

## Example 0: "Tolerances"

UNSPECIFIED TOLERANCES:	
2-PL DEC IN. (.XX)	$\pm .03$
3-PL DEC IN. (.XXX)	$\pm .005$
METRIC (MM)	$\pm 0.25$
DRILLED HOLES	$.010$
ANGLES	$\pm 0^{\circ}30'$

Example A

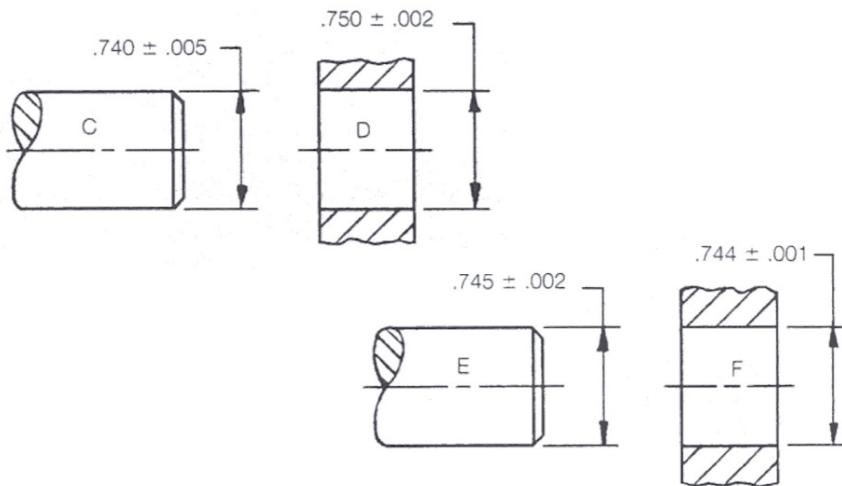
Tolerances Unless Noted Otherwise	
One Place Decimal	$\pm .1$
Two Place Decimal	$\pm .02$
Three Place Decimal	$\pm .004$
Angular	$\pm 0^{\circ}30'$
Concentricity	$\pm .02$ T.I.R.

Example B

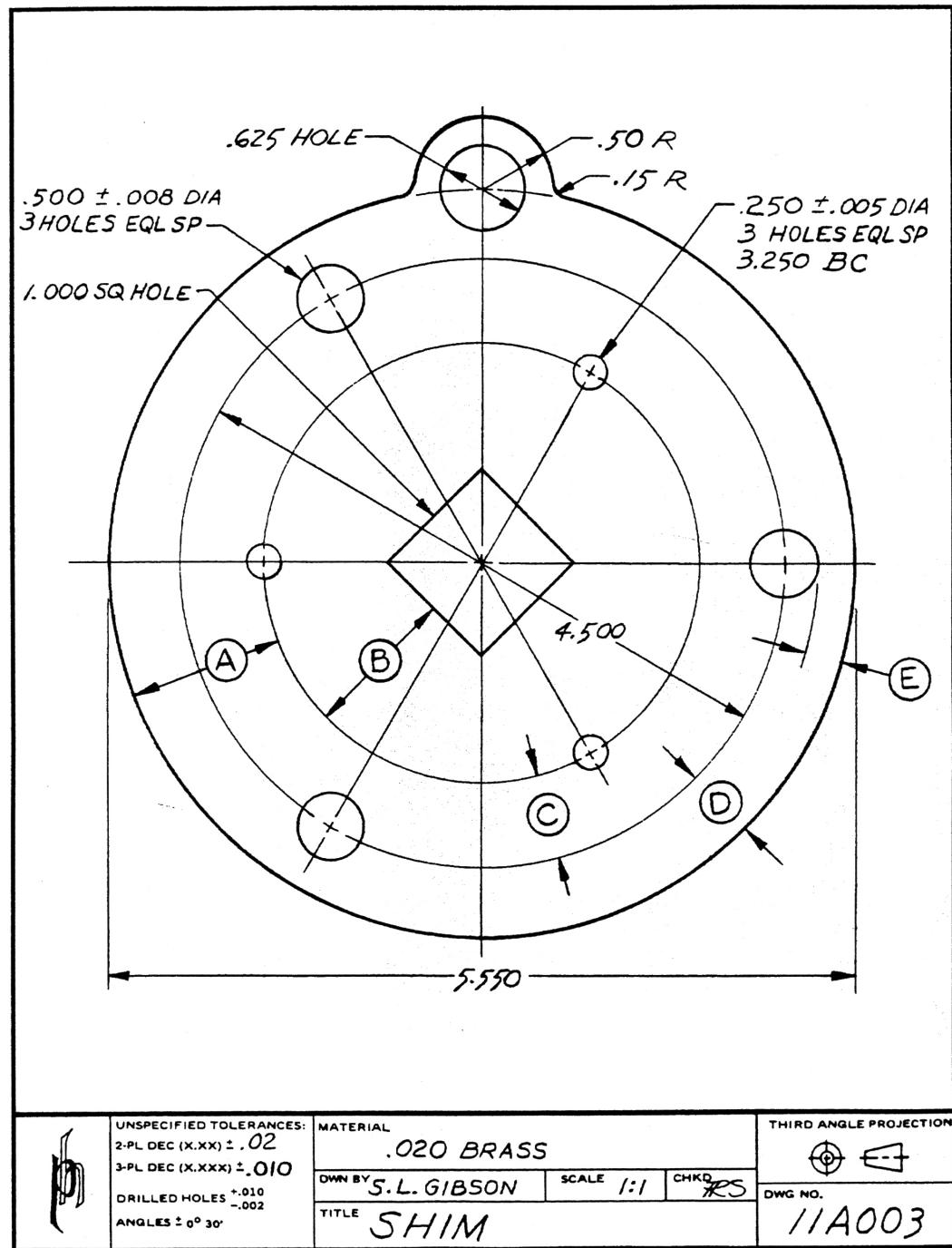
UNLESS OTHERWISE SPECIFIED:	
FRACTIONAL	$\pm 1/64$
.000	$\pm .003$
.00	$\pm .01$
.0	$\pm .1$
ANGULAR	$\pm 0^{\circ}30'$

