

AD-A083 498

NAVAL WEAPONS CENTER CHINA LAKE CA  
STRESS ANALYSIS OF THE EXTERNAL STORES DP EJECTION LAUNCHER/INN--ETC(U)  
NOV 78 A L FREEMAN, E R HANBLEM, G W PAXTON  
UNCLASSIFIED NWC-TM-3358 GIDEP=E140-2365 NL

| OF |  
400  
A083498

END  
DATE  
FILED  
5 80  
DTIC

ADA 083498

NWC Technical Memorandum 3358

STRESS ANALYSIS OF THE EXTERNAL  
STORES DP EJECTION LAUNCHER/  
INNER TUBE SUBSYSTEM.

by /C

Anthony L. Freeman  
Earl R. Hanblem  
Gale W. Paxton  
Engineering Division  
COMARCO INC.

for the  
Propulsion Systems Division  
Ordnance Systems Department

Nov [redacted] 78

~~Approved for public release, distribution unlimited~~

NAVAL WEAPONS CENTER  
China Lake, California

DISTRIBUTION STATEMENT A  
Approved for public release  
Distribution Unlimited

14 11/11-17A-3358

LMP-22651  
14  
S-22651

DTIC  
FILMED  
APR 25 1980  
S U A

Accession For	
NTIS G&I	<input checked="" type="checkbox"/>
DDC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/	
Availability Codes	
Dist	Available and/or special
A	

DDC FILE COPY  
300

63109243252

2

27 FEB 1979

OMB NO. 22-R036

## GOVERNMENT-INDUSTRY DATA EXCHANGE PROGRAM

## GENERAL DOCUMENT SUMMARY SHEET

(1) 1 OF 1

Please Type All Information - See Instructions on Reverse

1. ACCESS NUMBER <b>E140-2365</b>	2. COMPONENT/PART NAME PER GIDEP SUBJECT THESAURUS <b>Mechanical Assemblies, Launcher, Rocket</b>	
3. APPLICATION <b>Engineering</b>	4. MFR NOTIFICATION <input type="checkbox"/> NOTIFIED <input checked="" type="checkbox"/> NOT APPLICABLE	5. DOCUMENT ISSUE (Month/Year) <b>November 1978</b>
6. ORIGINATOR'S DOCUMENT TITLE <b>Stress Analysis of the External Stores DP Ejection Launcher/Inner Tube Subsystem</b>	7. DOCUMENT TYPE <input checked="" type="checkbox"/> GEN RPT <input type="checkbox"/> NONSTD PART <input type="checkbox"/> SPEC	
8. ORIGINATOR'S DOCUMENT NUMBER <b>NWC TM 3358</b>	9. ORIGINATOR'S PART NAME/IDENTIFICATION <b>N/A</b>	
10. DOCUMENT (SUPERSEDES) (SUPPLEMENTS) ACCESS NO. <b>None</b>	11. ENVIRONMENTAL EXPOSURE CODES <b>N/A</b>	
12. MANUFACTURER <b>N/A</b>	13. MANUFACTURER PART NUMBER <b>N/A</b>	14. INDUSTRY/GOVERNMENT STANDARD NUMBER
15. OUTLINE, TABLE OF CONTENTS, SUMMARY, OR EQUIVALENT DESCRIPTION  <i>[Handwritten signature]</i>		

The contents of this report are the results of a stress analysis conducted on the critical areas of the DP Ejection Launcher Inner Tube Subsystem. It was determined that the hardware and/or assemblies experiencing the critical load conditions were the tube, power cylinder assembly, detent assembly, warm cable cutter assembly, plumbing fittings and tubing. The stress analyses on these components and subsystems are presented on the following pages in the form of mathematical calculations and accompanying sketches without explanatory text. The drawings in Figures 1-5 (pages 50-54) show how the components relate to the overall system and give more detail on the items tested.

DTIC  
SELECTED  
APR 25 1980  
S E D

L T W G

79 09 24 292

16. KEY WORDS FOR INDEXING <b>Stress Analysis; Inner Tube Subassembly; Safety Factors; External Stores (Doc Des--P)</b>	
17. GIDEP REPRESENTATIVE <b>M. H. Sloan</b>	18. PARTICIPANT ACTIVITY AND CODE <b>Naval Weapons Center, China Lake, CA (X7)</b>

DD FORM 1 NOV 72 2000

REPRODUCTION OR DISPLAY OF THIS MATERIAL FOR  
SALES OR PUBLICITY PURPOSES IS PROHIBITED

64

NWC TM 3358

CONTENTS

Introduction .....	3
Abbreviations and Symbols .....	4
1.0 Tube .....	6
2.0 Power Cylinder Assy .....	7
2.1 Cylinder Wall .....	7
2.2 Threaded Cylinder Heads .....	10
2.3 Traction Rod .....	13
2.4 Threaded Hole, Piston End .....	15
2.5 Pin, Rod End .....	15
2.6 Rod End .....	16
2.7 Cap, Cylinder .....	17
2.8 Bracket, Cylinder .....	19
2.9 Mounting Screws, Bracket .....	20
3.0 Warm Cable Cutter Assy .....	23
3.1 Piston Housing .....	23
3.2 Fasteners, Piston Closure .....	25
4.0 Detent Assy .....	27
4.1 Detent Pin .....	27
4.2 Cover .....	28
4.3 Fasteners, Cover .....	29
4.4 Housing .....	30
4.5 Fasteners, Mounting .....	34
5.0 Lockout Bar .....	38
6.0 Plumbing Lines .....	40
7.0 Pipe and Tube Fittings .....	42
8.0 Summary .....	45

NWC TM 3358

**Figures:**

1.	DP Launcher Inner Tube Actuation System Diagram .....	50
2.	DP Launcher Assy .....	51
3.	DP Power Cylinder Assy .....	52
4.	DP Warm Cable Cutter .....	53
5.	DP Detent Assy .....	54

**Tables:**

8.1	Mechanical Properties Table .....	46
8.2	Data Summary Table .....	47

## INTRODUCTION

The contents of this report are the results of a stress analysis conducted on the critical areas of the DP Ejection Launcher Inner Tube Subsystem. It was determined that the hardware and/or assemblies experiencing the critical load conditions were the tube, power cylinder assembly, detent assembly, warm cable cutter assembly, plumbing fittings and tubing. The stress analyses on these components and subsystems are presented on the following pages in the form of mathematical calculations and accompanying sketches without explanatory text. The drawings in Figures 1-5 (pages 50-54) show how the components relate to the overall system and give more detail on the items tested.

