

# ORTHOGRAPHIC PROJECTION

SCALE:

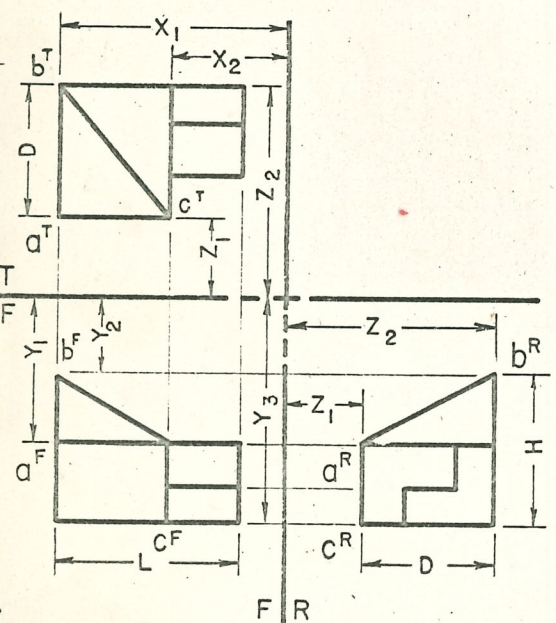
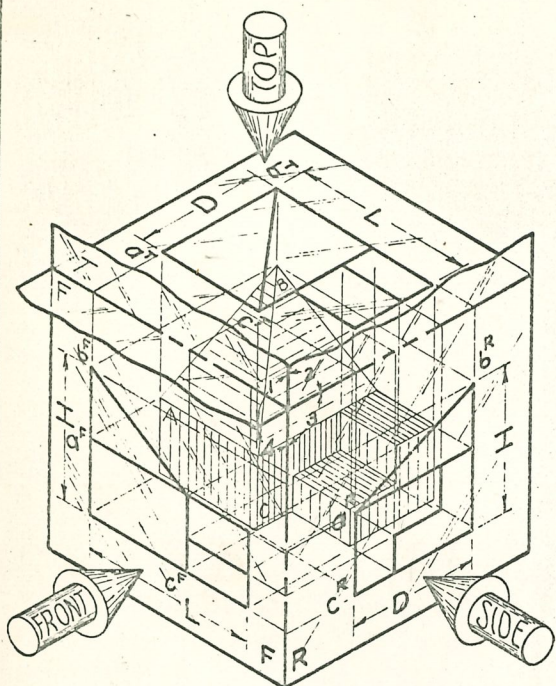
DRAWN BY: S BELLENOT

COURSE SECTION FILE NO. GRADE SHEET

DATE: 9-16-68

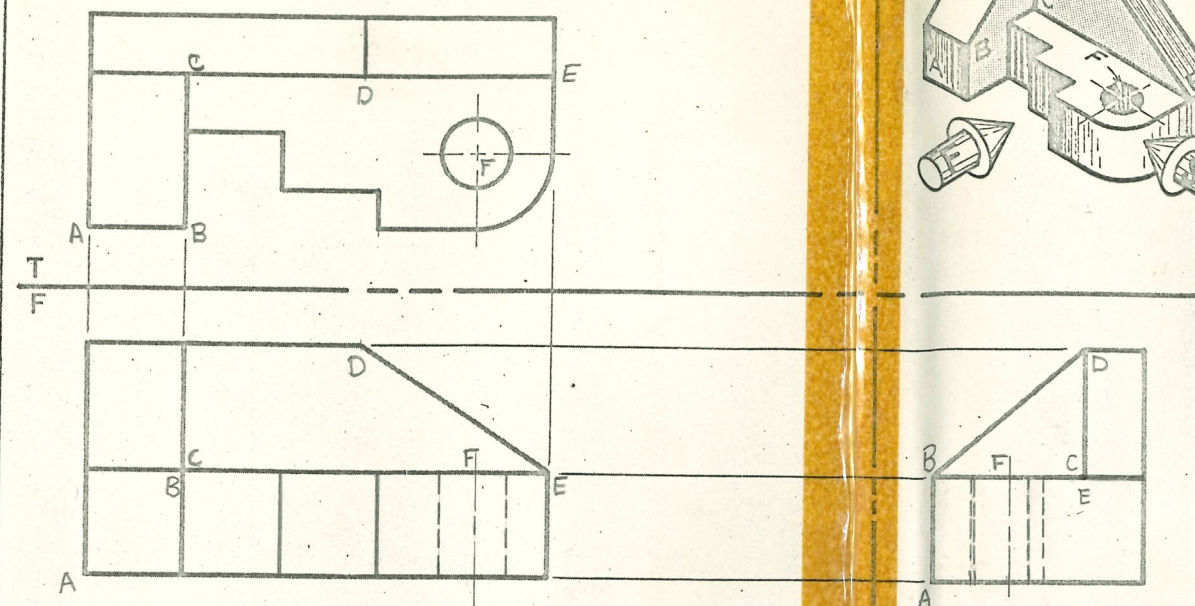
ACCEPTED BY: *[Signature]*

## THEORY



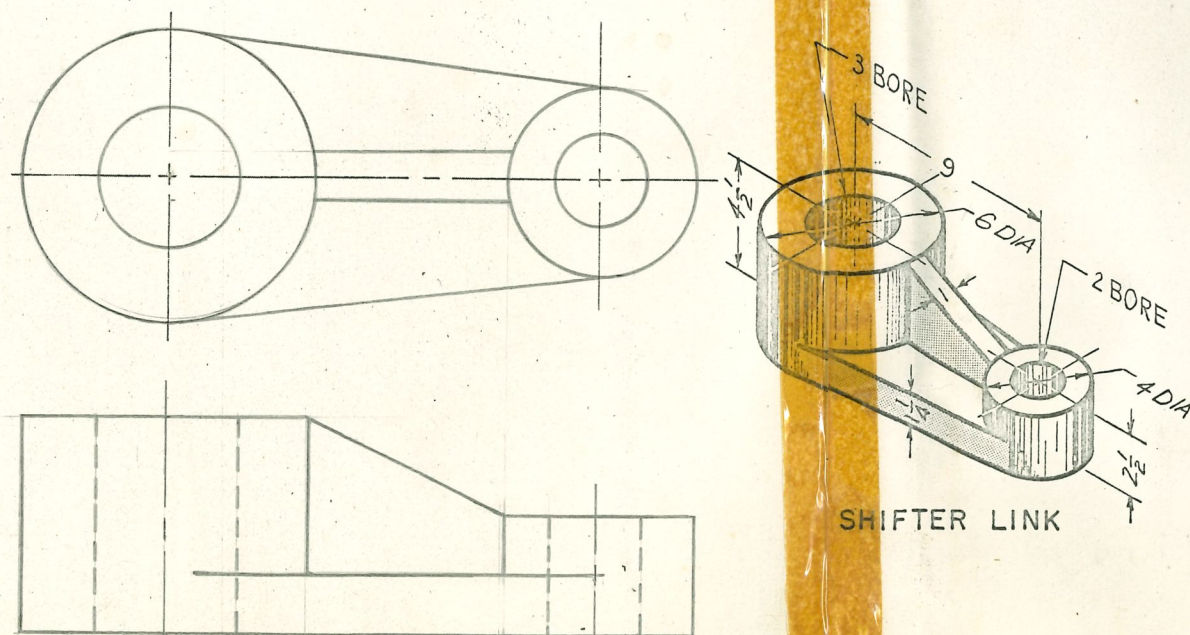
SPACE COORDINATES			
PT.	DIST. FROM T	DIST. FROM F	DIST. FROM R
A	$Y_1$ BELOW T	$Z_1$ BEHIND F	$X_1$ LEFT OF R
B	$Y_2$ BELOW T	$Z_2$ BEHIND F	$X_1$ LEFT OF R
C	$Y_3$ BELOW T	$Z_1$ BEHIND F	$X_2$ LEFT OF R

**Prob. 1** Complete the given views as to missing lines. Label points A through F in top, front, and side views. Fill in the table of space coordinates using a scale of 1"=10 units.

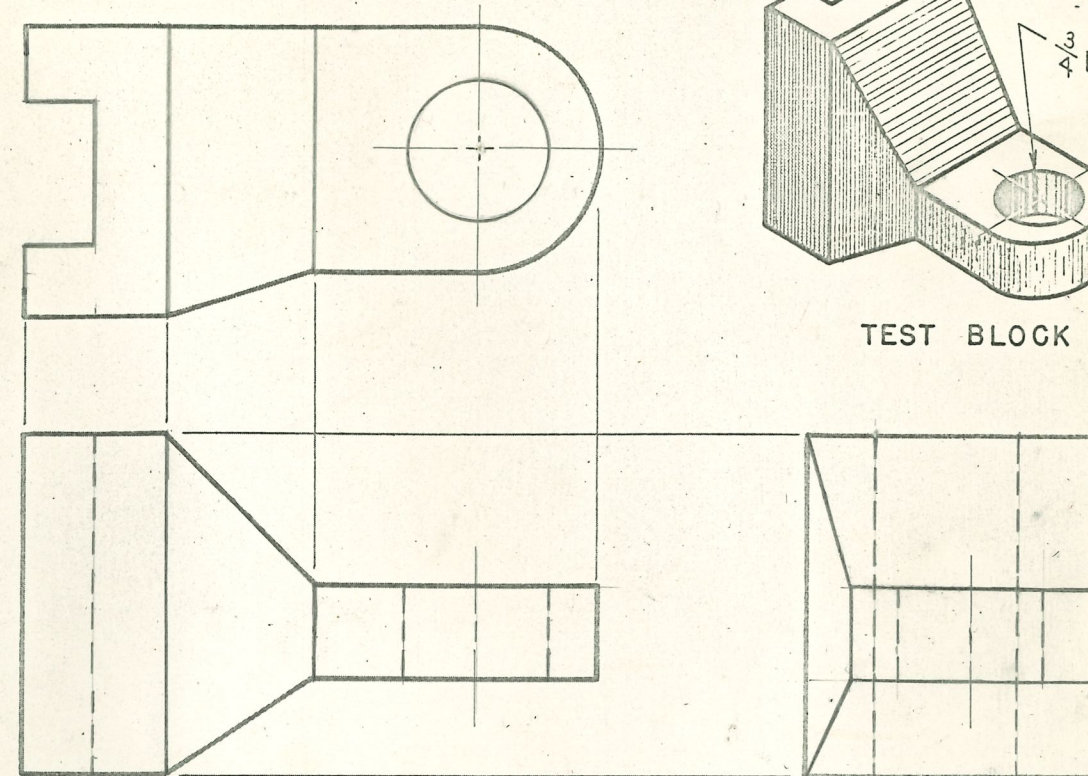


SPACE COORDINATES			
POINT	DISTANCE FROM T	DISTANCE FROM F	DISTANCE FROM R
A	15 UNITS	3 UNITS	41 UNITS
B	9.3	3	36
C	9.3	11	36
D	3	11	27
E	9.3	11	17
F	9.3	7	21

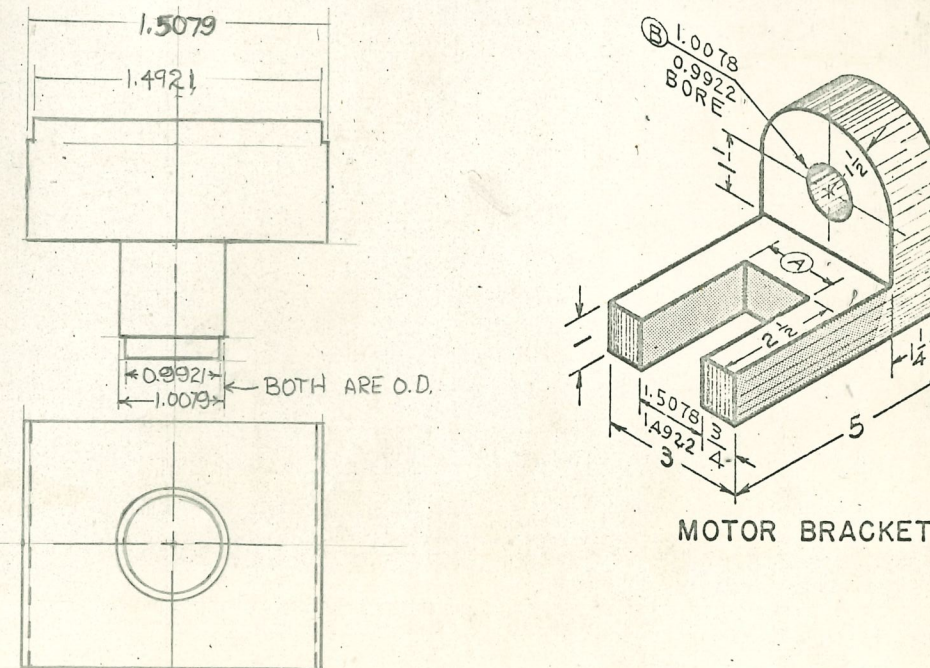
**Prob. 3** Describe the SHIFTER LINK shown in pictorial through the use of top and front views. Scale: 3"=1'-0".



