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27781

NOTES ON THE TEST-JIG MADE AND USED BY MARION F. MECKLENBURG 2 NOV 1989

This instrument is intended to stretch strips of paper, ½in wide, or films of adhesives, and to measure the forces that extend them by known distances. A small increment of tension may be applied, followed by an interval of seconds or minutes while the test-piece relaxes the added stress visibly to a minimum. The instrument occupies a rectangular volume that can be stacked with as many as nine others inside a chamber at a controlled relative humidity and temperature. Once set up, the only access necessary is to its front panel.

Layout of the components is shown in: Fig 1, a side elevation; Fig 2, an isometric view. A list of parts and dimensioned plans of each constructed part is also enclosed.

The instrument consists essentially of two grips for the ends of the test-piece. The front grip is attached to a carriage that rides on a screw thread turned by hand via a multi-turn knob that indicates rotation by full turns and one hundredths. The carriage for the back grip carries on its underside a pair of rails that ride on two trucks (bogies) from a model railway, fixed inverted beneath it. This back carriage is pulled against the upper end of a cantilever beam. Near the fixed end of the beam four strain gauges are attached, two on the compressed side, two on the stretched side, wired as a full-bridge circuit. The output from this bridge can be conditioned (i.e. multiplied by a factor, etc) in a Strain Indicator Unit (P-3500, Measurements Group, Raleigh, NC) and is there indicated on a liquid crystal display in "strain units".

The beam is calibrated in two stages. First, by inserting a length of hacksaw blade (inextensible at these low stresses) as the test-piece and then recording and plotting strain units indicated as the knob is turned by increasing fractions of turns. This measurement enables us to know how far the top of the beam, and hence the back of the test-piece, has moved, for any number of strain units indicated. This distance will later be subtracted from the distance that the front of a test-piece was pulled, in order to establish the actual extension of a test-piece.

Second, the hacksaw blade is replaced by a cylindrical spring of known constant. M.F.M. used 2.154 pounds tension per inch extension (28.47 gram per millimetre, or 48.85g per complete single turn of the screw). By a repetition of the experiment described above, the relation between tensions and strain units can be determined.

If more than one instrument is used at once, a Switch Balance Unit (SB-10) is also needed. This accepts up to ten inputs and routes them at will to one output for the Strain Indicator.

Notes

The full-bridge connection of the four strain gauges provides automatic compensation for temperature changes if the four have been applied symmetrically. Then, expansion or contraction of each bridge arm on the warming or cooling beam is identical. Each gauge suffers exactly the same change, increasing or decreasing, and the balance of the bridge remains undisturbed. M.F.M. reports that experimental irradiation of the beam with a heat lamp does not change the strain indicated.

In use, the screw thread is kept well lubricated in order to minimise friction between steel and aluminum. An oil hole added to the thrust bearing ("screw steady") will aid lubrication. For prolonged use, friction would be minimised if the aluminum of the bearing were replaced by brass.

The spring, ½in long, shown compressed between front panel and two locknuts on the screw, is essential. It serves to maintain a constant pressure on the thrust bearing.

If model railway trucks (bogies) and rails cannot be obtained but there is available a machine shop to cut the slot in the front clamp for the beam, the same shop might make up a kinematic mounting, thus: machine parallel "V" grooves in two lightweight slabs. Attach one slab, grooves down, to the underside of the carriage. Attach the other, grooves up, directly underneath the first slab. Insert three steel balls ("bearings"): two at the first and third fourths along one groove; one in the centre of the other. Then the carriage will roll along freely without binding or tipping.

