

## ISUS Port Dimensions

7/16-28 UNEF-2B

Thickness = 1.5"

L  $\varnothing$  .625 T .375

O-ring #2-012

V  $\leq 45^\circ \times \varnothing$  .50

TAP Drill .4040 (#1)

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MAT'L UNS50400 Gr 2 Ti

$S_y = 40 \text{ ksi}$   $S_u = 50 \text{ ksi}$

Maximum allowable Stress  $S_{allow} = S = 20.8 \text{ ksi}$

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SAE #4 Port 7/16-20 Spec J1926/3

Max allowable Pressure = 4568 psi

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Design Depth 2000 m = 2917.5 psi

Max Working Pressure = 3000 psi

Relief Pressure = 3050 psi

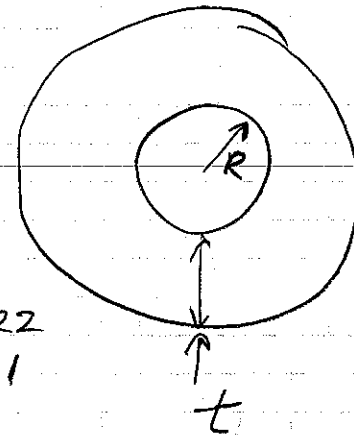
Max Allowable Pressure = 3100 psi

Design Pressure @ (S.F.=4:1) = 12,400 psi

UG-27 for Circumferential Stress

pp19

$$t = \frac{PR}{SE - 0.6P}$$



$P = \text{Internal Design Pressure}$

$= 3000 \text{ psi}$

$\phi 2.625$

$R = \text{Inside Radius} = 1.3125$

$2.722$   
 $1.361$

$S = \text{Max Allowable Stress}$

$= 20,800 \text{ psi}$

$E = \text{Joint Efficiency} = 1$   
(No joints)

$$t = \frac{(3000)(1.361)}{(20,800)(1) - 0.6(3000)} = \boxed{0.207 \text{ inch} = t_{\text{req'd}}}$$

$0.215 \text{ inch}$

Longitudinal Stress

$$t = \frac{PR}{2SE - 0.4P} = \frac{(3000)(1.3125)}{2(20,800)(1) - (0.4)(3000)}$$

$$t = .0975$$

Thick Cylindrical ShellsMandatory Appendix #1

$$\text{If } t > \frac{1}{2} R \quad \text{or} \quad P > .385 SE$$

$$.639 \stackrel{?}{>} \frac{1.361}{2} \quad 3000 \stackrel{?}{>} .385(20,800)(1)$$

$$.639 > .681 \quad 3000 \nless 8,008$$

$$\text{Then } t = R(Z^{\frac{1}{2}} - 1) \quad \text{where } Z = \frac{SE + P}{SE - P}$$

$$= \frac{(20,800)(1) + 3000}{(20,800)(1) - 3000}$$

$$Z = 1.161$$

$$t = 1.361[(1.161)^{\frac{1}{2}} - 1]$$

$$t = .105$$

?  
Not

Test Pressure UG-

1.3 x Design Pressure

$$(1.3)(3000 \text{ psi}) = \boxed{3,900 \text{ psi}}$$

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END Cap O-ring

#2-331

$$\text{Groove } \phi = 2.285 \begin{matrix} +000 \\ -004 \end{matrix}$$

$$\text{Plug } \phi = 2.622 \begin{matrix} +000 \\ -001 \end{matrix}$$

$$\text{Bore } \phi = 2.625 \begin{matrix} +002 \\ -000 \end{matrix}$$

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Bore Area ON End Cap

$$A_b = \frac{\pi d^2}{4} = \frac{\pi}{4} (2.625)^2 = \boxed{5.412 \text{ in}^2}$$