**Prob. 2** Complete the three views of the TEST BLOCK shown in pictorial.



**Prob. 4** Design a gage to measure dimensions A and B on the MOTOR BRACKET shown below. These dimensions are to be held to the tolerances shown. The design is to be communicated through a multiview drawing. Scale: Half Size.





# INTRODUCTION TO DIMENSIONING

SCALE:

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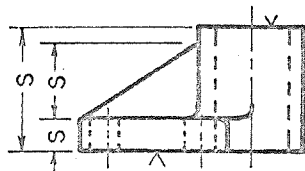
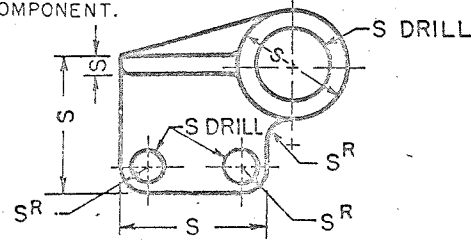
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## THEORY

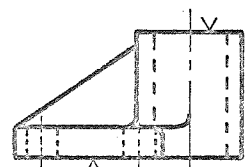
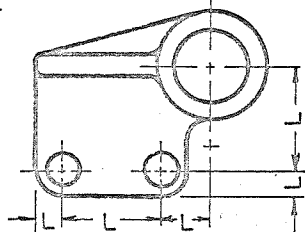
### SIZE DIMENSIONING

THE DIMENSIONAL DESCRIPTION (LENGTH, HEIGHT, & DEPTH) OF EACH GEOMETRIC COMPONENT.



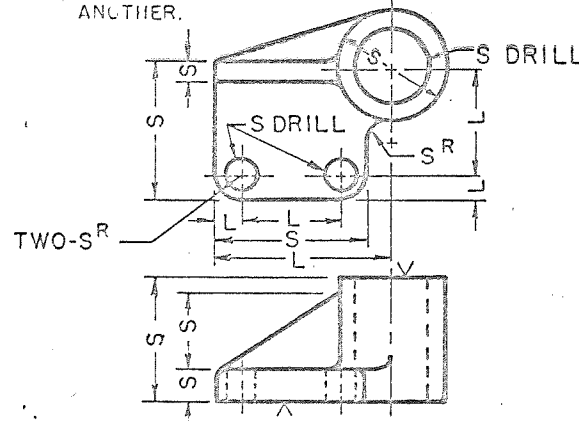
### LOCATION DIMENSIONING

THE DIMENSIONAL LOCATION OF ONE GEOMETRIC COMPONENT WITH RESPECT TO ANOTHER.

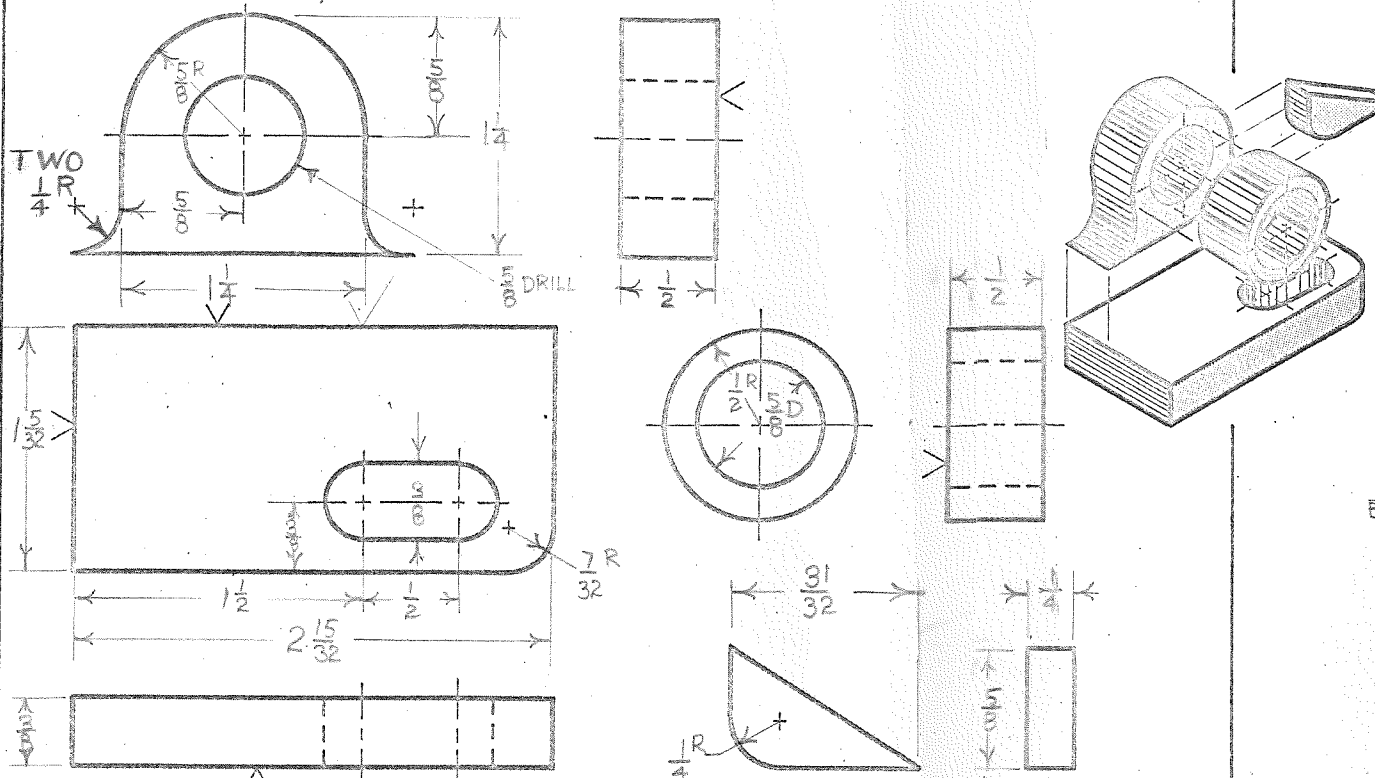


### COMPOSITE DIMENSIONING

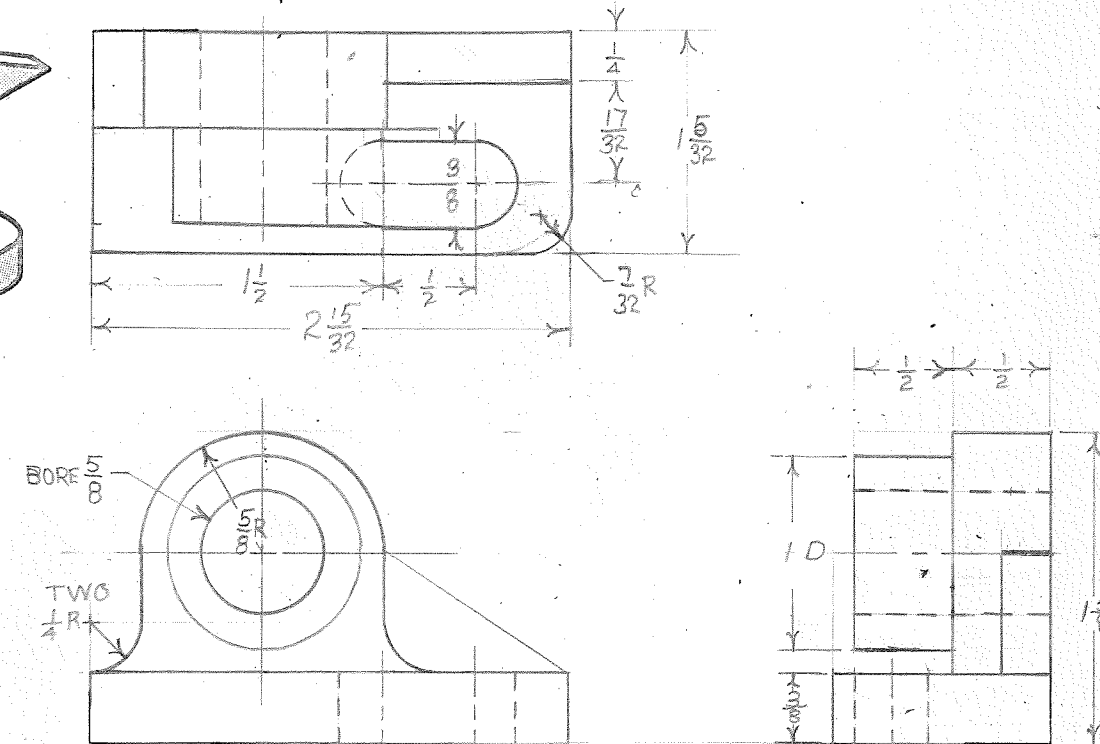
DIMENSIONING SHOULD BE APPROACHED THROUGH A "BREAKDOWN" OF GEOMETRIC COMPONENTS, AN UNDERSTANDING OF HOW EACH IS TO BE DIMENSIONED, AND THEN THE LOCATION OF ONE COMPONENT WITH RESPECT TO ANOTHER.



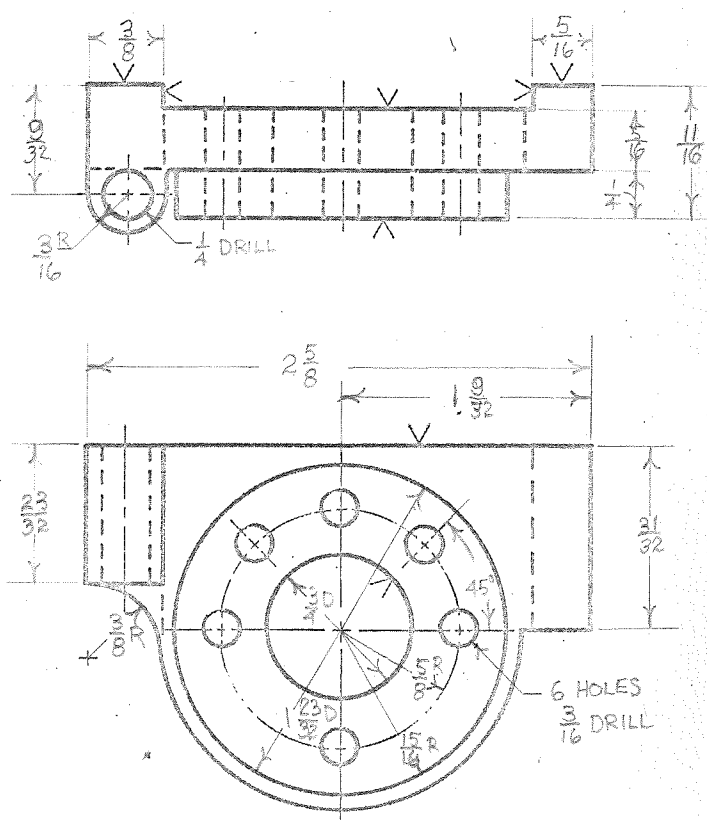
**Prob. 1 COMPONENT DIMENSIONING.** Dimension each of the four geometric shapes by scaling the drawing for sizes. Scale: Full Size. All dimensions are to be specified to  $\pm 1/64$  in.



**Prob. 2 COMPOSITE DIMENSIONING.** Assemble the four components shown in Prob. 1 to form a three view drawing of the SHAFT SUPPORT. Dimension the SHAFT SUPPORT by scaling the drawing for sizes. Scale: Full Size. All dimensions are to be specified to  $\pm 1/64$  in.



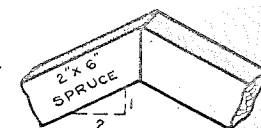
**Prob. 3** Dimension fully the THRUST PLATE shown represented below and calculate the weight of this part. Scale:  $1-1/2''=1'-0''$ . Specify dimensions to  $\pm 1/64$  in.



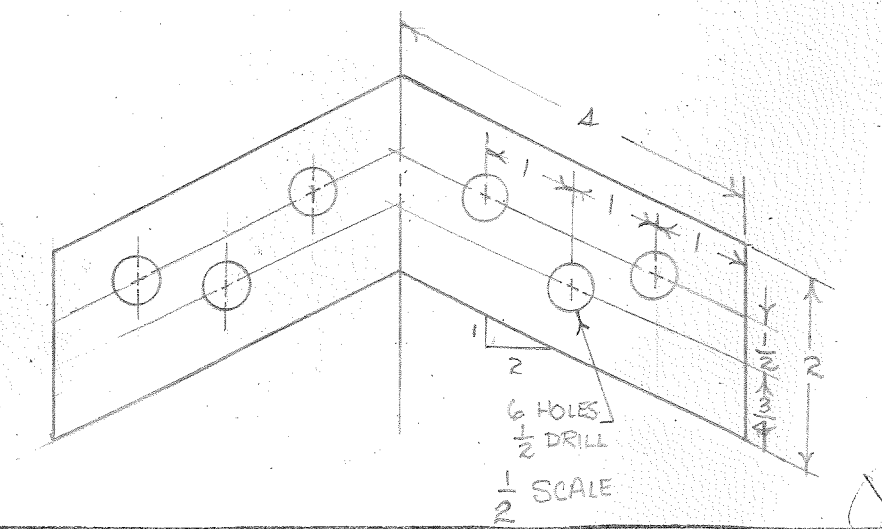
THRUST PLATE		CAST STEEL		0.282 LB/IN. <sup>3</sup>	
PART	DIMENSIONS	POSITIVE VOLUME	NEGATIVE VOLUME		
A					
B					
C					
D					
E					
F					
G					
H					
I					
J					
TOTALS					
NET VOLUME (IN. <sup>3</sup> )					
WEIGHT (LBS.)					