Example C

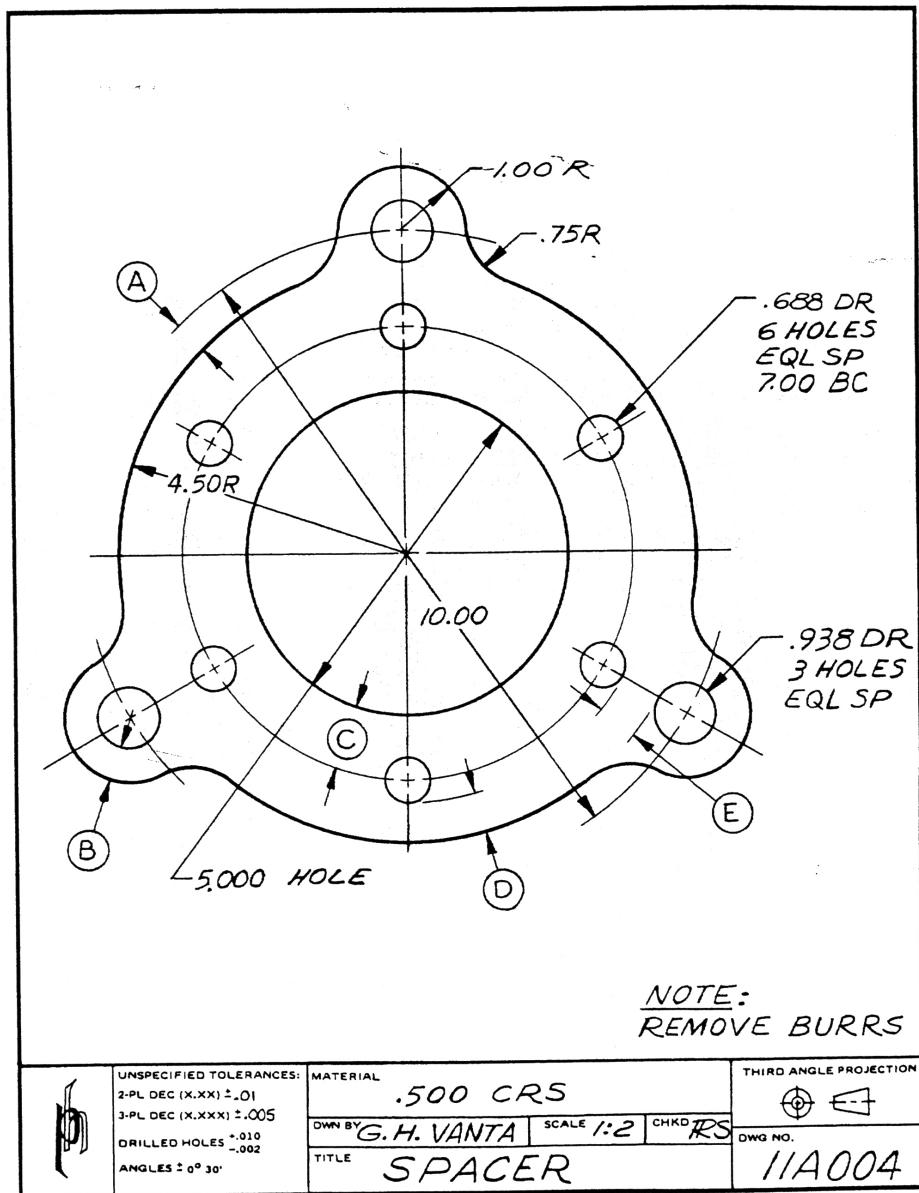
## Example II: "Allowance"



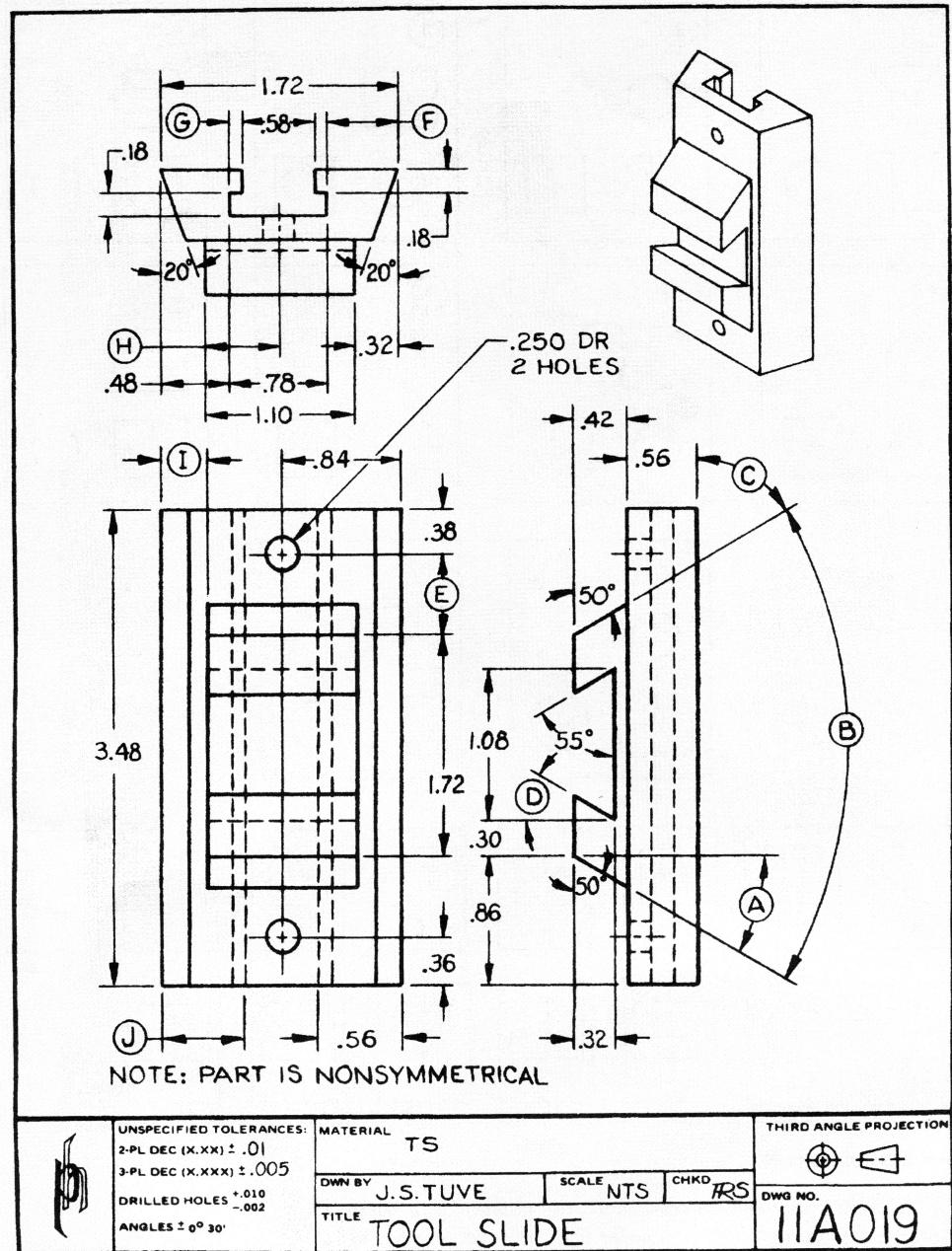
## Example I: "Shim"