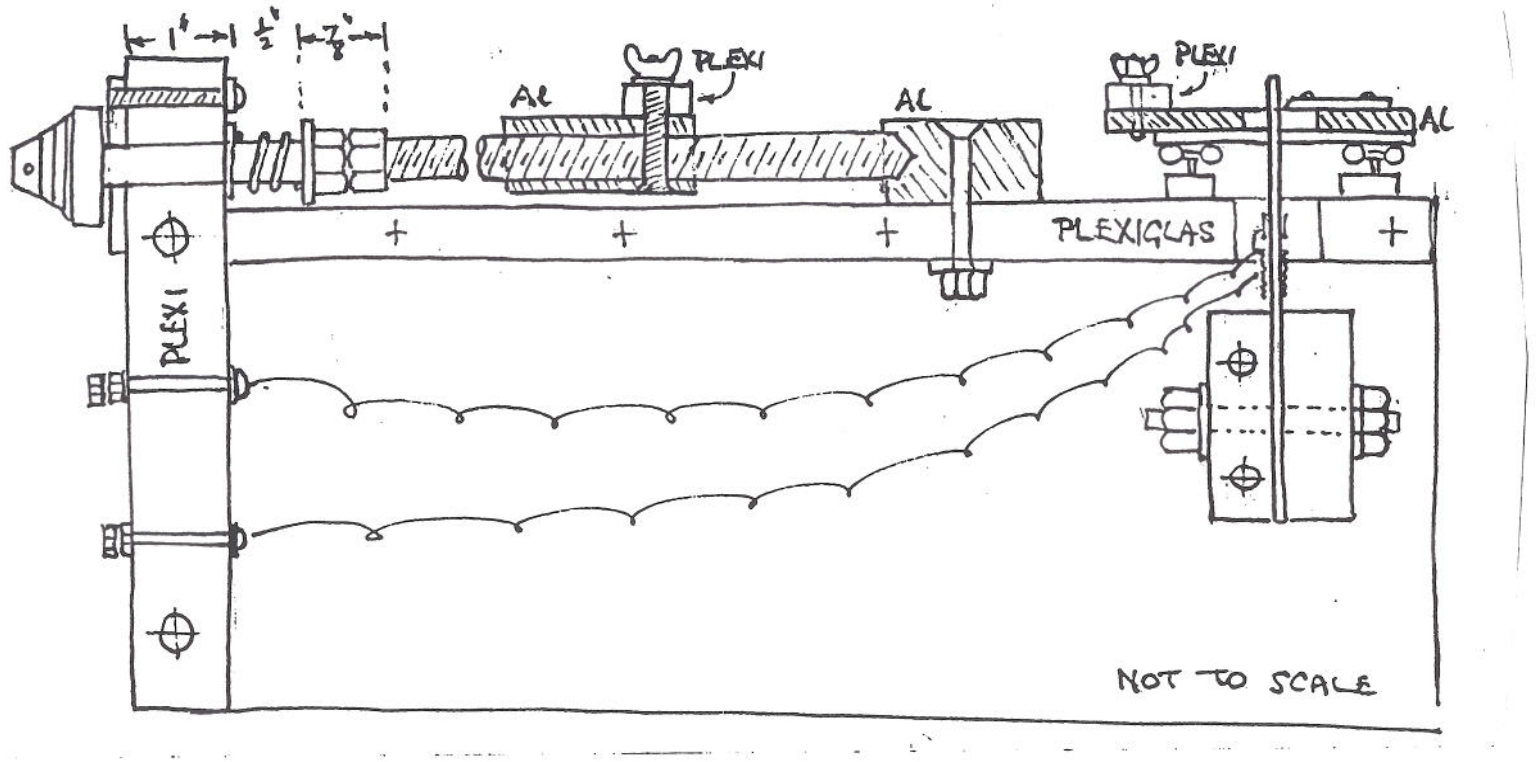
When soldering the wires to the strain gauge, use a soldering iron at a temperature high enough to melt the solder but not so high as to delaminate the strain gauges. (RMO has found Ersin Multicore, cored with activated resin, to be a quick-wetting and non-corrosive solder for electronics)

Clean off excess soldering flux thoroughly. If not cleaned off it will conduct electricity at high RH and the gauges will behave erratically. Use benzine and alcohol.

Coat the soldered gauges and all soldered connections with Rohm and Haas Acryloid B67 or equivalent, applying several coats. This will permit long-term use of the gauges in very high RH without corrosion or spurious signals in the circuits.

