KDN Tool & Automation Engineering Co. LLC
34 Church Street
West Warwick, RI 02893
401-615-0267
www.kdntool.com
sales@kdntool.com
kdntool@cox.net

2 Axis CNC Retrofit Kit For SIEG X2 Mini Mill.

Conversion Kit Features:

- Two axis CNC actuation
- Direct drive NEMA 23 motor mounts
- Oldham style anti-backlash slotted disc couplings
- Two pre-loaded grooved race ball thrust bearings per axis
- Precision machined 6061 aluminum components

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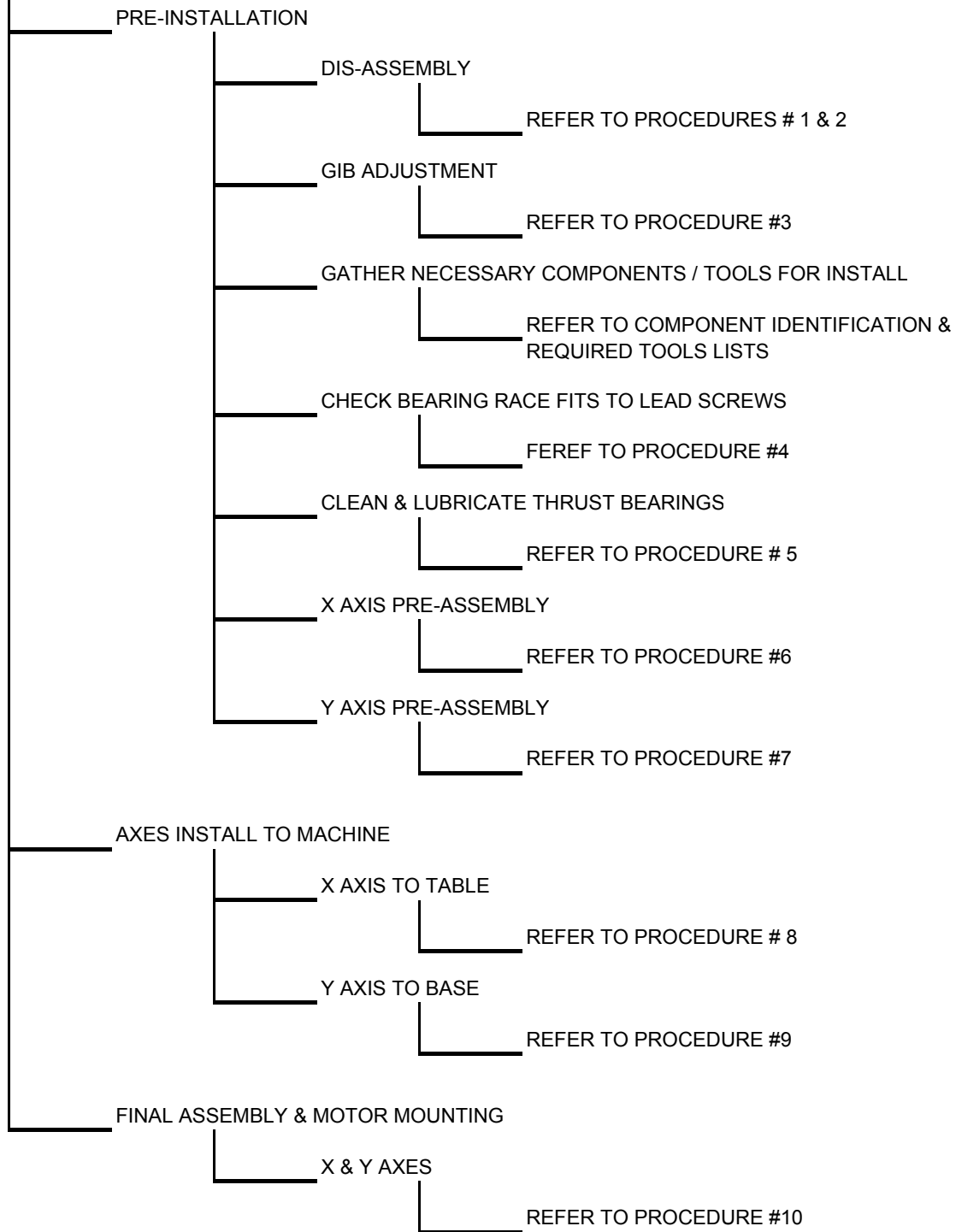sales@kdntool.com
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CNC Safety

