installation:

- 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.
- 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
- Standard or gauge blocks, 6"/150 mm
- Gauge block, 75 mm or 3"
- .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, 10 mm
- Transfer punch set
- Transfer screw set
- Feeler gage (Z glass scales)
- Pliers set
- File set
- Xacto knife with flat blade
- 3/4" 2 flute end mill
- Safety glasses

1.2 Suggested Fastener Stock

It is suggested that the ProtoTRAK/CNC2 installer has on hand the following fasteners in the event that they are inadvertently left out of the kit or lost during installation:

Qty	Fastener
6	5/16-18"x1 3/4" socket head cap screw, ballnut to yoke (BP)
6	10-32x3/8 socket head set screw, ballnut oil plug
7	1/4-20x1" hex head screw, bearing housing to drive housing bracket
4	3/8-16x2 1/2 socket head cap screw, drive bracket to table
4	oil line elbow, 15187
4	brass fitting, 15696
2	T-fitting, P2 TUB-2
6	Washers, 15759
1	3/8-24 screw, 16355-1
6	Spacer, 14772
6	8-32x3/8: socket head cap screw, mounting bracket plate
3	8-32x7/8 round head Phillips screw
2	1/2-20 nut
4	Washer, flat 3/8, 98017A200
2	Lockwasher, 91114A033
12	6-32x3/8 flat head Phillips screwdriver
3	5/16-18x2 socket head set screw
2	5/16-18x1 socket head cap screw
1	M10-1 screw, 16364-1
1	M10-1.5 screw, 16364-2
1	M10-1.5 screw, 16355-2
2	10-32x1
1	5/8-11 nut

1.3 Pre-Installation Requirements

- Power requirements: 115V, 60Hz, 1100VA, 10 amp power line dedicated to the ProtoTRAK/CNC2.
- Adequate working area around the machine to slide the table completely off the saddle.
- Availability of a lift table or cart capable of supporting the table once it is removed from the machine.

2.0 Installation Procedures

2.1 X and Y Ballscrew Installation

2.1.1 Removing the Table and Leadscrews

⚡ Tip: Before removing any of the assemblies as directed below, 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.

STEPS:

1. Center the table and remove the X gib.

⚡ Tip: If the machine has a power feed on the right end, save the left end assembly to mount later to the right end.

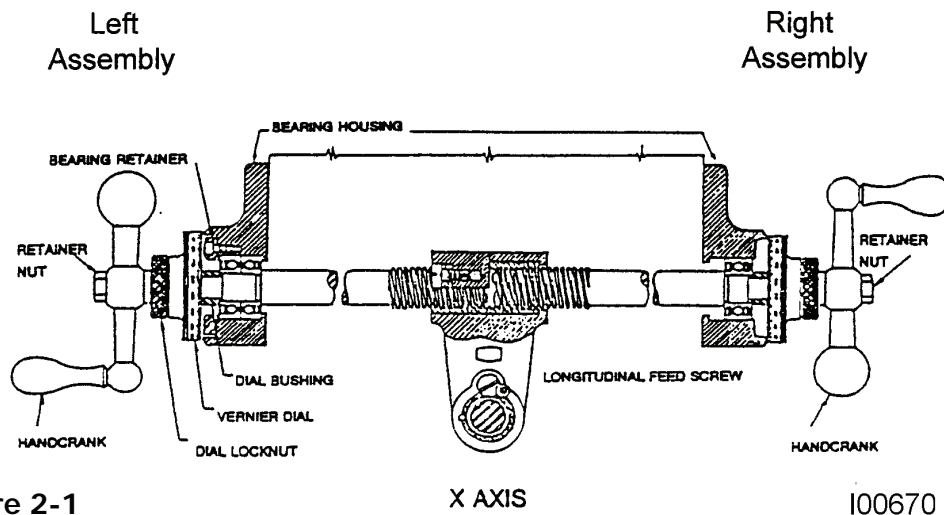


Figure 2-1
X and Y Ballscrew Installation

2. Remove the left and right bearing assemblies. Save the parts removed from the right side for use in installing the X-Axis ballscrew.
3. Slide the machine's table onto a lift table and move it away from the machine.

CAUTION!

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

4. Crank the saddle all the way forward and remove the Y-axis bearing assembly. Save the vernier dial for use with the Y-axis ballscrew.

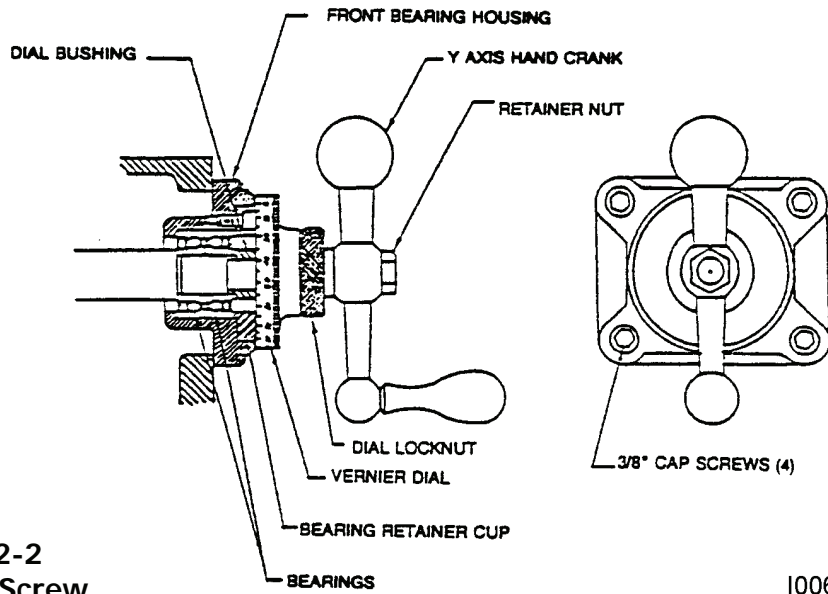


Figure 2-2
Y Lead Screw
Assembly

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5. Remove the X and Y leadscrews.

Tip: to remove a leadscrew, remove the nut retaining screw and slide the brass acme nut and the leadscrew out of the yoke together.

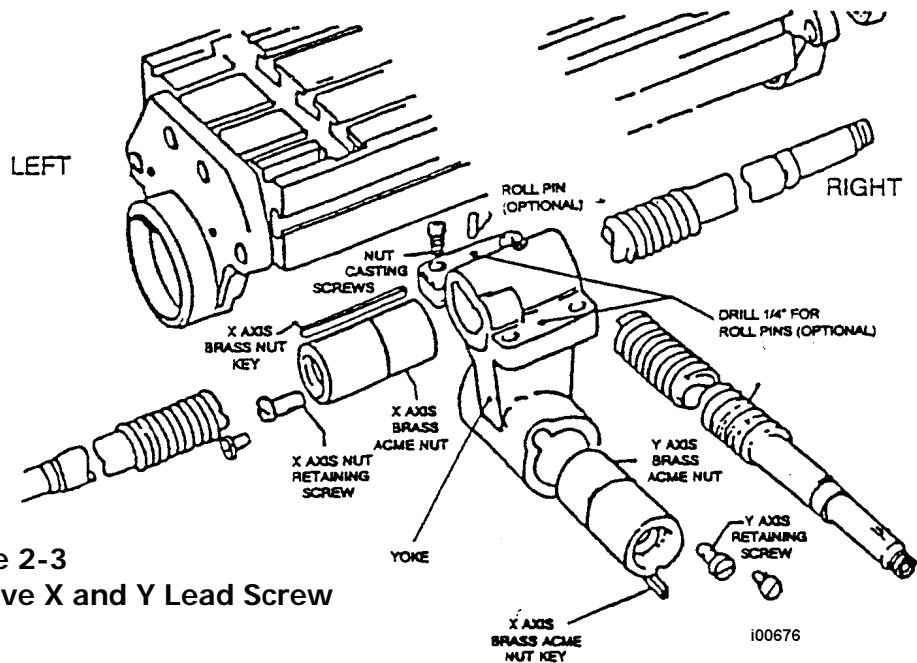


Figure 2-3
Remove X and Y Lead Screw

I00676

6. Remove the yoke from the saddle. Disconnect the oil lines from the yoke. If the yoke is to be re-used, it will be necessary to remove the brass nut key and pins. If the kit came with a yoke, the original yoke may be discarded.

- Clean the X and Y-axis gibs, oil grooves and slideways thoroughly. Also remove the sliding covers and clean them. Inspect the operation of the oiling system.

Tip: *Step 7 is worth extra care, especially with machines that have some wear, or new machines that may have some protective covering on the ways. System performance depends on smooth motion.*

2.1.2 X-Axis Ballscrew Installation - Part 1

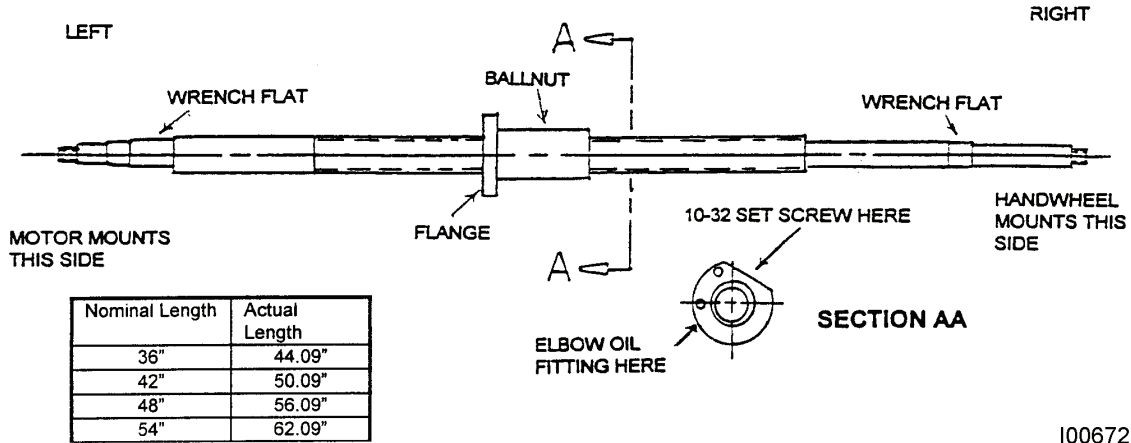
The ballscrews are to be installed in the following order:

- First - part of the X-axis ballscrew assembly.
- Second - the entire Y-axis ballscrew assembly.
- Third - the rest of the X-axis ballscrew assembly.

Parts required:

- Yoke kit 15182-(xx)
- X-Axis drive kit 15231-(xx)
- X-Axis ballscrew 14971-(xx)

X Axis Ballscrew



100672

Figure 2-4
X Axis Ballscrew

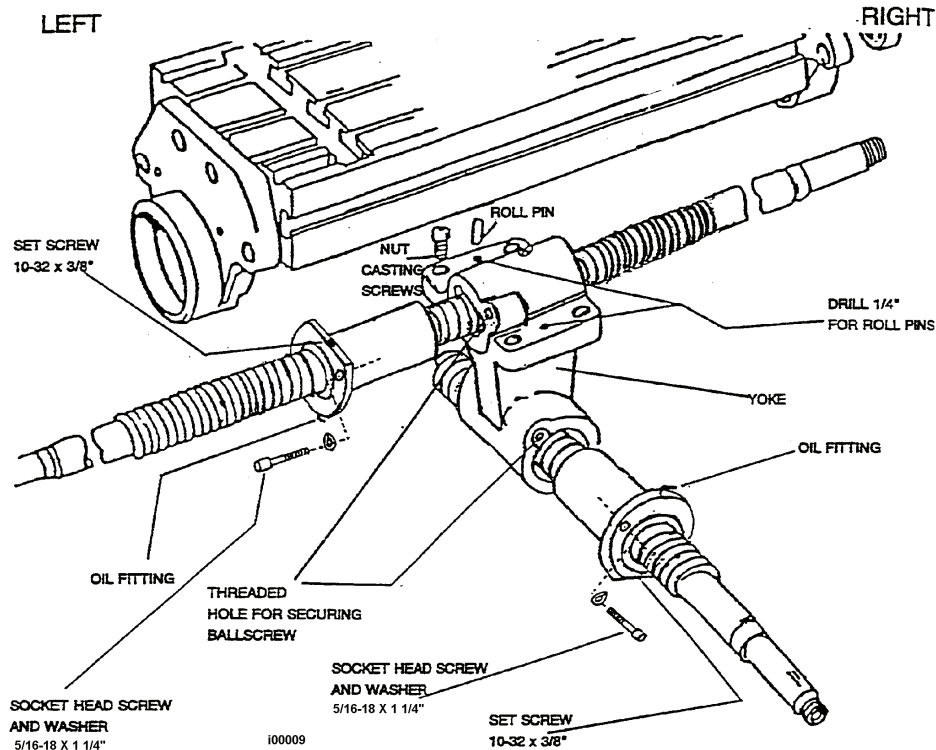
Tip: *There are wrench flats on the X and Y ballscrews for convenience.*

CAUTION!

Unlike a leadscrew, never unscrew a ballscrew from its nut.
This will destroy the ballscrew.

- Position the yoke in the saddle with the threaded hole on the left. Do not secure the yoke to the saddle yet, you will need to lift the yoke to slide in the ballscrew.

Figure 2-5
Yoke Assembly - AGE 2/3 Ballscrew



9. In the ballnut flange there are two tapped 10-32 holes. One for the provided elbow oil fitting, and one for a 10-32 setscrew. For the X ballscrew put the elbow oil fitting in the hole on the radius of the flange, and the setscrew in the hole on the flat. The function of the setscrew is only to prevent oil from flowing out of the ballnut. Screw it as far as possible being careful not to contact and deform the nylon wiper.
10. Attach the provided plastic oil line to the elbow oil fitting.
11. Slide the ballscrew into the yoke with the flange of the ballnut to the left. Do not install the 5/16-18 x 1 3/4" screw yet.
12. Secure the yoke to the saddle with the 4 screws, make it snug but not tight. You will need to move the yoke a little to align the ballscrew.
13. Secure the ballnut to the yoke with the 5/16-18 x 1 3/4" screw.
14. (Optional) If the yoke was pinned previously, replace the pins and then tighten the yoke to the saddle.
15. If the yoke was not pinned, it will be necessary to align the ballscrew:

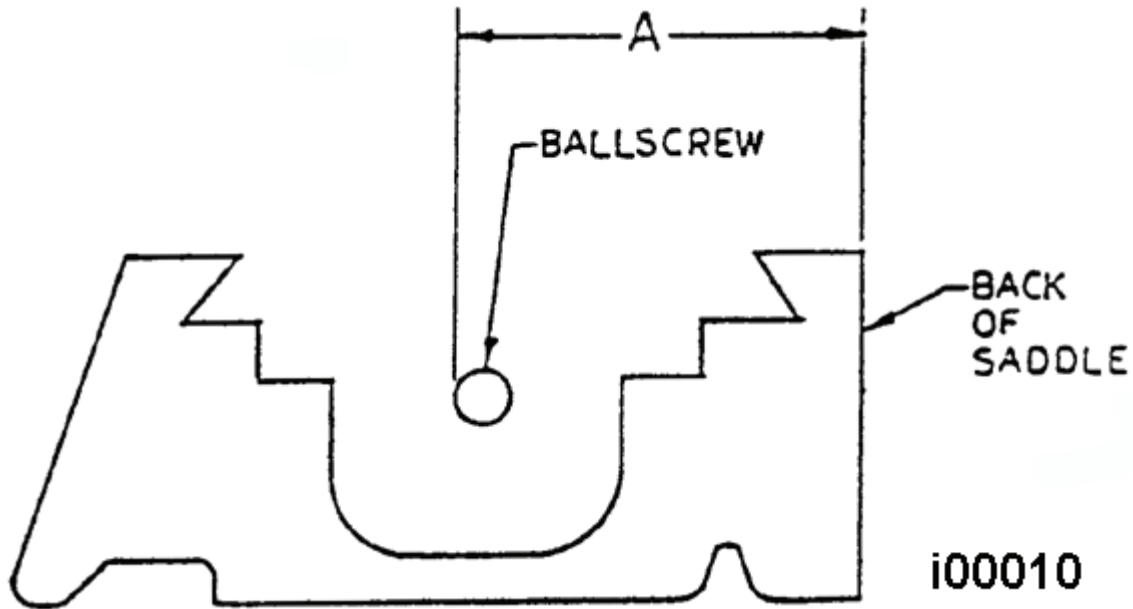


Figure 2-6 Ballscrew Alignment Measurement

Take measurement "A" on the left and right sides of the saddle casting. So that the measurements are comparable, measure from the OD of the thread of the ballscrew on both sides.

***Note:** If the back of the saddle casting is not a suitable reference, it may be necessary to position a piece of round stock inside the back dovetail to be used as a reference point.*

Adjust the position of the yoke until the two measurements are within 0.005" end to end (maximum).

CAUTION!

The alignment of the ballscrew is crucial. Misalignment can cause damage to the ballscrews and drive assemblies as well as poor system performance.

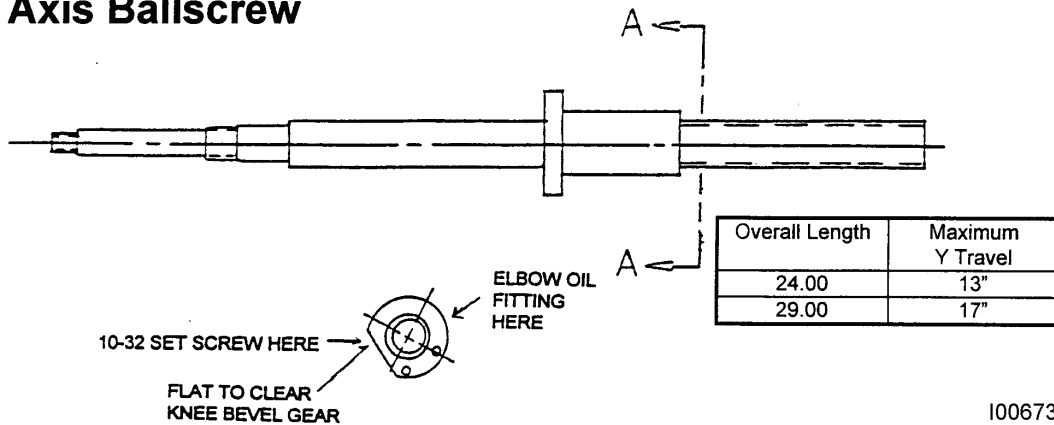
16. Tighten the yoke to the saddle casting. Check the alignment again to be sure the yoke did not move as it was tightened. Pin the yoke in position using the provided roll pin.

2.1.3 Y-Axis Ballscrew Installation

Parts required

- Yoke kit (already opened) – 15182(xx)
- Y-Axis drive assembly – 15230(xx)
- Y-Axis ballscrew – 14972(xx)

Y Axis Ballscrew



100673

Figure 2-7
Y-Axis Ballscrew

CAUTION!

Unlike a leadscrew never unscrew a ballscrew from its nut.
This will destroy the ballscrew.

17. In the Y-axis ballscrew, put the 10-32 set screw in the hole on flat part of the ballnut flange and the elbow oil fitting in the hole on the radius.
18. Attach the provided plastic oil line to the elbow oil fitting.
19. Pull the saddle all the way forward and install the ballscrew into the yoke with the provided 5/16-18 x 1 3/4" screw. The flat of the ballnut flange should match up with the flat on the yoke. These flats are there so that the yoke and ballnut will clear the bevel gear. Check that these clear now by pushing the saddle back.

If the yoke provided in the kit does not clear the bevel gear, it will be necessary to remove enough material from it so that it will clear.

Also check that the elbow fitting will clear the casting at the top front of the knee. If it interferes, it will be necessary to screw it down more, or grind away the casting to clear.

20. Route the oil line up through the hole in the saddle to the right rear of the yoke, trim it appropriately and attach it to one of the oil lines of the machine.

(KIT VARIATION: SOME MACHINES DO NOT HAVE SEPARATE OIL LINES RUNNING TO EACH LEADSCREW. USE THE SUPPLIED T FITTING TO ROUTE OIL TO EACH BALLSCREW.)

CAUTION!

Make sure that the oil line will not be sheared by the sliding covers when the saddle moves.

(KIT VARIATION: ON MACHINES WITH OIL RESTRICTORS ON THE YOKE, USE THE SUPPLIED BRASS FITTING AND THE ORIGINAL RESTRICTOR.)

21. Install the Y-axis drive assembly as shown (figure 2-8) in the following order:
 - a. Ballscrew.
 - b. Motor mounting bracket (item #1)

- c. Bearings and shim (items #27, 32, 47)
- d. Bearing retainer ring (item #25)
- e. Slip clutch (items #54, 10)
- f. Belt (item #22)
- g. Dial holder & vernier dial (items #11, 33)
- h. Handwheel (item #16)
- i. Motor – keep drive belt tight

Tip: Pushing down firmly on the motor (25-50 pounds) should install the drive belt sufficiently tight.

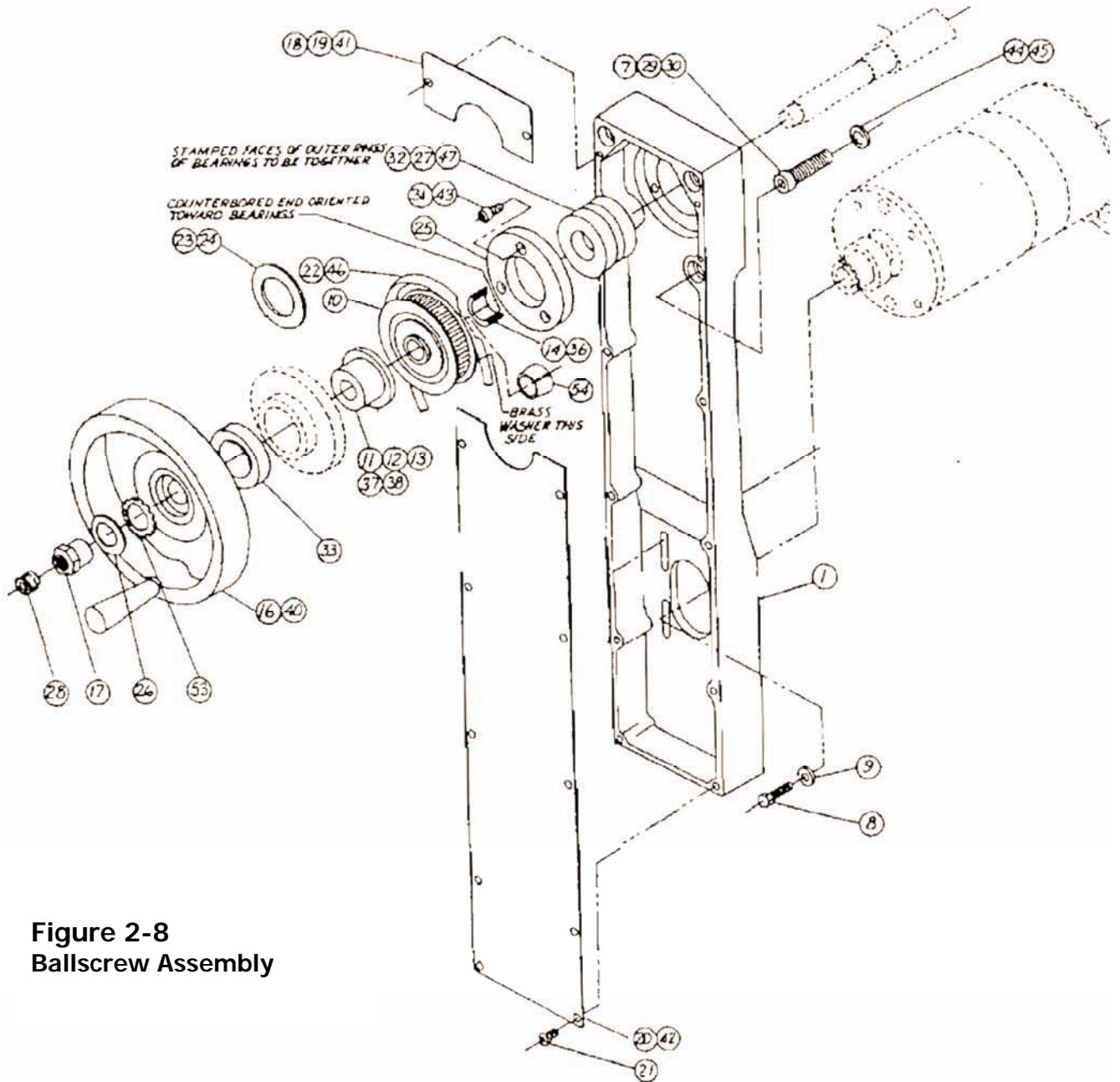


Figure 2-8
Ballscrew Assembly

Ballscrew Assembly Parts List

Part No.	Description	Item
15430	Brass ferrule	54
3/4"	Washer	53
#6	Washer, lock, split	51
SW-0278-10	Shim, .010 thick	47
890-5M-15	Belt, timing, 5 mm	46
M8	Washer, flat	45
98017A200	Washer, flat	44
1/4-20 X 1 1/4"	Screw, soc. head	43
14852-9	Cover	42
14852-7	Cover	41
14851-3	Handwheel	40
14852-5	Spacer	38
14852-4	Spacer	37
14852-3	Spacer	36
H-69	Nut, dial lock	33
RM204KT4DB	Bearing, matched pair	32
1/4-20 X 1/2"	Screw, soc. head	31
M8-1.25 X 65MM	Screw, soc. head	30
M10-1.5 X 60MM	Screw, soc. head	29
91376A707	Screw, set, 1/2-20 X 1/2	28
SW-0278-5	Shim, .005" thick	27
97063A113	Washer, 3/4 x 1 1/4	26
14724	Ring, bearing retainer	25
5702-411-30	Washer	24
5702-333-30	Washer	23
1000-5M-15	Belt, timing, 5 mm	22
#6-32 X 3/8"	Screw, flat head, Phil.	21
15243	Cover	20
15242-1	Cover-upper	18
14728	Nut	17
15314-1	Handwheel	16
14725-1	Spacer	14
14919	Dial holder	13
14887-5	Dial holder	12
14841-3	Dial holder	11
14844-2	Slip clutch assembly	10
1/4"	Washer	9
1/4-20 X 1"	Screw, Hex Head	8
3/8-16 X 2"	Screw, Soc. Head	7
15214-1	Bracket – motor mounting	1

