



FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

CNC CONVERSION PLANS

FOR THE SIEG-BUILT X2 MINI-MILL

Installation Guide and CAD Drawings



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PREFACE

These plans show you how to make and install mounting hardware for CNC operation in X, Y, and Z axes for your Sieg-built X2 mini-mill.

While the Sieg-built X2 mini-mill is quite a capable machine, converting it to CNC operation opens up a new world of machining to you.

The figNoggle Designs' CNC plans are unique in that it allows you to maintain manual operation – something that many CNC conversions leave behind. We believe that while CNC is very powerful and a nice way to machine many identical parts and/or 2D/3D contours, there are many times when manually machining a part saves time and is needed.

The figNoggle Designs' CNC plans are designed with the figNoggle Designs' DRO conversion plans in mind. However, these plans and its implementation do not interfere with the DRO conversion and vice versa.

If you already have a DRO conversion in place, you can still use these plans to install a CNC system.

The total time it takes to make and install these parts ranges between approximately 20 hours and 40 hours. The total cost of materials varies greatly depending on your final choice in drive train components such as ballscrews, ball nuts, and timing pulleys. (Note that this does not include the cost of motors or control hardware/software).

In our design, we chose to adhere to two criteria:

1. Assembly strength in each axis. This is why we mount the motor plates to the actual mini-mill base and column.
2. Low cost in materials. While you can certainly install precision rolled ballscrews, anti-backlash pre-loaded ball nuts, for example, we have provided the most economical option to get your mini-mill up and running with great accuracy for the price.

We welcome your comments. If you have any ideas, suggestions, or find errors in these plans, please let us know.

We hope you enjoy this conversion!



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THE BIGGER PICTURE OF CNC

What is does the acronym CNC stand for? Computerized Numerical Control.

We cannot cover the entire scope of CNC in these plans but will share with you the following next steps (in case you haven't gone there yet).

1. Motors You will need NEMA 23 frame motors. These could be stepper or servo motors. The NEMA 23 specification dictates where mounting hole locations are and will apply to all motor frames with that specification.
2. Driver You can choose from a wide array of vendors. For this installation, we used Xylotex products. Again, paying attention to cost, this is a solid option. (<http://www.xylotex.com>)
3. Controller Software Again, there are many options out there with a wide spectrum of pricing. One popular choice is Mach software. (<http://www.artofcnc.ca>)
4. CAD/CAM Software The CAD (computer-aided drafting) software such as AutoCad will let you sketch and design your idea in the computer. CAM (computer-aided modeling) software can for the most part do the same as CAD software. The one major difference here is that you will be able to generate G-code. G-code is what the controller software uses to tell the motors how to move and in turn, machine your part.

With the four ingredients listed above in addition to the CNC conversion mounts and hardware in this plan, you will be able to quickly get your mini-mill operational.



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DISCLAIMER

These plans are provided as-is. We assume no liability in your use of these plans or these plans' designs. While every precaution has been taken in the preparation of this document, the author(s) and publisher assume no responsibility for errors or omissions, or for damages resulting in or from the use of the information contained herein.

SAFETY FIRST!

Be sure to read and understand all instructions that come with your equipment. Be sure to wear appropriate protection to protect your body from injury or harm.



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INSTRUCTIONS

The figNoggle Designs' approach in this conversion is to machine as few parts as possible using the mini-mill itself for the machining of these parts. (Still, it is highly recommended you have access to a lathe since parts such as the ballscrew can be turned easily using a lathe.) The design must be mechanically sound and be strong enough to withstand the forces applied by manual and CNC machining.

While the dimensions are to the thousandths, you will need only to maintain this accuracy for mating parts. One of the most important dimensions you will need to pay attention to is the hole placement for the NEMA 23 frame motors.

In general, the parts are designed to allow for variations in dimension where mating parts do not exist (such as drilling the holes that mount to the machine base). It is highly recommended that machining be done using a digital readout (DRO).

To avoid misaligned or skewed holes, broken taps and improperly sized tapped holes, please use center punches, transfer punches, center drills, sharp drill bits (#25 and #7) and taps (#10-24 and 1/4"x20). As you will be tapping into cast iron, be sure to drill and tap with caution as to avoid broken bits.

There are few parts that are longer than what the mini-mill X-axis can handle. In these cases, the drawings reflect that by allowing you to work from both ends of the part. In addition, since the stock is 4" wide and one of the parts is just shy of that dimension, you may be inclined to think that you will not be able to machine the part using your mini-mill. On the contrary, you will certainly be able to have enough travel. You just need to test your Y-axis clearance with the part in the mill before machining the part.

All dimensions indicated are in inches.

While the pictorial installation guide offers one method of installing the machined parts, you could for the most part proceed with your preferred method. We do suggest that you start with the X, Y and then Z axis, as each axis assembly increases in labor and time in installation.



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MACHINED PARTS LIST

The following is a list of parts to be machined (CAD drawings are the at end of document). There are also assembly drawings that show each of the axes with its corresponding parts list. This following list will show only the parts to be machined.

PART NO.	DESCRIPTION
X-AXIS	
CNC_X_MOTOR_PLATE	PLATE HOLDING MOTOR
CNC_X_MOTOR_SHAFT_ADAPTER	ADAPTS BETWEEN FLEX COUPLING AND X-AXIS LEADSCREW
Y-AXIS	
CNC_Y_MOTOR_PLATE	PLATE HOLDING MOTOR
CNC_Y_MOTOR_RAIL	SPACER RAILS
CNC_PARTS_Y-AXIS_HANDLE	EXISTING MINI-MILL HANDLE
CNC_PARTS_30T_XL_TIMING_PULLEY	TIMING BELT PULLEY
Z-AXIS	
CNC_Z_BEARING_BLOCK	BLOCK THAT RETAINS ONE END OF THE BALLSCREW
CNC_Z_MOTOR_PLATE	PLATE THAT HOLDS MOTOR
CNC_Z_MOTOR_RAIL	SPACER RAILS
CNC_Z_COLUMN_BRACKET_RIGHT	BRACKET MOUNTING TOP ASSEMBLY TO COLUMN
CNC_Z_COLUMN_BRACKET_RIGHT	SAME AS ABOVE
CNC_Z_TOP_PLATE	PLATE HOLDING BALLNUT FLANGE
CNC_Z_TOP_ANGLE_BRACKET	ANGLE BRACKETS BETWEEN TOP PLATE AND COLUMN BRACKETS
CNC_Z_NUT_FLANGE	FLANGE THAT HOLDS BALLNUT
CNC_Z_SCREW	BALLSCREW



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MATERIALS LIST

This is a suggested list of items and vendor source/pricing. Note that you may already have some of these smaller items such as screws, nuts, and aluminum stock. We have consolidated these items such that the drive train components such as timing pulleys, belts, etc. are purchased from one source while part stock and fasteners are purchased from another.

You could very well purchase them both from the same source, but be aware that some sources are best for some products while other are best for others. In this case, ENCO is good catalog source for fasteners and material stock while MSC (a larger sister company) has many of the parts needed for this project including fasteners.

IMPORTANT NOTES

This conversion requires some specialized tooling that you may or may not have in your tool chest. We list this separately from the materials list:

1. 15/16" x 16 TPI tap (used for threading nut flange)
(MSC #04848693 - \$38.82)
2. 3/8" x 24 TPI die (used for threading ballscrew)
(MSC #03774189 - \$7.79)
3. #25 drill bit
4. #10 drill bit (#10-24 taps bottoming and plug)
5. #7 drill bit
6. 1/4" drill bit (1/4" x 20 taps bottoming and plug)

Additional tooling and machinery required and/or recommended (some are optional depending on how you plan to machine the parts):

1. Mini-mill and/or lathe
2. Vise (with greater than 4" jaw width capacity) and parallels
3. End mills and drill bits of varying sizes
4. Boring head and/or boring bar
5. Bandsaw
6. DRO scales installed on your mill, calipers, layout die, edge/center finder



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MSC DIRECT PARTS LIST (<http://www.mscdirect.com>)

VENDOR	QTY	ITEM NUMBER	DESCRIPTION	UNIT PRICE	SUBTOTAL
MSC	1	87792396	SINGLE BEAM COUPLINGS MAXIMUM BORE DIAMETER: 1/4 MINIMUM BORE DIAMETER: 1/4 OUTSIDE DIAMETER: 0.750 IN. OVERALL LENGTH: 0.900 IN. MATERIAL: ANODIZED ALUMINUM (X-AXIS)	\$23.82 EA	\$23.82
MSC	1	35375831	TIMING BELT PULLEY XL, 15 TOOTH, 1/4 BORE (Y-AXIS)	\$11.06 EA	\$11.06
MSC	1	35375922	TIMING BELT PULLEY XL, 30 TOOTH, 5/16 BORE (Y-AXIS)	\$19.56 EA	\$19.56
MSC	1	35375823	TIMING BELT PULLEY XL, 14 TOOTH, 1/4 BORE (Z-AXIS)	\$10.28 EA	\$10.28
MSC	1	35375849	TIMING BELT PULLEY XL, 16 TOOTH, 1/4 BORE (Z-AXIS)	\$11.27 EA	\$11.27
MSC	1	35393941	TIMING BELT NUMBER: 150XL025 SECTION: XL MATERIAL: NEOPRENE RUBBER (Y-AXIS)	\$2.50 EA	\$2.50
MSC	1	35393909	TIMING BELT NUMBER: 130XL025 SECTION: XL MATERIAL: NEOPRENE RUBBER (Z-AXIS)	\$2.37 EA	\$2.37
MSC	2	1377498	UNGROUND RADIAL BALL BEARINGS ID: 0.375 IN., 3/8 OD: 0.875 IN., 7/8 WIDTH: 0.281 IN. (Z-AXIS)	\$3.71 EA	\$7.42
MSC	1	36695179	PRECISION BALL SCREW LEAD: 0.200 IN. LENGTH: 72.000 IN. OPPOSING BALL BEARING DIAMETER: 0.625 IN. (Z-AXIS)	\$97.54 EA	\$97.54
MSC	1	36695302	PRECISION BALL SCREWS TYPE: STANDARD BALLNUT LEAD WIDTH: 0.200 IN. LENGTH: 1.710 IN. OPPOSING BALL BEARING DIAMETER: 0.625 IN. (Z-AXIS)	\$31.67 EA	\$31.67
Subtotal does not include shipping, handling or surcharges (where applicable).					MSC SUBTOTAL
					\$217.49



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ENCO DIRECT PARTS LIST (<http://www.use-enco.com>)

VENDOR	QTY	ITEM NUMBER	DESCRIPTION	UNIT PRICE	SUBTOTAL
ENCO	1	505-3687	1/2 X 4 6' RECTANGULAR ALUMINUM BAR 6061	\$77.26	\$77.26
ENCO	1	325-4284	1.250 X 4.000 X 12 6061 ALUMINUM RECTANGLE (Z-AXIS BEARING BLOCK)	\$37.98	\$37.98
ENCO	1	325-4216	1.000 DIA. X 12 6061 ALUMINUM RODS (X-AXIS SHAFT ADAPTER)	\$7.78	\$7.78
ENCO	100	325-3886	3/8-24 FINISHED HEX JAM NUT GRADE 2 ZINC PLATED	\$3.64 PER 100	\$3.64
ENCO	100	430-0076	1/4-20 X 1 INCH SOCKET HEAD CAP SCREW ALLOY STEEL	\$7.18 PER 100	\$7.18
ENCO	100	430-0078	1/4-20 X 1-1/2 SOCKET HEAD CAP SCREW ALLOY STEEL	\$6.83 PER 100	\$6.83
ENCO	100	430-0054	10-24 X 3/4 SOCKET HEAD CAP SCREW ALLOY STEEL	\$5.32 PER 100	\$5.32
ENCO	100	430-0056	10-24 X 1" SOCKET HEAD CAP SCREW ALLOY STEEL	\$6.15 PER 100	\$6.15
ENCO	100	430-0052	10-24 X 1/2 SOCKET HEAD CAP SCREW ALLOY STEEL	\$4.76 PER 100	\$4.76
ENCO	100	712-1447	M6 X 25MM IMPORTED METRIC SOCKET HEAD CAP SCREW	\$6.06 PER 100	\$6.06
ENCO	100	891-2839	#10 SAE STANDARD FLAT WASHER ZINC PLATED	\$1.13 PER 100	\$1.13
ENCO	100	891-2841	1/4 SAE STANDARD FLAT WASHER ZINC PLATED	\$1.78 PER 100	\$1.78
ENCO	100	891-2843	3/8 SAE STANDARD FLAT WASHER ZINC PLATED	\$2.61 PER 100	\$2.51
ENCO	100	431-0075	10-24 X 3/16 CUP POINT SOCKET SET SCREW	\$4.46 PER 100	\$4.46
ENCO	100	891-2842	5/16 SAE STANDARD FLAT WASHER ZINC PLATED	\$1.90 PER 100	\$1.90
ENCO	100	891-2859	1/4 BOLT SIZE MEDIUM SPLIT LOCK WASHER ZINC PLATED	\$.70 PER 100	\$0.70
Subtotal does not include shipping, handling or surcharges (where applicable).					ENCO SUBTOTAL
					\$175.54



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ALTERNATE VENDORS

Here is a comprehensive (not exhaustive) list of vendors from where you could source your drive train components. Note that many of these websites also offer free catalogs and information about drive train components that will help you understand more about how they work.

COMPANY	WEBSITE
McMaster-Carr	http://www.mcmaster.com
Misumi	http://www.misumiusa.com
Nook Industries	http://www.nookindustries.com
Quality Transmission Components	http://www.qtcgears.com
Reid Supply Company	http://www.reidsupply.com
Rockford Ball Screw	http://www.rockfordballscrew.com
Stock Drive Products / Sterling Instrument	http://www.sdpsi.com
W.M. Berg, Inc.	http://www.wmberg.com



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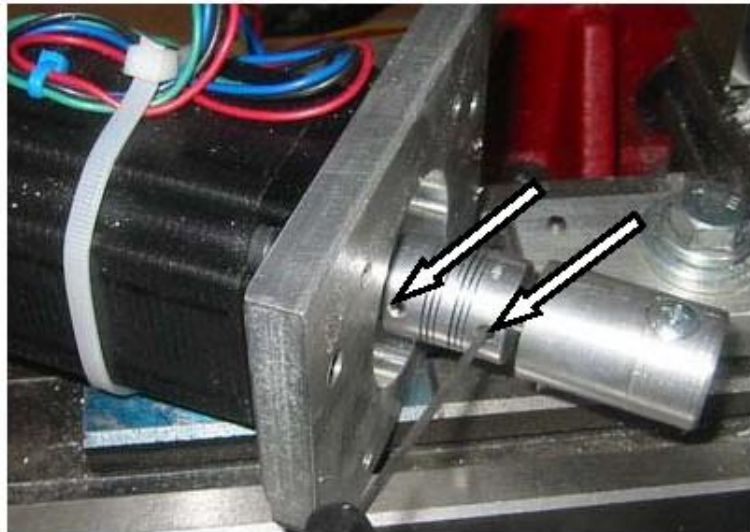
INSTALLING THE X-AXIS

Install the flex coupling to the shaft.

Lock the coupling to the shaft using the provided set screw (make sure the set screw is sitting on the flat spot on the motor shaft).

Insert the shaft adapter to the flex coupling.

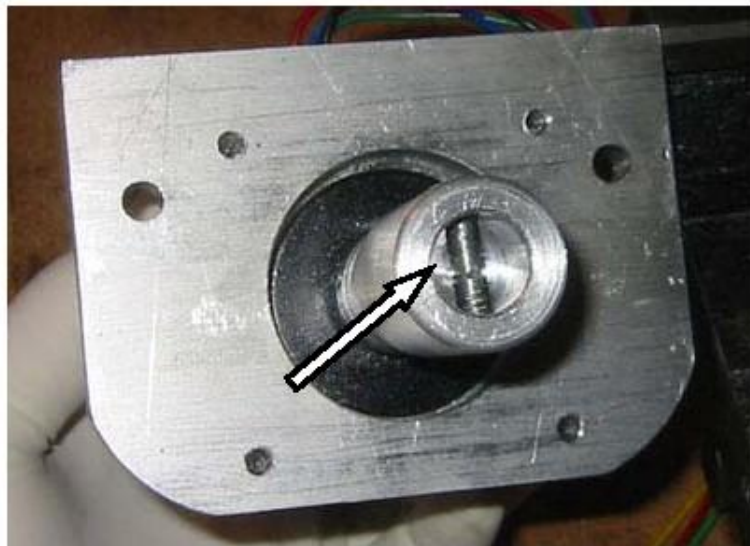
Lock the adapter to the coupling following the same instructions above.



Screw the shaft adapter leadscrew lockscrew as shown.

Note: it is advised to use thread locking compound to ensure that the screw does not come loose during operation.

It may be necessary to file down the exposed threads of the screw to fit it to the screw slot.





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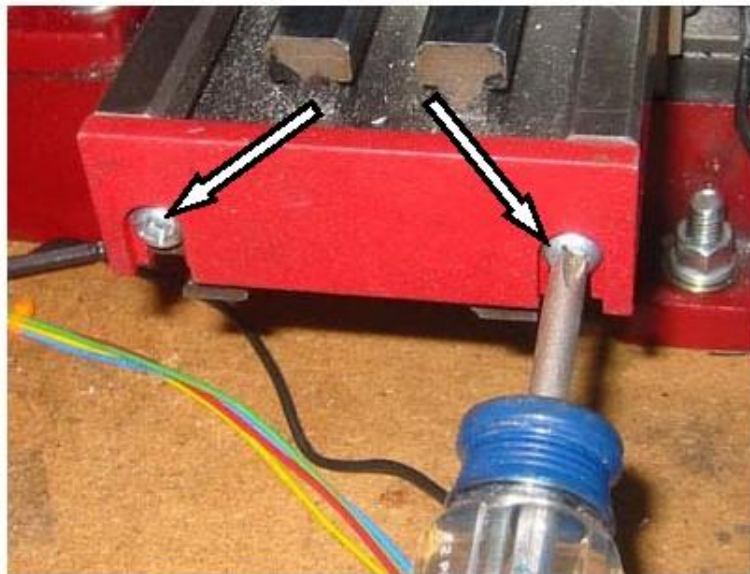
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Install the stepper motor to the X-axis motor mount using four (4) 1/2" #10-24 socket head screws.