NOTES:

**Prob. 4** Design a metal bracket for the purpose of connecting the two 2" x 6" spruce roof rafter timbers shown at right. Each rafter is to have a slope of 2:1. Present the design solution as a fully dimensioned detail drawing.



$\frac{1}{8}$  STEEL PLATE  
USE TWO





# SECTIONS AND CONVENTIONS

SCALE :

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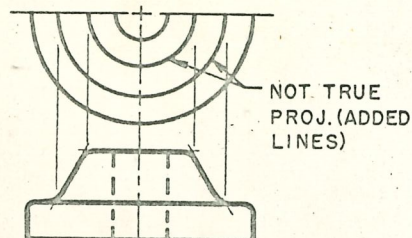
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## CONVENTIONS

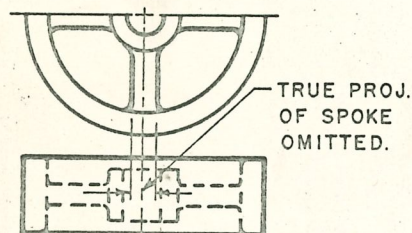
### CONVENTIONAL PRACTICE -

AN ACCEPTED VIOLATION OF PROJECTION FOR THE PURPOSE OF GAINING CLARITY IN REPRESENTATION.

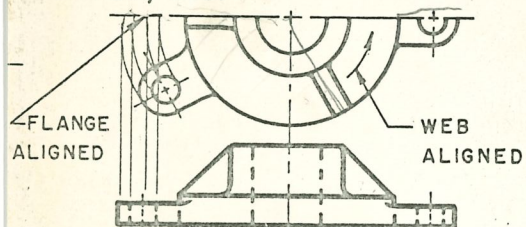
#### 1. ADDITION OF LINES FOR CLARITY



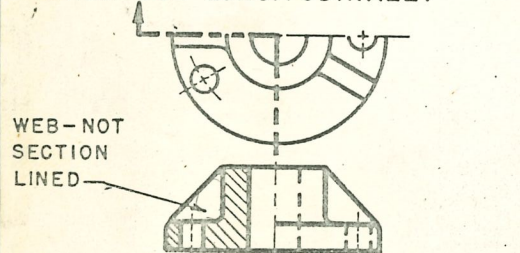
#### 2. DELETION OF LINES FOR CLARITY



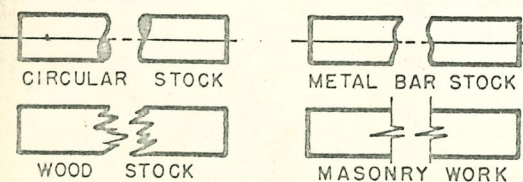
#### 3. ALIGNMENT OF SPOKES, RIBS, WEBS, HOLES, ETC.



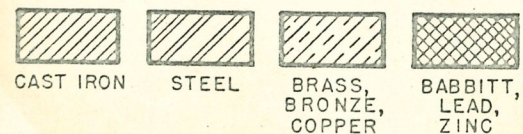
#### 4. NON-SECTION Lining RIBS, SPOKES, PINS, KEYS, BOLTS, SHAFTS, ETC. WHEN CUT LONGITUDINALLY



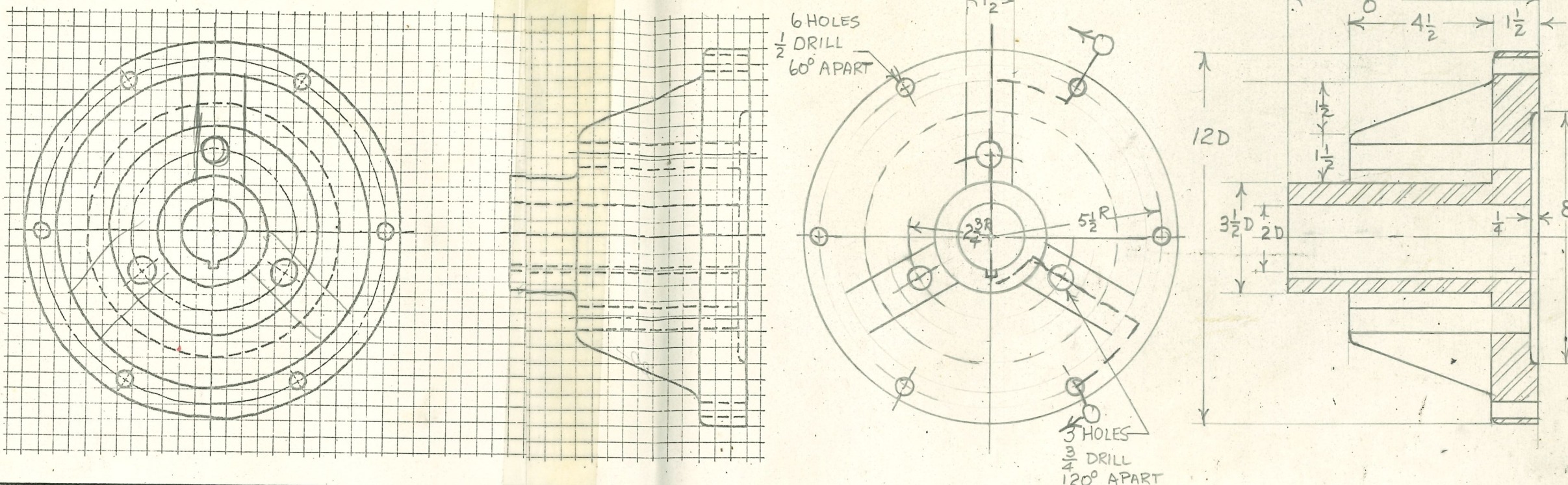
#### 5. CONVENTIONAL BREAKS.



#### 6. MATERIAL IN SECTION

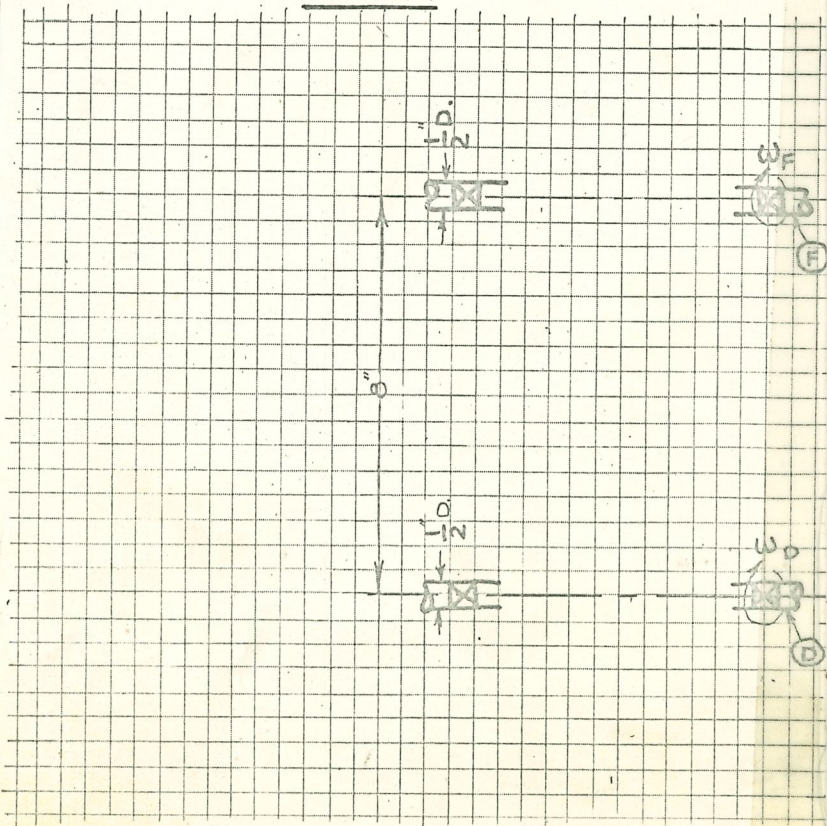


**Prob. 1** The sketch shown below represents the conceptual design of a PUMP COVER. This sketch, done on quadruled paper to an approximate scale of 1/4 size, represents the final concept which has been refined from many previous designs. The cover to be cast from steel was found to be too heavy and must be lightened approximately 10% while maintaining rigidity. Present a solution to this design in the form of a detail drawing showing how you would construct this cover. Include all dimensions and make use of sectional views.

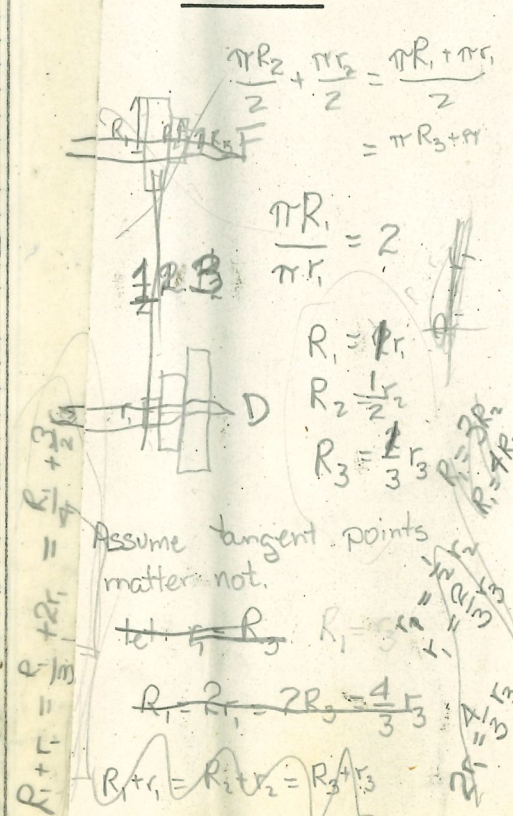


**Prob. 2** Show the concept and final design solution of a step pulley drive that will run shaft F at speeds of 1000 rpm, 2000 rpm, and 3000 rpm with an input speed to shaft D of 1000 rpm. Mounting distance between shafts = 8". Width of belt = 3/4". Include in the design all calculations to support the concept and present the solution in the form of a detail drawing to the shop.

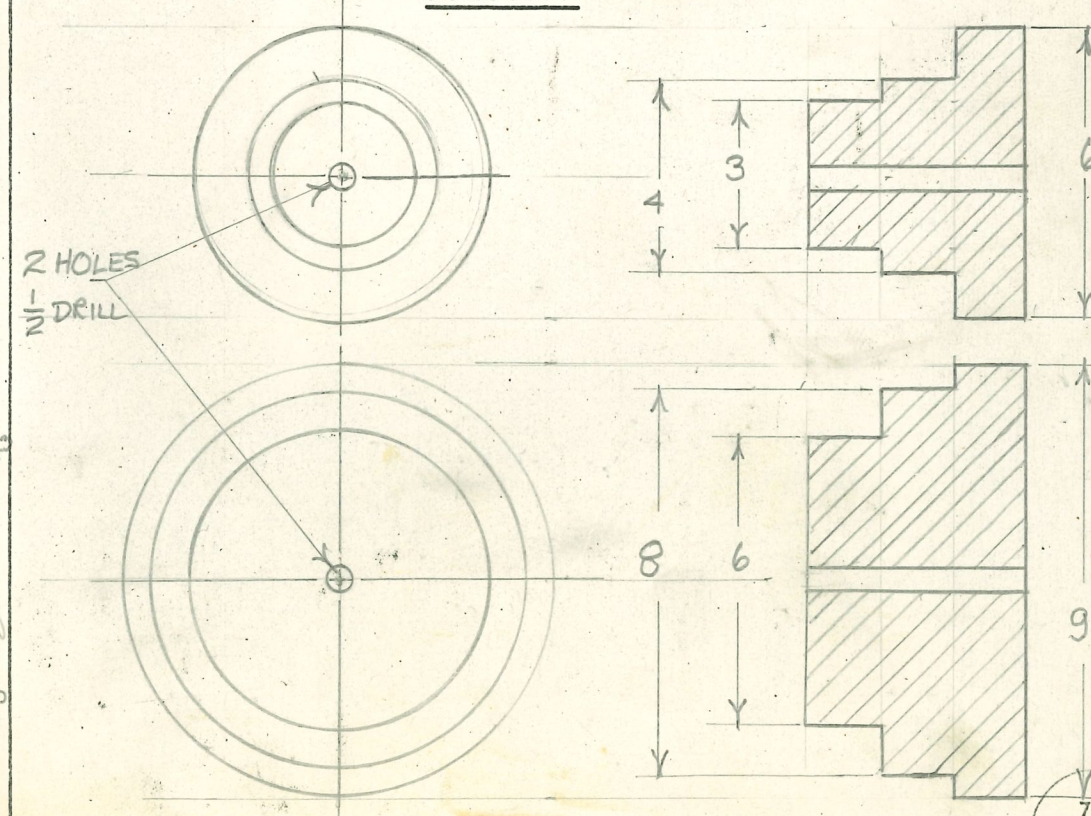
### CONCEPT



### ANALYSIS



### SOLUTION





# ATTENTION TO DETAIL

SCALE:

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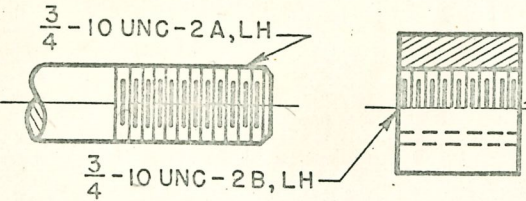
DATE: 9-17-68

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## DEFINITIONS

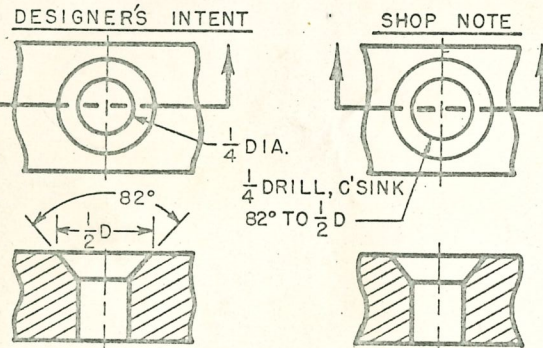
**FASTENERS** - ANY DEVICE WHOSE FUNCTION IS TO HOLD PARTS TOGETHER.