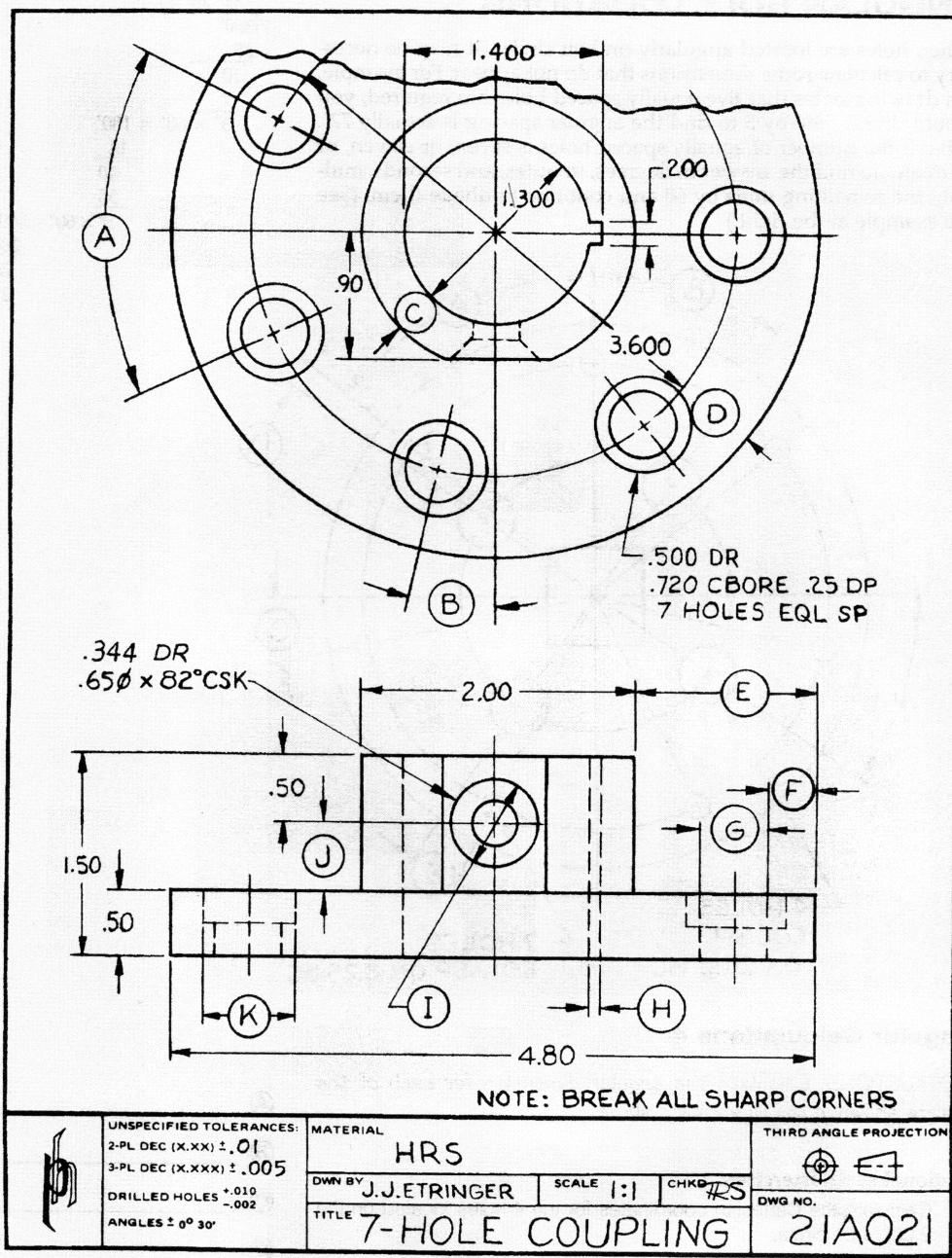
Example III: "Spacer"



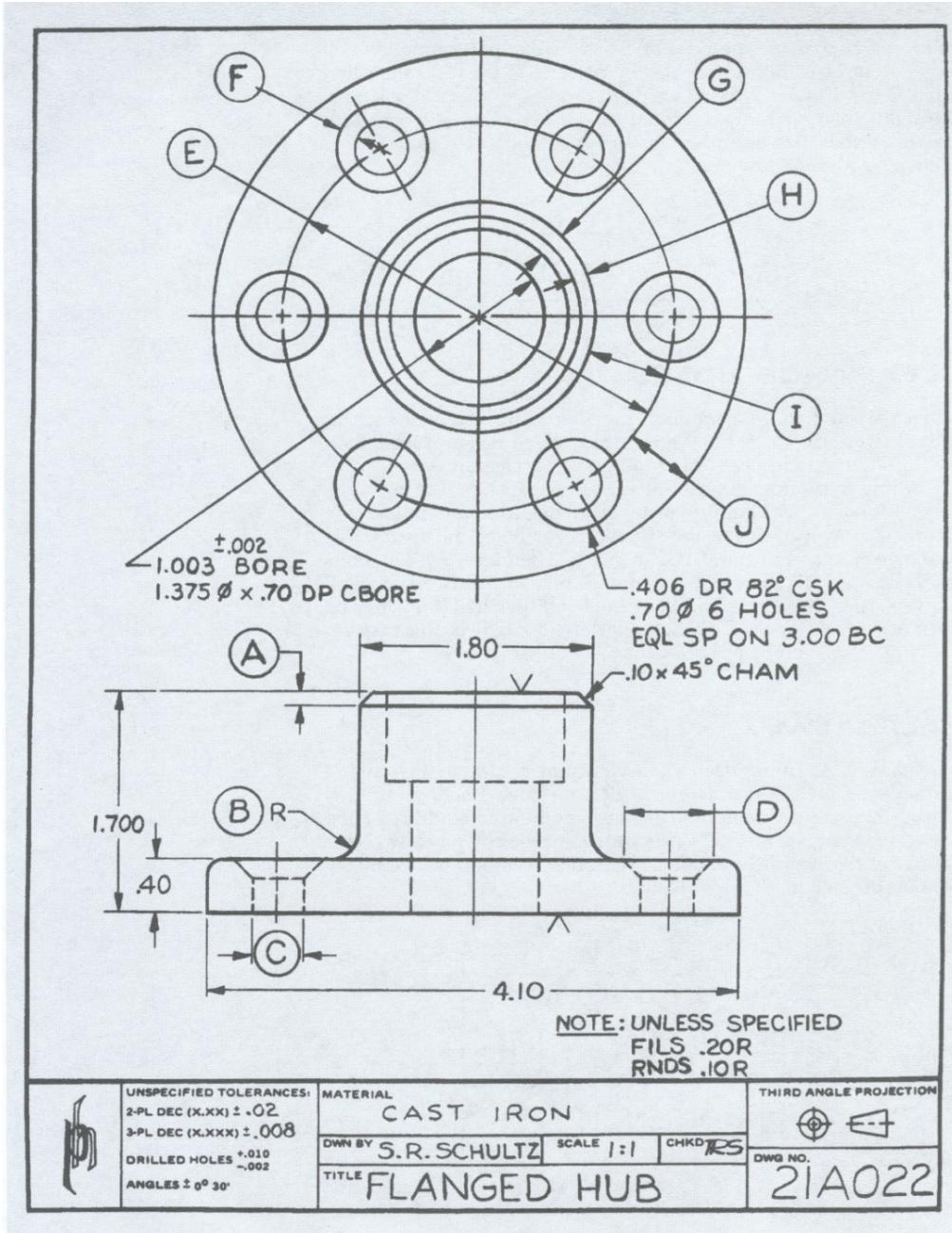
Example IV: "Tool Slide"