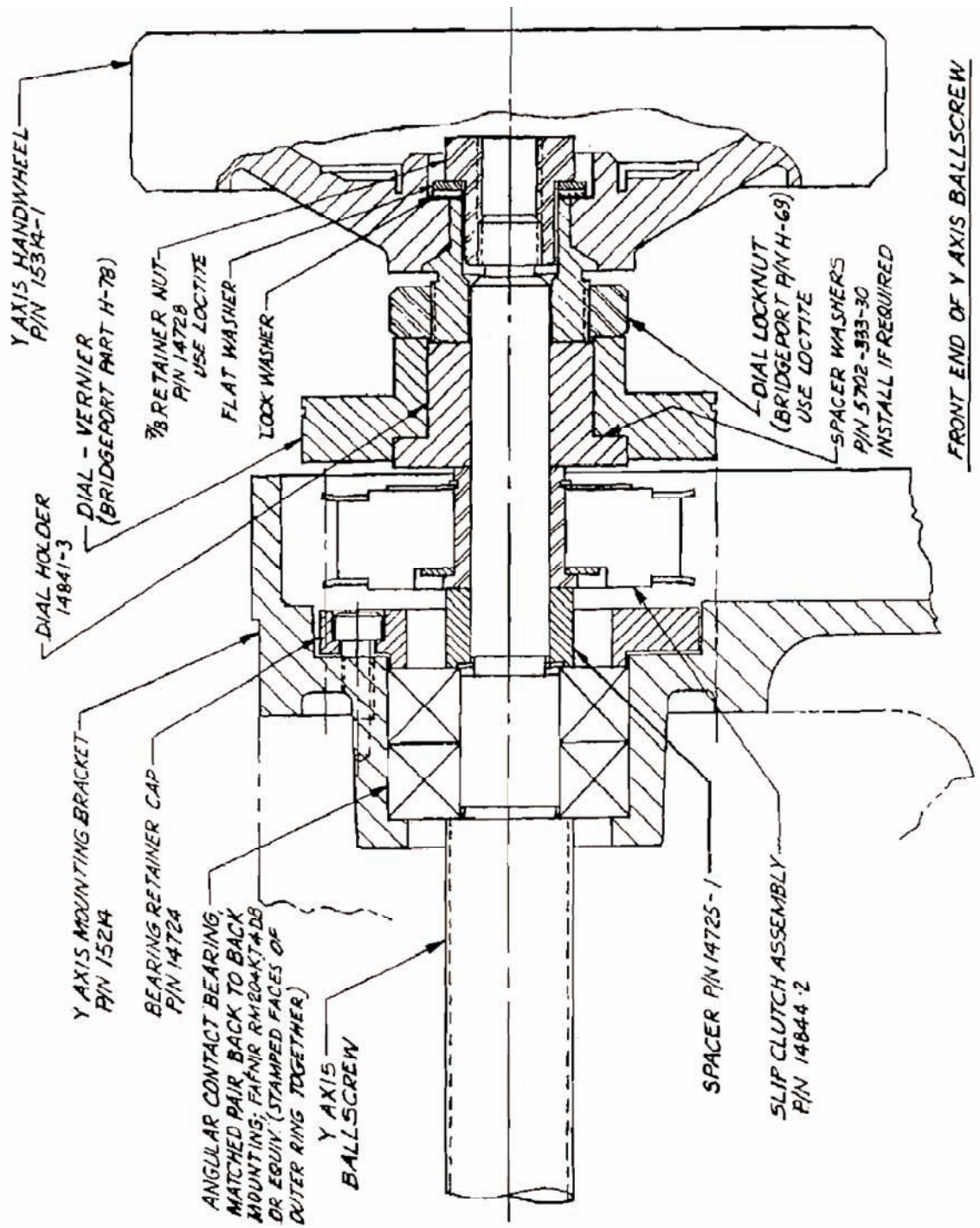


Figure 2-9
Y Axis Ballscrew – Front End

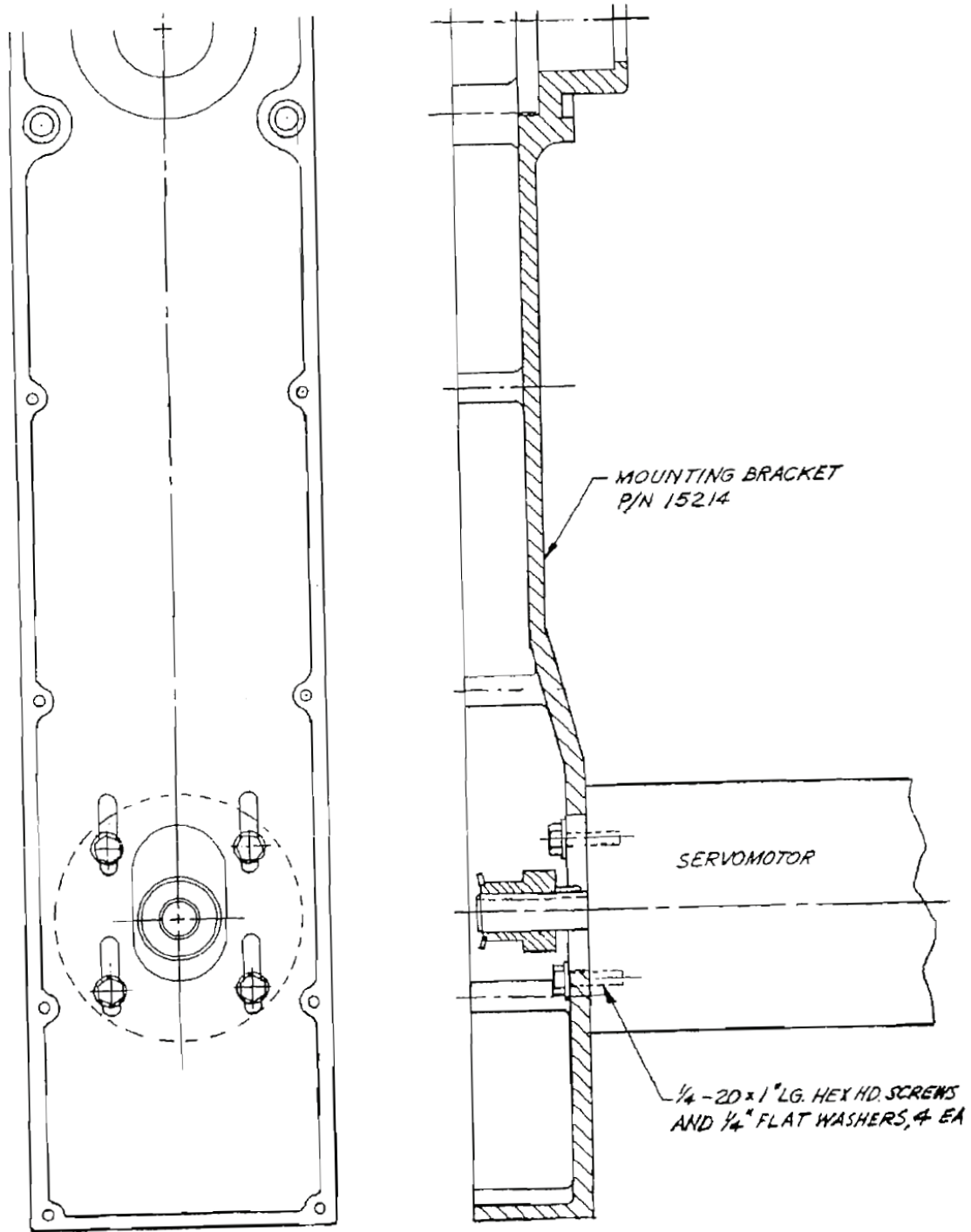


Figure 2-10
Y Axis Motor Mounting

CAUTION!

Unlike a leadscrew never unscrew a ballscrew from its nut.
This will destroy the ballscrew.

- 22. Attach the X-Axis ballscrew oil line. Liberally lubricate all way surfaces.
- 23. Screw the X-Axis ballscrew out of the way and remount the table. Oil and reinstall the X gib.

CAUTION! Make sure the gib locks have not fallen into the saddle before you slide the table back on.

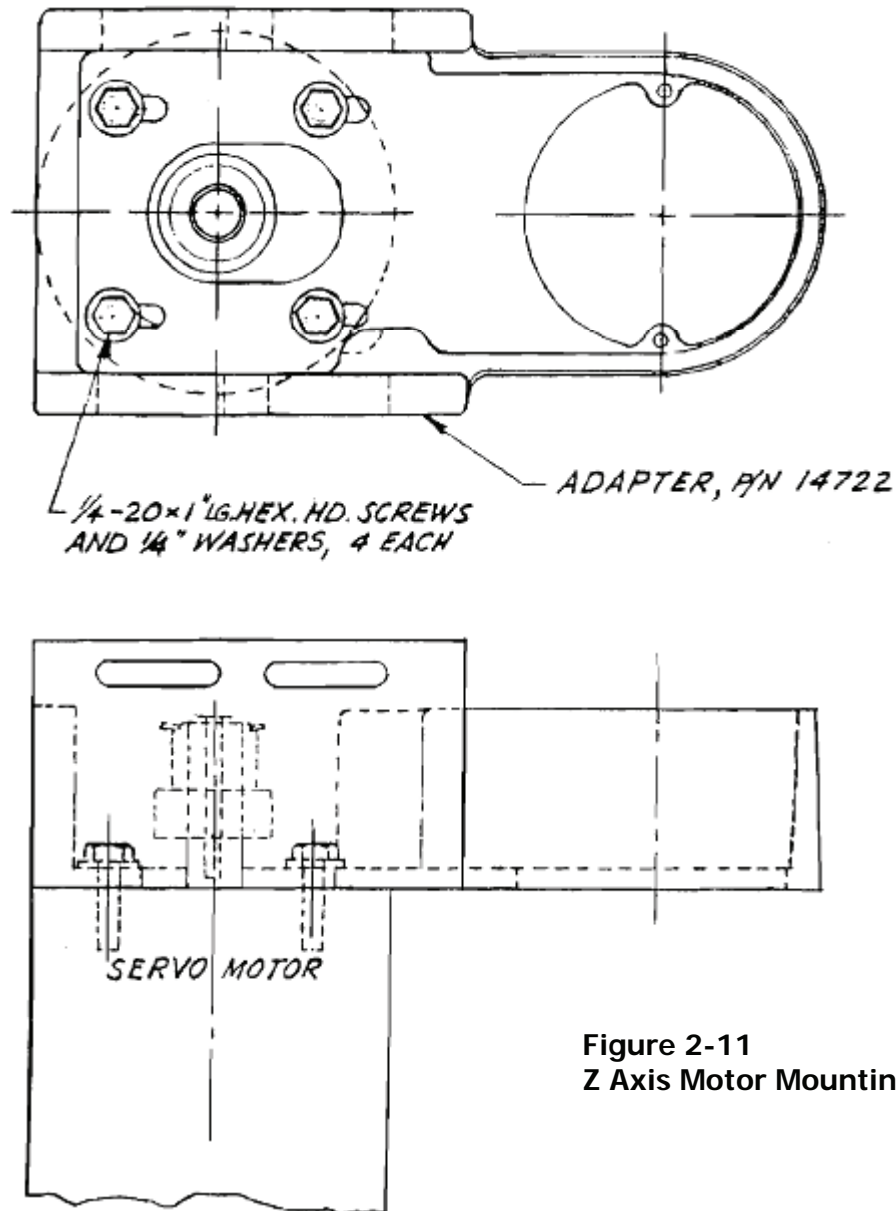


Figure 2-11
Z Axis Motor Mounting

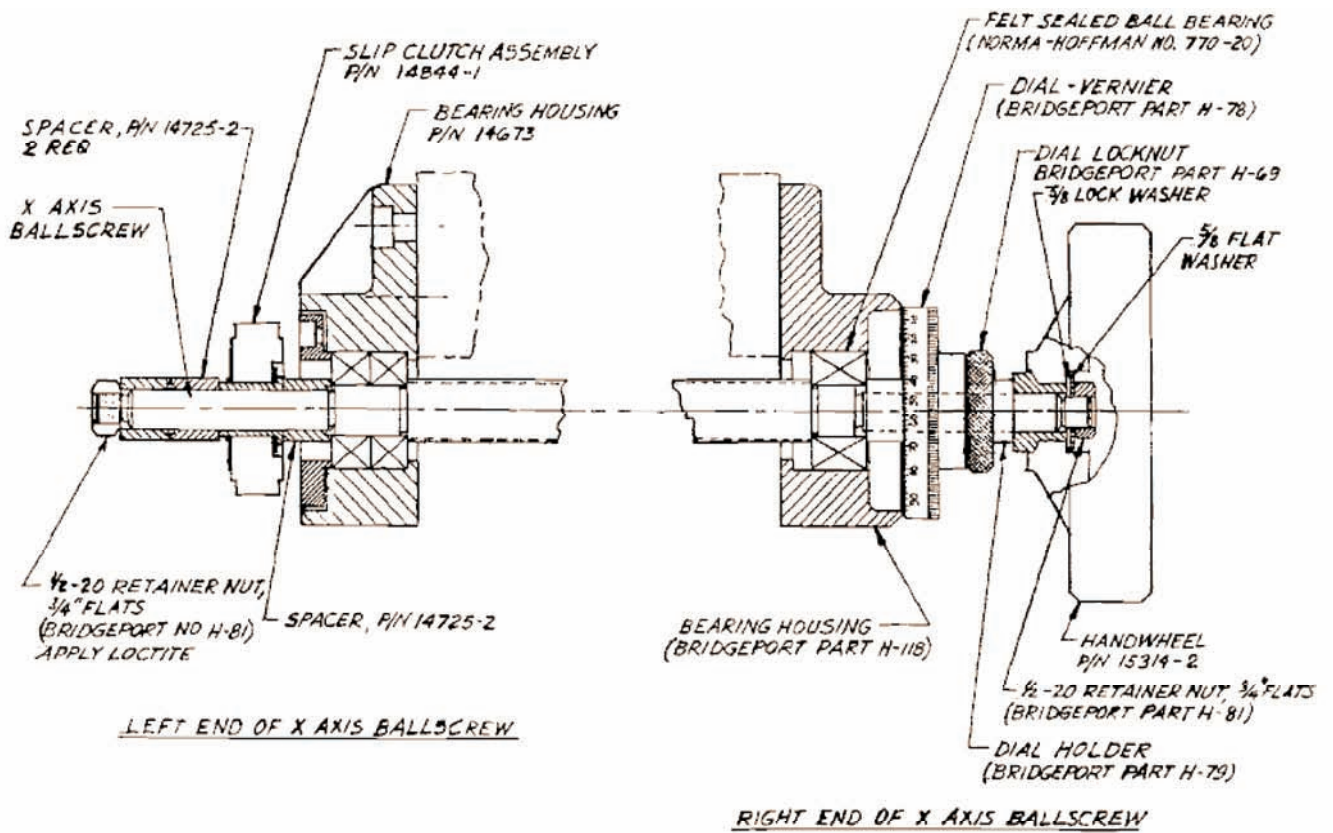


Figure 2-12
X Axis Ballscrew

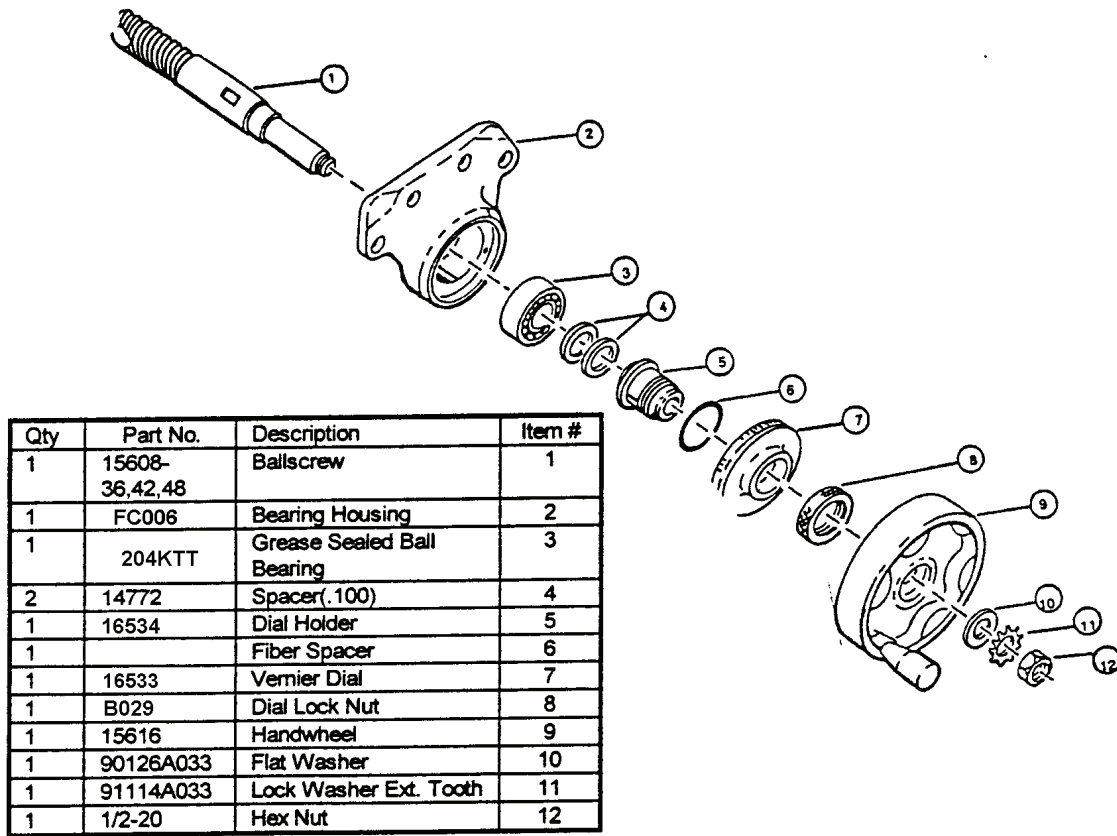
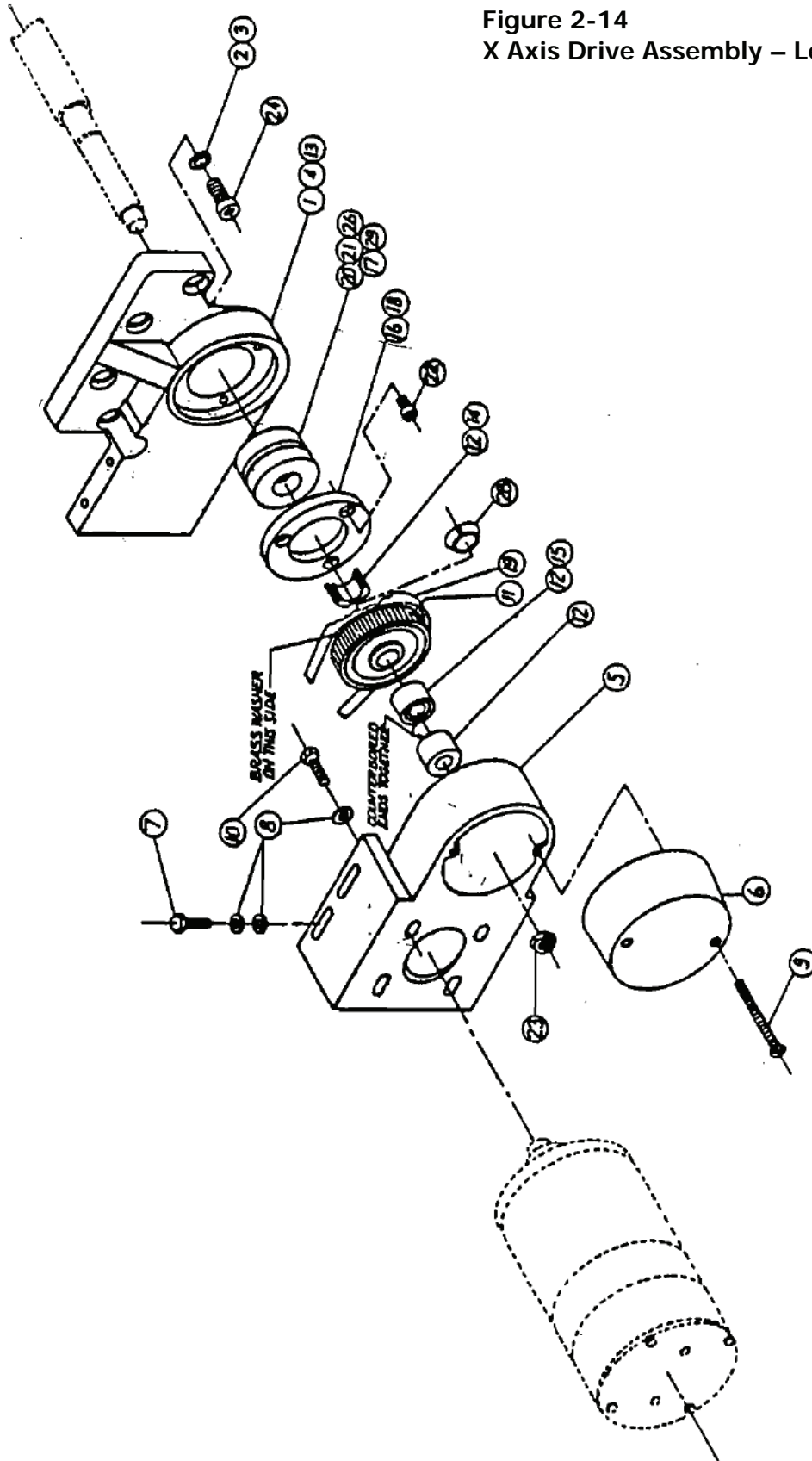


Figure 2-13
Drive Assembly – X Axis, Right Side

Figure 2-14
X Axis Drive Assembly – Left Side



X Axis Drive Assembly – Left Side Parts List

Part No.	Description	Item
SW-0151-10	SHIMS, .010 THICK	29
15430	BRASS FERRULE	28
SW-0278-10	SHIMS, .010 THICK	26
W205PP-C3	BEARING, RADIAL	25
3/8-16 X 1"	SCREW, SOC.HD.	26
1/2-20	NUT, HEX	23
1/4-20 X 1/2"	SCREW, SOC.HD	22
SW-0278-5	SHIMS, .005 THICK	21
RM204KT4DB	BEARING, MATCHED PAIR	20
400-5M-15	BELT, TIMING, 5 MM	19
14852-2	RING, BEARING RETAINER	18
SW-0151-3	SHIMS, .003 THICK	17
14724	RING, BEARING RETAINER	16
14851-5	SPACER	15
14851-4	SPACER	14
14673-1	HOUSING, BEARING	13
14725-2	SPACER	12
14844-1	SLIP CLUTCH ASSEMBLY	11
1/4-20 X 1"	SCREW, FLT.HD.	10
#6-32 X 2 1/2"	SCREW, FLT.HD	9
1/4"	WASHER, FLAT	8
1/4-20 X 1"	SCREW, HX, HD	7
14623	CUP	6
14722	ADAPTER, SERVOMOTOR	5
14851-1	HOUSING, BEARING	4
M8 (NARROW)	WASHER, FLAT	3
98017A200	WASHER, FLAT	2
14673	HOUSING, BEARING	1

24. Install the left end assembly items A, 7 and 8 as shown in Figure 2-14.
25. Slide the table so that the left end of the table is approximately over the left end of the ballscrew and install the drive housing onto the table with the four 3/8 -16 x 2 1/2" socket head cap screws.
26. Slide the table to the right and secure the drive housing bracket to the bearing housing per Figure 2-14.
27. Screw the ballscrew so that the table is positioned with the right side of table almost flush with the right edge of the saddle.

↳ Tip: *Temporarily install the 1/2 - 20 nut on the right of the ballscrew and use this to turn the ballscrew.*

28. Install the X-axis drive assembly (left side) – Figure 2-14 – in the following order:
 - a. Ballscrew
 - b. Bearing housing (item 1)
 - c. Bearings and shim (items 20, 21)
 - d. Bearing retainer ring (item 16)
 - e. Slip clutch belt (items 11, 19, 28)
 - f. Servo motor adapter bracket (item 5)
 - g. Motor with belt.

29. Install the original machine right side assembly and the SWI provided handwheel as per Figure 2-12. Tighten 1/2-20 nut to 50 ft/lb. (If the machine had a power feed, use the hardware from the left side).

Note: If the ballscrew requires a ballscrew extension see Step 30 - "Installing ballscrew extensions". Otherwise go to Step 31.

30. Ballscrew Extension Installation
 - a. Slide bushing onto end of ballscrew.
 - b. Screw threaded extension snugly onto ballscrew.
 - c. Tighten setscrew (inside of threaded extension) finger-tight.
 - d. Back off the threaded extension 1/16 of a turn.
 - e. Tighten setscrew.
 - f. Using two wrenches, tighten the threaded extension to the ballscrew.

31. Make a preliminary gib adjustment for each of the table and saddle gibs. Tighten the gibs until there is a noticeable drag on the table and saddle and then gradually loosen until the drag goes away and the motion is smooth again.