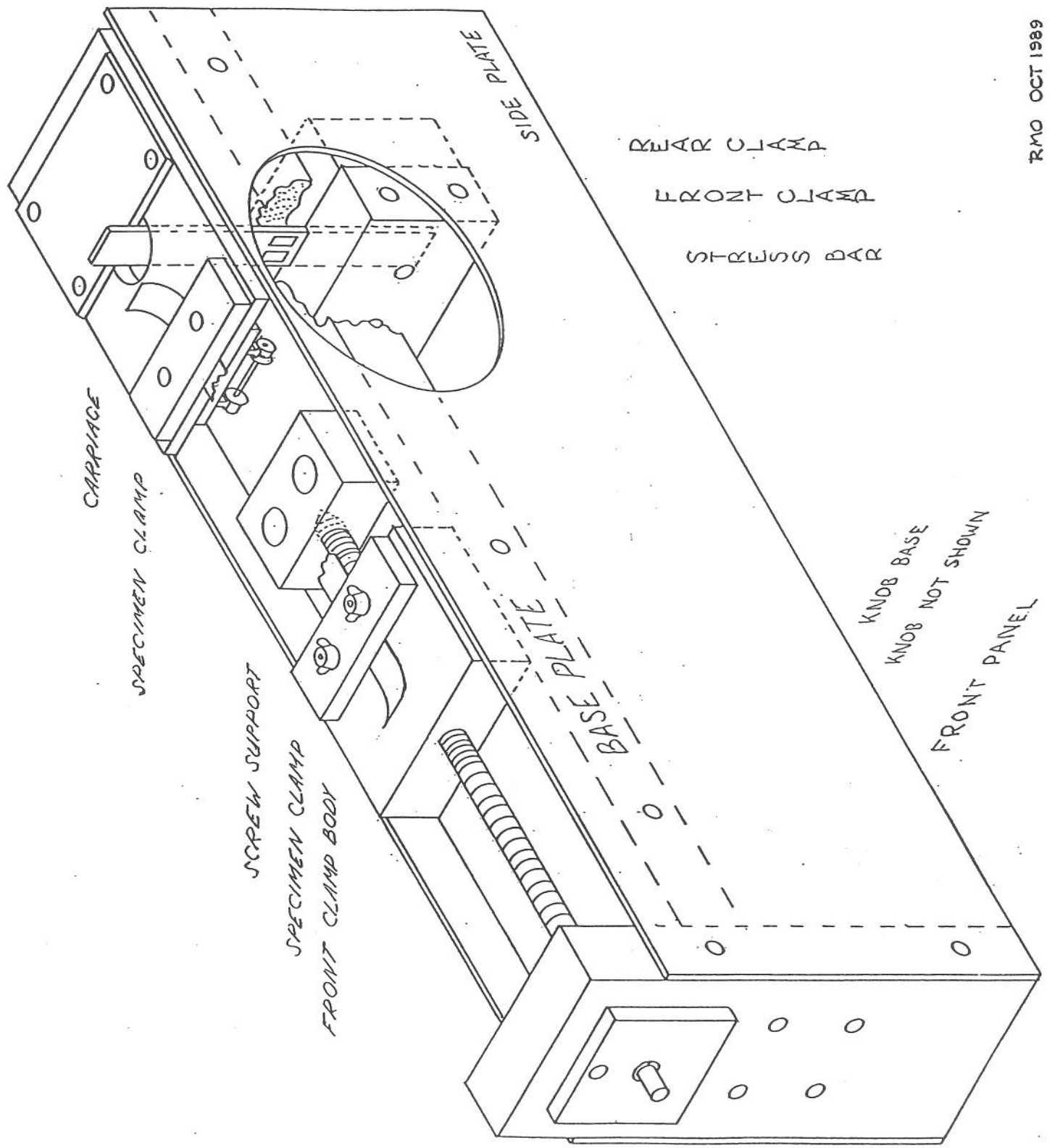
For typical results, see enclosed: Mecklenburg, M.F. (1988) The effects of atmospheric moisture on the mechanical properties of collagen under equilibrium conditions. Preprints of AIC 16th Annual Meeting, New Orleans, 231-244.

M.F.M. says that, in the U.K., help might be available from Gerry Hedley, Technology Department, Courtauld Institute of Art, 20 Portman Square, London W1H 0BE. He has worked with these instruments while on sabbatical at the Canadian Conservation Institute, Ottawa.


1"
½"
⅞"
AL
PLEXI
AL
PLEXI
AL
PLEXIGLAS
PLEXI
NOT TO SCALE

Adhesive Test Jig Materials List

QTY	ITEM	Plan
2	Side	*
1	Front	*
1	Baseplate	*
8	3.5" long 1/4-20 Hex Head Bolts	
8	1/4-20 Nuts	
16	Flat Washers	
1	Knob Panel	*
1	Multiturn Knob (Spectrol 21-1-11)	
4	1.5" long 10-32 Rd. Head Screw	
8	10-32 Nut	
1	Stress Bar	*
4	Strain Gauge (MM CEA-13-125UW-350)	
4	Terminal	
1	Front Stress Clamp	*
1	Back Stress Clamp	*
2	2.5" long 1/4-20 Hex Head Bolt	
2	1/4-20 Nut	
4	Flat Washer	
1	Drive Screw	*
1	Screw Support	*
2	2" long 1/4-20 Cap Screw	
2	1/4-20 Nut	
2	Flat Washer	
1	Spring, 0.75" long 0.625 I.D.	
2	Flat Washer, 1/2" I.D.	
2	Nut, 1/2-20	
1	Front Clamp Body	*
2	2" long 10-24 Flat Head Screw	
2	10-24 Wing Nut	
1	Specimen Clamp	*
1	Carriage Body	*
2	1.5" long 10-24 Flat Head Screw	
2	10-24 Wing Nut	
1	Specimen Clamp	*
2	2" long Section "HO" Track	
2	"HO" Truck	
1	Carriage Knife Edge	*
4	1/2" long 6-32 Round Head Screw	
4	6-32 Nut	