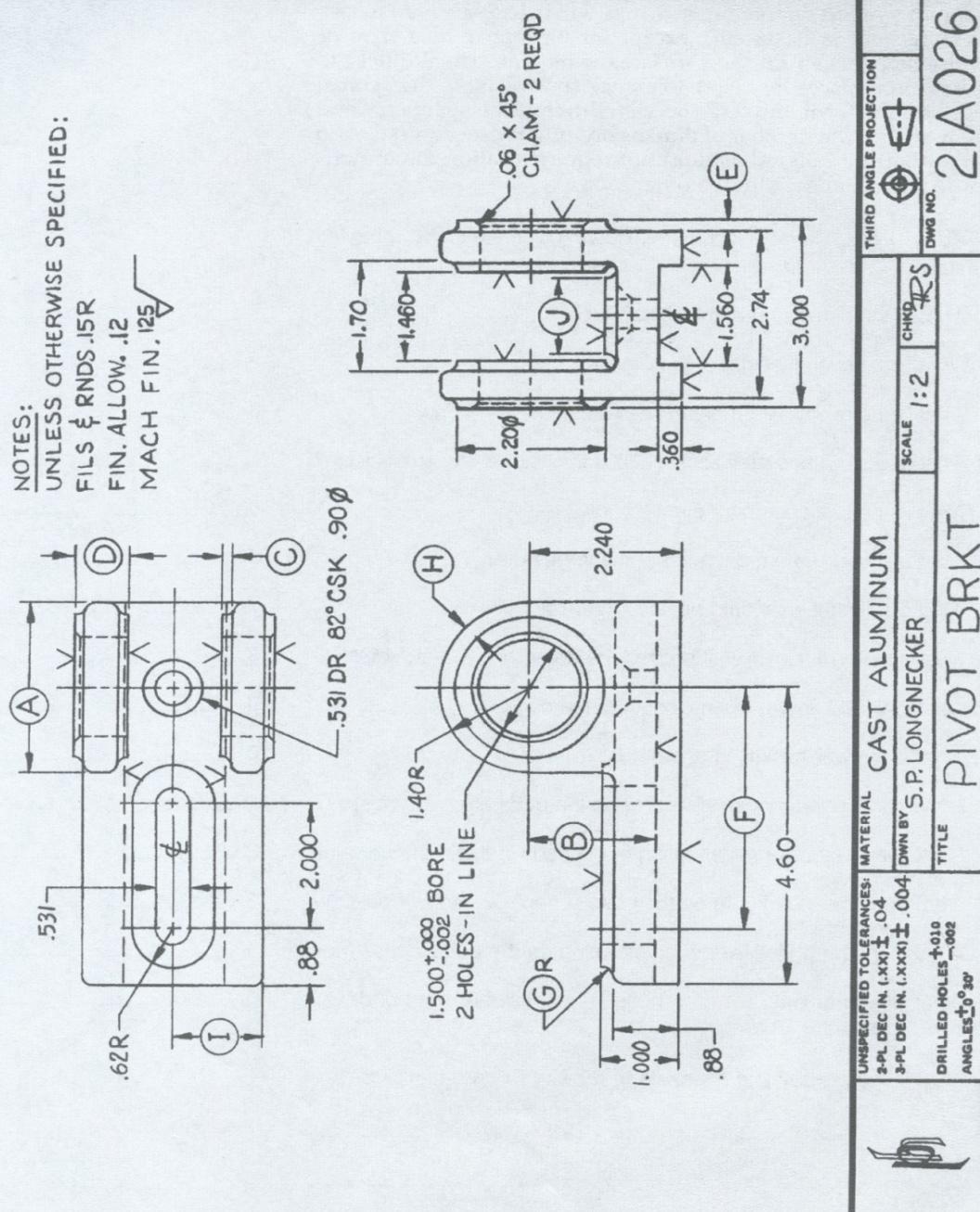
Example V: "7-Hole Coupling"



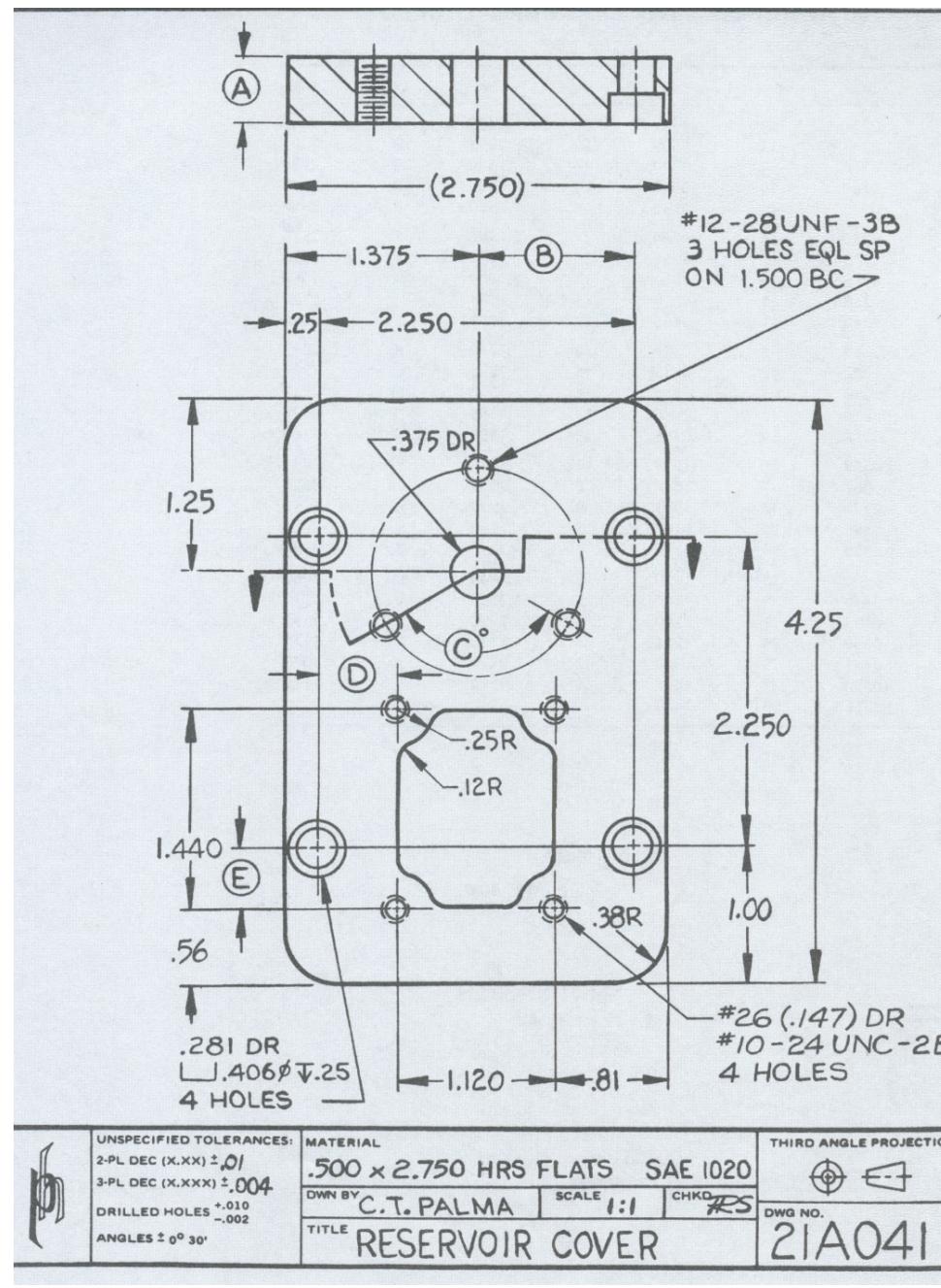
Example VI: "Flanged Hub"



Example VII: "Pivot Brkt"



Example VIII: "Reservoir Cover"



# SOLUTIONS

## Example 0: “Tolerances”

- A tolerance is the specified amount a dimension is permitted to vary from stated size
- It may be stated as equal bilateral ( $\pm .005$ ), unequal bilateral ( $+.008/-002$ ), or unilateral ( $+.000/-010$ )
- Total tolerance is the total amount of variation permitted from a specified size

UNSPECIFIED TOLERANCES:	
2-PL DEC IN. (.XX)	$\pm .03$
3-PL DEC IN. (XXX)	$\pm .005$
METRIC (MM)	$\pm 0.25$
DRILLED HOLES	$+.010$ $-.002$
ANGLES	$\pm 0^{\circ}30'$

Example A

Tolerances Unless Noted Otherwise	
One Place Decimal	$\pm .1$
Two Place Decimal	$\pm .02$
Three Place Decimal	$\pm .004$
Angular	$\pm 0^{\circ}30'$
Concentricity	$\pm .02$ T.I.R.