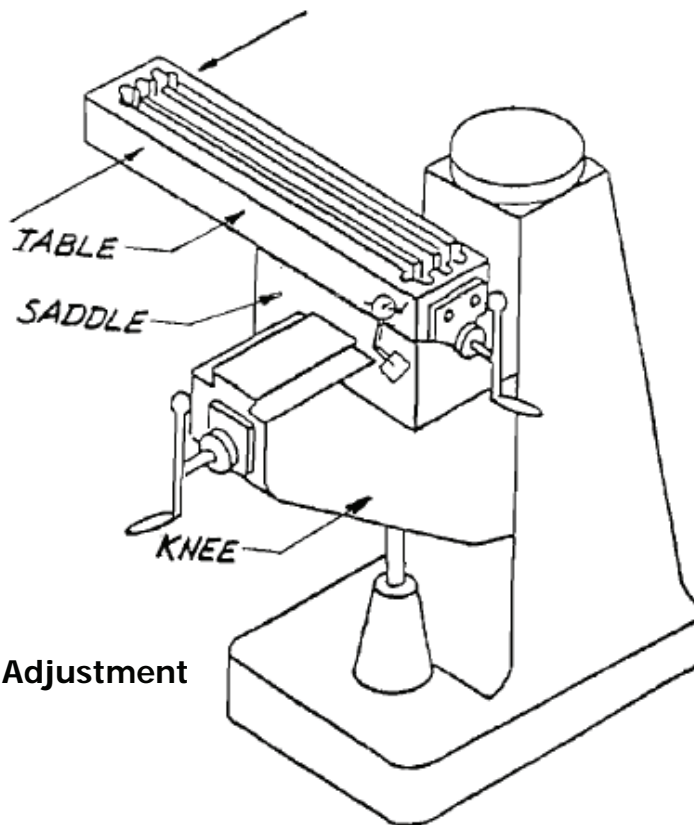
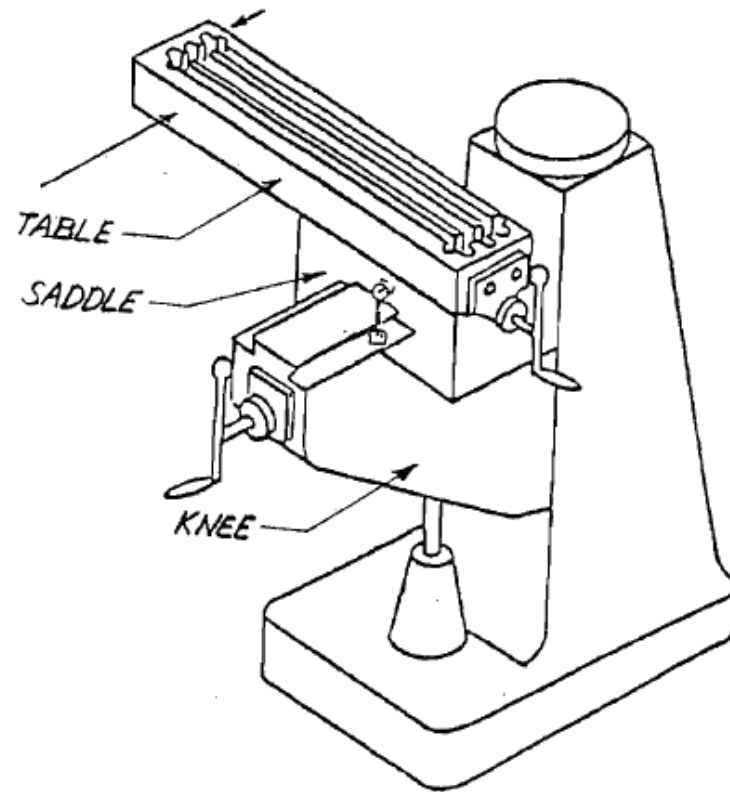
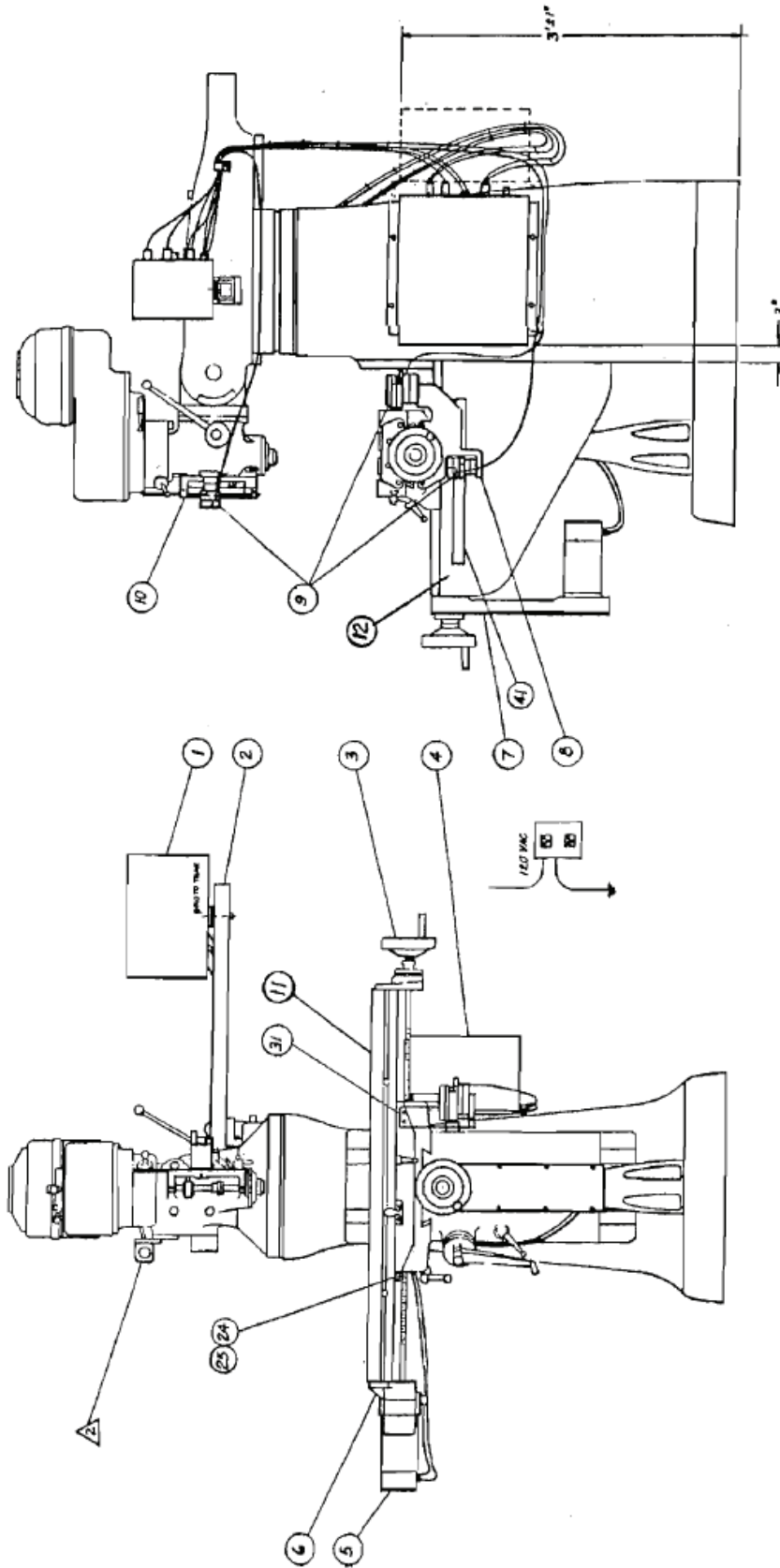
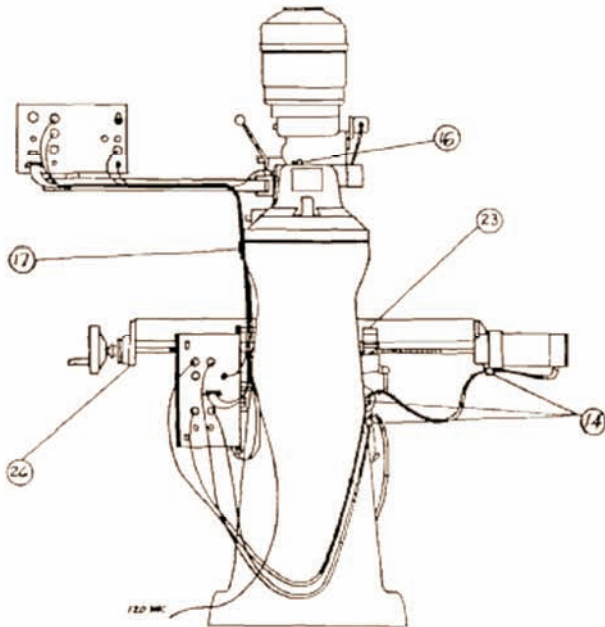


Figure 2-15
Checking Gib Adjustment

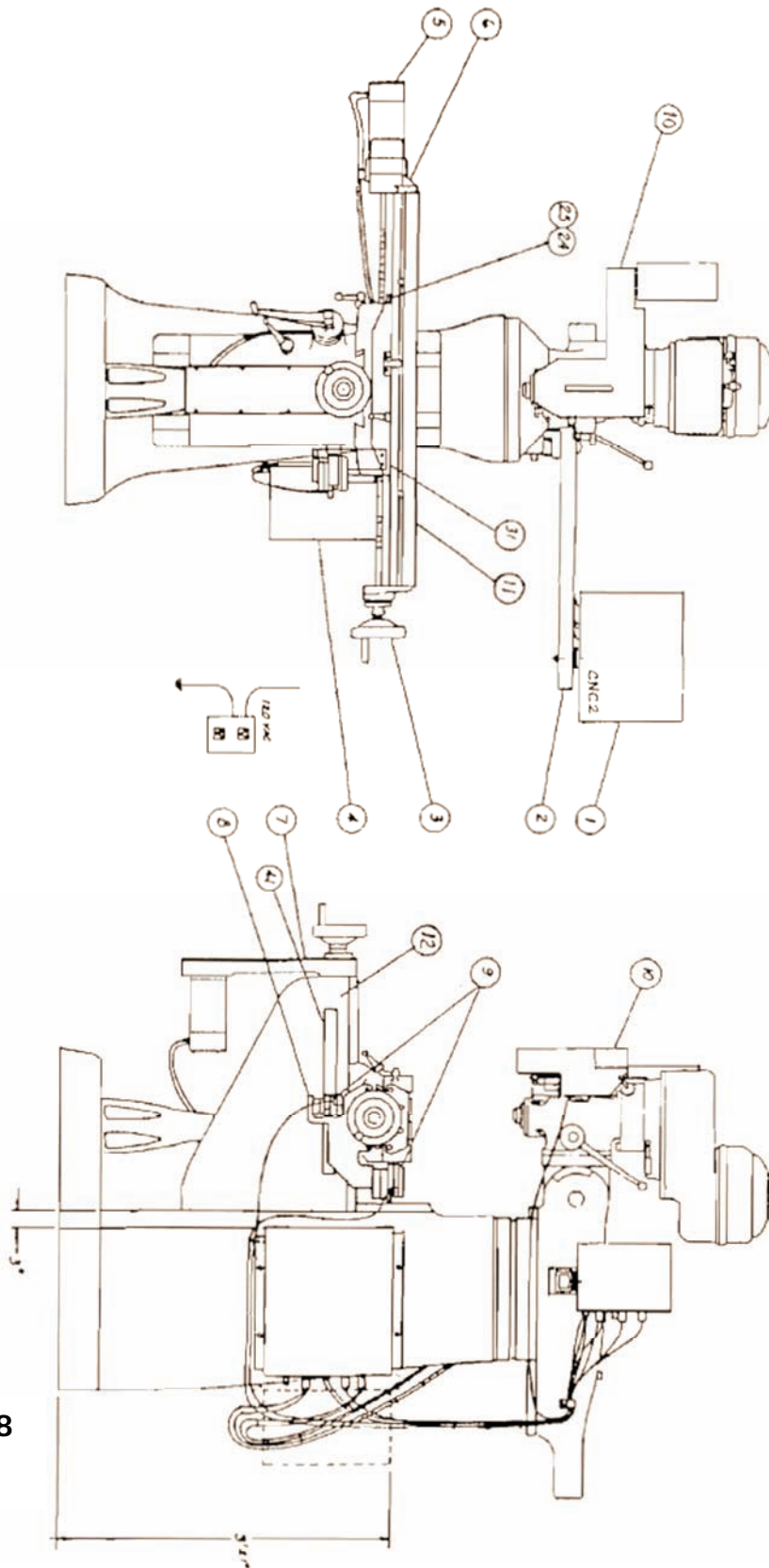


**Figure 2-16
For ProtoTRAK**

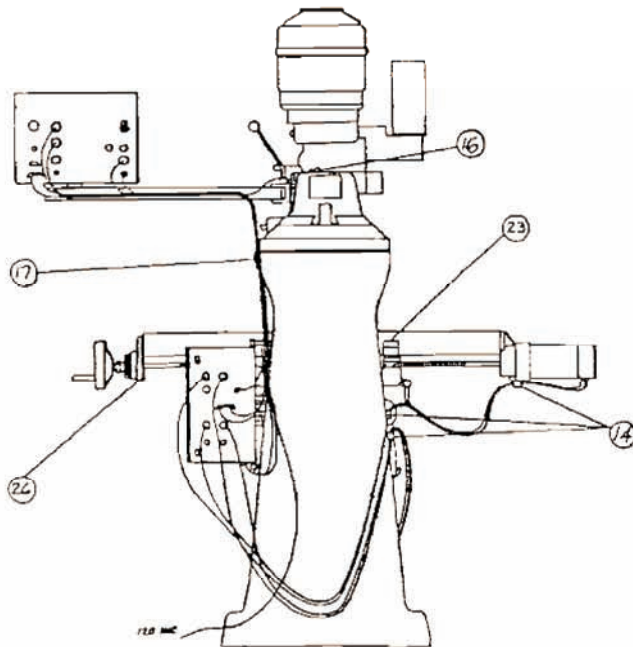


DESCRIPTION	ITEM NO.
E-STOP ASSEMBLY	19
TIE, PLASTIC-CABLE, 8" LG.	18
CLAMP-CABLE, SPECIAL	17
CLAMP-CABLE, PLACTIC	16
SCREW,CAP,SOC.HD,STL,BLK.OX	15
CLAMP-CABLE	14
DOCUMENTS	13
BALLSCREW ASSY. - Y AXIS	12
BALLSCREW ASSY. - X AXIS	11
BRACKET ASSEMBLY - Z AXIS	10
SENSOR ASSEMBLY	9
BRACKET ASSEMBLY - X & Y AXIS	8
DRIVE ASSEMBLY - Y AXIS	7
DRIVE ASSY-X AXIS LFT.END.TBL.	6
MOTOR & ENCODER ASSY-X&Y AXIS	5
POWER UNIT ASSEMBLY	4
DRIVE ASSY-X AXIS,RT.END.TBL.	3
PENDANT BAR ASSEMBLY	2
PENDANT DISPLAY ASSEMBLY	1

Figure 2-17
Rear view for ProtoTRAK



**Figure 2-18
For CNC2**



DESCRIPTION	ITEM NO.
TIE, PLASTIC-CABLE, 8" LG.	18
CLAMP-CABLE, SPECIAL	17
CLAMP-CABLE, PLACTIC	16
SCREW,CAP,SOC.HD,STL,BLK.OX	15
CLAMP-CABLE	14
DOCUMENTS	13
BALLSCREW ASSY. - Y AXIS	12
BALLSCREW ASSY. - X AXIS	11
BALLSCREW ASSEMBLY - Z AXIS	10
SENSOR ASSEMBLY	9
BRACKET ASSEMBLY - X & Y AXIS	8
DRIVE ASSEMBLY - Y AXIS	7
DRIVE ASSY-X AXIS LFT.END.TBL.	6
MOTOR & ENCODER ASSY-X&Y AXIS	5
POWER UNIT ASSEMBLY	4
DRIVE ASSY-X AXIS,RT.END.TBL.	3
PENDANT BAR ASSEMBLY	2
PENDANT DISPLAY ASSEMBLY	1

Figure 2-19
Rear View for CNC2

2.2 Mounting the M5 Base

Note: In each sensor hardware package, there are four (4) ¼-28 adjustment screws. Two of these are dressed (pusher screws) and two are not (puller screws).

- Step 1: Screw the pusher screws through the tapped holes in the bracket from the bottom up so that there are approximately three (3) threads exposed (this dimension may change as necessary).
- Step 2: (See figure 2-19: Place the M5 base on the pusher screws with the tilt screw away from the running surface.
- Step 3: Place on the two puller screws a brass spherical washer and then a steel washer. The puller screws will go through the bracket and thread into the tapped holes in the bottom of the M5 base. Finger-tighten the puller screws at this time.
- Step 4: Place a bubble level on top of the table aligned along the direction of travel and note the bubble location.
- Step 5: Place the bubble level across the two bumps on the top of the base parallel to the direction of travel and adjust the puller screws until the bubble position is the same as it is on the table. This assures repeatability.
- Step 6: Use a machinist square to ensure that the base is square to the running surface horizontally and vertically.

Step 7: Tighten the pusher screws while keeping the base level and square to the running surface.

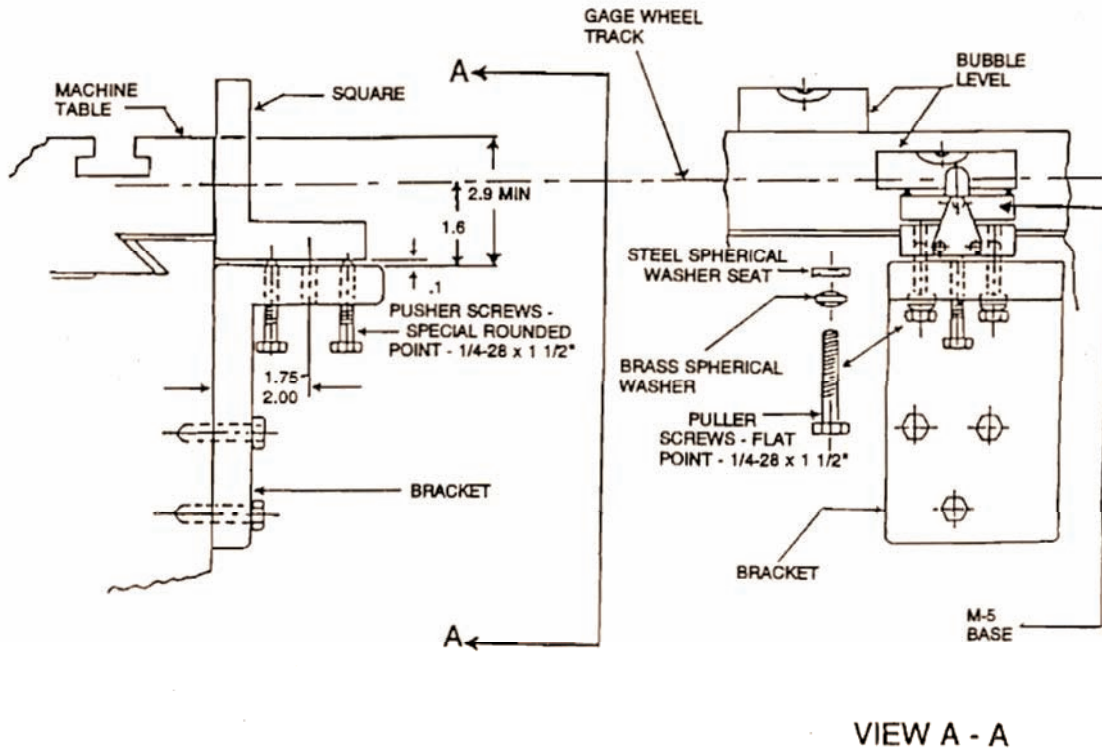


Figure 2-20
Mounting the M5 Base

2.3 Mounting the TRAK Sensor

- Step 1: Mount the sensor on the M5 base, as shown.
- Step 2: Using a machinist square, adjust the tilt screw so that the top of the sensor is perpendicular to the running surface.
- Step 3: Insert the 8-32 1 3/8 clamp screw and washer through the slot in the sensor tang, the hole in the hardened "L" washer, and the rubber "O" ring, and screw it into the tapped hole in the top of the M5 base.

Note: The hardened "L" washer goes beneath the tang with the lip pointed up and along the inside.

- Step 4: Push the sensor forward lightly until the wheel engages the running surface. Snug the 8'32 clamp screw.

- Step 5: Tighten the 1/4-28 X 1" load screw until the top white line on the side of the M5 base is between the bottom white lines. Do not overload this adjustment.
- Step 6: Finish tightening the clamp screw.

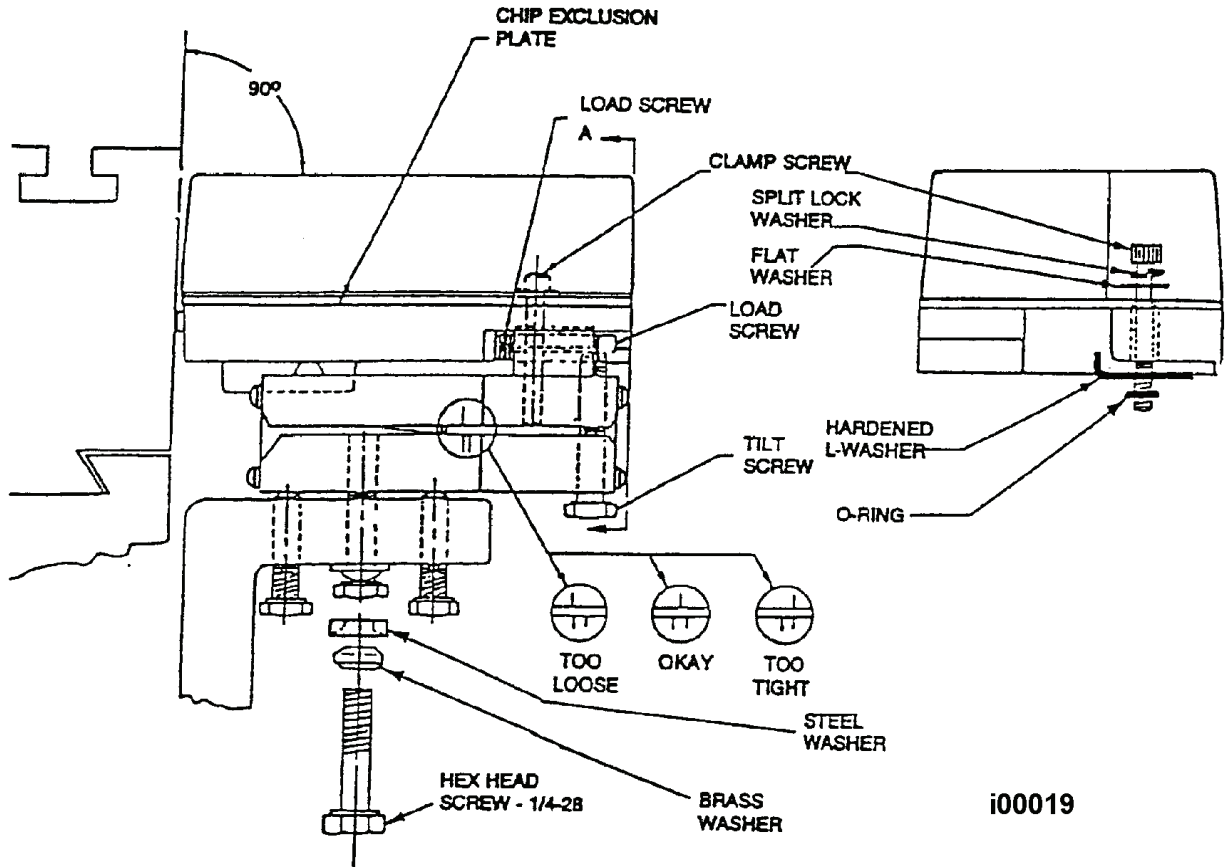


Figure 2-21
Mounting the TRAK Sensor

2.4 X-Axis TRAK Sensor Installation

Note:

- a) *The X sensor is mounted on the left rear of the saddle for Bridgeport Series I machines, but it could be mounted on the right rear with a different bracket on different machines.*
- b) *See figures ...*

- Step 1: Slide the table to the right so that the left edge of the table is approximately flush with the left side of the saddle.
- Step 2: (See Figure 2-22): Install the X sensor bracket (15725-1) as follows:

- a. Install the M5 base assembly on the bracket, but do not tighten the screws at this time.
- b. Mount the TRAK sensor on the M5 base temporarily.
- c. Place the bracket against the saddle on the left of the machine so that the top of the bracket is .010"-.020" from the back of the table and the sensor wheel clears the drain hole and any other holes which may be in the back of the table.

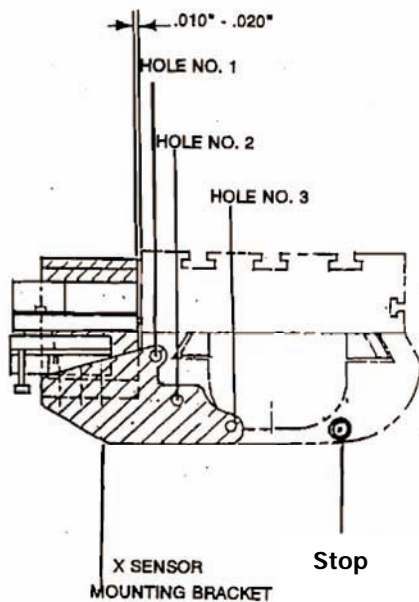
Note: Keep the sensor wheel as low as possible. If feasible, the bottom edge of the chip scraper should be in line with the bottom edge of the table.

- d. Transfer hole #1 from the bracket to the saddle. Drill and tap a 1/4-20 hole and secure the bracket to the saddle with one 1/4-20 X 1 1/14" screw.
 - e. Remove the sensor from the base, but leave the base on the bracket.
 - f. Adjust the bracket so that the top is approximately .010" to 0.020" from the back of the table.
- ↳ Tip: Use the cover of this manual as a gage between the bracket and the table.
- g. Transfer holes #2 and #3 to the saddle. Drill and tap 1/4-20 holes and secure the bracket with two (2) 1/4 -20 x 1 1/4 screws.

Step 3: Complete M5 base installation.