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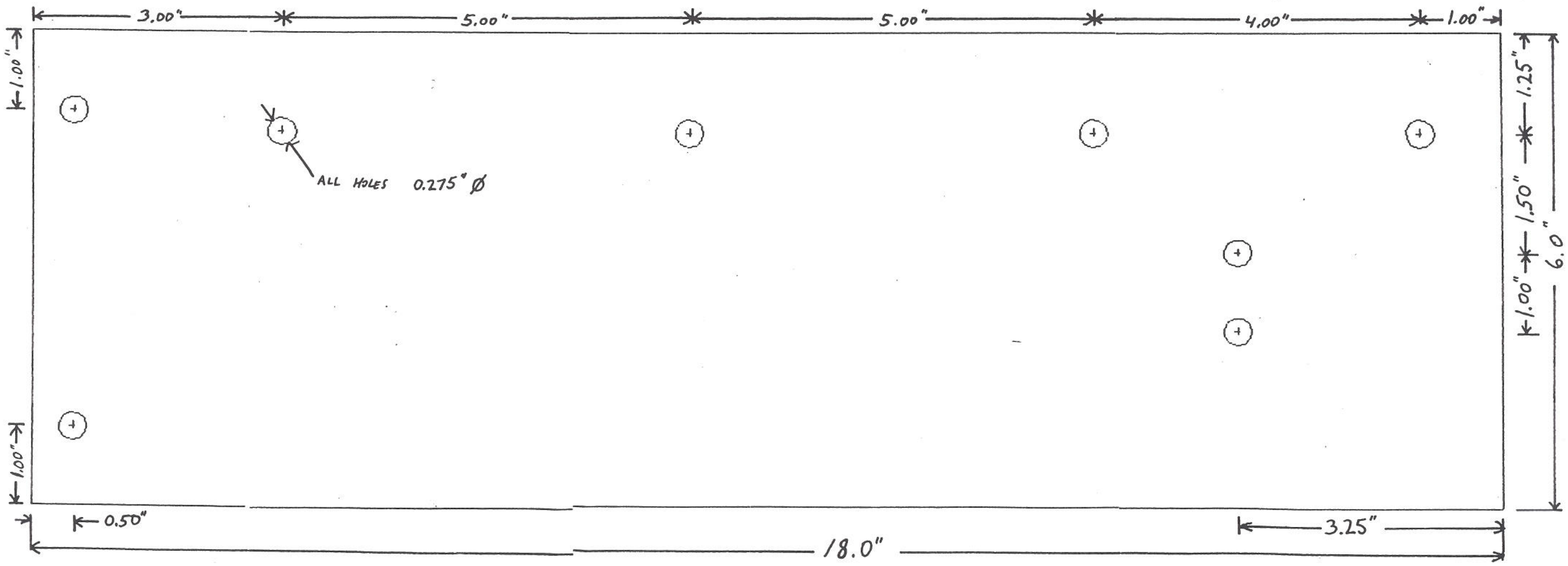
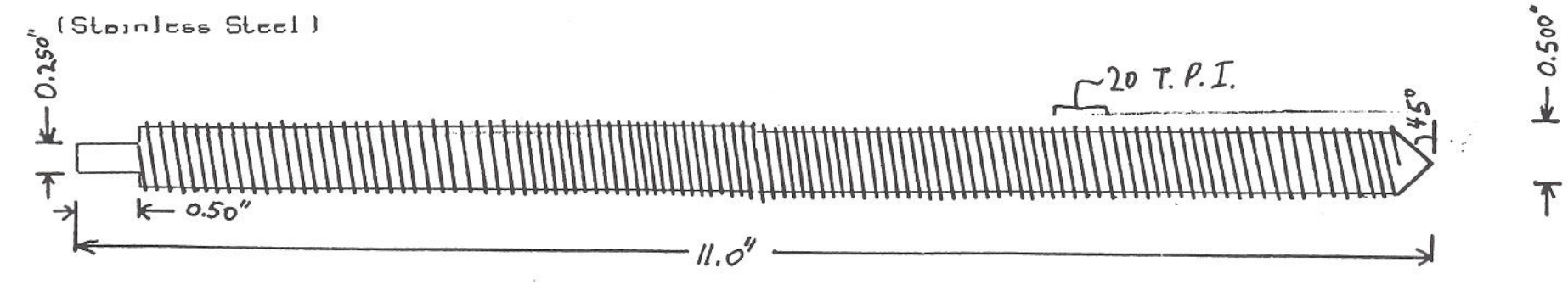
Side Plates

2x (Stainless Steel. **0.060"** thick)