Remove the existing plate from the left hand end of the table.





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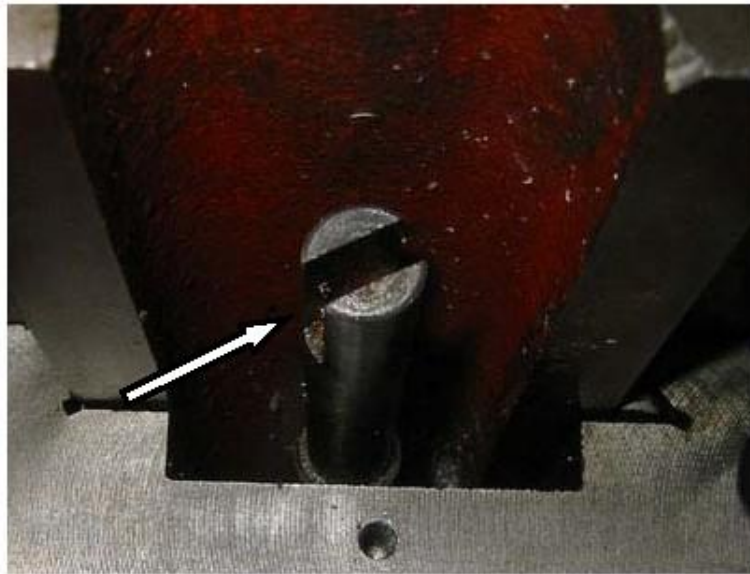
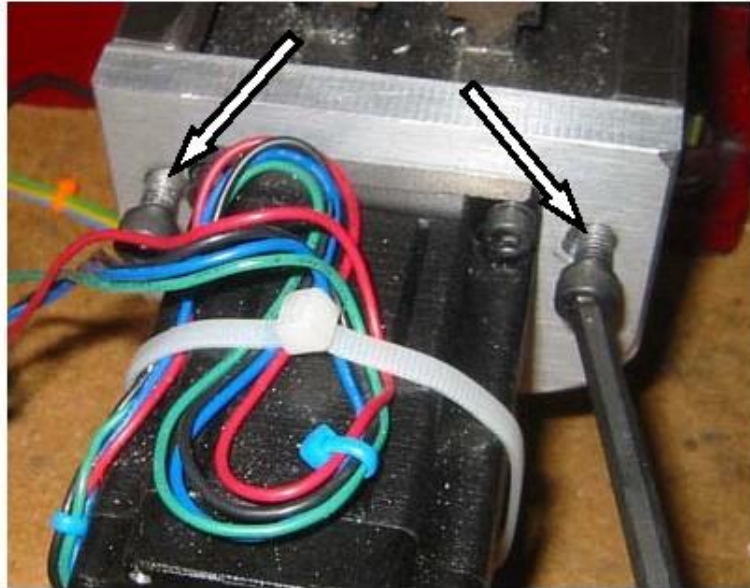
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Using two (2) M6x1 25mm socket head screws, mount the X-axis motor/plate assembly to the table using the existing holes used for the plate previously removed.

Note: when mounting the assembly to the table, you may need to rotate the leadscrew or motor shaft so that the lock pin aligns with the leadscrew's notch as shown.

Using one (1) #10-24 set screw, lock the adapter to the leadscrew.





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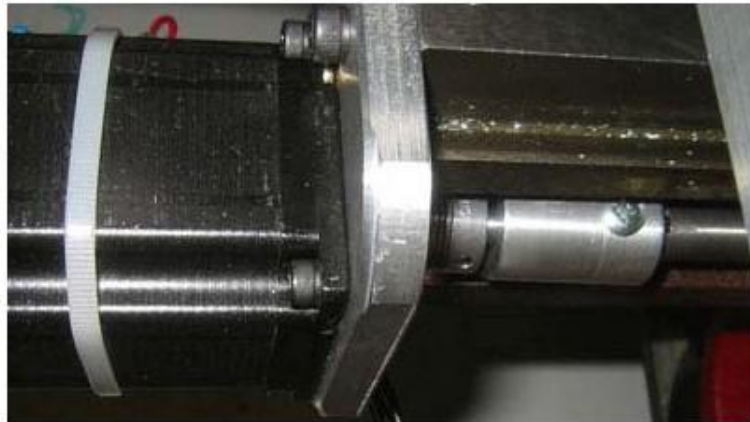
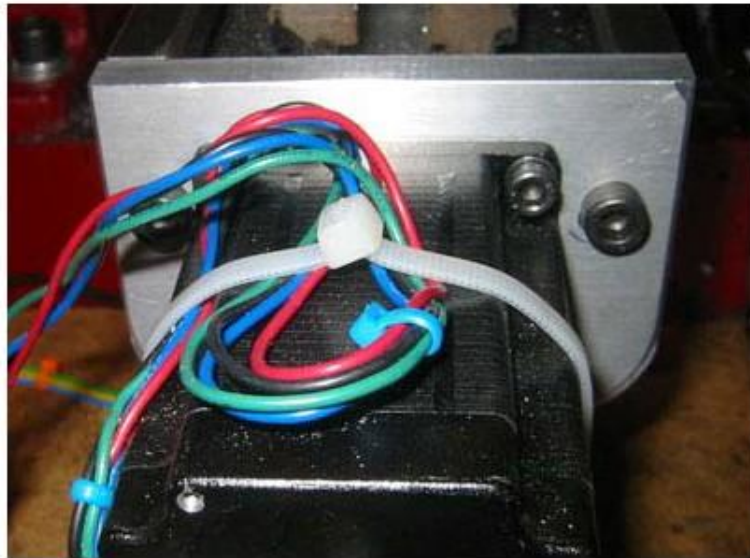
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The X-axis assembly is installed.

Turn the X-axis handle to make sure that there is no binding.

Note: when hand-cranking, you may notice a bit of “notchiness”. This is due to the motor’s detents and is normal.





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INSTALLING THE Y-AXIS

HANDLE/PULLEY UNIT

This step requires machining parts in either a lathe or rotary table on your mini-mill.

Remove Y-axis handle.

Note: be careful not to lose the key on the shaft!





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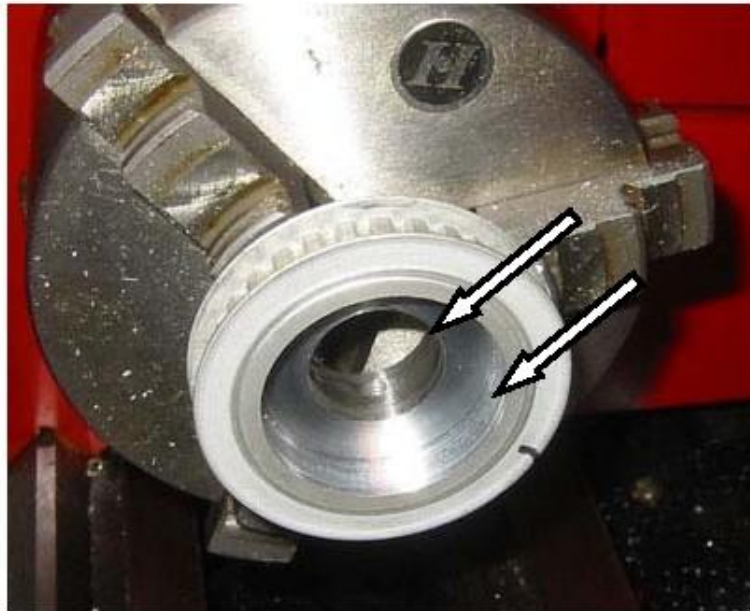
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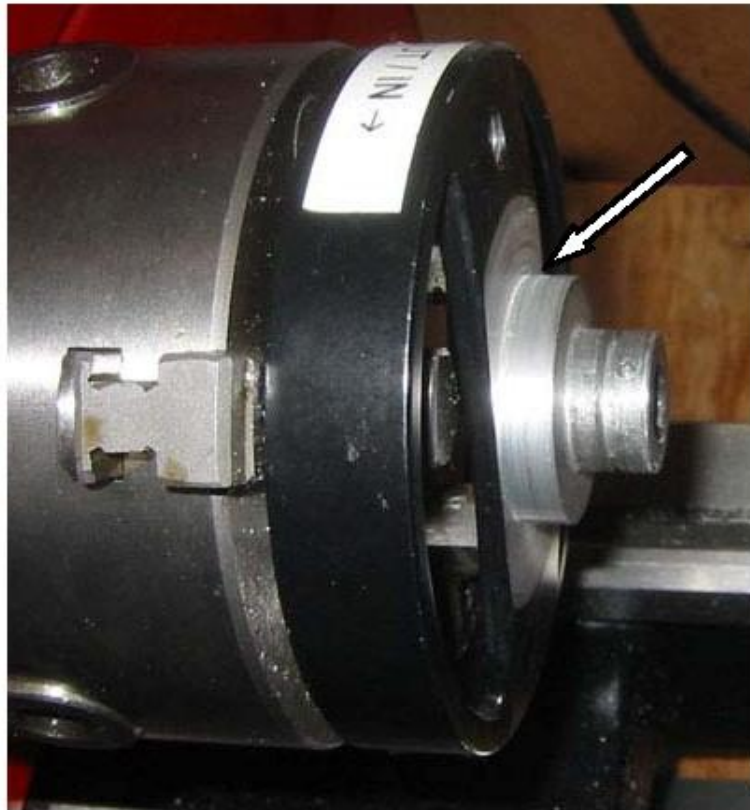
Turn the 30 tooth timing pulley as shown in the picture per the dimensions on the CAD drawing.

You will need to drill and bore it to size.

Dimensions need to be accurate enough to mate with turned handle shown in following picture.



Turn the handle in the lathe to match the dimensions of the turned pulley.





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A close-up of the pulley and handle.

They should have a tight slip-fit.



Mount the pulley and handle as shown.

Tighten the set screws from the pulley to lock the pulley to the handle.

Note: adding a thread locking compound will ensure that the pulley will not come loose.



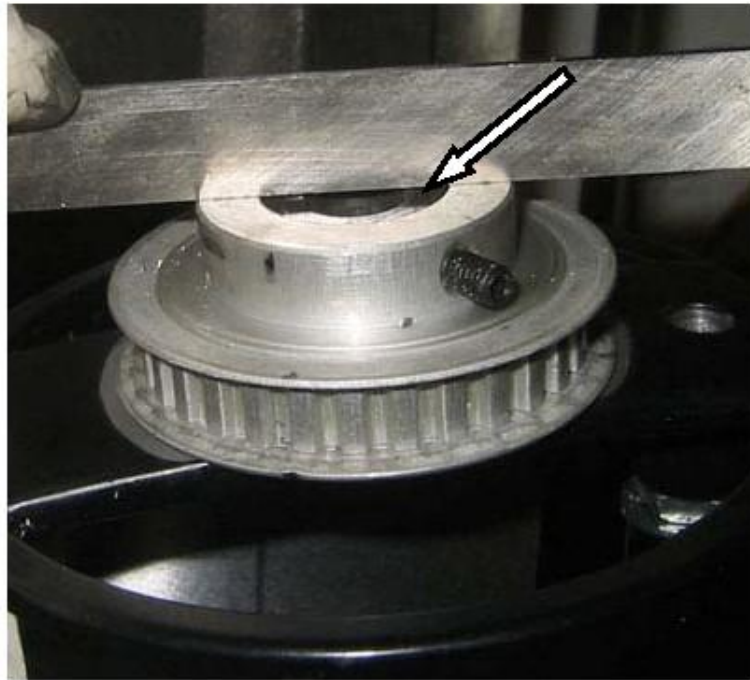


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Note that once the timing pulley is mounted to the handle, there is a little gap.



Insert a 5/16" washer onto the shaft. This will space the handle appropriately.

Re-install the key.

Slide the handle/pulley into back onto the shaft.





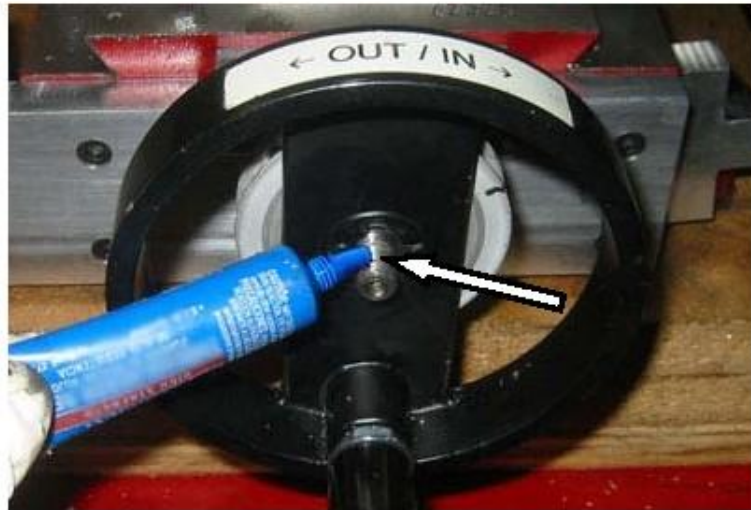
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Add a little thread locking compound to the threads to ensure that the nut will not come loose during operation.

Re-install the handle/pulley unit and adjust the nut(s) accordingly.



The Y-Axis handle/pulley unit installed.





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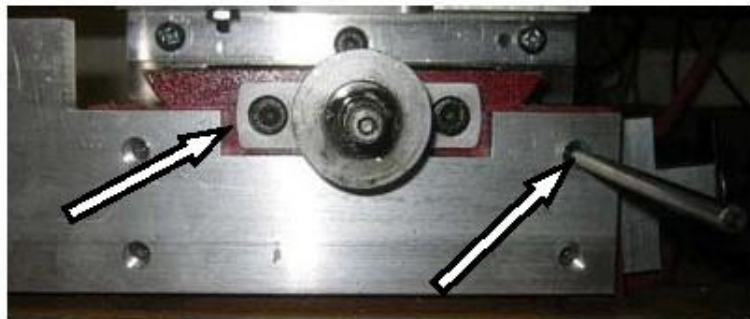
INSTALLING THE Y-AXIS

MOTOR PLATE

This step requires drilling and tapping holes into the base of your mill.

Using the Y-Axis motor plate as a guide, locate holes to drill and tap using a transfer punch.

Note: there should be equal spacing around the shaft block as indicated by the arrow.

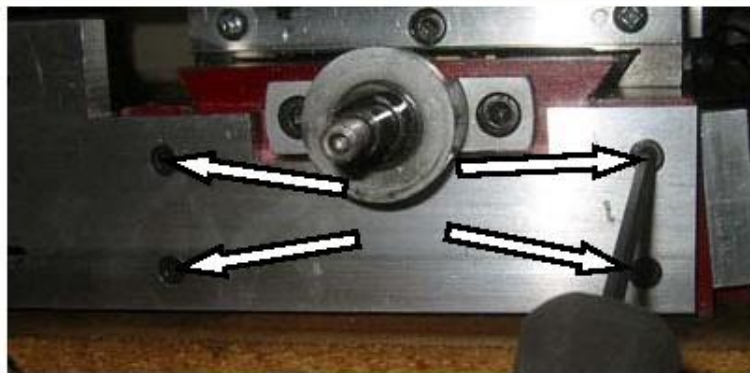


Drill and tap four (4) #10-24 holes $\frac{3}{4}$ " deep.

Note: using a tap block will ensure that your holes are perpendicular to the base.



Using four (4) $\frac{3}{4}$ " #10-24 socket head screws, mount the Y-Axis motor plate to the base.





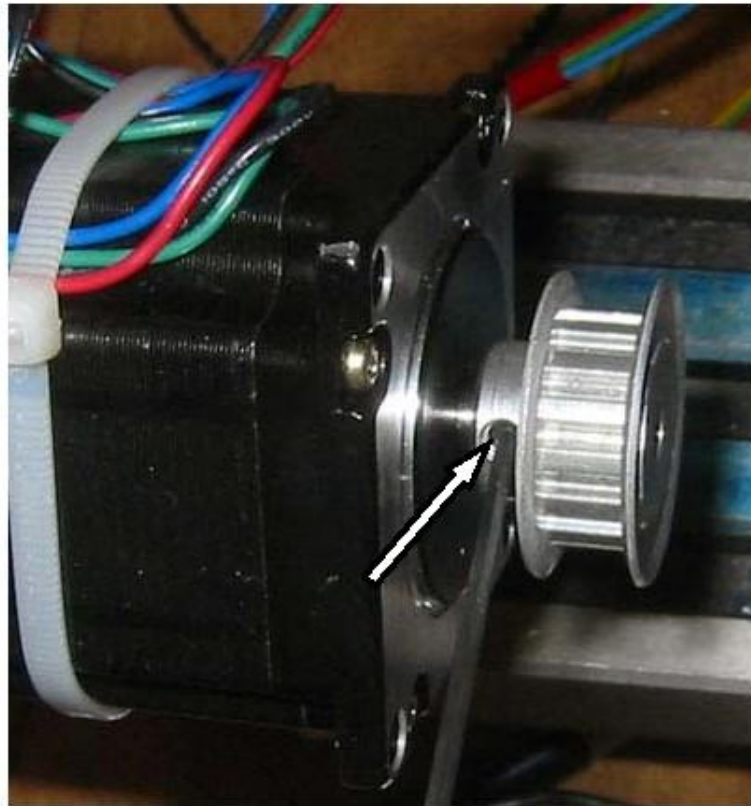
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Using the set screw provided with the pulley, tighten the set screw to the flat spot on the motor shaft.