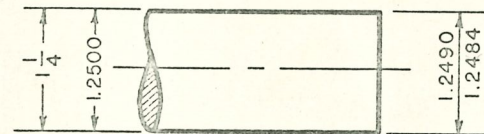
$\frac{3}{4}$  = MAJOR DIA.  
 10 = NO. OF THDS. PER IN.  
 UNC = UNIFIED FORM - COARSE THREADS  
 2 = CLASS OF FIT  
 A - EXTERNAL THREAD  
 B - INTERNAL THREAD  
 LH - LEFT HAND THREAD

**CLASS OF FITS:**  
 CLASS 1 - LOOSE  
 CLASS 2 - FREE  
 CLASS 3 - MEDIUM  
 CLASS 4 - CLOSE

**SHOP NOTES** - INSTRUCTIONS TO THE SHOP FOR THE MANUFACTURE OF DETAILS REQUIRED IN THE DESIGN OF A PART.

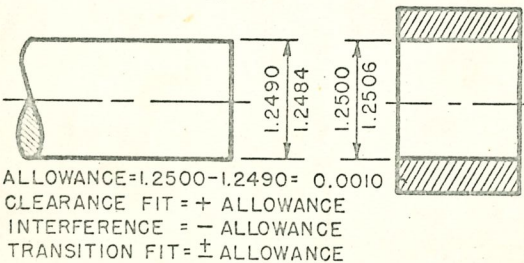


**TOLERANCE** - THE VARIATION IN SIZE OF A MANUFACTURED PART SET BY THE DESIGNER.



NOMINAL SIZE =  $1\frac{1}{4}$   
 BASIC SIZE 1.2500  
 TOLERANCE = 1.2490 - 1.2484 = 0.0006  
 LIMITS =  $\frac{1.2490}{1.2484}$

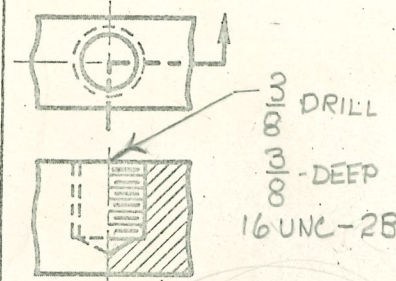
**ALLOWANCE** - THE MIN. CLEARANCE OR MAX. INTERFERENCE INTENDED BETWEEN MATING PARTS.



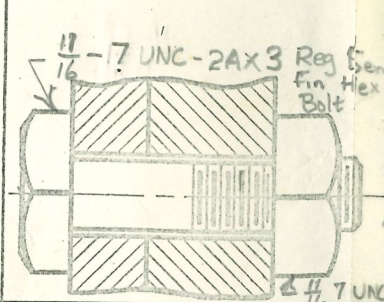
## THREADS AND FASTENERS

**Prob. 1** Specify each thread and fastener through means of a note. Scale drawing for sizes and refer to the ASA Standards.

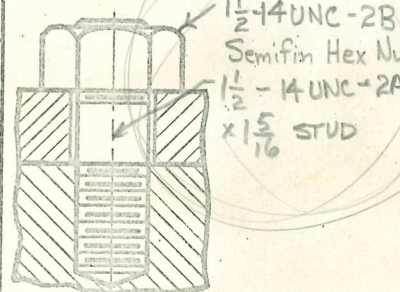
A. TAPPED HOLE (FULL SIZE).



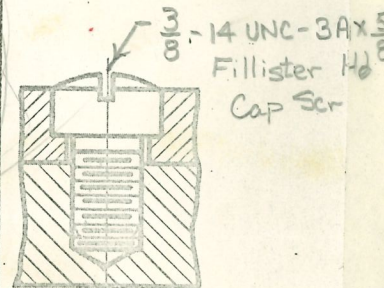
B. THROUGH BOLT (HALF SIZE).



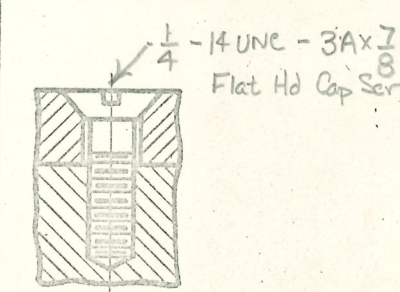
C. STUD BOLT (3" = 1'-0").



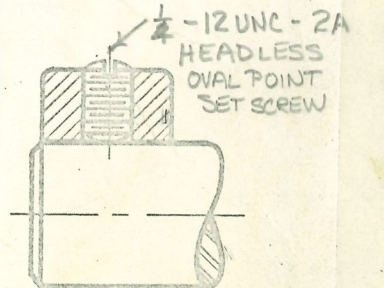
D. CAP SCREW (FULL SIZE).



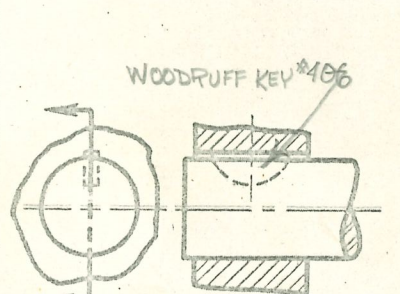
E. MACHINE SCREW (FULL SIZE).



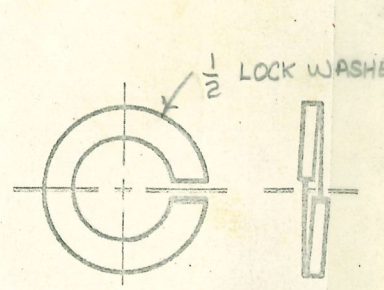
F. SET SCREW (FULL SIZE).



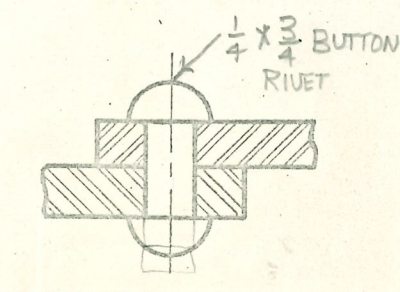
G. KEY (HALF SIZE).



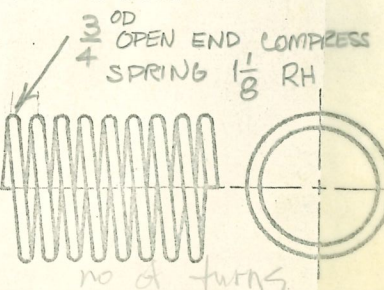
H. LOCK WASHER (FULL SIZE).



I. RIVETS (FULL SIZE).



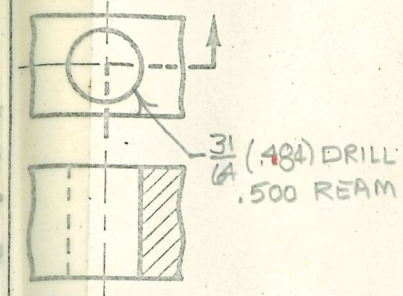
J. SPRING (FULL SIZE).



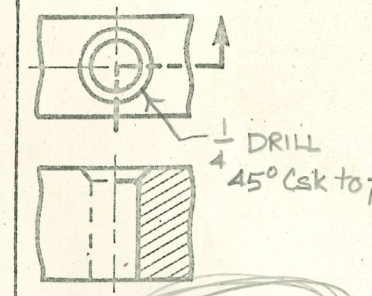
## NOTES TO THE SHOP

**Prob. 2** Give the standard note to the shop for each of the machine operations shown below. Scale drawing for sizes and refer to the ASA Standards.

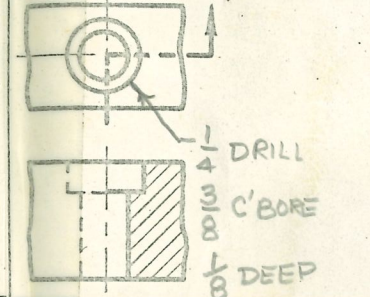
A. DRILL AND REAM (FULL SIZE).



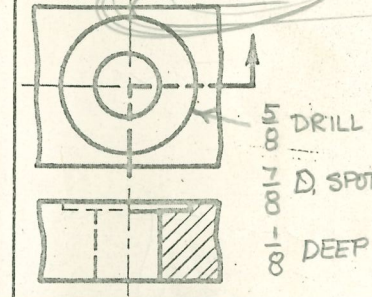
B. COUNTERSINK (FULL SIZE).



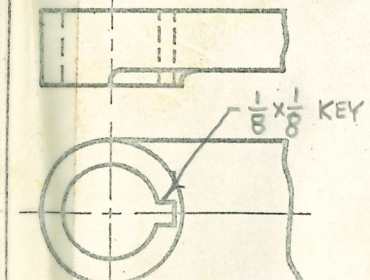
C. COUNTERBORE (FULL SIZE).



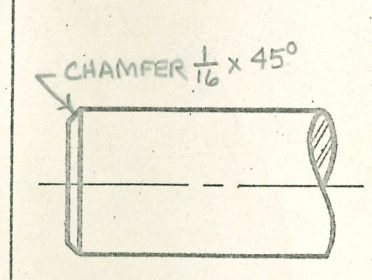
D. SPOTFACE (HALF SIZE).



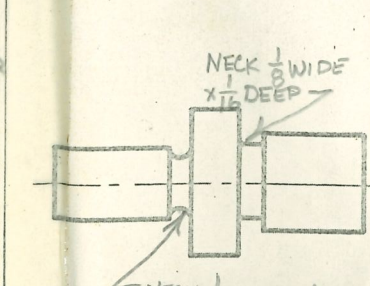
E. KEYWAY (FULL SIZE).



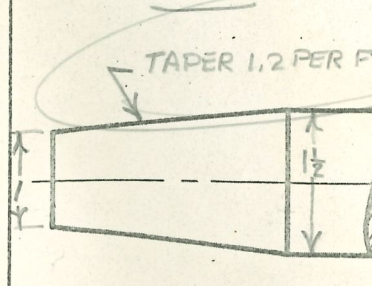
F. CHAMFER (FULL SIZE).



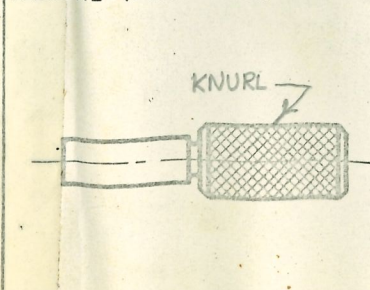
G. NECK (FULL SIZE).



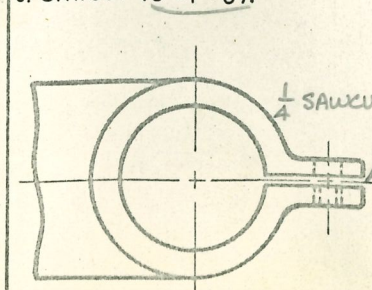
H. TAPER (HALF SIZE).