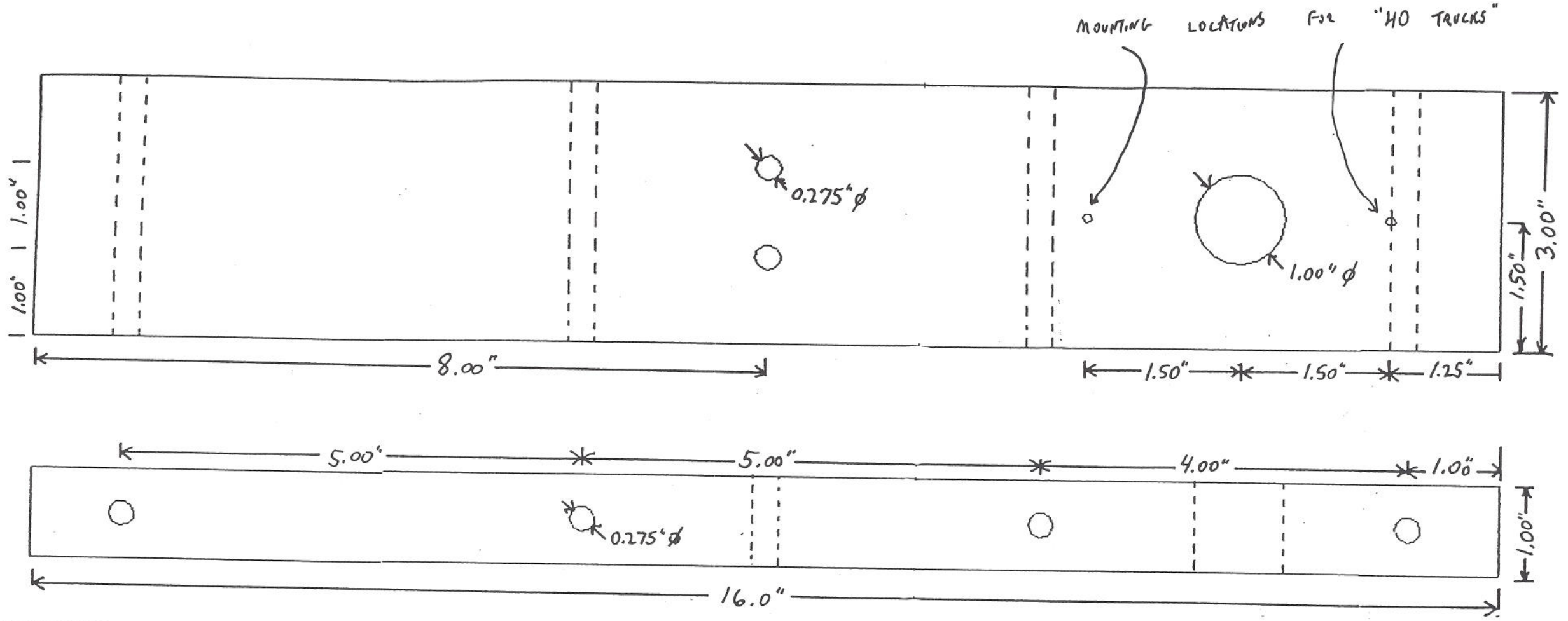
Drive Screw

(Stainless Steel)