Equations and other data used in this analysis were obtained from the *Machinery's Handbook*<sup>1</sup> and *Formulas for Stress and Strain*.<sup>2</sup>

The materials used throughout this analysis are 304, 316, and 17-4Ph corrosion resistant steel, AMS5700 series steel, and 6061-T6 aluminum alloy. The mechanical properties for all material used in this analysis are shown in Table 8.1, page 46. In all cases the lowest specified values were used to insure a conservative design.

Each area has been analyzed for worst case under the following conditions:

Maximum Internal Pressure ( $P_x$ ) . . . . .	5,000 psi
Internal Operating Pressure ( $P_y$ ) . . . . .	2,000 psi
Maximum External Pressure ( $P_z$ ) . . . . .	700 psi
Maximum Handling Load ( $P_H$ ) . . . . .	25,000 lb

Where worst case load conditions differ from those listed above, they are so noted at the specific point of analysis.

The final result is the safety factor (SF) achieved or in some cases, deflection. These values are listed in the Summary Table 8.2, page 47.

<sup>1</sup> *Machinery's Handbook*, 20th ed. New York, Industrial Press, Inc., 1976.

<sup>2</sup> Raymond J. Roark. *Formulas for Stress and Strain*, 3rd ed. New York, McGraw-Hill, 1971.

NWC TM 3358

ABBREVIATIONS AND SYMBOLS

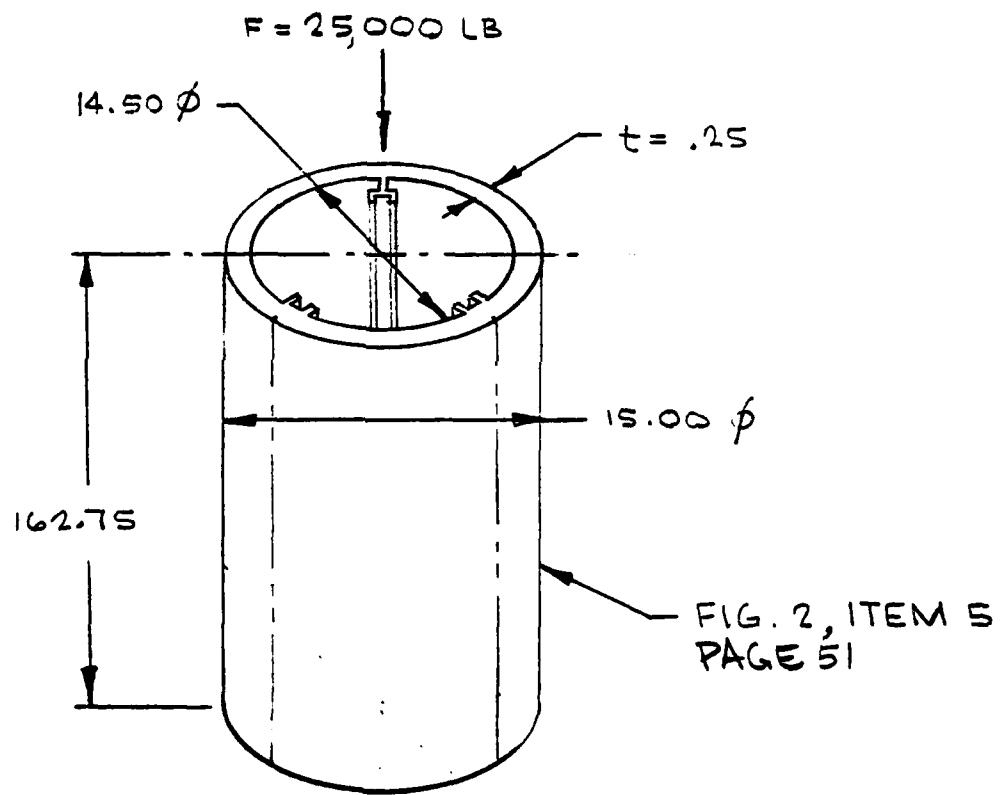
A area ( $\text{in}^2$ )  
Al aluminum  
ALY alloy  
 $B_A$  bearing area ( $\text{in}^2$ )  
 $B_L$  maximum bearing load (lbs)  
 $B_S$  bearing stress (psi)  
CRES corrosion resistant steel  
D outside diameter (in.)  
d inside diameter (in.)  
E modulus of elasticity (psi)  
I moment of inertia  
IN. inches  
 $\lambda$  moment arm (in.)  
LBS pounds  
M moment (in.lbs)  
m I/V  
n number of threads  
P external collapsing pressure (psi)  
 $P'_D$  pitch diameter (in.)  
 $P_E$  ejection load (lbs)  
 $P_H$  handling load (lbs)  
 $P_x$  maximum internal pressure (psi)  
 $P_y$  internal operating pressure (psi)  
 $P_z$  maximum external pressure (psi)  
P thread pitch  
PSI pounds per square inch ( $\text{lbs/in}^2$ )  
R radius (in.)  
 $S_A$  shear area (in.)  
 $S_B$  maximum bending stress (psi)  
 $S_L$  shear load (lbs)  
 $S_S$  shear stress (psi)

NWC TM 3358

$s_2$  hoop membrane stress (psi)  
SF safety factor  
 $T_A$  tensile area (in.<sup>2</sup>)  
 $T_L$  maximum tensile load (lbs)  
 $T_s$  tensile stress (psi)  
 $t$  thickness (in.)  
 $v$  Poisson's ratio  
 $y$  deflection (in.)  
 $Z$  section modulus  
 $\sigma_s$  shear strength (psi)  
 $\sigma_{ULT}$  ultimate tensile strength (psi)  
 $\sigma_{ULTB}$  ultimate bearing strength (psi)  
 $\sigma_y$  yield strength (psi)  
 $\sigma_{yB}$  bearing yield strength (psi)  
 $\phi$  diameter