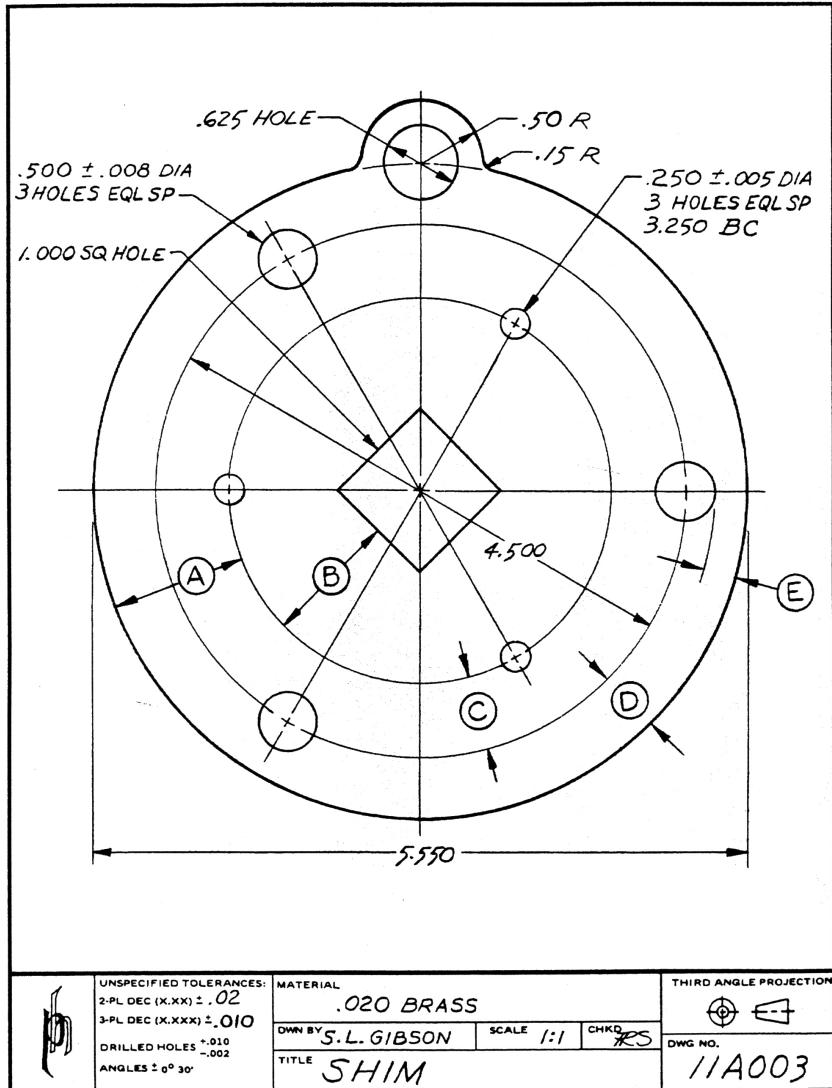
Example B

UNLESS OTHERWISE SPECIFIED:	
FRACTIONAL	$\pm 1/64$
.000	$\pm .003$
.00	$\pm .01$
.0	$\pm .1$
ANGULAR	$\pm 0^{\circ}30'$

Example C

1. What is the two place decimal tolerance in Example A?  **$\pm .03$**
2. What is the tolerance for drilled holes in Example A?  **$+.010/-002$**
3. What is the three-place decimal tolerance in Example B?  **$\pm .004$**
4. What is the fractional tolerance in Example C?  **$\pm 1/64$**
5. What is the angular tolerance in Example C?  **$\pm 0^{\circ}30'$**

## Example I: "Shim"



- How thick is the shim? **.020"**
- Is the shim symmetrical? **No**
- Are the bolt circles concentric? **Yes ("BC")**
- How many holes are in the shim? **8 (square hole)**
- What is the tolerance on the Ø.250 holes? **±.005**
- What is the tolerance on the Ø.500 holes? **±.008**
- What is the tolerance on the Ø1.000 hole? **±.010 (3-PL DEC)**
- What is the tolerance on the bolt circles? **±.010 (3-PL DEC)**
- What is the tolerance on the radii? **±.020 (2-PL DEC)**
- How much material is between the 5/8" hole and the nearest outside edge? **.5 - .3125 = .1875"**
- How far apart angularly are the three Ø.500 holes? **120°**

(A)  $= (5.550 - 3.250)/2 = 1.150"$

(B)  $= 3.250/2 - 0.500 = 1.125"$

(C)  $= (4.500 - 3.250)/2 = .625"$

(D)  $= (5.550 - 4.500)/2 = .525"$

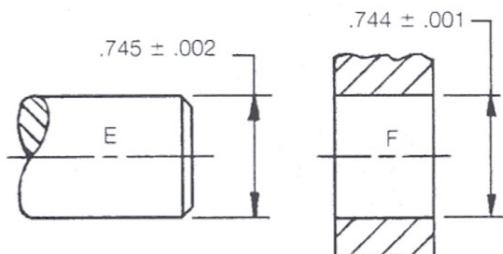
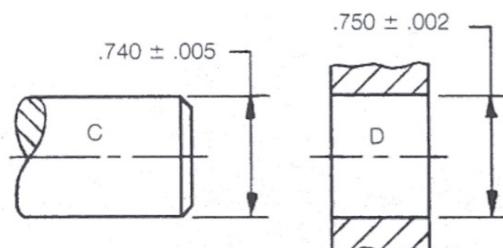
(E)  $= D - .500/2 = .275"$

# Allowances

- Minimum clearance between mating parts
- Maximum interference between mating parts
- Calculate by subtracting MMC of shaft from MMC of hole

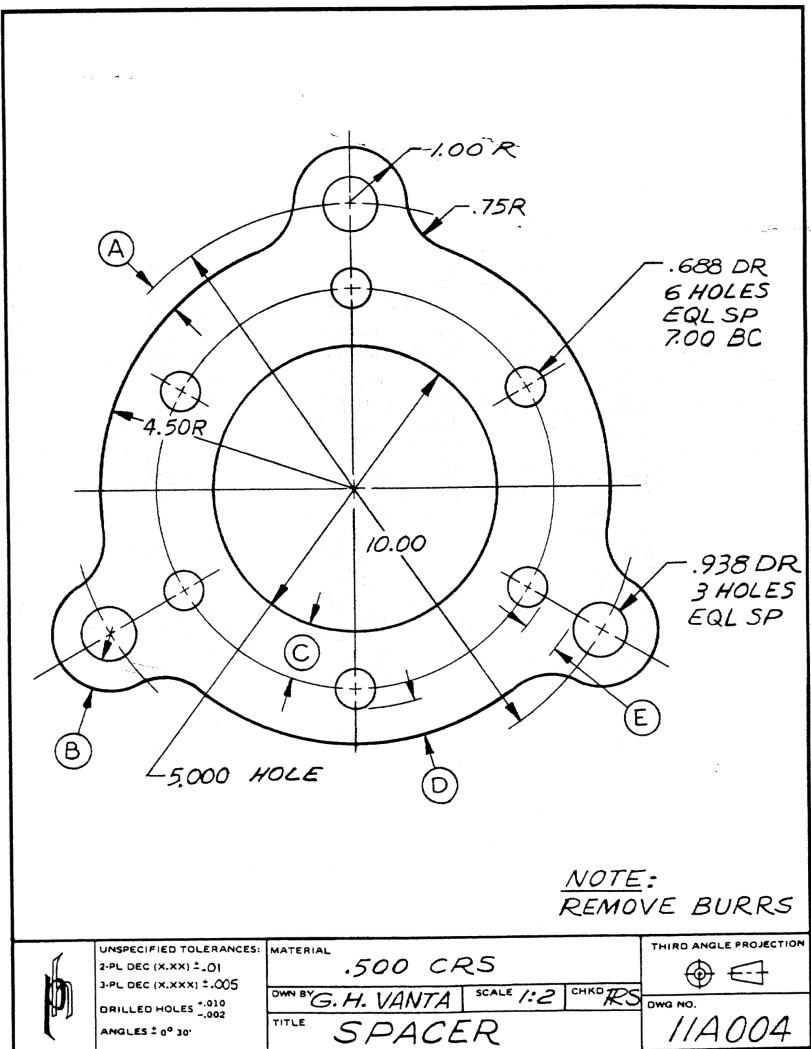
$$\text{Allowance} = \text{MMC Hole} - \text{MMC Shaft}$$