End Cap Thickness

UG-34 Case II (Threaded Ring)

$$Eq 1 \quad t = d \sqrt{\frac{CP}{SE}}$$

$$= 2.622 \sqrt{\frac{(-3)(12,400)}{(20,800)(1)}}$$

where

E=1 No joints

S = Max allowable stress = 20,800

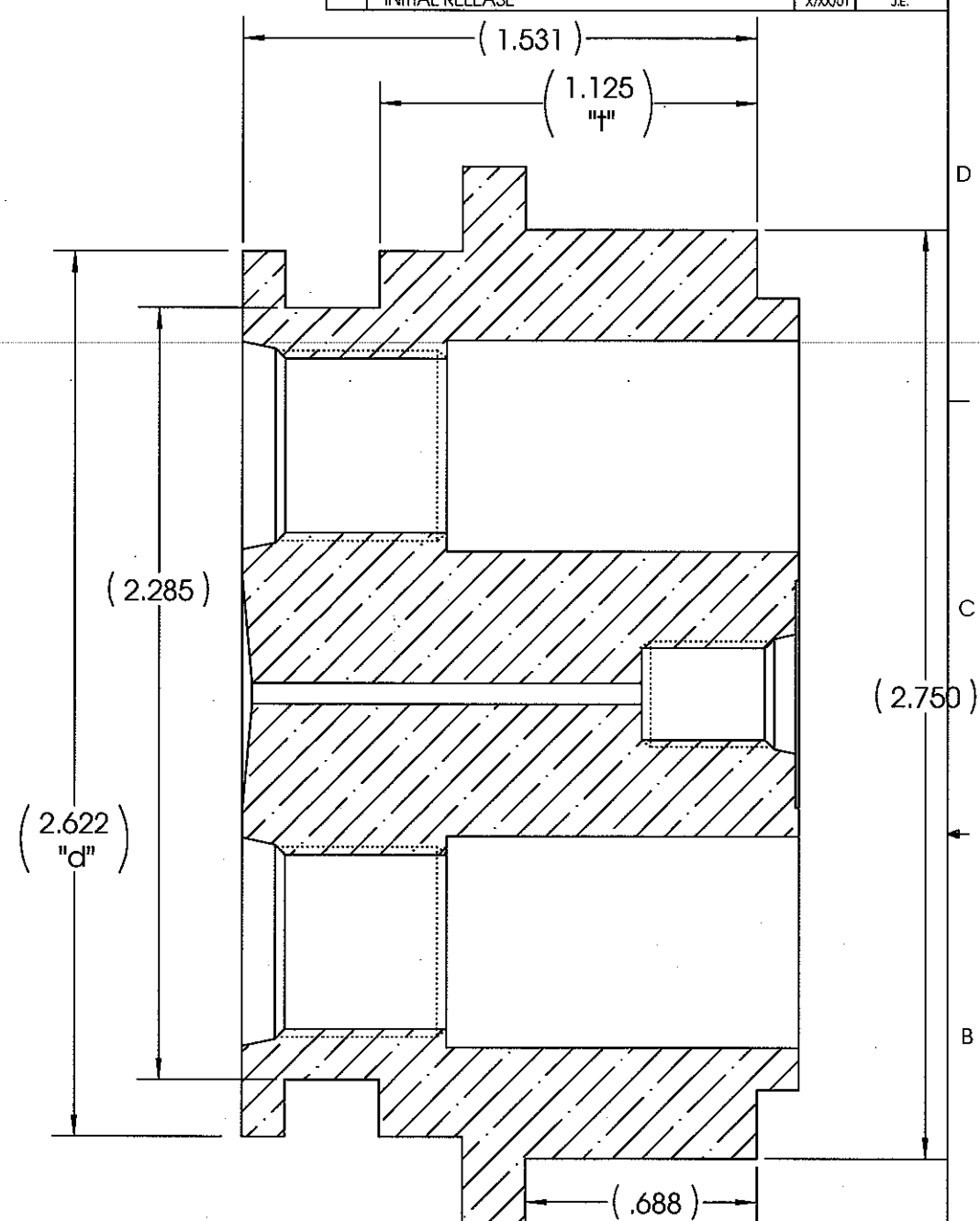
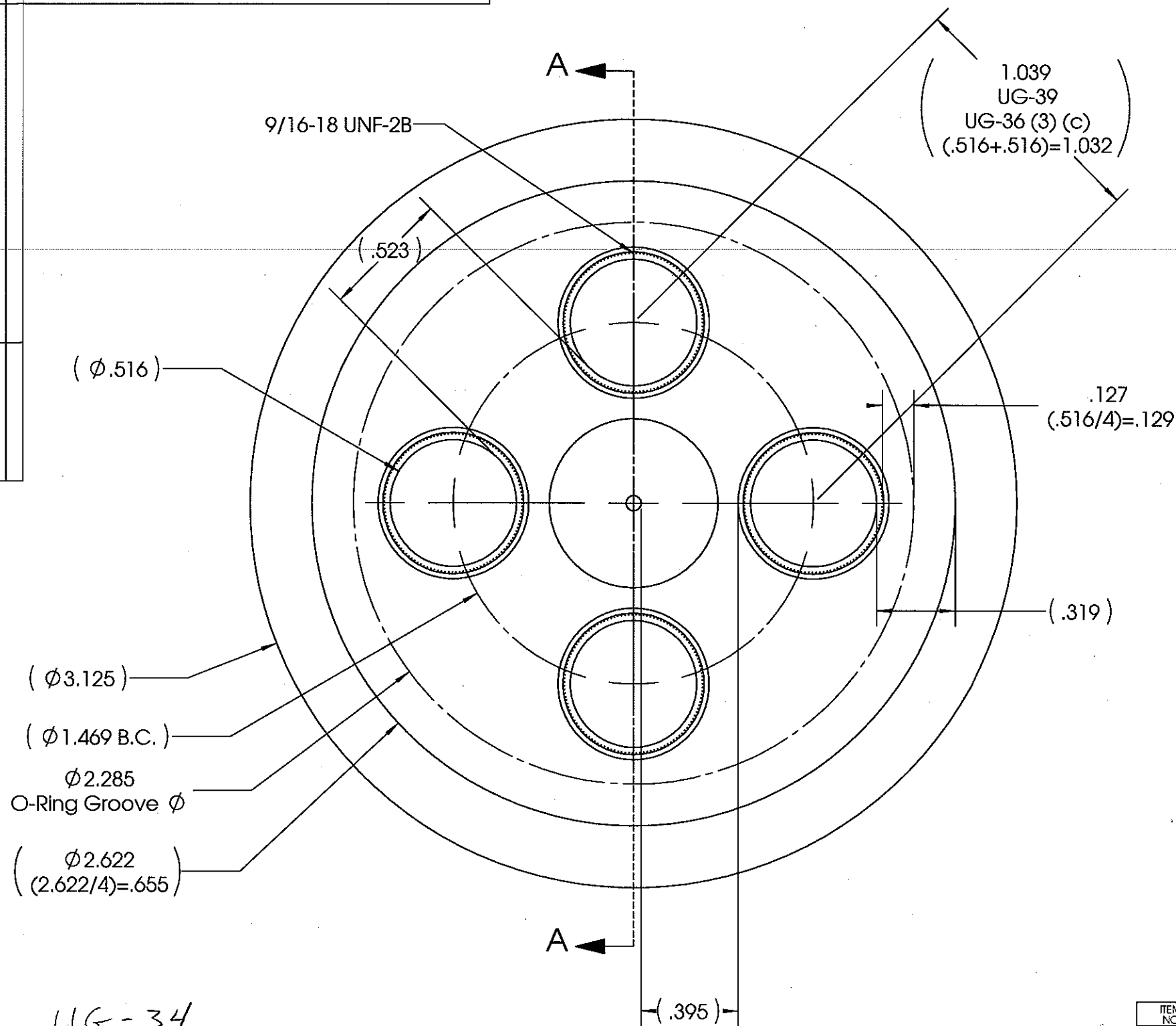
C = 0.30 (PP 34)