1.0 TUBE

MATERIAL: SEE TABLE B.1, ITEM 5, PAGE 6  
SOLVING FOR SF

COLUMN LOAD

$$\frac{P_H}{A} = \frac{25,000}{\frac{\pi}{4}[(15)^2 - (14.5)^2]} = \frac{25,000}{11.585} = \underline{\underline{2158 \text{ LBS}/\text{IN}^2}} \quad \leftarrow$$

$$SF = \frac{35,000}{2158} = \underline{\underline{16.22}} \quad \leftarrow$$

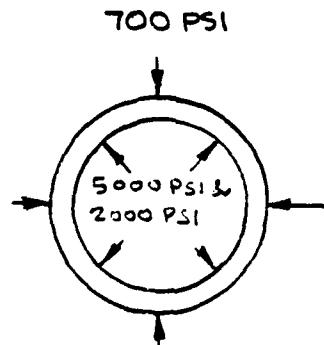
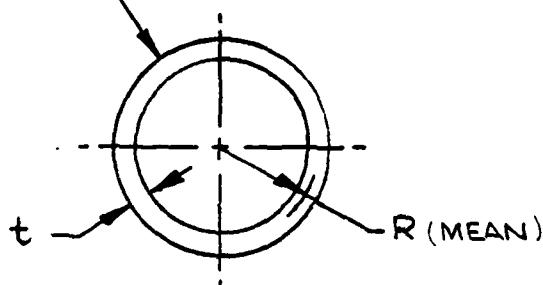
## 2.0 POWER CYLINDER

## 2.1 CYLINDER WALL

MATERIAL: SEE TABLE B.1, ITEM 1, PAGE 46.

SOLVING FOR SF

FIG 3, ITEM 1, PAGE 52

STRESS FROM INTERNAL PRESSURES

$$S_2 @ P_x \text{ & } \sigma_{ULT} \therefore S_2 = \frac{P_x R_{(MEAN)}}{t}$$

WHERE:  $P_x = 5,000 \text{ PSI}$ ,  $R_{(MEAN)} = 1.09375 \text{ IN.}$ ,  $t = .1875 \text{ IN.}$ 

$$\text{THEN } S_2 = \frac{(5000)(1.09375)}{.1875}$$

$$S_2 = \underline{\underline{29,167 \text{ PSI}}} \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_{ULT}}{S_2}$$

$$= \frac{80,000 \text{ PSI}}{29,167 \text{ PSI}}$$

$$\text{SF} = \underline{\underline{2.74}} \leftarrow$$

$$S_2 @ P_y \text{ & } \sigma_y \therefore S_2 = \frac{P_y R_{(MEAN)}}{t}$$

WHERE:  $P_y = 2,000 \text{ PSI}$ ,  $R_{(MEAN)} = 1.09375 \text{ IN.}$ ,  $t = .1875 \text{ IN.}$

$$\text{THEN } S_2 = \frac{(2000)(1.09375)}{.1875}$$

$$S_2 = \underline{11,667 \text{ PSI}} \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_y}{S_2}$$

$$= \frac{30,000 \text{ PSI}}{11,667 \text{ PSI}}$$

$$\text{SF} = \underline{\underline{2.57}} \leftarrow$$

### STRESS FROM EXTERNAL PRESSURE

$$P' = \frac{t}{R} \left[ \frac{\sigma_y}{1 + 4 \left( \frac{\sigma_y}{E} \right) \left( \frac{R}{t} \right)^2} \right]$$

$$P' = \frac{.1875}{1.09375} \left[ \frac{30 \times 10^3}{1 + 4 \left( \frac{30 \times 10^3}{28 \times 10^6} \right) \left( \frac{1.09375}{.1875} \right)^2} \right]$$

$$P' = (.1714) \left[ \frac{30 \times 10^3}{1 + (4.2857 \times 10^{-3})(34.028)} \right]$$

$$P' = (.1714) \left[ \frac{30 \times 10^3}{1.1458} \right]$$

$$P' = \underline{4488 \text{ PSI}} \leftarrow$$

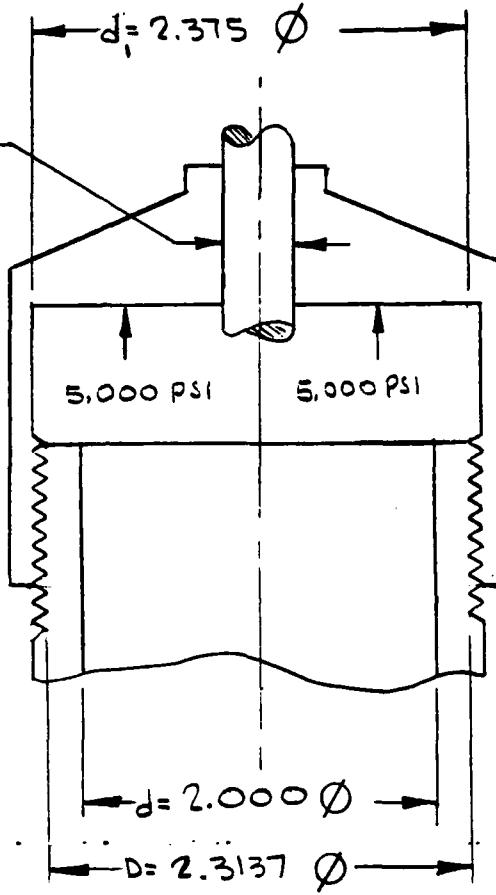
$$\text{EXISTING SF} = \frac{P'}{P_x}$$

$$= \frac{4488 \text{ PSI}}{700 \text{ PSI}}$$

$$\text{SF} = \underline{\underline{6.41}} \leftarrow$$

CYLINDER WALL, THREADED ENDSOLVING FOR SF

~~NOTE:~~  
 DISREGARD ROD DIA  
 FOR MAX. LOAD ON  
 THREADS.