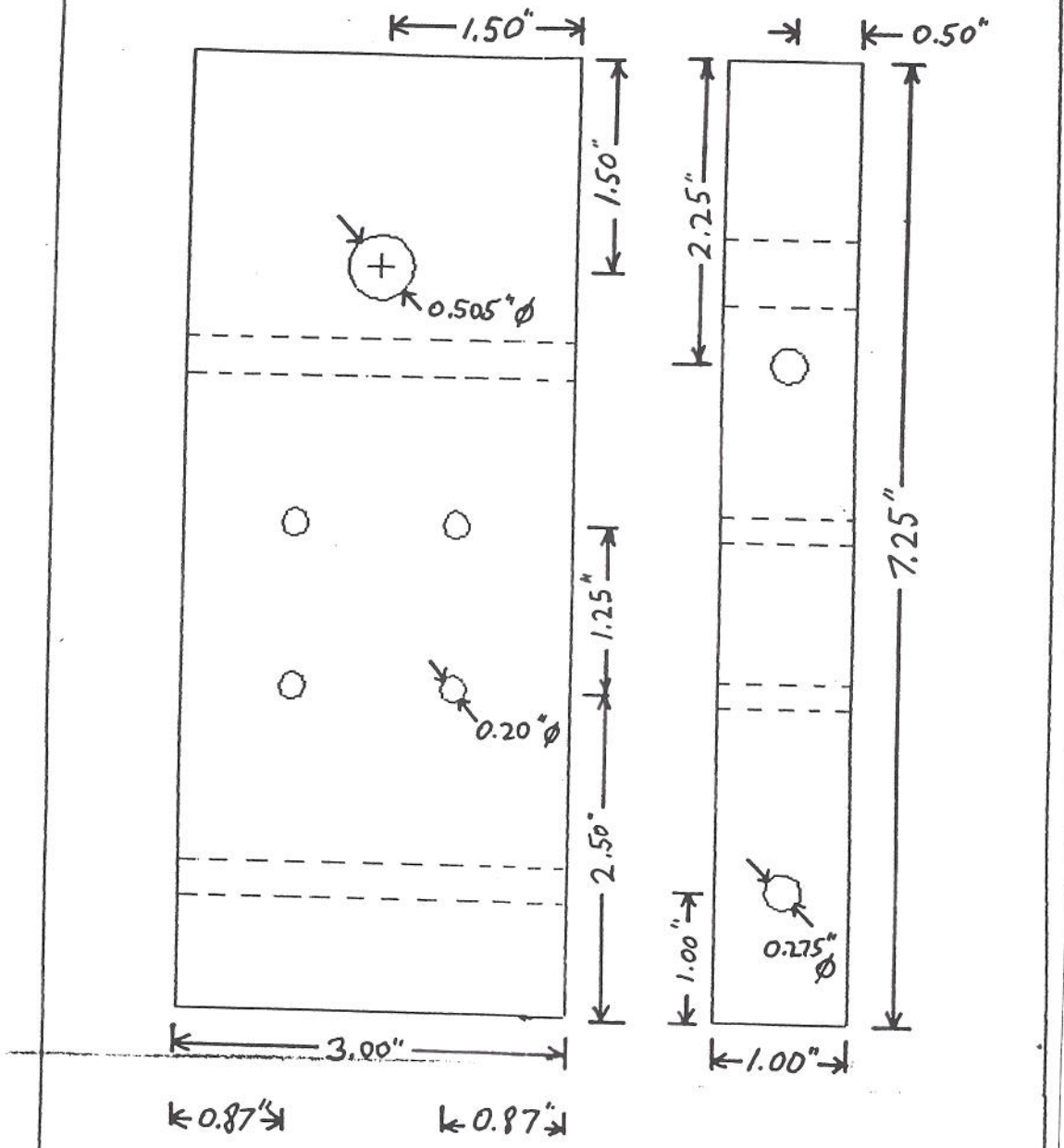
Baseplate

(Plex)glass



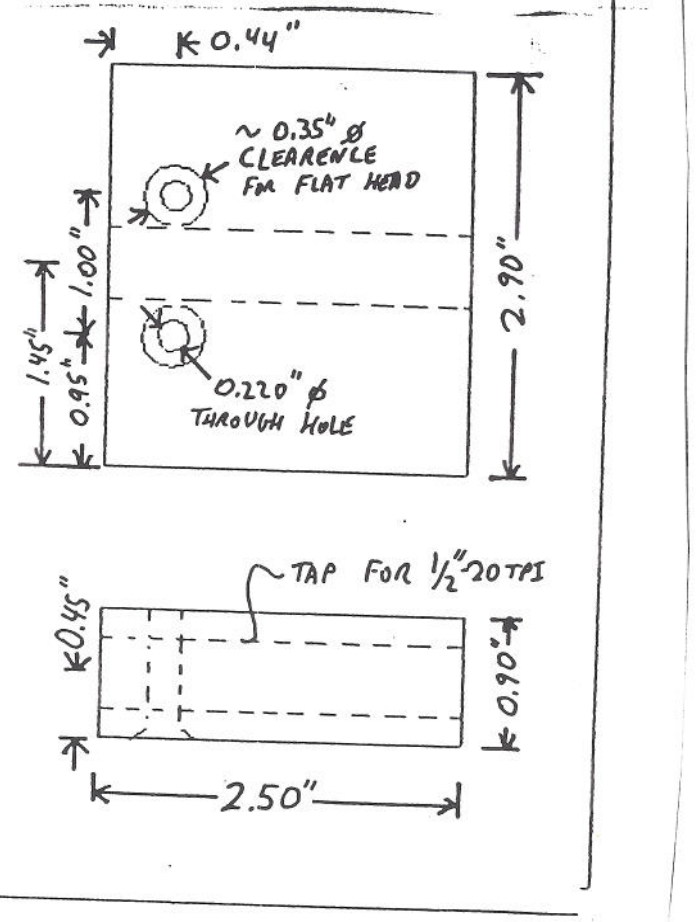
Front Panel

(Plexiglass)



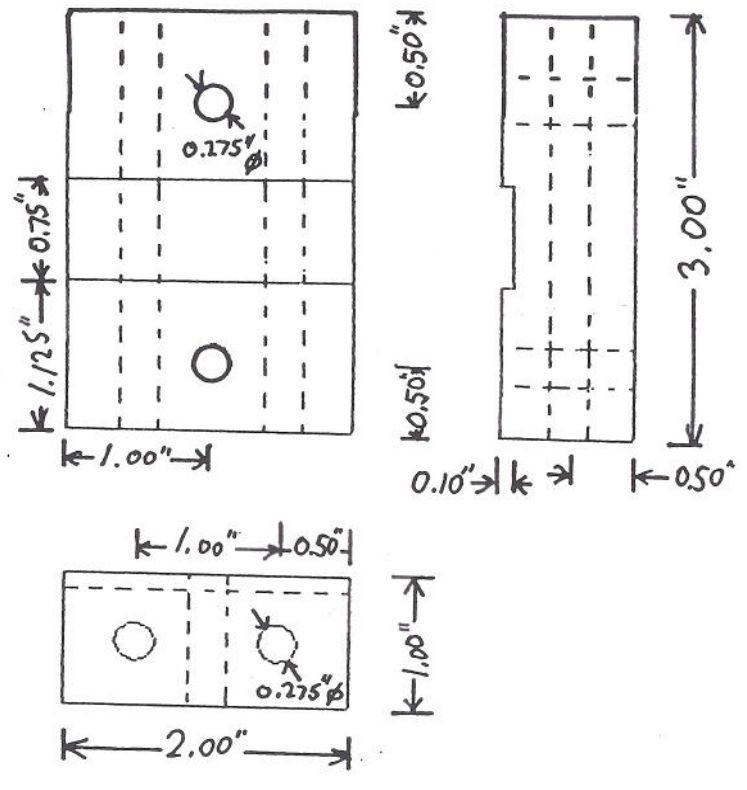
Front Clamp Body

(Aluminum)