P = 3000 psi (Design Pressure)

$$t = 1.108 \text{ inch}$$

(Both Ends)

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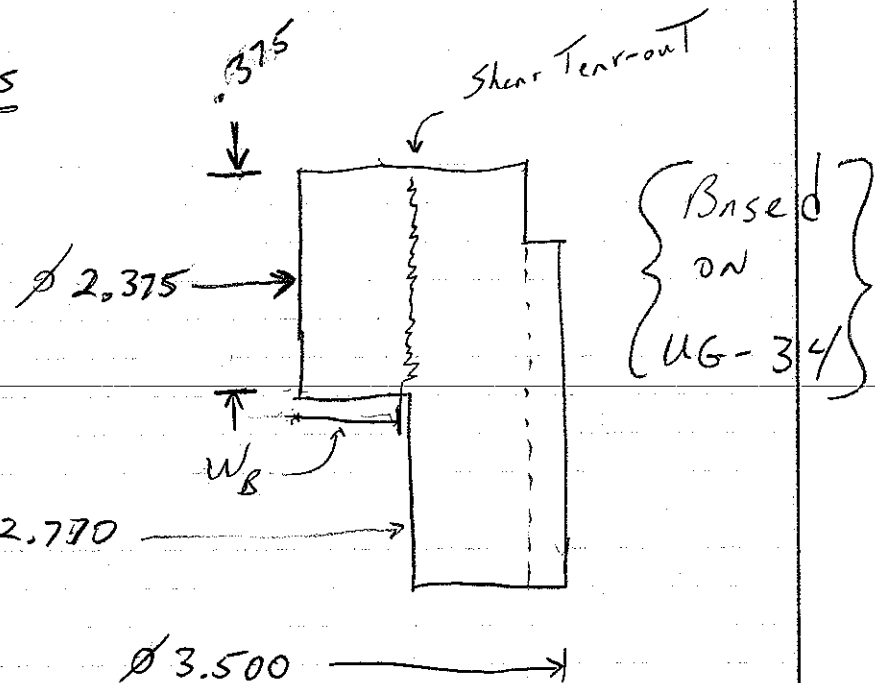
SECTION A-A  
SCALE 2 : 1

UG-34  
C = 0.30  
P = 12,400 psi.  
S = 20,800 psi  
E = 1.0

$$t = d \sqrt{CP/SE} = 2.622 \sqrt{\frac{(-3)(12,400)}{(1)(20,800)}} \Rightarrow t = 1.108$$

NOTES: (CONT. FROM TITLE BLOCK)

| ITEM NO.              | QTY. | PART NO.                                                                                                   | DESCRIPTION      | VENDOR                       | MATERIAL SPECIFICATION                                                                                                  |
|-----------------------|------|------------------------------------------------------------------------------------------------------------|------------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| BILL OF MATERIALS     |      |                                                                                                            |                  |                              |                                                                                                                         |
| Shop / Q.C.           |      | UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:                                                                 |                  | APPROVALS DATE               |                                                                                                                         |
| Inspector             |      | 1 PLACE DIM ±1/16                                                                                          | 2 PLACE DIM ±.02 | 3 PLACE DIM ±.005            | 4 ANGLES ±1°                                                                                                            |
| Shop Foreman          |      | 1. DIMENSIONS ARE IN INCHES                                                                                |                  | DRAWN J. ERICKSON X/XX/01    | Monterey Bay Aquarium Research Institute<br>MBARI<br>7700 Sandholdt RD.<br>Moss Landing, CA 95039<br>PH: (831) 775-1700 |
| Engineer              |      | 2. DIMENSION LIMITS HELD AFTER PLATING.                                                                    |                  | ENGINEER J. ERICKSON X/XX/01 |                                                                                                                         |
|                       |      | 3. REMOVE BURRS AND SHARP EDGES .015 MAX.                                                                  |                  | CHECKED                      |                                                                                                                         |
| NEXT ASSY Description |      | 4. MACHINED FILLET RADII .0150-.030.                                                                       |                  | PROJECT NO. XXX              | PROJECT NAME<br>Press. Test Cap                                                                                         |
| NEXT ASSY Number      |      | 5. MACHINED DIAMETERS ON A COMMON CENTERLINE CONCENTRIC WITHIN .005                                        |                  | PROJECT <u>XXXXXX</u>        |                                                                                                                         |
| Application           |      | 6. PERPENDICULARITY & PARALLELISM OF MACHINED SURFACES .002 PER INCH. MAX. .012 INCHES FOR SINGLE SURFACE. |                  | WEIGHT 1.226lb.              | SCALE 1:1                                                                                                               |
|                       |      | DO NOT SCALE DRAWING                                                                                       |                  | CAD FILE: MECHENG.ONTORINADO | SHEET 1 OF 1                                                                                                            |