TENSILE LOAD ON  
 THREADED PORTION  
 OF CYLINDER WALL

$$T_L = P_x A ; A = \frac{\pi}{4} d^2 = (.7854)(2.375)^2 = (.7854)(5.6406) = 4.4301 \text{ IN}^2$$

$$\therefore T_L = (5000)(4.4301)$$

$$T_L = \underline{22,151 \text{ LB}} \leftarrow$$

$$T_A = \frac{\pi}{4} [D^2 - d^2] = (.7854) [(2.3137)^2 - (2)^2]$$

$$= (.7854) [5.3532] - (4)$$

$$T_A = \underline{1.0628 \text{ IN}^2} \leftarrow$$

$$T_s = \frac{T_A}{T_L} = \frac{22151}{1.0628}$$

$$T_s = \underline{20,842 \text{ PSI}} \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_{ULT}}{T_s}$$

$$= \frac{80,000 \text{ PSI}}{20,842 \text{ PSI}}$$

$$\text{SF} = \underline{3.84} \leftarrow$$

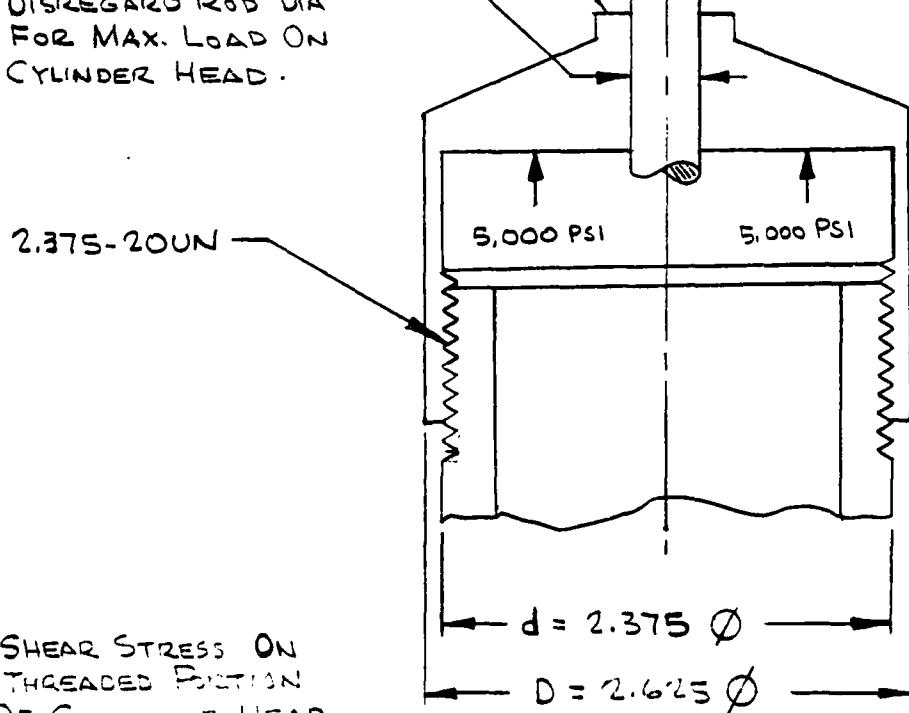
## 2.2 THREADED CYLINDER HEAD

MATERIAL: SEE TABLE 8.1, ITEM 1, PAGE 46.

SOLVING FOR SF

FIG. 3, ITEM 3, PAGE 52

NOTE:  
DISREGARD ROD DIA  
FOR MAX. LOAD ON  
CYLINDER HEAD.



SHEAR STRESS ON  
THREADED POSITION  
OF CYLINDER HEAD

$$T_L = P_x A, A = 4.4301 \text{ (FROM PAGE 9)}$$

$$T_L = \underline{22,151 \text{ LB}} \leftarrow \text{ (FROM PAGE 9)}$$

$$T_A = \pi P_o \frac{D}{2} n$$

$$T_A = \pi (2.3425) \left(\frac{0.5}{2}\right) (20)$$

$$T_A = \underline{3.6796 \text{ IN}^2} \leftarrow$$

$$T_S = \frac{T_L}{T_A} = \frac{22,151 \text{ LB}}{3.6796 \text{ PSI}}$$

$$T_S = \underline{6,020 \text{ PSI}} \leftarrow$$

$$\begin{aligned} \text{EXISTING SF} &= \frac{\sigma_s}{T_S} \\ &= \frac{15,000 \text{ PSI}}{6,020 \text{ PSI}} \end{aligned}$$

$$SF = \underline{\underline{2.49}} \leftarrow$$

TENSILE LOAD ON THREAD RELIEF AREA OF HEAD @ 5,000 PSI  
& 2,000 PSI CYLINDER PRESSURE.

$$T_L @ 5,000 \text{ PSI} = 22,151 \text{ LB (FROM PAGE 9)}$$

$$\begin{aligned} T_A &= \frac{\pi}{4} D^2 - \frac{\pi}{4} d^2 \\ &= (.7854) [(2.625)^2 - (2.375)^2] \\ &= (.7854) [(6.890625) - (5.640625)] \end{aligned}$$

$$T_A = \underline{.9817 \text{ IN}^2} \leftarrow$$

$$\begin{aligned} T_S &= \frac{T_L}{T_A} \\ &= \frac{22,151 \text{ LB}}{.9817 \text{ IN}^2} \end{aligned}$$

$$T_S = \underline{22,564 \text{ PSI}} \leftarrow$$

$$\begin{aligned} \text{EXISTING SF} &= \frac{\sigma_{ULT}}{T_S} \\ &= \frac{80,000 \text{ PSI}}{22,564 \text{ PSI}} \end{aligned}$$

$$SF = \underline{\underline{3.55}} \leftarrow$$

$$T_L @ 2000 \text{ PSI} = P_y(A) \quad A = 4.4301 \text{ IN}^2 \text{ (FROM PAGE 9)}$$