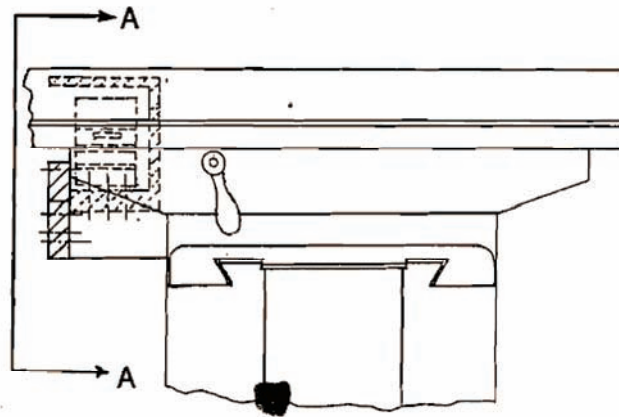
Step 4: Remount the M250 sensor. The sensor must clear the drain holes, etc. in the table.

Step 5: See figure 2-21. Route the sensor cable to the left and around the rear of the machine. Plug it into the computer box.



VIEW A - A

**Figure 2-22
Installation X Sensor Using
BR1P (15725-1) Bracket**



FRONT VIEW OF MILL

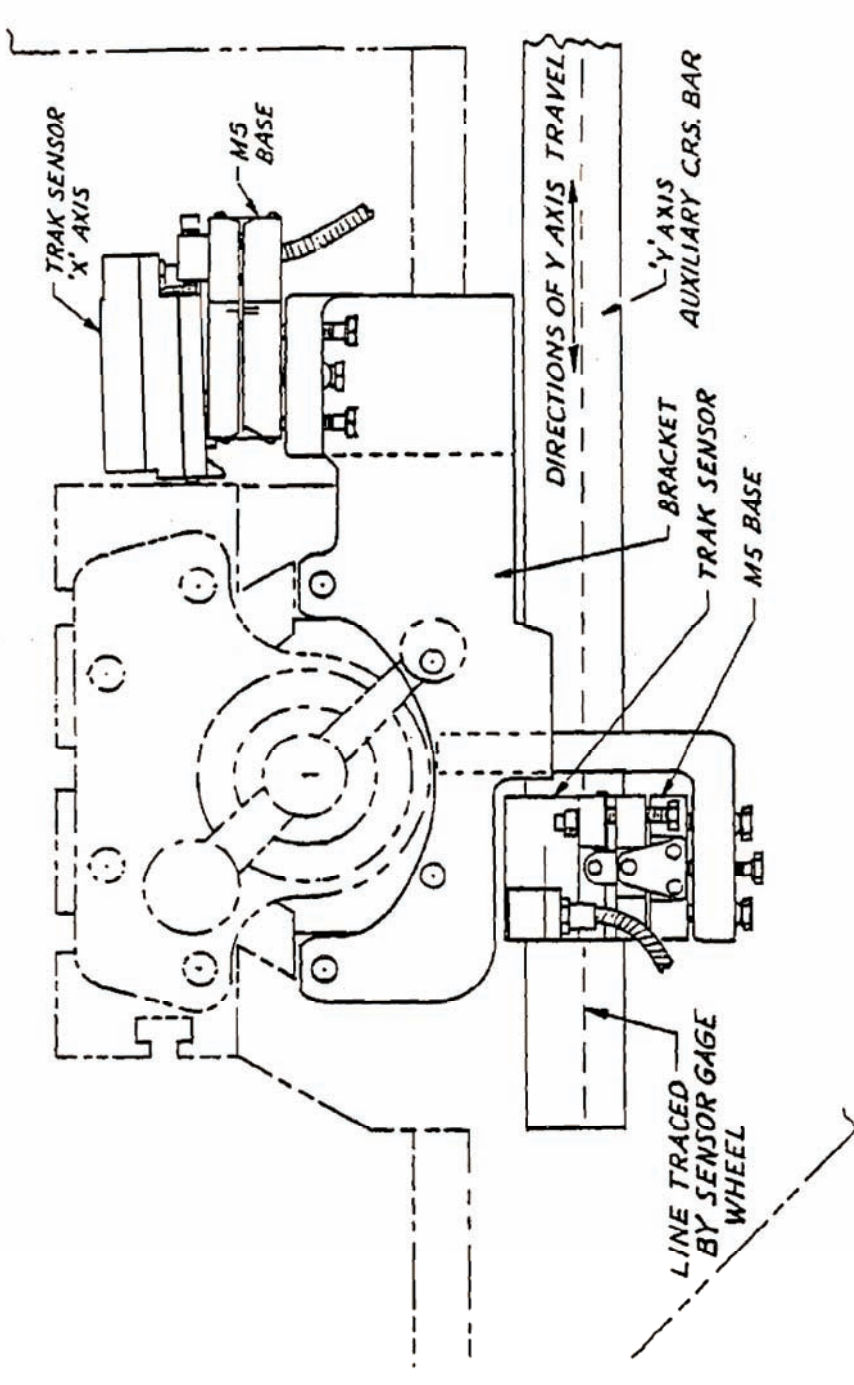


Figure 2-23

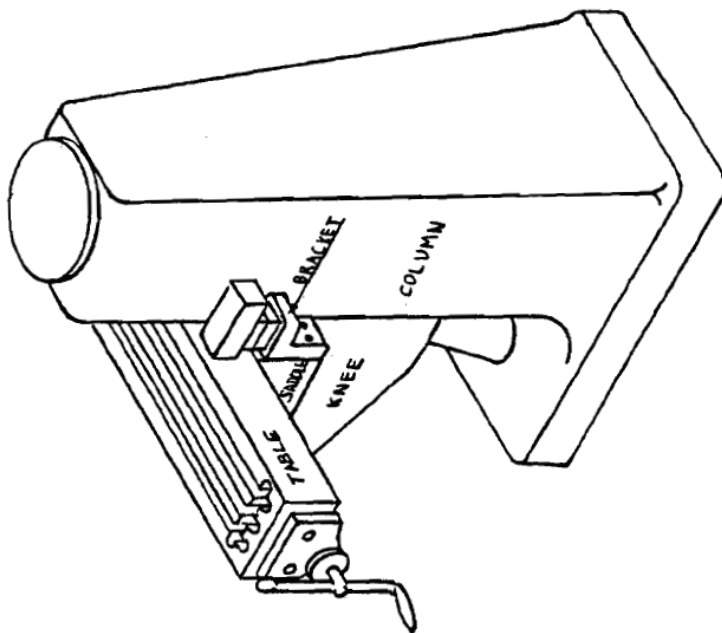
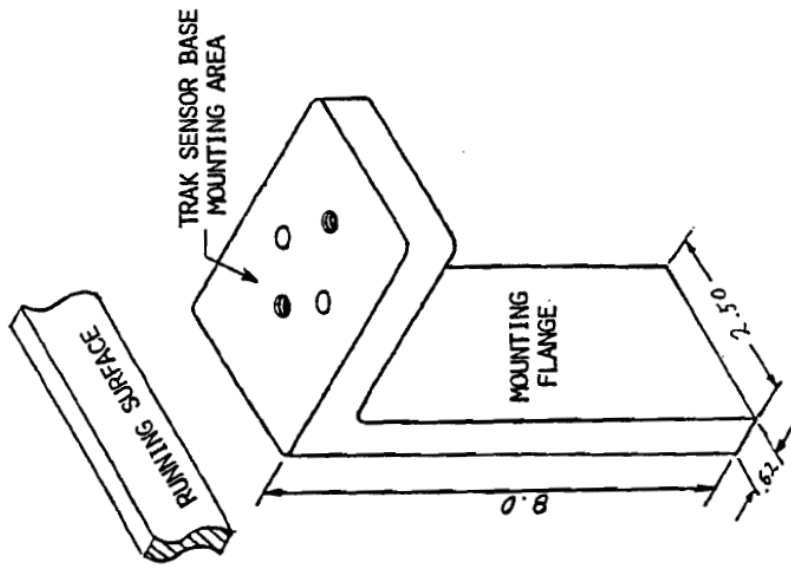


Figure 2-24
BR17 Bracket

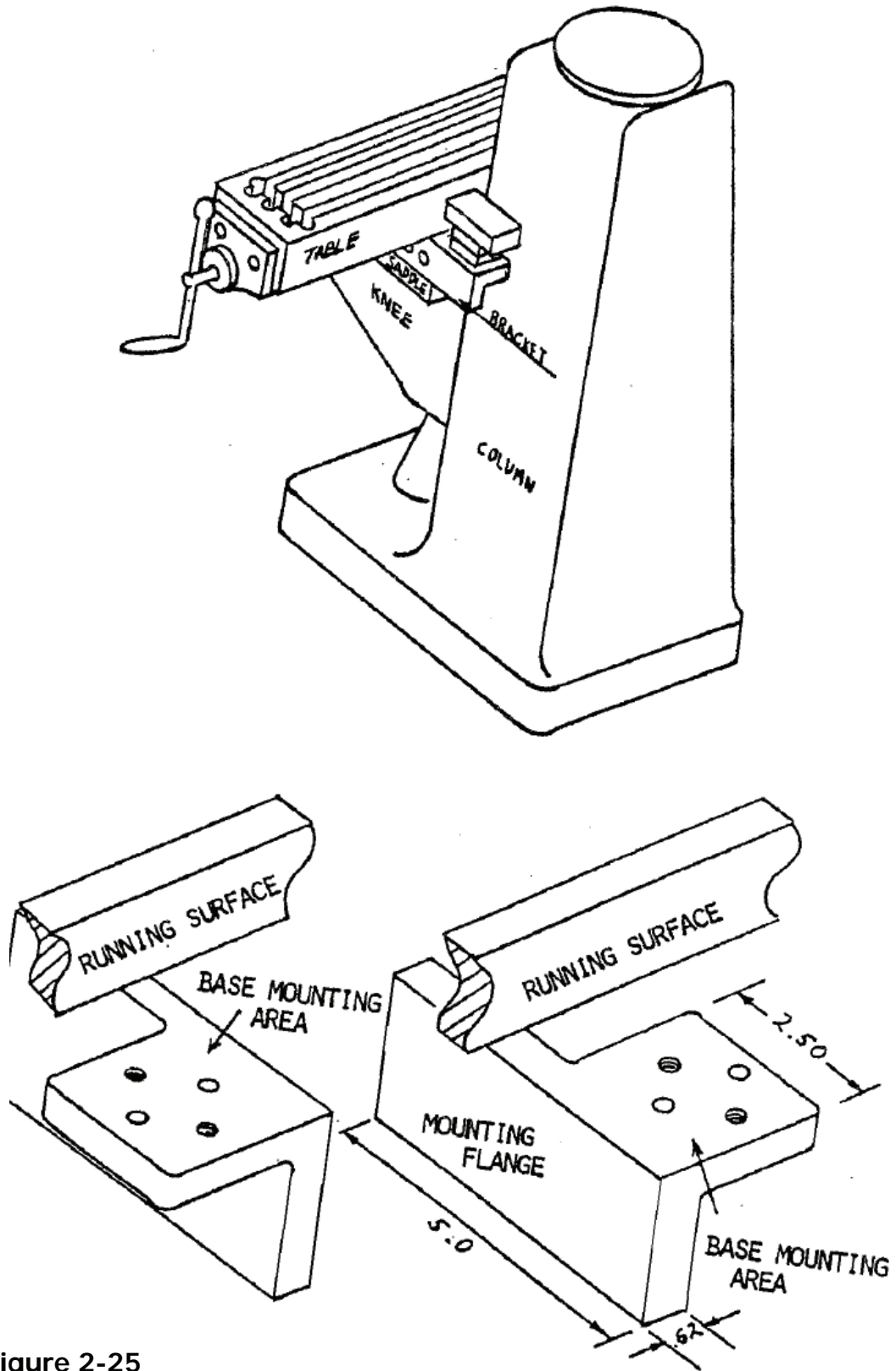


Figure 2-25
BR17-E and BR17-C Brackets

2.5 Y-Axis TRAK Sensor Installation

Note: The Y axis sensor is mounted on the right side of the saddle. Machines other than Bridgeport Series I may use different brackets and/or have different size mounting holes that may need retapping. See figure 2-26.

- Step 1: Clean paint and dirt from around the two 3/8-16 mounting holes located on the right side of the knee.
- Step 2: Install the runbar using two 1/8" spacers and two 3/8-16 socket head screws.
 - a. Orient counterbored holes on the runbar towards the top (see figure 2-26).
 - b. Shim the runbar so that it is parallel to the Y-axis travel to within .005" over full saddle travel.
- Step 3: Install Y-axis bracket with three (3) 1/4-20 x 1 1/4" screws.
- Step 4: Install the M5 mounting base onto the bracket (see Mounting the M5 Base).
- Step 5: Install the M250 sensor onto the M5 base.

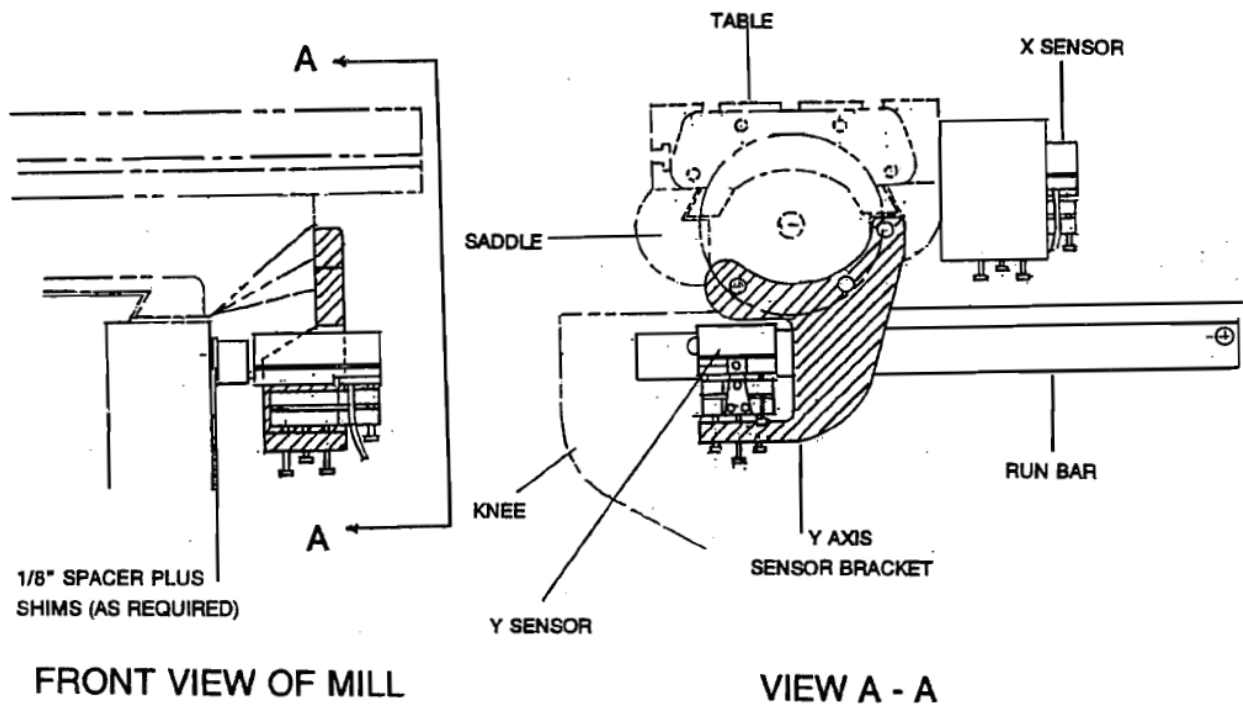


Figure 2-26
Installation Y Sensor using BR1-TSY (15740) Bracket

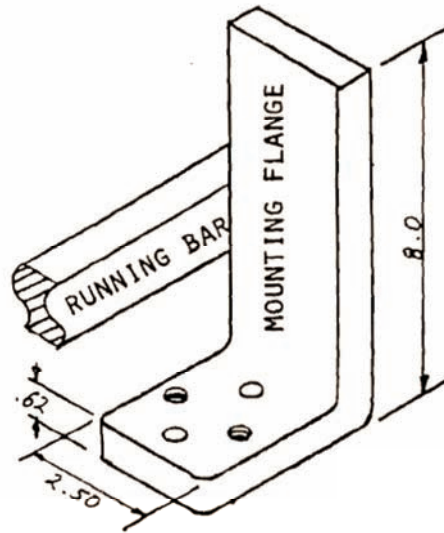
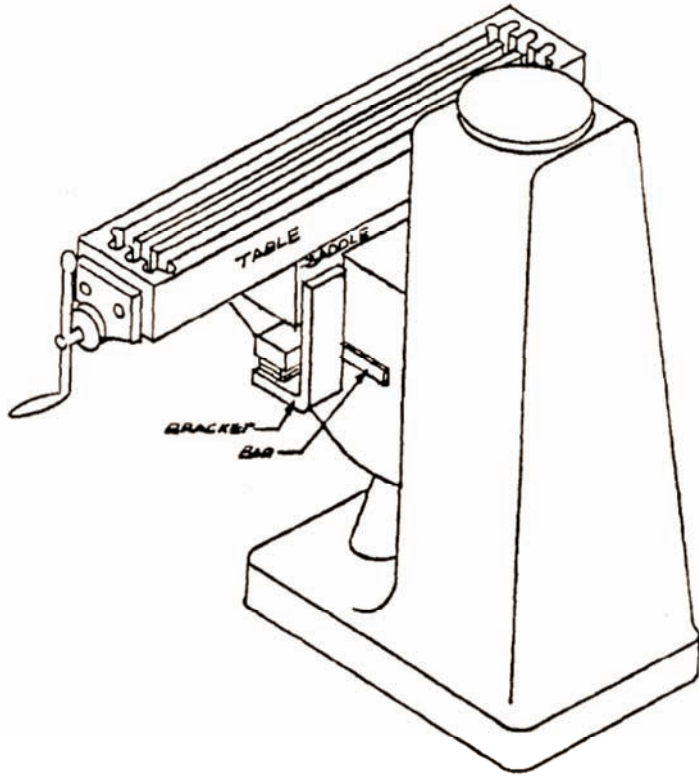


Figure 2-27
BR17-1 Bracket

3.0 Z Axis Sensor Installation Using BR1Z Bracket – ProtoTRAK Only

Step 1

- a. Present bracket to machine and transfer top hole (1) from BR1Z bracket to quill housing. Drill and tap 10-32 1/2" deep.
- b. Mount bracket using tapped hole and transfer bottom hole (2). Drill and tap 10-32 x 1/2" deep.

Step 2

- a. Install the quill stop knob clamp as shown in figure 3-1.

Note: Ensure that the quill stop knob clamp is slightly below the top of the quill stop knob. This will prevent the quill stop knob clamp from shifting when the quill is topped out.

- b. Move the quill through full travel to ensure the clamp does not hit or rub. It may be necessary to shift graduated scale to the left.

Step 3

- a. Mount the M5 base and M250 sensor to mounting pad of the BR1Z bracket using steps 2, 7a, 7b, and 7c from section 2.0.

Note: Due to a wide variety of product applications in which the BR1Z bracket is used, it will be necessary to use the 3/8" spacer plate and two 1/4-28 x 2 1/2" puller screws provided. Note that the bottom of the 3/8" spacer plate is designed exactly like the bottom of the M5 base. Position the 3/8" spacer plate to the bottom of the M5 base so the steel pusher screw pads are positioned the same as they are on the bottom of the M5 base.

- b. Ensure that the wheel is centered on the runbar incorporated in the bracket and the sensor is square and parallel to the run bar.

Step 4

- a. Install the bracket so the clamp bar driver fits into the rectangular space on the BR1Z bar (4 on figure 3-1). Adjust the clamp so the fit is proper.
- b. Secure the bracket to quill with two 10-32 capscrews.
- c. Secure the clamp bar driver with the set screw.

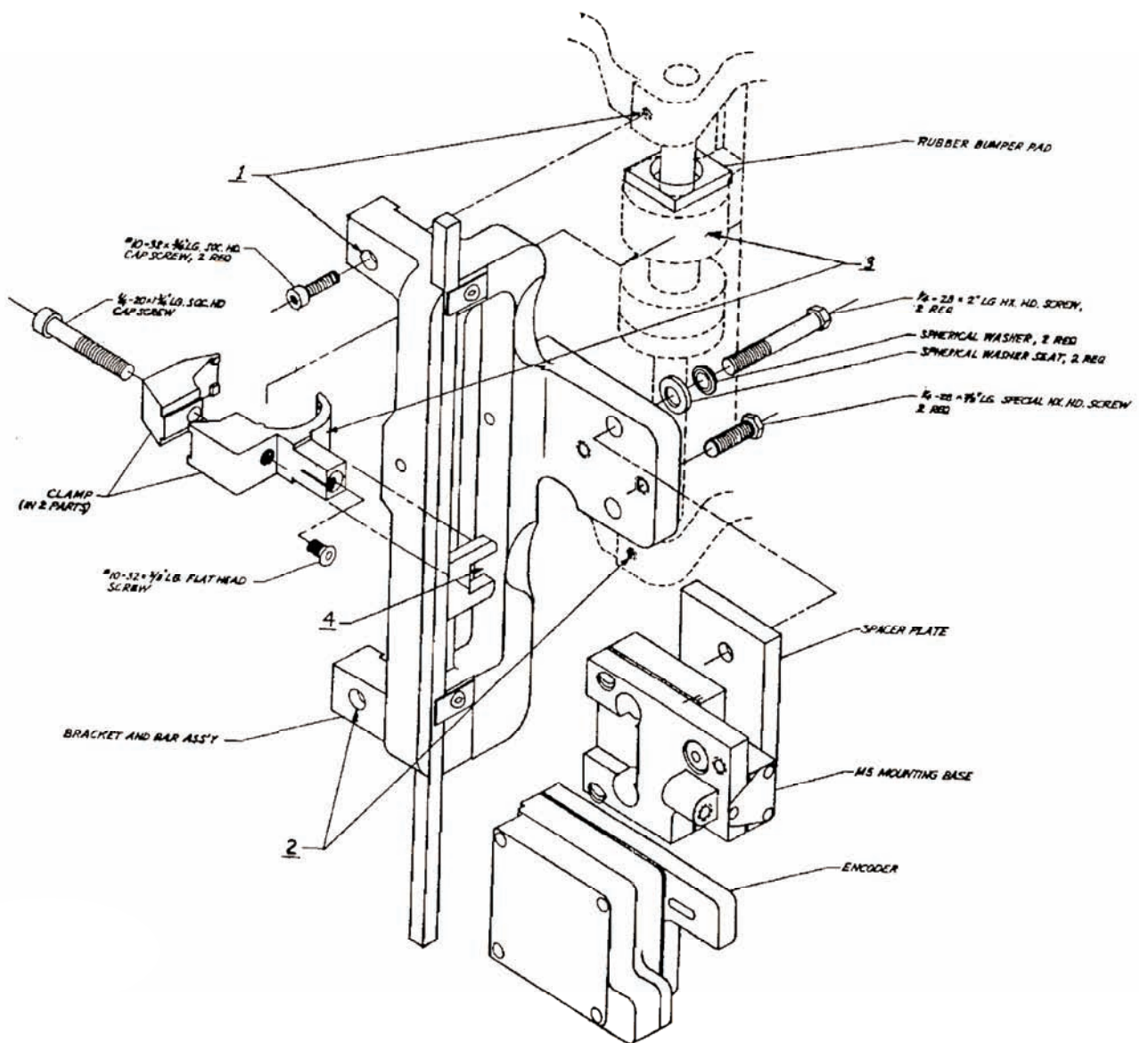


Figure 3-1
Mounting Z-Axis Sensor Using BR1Z Bracket

3.1 Z Axis Sensor Installation Using BR103Z Bracket – ProtoTRAK Only

Step 1

Remove the quill stop knob as follows.

- a. Remove the lock screw (d) and rectangular pin (e)
- b. Remove the snap ring (c)
- c. Remove the cap (a) and the pin (b)
- d. Drop the threaded quill stop rod until the capscrew securing the quill stop knob (f) is accessible and remove the quill stop knob.

Step 2

Install the provided SWI quill stop knob using the capscrew from Step 1 in place of original quill stop knob. Install the driver link assembly to the quill stop knob.

Step 3

Reinstall the cap (a), pin (b), and snap ring (c), rectangular pin (e), and lockscrew (d) removed in Step 1.

Step 4

- a. Position the bracket on the head directly above the quill so the contour on the bottom of the bracket matches the contour of the bottom edge of that part of the head.
- b. Transfer the 3 counterbored holes in the bracket that have been drilled for a 1/4 bolt. These are the most left, most right, and most both counterbored holes.
- c. Drill and tap the 3 holes 1/4-20 x 3/4" deep into the head.
- d. Mount the bracket using 1/4-20 x 1" sockethead capscrews.

Step 5

Position the quill to the top of the stroke and position the bar over the center of the driver link. Transfer the hole location from the bar to the driver link, remove the driver link, drill a clearance hole (.220"), and reinstall the driver link.

Step 6

With the quill all the way up, attach the bar to the driver link with 10-32 x 1" screw, washers, and hex locking nut. Ensure that the bar is attached to the driver link and locked in place with the hex nut as tightly as possible so that there is no lost motion. If the bar is not locked tightly to drive the link, the TRAK sensor may not repeat, and calibration may be difficult.

Step 7

- a. Mount the M5 base and M250 sensor to the mounting pad of the BR48Z bracket using Steps 2, 7a, 7b, and 7c from section 2.0.
- b. Ensure that the wheel is centered on the runbar incorporated in the bracket and the sensor is square and parallel to the runbar.

Step 8

Be certain the top of the bar does not contact the overhang on the head when the quill is fully retracted. If it does, remove the bracket and slot the mounting holes so that the top of the bar just clears the overhang. Remount as above.