All machinery has a certain level of danger about it. CNC machinery has a heightened level in that it has the potential to move, turn the spindle on, to run off course, etc without any input from you. The wisdom to not "reach-in" or "place your hand too close" while a machine is operating is common place for some, learned the hard way knowledge for others, and still some may never comprehend it at all. Body parts are not replaceable!! End mills, drills, reamers, scales, and clamps, even machine tables are. Respect, good judgment, and common sense are a must for operating CNC machine tools and all the guarding and/or bright colored stickers in the world will not protect you better than they can!!!!! Safety Glasses are also a no-brainer when you are in the trajectory range of an operating machine. Try to fathom the thought of a smoking chip of steel penetrating your eye and it will become quite obvious why you need them.

I recently ordered an industrial sized package of straight edge razor blades and sure enough, printed on the sticker, it said "CAUTION: Blades are sharp". I stopped and thought to myself, "sharp razor blades, what a novel idea".
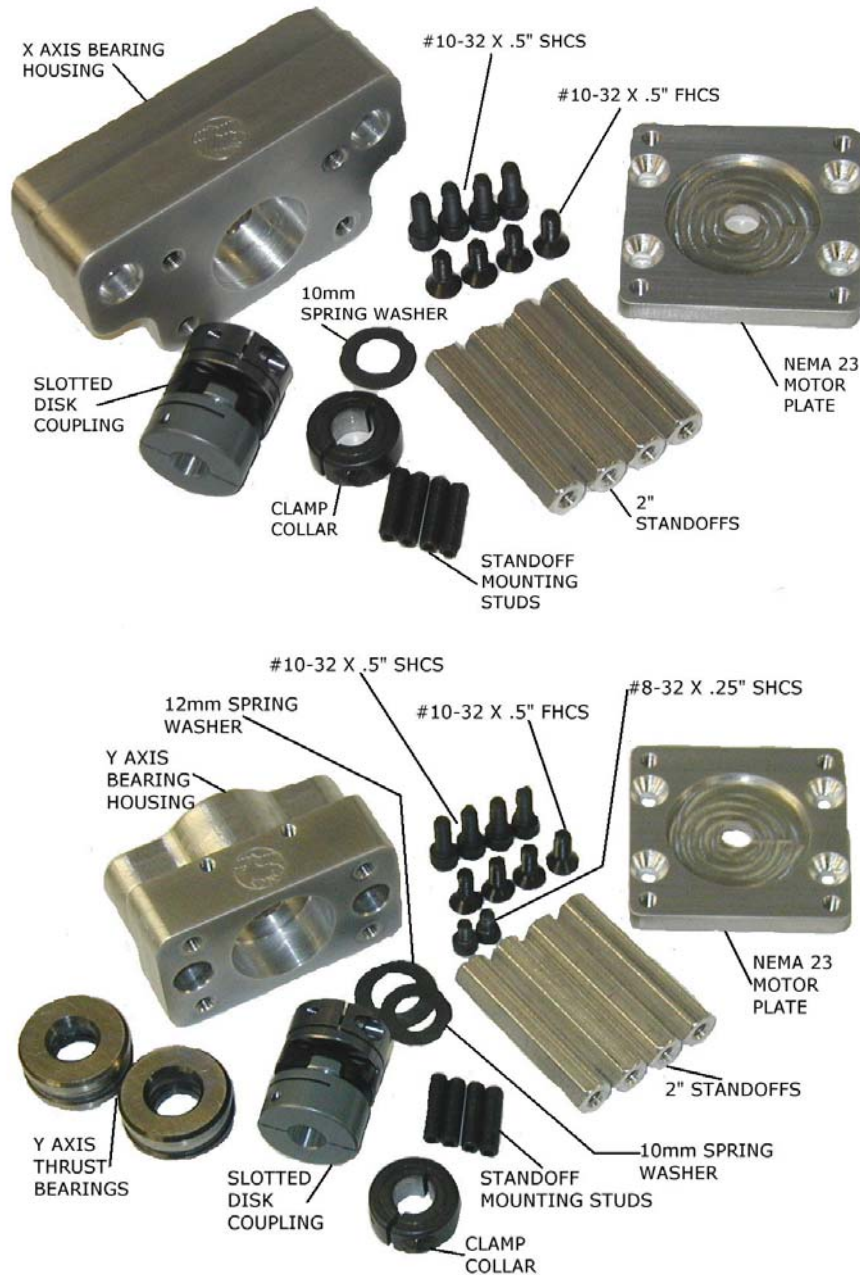
By assuming the role of a CNC machine tool operator you place yourself at risk of bodily harm / dismemberment or even worse unmentionable dangers. Take this responsibility, apply your own respect, good judgment, and common sense; and you will benefit from an enjoyable CNC machining experience.