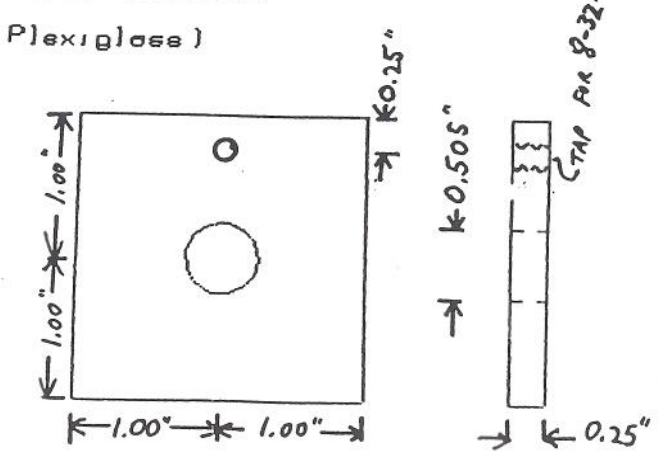
Front Stress Bar Clamp

(Aluminum)



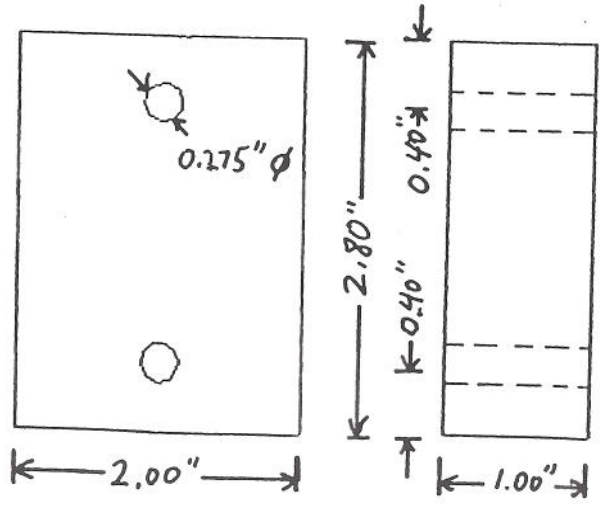
Knob Base

(Plexiglass)



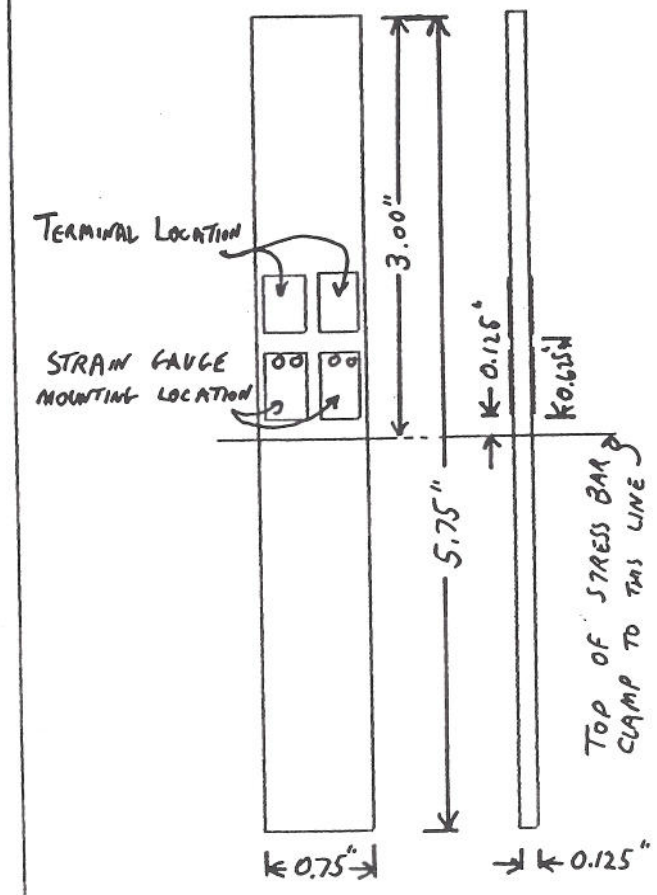
Rear Stress Bar Clamp

(Aluminum)



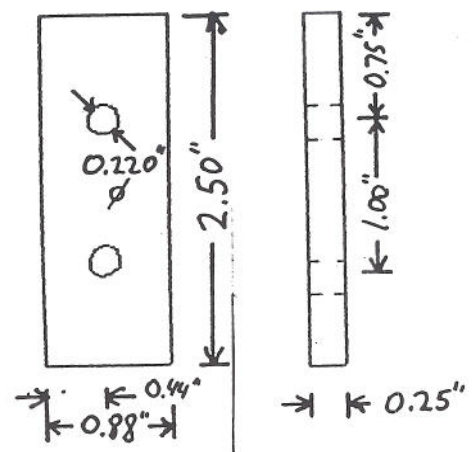
Stress Bar

(Aluminum)