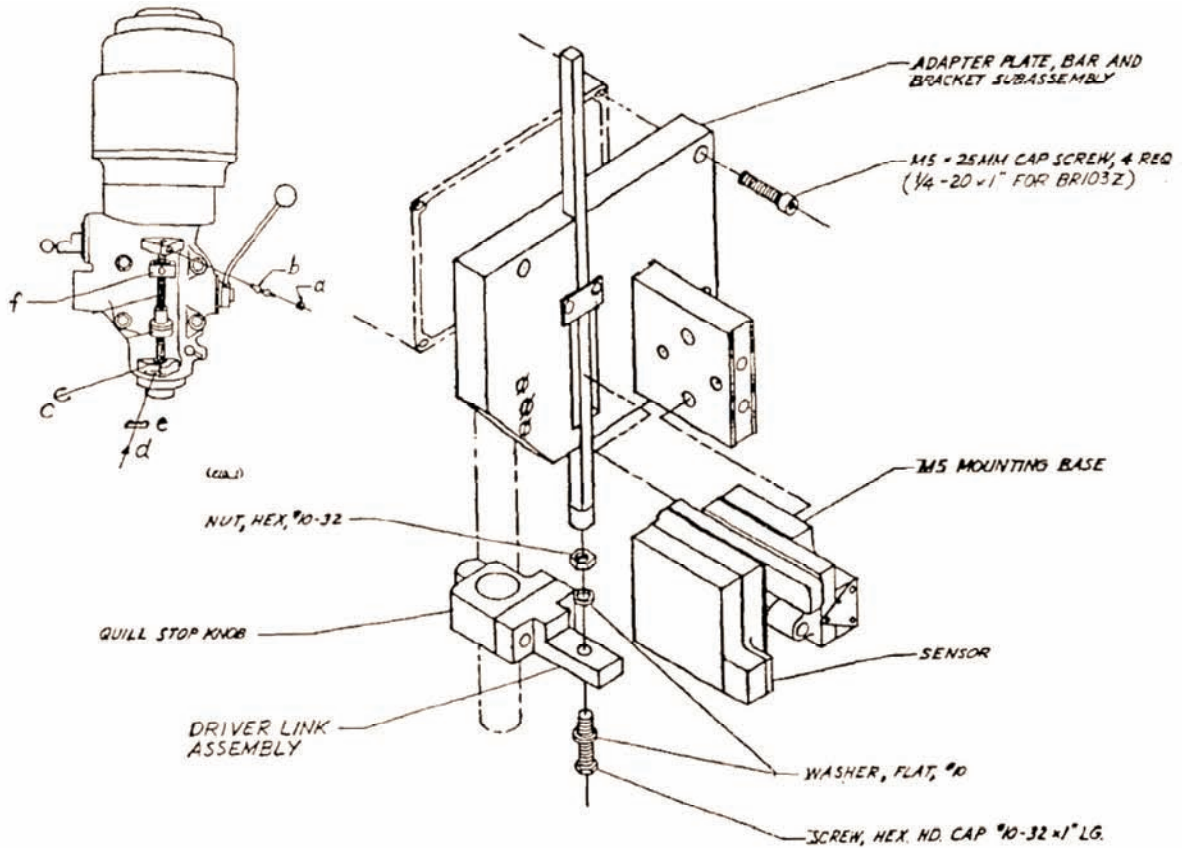


Figure 3-2

Bracket shown is BR48Z. BR103Z is nearly identical, except the main bracket plate is contoured instead of rectangular and holes are at different locations.

3.2 Z Axis Sensor Installation Using BR48Z Bracket

Step 1

Remove the quill stop knob as follows.

- a. Remove the lock screw (d) and rectangular pin (e)
- b. Remove the snap ring (c)
- c. Remove the cap (a) and the pin (b)
- d. Drop the threaded quill stop rod until the capscrew securing the quill stop knob (f) is accessible and remove the quill stop knob.

Step 2

Install the provided SWI quill stop knob using the capscrew from Step 1 in place of original quill stop knob. Install the driver link assembly to the quill stop knob.

Step 3

Reinstall the cap (a), pin (b), and snap ring (c), rectangular pin (e), and lockscrew (d) removed in Step 1.

Step 4

Remove the nameplate from the front of the quill housing (4 screws) and install adapter plate assembly in its place using the four provided M5 cap screws. Position the bar parallel to the quill travel by eyesight from the front and side and then tighten capscrews.

Note: It is possible that the two top or two bottom holes will have to be shimmed to get the bar parallel to the quill as viewed from the side.

Step 5

Position the quill to the top of the stroke and position the bar over the center of the driver link. Transfer the hole location from the bar to the driver link, remove the driver link, drill a clearance hole (.220"), and reinstall the driver link.

Step 6

With the quill all the way up, attach the bar to the driver link with 10-32 x 1" screw, washers, and hex locking nut. Ensure that the bar is attached to the driver link and locked in place with the hex nut as tightly as possible so that there is no lost motion. If the bar is not locked tightly to drive the link, the TRAK sensor may not repeat, and calibration may be difficult.

Step 7

- a. Mount the M5 base and M250 sensor to the mounting pad of the BR48Z bracket using Steps 2, 7a, 7b, and 7c from section 2.0.
- b. Ensure that the wheel is centered on the runbar incorporated in the bracket and the sensor is square and parallel to the runbar.

3.3 Installing Z-Axis Assembly – CNC2

Step 1

Remove the threaded quill stop rod and quill stop knob.

Step 2

Remove three (upper right, lower left, and lower right) head locking nuts.

Step 3

Install the three provided spool nuts and tighten. Torque to 80 ft/lb.

Step 4

Remove the upper left 1/2-13 head locking nut and replace with special locking nut provided and tighten. Torque to 80 ft/lb.

Step 5

Attach form to spindle using the provided 3/8" capscrew. Using a torque wrench, tighten to 35 ft/lb. Make sure the fork clears the sides of the slots in the head by moving the quill (spindle) through its full travel. If binding occurs, loosen the fork, realign, and retighten. If binding persists, it may be necessary to file the fork where contact is made.

Once proper fork position is determined, install the fork using the locktite on the 3/8" capscrew and tighten the set screw in the fork.

Step 6

Following is the method for determining the correct thickness of shims that will compensate for the differences in height between the spool nuts. As the Z-axis bracket is mounted against the flats of the spool nuts, it is vital that the correct thickness of shims (within .010") be determined in order to properly align the ballscrew. The provided shims are attached to the Z-axis bracket with screws.

*Note: The following procedure is critical to correct ballscrew operation. **Take the time to do it right.***

- a. Position the mag base and indicator on the table so that the indicator stem will touch the flat of the lower left spool nut.
- b. Move the saddle and table until the dial indicator will touch the flat of the lower right spool nut. Move the Y-axis in until the vernier reads zero. The dial indicator will not register the difference (+ or -) between the lower left and lower right spool nut flats. Record this measurement.
- c. Move the saddle and knee (table doesn't have to be moved) until the dial indicator touches the flat of the upper right spool nut. Move the Y-axis in until the vernier reads zero. The dial indicator will now register the difference (+ or -) between the lower left and upper right spool nut. Record this measurement.
- d. Using these measurements, determine which spool nut is farthest out (towards operator). Then determine how many shims need to be put on each of the other two spool nuts so that all three register zero on the dial indicator.

For example, if the dial indicator registers at +.025" on the lower right spool nut and -.010" on the upper right (- being out towards operator) then the upper right spool nut would be farthest out. Using the upper right nut as zero, you would need the shims equaling .010" on the lower left spool nut and shims equaling .035" on the lower right spool nut. These combinations would put the outer flat of each spool nut at the same point.

- e. Add an additional .050" of shims for each of the three spool nuts and attach each set of shims to the correct location on the Z casting using the provided 6-32 panhead screws. This sets the Z ballscrew casting out so that it will not hit any part of the machine head and distort when tightened down.

Caution

Improper shimming will cause the casting to distort and may result in improper system operation and irreparable damage to the ballscrew.

Step 7

The main bracket is shipped partially assembled. Prior to mounting,

- a. Remove the front sheet metal cover.
- b. Remove the top sheet metal cover.
- c. Remove protective covering from ballscrews.

Note: Do not remove the tape holding the beveled brass and steel washers to ball nut flange.

- d. Remove protective covering from encoder (foam or other packing material).
- e. Remove top handle retainer from motor lock out assembly.

Step 8

Position the fork about 2/3 of the way down from its full up position and lock.

Step 9 (see figure 3-6)

Carefully mount the main bracket to the head ensuring that

- a. The main bracket locating pin is resting on top of the bottom locating pad on the head.
- b. The flats of the ball nut are located between the arms of the fork.

Step 10

Secure the main bracket to the head by threading the three 1/2-13 capscrews and washers provided into the spool nuts finger tight.

- a. Upper right: 1/2-13x2 3/4" capscrews and 1" diameter washer.
- b. Lower left and right: 1/2-13 x 2 1/2" capscrews and 1 1/2" diameter washers.

Step 11 (see figure 3-6)

Push the main bracket to the right and, while holding it against the locating pads on the head, tighten the three capscrews. Torque to 80 ft/lb.

Step 12 (see figure 3-7)

Remove the tape holding the beveled brass and steel washers to the ball nut flange.

Step 13 (see figure 3-7)

Push the ball nut down until the ball nut flange is seated against the beveled steel washer that is seated on the top surface of the fork arms. Align the flat edge of the brass washer so that it faces forward as squarely as possible. If the brass washer is cocked, it will rub on the inside of the front sheet metal cover.

Step 14 (see figure 3-7)

Insert the two 10-32 x 1 1/2" flat head screws through the two holes in the ball nut flange and the fork arms with the threads down.

Step 15 (see figure 3-7)

Mount the spring tension assemblies to the 10-32 screws and secure with the special locking nuts. Tighten the nuts until Allen wrench in the screw head won't move, then back nut off 1/2 turn. This puts the proper force on the spring tension assemblies.

Step 16

Move the quill and ballscrew through full travel three or four times. If the quill moves smoothly, proceed to Step 17, but if any binding is noticed, the main bracket is either not properly aligned or shimmed. Determine the cause of the binding or roughness and fix before proceeding.

- a. Ensure manual quill lock on head is not engaged.
- b. Loosen the top right 1/2-13 capscrew.
- c. Move the quill through full travel.

- If no binding is noticed with this capscrew loose, remove the main bracket and add another .005" shim at this location on the rear main and repeat steps 10 through 16.
 - If quill still binds, retighten this capscrew and repeat the procedure with the lower right and lower left capscrews.
- d. If quill still binds,
- Loosen locking nuts on spring tension assemblies
 - Loosen all three 1/2-13 mounting screws
 - Push main bracket to right against locating pads on the head and retighten the screws, snug only
 - Retighten the locking nuts on the spring tension assemblies
 - If the quill does not bind with the three capscrews snug but does bind when any one or more are tight, return to step 6 and start over.

Step 17

Move the quill to full up position and ensure that the top of the ball nut flange does not hit the main bracket. Move to the full down position and ensure that the bottom of the fork does not hit the main bracket. If it hits at either the top or bottom, loosen the three mounting screws and move the main bracket up or down as required.

Step 18 (see figure 3-6)

Mount the motor to the main bracket as follows:

- a. Orient the motor correctly and slide the motor pivot shaft into the sleeve in the main bracket.
- b. Ensure that the drive belt is located between the motor sprocket and the belt retainer bracket.
- c. Put cotter pin through the hole in the bottom of the motor pivot shaft.
- d. Orient the motor lock out handle forward and install the top handle retainer (removed in step 7e above) onto the lock out stop block using 6-32 capscrews.
- e. Belt tension with motor engaged should permit approximately 1/4" movement at the center. If the belt tension is incorrect, disengage the motor, loosen the two 1/4-20 capscrews on the bottom of the lock out stop block, and reposition the stop block to obtain the correct belt tension.

Step 19

Attach the fine feed knob to the bottom of the ballscrew shaft with the setscrew. Ensure that the setscrew contacts flat of shaft.

Step 20

Ensure that the encoder connector is plugged into the connector box on the rear of the main bracket.

Step 21

Check all screws, connections, etc. to ensure that they are correct and tight.

Step 22

Install the front sheet metal cover using the seven provided panhead screws.

Step 23

Install the top sheet metal cover using the five provided panhead screws.

1. REMOVE CAP (A) AND PIN (B)
2. REMOVE SNAPRING (C)
3. REMOVE LOCKSCREW (D) AND RECTANGULAR PIN (E)
4. DROP THREADED ROD, SCREW OFF QUILL STOP AND REMOVE THREADED ROD THRU BOTTOM.
5. REMOVE QUILL STOP KNOB (3/8-16 CAPSCREW).
6. REINSTALL PIN (B), CAP (A) RECTANGULAR PIN (E) AND LOCKSCREW (D).
7. GIVE CUSTOMER: QUILL STOP, QUILL STOP KNOB, SNAP RING AND THREADED ROD TO SAVE FOR POSTERITY.