Note: using a little thread locking compound will prevent the pulley from coming loose and slipping.



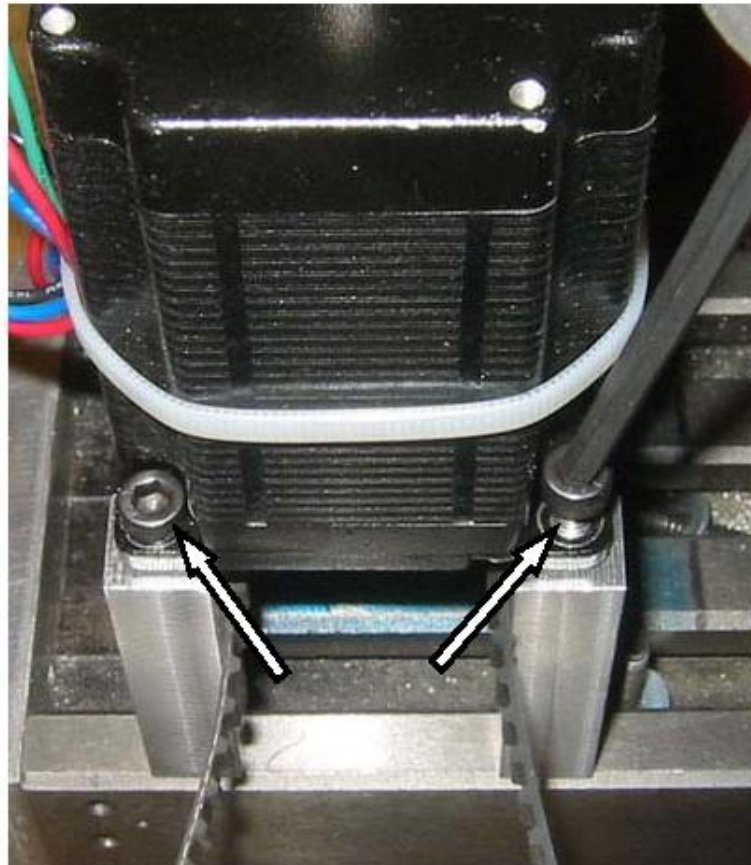


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Using four (4) $\frac{3}{4}$ " #10-24
socket head screws,
mount the motor to the
motor rails.



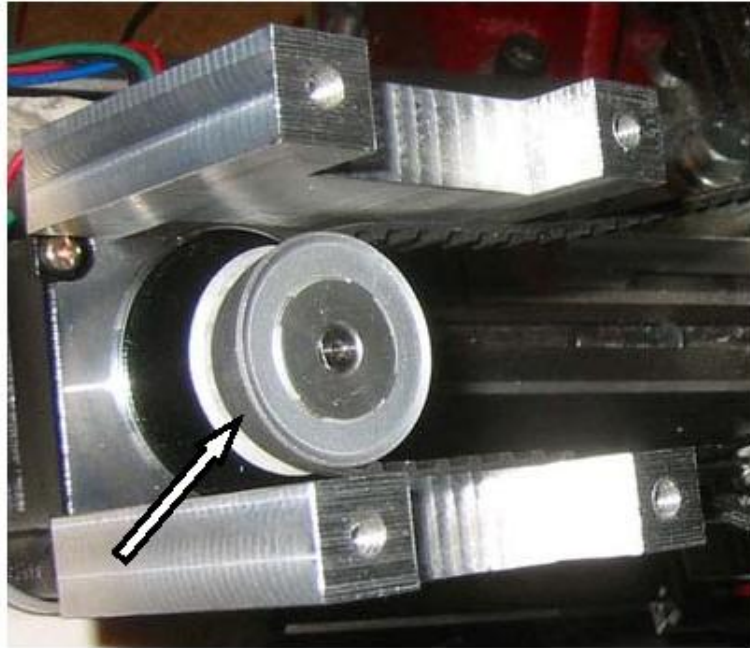


FigNoggle Designs

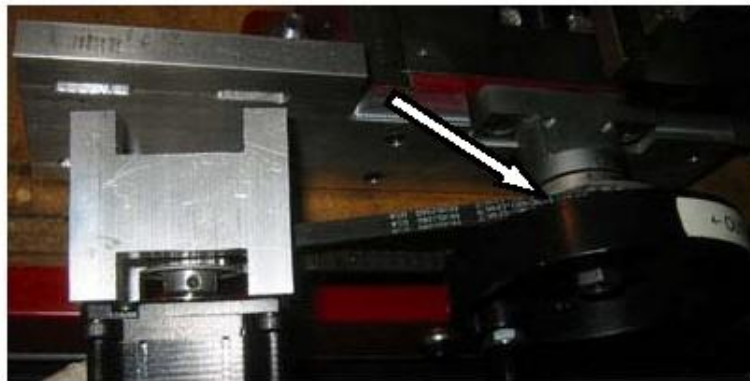
CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Install the timing pulley.



Slip the timing belt around the handle/pulley unit.





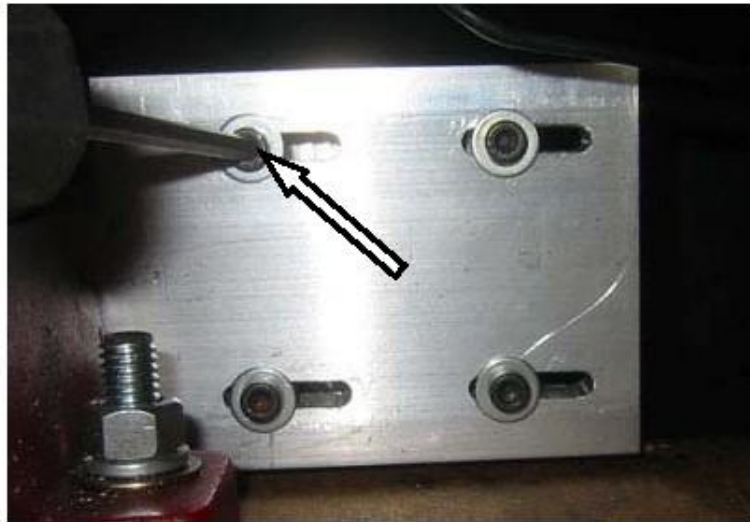
FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Using four (4) $\frac{3}{4}$ " #10-24 socket head screws and #10 washers, mount the motor rails to the motor plate.

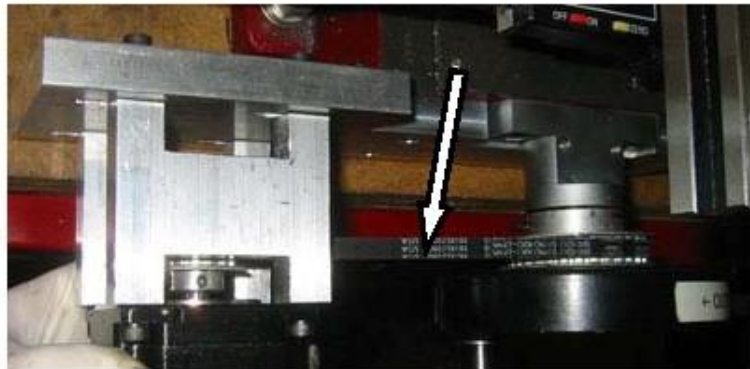
Do not tighten the screws fully.



From the front, pull the motor until the belt is tight.

Note: the belt should not be too tight. You should be able to push down on the belt as shown by the arrow $\frac{1}{8}$ " or so.

Tighten the screws from the back side of the plate until the motor is held tightly in position.



The Y-Axis is installed.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

INSTALLING THE Z-AXIS

SHORTENING THE HIGH/LOW LEVER

This step requires the shortening of your high/low gear shift lever.

Remove the high/low lever by unscrewing it from the shaft.



Cut roughly 3/8" of thread from one end of the threaded rod.

Re-install the gear shift lever.

If you find the lever too long after you have completed the Z-axis installation, remove more thread until there is enough clearance to operate the lever with the assembly in place.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

INSTALLING THE Z-AXIS

REMOVING THE TORSION SPRING

This step requires the removal of the torsion spring. If your mini-mill does not come equipped with a torsion spring, you may skip this step provided your column is clear of obstructions.

Lift the head to near the top of the column.

Lock the head into position. You can also use the stop.

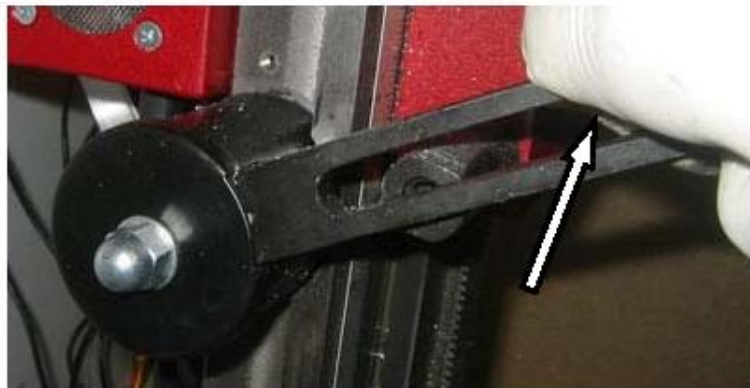
Using a wrench, loosen the bolt that holds the spring arm to the head.



As you undo the bolt, be sure to hold the arm so that it does not snap back.

CAUTION! THE ARM IS IN TENSION.

While still holding the arm, rotate the arm towards the back of the mill until there is no more spring tension.





FigNoggle Designs

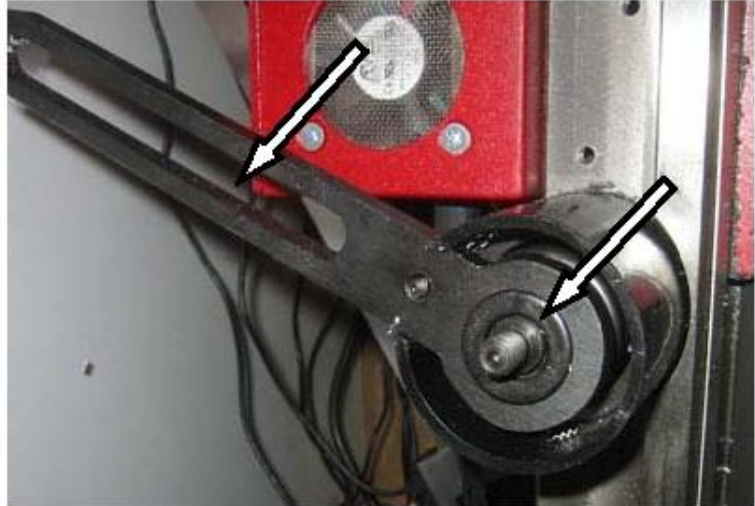
CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Remove the cap by first removing the hex cap nut.



Remove the arm and washer.





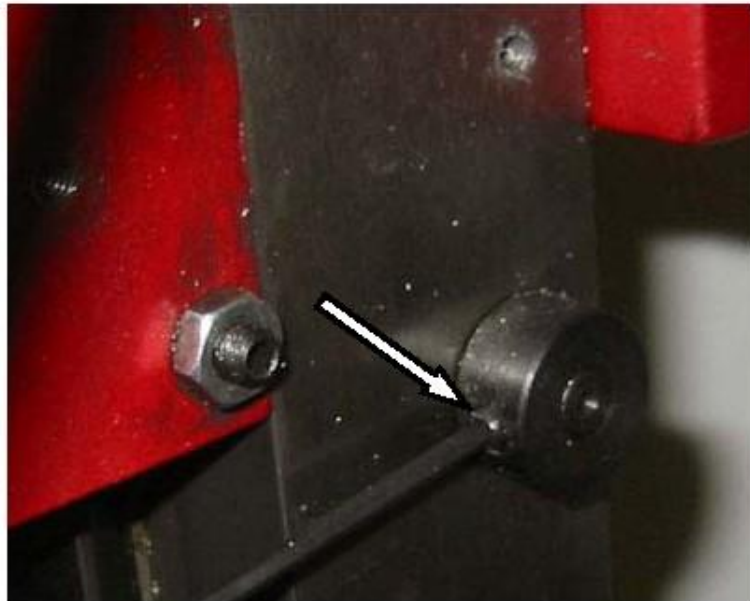
FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Before removing the shaft, you will need to remove the collar retaining the shaft in the column.

Using a hex head wrench, remove the collar.



With the collar removed, pull the shaft out.

Note: do not lose the key as indicated by the arrow.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Pull the spring out of the retaining cup.



Remove the plastic cup cover.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Finally, to remove the metal retaining cup, remove the three Phillips head screws.

Now the column is ready for the Z-axis assembly.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

INSTALLING THE Z-AXIS

MOTOR AND HOUSING ASSEMBLY

This step requires the most time in this conversion. Please make sure you measure your column width to make sure it matches the dimensions shown in the drawings. The drawings accommodate a 3.930" wide column.

Before we start...

If you have installed the Z-Axis DRO scale per figNoggle Designs' plans, remove the scale bracket from the head.

Note: If you also have the black plastic cap that sits on top of the column, use a flat head screwdriver or a putty knife to remove it. Using gentle pressure, pry the cap off.





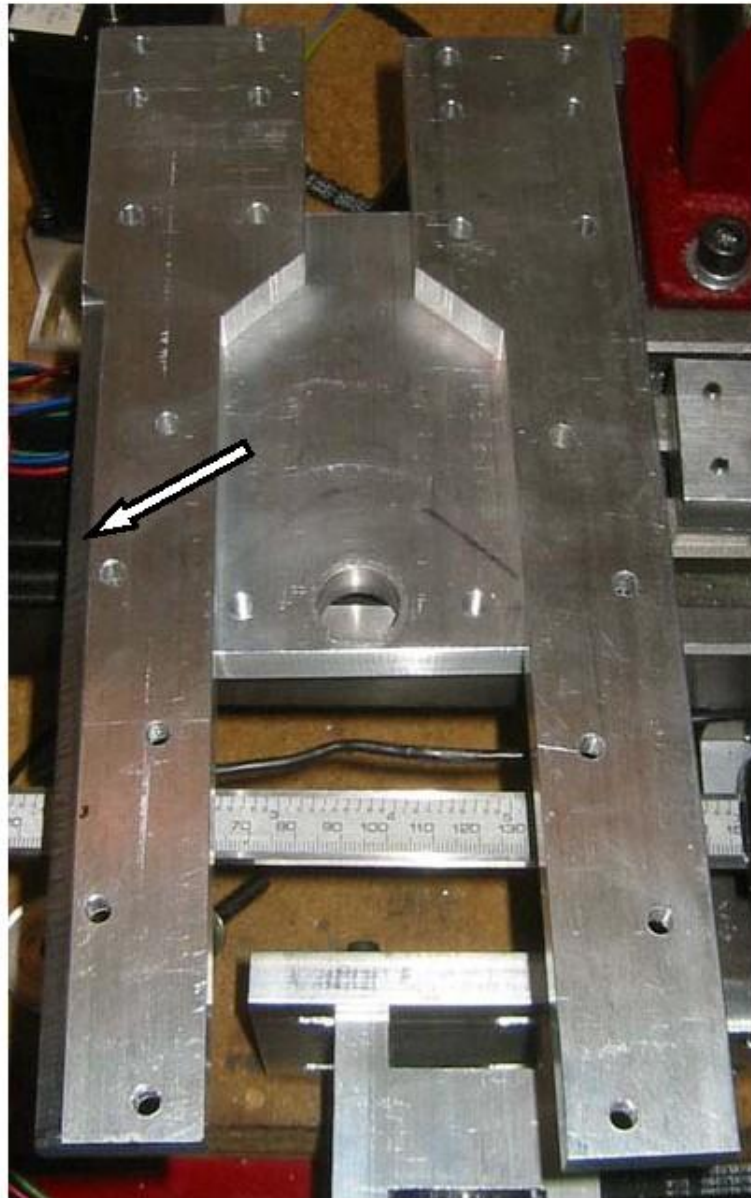
FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

First, lay out the two side brackets and top plate as shown.

Note: the right hand side bracket has the chamfer as indicated by the arrow.