$$= 2000 \text{ LBS/IN}^2 \times 4.4301 \text{ IN}^2$$

$$T_L = \underline{8860 \text{ LBS}} \leftarrow$$

$$T_A = \underline{.9817 \text{ IN}^2} \leftarrow \text{ (FROM PAGE 11)}$$

$$T_s = \frac{T_L}{T_A}$$

$$= \frac{8860 \text{ LBS}}{.9817 \text{ IN}^2}$$

$$T_s = \underline{9025 \text{ LBS/IN}^2} \leftarrow$$

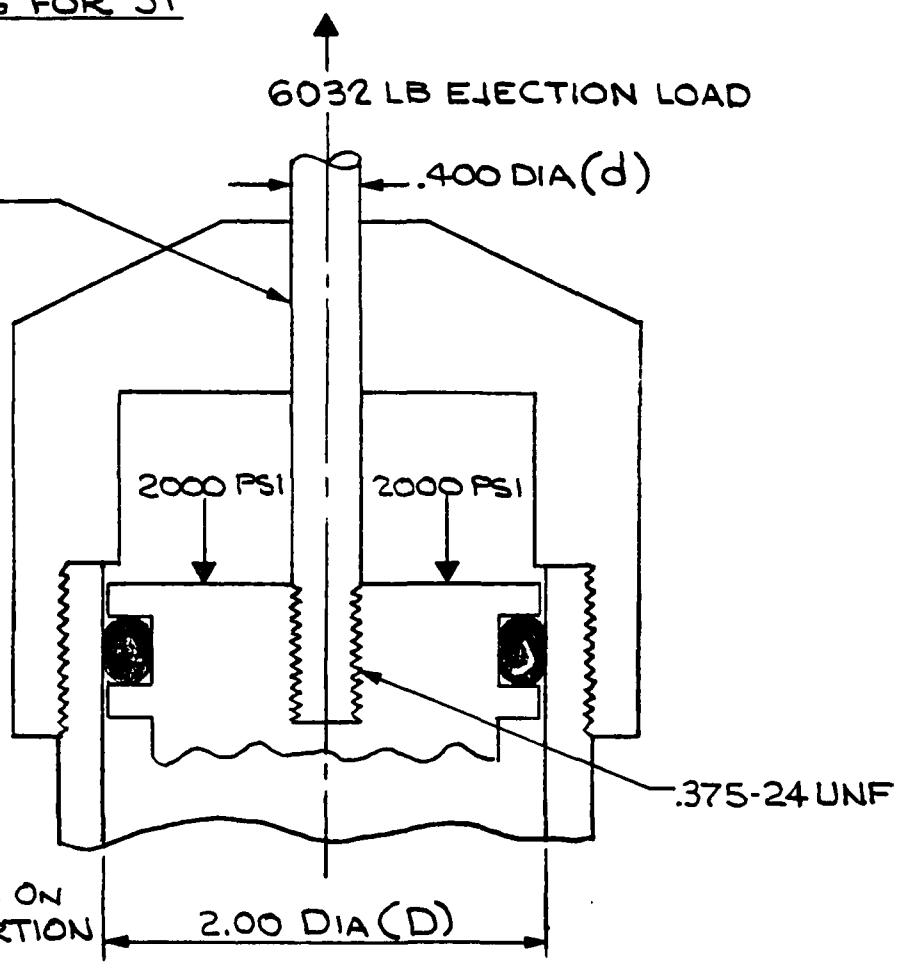
$$\text{EXISTING SF} = \frac{\sigma_y}{T_s}$$

$$= \frac{30,000 \text{ LBS/IN}^2}{9,025 \text{ LBS/IN}^2}$$

$$\text{SF} = \underline{\underline{3.32}} \leftarrow$$

2.3 TRACTION ROD

MATERIAL: SEE TABLE 8.1, ITEM 2 , PAGE 46

SOLVING FOR SFFIG.3, ITEM 5,  
PAGE 52

$$T_L = P_y(A) \quad A = \frac{\pi}{4} D^2 - \frac{\pi}{4} d^2 = \frac{\pi}{4} (2.00)^2 - \frac{\pi}{4} (.400)^2 = 3.016 \text{ IN}^2 \\ = 2000 \text{ LBS/IN}^2 \times 3.016 \text{ IN}^2$$

$$T_L = \underline{6032 \text{ LBS}} \leftarrow$$

$$T_A = \pi P_D \left(\frac{P}{2}\right)(n) \quad P_D = .3430, \quad P = .04167, \quad n = 16.5$$

$$= 3.1416 \times .3430 \left(\frac{.04167}{2}\right) \times 16.5$$

$$= 3.1416 \times .3430 \times .0208 \times 16.5$$

$$T_A = \underline{.3698 \text{ IN}^2} \leftarrow$$

$$T_S = \frac{T_L}{T_A}$$

$$= \frac{6032 \text{ LBS}}{.3698 \text{ IN}^2}$$

$$T_S = \underline{16,311 \text{ LBS/IN}^2} \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_s}{T_S}$$

$$= \frac{72,500 \text{ LBS/IN}^2}{16,311 \text{ LBS/IN}^2}$$

$$\text{SF} = \underline{4.44} \leftarrow$$

### TENSILE STRESS ON ROD USING MINOR THREAD DIA

$$\text{NOTE: } T_L = \underline{6032 \text{ LBS}} \leftarrow$$

$$T_A = \frac{\pi}{4} (.3228)^2 \quad \text{NOTE: } .3228 = \text{MINOR THREAD DIA.}$$

$$= .7854 \times .1042$$

$$T_A = \underline{.0818 \text{ IN}^2} \leftarrow$$

$$T_S = \frac{T_L}{T_A}$$

$$= \frac{6032 \text{ LBS}}{.0818 \text{ IN}^2}$$

$$T_S = \underline{73,740 \text{ LBS/IN}^2} \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_y}{T_S} = \frac{145,000 \text{ LBS/IN}^2}{73,740 \text{ LBS/IN}^2} = \underline{1.97} \leftarrow$$