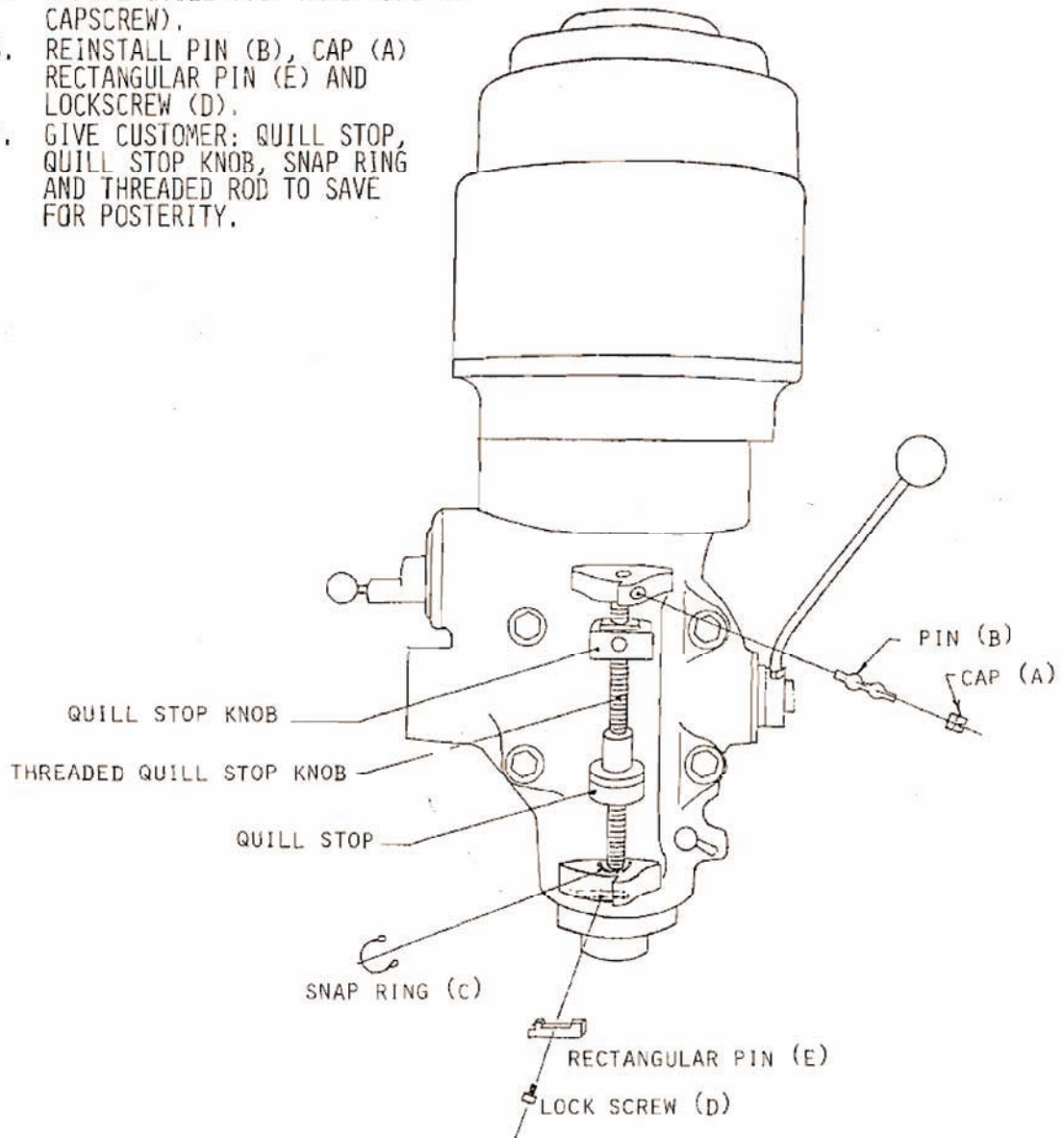


Figure 3-3
Removing Quill Stop Knob/Threaded Rod

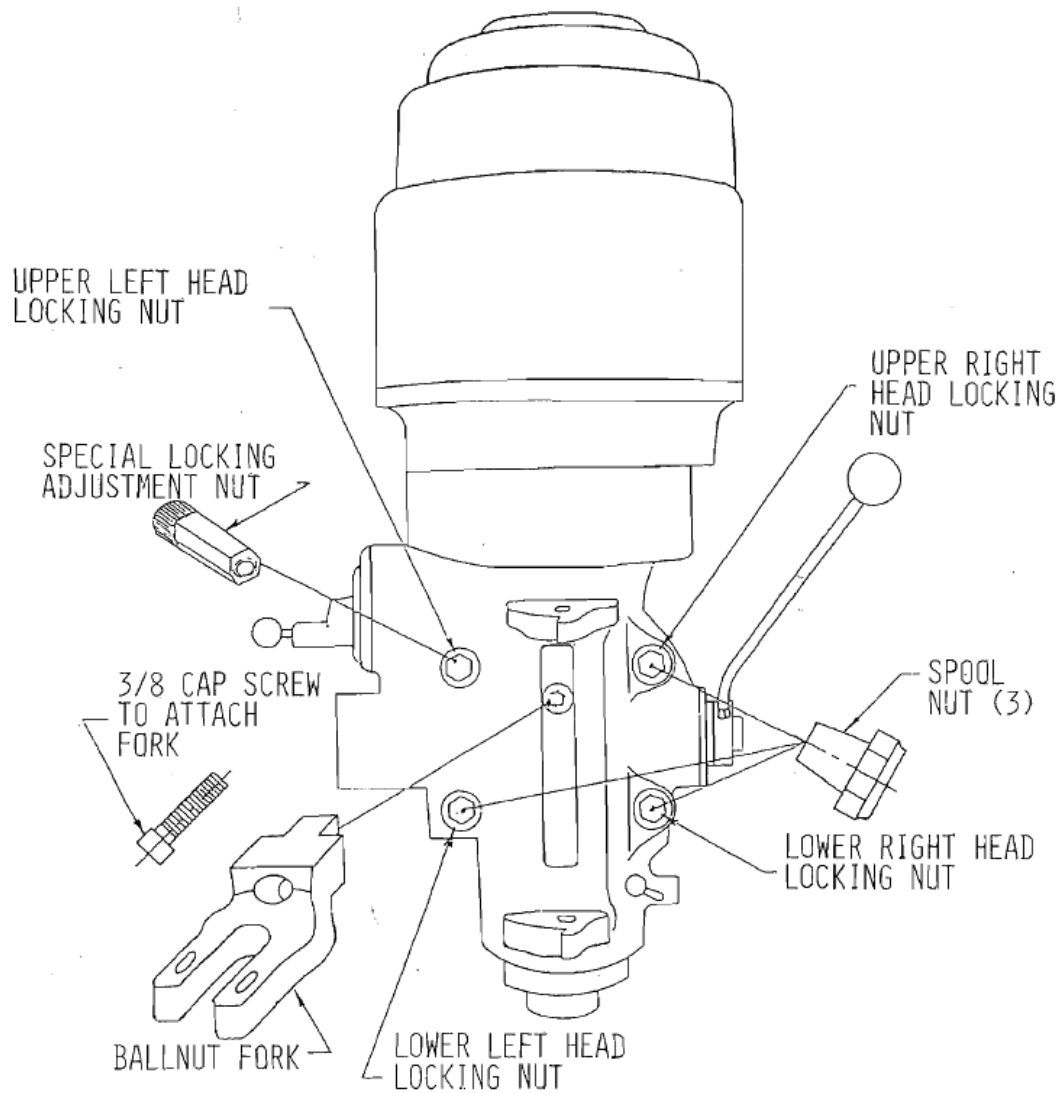


Figure 3-4
Installing CNC2 – 2 Axis Drive

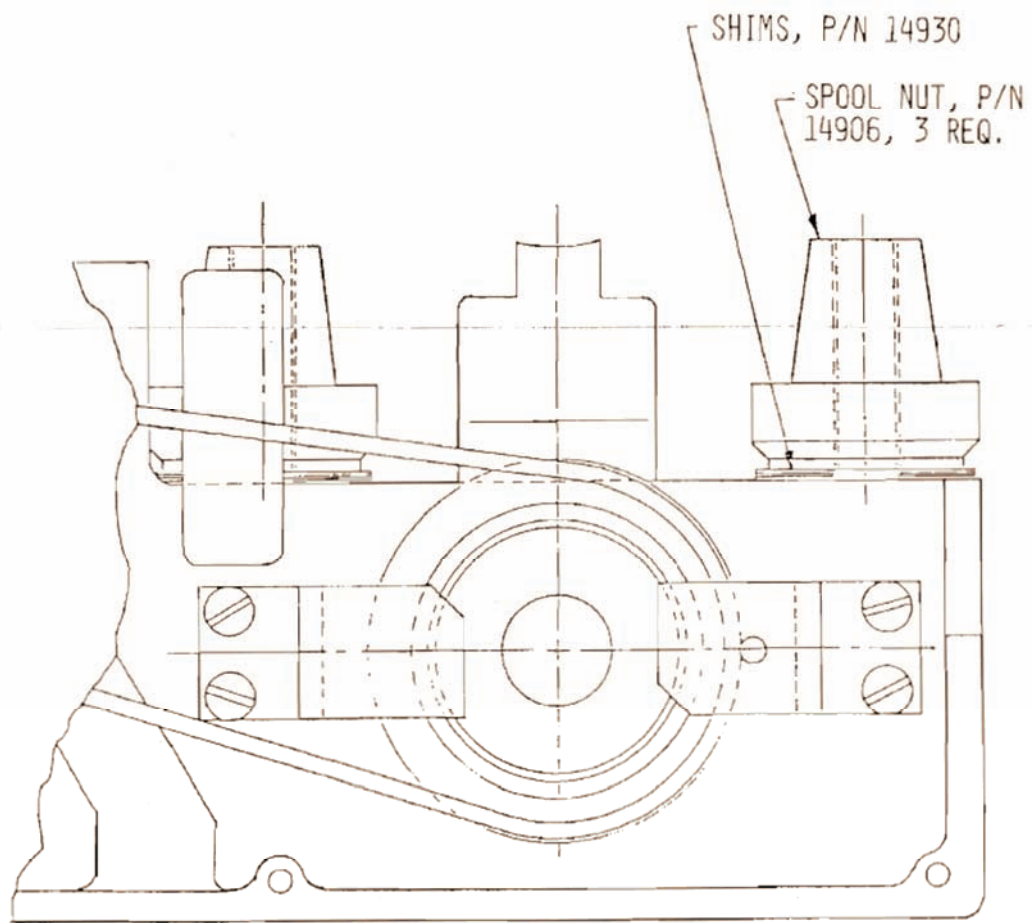


Figure 3-5
Installing CNC2 – 2 Axis Drive

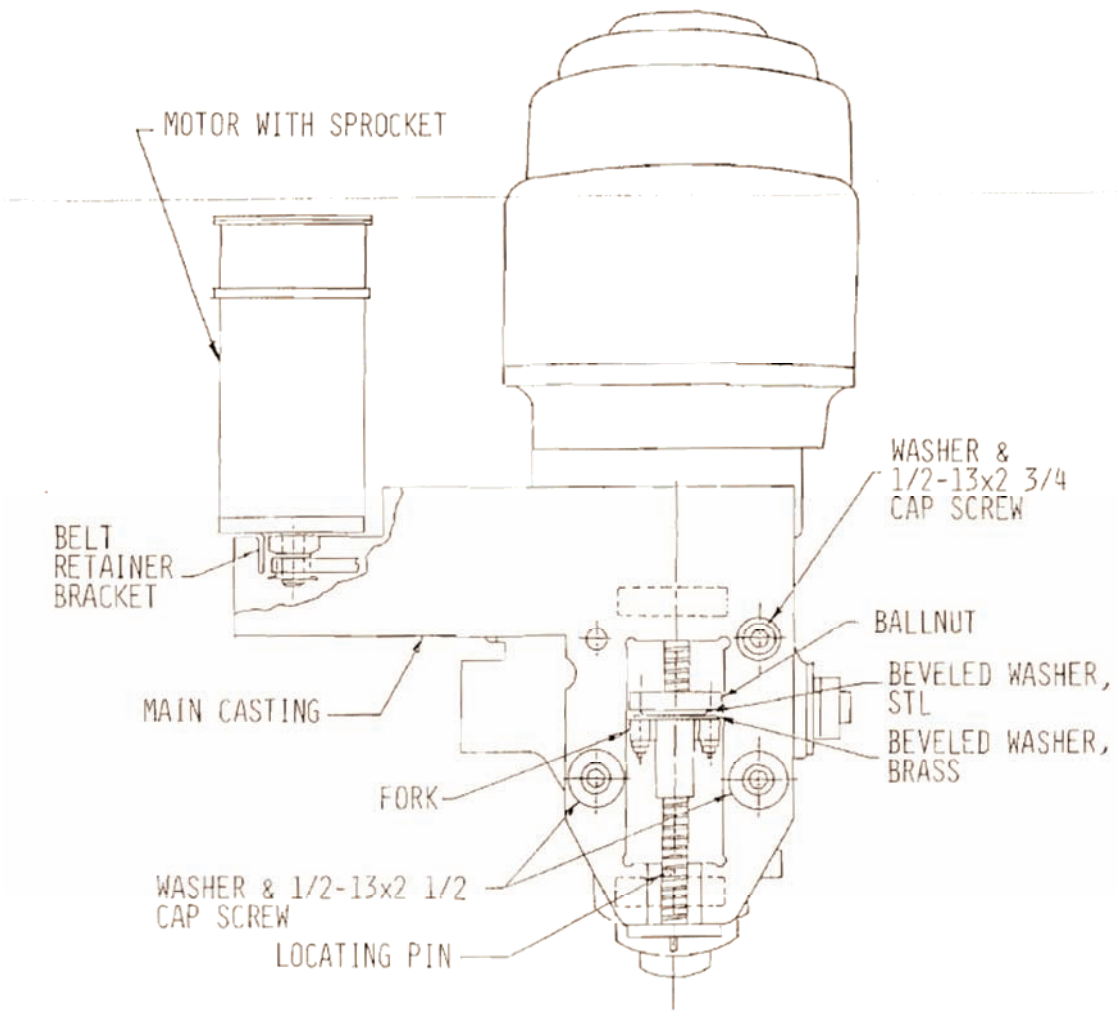


Figure 3-6
CNC2 – Z Axis Drive

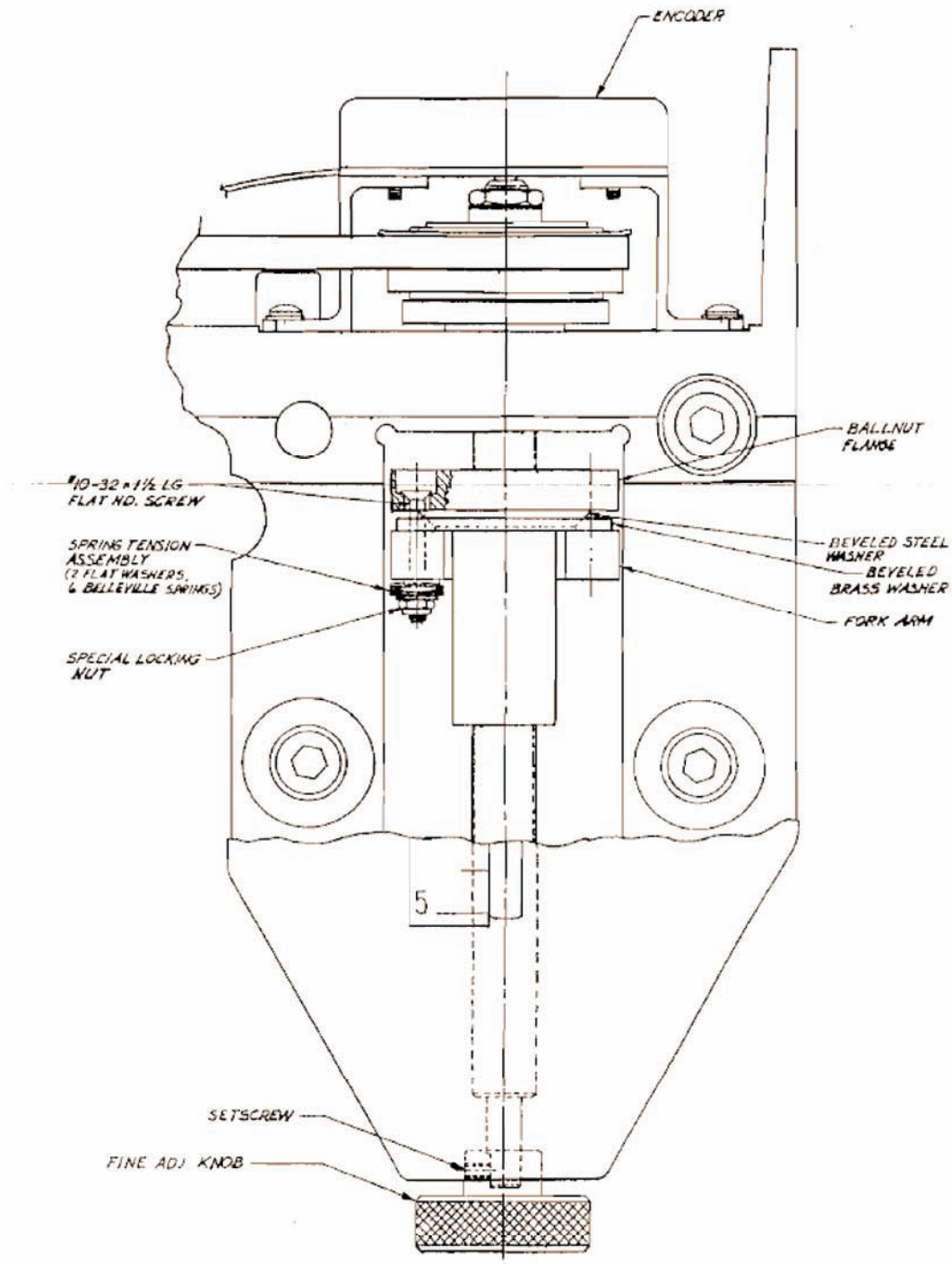


Figure 3-7
CNC2 – Z Axis Drive

3.4 Pendant Arm & Pendant Display Installation

Step 1 (see figure 3-8)

Mount the bracket on the right side of the ram and transfer two 5/16" holes. Drill the tap ram 5/16-18 at least 1" deep.

Step 2

Secure the bracket to the ram with two 5/16-18 x 1 1/2" capscrews and lock the washers. If the side of the ram is not flat, use the leveling screws to adjust the bracket as necessary so that it is as square to the ram and as level as possible.

Step 3

- a. Insert the pendant bar with a steel washer below and above into the bracket and push the 5" bolt up from the bottom through the bracket, bottom steel washer, pendant bar, top washer, and top portion of the bracket.
- b. Drop 4 dowel pins through 4 holes on the bracket so they rest on top of the steel washer.
- c. Place a third steel washer over the bolt and on top of the dowel pins slightly protruding above the top of the bracket.
- d. Screw on the net and tighten it so that the bar is stiff but can still be rotated back and forth with a reasonable effort.

Step 4

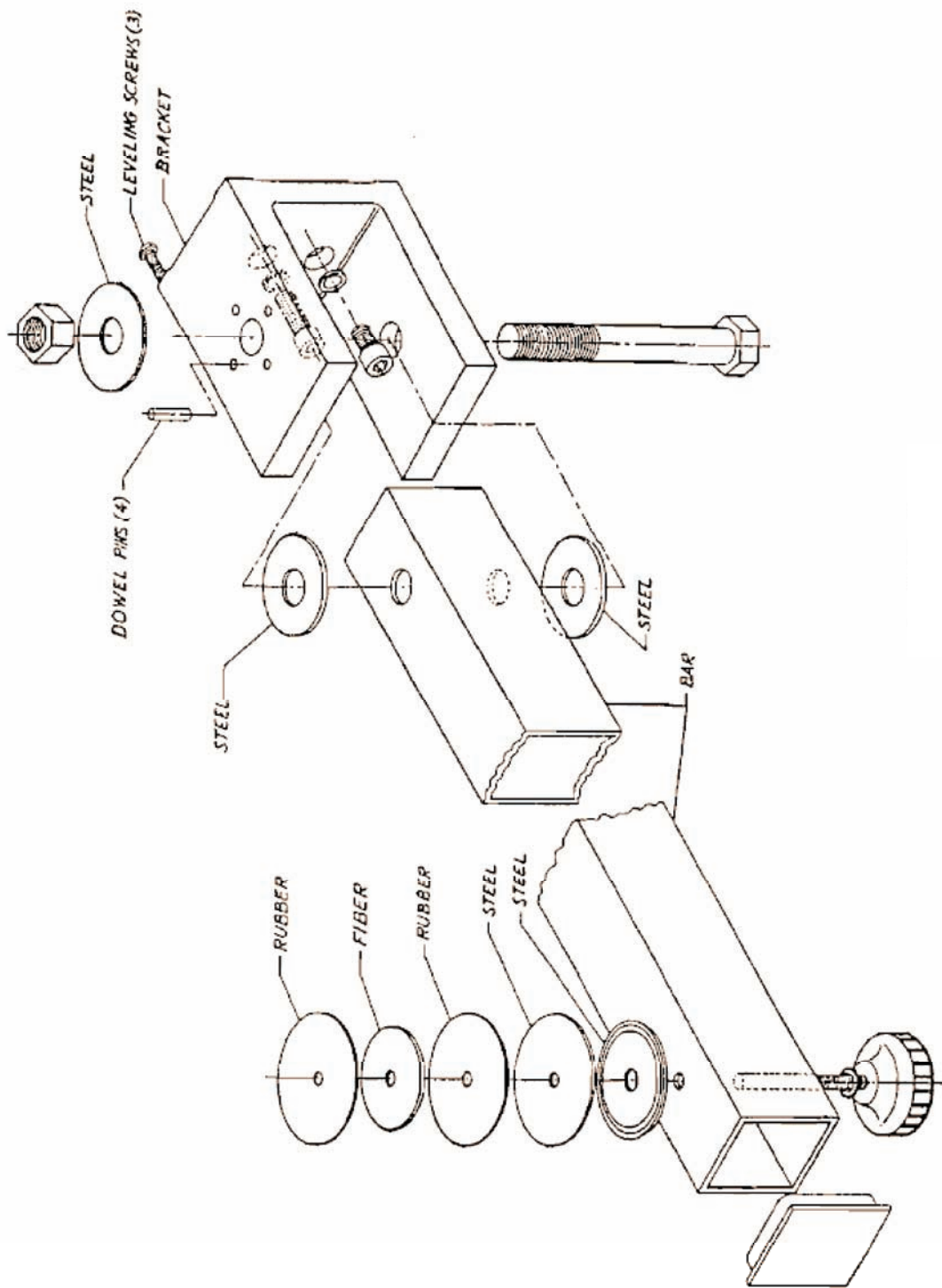
Insert the black knob and star washer through the pendant bar from the bottom and stack in the following order: steel with curled lip, flat steel, rubber, fiber, and rubber washers as shown, onto the threaded portion of the knob sticking out the top of the bar.

Step 5

Align the threaded hole in the bottom center of the pendant display with the threaded portion of the knob and secure.

Step 6

Put the end cap on the pendant bar.



**Figure 3-8
Pendant Arm**

3.5 Power Unit Installation

Step 1

The power unit may be hung on the right side (recommended) or back of the machine's column.

Caution
Never mount the power unit on the left side of the column.

Step 2

Move the saddle to full rear (toward the column) position. Present the power unit to the right side (or rear) of the mill so that the top is 36" from the floor and does not hit the sensor or pinch the cables. Transfer the two top holes from the upper flange to the mill (use inside 2 holes if mounted on the rear). Drill and tap 5/16-18 at least 1" deep.

Step 3

Screw two 5/16-18 x 2" set screws into the tapped holes so that approximately 3/4" of the thread remains on the outside. Lock set screws into position with 5/16 washer-type nuts.

Step 4

Hang power unit on two studs just installed and transfer two bottom holes. Drill and tap 5/16-18 at least 1" deep. Install two 5/16-18 x 2" set screws as in previous step and lock in place with washer-type nuts.

Step 5

Install power unit on four studs and secure with 5/16 nuts and lock washers. If the holes for the studs were not drilled very straight, it may be necessary to open the holes on the power unit. Do not hammer the studs sideways to get them to line up with the power unit holes.

3.6 E-STOP Installation

Step 1 (see *General Layout* in *Introduction*)

The E-STOP is designed to be attached to the left side of the machine tool head. However, there are no restrictions to where it is mounted, and it can be positioned where convenient to the operator.

Step 2

- a. Remove the two upper 10-24 capscrews on the plate holding the quill feed adjustment lever.
- b. Use the two included 10-24 x 1" screws to mount the E-STOP bracket (attached to the switch housing) to these same holes.

Note: The bracket may be removed from the switch housing and rotated 180 degrees if more convenient.

3.7 System Interconnection

Step 1 (see figures 3-9 and 3-10)

Connect the X, Y, & Z sensor connectors to the connections marked "X-axis, Y-axis, & Z-axis" respectively on the rear panel of the pendant display.

Step 2

Connect one end of the power control umbilical (flat black ribbon cable) to the rectangular connection marked "Power Control" on the rear of the pendant display. This connector properly fits only one way. Be certain not to force it together incorrectly.

Step 3

Attach the other end of the power control umbilical to the connector marked "Power Control" on the power unit. Secure with the screws as with the other end.

Step 4

Connect the power umbilical (round black cable from power unit) to the connection marked "Power" on the rear of the pendant display.

Step 5

Connect the E-STOP connector to the connection marked "E-STOP" on the power unit – ProtoTRAK only.

Step 6

Note that there are two cables/connectors from each motor – one armored and one not. Connect the armored cable from the X motor to the connector marked "X ENCODER" on the power unit. Connect the black rubber (not armored) cable from the X motor to the connector marked "X MOTOR" on the power unit. Connect the cables from the Y motor the same way – armored to "Y ENCODER" and black rubber (not armored) to "Y MOTOR." These cables should be routed around the left side and rear of the machine.

Step 7

There are a number of cable ties and cable clamps provided for system tie down. The General Overview preceding section 1 suggests the appropriate cable routing and tie down. Not when tying down cables that you allow enough slack so that the saddle can be positioned full forward (toward the operator) and the knee full down without creating strain on the connectors. Before tying down the system, proceed to Section 8 and perform the system check-out procedures.

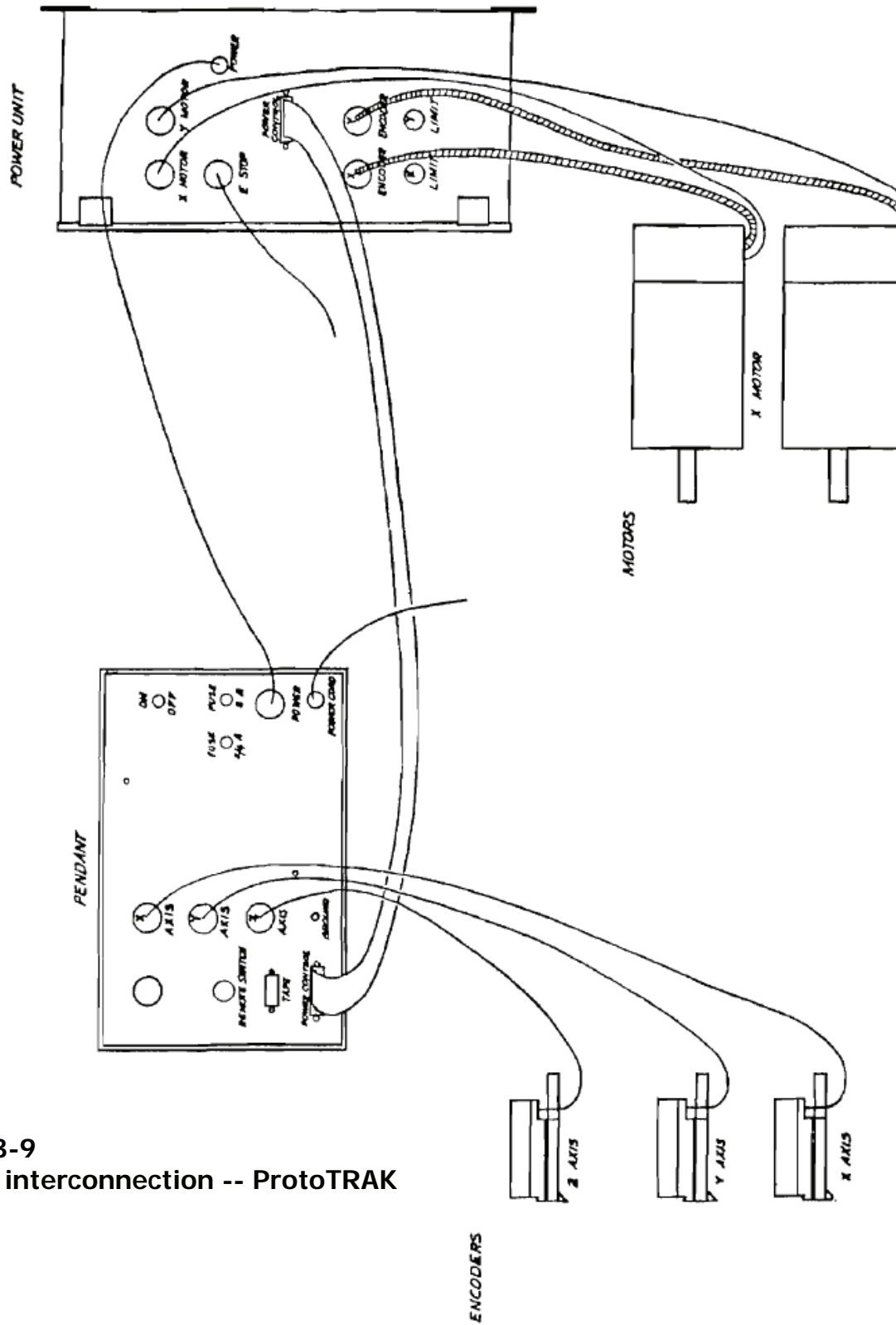


Figure 3-9
System interconnection -- ProtoTRAK

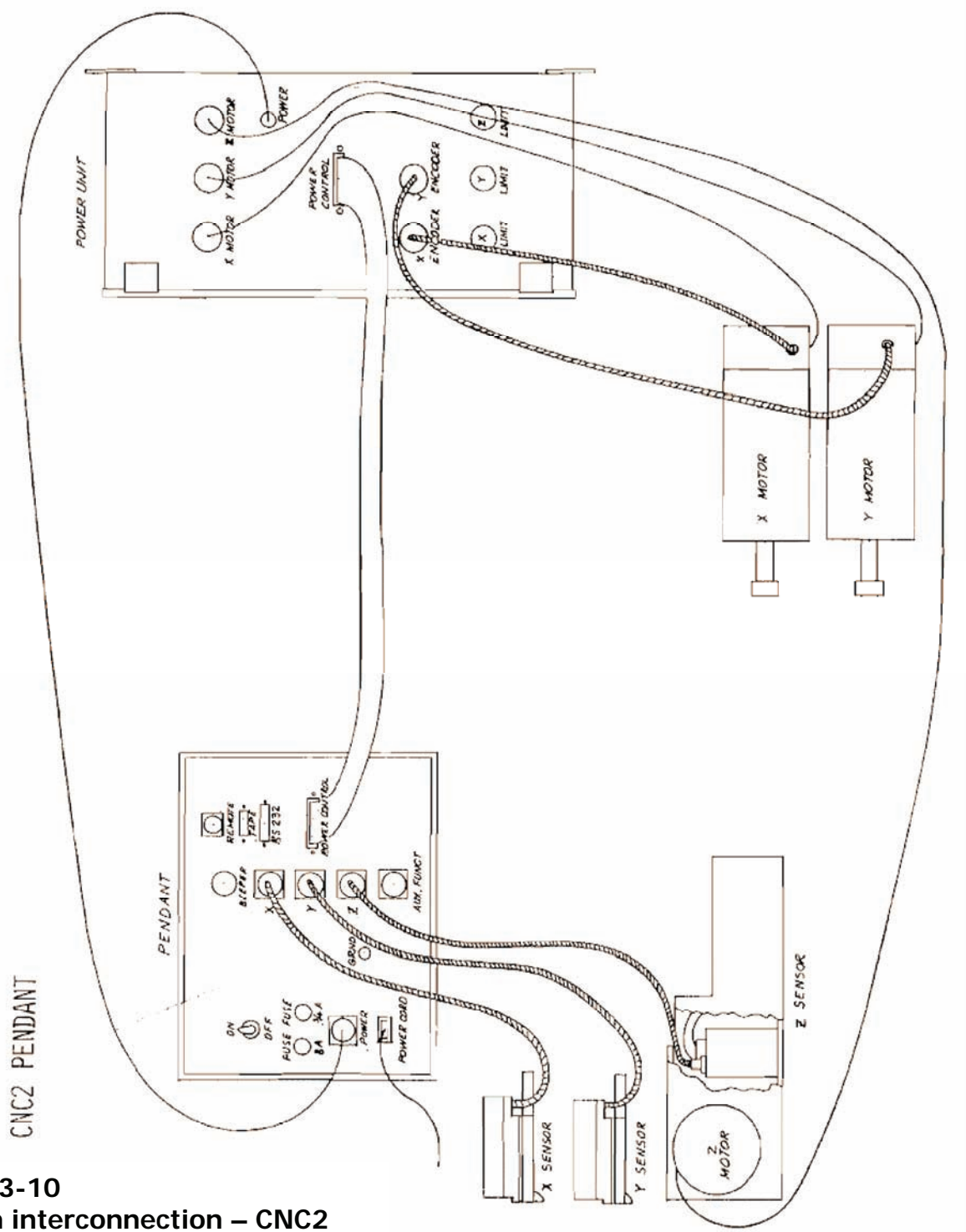


Figure 3-10
System interconnection – CNC2

3.8 Checkout Procedures

As the check out procedures are performed, put a check mark in the "OK" column next to each step that checks out correctly. If you notice any anomalies as you are checking out the system, refer to the corresponding step number on the diagnostic sheet that immediately follows the procedure. This sheet is not a comprehensive troubleshooting guide but directs you to recheck various things done during installation that could cause problems. If the indicated actions don't resolve the problem, call your local SWI representative or SWI/LA at 800.367.3165 for instructions.

4.0 Checkout Check Lists

4.1 ProtoTRAK

OK?	Step #	Action	Results/Indications
	1	Center the table & saddle, turn <i>ON/OFF</i> switch to OFF	No indication
	2	Push <i>E-STOP</i> button in	No indication
	3	Plug power cord into 115VAC outlet	No indication
	4	Turn <i>ON/OFF</i> switch to ON	
	5	Push <i>EDIT</i> four (4) times Push <i>ABS SET</i> Push <i>101, INC SET</i>	<ul style="list-style-type: none"> • Display reads <i>SPEC MODE</i> • Display reads <i>CODE</i> • All axes at zero
	6	Use X axis handwheel to move table to the left 5"	<ul style="list-style-type: none"> • X display counts in positive direction • Z display shows data from X motor encoder and counts in positive direction to about 27"
	7	Use handwheel to move table to the right 10"	<ul style="list-style-type: none"> • Y display counts from 5.000 down to 0 and then counts in negative direction to -5.000 • Z counts to about -27"
	8	Push <i>RSTR</i> Push <i>EDIT</i> four (4) times Push <i>ABS SET</i> Push <i>102, INC SET</i>	<ul style="list-style-type: none"> • Display reads <i>SPEC MODE</i> • Display reads <i>CODE</i> • All axes at zero
	9	Use Y axis handwheel to move saddle out (toward operator) 5"	<ul style="list-style-type: none"> • Y display counts in a positive direction • Z display shows data from Y motor encoder and counts in positive direction to about 27"
	10	Use handwheel to move saddle in (toward column) 10"	<ul style="list-style-type: none"> • Y display counts from 5.000 down to 0 and then counts in negative direction to -5.000 • Z counts to about -27"
	11	Push <i>RSTR</i>	
	12	Move spindle down 3"	<ul style="list-style-type: none"> • Z display counts in negative direction to -3.000 • Spindle movement is 3"
	13	Move spindle up 4"	<ul style="list-style-type: none"> • Z display counts to 0 then counts in positive direction to 1.000 • Spindle movement is 4"
	14 15 16	Calibrate X axis Calibrate Y axis Calibrate Z axis	See calibration procedure in section 4.4
	17	Pull out <i>E-STOP</i> button	<ul style="list-style-type: none"> • Fan running in power unit • Green LEDs on in power unit
	18	Push <i>E-STOP</i> button in	<ul style="list-style-type: none"> • Fan turns off in power unit • Green LEDs fade out in 30-45 seconds

OK?	Step #	Action	Results/Indications
	19	Pull <i>E-STOP</i> button out	<ul style="list-style-type: none"> Fan turns on in power unit Green LEDs on in power unit
	20	Push and hold <i>GO</i> key for 3 seconds	JOG + flashing in conversation strip
	21	Jog X axis 5-6"	Table moves to left at 100 ipm
	22	Push +/- key	JOG – flashing in conversation strip
	23	Jog X-axis back to 0 by pushing and holding X key	Table moves to the right 100 ipm
	24	Jog X-axis 3-4" by pushing and holding Y key	Saddle moves back toward column at 100 ipm
	25	Push +/- key	JOG + flashing in conversation strip
	26	Jog Y-axis back to 0 by pushing and holding Y key	Saddle moves out toward operator at 100 ipm
	27	Push <i>RESTORE</i> key	JOG + stops flashing, no lights in conversation strip
	28	Push <i>EDIT</i> four (4) times Push <i>ABS SET</i> Push <i>100, ABS SET</i> Push <i>X</i> Push <i>ABS SET</i> Push <i>GO</i>	<ul style="list-style-type: none"> Display reads <i>SPEC MODE</i> Display reads <i>CODE</i> Display reads <i>AXIS</i> Display reads <i>DIR? +</i> Display reads <i>PRESS GO</i> Display reads max speed which should be over 100 X reads distance which should be about 1% of speed Z reads X motor encoder distance which should be about 5.4 times X display readout
	29	Repeat 28, but press +/-, <i>ABS SET</i> when display reads <i>DIR? +</i>	Same indication as 28 but opposite sign
	30	Repeat 28 and 29 but substitute Y for X	Same indication as 28 and 29 but for Y-axis
	31	Push <i>DO ONE</i> key	Event readout blank
	32	Push <i>MILL</i> key	<ul style="list-style-type: none"> Event display <i>X BEG</i> X-axis display blanks
	33	Enter <i>ABS SET</i>	<ul style="list-style-type: none"> +0.0000 in X-axis display Event display <i>Y BEG</i> Y-axis display blanks
	34	Enter <i>ABS SET</i>	<ul style="list-style-type: none"> +0.0000 in Y-axis display Event display <i>X END</i> X-axis display blanks
	35	Enter <i>-, 1, ., ABS SET</i>	<ul style="list-style-type: none"> -0.0000 in X-axis display Event display <i>Y END</i> Y-axis display blanks
	36	Enter <i>ABS SET</i>	<ul style="list-style-type: none"> +0.0000 in Y-axis display Event display <i>CO R1 L2</i> Z-axis display blanks
	37	Enter <i>1, SET</i>	<ul style="list-style-type: none"> Z-axis display shows <i>1</i> then blanks when <i>SET</i> key is pushed Event display <i>FEEDRATE</i>
	38	Enter <i>1, SET</i>	<ul style="list-style-type: none"> Z-axis display shows <i>1</i> then blanks when <i>SET</i> key is pushed Event display <i>START</i>