$$S_{allow} = 15,000 \text{ psi}$$


## Bearing Area

$$W_B = [(2.770 - 2.375) / 2] - .020 = .1775, \text{ in } ?$$

$$A_B = \frac{\pi}{4} \left\{ [2.375 + (.1075 \times 2)]^2 - [2.375]^2 \right\}$$

$$= \frac{\pi}{4} \{ 1.8123 \}$$

$$A_B = 1,4234 \text{ in}^2$$

$$\text{Bore Area} = \frac{\pi}{4} (2.625)^2 = 5.4119 \text{ in}^2$$

@ 3100 psi

$$F = 16,777.16f$$

## Bearing Stress

$$\sigma_B = \frac{F}{A_B} = \frac{16,777 \text{ lbf}}{1,423 \text{ in}^2} = 11,787 \text{ psi}$$

$$(\sigma)_{allow} = 15,000 \text{ psi}$$

OK

Plug Shear Tear-out

shear Area (cylindrical)

$$A_s = \pi dh = \pi [2.770 - .040] (.375)$$

$$A_s = 3.216 \text{ in}^2$$

00

Pin (I)

$$F = 16,777 \text{ lbf}$$

$$\tau = \frac{F}{A_s} = 16,777 / 3.216 = \boxed{5,217 \text{ psi}}$$

Allowable Shear Stress.

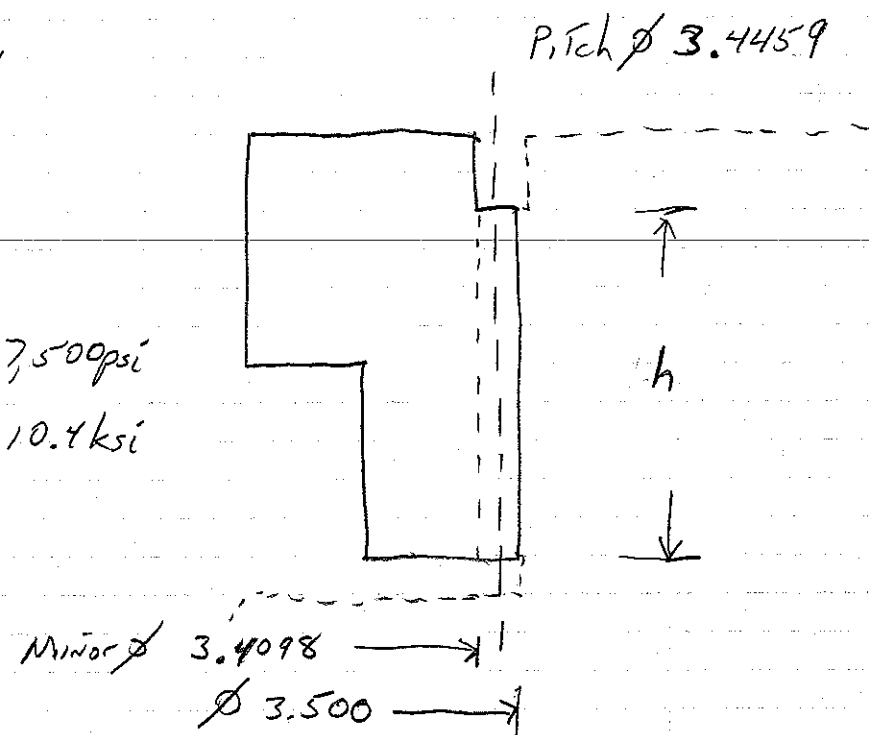
$$\tau_{\text{allow}} = \frac{(.5)(S_y)}{FS} = \frac{(.5)(60 \text{ ksi})}{4} = \underline{\underline{7,500 \text{ psi}}}$$