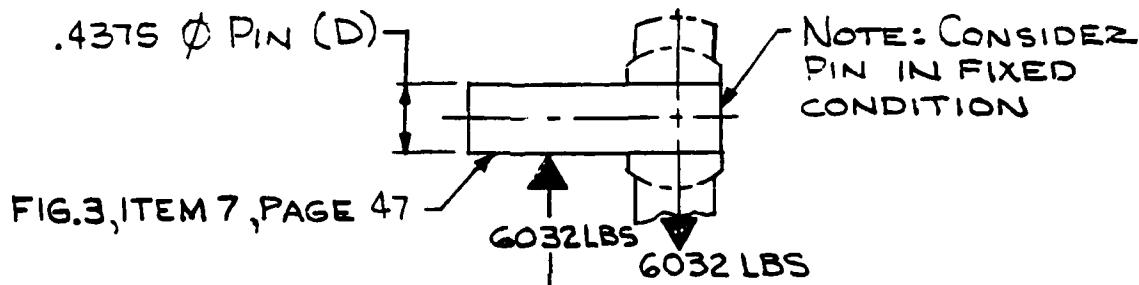
## 2.4 THREADED HOLE, PISTON, CYLINDER

NOTE: THE PISTON & ROD MATERIAL IS IDENTICAL  
SO THE PREVIOUS THREAD CALCULATIONS  
FOR THE ROD (PAGES 8 & 9) ALSO APPLY  
TO THE PISTON THREADS.

## 2.5 PIN, ROD END

MATERIAL: SEE TABLE 8.1, ITEM 2, PAGE 46

SOLVING FOR SF



$$S_L = T_L \quad T_L = 6032 \text{ LBS} \text{ (FROM PAGE 13)}$$

$$S_L = \underline{6032 \text{ LBS}} \leftarrow$$

$$\begin{aligned} S_A &= \frac{\pi}{4} D^2 \\ &= .7854 (.4375)^2 \end{aligned}$$

$$= .7854 \times .1914$$

$$S_A = \underline{.1503 \text{ IN}^2} \leftarrow$$

$$\begin{aligned} S_S &= \frac{S_L}{S_A} \\ &= \frac{6032 \text{ LBS}}{.1503 \text{ IN}^2} \end{aligned}$$

$$S_S = \underline{40,133 \text{ LBS/IN}^2} \leftarrow$$

$$\text{EXISTING SF} = \frac{S_S}{S_S} = \frac{72,500 \text{ LBS/IN}^2}{40,133 \text{ LBS/IN}^2} = \underline{\underline{1.806}} \leftarrow$$