I. KNURL (FULL SIZE).

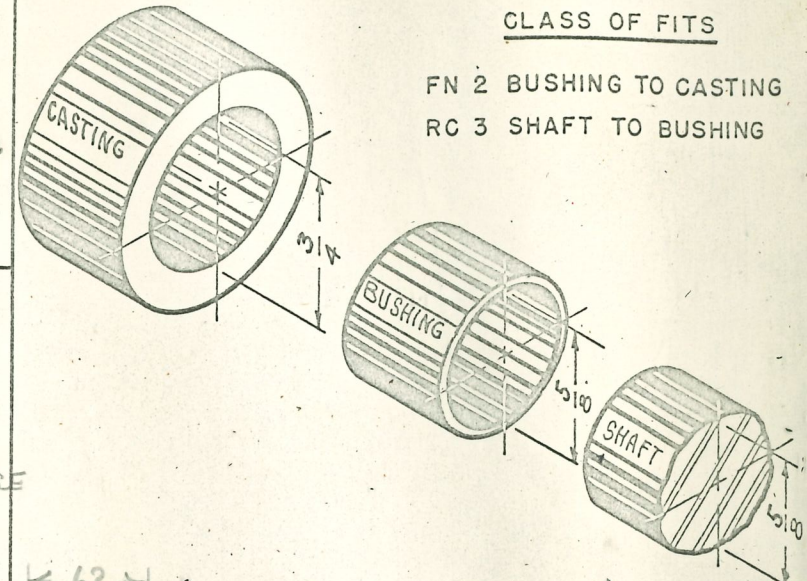


J. SAWCUT (3" = 1'-0").



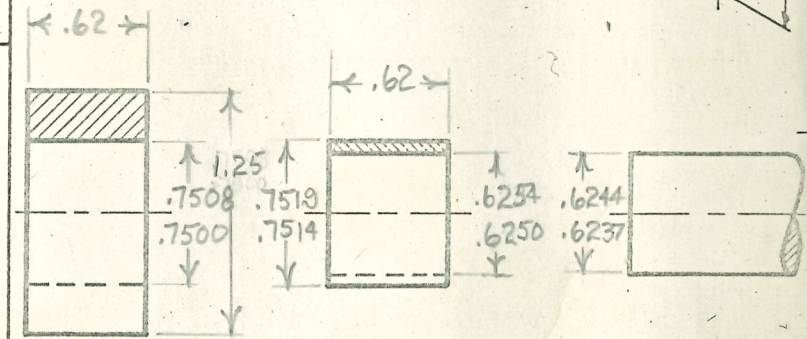
## TOLERANCE AND ALLOWANCE

**Prob. 3** The nominal sizes of a shaft, bushing, and casting are shown below. It is required to assemble the three parts according to the class of fits specified. Compute the limits for each part and dimension the orthographic views to maintain the specified fits. Refer to the ASA Standards.



### CLASS OF FITS

FN 2 BUSHING TO CASTING  
 RC 3 SHAFT TO BUSHING



### COMPUTATION OF LIMITS

	CASTING	BUSHING	SHAFT
BASIC SIZE	.7500	.7500	.6250
LIMITS	.7508 .7500	.7519 - .7514 .6254 - .6250	.6244 .6237
TOLERANCE	.0008	.0005 .0004	.0007
ALLOWANCE	.0019		.0006
TYPE OF FIT	INTERFERENCE		CLEARANCE



# ISOMETRIC PICTORIALS

SCALE:

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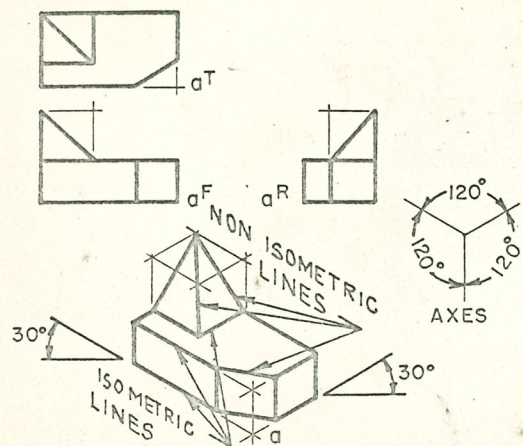
DATE: 9-18-68

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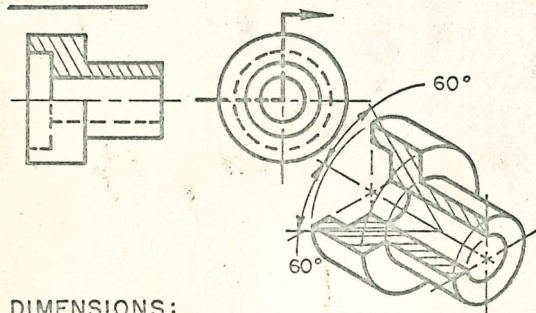
## PROCEDURES

ISOMETRIC LAYOUT IS PROBABLY THE MOST RAPID AND EFFECTIVE MEDIUM OF COMMUNICATING DESIGN IDEAS TO ONE'S SELF AS WELL AS TO OTHERS.

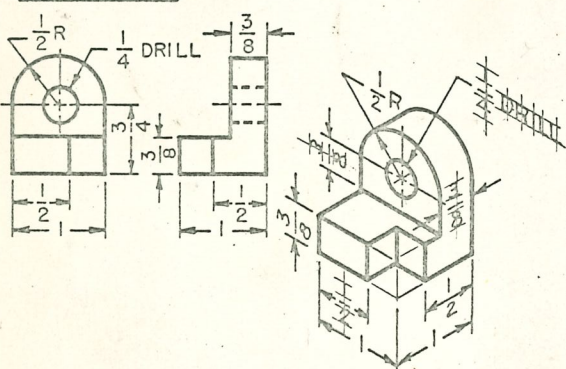
### LAYOUT:



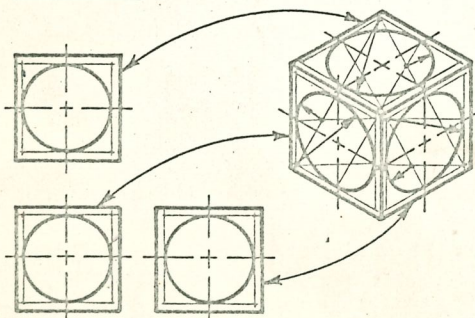
### SECTIONS:



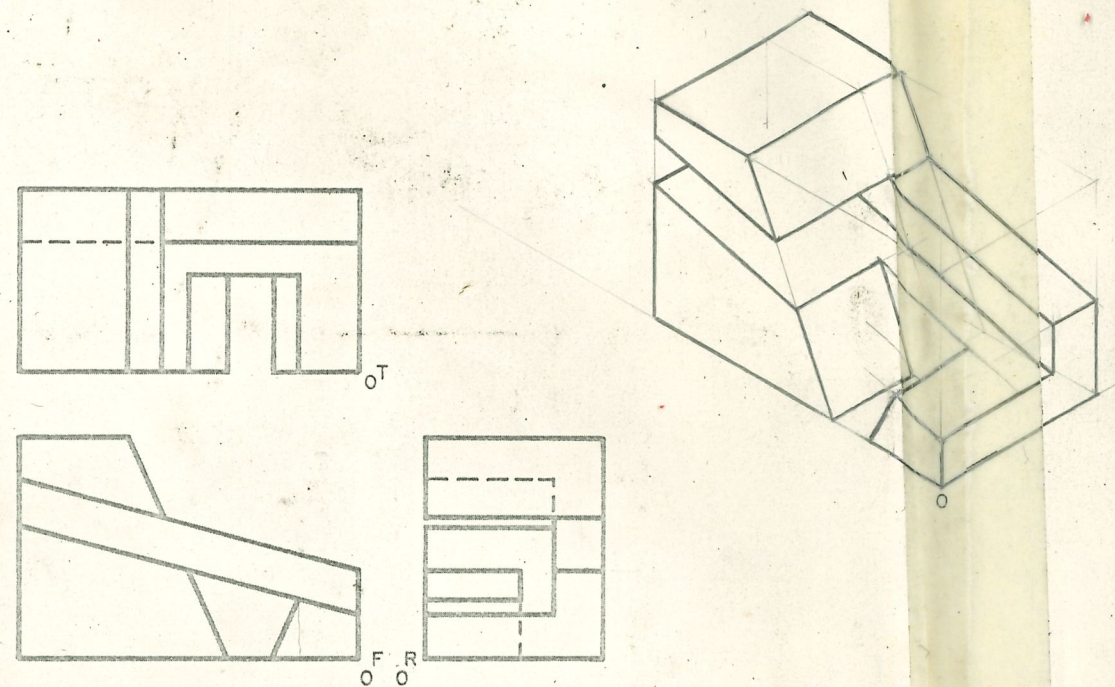
### DIMENSIONS:



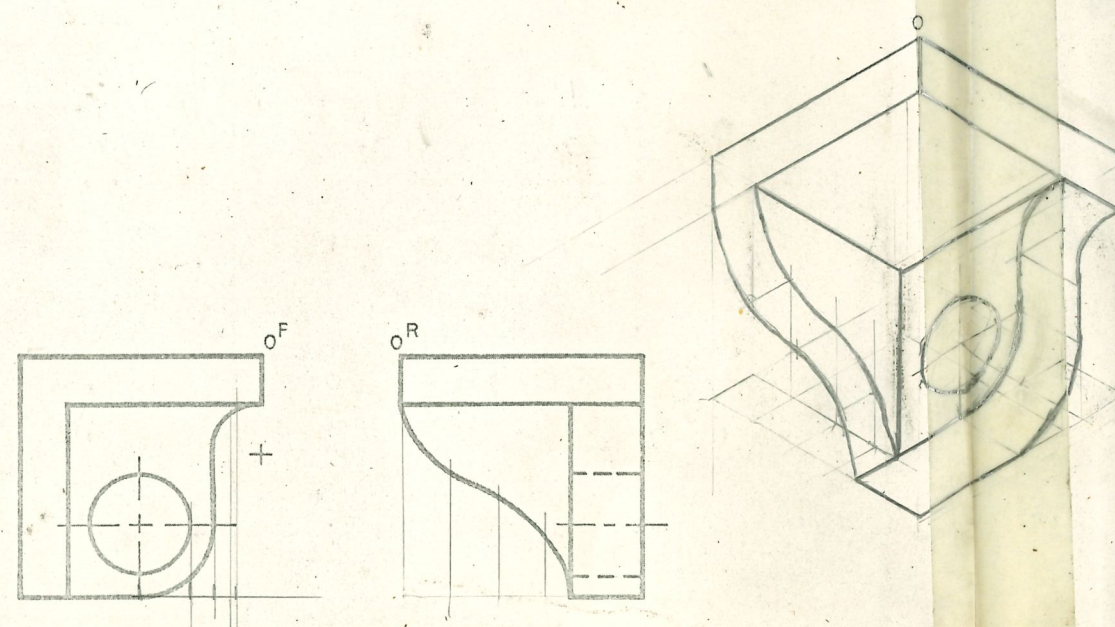
### CIRCLES:



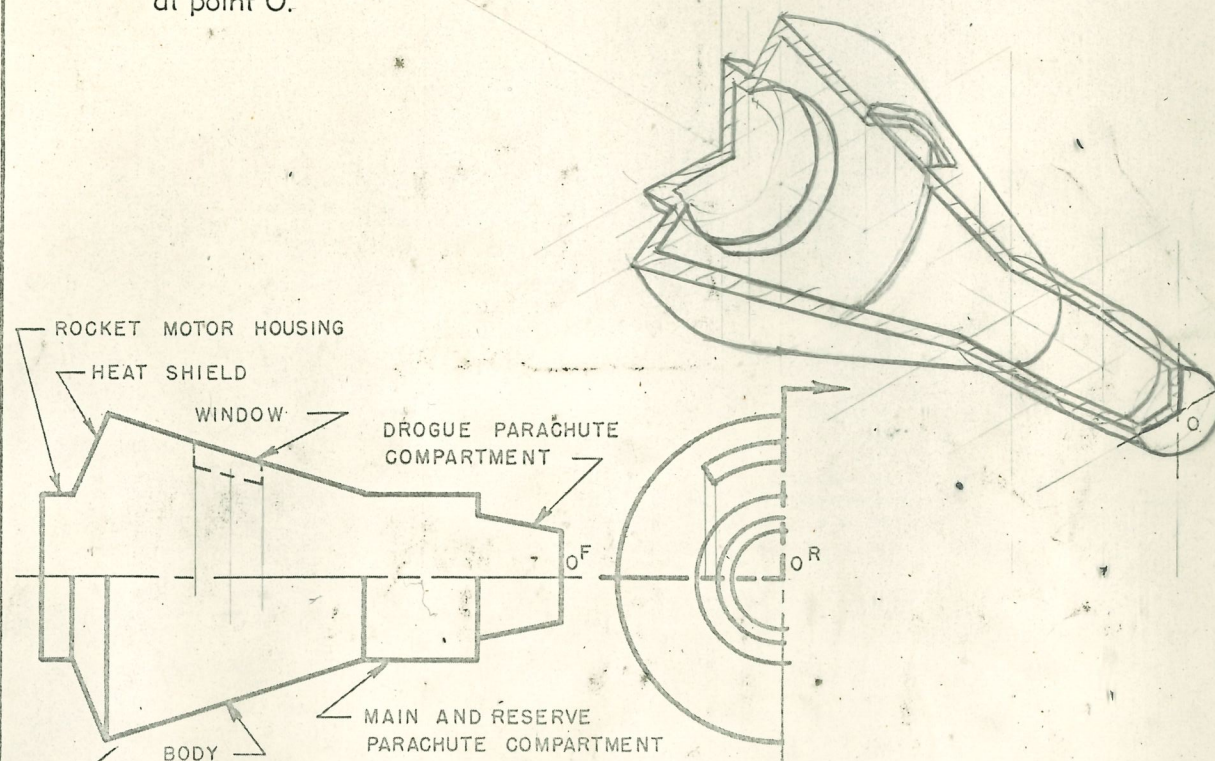
Prob. 1 Make an isometric layout of the GAGE BLOCK shown below beginning at point O.