OK?	Step #	Action	Results/Indications
	39	Enter <i>., 5, SET</i>	<ul style="list-style-type: none"> • Z-axis display <i>0.5000</i> then <i>0.0000</i> when <i>SET</i> key is pushed • Event display <i>TOOL DIA</i>
	40	Push and hold <i>STARTKEY</i> for 3 seconds	Event display <i>M CHECK Z</i> (ensure spindle is retracted)
	41	Push <i>GO</i>	<ul style="list-style-type: none"> • Table and saddle move at 100 ipm to starting position • Event display <i>SET Z</i> • <i>SERVOS ON</i> and <i>IN POSITION</i> lights on
	42	Push <i>GO</i>	Table starts moving at 1 ipm to the right
	43	While system is moving, push <i>50%</i>	<ul style="list-style-type: none"> • Table moves noticeably slower • Event display <i>0.5</i>
	44	Push <i>GO</i>	<ul style="list-style-type: none"> • Table moves noticeably faster • Event display <i>01.5</i>
	45	When table reaches <i>-1.000</i>	Event display blank
	46	Repeat 31 through 45, change step 35 to <i>+1, 9 ABS SET</i>	Table moves left at 1 ipm
	47	Repeat 31 through 45, change step 35 to <i>0 ABS SET</i> , and step 36 to <i>-1, ABS SET</i>	Saddle moves in toward column
	48	Repeat 31 through 45, change step 35 to <i>0, ABS SET</i> , and step 36 to <i>+, 1, ., ABS SET</i>	Saddle moves out toward operator
	49	Push <i>EDIT</i> Push <i>EDIT</i> Push <i>EDIT</i> Push <i>EDIT</i> Push <i>ABS SET</i> Enter <i>1, 1, SET</i>	<ul style="list-style-type: none"> • Event display <i>RECALL</i> • Event display <i>ADD EVENT</i> • Event display <i>DLT EVENT</i> • Event display <i>SPEC MOD</i> • Event display <i>CODE</i> • Event display blanks • X axis display should read less than <i>.005</i> • Y axis display should read less than <i>.005</i>
		Connect cassette deck to pendant display cassette connector on pack panel and load test tape side A (side A face down)	
	50	Push <i>TAPE</i> key Push <i>1</i> Push <i>RESTORE</i> Unplug cassette deck <ul style="list-style-type: none"> • Secure a vise to the center of the table. Load a rectangular piece of aluminum (at least 6"x6"x3/8") into the vise. • Load a 3/8" end mill into the spindle and set an appropriate spindle speed. • Move the table and saddle until the tool is at the approximate center of the work piece. • Move the spindle down until the tool is just touching the top of the work piece. 	<ul style="list-style-type: none"> • Event display flashes <i>READ-1, WRITE+2, READ=1</i>, etc. • The small red light on the cassette deck will turn on for one to two minutes, then event display blanks.
	51	Push and hold <i>START</i> for 3 seconds	Event display <i>TOOL 1</i>

OK?	Step #	Action	Results/Indications
	52	Push <i>GO</i> Move quill down into the work piece until Z display shows <i>-0.0500</i> .	<ul style="list-style-type: none"> • Table and saddle move at 100 ipm to starting position of <i>EVENT 1</i> • X display <i>+0.0000</i> • Y display <i>+0.0000</i> • Event display <i>M01 SET Z</i> • <i>SERVOS ON</i> and <i>IN POSITION</i> lights are on
	53	Push <i>GO</i>	System mills a rectangular frame whose dimensions are 2" x 3"
	54	System mills rectangle and stops	Event display <i>CHECK Z</i>
	55	Retract quill and push <i>GO</i> Move quill down into work piece until Z display shows <i>-0.0500</i>	<ul style="list-style-type: none"> • Table and saddle move at 100 ipm to starting position of <i>EVENT 6</i> • Event display <i>A06 SET Z</i> • Servos on and in position LEDs on
	56	Push <i>GO</i>	System mills circular frame of diameter 2.5"
	57	System mills circle and stops	<ul style="list-style-type: none"> • Event display <i>RUN OVER</i> • Servos on LED on
	58	Retract quill and push <i>RESTORE</i>	Event display blanks
	59	Measure rectangle	<ul style="list-style-type: none"> • Y axis dimension = 2" +/- .001 • Y axis dimension = 3" +/- .001
	60	Measure circle Connect the cassette deck to the pendant display cassette connector on the back panel and load the test tape side B (side B face down)	<ul style="list-style-type: none"> • X axis diameter = 2.5" +/- .001 • Y axis diameter = 2.5" +/- .001 • Diagonals = 2.5" +/- .001
	61	<p>Caution – This test program will move the table through 12" of travel and the saddle through 10" of travel at 20 to 100 ipm. Make sure the table and saddle are as closely centered as possible and that the quill is retracted.</p> <p>Push <i>EDIT</i> Push <i>EDIT</i> Push <i>EDIT</i> Push <i>EDIT</i> Push <i>ABS SET</i></p> <p>Caution – The next step will read the tape into the system and automatically start the program running at 100 ipm. Ensure that the table and the saddle are centered and that the quill is retracted.</p> <p>Push <i>5, 5, SET</i></p> <p>This program exercises the system by running through all events and many combinations. This program consists of 150 events and will run continuously until stopped. Allow the program to exercise the system for about 10 minutes. Ensure that the machine is well oiled.</p>	<ul style="list-style-type: none"> • Event display <i>RECALL</i> • Event display <i>ADD EVENT</i> • Event display <i>DLT EVENT</i> • Event display <i>SPEC MODE</i> • Event display <i>CODE</i> <ul style="list-style-type: none"> • The small red light on the cassette deck will turn on for one to two minutes and then the table and saddle will start to move at 100 ipm as the program runs.
	62	Push <i>STOP</i> Push <i>RESTORE</i>	Event display blanks.

4.2 CNC2

OK?	Step #	Action	Results/Indications
	1	Turn <i>ON/OFF</i> switch to OFF	No indication
	2	Push <i>E-STOP</i> button in	No indication
	3	Plug power cord into 115VAC outlet	No indication
	4	Turn <i>ON/OFF</i> switch to ON	Display powers up and shows <i>+0.0000</i> on X, Y, and Z axes and <i>SELECT MODE</i> in conversation strip
	5	Push <i>MODE</i> key until <i>SPECIAL MODE</i> is displayed and press <i>ENTER</i> Push <i>9, 9, ENTER</i> Move X axis (table) .0020" to the left Move Y axis (saddle) .0020" out Push <i>9, 7, ENTER</i>	This procedure sets the direction of count to correctly configure the system
	6	Zero all axis Enter Special Mode again Push <i>101 ENTER</i>	Display asks for <i>CODE</i>
	7	Use X axis handwheel to move the table to the left 5"	<ul style="list-style-type: none"> • X display counts in positive direction to 5" • Z display shows data from X motor encoder and counts in positive direction to about 13.5
	8	Use handwheel to move table to the right 10" Push <i>RSTR</i>	<ul style="list-style-type: none"> • X display counts from 5" down to 0 and then to -5" • Z counts to about -13.5"
	9	Repeat step 7 for the Y axis using <i>CODE 102</i> Push <i>RSTR</i>	
	10	Move spindle down 3"	<ul style="list-style-type: none"> • Z display counts in negative direction to -3.000" • Spindle movement is 3"
	11	Move spindle up 4"	<ul style="list-style-type: none"> • Z display counts to 0 then counts in positive direction to 1.000" • Spindle movement is 4"
	12 13 14	Calibrate X axis Calibrate Y axis Calibrate Z axis	See calibration procedure in section 4.4
	15	Disengage <i>E-STOP</i> button	<ul style="list-style-type: none"> • Fan running in power unit • Green LEDs on in power unit
	16	Push <i>E-STOP</i> button in	<ul style="list-style-type: none"> • Fan turns off in power unit • Green LEDs fade out in 30-45 seconds
	17	Disengage <i>E-STOP</i> button out	<ul style="list-style-type: none"> • Fan turns on in power unit • Green LEDs on in power unit
	18	Push <i>MODE</i> key until <i>DRO MODE</i> is displayed in conversation strip and push <i>ENTER INC</i>	Conversation strip blanks out
	19	Push <i>JOG FAST</i> key	<i>JOG +</i> displayed in conversation strip
	20	Jog X axis 5-6" by pushing and holding <i>X</i> key	Table moves to the left at 100 ipm
	21	Push <i>+/-</i> key	<i>JOG -</i> displayed in conversation strip

OK?	Step #	Action	Results/Indications
	22	Jog X axis back to 0 by pushing and holding <i>X</i> key	Table moves to the right at 100 ipm
	23	Jog Y axis 3-4" by pushing and holding by pushing and holding <i>Y</i> key	Saddle moves back toward the column at 100 ipm
	24	Push +/- key	<i>JOG +</i> displayed in conversation strip
	25	Jog Y axis back to 0 by pushing and holding <i>Y</i> key	Saddle moves out toward the operator at 100 ipm
	26	Push +/- key	<i>JOG -</i> displayed in conversation strip
	27	Jog Z axis 2"-3" by pushing and holding <i>Z</i> key	Spindle moves down at 100 ipm
	28	Push +/- key	<i>JOG +</i> displayed in conversation strip
	29	Jog Z axis back to 0 by pushing and holding <i>Z</i> key	Spindle moves up at 100 ipm
	30	Push <i>JOG SLOW</i> KEY	
	31	Repeat steps 19 through 28	Same indication at 10 ipm
	32	Push <i>JOG SLOW</i> key	Jog function disabled, conversation strip blanks
	33	Zero all axes, center table and saddle Enter Special Mode Push <i>100 ENTER</i> Push <i>X</i> Push <i>ENTER ABS</i> Push <i>GO</i> Push <i>RSTR</i>	<ul style="list-style-type: none"> • Display asks for <i>CODE</i> • Display reads <i>AXIS</i> • Display reads <i>DIR ? +</i> • Display reads <i>PRESS GO</i> • Display reads max speed which should be over 100 • X reads distance which should be about 1 of speed • Z reads X motor encoder distance which should be about 2.7 times X
	34	Repeat step 33, but press +/-, <i>ENTER ABS</i> when display reads <i>DIR ? +</i>	Same as 33, except opposite movement and sign
	35	Repeat 33 and 34, but press <i>Y</i> when display asks <i>AXIS</i>	Same as 33 and 34, but in Y axis
	36	Repeat 33 and 34, but press <i>Y</i> when display asks <i>AXIS</i> Caution – Be sure quill is extended 2.5" from full up before initiating this step	Same as 33 and 34, but in Z axis. Only Z distance data is shown
	37	Push <i>DO ONE</i> KEY	<i>DO ONE EVENT</i> displayed in conversation strip
	38	Push <i>ENTER</i>	<i>ENTER EVENT TYPE</i> displayed in conversation strip
	39	Push <i>MILL</i> key	Conversation strip displays <i>X BEG</i>
	40	Push <i>ENTER ABS</i>	Conversation strip displays <i>Y BEG</i>
	41	Push <i>ENTER ABS</i>	Conversation strip displays <i>X END</i>
	42	Push <i>-, 1, ., ENTER ABS</i>	Conversation strip displays <i>Y END</i>
	43	Push <i>ENTER ABS</i>	Conversation strip displays <i>RT=1, LF-2, CT=0 0</i>

OK?	Step #	Action	Results/Indications
	44	Push <i>1, ENTER</i>	<ul style="list-style-type: none"> Shows 1.0 then conversation display blanks when Enter key pushed Conversation strip displays <i>XY FEEDRAT</i>
	45	Push <i>1, ., ENTER</i>	<ul style="list-style-type: none"> Shows 1.0 then conversation strip blanks when Enter key pushed Conversation strip displays <i>TOOL DIA</i>
	46	Push <i>., 5, ENTER</i>	<ul style="list-style-type: none"> Conversation strip displays <i>.5000"</i> Conversation strip displays <i>START</i>
	47	Push and hold <i>START</i> key for 3 seconds	Conversation strip displays <i>CHECK Z</i> (ensure spindle is retracted)
	48	Push <i>GO</i>	<ul style="list-style-type: none"> Table and saddle move at 100 ipm to starting position Conversation strip displays <i>SET Z</i>
	49	Push <i>GO</i>	Table starts moving at 1 ipm to the right
	50	While system is moving, set <i>FRO TO 50%</i>	<ul style="list-style-type: none"> Table moves noticeably slower Conversation strip displays <i>0.5</i>
	51	Set <i>FRO</i> to 150%	<ul style="list-style-type: none"> Table moves noticeably faster Conversation strip displays <i>01.5</i>
	52	When table reaches <i>-1.000</i>	Conversation strip blanks out
	53	Repeat steps 37 through 52, change step 42 to <i>+1.0 ABS SET</i>	Table moves to the left at 1 ipm
	54	Repeat steps 37 through 52, change step 42 to <i>0 ENTER ABS</i> , STEP 43 TO <i>-1, ., ENTER ABS</i>	Saddle moves in towards column
	55	Repeat steps 37 through 52, change step 43 to <i>+1, ., ENTER ABS</i>	Saddle moves out towards operator
	56	Push <i>MODE</i> key until <i>SPECIAL MODE</i> is displayed on conversation strip Push <i>ENTER ABS</i> Push <i>1, 1, ENTER</i>	<ul style="list-style-type: none"> Conversation strip displays <i>SPEC MOD</i> Conversation strip displays <i>CODE</i> X axis display should read less than .005 Y axis display should read less than .005

OK?	Step #	Action	Results/Indications
	64	Push <i>GO</i>	Conversation strip displays <i>START OR GO</i>
	65	Measure rectangle	<ul style="list-style-type: none"> • X axis dimension = 2" +/- .001 • Y axis dimension = 3" +/- .001
	66	Measure circle Connect cassette deck to pendant display cassette connector on back panel and load test tape side B (side B face down)	<ul style="list-style-type: none"> • X axis diameter = 2.5" +/- .001 • Y axis diameter = 2.5" +/- .001 • Diagonals = 2.5" +/- .001
Caution – This test program will move the table through 12" of travel and the saddle through 10" of travel at 20 to 100 ipm. Make sure the table and saddle are as closely centered as possible and that the quill is retracted.			
	67	Push <i>MODE</i> key until <i>PROGRAM MODE</i> is displayed in conversation strip and Push <i>ENTER</i> Push <i>TAPE/RS232</i> key Push <i>1, ENTER</i> Push <i>1, ENTER</i> Unplug cassette deck	<ul style="list-style-type: none"> • Conversation strip displays <i>TAPE=1,RS232=2</i> • Conversation strip displays <i>READ=1,WRITE=2</i> • The small red light on the cassette deck will turn on for 1 to 2 minutes, then conversation strip displays <i>READ COMPLETE</i> for 3 seconds and then displays <i>SELECT MODE</i>
	68	Push <i>MODE</i> key until <i>SET-UP MODE</i> is displayed on conversation strip and <i>ENTER</i> Push <i>ENTER</i> Push <i>ENTER</i> Push <i>ENTER</i> Push <i>ENTER</i> Push <i>ENTER</i> Push <i>ENTER</i> Push <i>ENTER</i> Push <i>ENTER</i> Retract quill and <i>ENTER</i> Push <i>.,3,5,7,ENTER</i> Push <i>ENTER</i> Push <i>ENTER</i> Push <i>ENTER</i> Push <i>ENTER</i>	<i>X HOME</i> displayed <i>Y HOME</i> displayed <i>X LIMIT</i> displayed <i>X LIMIT</i> displayed <i>Y LIMIT</i> displayed <i>Y LIMIT</i> displayed <i>Z LIMIT</i> displayed <i>SET Z TOOL #01</i> displayed <i>TL 1 DIA</i> displayed <i>Z START</i> displayed <i># FIXTURES</i> displayed <i>TRIAL?/YES=1</i> displayed <i>SET Z RETRACT</i> displayed <i>SET-UP COMPLETE</i> displayed
	69	Push <i>MODE</i> key until <i>RUN MODE</i> displayed and <i>ENTER</i>	<i>POSITION & START</i> displayed
	70	Push and hold <i>START</i> for 3 seconds	<i>START SPINDLE</i> displayed
	71	Push <i>GO</i> This program exercises the system by running through all events and many combinations. This program consists of 150 events and will run continuously until stopped. Allow the program to exercise the system for about 30 minutes. Ensure that machine is well oiled.	
	72	Push <i>STOP</i> Check out complete	

4.3 Diagnostic Sheet for Checkout Procedures

Note: If the procedures indicated below do not fix the problem, go to the Troubleshooting Guide (Section 5.0) of this manual.

- 1-3 No indication

- 4 Check power cord, AC IN, fuses, On/Off switch

- 5-13 Change polarity connector inside the pendant display

- 14-16 Review calibration procedures

- 17-19 Make sure E-Stop connector is correct

- 20-27 Sensor connectors in correct axes
Motor encoder connectors in correct axes
Motor power connectors in correct axes

- 28-48 Check power, fuses, etc.
Turn system off for 1 minute then back on
Check all connectors
Brackets, sensors tight

- 49 Check gib adjustment
Brackets secure
Sensors and bases tight
X and Y axes mechanical assemblies correct
 - thrust bearings may need to be shimmed (.003" to .008") between outer races
 - spacers
 - slip clutchesBall nut housing secured to saddle
Ballscrew nuts secured to ball nut housing

- 50 Check operator's manual for cassette error messages
Replace tape
Replace cassette deck

- 51-60 Check connectors
Check gib adjustment
Recalibrate
Change sensor

- 61-62 Check connectors
Check brackets, bases, and sensors
Check mechanical assemblies X and Y axes
Check ballscrews

4.4 Calibration Procedure

For calibration you will need a 6"/150 mm standard (gauge blocks, etc.) and a .0001" dial indicator.

Adjusting repeatability:

Step 1

Using the handwheels, move the table and saddle through their full travel four to six times to allow the sensor wheel to form the micro rack and pinion system with the running surface.

Step 2 (figure 4-1)

Set up a 6"/150 mm SWI standard (or gauge blocks) on the mill table parallel to the direction of travel. The table and saddle should be parallel to the direction of travel. The table and saddle should be approximately centered and the knee should be locked at the height where most machining work is done.

Step 3

Set a .0001" resolution dial indicator in the spindle as shown

Step 4

Touch the dial indicator to the zero reference on the standard and zero both the dial indicators and the X-axis display. Push *X*, *ABS SET*, *X INC SET* on pendant display.

Step 5

Move the table away from the indicator (at least 8") and then back until the dial indicator is zeroed on the zero reference of the standard.

Step 6

Check the X-axis display to see if it is back at 0. If it is, proceed to Step 7. If it is not at 0, then the puller screws must be adjusted for repeatability.

- a. Place bubble level along the direction of travel on the table or saddle and note the bubble location. Next, place the level across the top of the sensor oriented along the direction of travel to be sure they are the same. A more accurate measurement can be made by using a dial indicator. For example, on X, place the indicator on the table and touch off the top of the sensor on one side. Next, move the table so that the indicator touches the top of the other side. There should be no indicator movement.
- b. If the sensor is not level, loosen one of the puller screws (figure 4-1) and tighten the other an equal amount until the sensor is correctly positioned.
- c. Occasionally the procedure in (a) is not sufficient. A trial and error method may be used as the last resort. Measure the amount of repeatability. Adjust the puller screws as described in (b) above. Check repeatability again. If it gets worse, then adjust the opposite way. If it gets better, keep adjusting until it is within +/- .0003" measured on the dial indicator.

Electronic Calibration Procedures (ProtoTRAK and CNC)

Step 7

Press the *EDIT* key until *SPEC MOD* is displayed on the event display and then press the *ABS SET* key. When the system prompts for *CODE*, enter *1, 2, 3, ABS SET*; the event display will then prompt *SELECT AXIS*.

Step 8

The following chart walks through the calibration procedure for the X-axis:

ProtoTRAK

Displayed Prompt	Definition of Prompt	Keyboard Input
Select Axis	Select axis to be calibrated	X
<i>Beg STD/Press Set</i> (flashing)	Move table to zero dial indicator to zero reference point on standard	INC SET or ABS SET
<i>End STD/Press Set</i> (flashing)	Move table to zero dial indicator to gage reference point on standard <i>Note: Display must read standard length or slightly more, if not, check installation and standard</i>	INC SET or ABS SET
<i>Input STD/Press Set</i> (flashing)	Input the standard length through numeric keyboard	NUMERIC DATA, INC SET, or ABS SET

CNC

Displayed Prompt	Definition of Prompt	Keyboard Input
Select Axis	Select axis to be calibrated	X
<i>Zero X on STD</i>	Move table to zero dial indicator to zero reference point on standard	ENTER
<i>Move X to STD</i> (flashing)	Move table to zero dial indicator to gage reference point on standard <i>Note: Display must read standard length or slightly more, if not, check installation and standard</i>	ENTER
<i>Input STD</i> (flashing)	Input the standard length through numeric keyboard	NUMERIC DATA, ENTER
<i>Calibrate OK</i>	Calibration factor is OK and has been stored	No input required

If calibration is accepted, the system will default to the DRO mode. If the calibration is not accepted, the display will read *CAL ERROR*. This indicates that the displayed readout was either less than the input standard length or more than 1% of the standard length. For example, if the standard length were 150 mm, the displayed readout must be at least 150.00 mm but not greater than 151.50 mm ($150 + [.01 \times 150] = 151.50$). If *CAL ERROR* is displayed, check installation and standard.

Step 9

Repeat steps 2 through 8 for the Y-axis (saddle).

Step 10

Repeat Steps 2 through 8 for the Z-axis (quill). Note that for the Z-axis, a standard length of 3" or 75 mm is recommended.

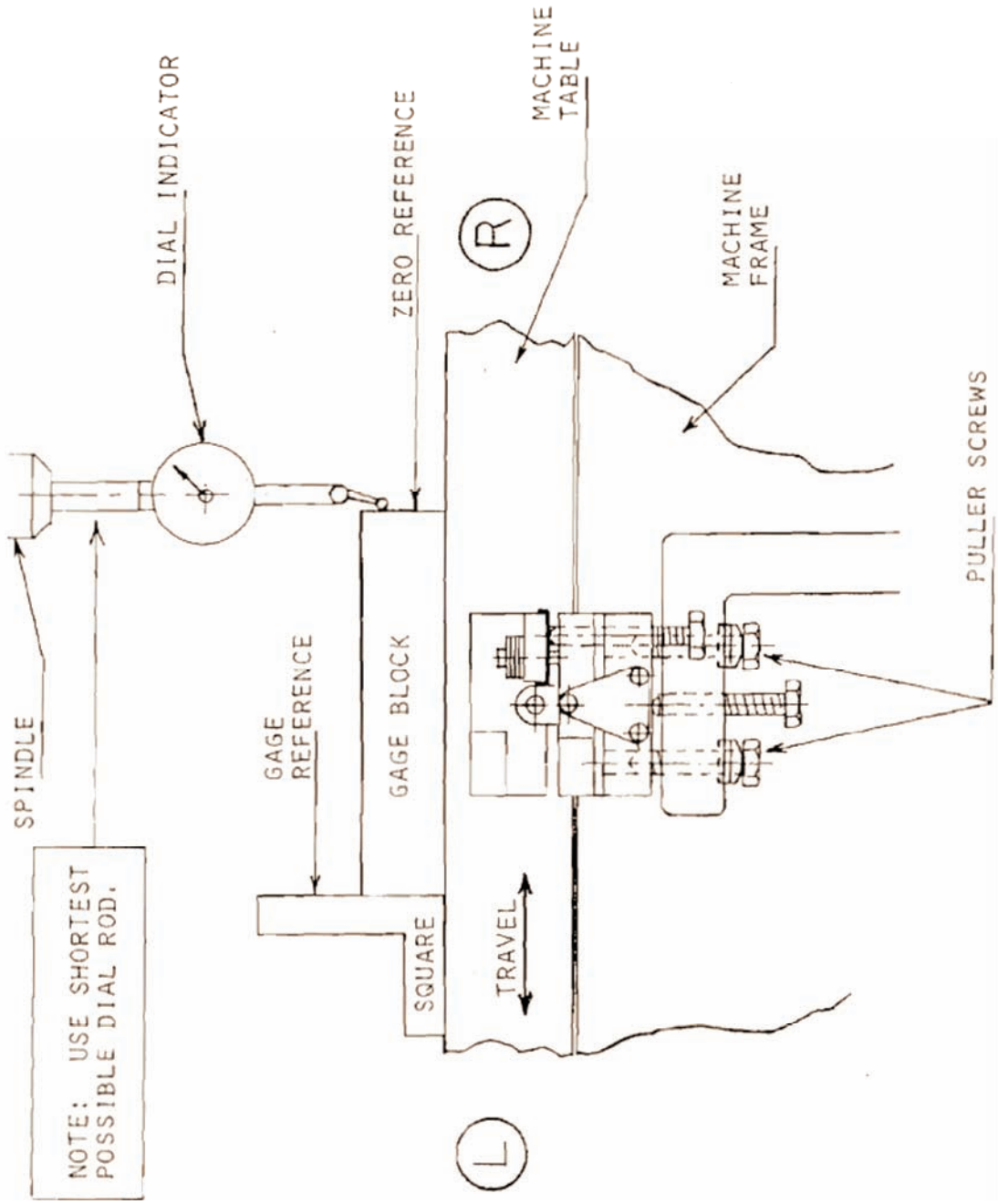


Figure 4-1
Sensor Calibration

4.5 Servo Amp Module Removal and Reinstallation

Removal (for ProtoTRAK/CNC2)

Step 1 (figures 4-2, 4-3)

Turn off system and unplug main pendant power cord from AC in. Open door to power control cabinet.

Step 2

Disconnect wires marked 1, 2, and 3 from transformer terminals. Note that terminal 3 may be near the cabinet backwall on some power units. These are spade type connectors which pull off and push on easily.

Step 3

Disconnect X and Y control harness connectors. Pull out in direction of arrow.