## Example II: “Allowance”



1. What is the MMC of hole “D”? .748”
2. What is the MMC of Shaft “C”? .745”
3. What is the allowance between “C” and “D”? +.003”
4. Is the allowance between “C” and “D” positive or negative? Positive
5. Is it a clearance or interference fit? Clearance
6. What is the MMC of hole “F”? .743”
7. What is the MMC of shaft “E”? .747”
8. What is the allowance between “E” and “F”? -.004”
9. Is the allowance between “E” and “F” positive or negative? Negative
10. Is it a clearance or interference fit? Interference

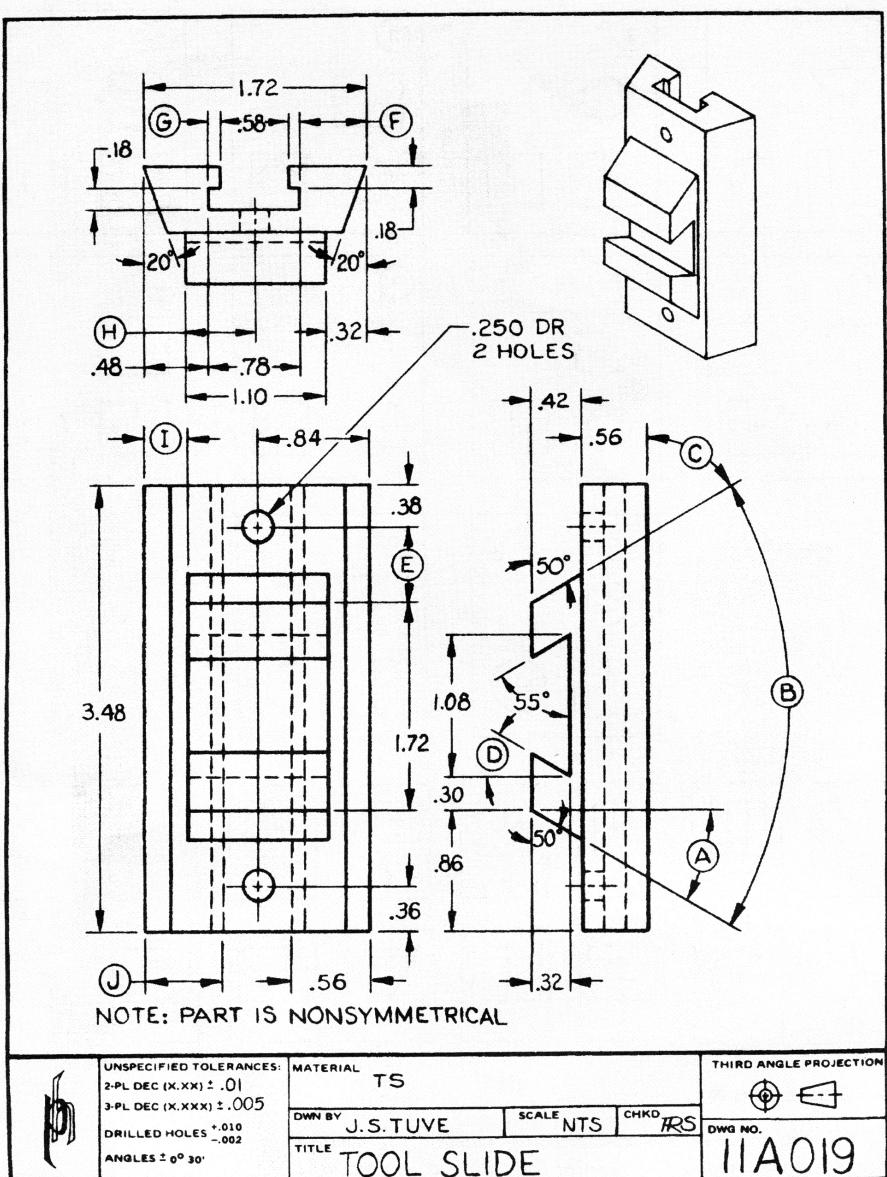
## Example III: “Spacer”



1. Is the print drawn to (a) half-size or (b) twice-size? **1:2 is half-size**
2. What is the thickness of the spacer? **.500"**
3. What is the angular dimension between each small hole? **60°**
4. What is the angular dimension between each large hole? **120°**
5. What is the tolerance on the center hole diameter? **±.005"**
6. What is the MMC of the center hole? **5.000-.005 = 4.995"**
7. What is the MMC of the .688 holes? **.688-.002 = .686"**

“CRS” – Cold Rolled Steel

## Example IV: “Tool Slide”



- What is the length of the tee slot? **.348"**
- What is the depth of the dovetail slot? **.32"**
- What is the length of the dovetail slot? **1.10"**
- How much tolerance can accumulate in the full depth of the tee slot? **(.18+.18) so tol.  
is  $2 \times \pm .01 = \pm .02$**
- What angle is created between the two sides of the dovetail slot?  **$180^\circ - 2(55^\circ) = 70^\circ$**
- What is the MMC of the overall depth of the tool slide? (Top and right side views.)  **$.42 + .56 + 2(.01) = 1.00"$**
- What is the MMC of the drilled holes? (Observe separate tolerance for drilled holes.) **.250-.002 = .248"**