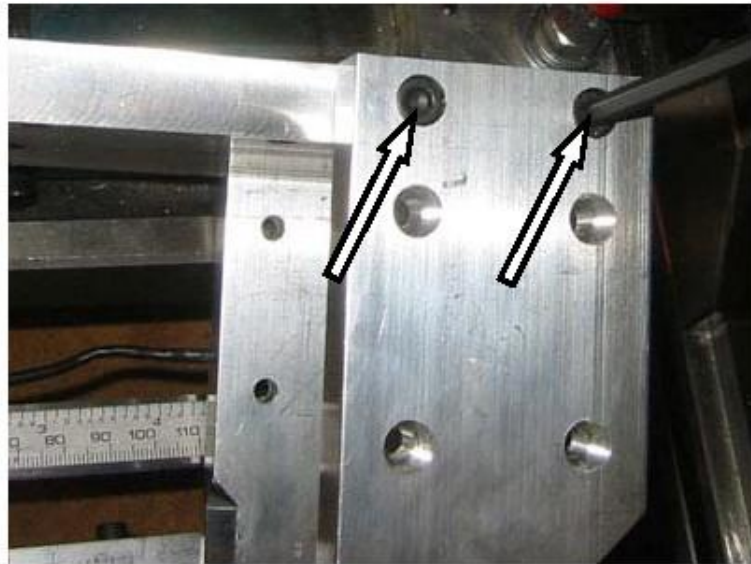
FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills

Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

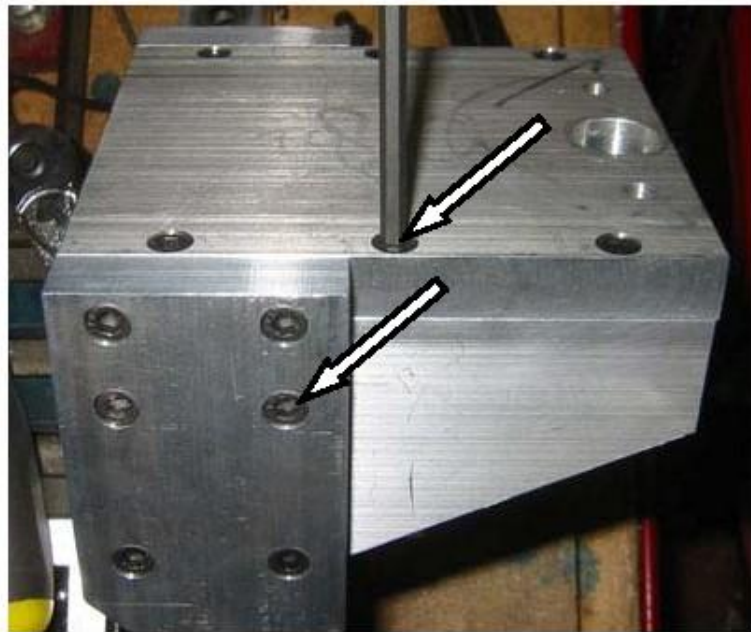
Begin by assembling the top plate to the side column brackets using two (2) $\frac{3}{4}$ " #10-24 socket head screws per side.



Next, assemble the angle bracket to the side and top plates using seven (7) $\frac{3}{4}$ " #10-24 socket head screws per side.

It is suggested to mount the angle plate by first starting with the top plate, then the side plate. Tighten the screws only when all screws have been installed.

Note the orientation of the pieces.





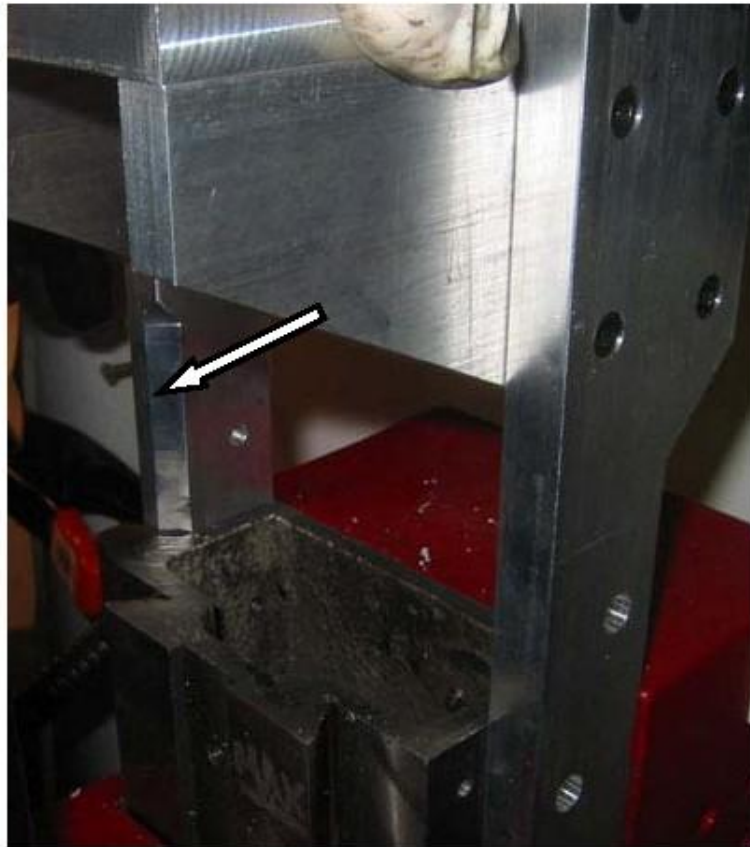
FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

With the Z-Axis frame assembled, slip it on the column as shown.

Note the chamfered bracket is on the left hand side of the column.





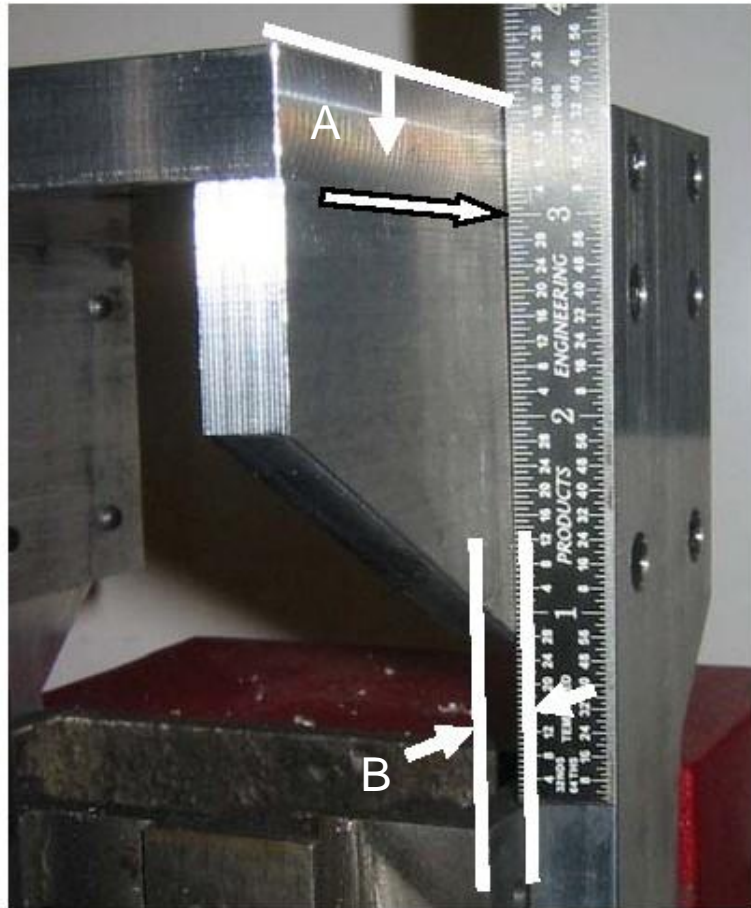
FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

A. Slip the assembly on the column until the top of the top plate is 3" from the top of the column.

B. Pull the assembly towards the front of the machine until the distance between the edge of the column and the front of the bracket is $36/64$ ". You can also pull the assembly towards the front of the machine until the left hand side bracket sits flush against the ruled side of the column.



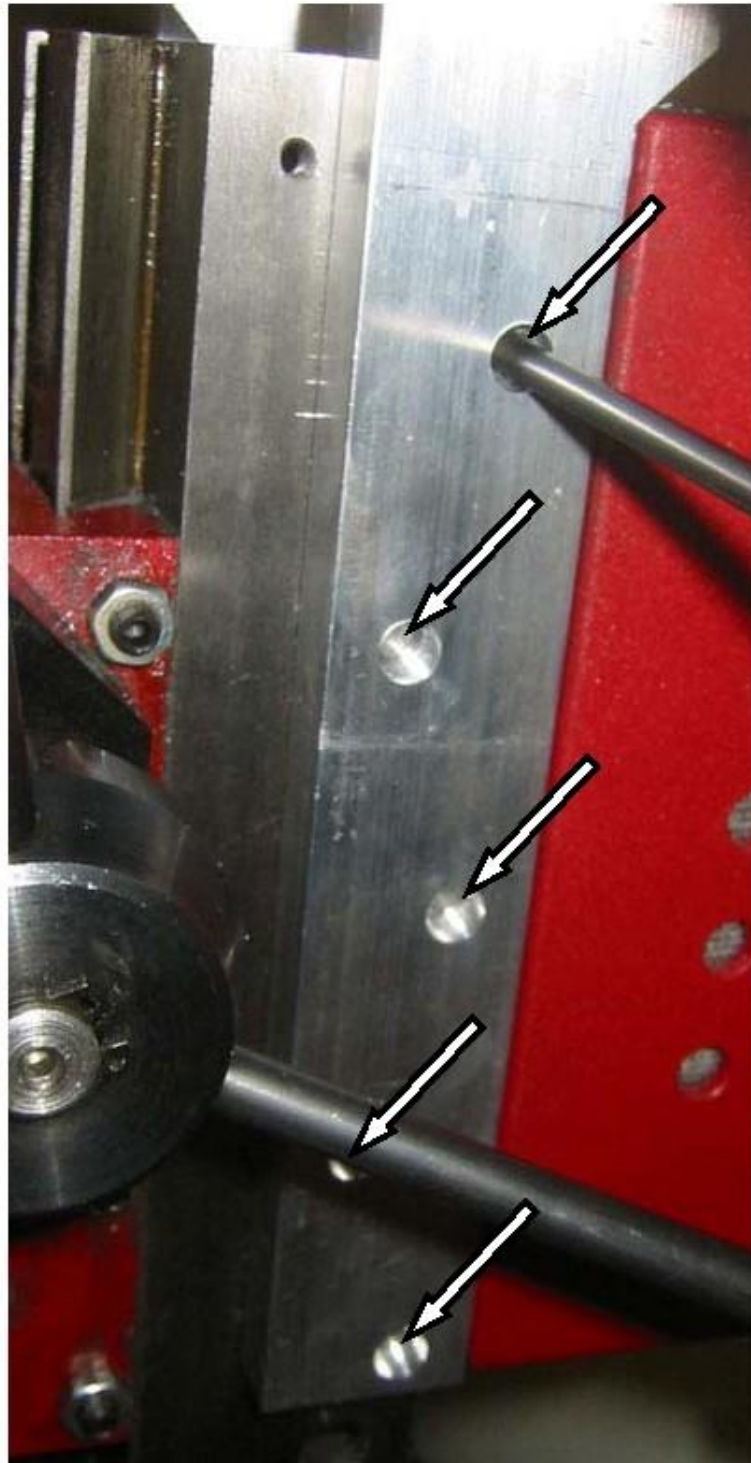


FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Use a transfer punch to mark the five (5) holes per side bracket.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Drill (#25) and tap (#10-24) through the five (5) corresponding holes per each side of the column.

Note: use a tap block to ensure that the holes are perpendicular to the column.



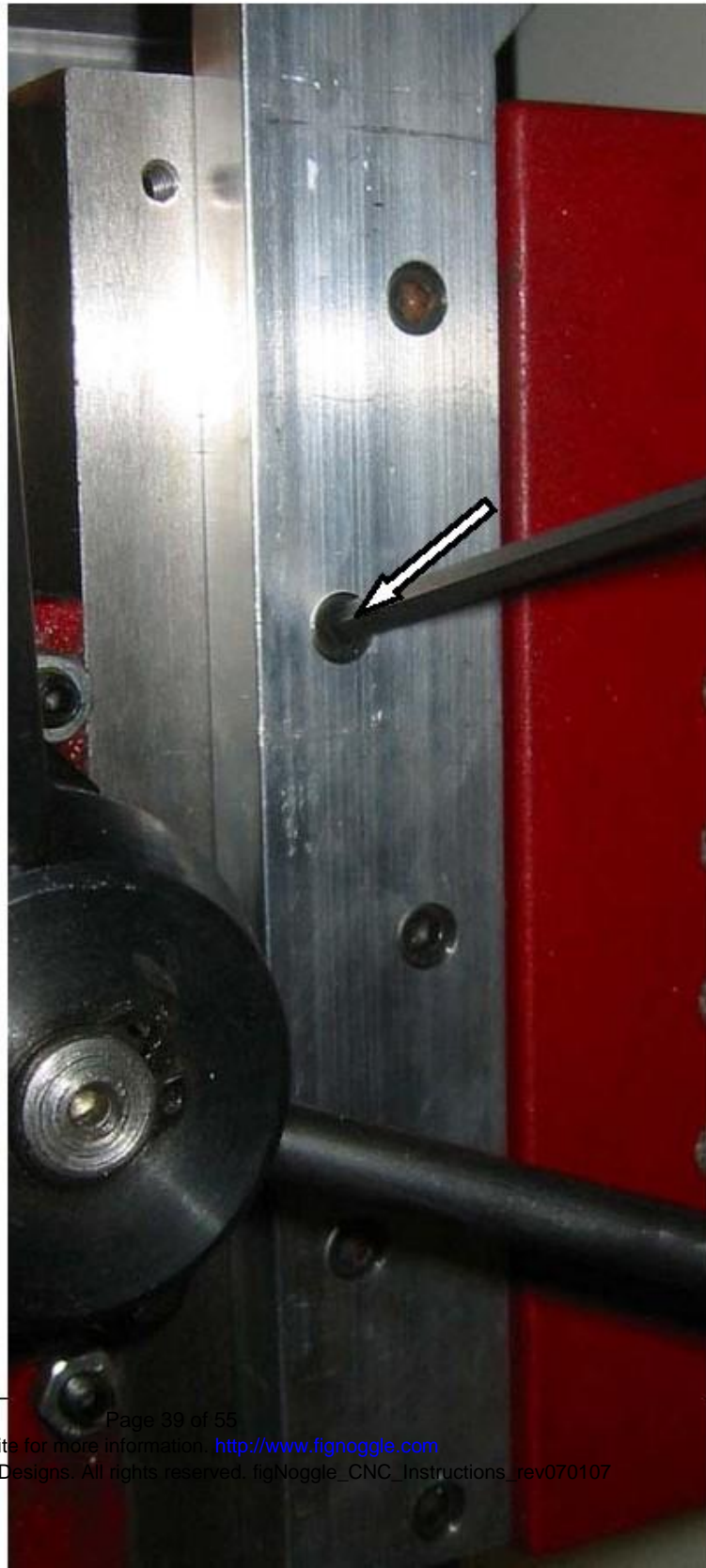


FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Using five (5) $\frac{3}{4}$ " #10-24 socket head screws per side, mount the brackets to the column.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

The Z-axis top assembly
is installed.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

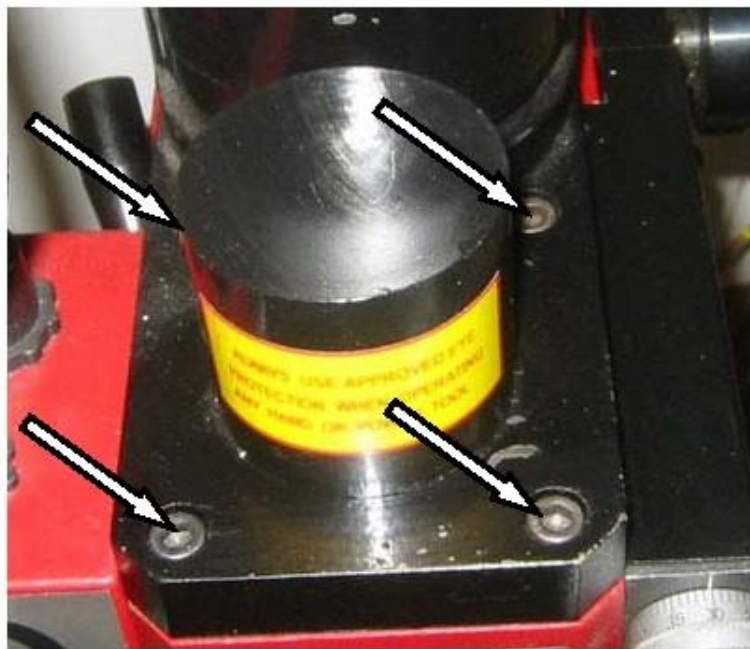
Lower the head near the bottom of its travel. The head should be roughly 5" from the table.

We will now remove the motor from the top of the head to allow for workspace.



Locate the four (4) socket head bolts to be removed.

These bolts hold the motor in place on the head.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Remove the cap that covers the drawbar.

Remove the four (4) socket head bolts.



Lift the motor.

With the head still 5" from the table, place the motor assembly on the table as shown previously.

Be careful not to let the motor fall off the table!





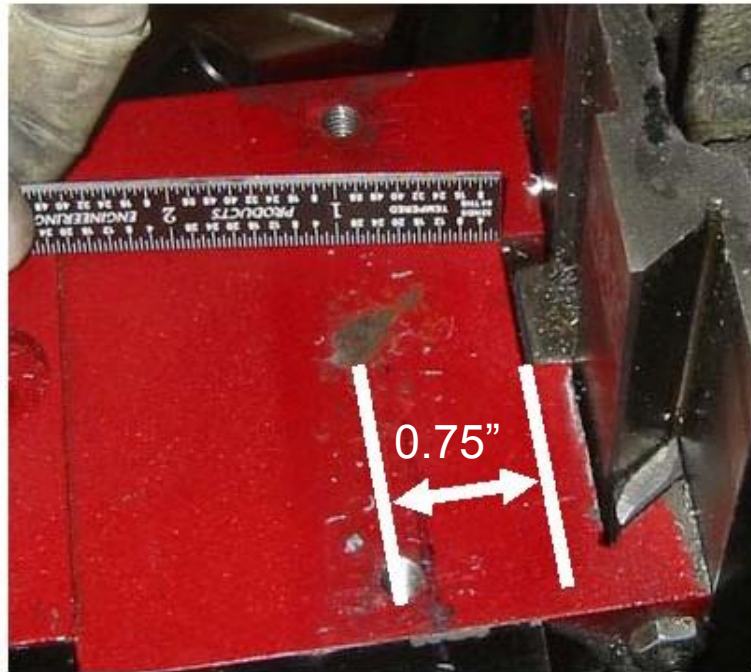
FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Locate the two (2) holes to be drilled and tapped for the bearing/pulley block and motor plate.