Ken Cardolino
KDN Tool & Automation Engineering Co. LLC

8/26/05

KIT INSTALLATION

PRE-INSTALLATION

DIS-ASSEMBLY

REFER TO PROCEDURES # 1 & 2

GIB ADJUSTMENT

REFER TO PROCEDURE #3

GATHER NECESSARY COMPONENTS / TOOLS FOR INSTALL

REFER TO COMPONENT IDENTIFICATION & REQUIRED TOOLS LISTS

CHECK BEARING RACE FITS TO LEAD SCREWS

FEREF TO PROCEDURE #4

CLEAN & LUBRICATE THRUST BEARINGS

REFER TO PROCEDURE # 5

X AXIS PRE-ASSEMBLY

REFER TO PROCEDURE #6

Y AXIS PRE-ASSEMBLY

REFER TO PROCEDURE #7

AXES INSTALL TO MACHINE

X AXIS TO TABLE

REFER TO PROCEDURE # 8

Y AXIS TO BASE

REFER TO PROCEDURE #9

FINAL ASSEMBLY & MOTOR MOUNTING

X & Y AXES

REFER TO PROCEDURE #10

Component Identification:

(X AXIS BEARING HOUSING)
#10-32 X .5" SHCS
#10-32 X .5" FHCS
10mm SPRING WASHER
NEMA 23 MOTOR PLATE
SLOTTED DISK COUPLING
CLAMP COLLAR
STANDOFF MOUNTING STUDS
2" STANDOFFS

#10-32 X .5" SHCS
12mm SPRING WASHER
#10-32 X .5" FHCS
#8-32 X .25" SHCS
Y AXIS BEARING HOUSING
NEMA 23 MOTOR PLATE
Y AXIS THRUST BEARINGS
SLOTTED DISK COUPLING
CLAMP COLLAR
STANDOFF MOUNTING STUDS
10mm SPRING WASHER
2" STANDOFFS

Tools & Items Required For Installation:

- Metric hex key set
- Imperial hex key set
- 3/8" box end wrench or 3/8" socket and ratchet
- 13 mm end wrench or 13 mm socket and ratchet
- Bench Block or similar device
  (any item with a minimum thickness of 1.5" and a 0.40" minimum diameter thru hole)
- Small syringe for bearing grease (optional)
- Lint free or low lint cloth (for cleaning bearings)
- Cleaning solvent such as mineral spirits (paint thinner)
- Bearing grease (Lubriplate 630-AA or equivalent)