2.6 ROD END, THREADED

MATERIAL: SEE TABLE 8.1, ITEM 1, PAGE 46

SOLVING FOR SF

$$T_A = \frac{\pi}{4} [(0.562)^2 - (0.375)^2]$$

$$T_A = .1376 \text{ IN}^2 \leftarrow$$

$$T_L = 6,032 \text{ LBS} \text{ (FROM PAGE 13)}$$

$$T_S = \frac{T_L}{T_A}$$

$$= \frac{6,032 \text{ LBS}}{.1376 \text{ IN}^2}$$

$$T_S = \underline{43,837 \text{ LBS/IN}^2} \leftarrow$$

$$\sigma_{ULT} = \frac{11,250 \text{ LB}}{\text{IN}^2}$$

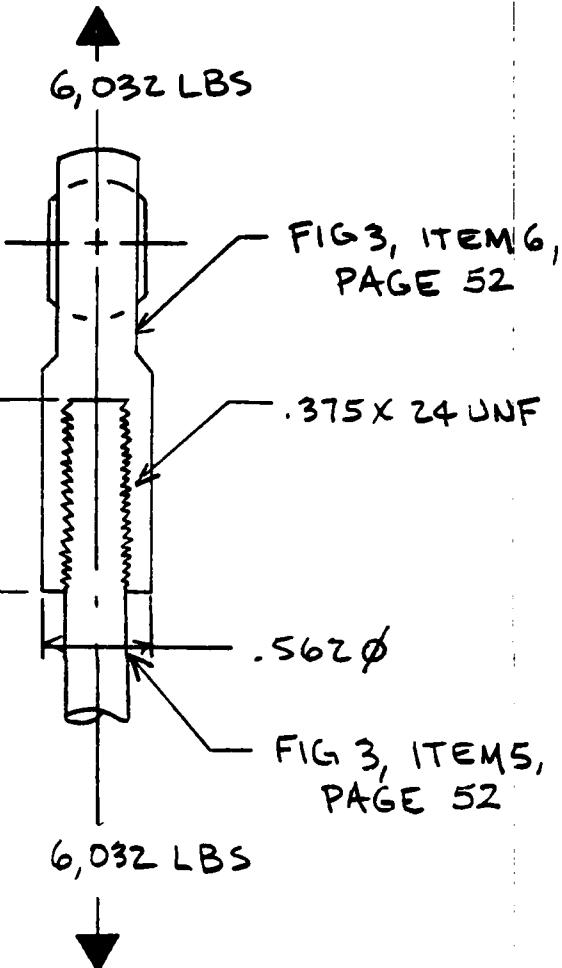
$$= \frac{11,250}{.1376}$$

$$\sigma_{ULT} = \underline{81,759 \text{ LBS/IN}^2} \leftarrow$$

$$\text{EXISTING SF} = \frac{81,759 \text{ LBS/IN}^2}{43,837 \text{ LBS/IN}^2}$$

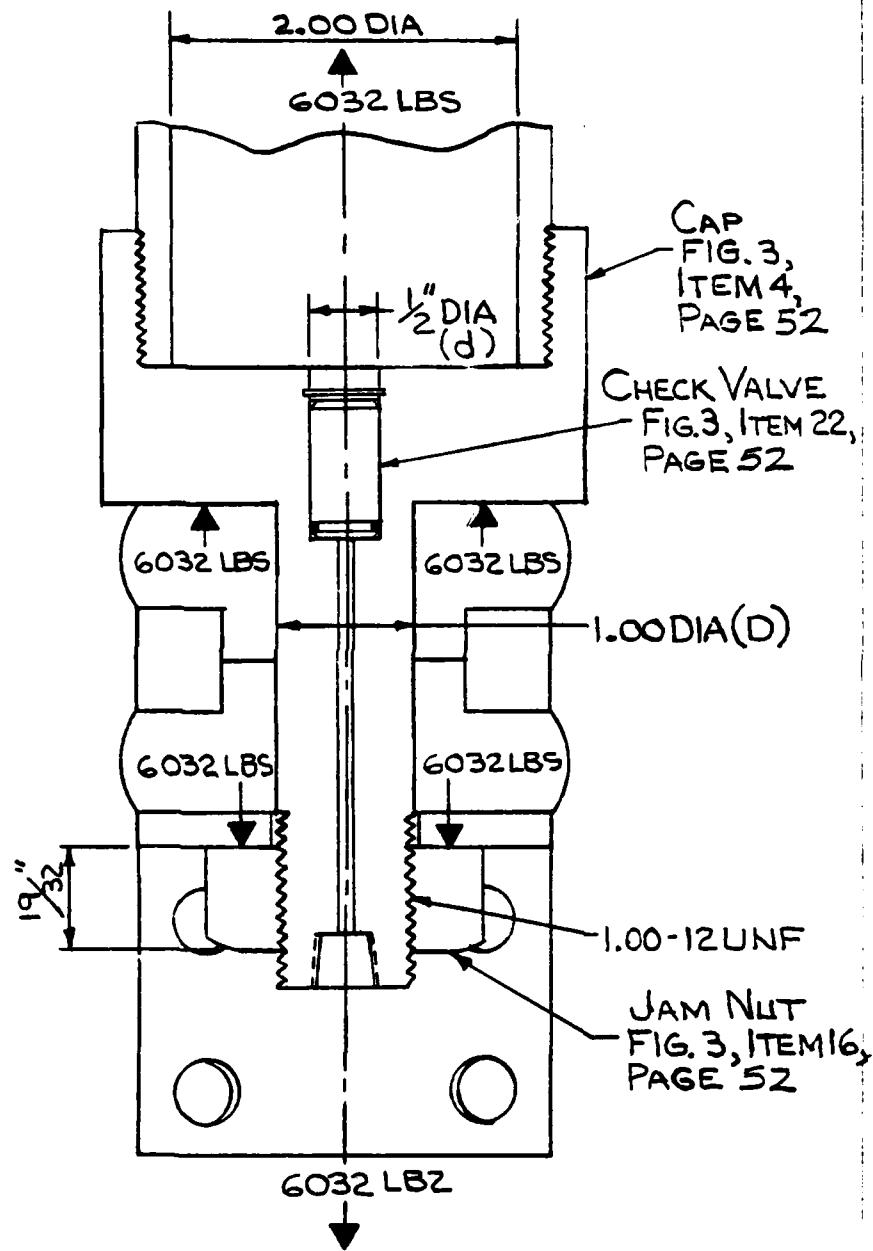
$$\text{SF} = \underline{1.87} \leftarrow$$

NOTE: 11,250 LB WAS OBTAINED FROM VENDOR SPEC,  
REF. SOUTHWEST PRODUCTS CO., P/N 2DREF-6.



2.7 CAP, CYLINDER

MATERIAL: SEE TABLE B.1, ITEM 1, PAGE 46

SOLVING FOR SF

NOTE: THE INSIDE DIA THREADS ON THE CYLINDER CAP & HEAD ARE IDENTICAL SO THE PREVIOUS THREAD CALCULATIONS FOR THE HEAD (PAGES 13 & 14) ALSO APPLY TO THE CYLINDER CAP.

CONSIDER THE TENSILE STRESS ON THE THINNEST WALL SECTION IN THE CHECK VALVE AREA OF THE CYLINDER CAP.

NOTE:  $T_L = \underline{6032 \text{ LBS}}$  ← (FROM  $T_L$  ON PAGE 13)

$$\begin{aligned} T_A &= \frac{\pi}{4} D^2 - \frac{\pi}{4} d^2 \\ &= .7854(1.00)^2 - .7854(.500)^2 \\ &= .7854 - .19635 \end{aligned}$$

$$T_A = \underline{.589} \leftarrow$$

$$\begin{aligned} T_S &= \frac{T_L}{T_A} \\ &= \frac{\underline{6032 \text{ LBS}}}{.589} \end{aligned}$$

$$T_S = \underline{10,241 \text{ LBS/IN}^2} \leftarrow$$

$$\begin{aligned} \text{EXISTING SF} &= \frac{\delta_Y}{T_S} \\ &= \frac{30,000 \text{ LBS/IN}^2}{10,241 \text{ LBS/IN}^2} \end{aligned}$$

$$SF = \underline{2.93} \leftarrow$$

CONSIDER THE SHEAR STRESS ON JAM NUT THREADS.

NOTE:  $T_L = \underline{6032 \text{ LBS}}$  ← (FROM  $T_L$  ON PAGE 13)

$$\begin{aligned} T_A &= \pi P_D \left(\frac{P}{2}\right)(n) \quad P_D = .9459, P = .0833, n = 7.125 \\ &= 3.1416 \times .9459 \times \left(\frac{.0833}{2}\right) \times 7.125 \\ &= 3.1416 \times .9459 \times .0416 \times 7.125 \end{aligned}$$

$$T_A = \underline{.880 \text{ IN}^2} \leftarrow$$

$$T_s = \frac{T_L}{T_A}$$

$$= \frac{6032 \text{ LBS}}{.880 \text{ IN}^2}$$

$$T_s = \underline{6854 \text{ LBS/IN}^2} \quad \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_s}{T_s}$$