The distance between the center of the holes and the rack and pinion relief in the head is 0.75" as shown. Mark this line.

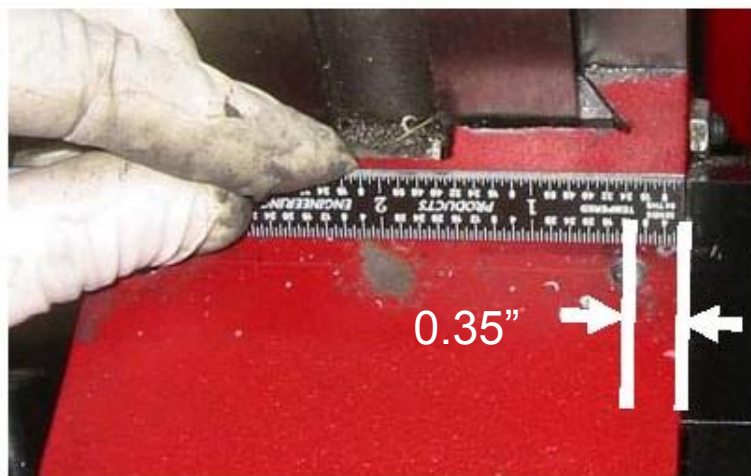


Next, locate the distance between the edge of the head and the center point of the hole to be drilled. It should be 0.350\"/>

Do the same with the other side of the head.

Make sure that the center point of the holes lies on the previously drawn line.

Using a center punch, mark the two holes.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

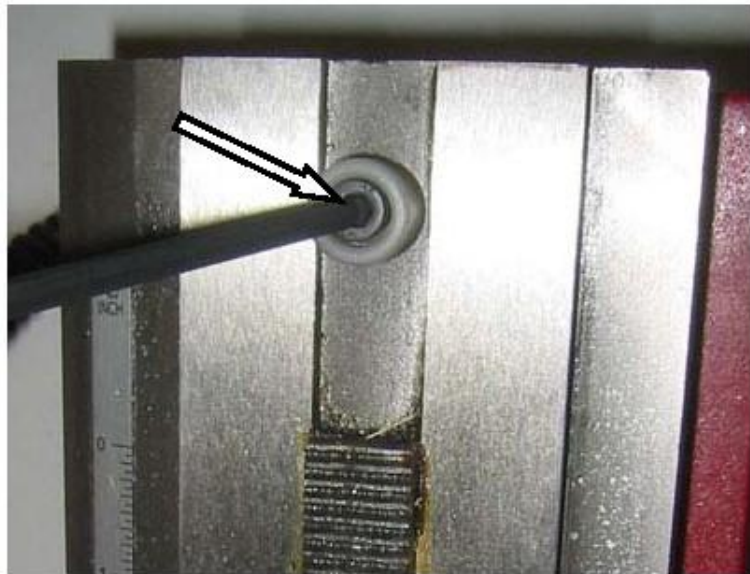
Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Drill (#7) and tap (1/4" x 20) the two holes 3/4" deep.

Note: using a tap block will ensure that the holes are perpendicular to the head.



Using a socket head wrench, remove the plastic stop at the top of the column.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Install the ballnut onto the ballscrew per manufacturer instructions.

Screw the ballnut flange onto the ballnut.

Note: depending on how you started your thread while threading the ballnut flange, the ballnut face may or may not be parallel to the ballnut flange face. This is OK.

Screw two (2) 3/8"x24TPI hex jam nuts onto the ballscrew at the threaded end as shown.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills

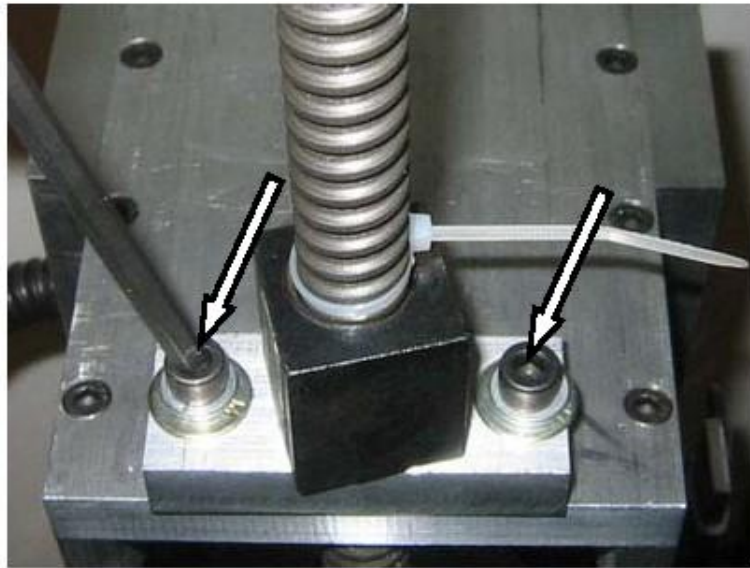
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Insert the ballscrew through top plate hole.

Using a 1" $\frac{1}{4}$ "x20 socket head screw and $\frac{1}{4}$ " washer and $\frac{1}{4}$ " lock washer, lightly tighten the ballnut flange to the top plate.

Note: orient the nut flange such that the ballnut bearing race is facing towards the back of the machine. This will prevent clearance issues when the motor travels up.

Tip: using a zip-tie around the ballscrew will prevent the ballscrew from traveling due to gravity.



Insert the ball bearings into the bearing block, one on each side of the block.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills

Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

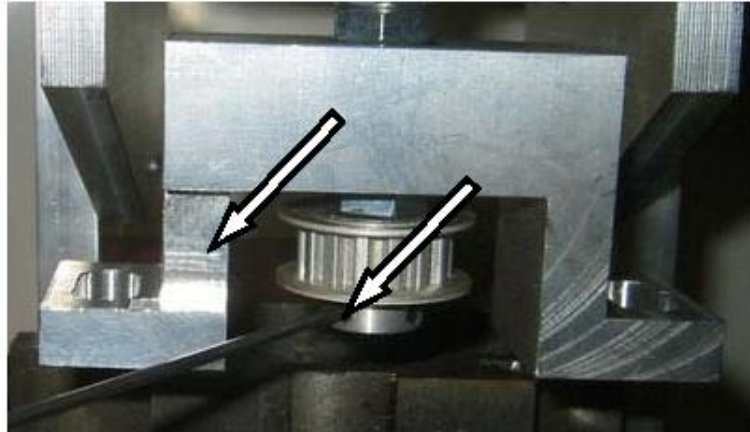
Insert the bearing block through the ballscrew as indicated by the arrow.

Note that the relief cut on the block should be on the left hand side.

Thread one (1)
3/8"x24TPI hex jam nut
hand-tightened.

Install the timing pulley as shown.

Note that the set screws are on the bottom. Using thread locking compound will prevent the set screw from coming loose. Make sure one of the set screws is sitting on the flat spot on the ballscrew.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

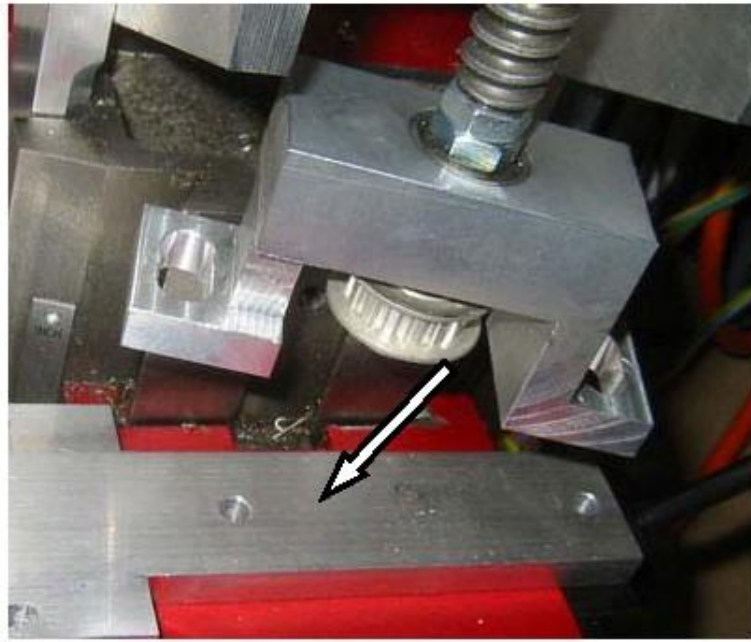
Asian/SIEG-made (X2) mini-mills

Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Remove the zip-tie (if used) from the ballscrew.

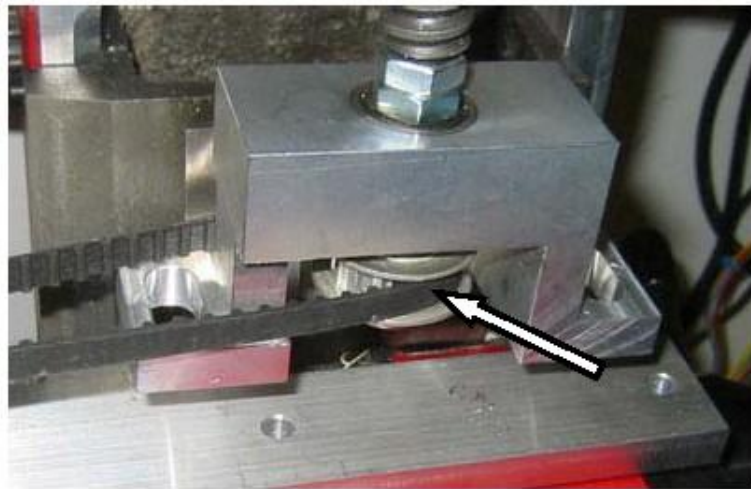
Place the motor plate on the head as indicated by the arrow.

Make sure that the plate is oriented such that the extended relief cut is facing towards the front of the mill. This provides clearance for the high/low shift lever.



Place the timing belt around the timing pulley.

Note: we are preparing to bolt the bearing block to the head, so the belt needs to be clear for this operation.





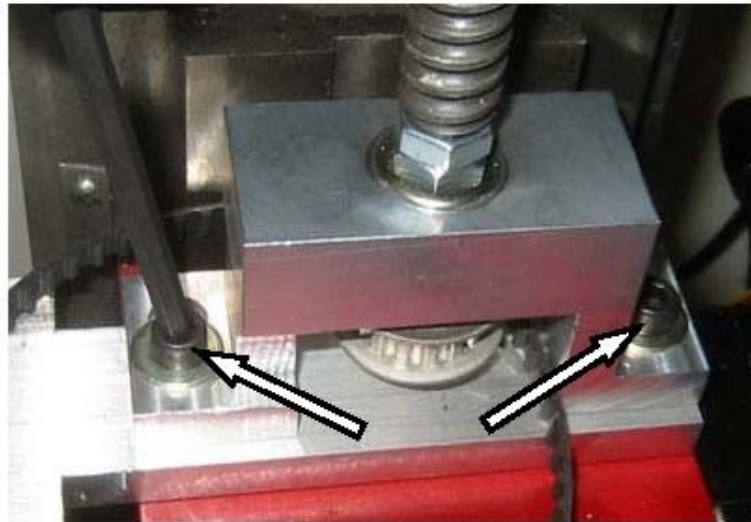
FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Using two (2) 1½" ¼"x20TPI socket head screws and two (2) ¼" washers and two (2) ¼" lock washers, loosely tighten the bearing block and motor plate to the head.

Note: we are preparing to adjust the Z-axis, so make sure you can still move the bearing block back and forth using your hands.



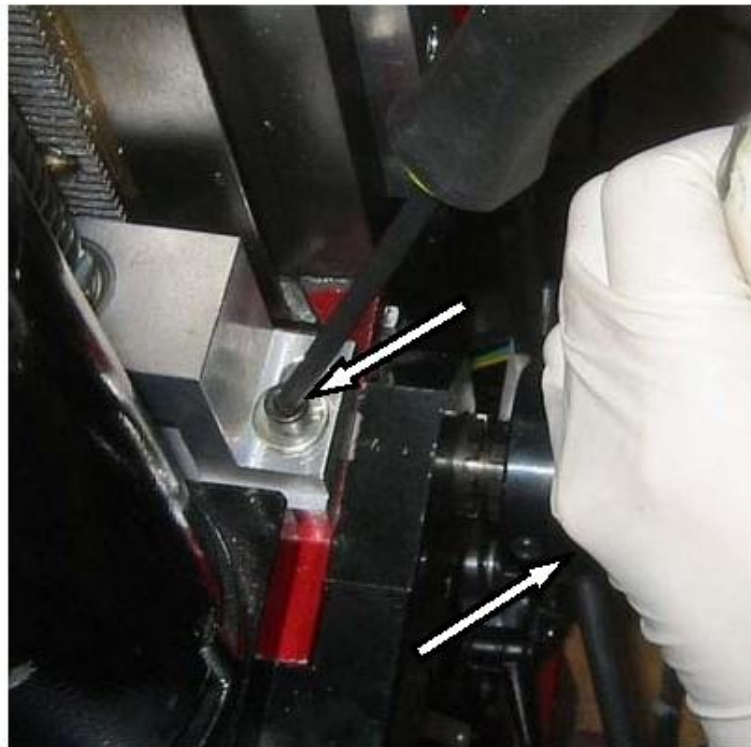
Adjust the hex jam nuts on top of the bearing block so that there is no ballscrew/bearing backlash. Do not tighten with a wrench.

With one hand on the Z-axis feed handles, move the head up and down until you have smooth motion and no binding.

Note: you may have to adjust the fore/aft location of the bearing block during this time.

Tighten the bolts.

Re-check for binding.
Repeat as necessary.





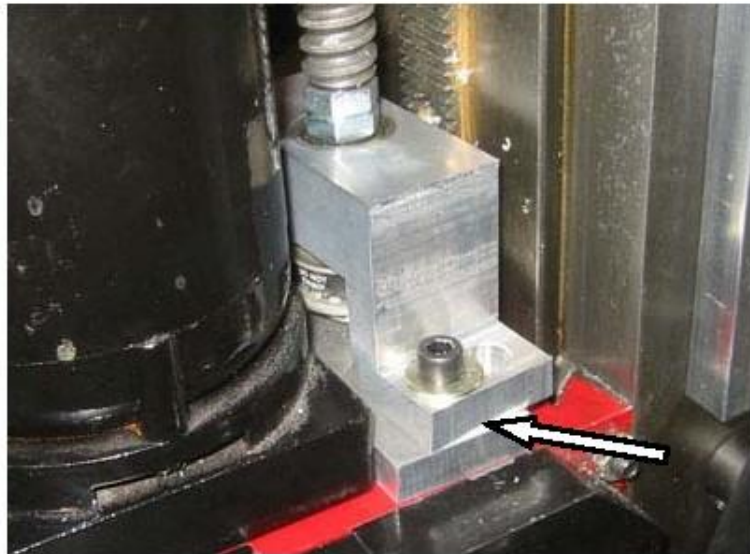
FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

The bearing block is now in place.

Note that the block is not parallel to the edge of the head. This is OK.



We are now ready for the motor.





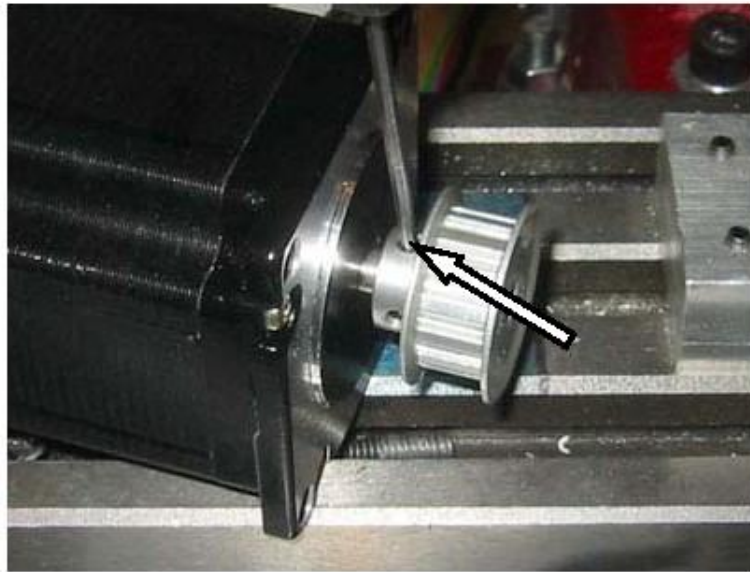
FigNoggle Designs

CNC Plans for Asian Mini-Mills

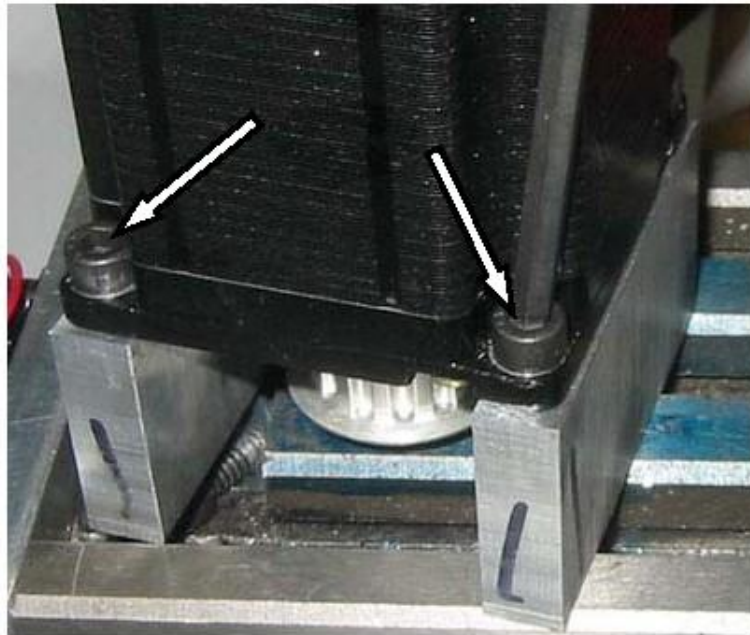
Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Install the timing pulley on the shaft of the motor.