ITEM	QTY.	DESCRIPTION	KDN PART NUMBER
1	1	X AXIS THRUST BEARING HOUSING	MM1001B
2	1	X AXIS LEAD-SCREW	NOT INCLUDED SHOWN FOR REFERENCE ONLY
3	2	X AXIS THRUST BEARING	NOT INCLUDED SHOWN FOR REFERENCE ONLY
4	4	#10-32 X .500" FHCS	MM1021
5	4	#10-32 X .500" SHCS	MM1020
6	1	10mm PRE-LOAD WASHER	MM1008
7	1	10mm CLAMP COLLAR	MM1012
8	1	10mm X .250" SLOTTED DISK COUPLING	MM1045-10
9	4	#10-32 X .750" MOUNTING STUD	MM1019
10	4	3/8" HEX X 2.000" LONG STANDOFF	MM1015
11	1	MOTOR MOUNT PLATE (NEMA 23 SHOWN)	MM1017-NEMA 23 MM1018-NEMA 34
12	2	M6 X 35mm SHCS	MM1028
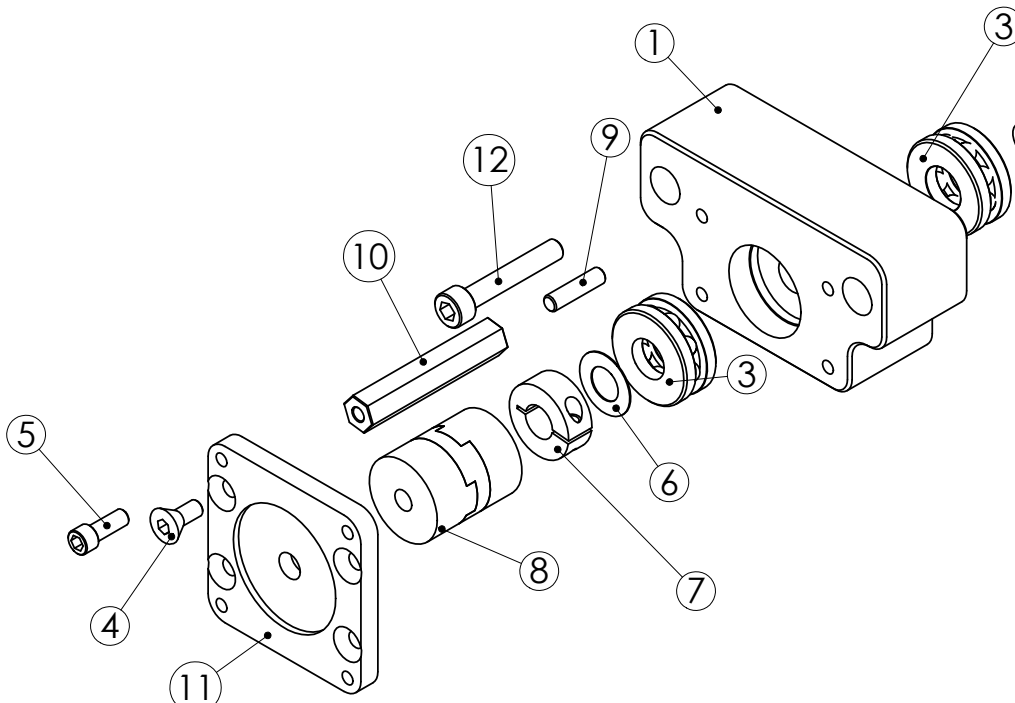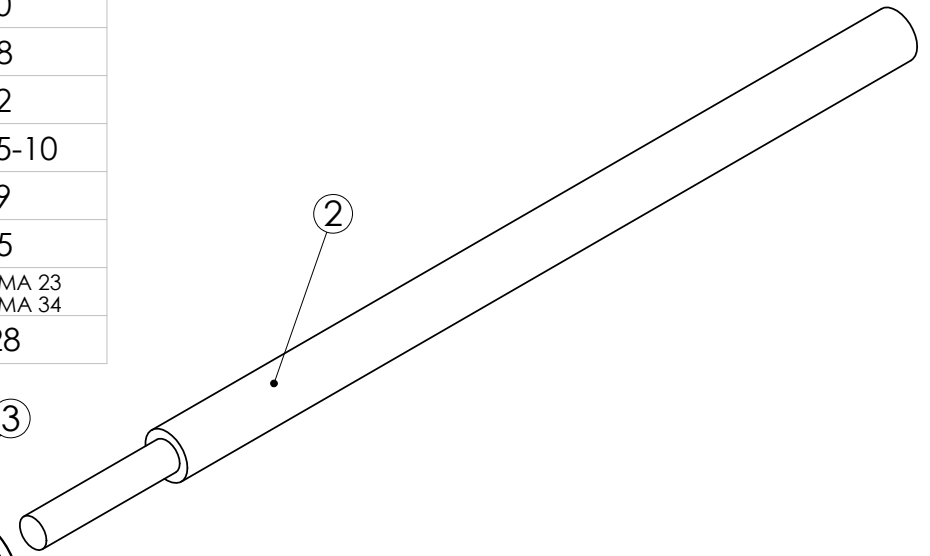
ASSEMBLY NO.