(A)  $= 90^\circ - 50^\circ = 40^\circ$

(B)  $= 2(A) = 80^\circ$

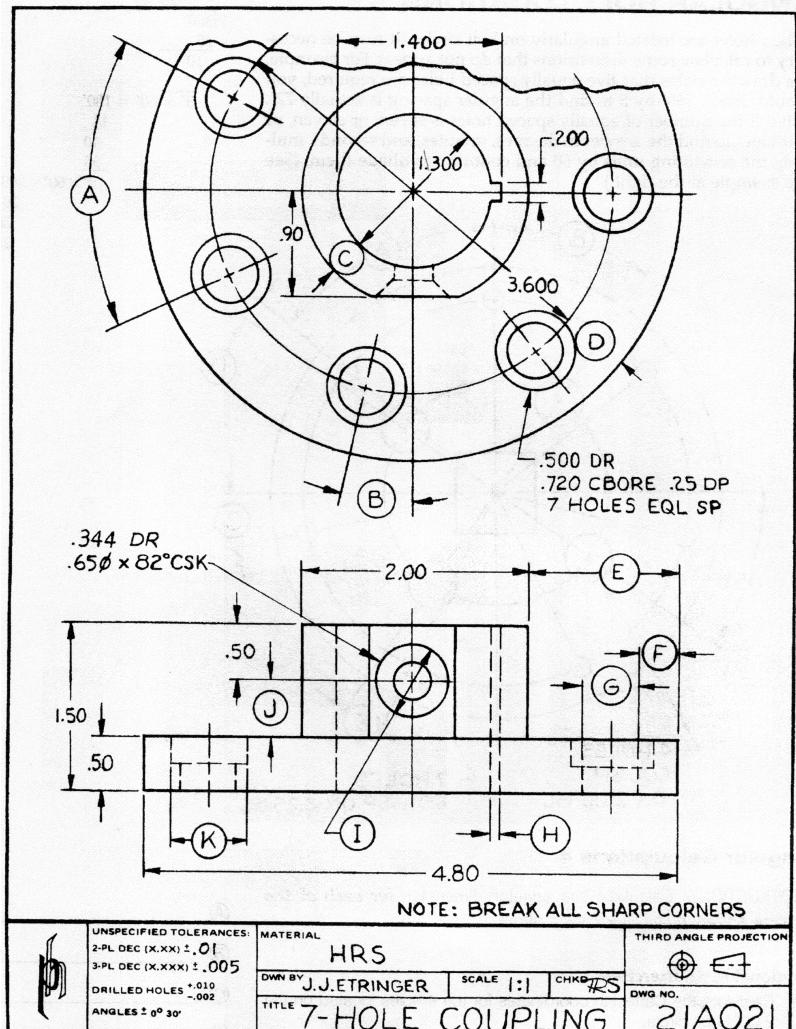
(C)  $= 50^\circ$

(D)  $= 90^\circ - 55^\circ = 35^\circ$

(E)  $= 3.48 - .86 - 1.72 - .38 = .52"$

(F)  $= 1.72 - .48 - .78 = .46"$

## Example V: “7-Hole Coupling”



1. Calculate the maximum flange diameter.  $4.80 + .01 = 4.81"$
2. Calculate the minimum flange thickness.  $.50 - .01 = .49"$
3. Calculate the maximum hub diameter.  $2.00 + .01 = 2.01"$
4. Calculate the minimum keyway width.  $.200 - .005 = .195"$
5. Calculate the maximum counterbore depth.  $.25 + .01 = .26"$
6. What is the included angle of the countersink.  $82^\circ$
7. Calculate the minimum bolt circle.  $3.600 - .005 = 3.595"$
8. Calculate the maximum bore diameter.  $1.300 + .005 = 1.305"$
9. Calculate the minimum diameter of drilled holes.  $.500 - .002 = .498"$

(A)  $= 360^\circ / 7 = 51.43^\circ$

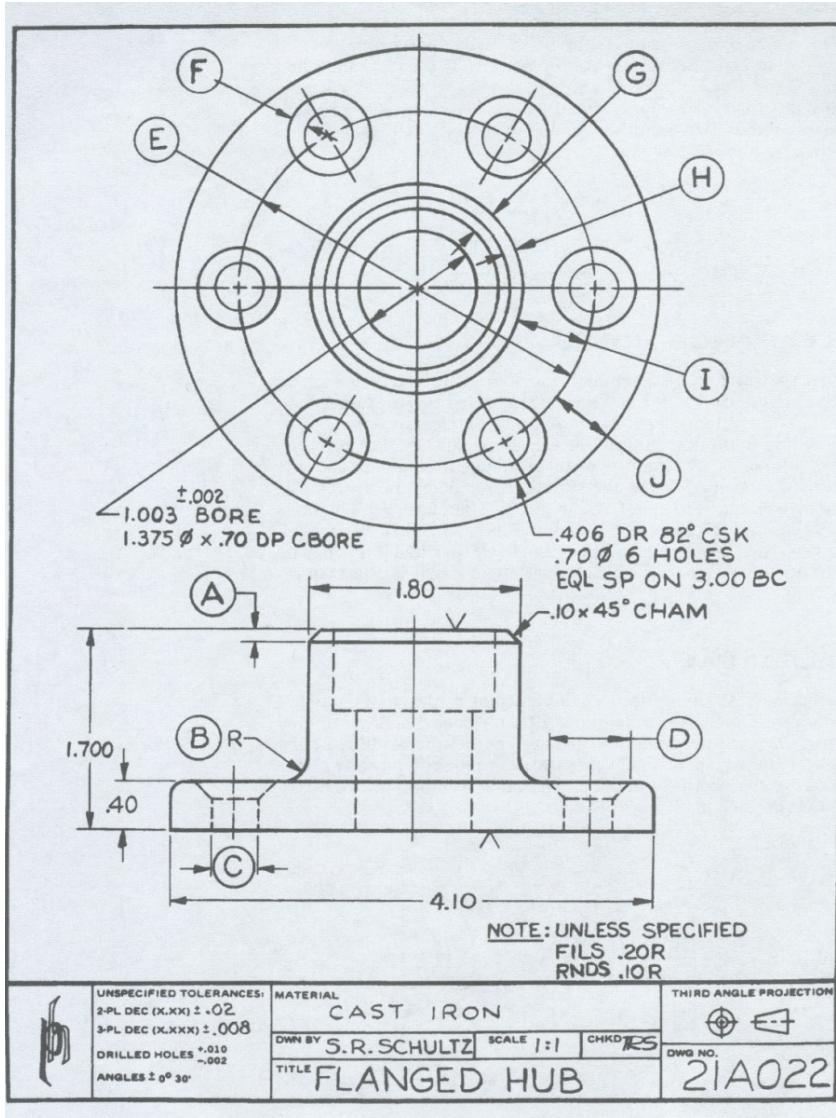
(G)  $= .500"$

(I)  $= .65"$

(J)  $= 1.50 - .50 - .50 = .50"$

(K)  $= .720"$

## Example VI: “Flanged Hub”



- What is the size of the fillet? .20"R
- What is the size of the round? .10"R
- How deep is the counterbore? .70"
- What is the bored hole tolerance? ±.002
- What is the MMC of the bored hole? 1.003-.002 = 1.001"
- What is the MMC of the drilled hole? .406-.002=.404"
- What size fasteners are intended to fit the clearance holes in the flange? Hole is .406" – screw table - 3/8" screw would work (0.375")

(A) .10"

(B) = .20"