Note: using a thread locking compound will ensure that the set screws do not come loose. Also make sure that one set screw is sitting on the flat spot on the motor shaft.



Install the two (2) motor rails using two (2) 1/2" #10-24 socket head screws for each rail.



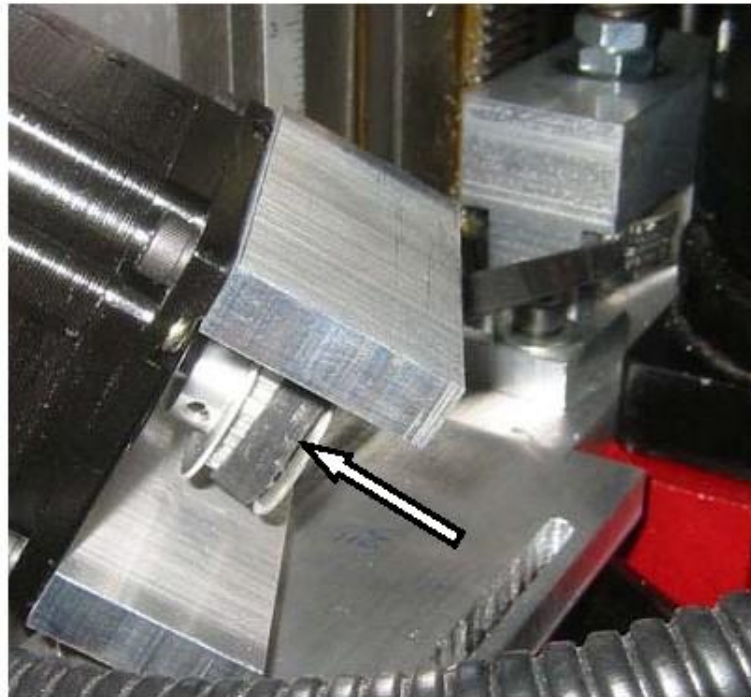


FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

Loop timing belt around
the motor's timing pulley





FigNoggle Designs

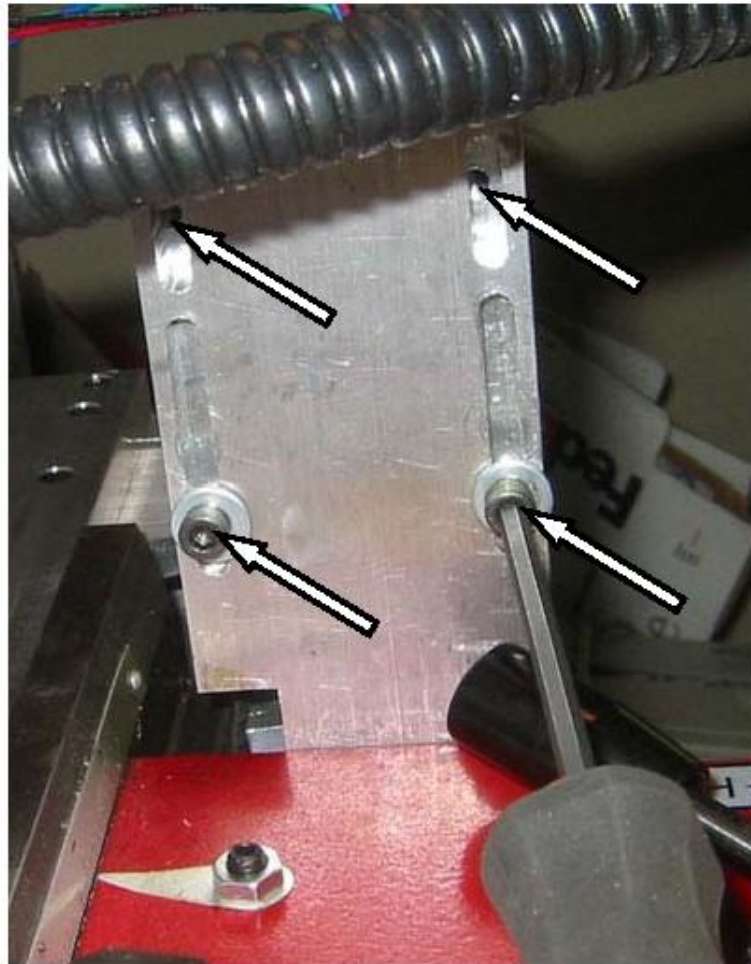
CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

From the underside of the motor plate, use four (4) $\frac{3}{4}$ " #10-24 socket head screws and four (4) #10 washers to secure the motor rails to the motor plate.

Pull the motor away from the head to tighten the timing belt.

Tighten all four (4) screws.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

The Z-Axis is complete.





FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/SIEG-made (X2) mini-mills
Harbor Freight (#44991), Grizzly (#G8689), Micro-Mark (#82573), Homier (#3947), Cummins (#7877)

CAD DRAWINGS

The following pages include CAD drawings of the parts to be machined:

1. CNC_X-AXIS_ASSEMBLY (CONTAINS PARTS LIST)
2. CNC_X_MOTOR_SHAFT_ADAPTER
3. CNC_X_MOTOR_PLATE
4. CNC_Y-AXIS_ASSEMBLY (CONTAINS PARTS LIST)
5. CNC_PARTS_30T_XL_TIMING_PULLEY
6. CNC_PARTS_Y-AXIS_HANDLE
7. CNC_Y_MOTOR_RAIL
8. CNC_Y_MOTOR_PLATE
9. CNC_Z-AXIS_ASSEMBLY (CONTAINS PARTS LIST)
10. CNC_Z_COLUMN_BRACKET_LEFT
11. CNC_Z_COLUMN_BRACKET_RIGHT
12. CNC_Z_TOP_PLATE
13. CNC_Z_TOP_ANGLE_BRACKET
14. CNC_Z_BEARING_BLOCK
15. CNC_Z_NUT_FLANGE
16. CNC_Z_MOTOR_RAIL
17. CNC_Z_MOTOR_PLATE
18. CNC_Z_SCREW

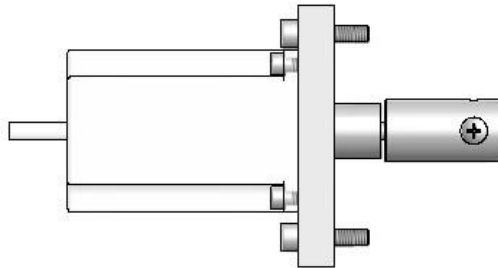


FigNoggle Designs

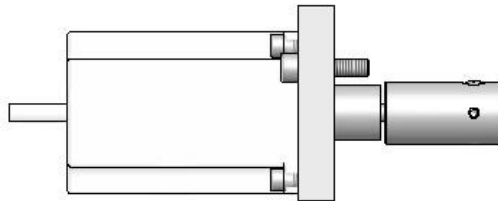
CNC Plans for Asian Mini-Mills

Asian/Chinese-made (32) Mini-mills

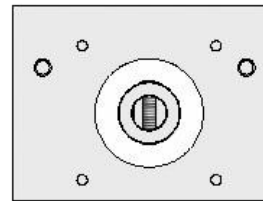
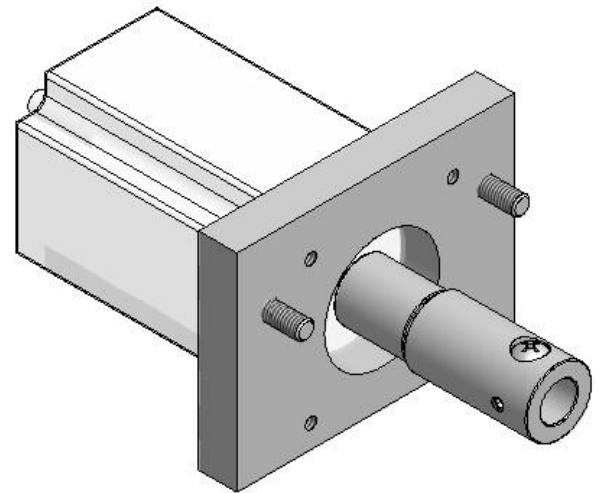
Maxim Powerlight (944073), Delvaco (900689), Micro-Mark (992073), Romex (93447), Comline (97477)



TOP VIEW



SIDE VIEW



FRONT VIEW

Parts List

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	CNC_X_MOTOR_PLATE	
2	1	CNC_X_MOTOR_SHAFT_ADAPTER	
3	4	No. 10 - 24 - 1/2	SOCKET HEAD SCREW
4	2	M6x1 x 25	SOCKET HEAD SCREW - METRIC
5	1	No. 10 - 24 - 3/4	CROSS PAN HEAD MACHINE SCREW
6	1	10-24 UNC x 0.19	SOCKET HEAD SET SCREW - FLAT POINT
7	1	FLEX COUPLING	MSCDIRECT #02600096
8	1	NEMA 23 FRAME MOTOR	

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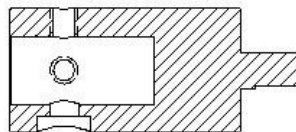
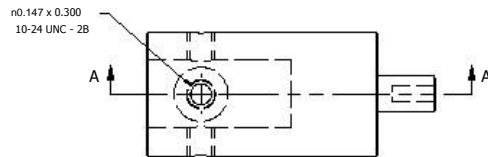
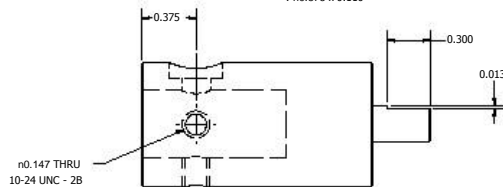
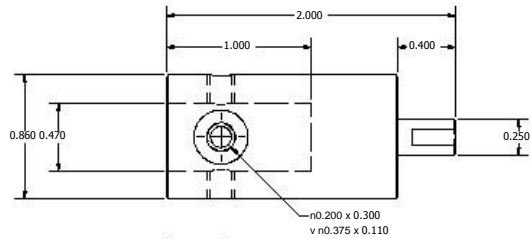
DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_X-AXIS_ASSEMBLY	
APPROVED		REV	
		SIZE C	2.1
		SCALE	
		SHEET 1 OF 1	



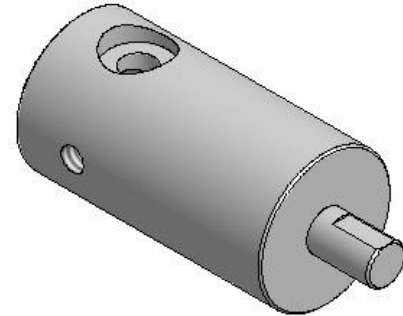
FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asiatic/OIDB-made (32) mini-mills
Hobby Knight (844932), Grizzly (808409), Micro-Mark (802473), Homier (814471), Cammar (874771)



SECTION A-A



NOTES:

1. CHAMFER ALL EDGES

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DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_X_MOTOR_SHAFT_ADAPTER	
FIG			
APPROVED			
		SIZE C	DWG NO CNC_X_MOTOR_SHAFT_ADAPTER
		SCALE	REV

SHEET 1 OF 1

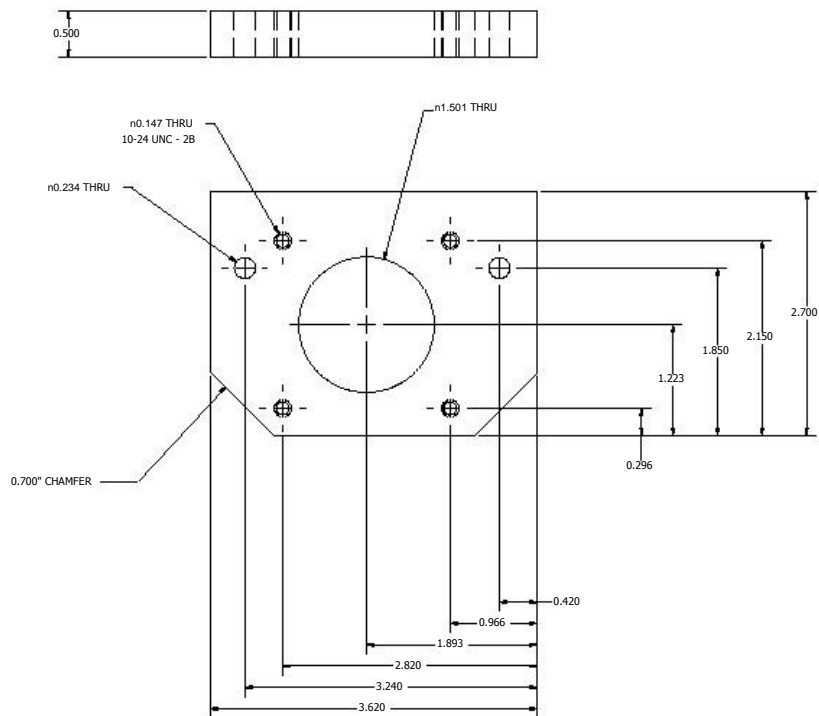
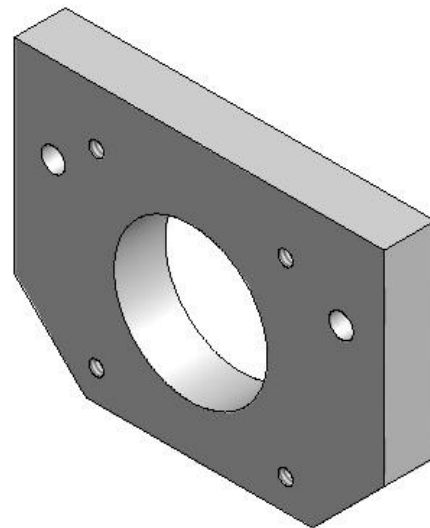


FigNoggle Designs

CNC Plans for Asian Mini-Mills

Lat40/0150-made (32) mini-mills

Machine Penlight (844991), Grizzly (800497), Micro-Mark (882073), Komar (82147), Cammar (87477)



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DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_X_MOTOR_PLATE	
FIG			
APPROVED			
		SIZE C	DWG NO CNC_X_MOTOR_PLATE
			REV 2.1
		SCALE	SHEET 1 OF 1

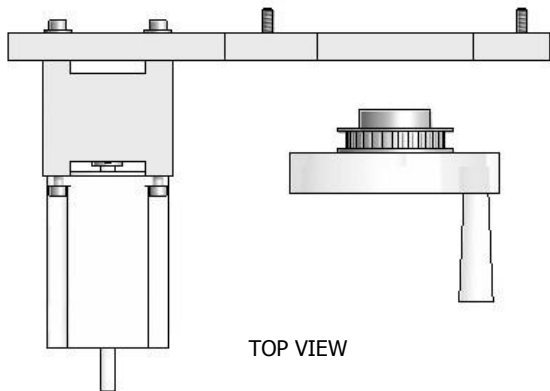


FigNoggle Designs

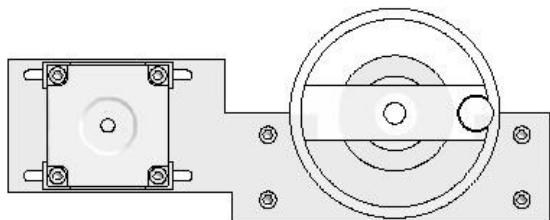
CNC Plans for Asian Mini-Mills

Asian/0180-made (32) mini-mills

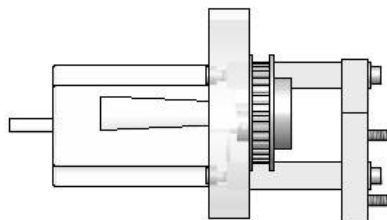
Router: ProNight (844592), Grizzly (808609), Micro-Mark (802473), Router (811471), Camaster (87477)



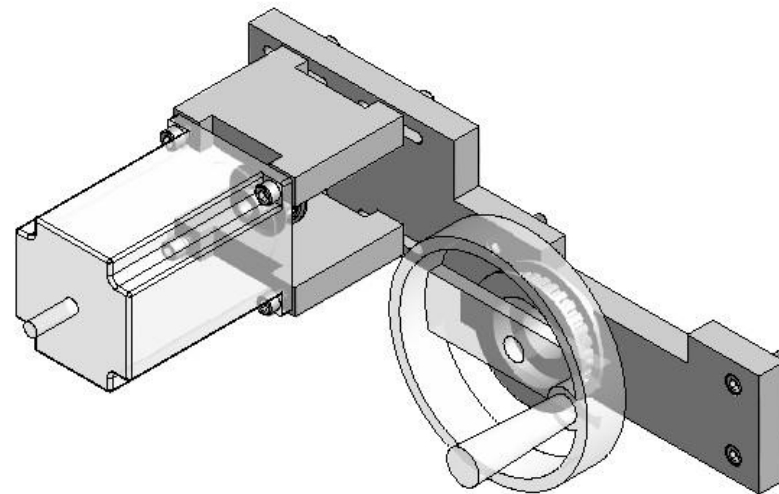
TOP VIEW



FRONT VIEW



SIDE VIEW



Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	CNC_Y_MOTOR_PLATE	
2	2	CNC_Y_MOTOR_RAIL	
3	1	Y-AXIS HANDLE	
4	12	No. 10 - 24 - 3/4	SOCKET HEAD SCREW
5	4	No. 10	WASHER (HARDENED PREFERRED)
6	1	3/8"	WASHER (HARDENED PREFERRED)
7	1	TIMING PULLEY 15T XL	MSCDIRECT #35375831
8	1	5/16"	WASHER (HARDENED PREFERRED) (NOT SHOWN)
9	1	TIMING PULLEY 30T XL	MSCDIRECT #35375922
10	1	TIMING BELT 75T XL	MSCDIRECT #35393941 (NOT SHOWN)
11	1	NEMA 23 FRAME MOTOR	