DISTR | FILE | ASSY | INSP | ENG | MODEL NO. | PART NO.

| REV. | DESCRIPTION | DATE | APP |

TITLE	SIGNATURE	DATE
DR.	KWC	11/3/05
APP		

FINISH
NONE

HEAT TREAT
NONE

KDN TOOL & AUTOMATION
ENGINEERING CO. LLC

TITLE:
X2 BASIC X AXIS EXPLODED

SIZE A | CODE IDENT. NO. 0001 | SCALE: 1:2 | SHEET 1 OF 1

MATERIAL

PART NO.

REV. N/R

NOTES: UNLESS OTHERWISE SPECIFIED

C:\HENRI\.SLDDRW

ITEM	QTY.	DESCRIPTION	KDN PART NUMBER
1	1	Y AXIS THRUST BEARING HOUSING	MM1002B
2	1	Y AXIS LEAD-SCREW	NOT INCLUDED SHOWN FOR REFERENCE ONLY
3	2	Y AXIS THRUST BEARING	MM1005
4	4	#10-32 X .500" FHCS	MM1021
5	4	#10-32 X .500" SHCS	MM1020
6	1	10mm PRE-LOAD WASHER	MM1008
7	1	12mm PRE-LOAD WASHER	MM1009
8	1	#10-32 x .750" MOUNTING STUD	MM1019
9	4	3/8" HEX X 2.000" LONG STANDOFF	MM1015
10	4	10mm CLAMP COLLAR	MM1012
11	1	10mm X .250" SLOTTED DISK COUPLING	MM1045-10
12	1	MOTOR MOUNT PLATE(NEMA 23 SHOWN)	MM1017 - NEMA 23 MM1018 - NEMA 34
13	2	M6 X 35mm SHCS	MM1028

NOTES: UNLESS OTHERWISE SPECIFIED

Procedure 1: X-Axis Disassembly

Refer to the SIEG exploded drawing for item numbers.

1. Move the X-axis to mid-travel.
2. Remove the X-axis hand wheel by removing nut 15, hand wheel 14, dial 04, and key 02-1.
3. Remove both cap screws 17 that secure the X-axis bearing retainer.
4. Remove the X-axis-bearing retainer 18. Remove and save two bearings 13 for re-use.
5. Unscrew and remove the X-axis feed screw 20 and set it aside for re-use.

Procedure 2: Y-Axis Disassembly

Refer to the SIEG exploded drawing for item numbers.

1. Move the Y-axis to mid-travel.
2. Remove the Y-axis hand wheel by removing nut 15, hand wheel 05, dial 04, and key 02-1.
3. Remove both cap screws 17 that secure the Y-axis bearing retainer.
4. Remove the Y-axis-bearing retainer 26.
5. Unscrew and remove the Y-axis feed screw 02 and set it aside for re-use.

Procedure 3: Gib Adjustment

With the lead screws removed, now is a good time to check and adjust the gibs. Proper gib adjustment will provide a uniform amount of resistance through the entire range of travel.