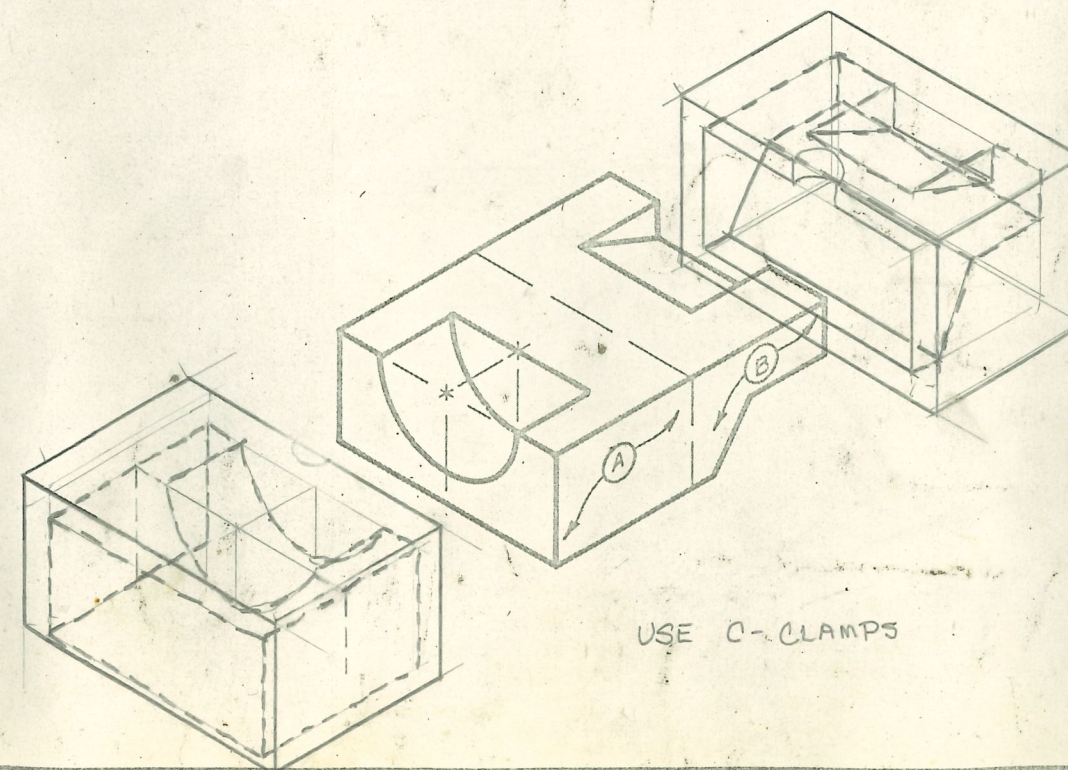
Prob. 3 Dimension the orthographic views of the CORNER BRACKET shown below. Make an isometric layout of the corner bracket beginning at point O and dimension this view. Scale: Full Size.



Prob. 2 The shell of the Project Mercury SPACECRAFT is shown below. This spacecraft is of the type used in the first U. S. manned orbital flight on February 20, 1962. Using good engineering judgment, add wall thickness to the vehicle shown in front and side views. Make an isometric half section layout of the spacecraft beginning at point O.



Prob. 4 The part shown below is to be cast in a two-piece mold. Design the mold for half A and half B and describe design through an exploded view isometric full section layout beginning at the indicated starting points. The mold is to have a minimum of 1/8" wall thickness. Show openings in the mold halves for sprue and riser. Design a means of clamping the mold halves together.





# ANALYSIS OF POINTS, LINES, AND PLANES

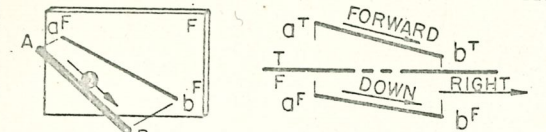
SCALE:  
DATE: 9-18-68

DRAWN BY: S. BELLENOT  
ACCEPTED BY: PRC

COURSE SECTION FILE NO. SHEET GRADE  
" 6

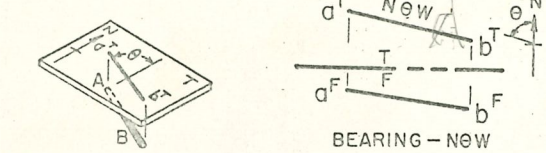
## THEORY

**POSITION OF A LINE**—THE DIRECTION A LINE PASSES THROUGH SPACE, READ ALPHABETICALLY.



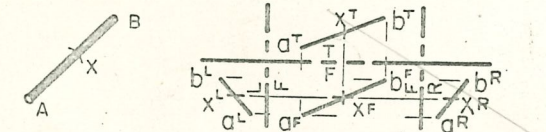
POSITION—DOWN, FORWARD, RIGHT

**BEARING OF A LINE**—THE HORIZONTAL ANGLE (LESS THAN 90°) BETWEEN THE LINE AND THE N-S DIRECTION.

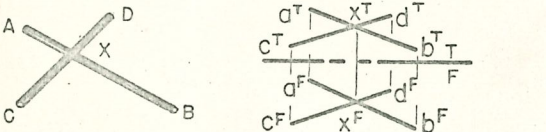


BEARING—NOW

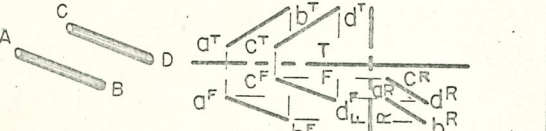
**POINT ON A LINE**—WHEN A POINT IS ON A LINE, THE PROJS. OF THAT POINT MUST LIE ON ALL RESPECTIVE PROJS. OF THAT LINE.



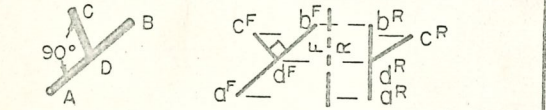
**INTERSECTING LINES**—WHEN TWO LINES INTERSECT IN SPACE, THEIR RESPECTIVE PROJS. MUST INTERSECT AT A COMMON POINT.



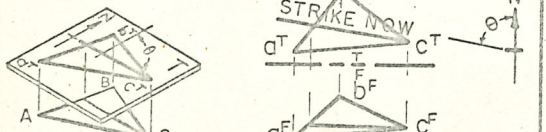
**PARALLEL LINES**—WHEN TWO LINES ARE PARALLEL IN SPACE, THEIR RESPECTIVE PROJS. MUST BE PARALLEL OR COINCIDE.



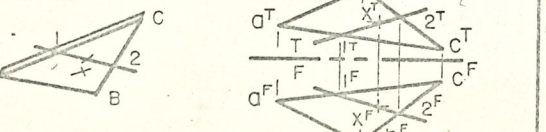
**PERPENDICULAR LINES**—WHEN TWO LINES ARE PERPENDICULAR IN SPACE, A PRINCIPLE PROJ. IS PERPENDICULAR WHEN ONE OF THE LINES IS PARALLEL TO A PRINCIPAL PLANE.



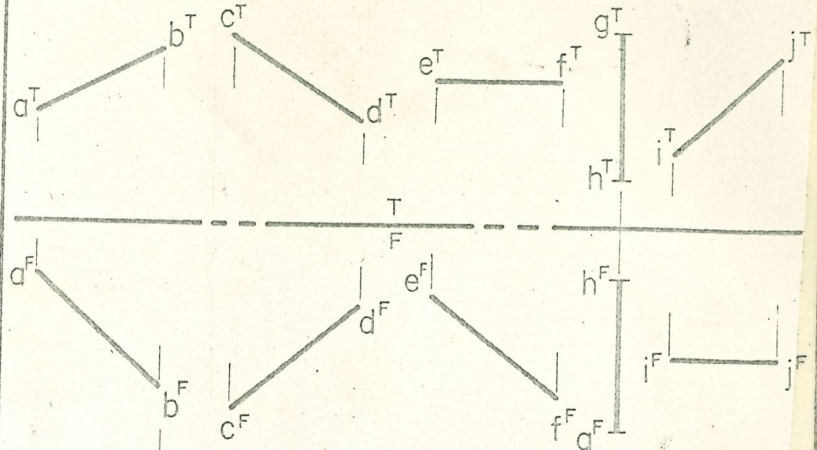
**STRIKE OF A PLANE**—THE BEARING (HORIZONTAL ANGLE LESS THAN 90°) OF A HORIZONTAL LINE IN THE PLANE.



**POINT IN A PLANE**—WHEN A POINT IS IN A PLANE, THE POINT MUST BE ON A LINE IN THE PLANE.

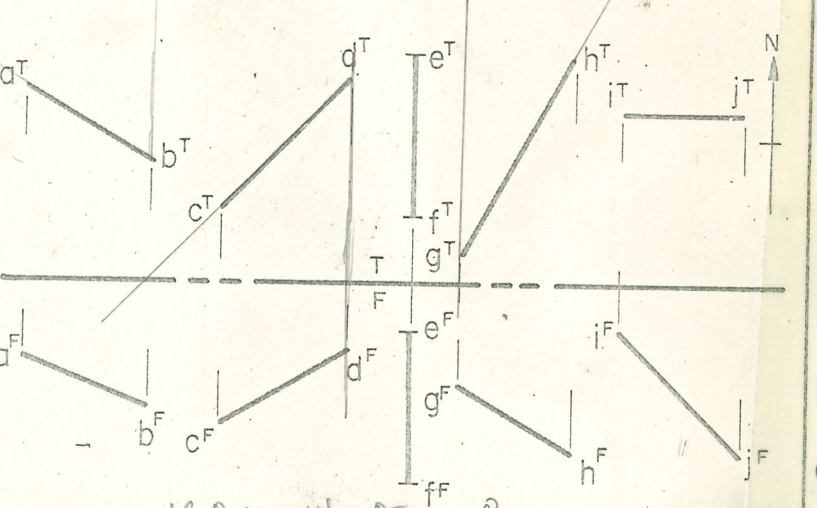


**Prob. 1** Read and record the position of each of the lines shown below.



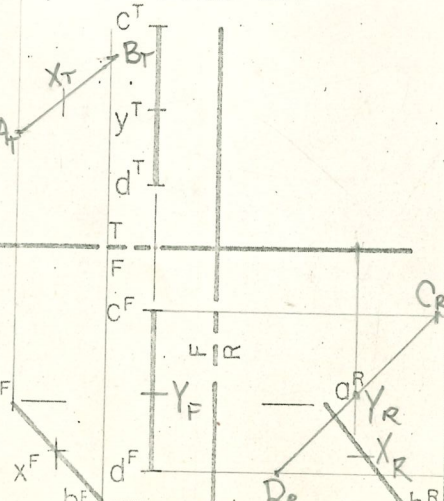
POSITION: AB D, B, R CD V, F, R EF D, R GH V, F IJ B, R

**Prob. 2** Measure and record the bearing of lines AB through IJ.

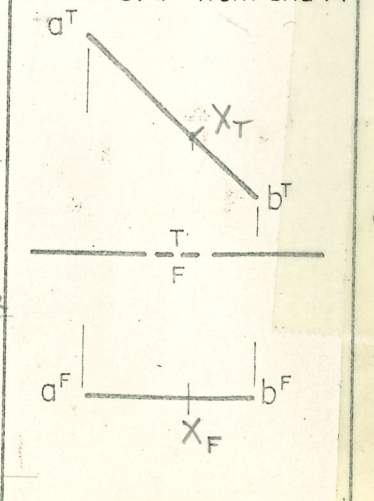


BEARING: AB N 60° W CD N 45° E EF 0° GH N 30° E IJ N 90° E

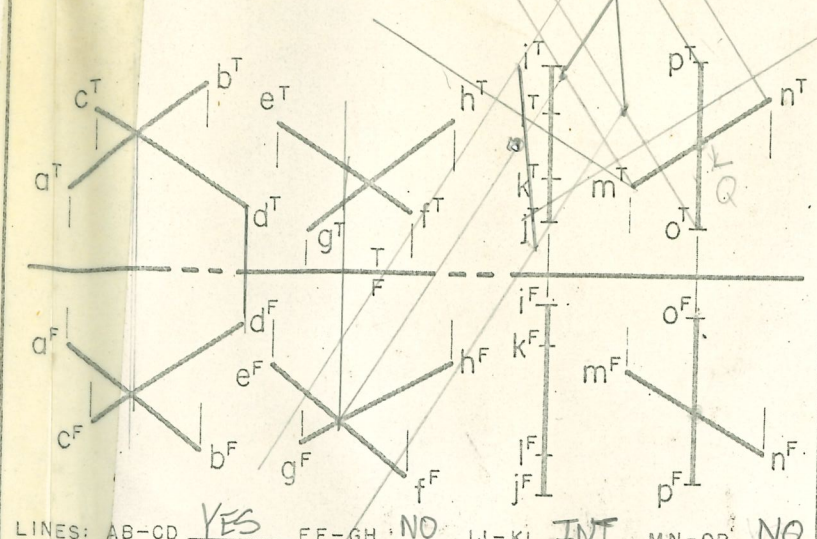
**Prob. 3** Locate the two missing projections of point X on line AB and point Y on line CD.