Thread Shear on Lock Ring To Case

Based on UG-34

(2) sketch(n)

Assumes

CDA 642  $\tau_{allow} = 7,500 \text{ psi}$ Gr. 2 Ti  $\tau_{allow} = 10.4 \text{ ksi}$ Lock Ring Root  $\phi 3.409$ Root Area  $A_r = \pi D h$ Allowable Shear Stress in Lock Ring Root

$$\tau_{allow} = 7,500 = \frac{F}{A_r} = \frac{16,777}{\pi(3.409)h}$$

minimum  $h = .208 \text{ inch}$

Shear Thru Pitch Dia.

$$7,500 = \left( \frac{F}{A_{PD}(.5)} \right) = \frac{16,777}{\pi(3.4459)h(.5)}$$

$h_{\text{minimum}} = .413 \text{ inch}$

Thread Shear Thru on Base Plug $\frac{5}{8}$ -16 UN Root Dia = 2.551 in

Assume:

MATERIAL UNS50400 Gr2 Ti

$S_u = 50 \text{ ksi}$

$S_y = 40 \text{ ksi}$

$S_{allow} = 20.8 \text{ ksi}$

Allowable Shear Stress  $\frac{1}{2} S_y$ 

$\tau_{allow} = 10.4 \text{ ksi}$

Minimum Thread Length

$A_s = \pi D_{root} (h)$

$\tau_{allow} = \frac{F}{A_s}$

Design Pressure

Force on Base

$P = 12,400 \text{ psi}$

Area of Base

$A_B = \frac{\pi}{4} (2.625)^2 = 5.412 \text{ in}^2$

$F = (12,400 \text{ psi})(5.412 \text{ in}^2) = 67,107 \text{ lbf}$

$\tau_{allow} = \frac{F}{A_s} = \frac{67,107 \text{ lbf}}{\pi (2.551) h} = 10.4 \text{ ksi}$

 $\therefore$  Thread Length (Minimum)

$h = .805 \text{ inch} \Rightarrow 1.0$

Tensile Stress on Case @ End Cap Thread

Force on End Cap

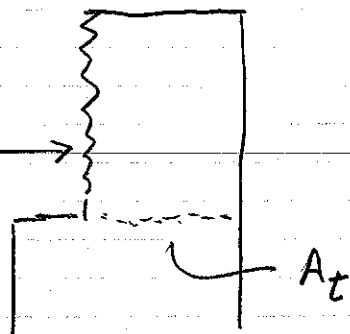
Fin (I)