Proper lubrication of the sliding surfaces is essential to correct gib function. Mobil 1 synthetic motor oil, in a grade from 5W-20 to 10W-30 is recommended for this application.

1. With the gibs as they are currently adjusted, move each axis thru its range of motion while feeling for sticky spots, or areas with a tighter feel than the rest of the travel. Apply force side to side and observe any motion that occurs where the two sliding surfaces meet. If either of the conditions are present, then adjustments are in order.
2. Back off the gib screw locknuts and slightly loosen all the gib screws. Don't loosen them so much that they become disengaged from the gib strip detents.
3. Beginning with the innermost gib screws, tighten slowly while moving the axis until drag is felt in the motion. At this point stop tightening the screw and hold it in place with the hex key. Tighten the lock nut while assuring no further movement of the screw.
4. Run the axis thru its full range of motion to feel for tight spots. Repeat for the balance of the gib screws working from innermost screws to outermost screws in a back and forth pattern. Once all gibs screws and nuts are tightened, move the axis through its entire travel range to confirm that the adjustment is correct.

Procedure 4: Check Bearing Race Fits

The thrust bearings in this kit, as well as the stock SIEG X-axis bearings comprise three separate parts; two races and a ball cage. One race has a smaller diameter ID, and thus it has a tight fit on the shaft it is intended for. The second race has a larger diameter ID and thus it has quite a loose fit to the shaft.

In this kit the tight fitting races are positioned on the outboard ends of the bearing housings against the lead screw shoulder or pre-load washer and clamp collar. This allows free rotation of the lead screws.

1. Take the stock X-axis thrust bearings and identify the races with the smaller diameter bore.

2. Check the fit of the tight races on the X-axis lead screw. The bearing should fit snugly to the shaft, but not be hard to install or remove.

3. If necessary, deburr and/or polish the lead screw bearing diameter so the bearing race fits properly.

4. Removal of ½ of the M8 thread on the end of the lead screws will be necessary to allow proper engagement of the shaft couplings. This is easily achieved using a hacksaw, cut-off wheel, or lathe.

Procedure 5: Clean & Lubricate Bearings

Use a good quality bearing grease for long bearing life. Lubriplate 630-AA is a good choice, but any quality bearing grease will work fine.

1. Thoroughly clean the bearings with mineral spirits (paint thinner). This is especially important for the stock bearings from the X-axis. Use a lint free or at least low lint cloth. Standard red shop rags tend to leave balls of lint behind on any sharp edges. Take care to ensure that no debris is left inside the bearings between the ball cages and races. Even small bits of junk will cause binding in the thrust bearing.

2. Lubrication is easily and neatly applied using a small syringe (with no needle) from your local pharmacy. Pack the areas around the balls in the ball cage with grease.
For the messy approach: place a small lump of grease on the heel of your hand below the pinky finger, and with the ball cage in the opposite hand and the open spaces facing down, press the ball cage into the grease. Lift the ball cage up and rotate slightly. Then press it again into the grease until all of the open spaces in the ball cage are filled.

3. Once the bearings are cleaned and lubricated, place them aside until you need them for assembly. Cover them to prevent contamination.

## Procedure 6: X-Axis Pre-Assembly

1. Take one of the stock X-axis thrust bearings and identify the race with the smaller diameter bore.

2. Insert the X-axis lead screw into the thrust bearing entering the race with the smaller bore first. Push the bearing on until rear face of the bearing race contacts the shoulder of the lead screw.

3. Insert the bearing / lead screw assembly into the rear of the x-axis bearing housing until the outer face of the loose bearing race contacts the land of the bearing counter bore.

4. Take the other stock X-axis thrust bearings and identify the race with the larger diameter bore.

5. Install the second stock x-axis thrust bearing onto the lead screw entering the race with the larger bore first. Seat it into the bearing housing against the bearing counter bore land.
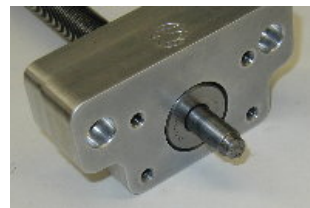
6. Install one of the smaller spring washers (10mm ID) onto the lead screw with the convex side

facing outward. The concave side of the washer should contact the thrust bearing.