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DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_Y-AXIS_ASSEMBLY	
FIG			
APPROVED			
		SIZE C	DWG NO CNC_Y_ASSEMBLY_FULL
		SCALE	REV 2.1
			SHEET 1 OF 1

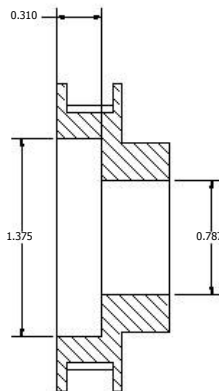
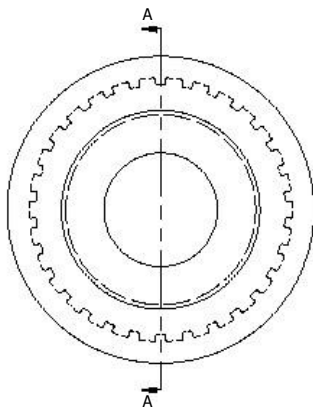
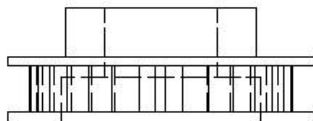


FigNoggle Designs

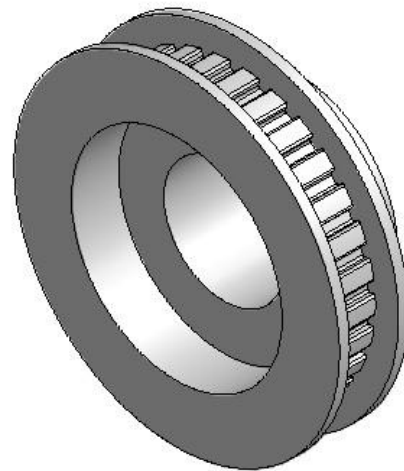
CNC Plans for Asian Mini-Mills

86166/0180-made (32) Mini-Mills

Machine: Fagor (860951), Grizzly (860483), Micro-Mach (862573), Komax (818471), Commins (878777)



SECTION A-A



NOTES:

1. HANDLE DIMENSIONS MAY DIFFER.
MACHINE TO MATCH DIMENSIONS OF
PULLEY.

2. BORE THRU 0.787"

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DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_PARTS_30T_XL_TIMING_PULLEY	
FIG			
APPROVED			
		SIZE C	DWG NO. CNC_PARTS_TIMING_PULLEY_XL30T
		SCALE	REV

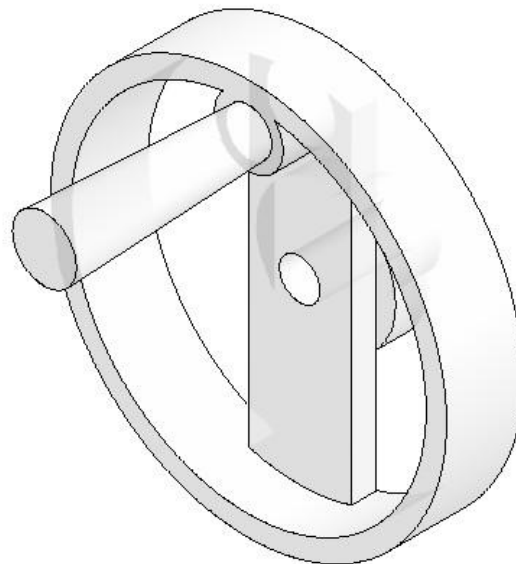
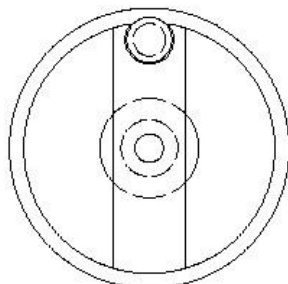
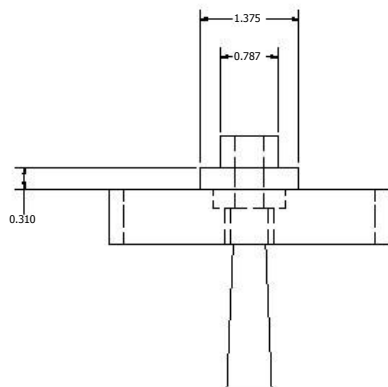


FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asi40/0180-made (32) mini-mill

Machine Weight: (844991), Grizzly (800491), Micro-Mark (882071), Romet (821471), Comline (874771)



NOTES:

1. HANDLE DIMENSIONS MAY DIFFER. MACHINE TO MATCH DIMENSION OF 30T TIMING PULLEY.

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DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_PARTS_Y-AXIS_HANDLE	
FIG			
APPROVED			
		SIZE C	DWG NO CNC_PARTS_HANDLE
		SCALE	REV 2.1
			SHEET 1 OF 1

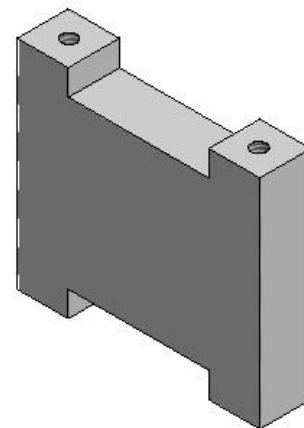
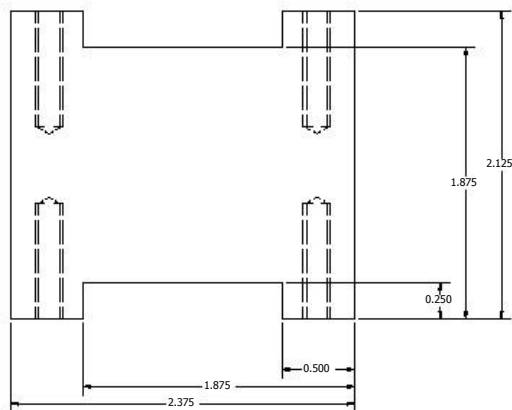
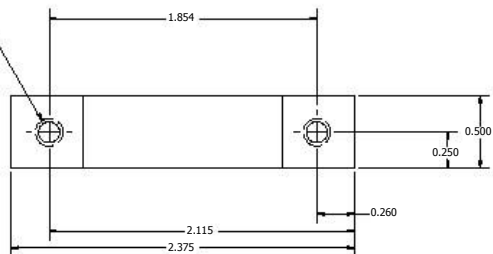


FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asian/G180-made (83) mini-mill
Master Wright (844932), Glatky (888900), Micron-Mark (862473), Hones (809497), Cummins (878777)

n0.147 x 0.800
10-24 UNC - 2B

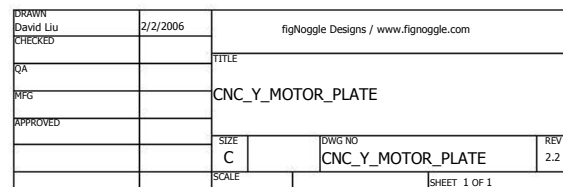


NOTES:

1. MAKE TWO (2) PIECES.

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DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_Y_MOTOR_RAIL	
FIG			
APPROVED			
		SIZE C	DWG NO CNC_Y_MOTOR_RAIL
		SCALE	REV 2.1
			SHEET 1 OF 1





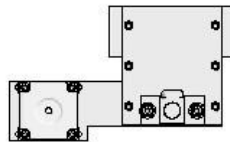
FigNoggle Designs

CNC Plans for Asian Mini-Mills

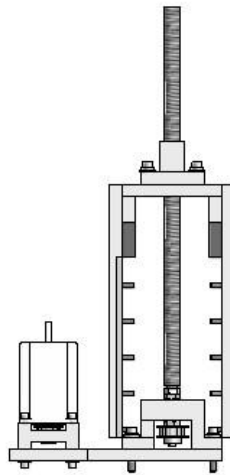
Axis: 0180-Axis (02) Mini-Mill

Machine Weight: (04551), Density: (00400), Motor: (00250), Machine: (01800), Controller: (01800)

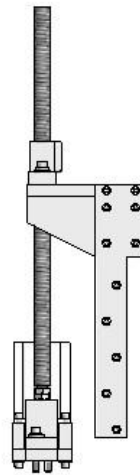
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	CNC_Z_AXIS_BLOC	
2	1	CNC_Z_AXIS_PLATE	
3	2	CNC_Z_AXIS_RAIL	
4	1	CNC_Z_AXIS_COLUMN_BRACKET_RIGHT	
5	1	CNC_Z_AXIS_COLUMN_BRACKET_LEFT	
6	1	CNC_Z_AXIS_TOP_PLATE	
7	2	CNC_Z_AXIS_ANGLE_BRACKET	
8	1	CNC_Z_AXIS_FLANGE	
9	3	3/8" - 24	HEX JAM NUT
10	2	1/4 - 20 - 1	SOCKET HEAD SCREW
11	2	1/4 - 20 - 1 1/2	SOCKET HEAD SCREW
12	4	1/4	WASHER (HARDENED PREFERRED)
13	4	1/4	LOCK WASHER
14	28	No. 10 - 24 - 3/4	SOCKET HEAD SCREW
15	4	No. 10 - 24 - 1	SOCKET HEAD SCREW
16	4	No. 10 - 24 - 1/2	SOCKET HEAD SCREW
17	4	No. 10	WASHER (HARDENED PREFERRED)
18	2	3/8" ID RADIAL BALL BEARING	MSCDIRECT #01377498
19	1	5/8" BALL SCREW 0.200" LEAD	MSCDIRECT #36695179
20	1	5/8" STANDARD BALL SCREW NUT	MSCDIRECT #36695302
21	1	TIMING PULLEY 14T XL MSCDIRECT	#35375823
22	1	TIMING PULLEY 16T XL MSCDIRECT	#35375849
23	1	TIMING BELT 65T XL	MSCDIRECT #35393909 (NOT SHOWN)
24	1	NEMA 23 FRAME MOTOR	



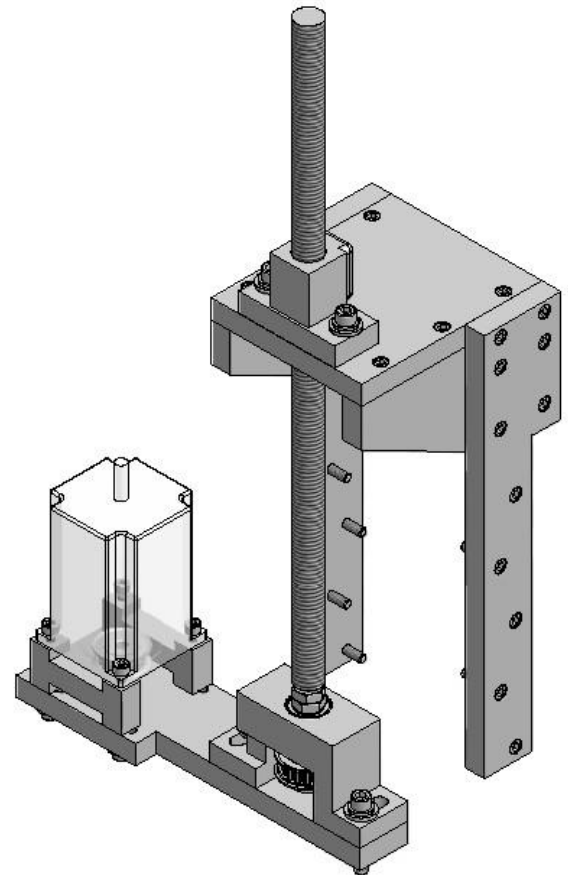
TOP VIEW



FRONT VIEW



SIDE VIEW



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DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_Z-AXIS_ASSEMBLY	
APPROVED		REV	
		SIZE	DWG NO.
		C	CNC_Z-AXIS_ASSEMBLY_FULL
		SCALE	2.1
		SHEET 1 OF 1	

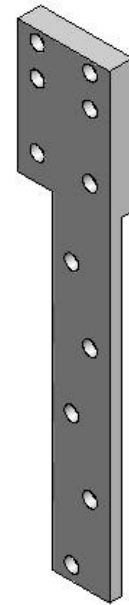
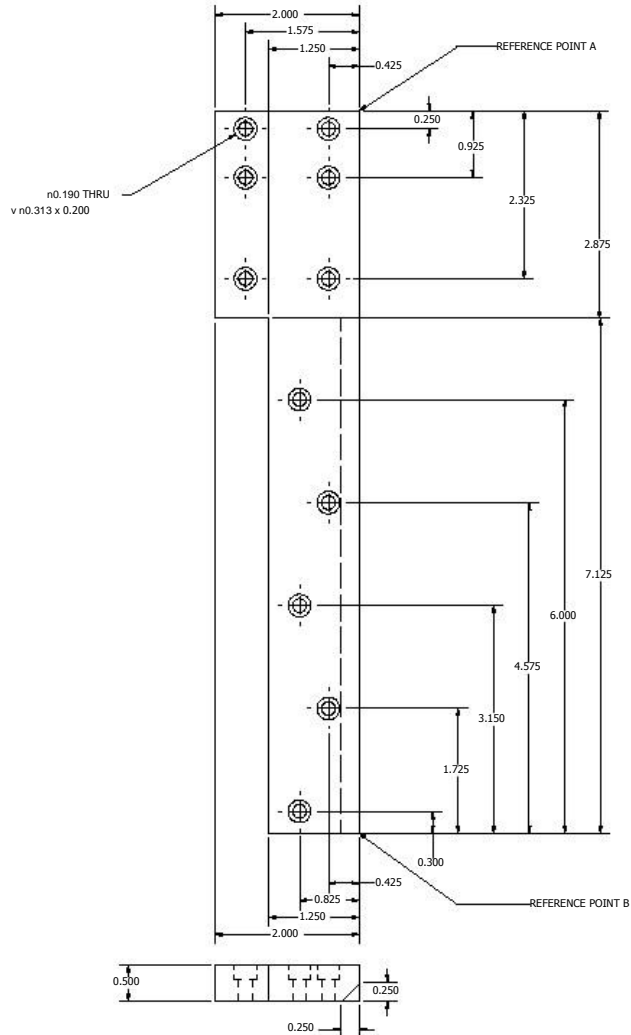


FigNoggle Designs

CNC Plans for Asian Mini-Mills

Axis/0180-mach (32) Mini-Mill

Master (945911), Detail (908893), Master-Mach (902573), Master (919471), Customer (976777)



NOTES:

1. MACHINE THIS PART FROM BOTH ENDS AS INDICATED BY REFERENCE POINTS A & B (SEE DIMENSIONS)
2. CHAMFER EDGE SHOWN 0.250"

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DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_Z_COLUMN_BRACKET_LEFT	
FIG			
APPROVED			
		SIZE C	DWG NO CNC_Z_COLUMN_BRACKET_LEFT
		SCALE	REV

SHEET 1 OF 1

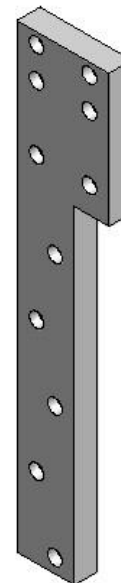
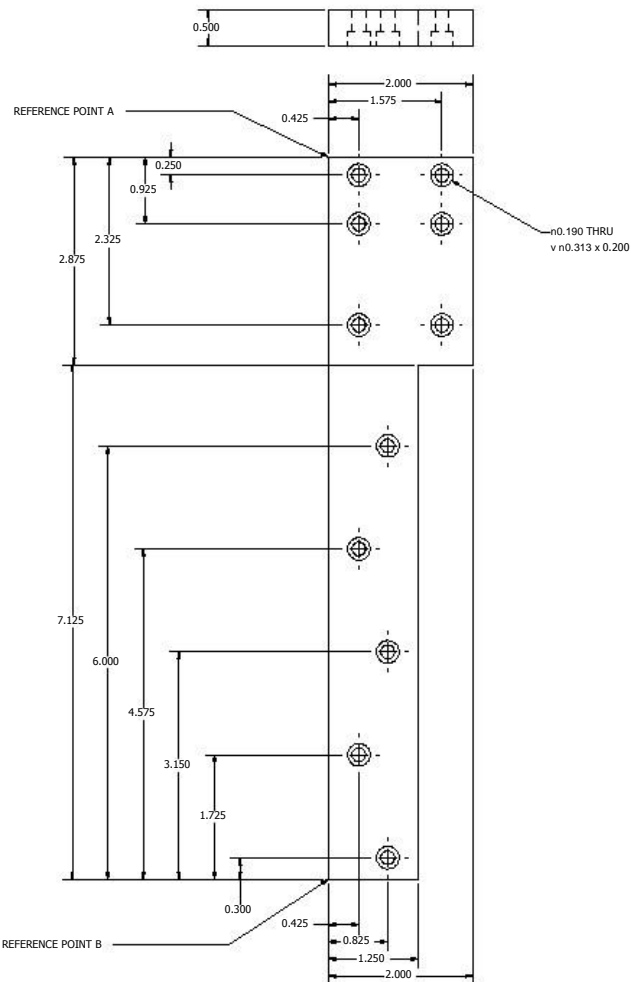


FigNoggle Designs

CNC Plans for Asian Mini-Mills

Axis4/0180-mach (C2) mini-mill

Master: Pricer (844931), Gcrazy (808880), Micro-Mach (802873), Bimach (81947), Camdun (878777)



NOTES:

1. MACHINE THIS PART FROM BOTH ENDS
AS INDICATED BY REFERENCE POINTS A & B
(SEE DIMENSIONS)

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DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_Z_COLUMN_BRACKET_RIGHT	
FIG			
APPROVED			
C		SIZE	DWG NO
		SCALE	REV
			CNC_Z_COLUMN_BRACKET_RIGHT
			SHEET 1 OF 1

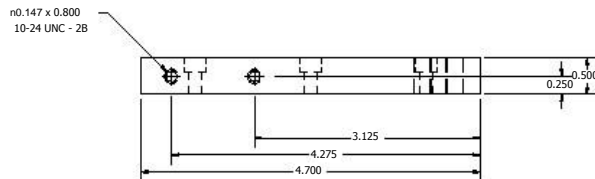
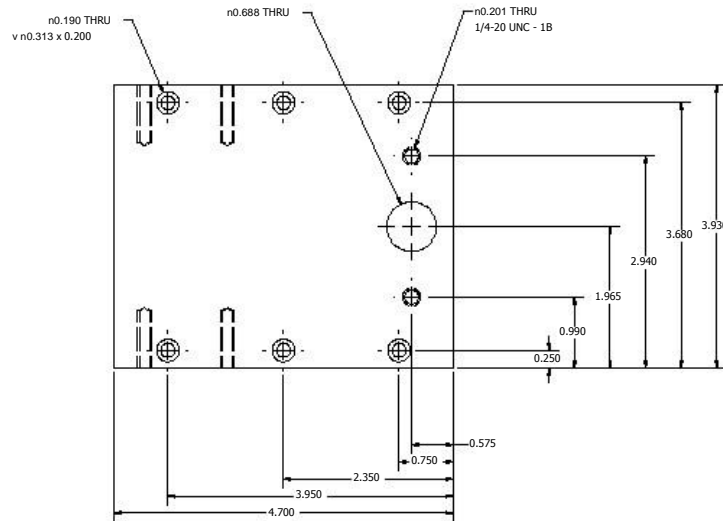
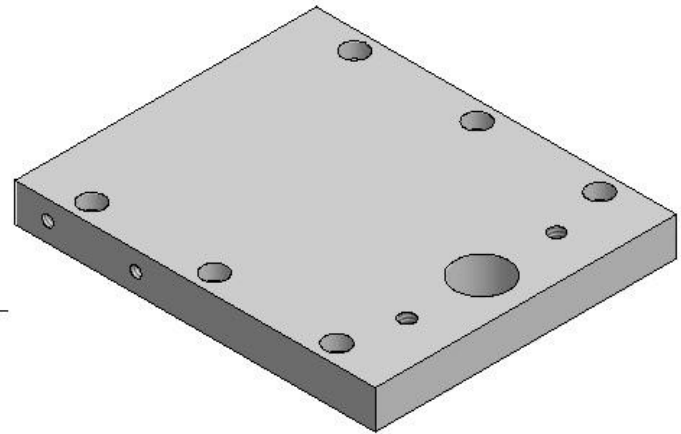


FigNoggle Designs

CNC Plans for Asian Mini-Mills

Axis/0180-mach (32) Mini-Mill

Master Profile: (044931), Gately (000001), Micro-Mach (002572), Romex (01947), Chamdon (07077)



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DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_Z_TOP_PLATE	
FIG			
APPROVED			
		SIZE C	DWG NO. CNC_Z_TOP_PLATE
			REV 2.1
		SCALE	SHEET 1 OF 1

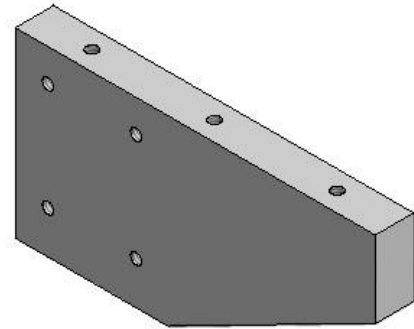
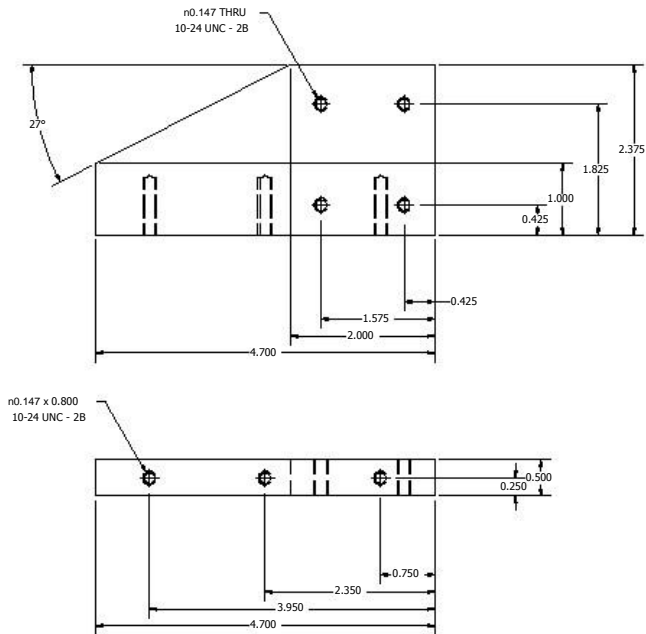


FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asia/OSB-made (32) mini-mill

Master (945911), Grizzly (808889), Micro-Mark (802572), Homax (81947), Chamico (878777)



NOTES:

1. MAKE TWO (2) PIECES.

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DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_Z_TOP_ANGLE_BRACKET	
FIG			
APPROVED			
		SIZE C	DWG NO CNC_Z_TOP_ANGLE_BRACKET
		SCALE	REV 2.1
			SHEET 1 OF 1

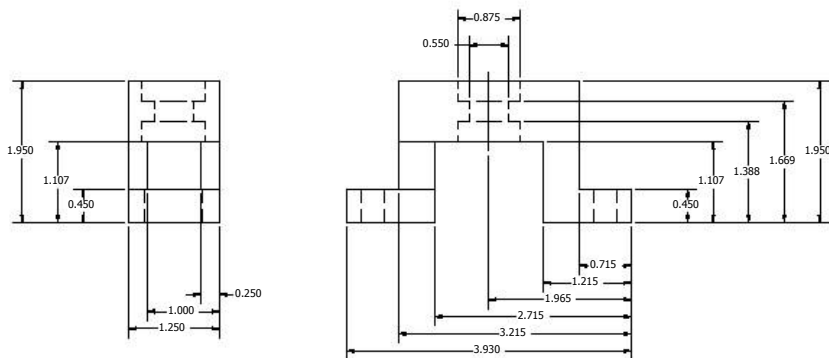
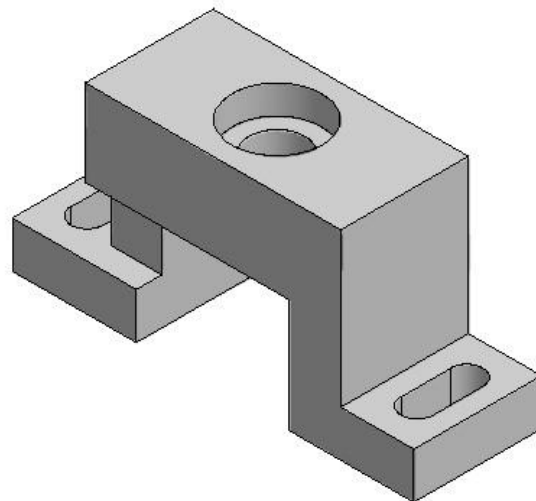
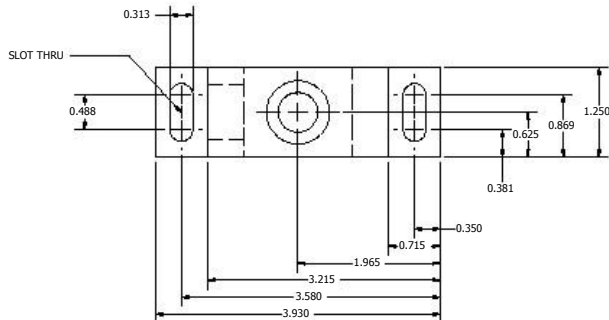


FigNoggle Designs

CNC Plans for Asian Mini-Mills

Lathe/Drill-mills (2) mini-mills

Machine Footprint (848992), Driveway (800689), Mower-Block (802972), Router (833477), Compressor (878777)



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DRAWN	David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED			TITLE	
QA			CNC_Z_BEARING_BLOCK	
FIG				
APPROVED				
			SIZE	DWG NO
			C	CNC_Z_BEARING_BLOCK
			SCALE	REV
				2.1
			SHEET 1 OF 1	

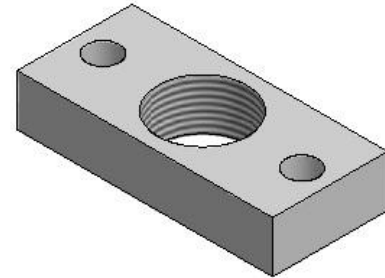
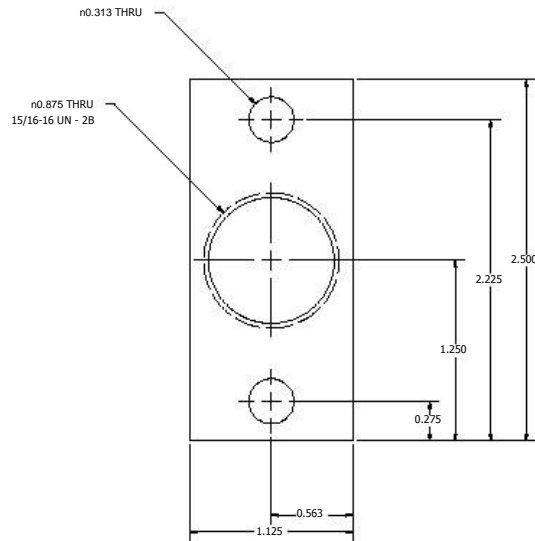


FigNoggle Designs

CNC Plans for Asian Mini-Mills

Axis/0180-mach (32) mini-mill

Master (944931), Grizzly (802889), Micro-Mach (802873), Romex (811877), Chamdon (878777)



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DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_Z_NUT_FLANGE	
FIG			
APPROVED			
		SIZE C	DWG NO CNC_Z_NUT_FLANGE
			REV 2.1
		SCALE	SHEET 1 OF 1



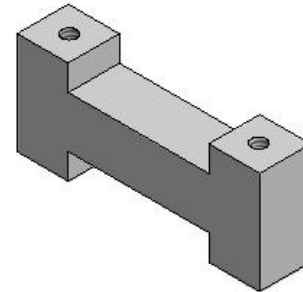
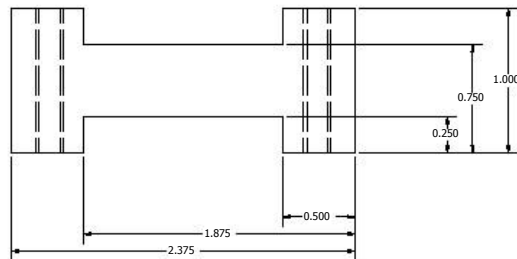
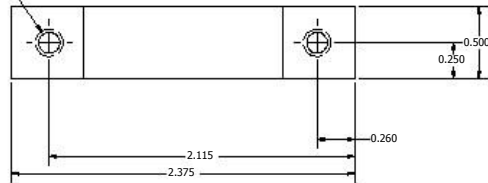
FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asiatic/OEM-made (32) Mini-Mill

Master: Prolog (844931), Grizzly (808889), Micro-Mark (802572), Homax (81947), Champion (87877)

M0.147 THRU
10-24 UNC - 2B



NOTES:

1. MAKE TWO (2) PIECES

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DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_Z_MOTOR_RAIL	
FIG			
APPROVED			
		SIZE C	DWG NO CNC_Z_MOTOR_RAIL
			REV 2.1
		SCALE	SHEET 1 OF 1



FigNoggle Designs

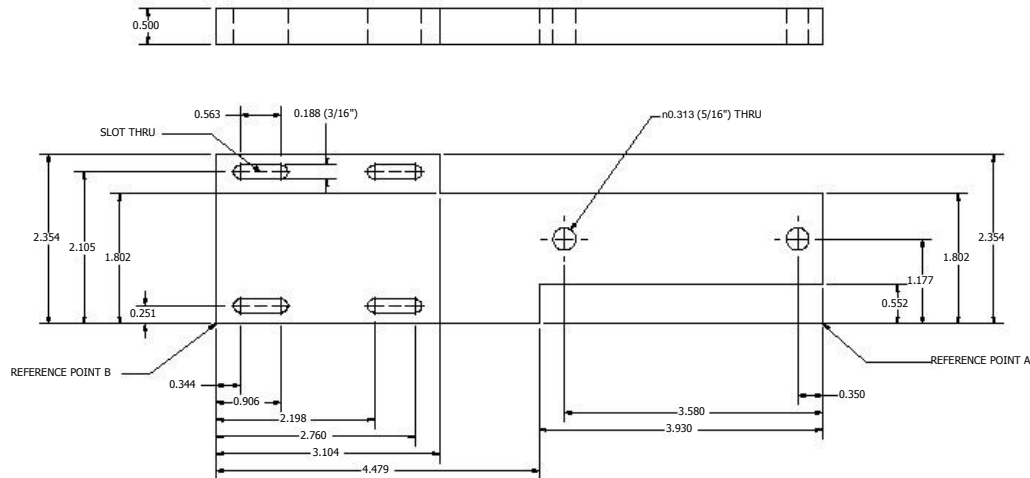
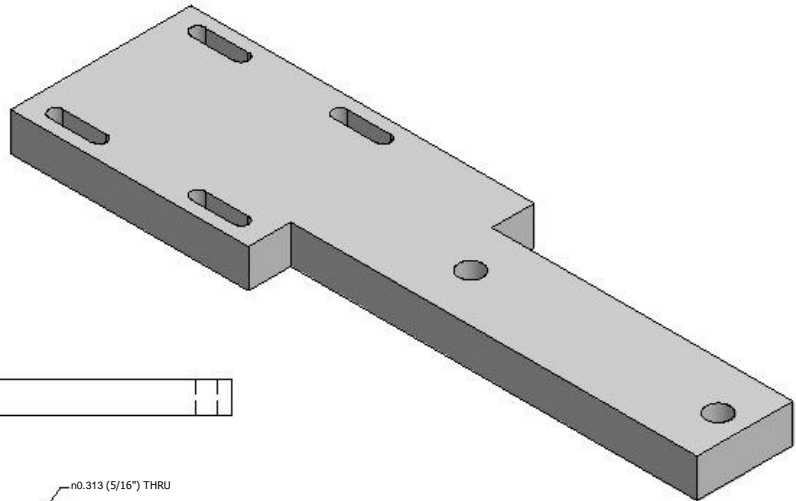
CNC Plans for Asian Mini-Mills

Axis/0180-mach (32) mini-mill

Master (945911), G-code (908880), Micro-Mach (902573), Router (911977), Chamfer (978777)

NOTES:

1. MACHINE THIS PART FROM BOTH ENDS AS INDICATED BY REFERENCE POINTS A & B (SEE DIMENSIONS)



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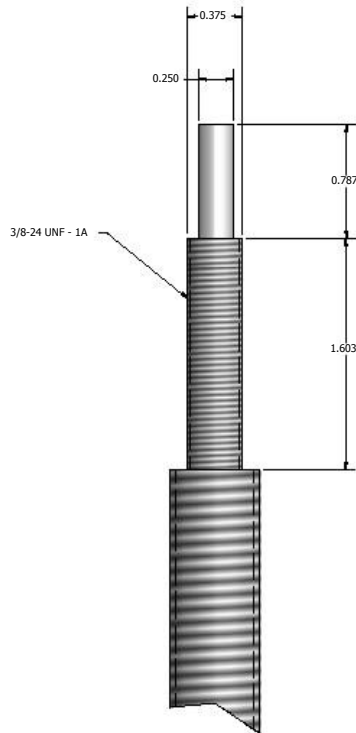
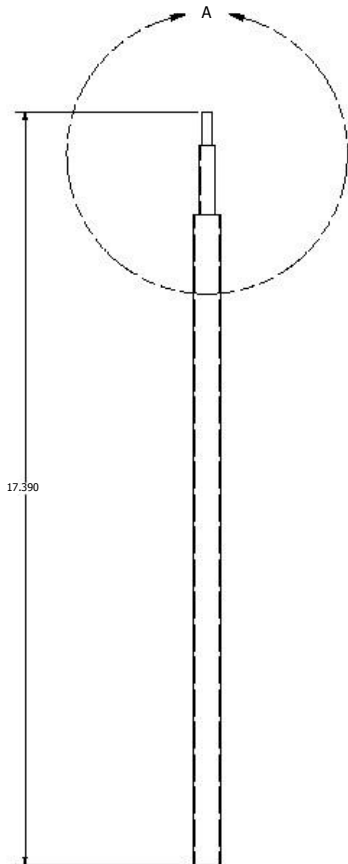
DRAWN David Liu	2/2/2006	figNoggle Designs / www.fignoggle.com	
CHECKED		TITLE	
QA		CNC_Z_MOTOR_PLATE	
FIG			
APPROVED			
		SIZE C	DWG NO CNC_Z_MOTOR_PLATE
		SCALE	REV 2.1
			SHEET 1 OF 1



FigNoggle Designs

CNC Plans for Asian Mini-Mills

Asaka (2182-made (52) mini-mills)
Hoshizaki (2182-made (52) mini-mills), Hoshizaki (2182-made (52) mini-mills), Hoshizaki (2182-made (52) mini-mills), Hoshizaki (2182-made (52) mini-mills)



DETAIL A



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CHECKED		TITLE	
QA		CNC_Z_SCREW	
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		SIZE C	DWG NO CNC_Z_SCREW
		SCALE	REV