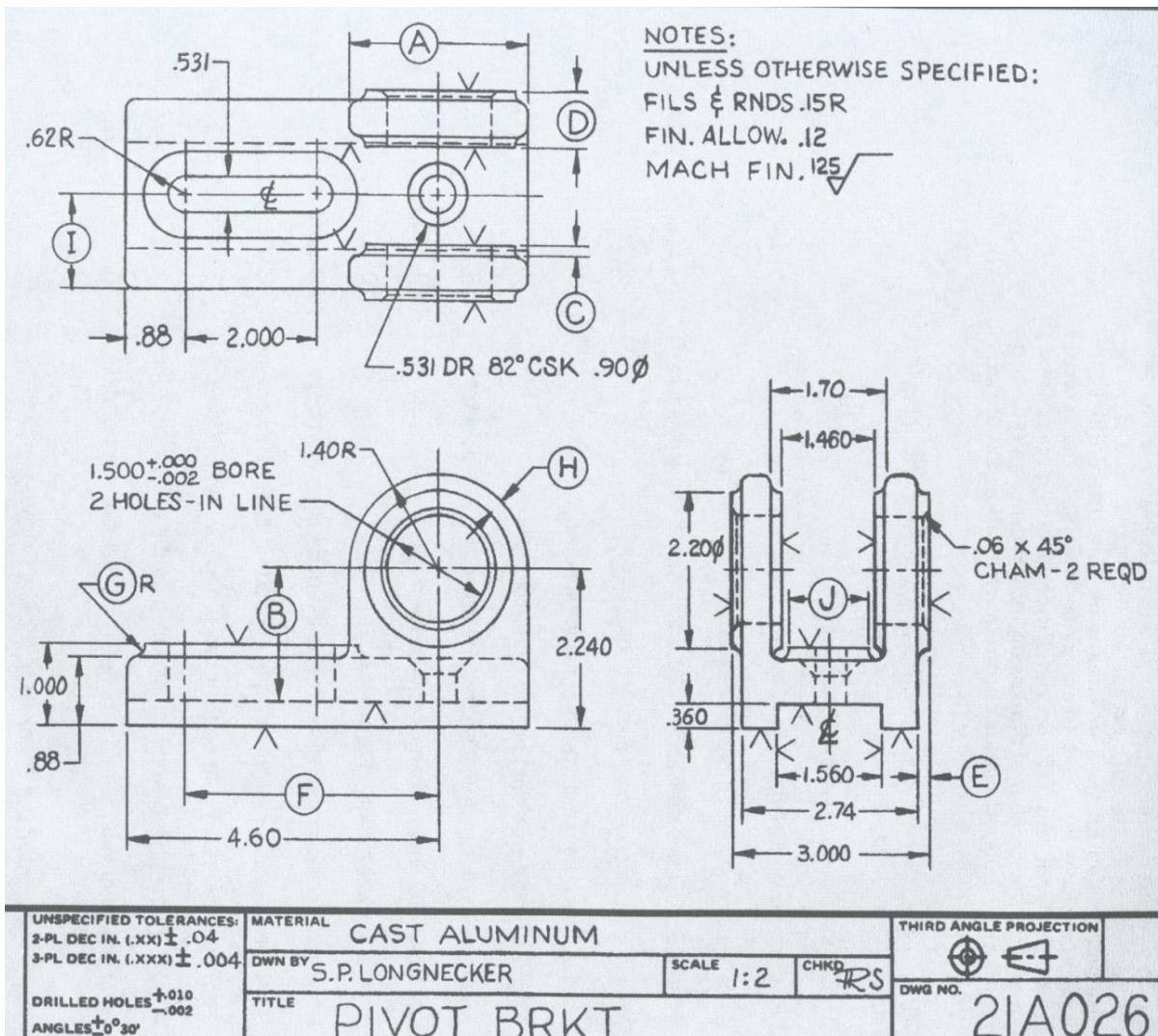
(C) =.406"

(D) =.70"

(I) = 3.00/2-1.80/2 = .6"

(J) = 4.1/2 – 3.00/2 = .55"

## Example VII: “Pivot Brkt”



1. Is the surface roughness height designated in decimal inch value as: .125, .00125, .000125?

.000125

2. Would the fastener size for the slotted hole be: (a) .500, (b) .531, or (c) .562?

Assume clearance - .500 (.531 is exact slot size)

3. Is the bore dimensioned by: (a) limits, (b) unilateral tolerance, or (c) bilateral tolerance?

## Unilateral (+.000/-002)

4. Is the included angle of the countersink: (a)  $41^\circ$ , (b)  $82^\circ$ , (c)  $164^\circ$ ?

82°

- ## 5. What is the MMC of the bored holes?

$$1.500 - .002 = 1.498"$$

$$\textcircled{A} \quad = 2(1.40) = 2.80''$$

$$D = (3.000 - 1.460) / 2 = .770"$$

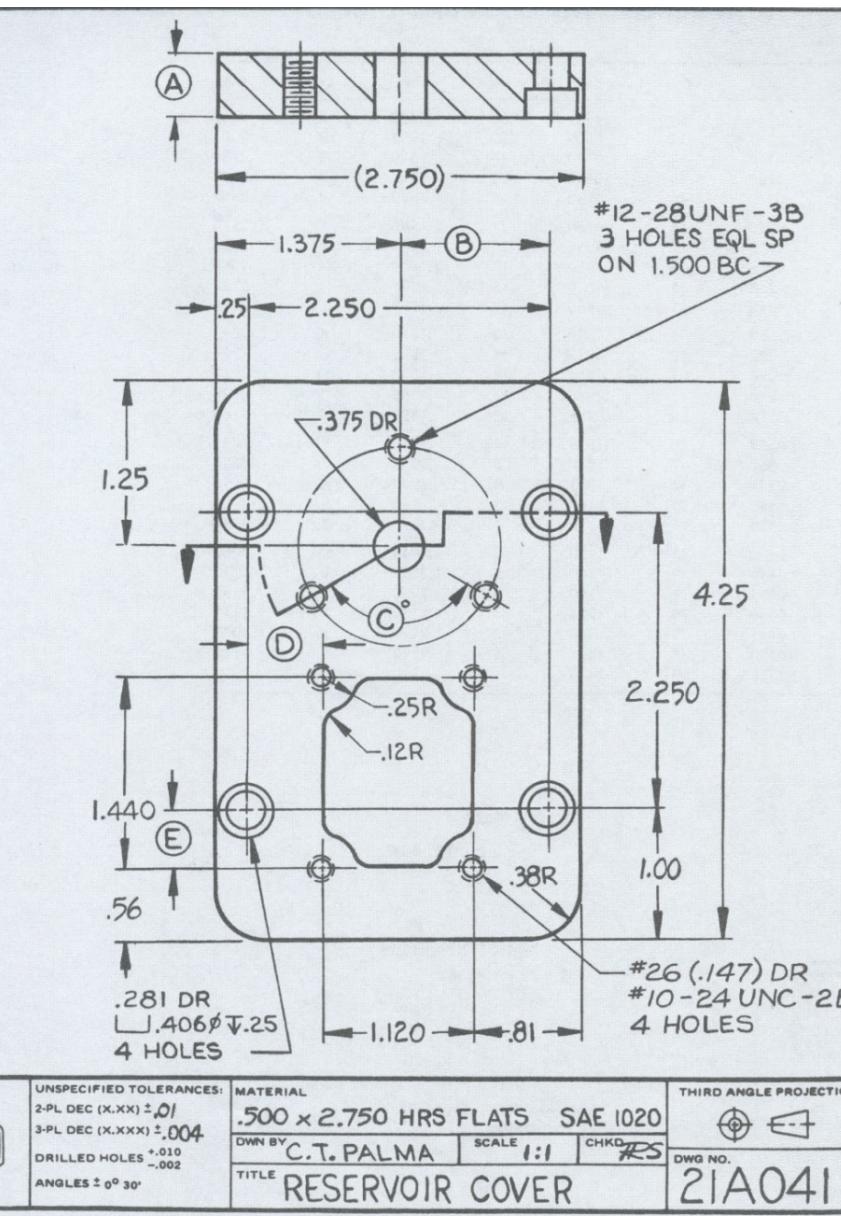
$$H = A - 2.20 = .60''$$

$$B = 2.240 - .360 = 1.880''$$

=.15"R

$$I = 3.000/2 = 1.500''$$

## Example VIII: “Reservoir Cover”



- How many threaded holes does the part contain? **7**
- What thread series is specified on the No. 12 holes? **#12-28UNF-3B**
- What is the major diameter of the No. 10 threaded holes? **Screw table - .190"**
- Is the proper tap drill specified for the No. 10 tapped holes? **Tap drill table says #25, but #26 works**
- What diameter tap drill is recommended for the No. 12 tapped holes? **Tap drill table - #14 drill**
- What do the parentheses around the width dimension represent? **Reference dimension – don't use to machine**

(A) = .500"

(B) =  $.25 + 2.250 - 1.375 = 1.125"$

(C) =  $360^\circ / 3 = 120^\circ$