7. Install a clamp collar onto the lead screw with the flat face positioned in toward the spring washer.

8. Invert the entire assembly onto a bench block or suitable fixture that is at least 1.5" thick and has a 0.40" diameter hole through it. Support the clamp collar to ensure it does not fall off as you position the assembly. The outer grooved face of the clamp collar should contact the top surface of the bench block.

9. Turn the clamp collar so you can reach the setscrew with the appropriate hex key for tightening.
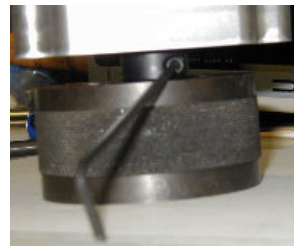
10. Grasp the exposed lead screw and apply firm downward pressure against the bench block to pre-load the spring washer. Tighten the setscrew.

11. Remove the entire assembly from the bench block and inspect the bearing preload by checking for any axial or radial play between the lead screw and the bearing housing. The lead screw should turn smoothly with no tight or gritty spots.

12. If any of the above conditions exist, loosen the setscrew and repeat the previous four steps until the lead screw rotates smoothly with no noticeable axial or radial play.

Procedure 7: Y-Axis Preassembly

Take one of the new Y-axis thrust bearings and identify the race with the smaller diameter bore.

1. Insert the Y-axis lead screw into the thrust bearing entering the race with the smaller bore first. Push the bearing on until rear face of the bearing race contacts the shoulder of the lead screw.

2. Insert the bearing / lead screw assembly into the rear of the Y-axis bearing housing until the outer face of the loose bearing race contacts the land of the bearing counter bore.

3. Take the other stock X-axis thrust bearings and identify the race with the larger diameter bore.

4. Install the second new Y-axis thrust bearing onto the lead screw entering the race with the larger bore first. Seat it into the bearing housing against the bearing counter bore land.

5. Install one of the large spring washers (12mm ID) onto the lead screw with the convex side facing in toward the bearing race. The concave side should be facing out. Install one of the small spring washer (10mm ID) onto the lead screw with the convex side facing outward. The concave side of the small spring washer should contact the concave side of the large spring washer. When assembled correctly, the two spring washers should be facing in different directions.

6. Install a clamp collar onto the lead screw with the flat face positioned in toward the spring washer.

7. Invert the entire assembly onto a bench block or suitable fixture that is at least 1.5" thick and has a 0.40" diameter hole through it. Support the clamp collar to ensure it does not fall off as you position the assembly. The outer grooved face of the clamp collar should contact the top surface of the bench block.

8. Turn the clamp collar so you can reach the setscrew with the appropriate hex key for tightening.
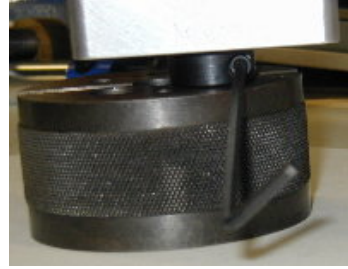
9. Grasp the exposed lead screw and apply firm downward pressure against the bench block to pre-load the spring washer. Tighten the setscrew.


10. Remove the entire assembly from the bench block and inspect the bearing preload by checking for any axial or radial play between the lead screw and the bearing housing. The lead screw should turn smoothly with no tight or gritty spots.

11. If any of the above conditions exist, loosen the setscrew and repeat the previous four steps until the lead screw rotates smoothly with no noticeable axial or radial play.

Procedure 8: Assemble X-axis to Machine Table

1. Thread the end of the lead screw into the X-axis lead nut and continue rotating until the rear face of the bearing housing is about to contact the end of machine table.