**Prob. 4** Locate the T and F projections of point X on line AB 3/4" from end A

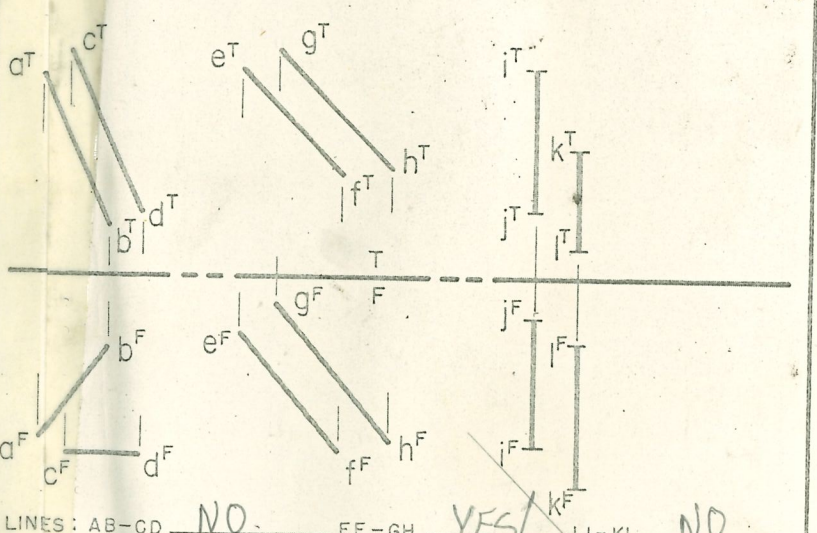


**Prob. 5** State which of the lines shown below are intersecting or non-intersecting.



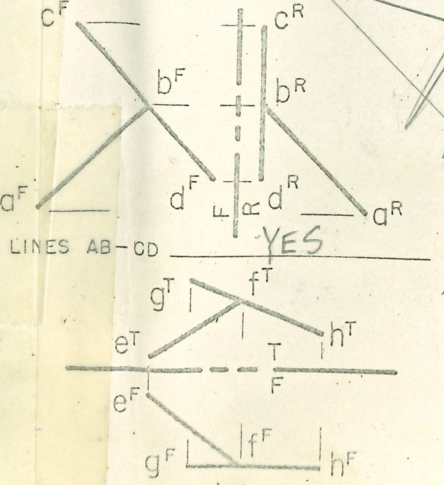
LINES: AB-CD YES EF-GH NO IJ-KL INT MN-OP NO

**Prob. 6** State which of the lines shown below are parallel or non-parallel.



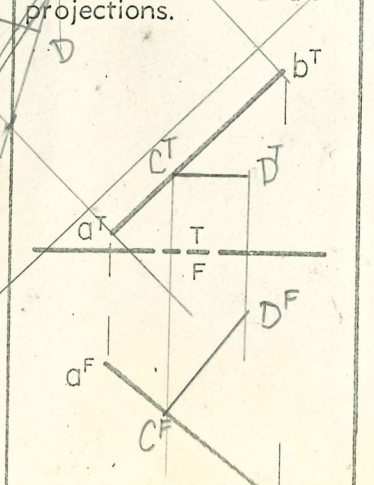
LINES: AB-CD NO EF-GH YES IJ-KL NO

**Prob. 7** State which of the lines shown below are perpendicular or non-perpendicular.

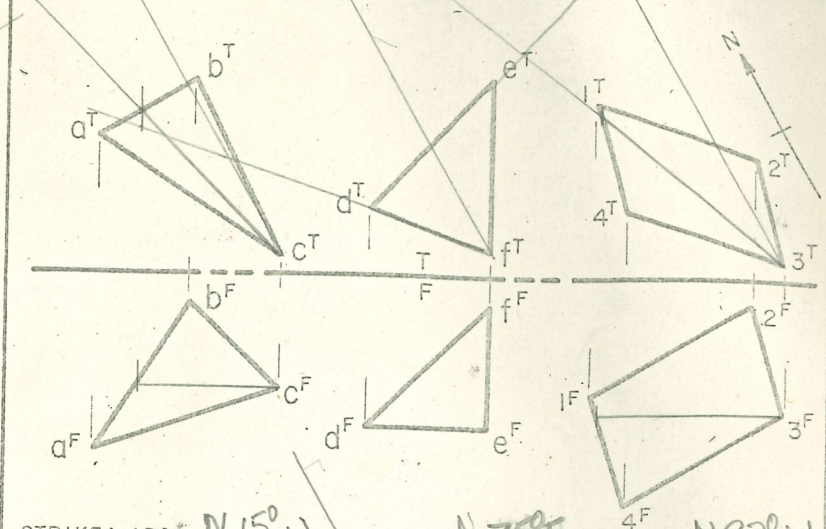


LINES EF-GH NO

**Prob. 8** Construct line CD perpendicular to line AB and show the T and F projections.

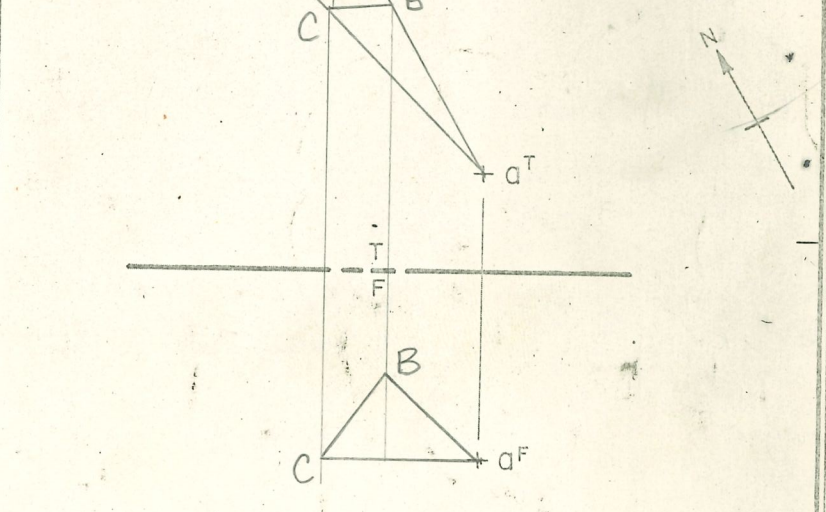


**Prob. 9** Measure and record the strike of each of the planes shown below.

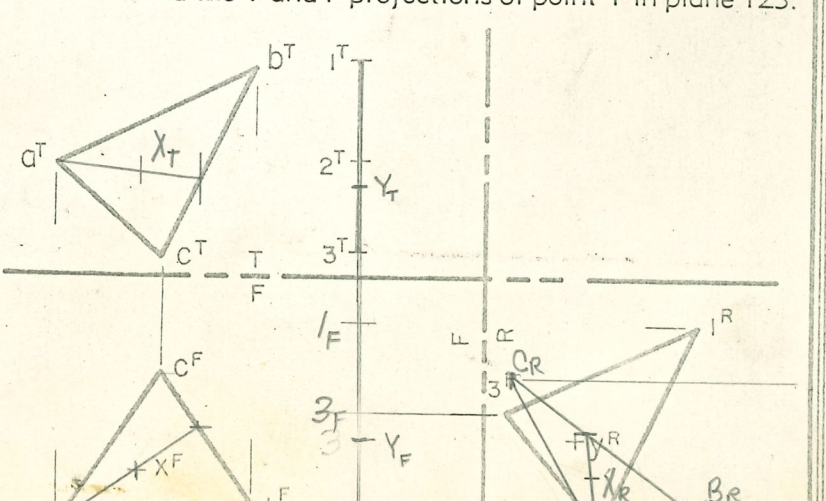


STRIKE: ABC N 15° W DEF N 75° E GHI N 22° W

**Prob. 10** Construct the T and F projections of a plane ABC having a strike of N 15° W.



**Prob. 11** Locate the T projection of point X in plane ABC and the T and F projections of point Y in plane 123.

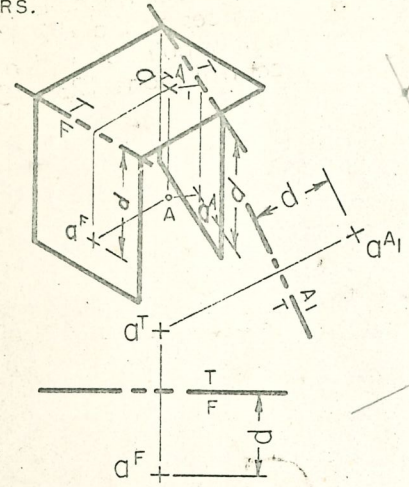




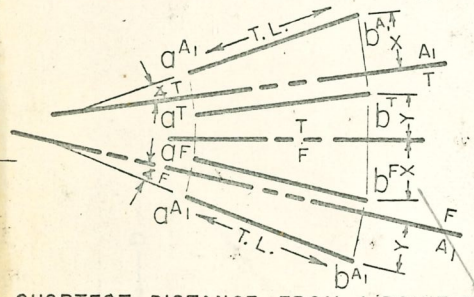
# PRIMARY AUXILIARY PROJECTION

## THEORY

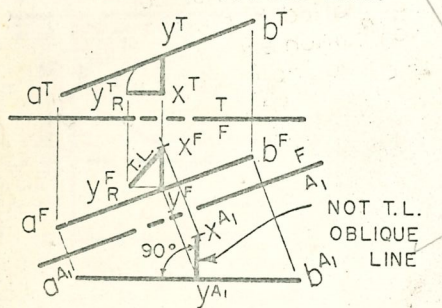
**PRIMARY AUXILIARY PLANE**  
 A PLANE OF PROJECTION PERPENDICULAR TO A PRINCIPAL PLANE AND OBLIQUE TO THE OTHERS.



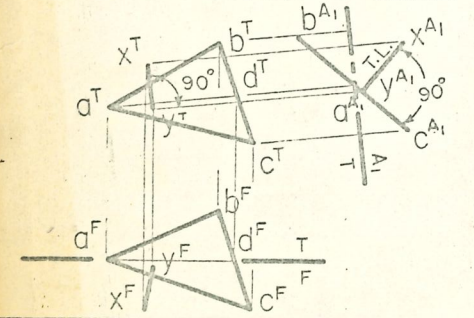
**TRUE LENGTH OF OBLIQUE LINE AND ANGLES WITH PRINCIPAL PLANES**  
 THE PRIMARY AUXILIARY PLANE IS SET PARALLEL TO THE OBLIQUE LINE.



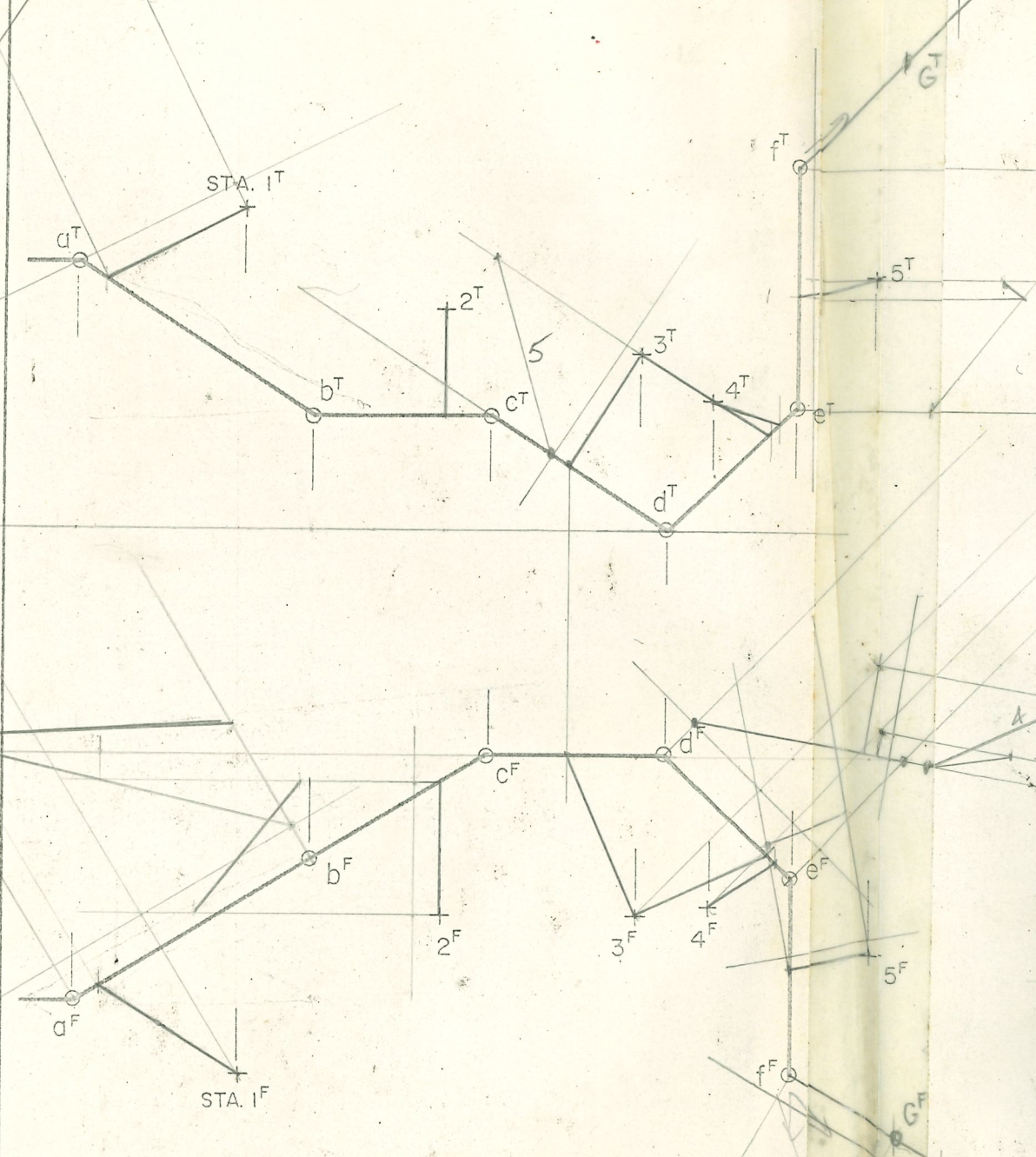
**SHORTEST DISTANCE FROM A POINT TO AN OBLIQUE LINE - THE PRIMARY AUX. PLANE IS SET PARALLEL TO OBLIQUE LINE.**