Removal (for CNC2 – XYZ harnesses)

Step 4

Disconnect fan cable connector. This connector may be stiff. Pull out in direction of arrow.

Step 5

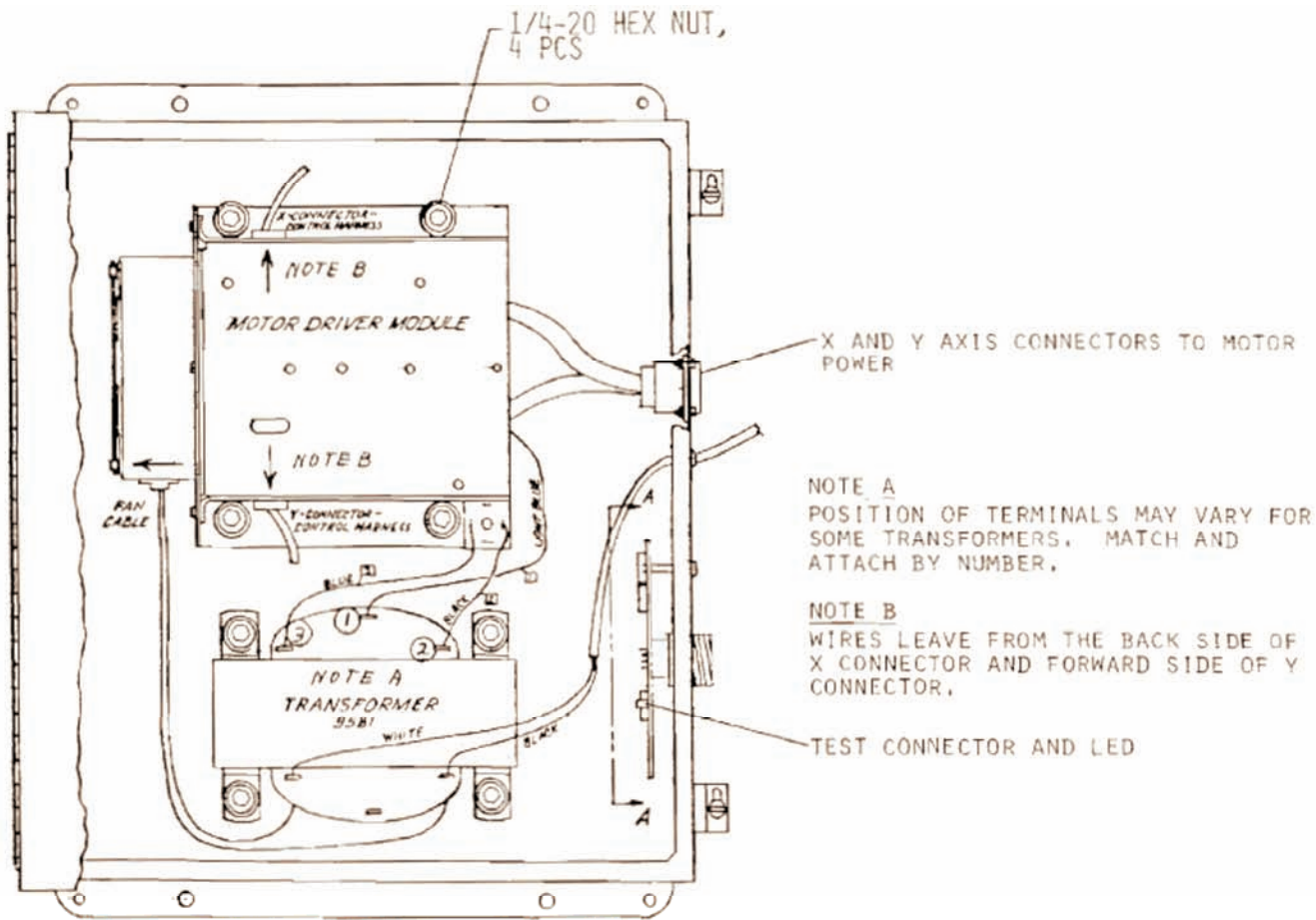
Remove X and Y connectors to the motor power cables from side wall of power control cabinet by removing the two #4-40 screws and hex nuts on each connector.

Step 6

Remove the four 1/4-20 nuts (with a 7/16" socket and extension) securing the servo amp module to power control cabinet back panel. Remove servo amp module.

Reinstallation (figures 4-2, 4-3)

To reinstall the servo amp module, follow steps 2 through 6 in reverse order and connect wires, screws, and connectors. Be careful not to bend any pins.



**Figure 4-2
ProtoTRAK**

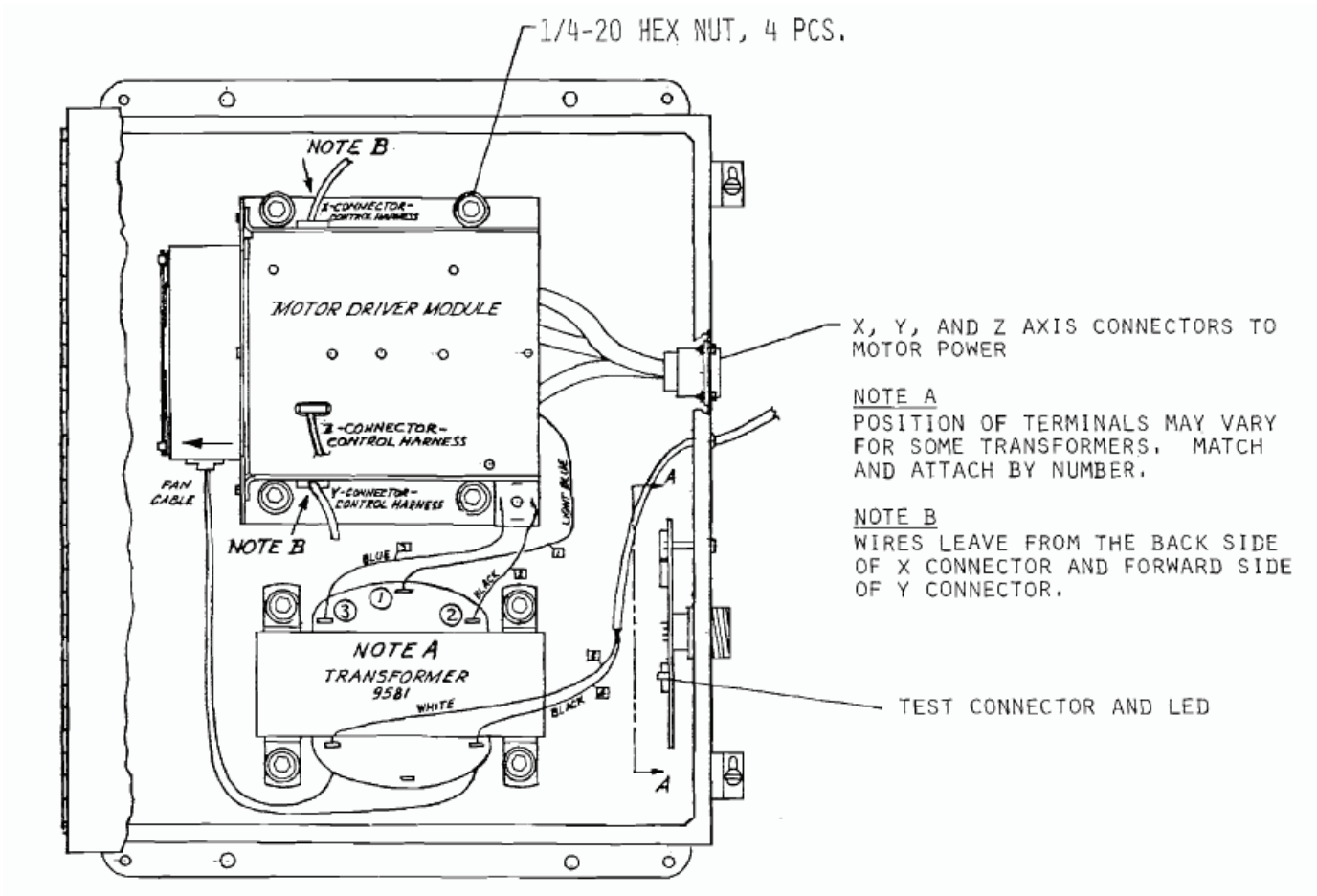


Figure 4-3
CNC2

5.0 Troubleshooting Guide

The purpose of troubleshooting a ProtoTRAK is to identify which major subassembly is malfunctioning so that it can be corrected or replaced. The major subassemblies are

- Ballscrews/bearings
- Connectors/cables
- TRAK sensors
- E-STOP
- Motors
- Display pendant
- Servo-Amp module

This guide is divided into two parts – Procedures and Symptoms. The first part describes in detail the procedures for inspecting and checking out each subassembly. The second lists various symptoms that may occur if the ProtoTRAK malfunctions and suggests a series of steps that should be followed (based on the procedures) to probably diagnose the problem

If this troubleshooting guide does not resolve your problem, please contact your local service representative or call Southwestern Industries Service Department at 800.367.3165.

5.1 Procedures

A. Ballscrews and Bearings

1. Tightness, Roughness, Jamming

Turn the display off and then back on. Move the table or saddle by hand through the full travel in both directions. Feel for rough spots, tightness, jams, etc.

Step 1: If the screw is noticeably stiffer in one direction than the other, disconnect the power cable for the motor on that axis at the power unit cabinet. If the difference in stiffness goes away, the servo amp module is probably bad.

Step 2: If the ballscrew is stiff in both directions or no change results after performing step 1, review section I to be sure the screw is properly aligned, the inner and outer race of the bearings are not jammed relative to each other, or the dial vernier is not dragging on the casting.

Step 3: Remove the retainer nut, spacers, slip clutch, plus vernier for Y, retainer cap, and bearings. For X, also loosen the four end cap screws on the right side. If the ballscrew turns without roughness or stiffness, then it is okay. Double check the alignment and bearings as described below. If the ballscrew has very noticeable rough spots or jams, replace it.

Step 4: Remove and inspect the thrust bearings. Compare one to the other. Are they smooth? If not, replace them.

2. Backlash

Step 1: With the X and Y ballscrews and drives fully assembled, enter the *SPECIAL MODE* in Edit. Input Code 11 when prompted. The X and Y display will readout the total system hysteresis in each axis on the X and Y display. If the hysteresis is greater than 0.005 in either axis, remove the thrust bearings and place a .003 to .005 inch shim between the outer races. Reassemble and check again. If the shims are too thick, the

ballscrew will be stiff when the retainer nut is securely tightened. Press *RESTORE* to abort the test.

Step 2: Be certain ball nut is tight in leadscrew nut retainer and that the leadscrew nut retainer is tightly bolted to the saddle.

B. Connectors and Cables

Note: Never force a connector. Connectors should attach and unattach easily.

Step 1: Visually inspect each cable to be certain it is not crimped or damaged.

Step 2: Unhook each connector and inspect the pins. Do the male pins all protrude the same distance and are they firmly set in the connector? Have any of the female receptacles been pushed too far back into their connector?

Step 3: Be sure the umbilical cable is not inserted upside down. Notice that the connector is wider at either the top or the bottom. If the umbilical cable is inserted upside down, the table could run away at rapid speed.

Step 4: Be certain none of the ProtoTRAK's cables are attached to or even next to the power cable to the machine tool's spindle motor or on/off (reversing) switch.

C. TRAK Sensors

1. Counting

Step 1: Inspect the cable connector.

Step 2: Unplug the sensor connector from the axis that will not count and reconnect it to one of the other two axes. Move the table, saddle, or quill that wouldn't count before. If it still won't count (as displayed in the axis to which it was connected) replace the sensor. If it now counts, try it again in its correct axis. If it still won't count in its correct axis, replace the display.

2. Repeatability

Step 1: Check if the nonrepeatability is random or accumulates – that is, does the error increase each time the table moves back and forth?

Step 2: If the nonrepeatability is random, check to be sure the brackets are very solid. Check that the M5 base end plates are not buckled. Check that the sensor is properly mounted and loaded. If okay, remove the sensor and check wheel and running surface for damage.

Step 3: If nonrepeatability accumulates, check all above and adjust puller screws for repeatability as in section 4.4, step 6.

Swap, remount, and recalibrate sensor with one from another axis and check repeatability again.

Step 4: If the above procedures do not correct the repeatability, replace the sensor.

3. Accuracy

Step 1: Recalibrate the sensor per instructions in section 4.4.

Step 2: Move the standard (or job blocks, rod, etc.) to another part of the table or saddle and check again. If the error is greater than 0.001 inch, check the gib adjustment as described in section 4.2, step 33.

Step 3: Swap, remount, and recalibrate sensor with one from another axis and check again.

Step 4: If the above procedures do not correct the problem, replace the sensor.

D. E-STOP

1. Check Off

Push the red E-Stop (emergency stop) in. Make sure the display pendant is plugged in and turned on and make sure the power unit is plugged into the display. Open the power unit cabinet and observed that the fan is not on and the green and red LED lights on the servo amp module printed circuit boards are not lit. If they are, and the E-Stop cable and connector are okay, then replace the E-Stop assembly.

2. Check On

Pull out red E-Stop or rotate to pull out if the button has arrows. Make sure the display pendant is plugged in and turned on and make sure the power unit is plugged into the display. Open the power unit cabinet and observe that the fan is on. If not, then check all cables, connectors, and pendant fuses. If they are okay and the fan is still not on, then replace the E-Stop assembly.

E. Motors

1. Motor Encoders

Step 1: Be certain TRAK Sensors operate correctly.

Step 2: Enter Special Mode (see section 8.0 of Operator's Manual, P/N 15261) and input *101, ABS SET* when display prompts for *CODE*. This special mode automatically switches the display of the X motor encoder into the Z display axis.

Step 3: Move the table back and forth 1 or 2 inches as fast as possible by hand. Move the table until X reads 1.0000. The Z axis should read 5.3 to 5.5 and with the same sign as X. If not, check again and then replace X motor. Press *RESTORE* to abort the test.

Step 4: If these results are not met, double check the TRAK sensors and then replace the motor.

Step 5: Repeat steps 2 and 3 above for Y by using Code 102.

2. Motors

Step 1: Be certain the motor encoders operate correctly (see step 1 of section 5.1.1.6.1).

Step 2: Enter Special Mode (see section 8.0 of Operator's Manual) and input *100, ABS SET* when display prompts for *CODE*. Display prompts *AXIS?*, press *X*. Display prompts *DIR?+*, press *ABS SET*. Display prompts *PRESS GO*, make sure tool is clear and press *GO*. The table should move to the left at its maximum speed for 1 second then stop. Conversation display will read max speed which should be over 100. X should read about 1% of the speed. For example, if the speed was 132, then X should read between 1.2 and 1.45. Z shows the X motor encoder output and should read about 5.4 times X. If okay, press *RESTORE* to abort test.

Step 3: Repeat step 2 above, except press *+/-* when the display prompts *DIR?+* and then press *ABS SET*, continue. This will repeat the test but move the table to the right.

Step 4 Repeat steps 2 and 3 above selecting *Y* instead of *X*.

Step 5 If any axis passes these tests for movement in both directions, its motor and servo amp are probably okay.

Step 6 If either axis fails, swap the X and Y motors. Be certain to swap X motor and motor encoder cables with the corresponding Y cables at the power unit cabinet. Do not swap the TRAK sensor cables. Repeat steps 2, 3, and 4 above. If the axis which previously failed moves to the other axis, then that motor is bad and must be replaced. If the original problem stays on the same axis (even through the motors were swapped), then the motors and encoders are okay. Check the ballscrews, display pendant, and servo amp module.

F. Display Pendant

1. Power Up

Step 1: Check 3/4 amp slow-blow fuse on display back panel.

Step 2: Check 115V +/-10V AC line in.

Step 3: Disconnect all cables, including power-to-power unit cabinet. Turn display on. If it does not light up, replace it. If the display does light up, reconnect each connector one at a time. If connecting any cable into the display causes it to blank out, investigate that subassembly.

2. Counting

Step 1: Disconnect all cables, except X, Y, Z sensors.

Step 2: If display does not count in one axis, follow procedure 5.1.1.3, step 1 for TRAK sensors.

Step 3: If display does not count in all axes, replace it.

3. Programming

Step 1: Double check the program—get assistance on programming problems.

Step 2: Write a simple program to determine if the display pendant will not accept any program or one particular program or step. If the latter is true, then recheck the program and notify SWI in Los Angeles at 800.367.3165. If it will not accept any program, replace the pendant.

4. Program Run

Step 1: Double check the program. Write a very simple program to determine if the ProtoTRAK won't run any program or a particular program. Get assistance in making certain the program is correct before diagnosing the equipment.

Step 2: Enter *SPECIAL MODE* and press *2, 2, ABS SET* when prompted for *CODE*. This is the Simulation Special mode that will dry run a program through the display but suppress all X and Y drive movement. Simulation will operate even if the display is disconnected from all other subassemblies.

Step 3: Write and run a simple program in simulation. During run display the X, Y, and Z absolute position. Does the display move to the programmed positions? Remember the display will read out the tool center position so, if tool offsets are programmed, the absolute readout will be shifted from the programmed positions.

Step 4: If display will not run correctly in simulation, replace it.

5. Output to Servo Amp

This procedure may only be used when the ProtoTRAK has a new style power unit. This new style has a printed circuit board mounted on the right inside wall of the power unit to the right of the large transformer.

The purpose of this test is to determine if the pendant is sending the right kind of signal to the power unit.

Step 1: Remove the cable supplying power from the display pendant to the power unit. Check to be sure the fan is off.

Step 2: Program a *DO ONE MILL* event with *X BEG* equal to *0 INC SET*, *Y BEG* equal to *0 INC SET*, *X END* equal to *1.0 INC SET* and any valid input for the rest of the data. Complete the program until the display reads *START?*

Step 3: Disconnect the X connector control harness from the servo amp module (see figure ___). Reconnect it to the test connector on the printed circuit board on the right inside wall of the power unit cabinet. The wires should come out of the connector pointing towards you. Do not force the connector.

Step 4: Press and hold *START* for 3 seconds until display reads *CHECK Z*, then press *GO*. The *In Position* light on the front panel should go on.

Step 5: The test LED next to the test connector should come on with a greenish-yellow color. Move the X handle 1/8 turn or less in one direction. The test LED should change to green or red. Without delay, turn on the handle back the other way past its original position. The LED should change to the opposite color (red or green) from before. You probably have only a few seconds to do this experiment before the display *FAULTS*. If it does, reprogram as in step 2 and run it again as in steps 4 and 5.

Step 6: If you do not get these results, try again and then replace the pendant.

Step 7: Replace the X connector control harness to the servo amp module.

Step 8: Repeat steps 2 through 7 for the Y-axis. You may need someone to move the Y handles while you observe the test LED.

G. Servo and Module

In general, it is difficult to specifically troubleshoot the servo amp module. Problems in the servo amp are usually identified by eliminating all other alternatives.

Step 1: Check the 8 amp and 3/4 amp fuse on the display pendant back panel. If bad, replace.

Step 2: LED check

- a. Be sure E-Stop is pulled out and all cables properly connected.
- b. Open the power unit cabinet. Look in the right inside of the servo amp module. There is a printed circuit board on the top and bottom. Each board has a red and green LED next to each other (forward on the top board and back on the bottom one) and a single red LED (back on the top board, and forward on the bottom one).
- c. With the display turned on, the green LED should be on and the single red LED should be faintly lit for both axes. If either of these are off, or the red LED next to the green is on or flashing, replace the servo amp module.

Step 3: Inspect the 6-amp fuse mounted near the above LEDs on each printed circuit board. If bad, replace.

6.0 Symptoms

6.1 Fault 01

- a. Procedure B, especially B4
- b. Procedure C3
- c. If problem persists, replace display pendant.

6.2 Fault 02, 03, 04, or 05

- a. Press *RESTORE*. Turn display off for 1 minute and then back on.
- b. If problem persists, replace display pendant.

6.3 Fault 32

- a. This may occur normally when the ProtoTRAK is first powered up. Press *RESTORE*.
- b. If problem persists, replace display pendant.

6.4 Fault 33

- a. Press *RESTORE*. Turn display off for 1 minute and then back on.
- b. If problem persists, replace display pendant.

6.5 Fault X or Y or XY

- a. Check if table or saddle are at their travel limit or jammed.
- b. Check if E-Stop is pulled out; perform procedure D2.
- c. Procedure B. For *FAULT XY*, be sure motor, motor encoder, or sensor cables are not switched.
- d. Check that the retaining nut on the end of the ballscrew is very tight (on Y loosen set screw then retighten).
- e. Procedure A
- f. Procedure E
- g. Procedures F4 and F5
- h. Procedure G

6.6 Fault Calibrate X, Y, Z

- a. Procedure B, especially B5
- b. Procedure C3
- c. If problem persists, replace display pendant.

6.7 Fault MEM ERR

- a. Press *RESTORE*.
- b. Procedure B, especially B4
- c. If problem persists, replace display pendant.

6.8 Fault EEM ERR

- a. Press *RESTORE*.
- b. Procedure B, especially B4
- c. Procedure C3 for all axes
- d. If problem persists, replace display pendant.

6.9 One axis won't count, repeat, measure accurately

- a. Procedure C

6.10 Display pendant won't light up, count, perform DRO functions

- a. Procedure B
- b. Procedures F1 and F2

6.11 Ballscrew is rough, tight, jams, etc.

- a. Procedure A

6.12 Poor finish on work piece

- a. Procedure A2
- b. Check gib adjustment – section 3.1.3, step 31. Lock gibs between knee and column.
- c. Procedure A1
- d. Procedure E
- e. Procedure F5
- f. Procedure G

6.13 Parts inaccurate

- a. Procedure C3 – for ProtoTRAKs with Version 2 software (see section 6.8.4.4 in Operator Manual), make sure X and Y mechanical tilt is within .02 mm over 150.00 mm standard.
- b. Procedure F4
- c. Check gib adjustment – section 3.1.3, step 31. Lock gibs between knee and column.

6.14 DATA ERR message

- a. Refer to section 10.2.3 of Operator Manual. Verify data.
- b. Get programming or computation help.

6.15 Won't program or hold program

- a. Procedure F3

6.16 Won't run program properly

- a. Procedure B
- b. Procedure F4
- c. Procedure F5
- d. Procedure G
- e. Procedure E

6.17 Table or saddle runs away

- a. Procedure B4
- b. Procedure B
- c. Procedure G
- d. Procedure F5

6.18 Hunting on X or Y ballscrew greater than .005 inch

- a. Procedure A2
- b. Procedure A1
- c. Procedure E1
- d. Procedure C2

6.19 3/4 amp fuse blows repeatedly

- a. Check 115V input line voltage.
- b. Be certain 115V line is dedicated to just the ProtoTRAK from the wall to the system.
- c. Procedure F1.

6.20 8 amp fuse blows repeatedly

- a. Check connector and cable that provides power from display pendant to power unit cabinet.
- b. Visually inspect large transformer in power unit cabinet for physical, heat, or electrical damage. If damaged, replace.
- c. Replace servo amp module if (a) and (b) are okay.

6.21 6 amp fuse on servo module printed circuit board blows repeatedly

- a. check motor power cable and connector for axis that blows fuse.
- b. Swap X and Y motors (be sure to swap X and Y motor and motor encoder connector as well) to see if problem moves to other axis. If the same printed circuit board fuse blows, replace the servo amp module. If the fuse on the other printed circuit board blows, replace the motor.

6.22 Special Codes

	CNC2	PT	PT+	
1	X			Auxiliary function test
11	X	X	X	Backlash hysteresis test
12		X	X	Determine feed forward constant (EEPROM)
13			X	Set default feed forward constant (EEPROM)
22	X	X	X	Simulation mode
33	X	X	X	Software identification
35			X	Trial run mode
44		X	X	Extend display mode (most significant digits)
54		X	X	Continuous run mode
55		X	X	Self tape load and run mode
66	X	X	X	Metric default, bytes of RAM for CNC2 (EEPROM)
67	X	X	X	English default (EEPROM)
68		X	X	0.01 mm (.0005") display
69		X	X	0.01 mm (.001") display, 0.02 mm for PT and PT+
70		X	X	0.005 mm (0.0001")
73	X			Single step mode
77	X	X	X	Streamline programming, front LED for CNC2
78		X	X	Out of streamline programming
79				Turn on beeper
80		X	X	Turn off beeper
81			X	Keyboard test
88	X	X	X	Keyboard test, nonextended display for PT, PT+
89	X	X	X	Out of simulation mode
99	X	X	X	Master reset and clear program memory
100	X	X	X	Axis open loop test
101	X	X	X	X-axis motor encoder test
102	X	X	X	Y-axis motor encoder test
123	X	X	X	Sensor calibration mode (EEPROM)
125		X	X	Display calibration factors
975	X			Set personality, default is 100

Southwestern Industries, Inc

TRAK WARRANTY POLICY

Warranty

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

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

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

If a unit under warranty fails, it will be repaired or exchanged at our option for a properly functioning unit in similar or better condition. Such repairs or exchanges will be made FOB Factory/Los Angeles or the location of our nearest factory representative or authorized distributor.

Disclaimers of Warranties

- This warranty is expressly in lieu of any other warranties, express or implied, including any implied warranty of merchantability or fitness for a particular purpose, and of any other obligations or liability on the part of SWI (or any producing entity, if different).
- Warranty repairs/exchanges do not cover incidental costs such as installation, labor, freight, etc.
- SWI is not responsible for consequential damages from use or misuse of any of its products.
- TRAK products are precision mechanical/electromechanical measurement systems and must be given the reasonable care that these types of instruments require:
- Replacement of chip scrapers and wipers is the responsibility of the customer. Consequently, the warranty does not apply if chips have been allowed to enter the mechanism.
- Accidental damage, beyond the control of SWI, is not covered by the warranty. Thus, the warranty does not apply if an instrument has been abused, dropped, hit, disassembled or opened.
- Improper installation by or at the direction of the customer in such a way that the product consequently fails, is considered to be beyond the control of the manufacturer and outside the scope of the warranty.