2. Install two M6 x 35mm SHCS into the mounting holes of the bearing housing and thread them into the machine table. Leave the bolts slightly loose.
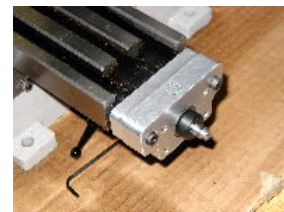
3. Rotate the lead screw through the entire range of travel while feeling for tight spots. It may be necessary to loosen the two lead nut retaining screws (#22) and reposition the lead nut to remedy any tight or binding conditions. Be certain to retighten the lead nut retaining screws once the lead nut is adjusted.

4. Fully tighten the two M6 x 35mm SHCS bearing housing bolts.

5. Again, rotate the lead screw through its entire travel range feeling for tight spots or binding. Adjust as necessary by loosening the mounting bolts and repositioning the bearing housing and/or the lead nut.

Procedure 9: Assemble Y-Axis to Machine Base

1. Insert the Y-axis lead screw through the hole in the front of the machine base.
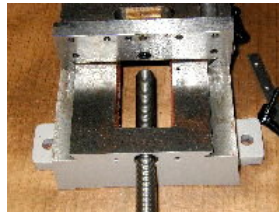
2. Thread the end of the lead screw into the Y-axis lead nut and continue rotating until the rear face of the bearing housing is about to contact the front face of machine base.

3. Install two M6x35 SHCS into the mounting holes of the bearing housing and thread them into the machine base. Leave the bolts slightly loose.

4. Rotate the lead screw through the entire range of travel while feeling for tight spots. It may be necessary to loosen the lead nut retention screw (#38) and reposition the lead nut to remedy any tight or binding conditions in the travel. Be certain to retighten the lead nut retaining screw once the lead nut is adjusted..

5. Fully tighten the two M6x35 SHCS bearing housing bolts at this point.
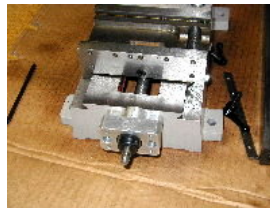
6. Again, rotate the lead screw through its entire travel range feeling for tight spots or binding. Adjust as necessary by loosening the mounting bolts and repositioning the bearing housing and/or the lead nut.

Procedure 10: Mounting Motors

1. Install four standoff mounting studs into the front face of the bearing housing. Leave 0.38" of the

studs exposed to mount the standoffs.

2. Install a slotted disk shaft coupling onto the end of the lead screw. Leave the coupling loose until the motor is mounted to facilitate final positioning.

3. Install a 2" long standoff onto each of the four mounting studs. Tighten with a 3/8" end wrench or socket.

4. Attach the motor mounting plate with four #10-32x ½" FHCS. Leave the screws loose until all four screws are installed. Tighten the screws using a crisscross pattern until all four are tight.

5. Attach the motor to the motor plate using four #10-32x ½" SHCS. Position the shaft coupling until it is half on the lead screw and half on the motor shaft. Tighten both coupling clamp screws.

Suggested sources for step motors, motor drivers, and control software

Motors
www.homeshopcnc.com   Good prices on imported steppers
www.xylotex.com   Imported steppers and domestic drivers
www.clickautomation.com   Mycom / Nyden motors and drivers

Motor Drivers
www.xylotex.com   Imported steppers and domestic drivers
www.stirlingsteele.com   US rep for Canadian driver boxes
www.geckodrive.com   The Ultimate Motor Drivers
www.clickautomation.com   Mycom / Nyden driver lines
www.embeddedtronics.com   Raw pc boards for do-it-yourselfers

Control Software
www.dakeng.com/turbo.html   Home of the infamous DOS based TurboCNC
www.deskcnc.com   Home of windows based DeskCNC
www.artofcnc.com   Home to Mach I, II, III software

Complete Systems
www.kdntool.com   Complete system integration
www.cadcamcadcam.com   DeskCNC rep with compatible servo systems
www.timgoldstein.com/secure/eStore/   Driver and software packages