**SHORTEST DISTANCE FROM A POINT TO AN OBLIQUE PLANE - THE PRIMARY AUX. PLANE IS SET PERPENDICULAR TO OBLIQUE PLANE.**

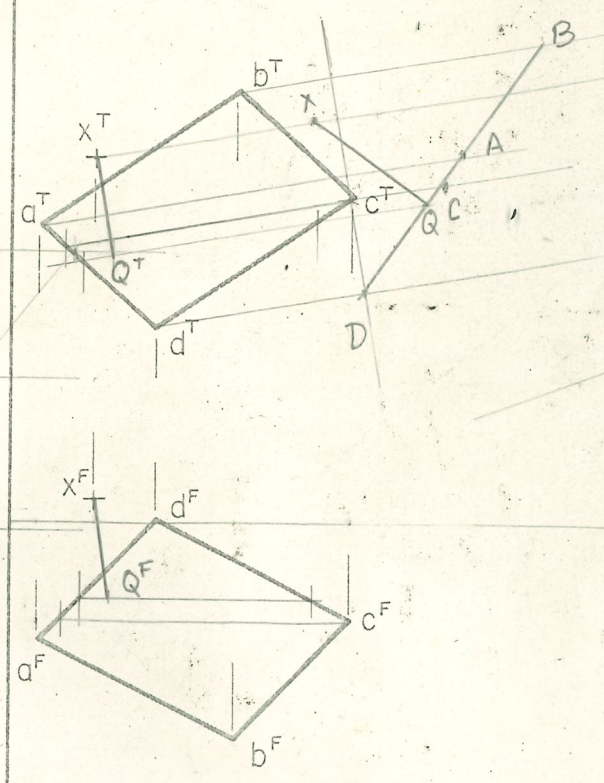


**Prob. 1** The proposed design layout of a hydraulic system is shown in schematic below. It is required to branch the closest connecting line from each of the stations (1-5) to the main line (A-F). Determine the location and true length of each branch line and fill in the specification table. Continue the main line from point F to G with a pipe 4'-0" long, making an angle of 30° with T and 45° with F, and having a position of down, back, and to the right. Scale: 1/4"=1'-0".

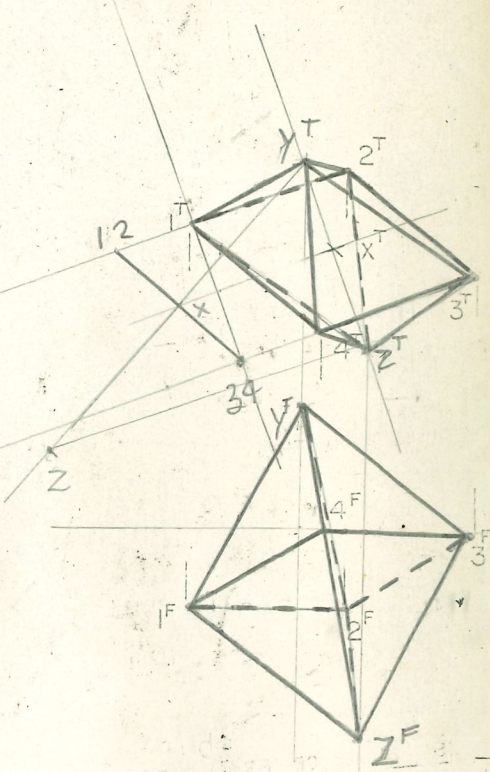


HYDRAULIC LINE SPECIFICATIONS			
MAIN LINE	LENGTH	BRANCH LINE	LENGTH
AB	7 1/2'	1	4 1/2'
BC	5'	2	4'
CD	5'	3	5' 4"
DE	5'	4	2'
EF	7' 4"	5	2'
TOT. MAIN	29' 10"	TOT. BRANCH	17' 6" - 16' 6"

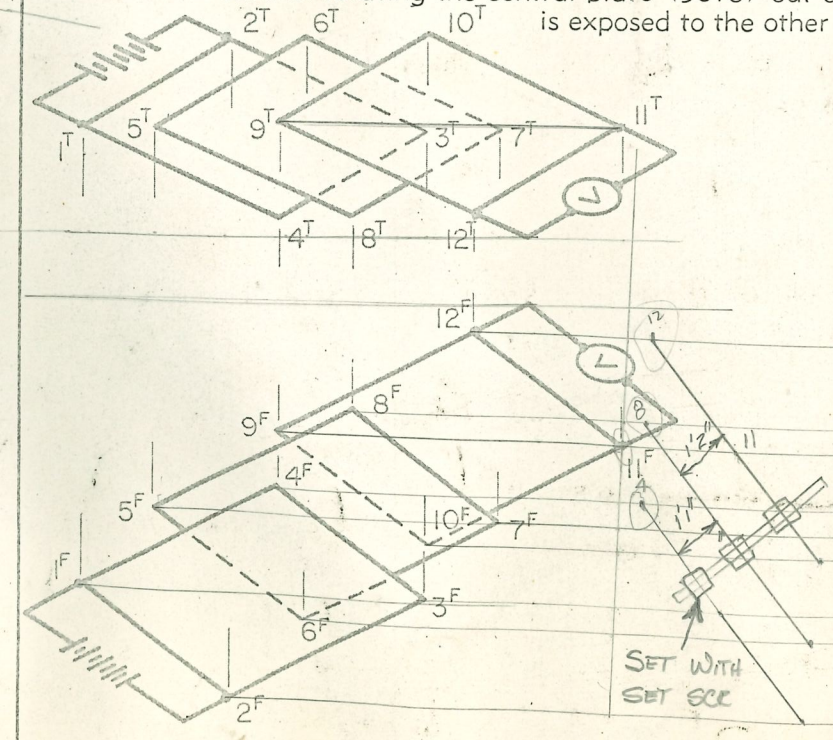
**Prob. 2** Determine the shortest distance and location of the shortest control rod from point X to the plane of the control hatch ABCD.



**Prob. 3** Construct an octahedron having vertices at Y and Z 1" above and below point X which lies in the central plane 1234. Show visibility.

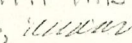


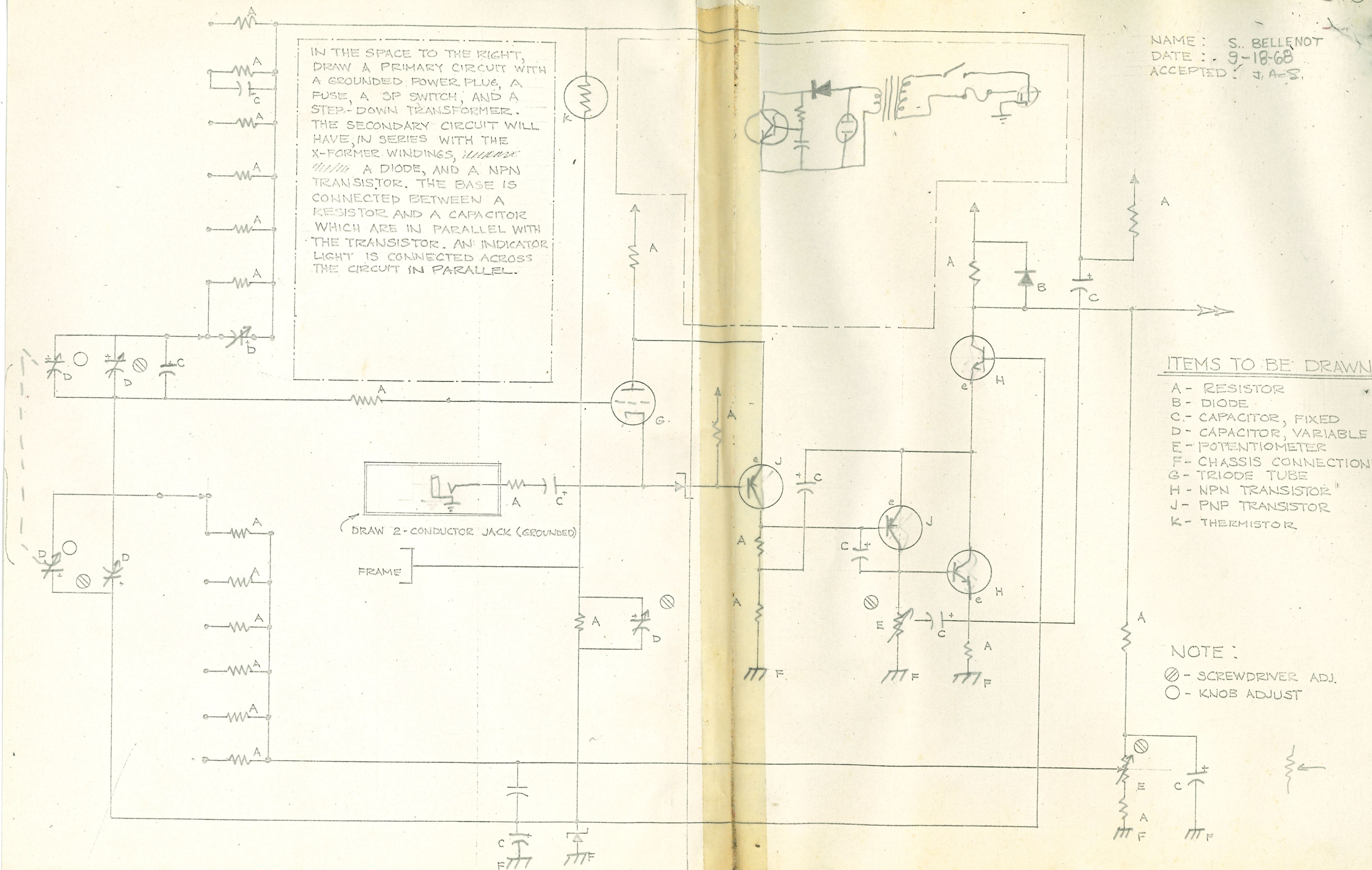
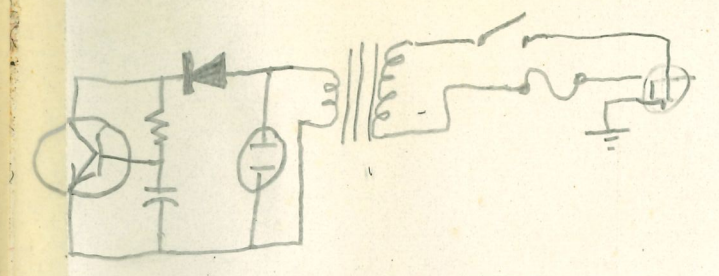
**Prob. 4** The views below show the arrangement of three electrically conductive plates. Determine the distance between plates and show the location of a non-conductive rod that will allow the distance between plates to be varied but planes to remain parallel. Design a device that will allow the rod to position each plate and provide a means of rotating the central plate (5678) out of position so that more or less is exposed to the other two plates. Scale: 3"=1'-0"







NAME : S. BELLENOT  
 DATE : 9-18-68  
 ACCEPTED : J.A.S.

IN THE SPACE TO THE RIGHT,  
 DRAW A PRIMARY CIRCUIT WITH  
 A GROUNDED POWER PLUG, A  
 FUSE, A 3P SWITCH, AND A  
 STEP-DOWN TRANSFORMER.  
 THE SECONDARY CIRCUIT WILL  
 HAVE, IN SERIES WITH THE  
 X-FORMER WINDINGS,  A DIODE, AND A NPN  
 TRANSISTOR. THE BASE IS  
 CONNECTED BETWEEN A  
 RESISTOR AND A CAPACITOR  
 WHICH ARE IN PARALLEL WITH  
 THE TRANSISTOR. AN INDICATOR  
 LIGHT IS CONNECTED ACROSS  
 THE CIRCUIT IN PARALLEL.



ITEMS TO BE DRAWN

- A - RESISTOR
- B - DIODE
- C - CAPACITOR, FIXED
- D - CAPACITOR, VARIABLE
- E - POTENTIOMETER
- F - CHASSIS CONNECTION
- G - TRIODE TUBE
- H - NPN TRANSISTOR
- J - PNP TRANSISTOR
- K - THERMISTOR

NOTE :  
 - SCREWDRIVER ADJ.  
 - KNOB ADJUST