$$F = 16,777 \text{ lbf}$$

IF  $G_2 T_i$   $S_y = 40 \text{ ksi}$

$\phi 3.5$

Max Allowable Stress



$$\sigma_{allow} = \frac{40 \text{ ksi}}{4} = 10 \text{ ksi}$$

$$\sigma_{allow} = 10 \text{ ksi} = \frac{F}{A_t}$$

$$A_t = \frac{16,777}{10 \text{ ksi}} = 1.677 \text{ in}^2$$

$$A_t = \frac{\pi}{4} (D^2 - (3.5)^2)$$

$$(1.677 \text{ in}^2) \frac{4}{\pi} + (3.5)^2 = D^2 = 14.386$$

$$D = 3.793$$

$\Rightarrow$

$$4" \phi$$

Compressability of Water 0 psi  $\rightarrow$  3000 psi

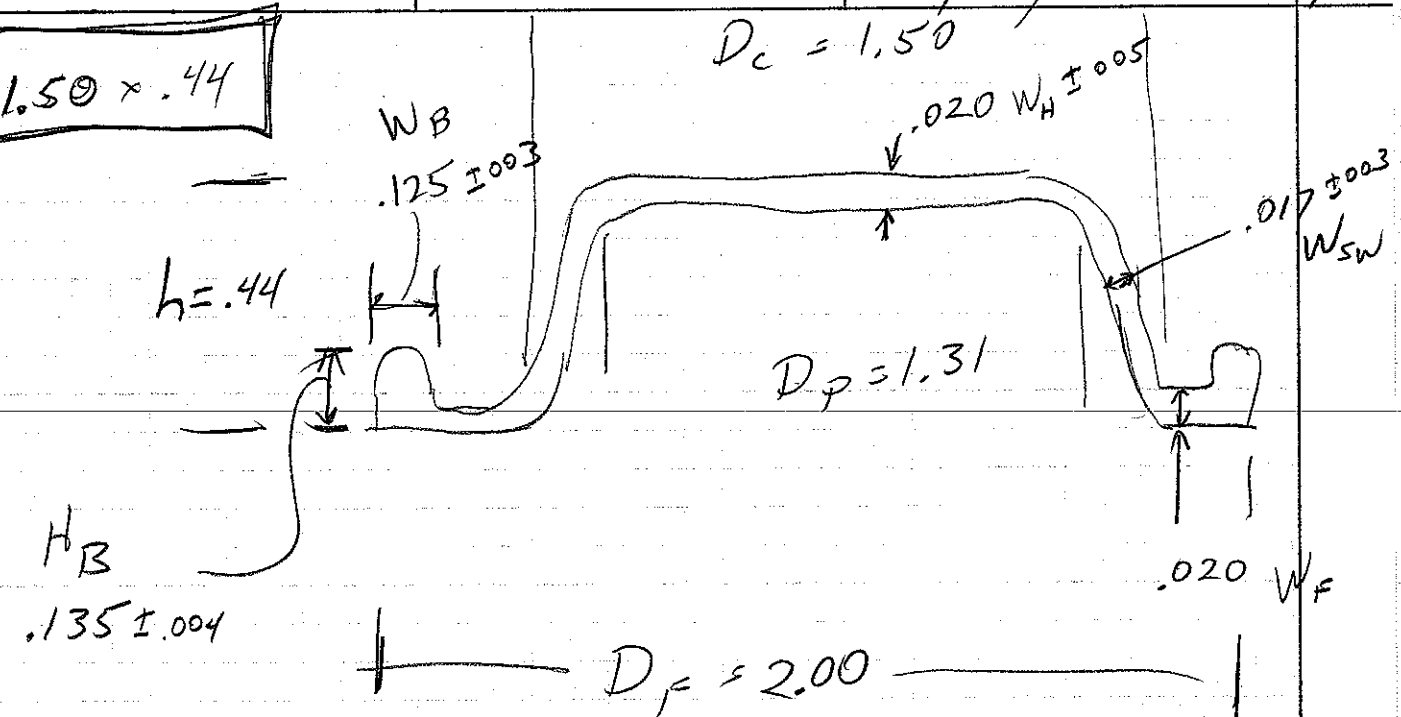
$$Vol)_0 = \frac{\pi d^2}{4} h = \frac{\pi (2.5)^2 (7.625)}{4} = \boxed{37.478 \text{ in}^3}$$

Bulk Modulus of  $\text{CH}_2\text{O}$   $\Rightarrow K = 300,000 \text{ psi}$

$$K = \frac{\Delta P V_0}{\Delta V}$$

$$\Delta V = \frac{(3000 \text{ psi})(37.478 \text{ in}^3)}{300,000} = \boxed{.375 \text{ in}^3}$$

$$(.375 \text{ in}^3)(16.3866) = \boxed{6.1 \text{ ml}}$$

$1.50 \times .44$ 

MAT'L - Silicone

PART No 3-1.5-.44-A