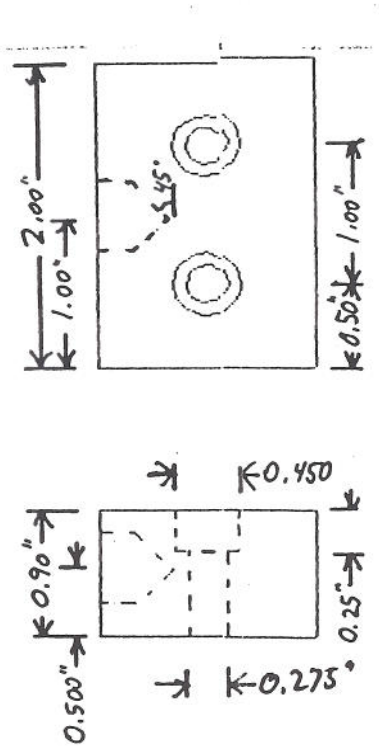
Specimen Clamps

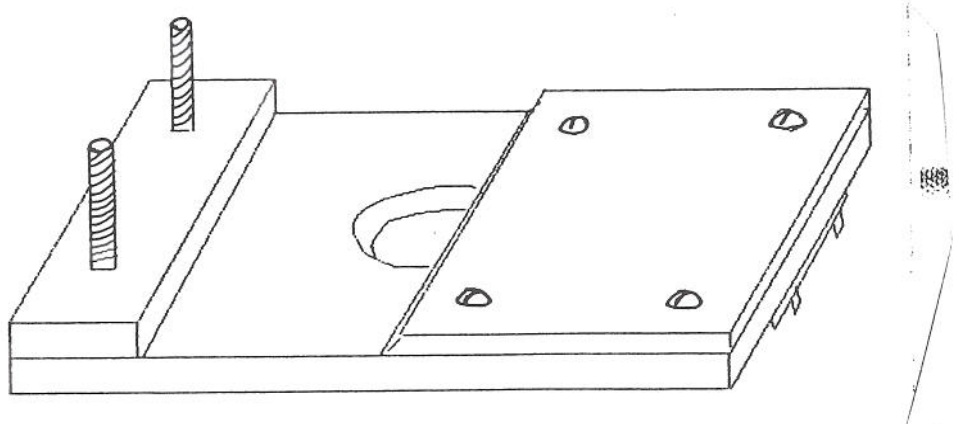
2x (Plexiglass)



Screw Support

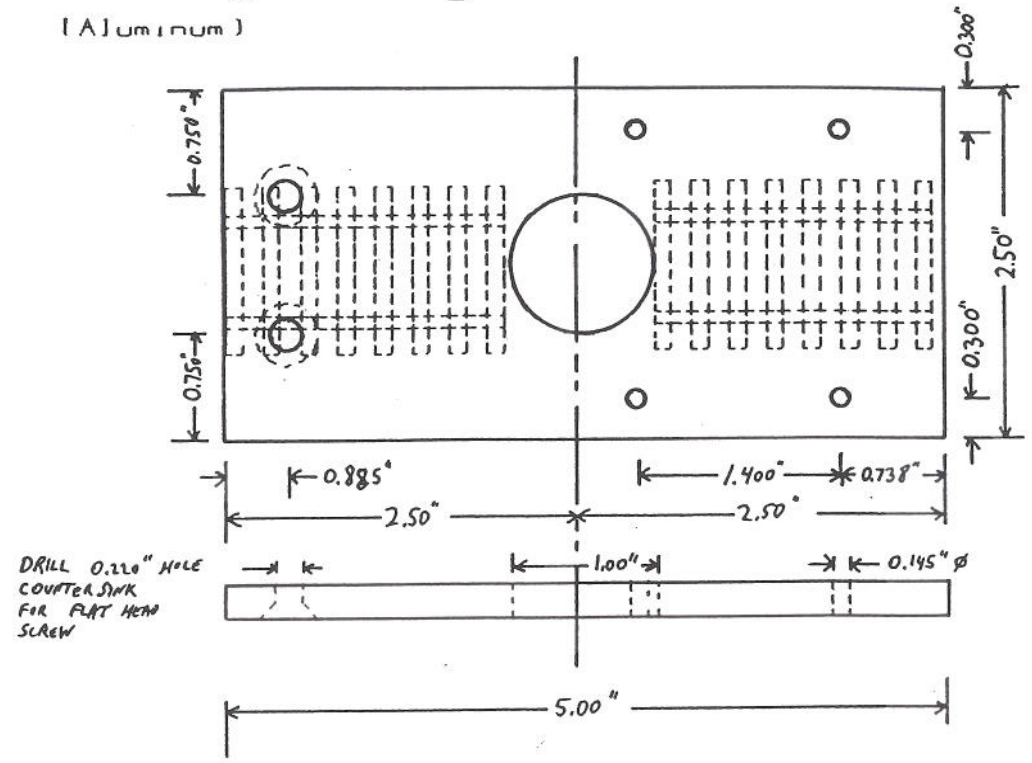
(Aluminum)





Carriage Body

(Aluminum)



Carriage Knife Edge

(Stainless Steel)