$$= \frac{15,000 \text{ LBS/IN}^2}{6,854 \text{ LBS/IN}^2}$$

$$\text{SF} = \underline{2.19} \quad \leftarrow$$

## 2.8 BRACKET, CYLINDER

MATERIAL: SEE TABLE 8.1, ITEM 2, PAGE 46

SOLVING FOR SF

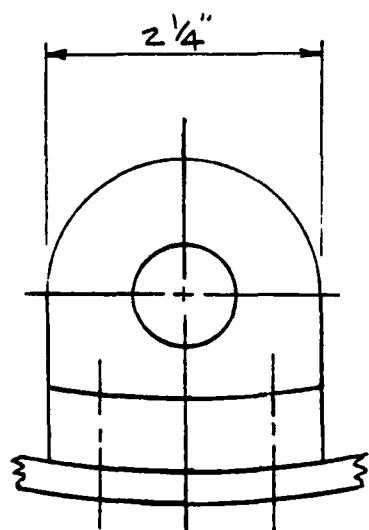
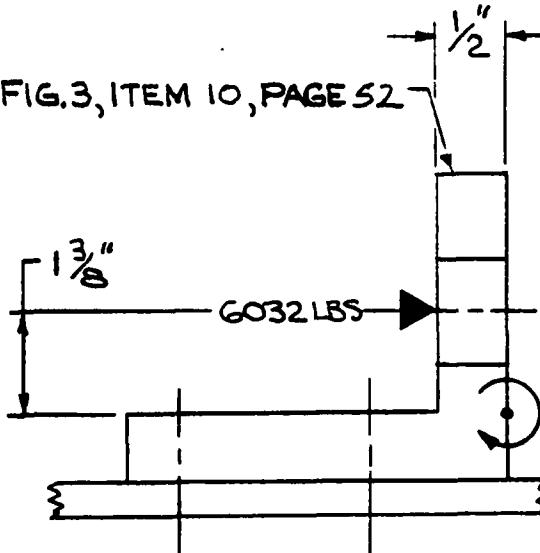


FIG.3, ITEM 10, PAGE 52



BENDING @ 2000PSI = 6032 LBS (PAGE 13)

$$S_B = \frac{M}{Z}$$

$$S_B = \frac{8294 \text{ IN-LBS}}{.09375 \text{ IN}^3}$$

$$S_B = \underline{88,470 \text{ LBS/IN}^2} \leftarrow$$

$$M = 6032 \text{ LBS} \times 1.375 \text{ INS.} \\ = \underline{8294 \text{ IN-LBS}} \leftarrow$$

$$Z = \frac{bd^2}{6} \quad b = 2.25 \text{ INS.}, d = .50 \text{ INS.} \\ = \frac{(2.25)(.50)^2}{6} \\ = \frac{6}{2.25 \text{ INS} \times .25 \text{ IN}^2} \\ = \underline{.09375 \text{ IN}^3} \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_r}{S_B}$$

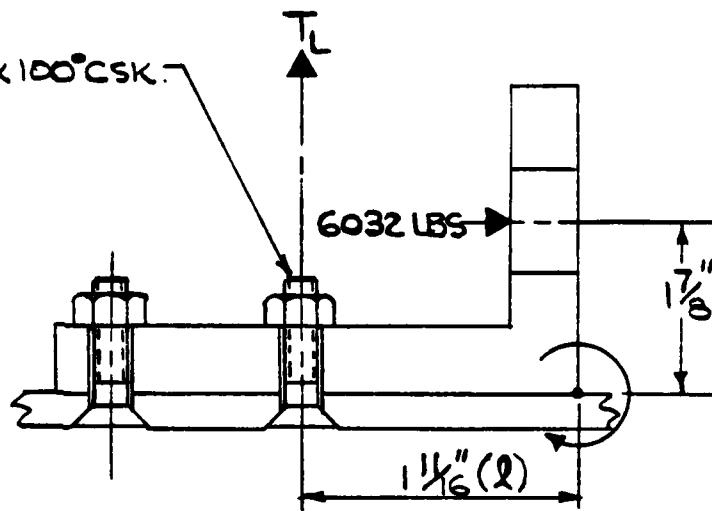
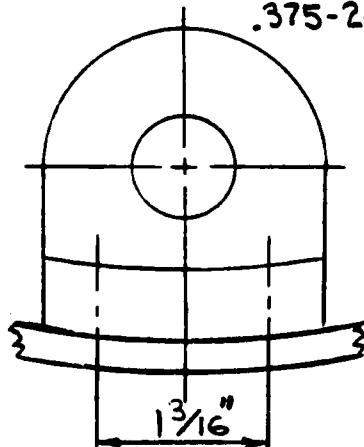
$$= \frac{145,000 \text{ LBS/IN}^2}{88,470 \text{ LBS/IN}^2}$$

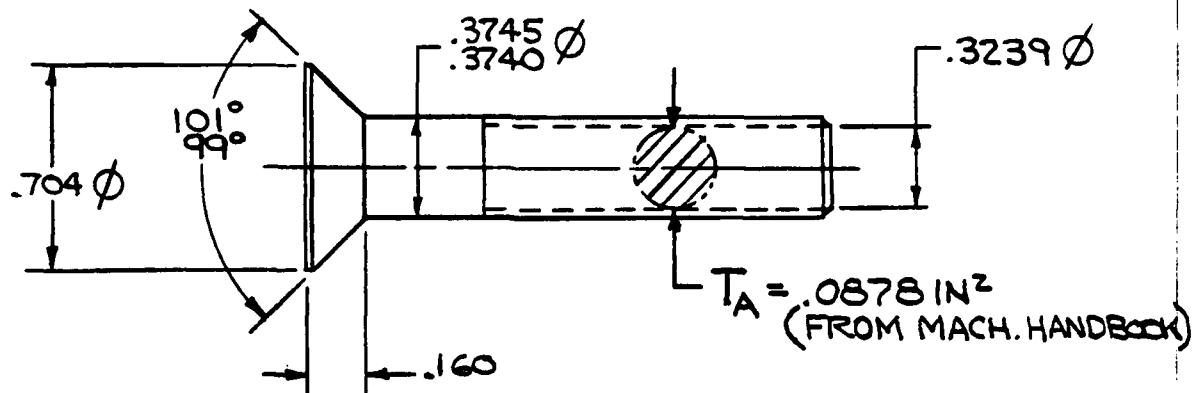
$$\text{SF} = \underline{1.64} \leftarrow$$

## 2.9 MOUNTING SCREWS, BRACKET, CYLINDER

MATERIAL: SEE TABLE 8.1, ITEM 4, PAGE 46

SOLVING FOR SF





MILITARY STANDARD  
ZINC CHROMATE SQUARE

CONSIDER 2 SCREWS ARE TAKING THE TOTAL LOAD IN TENSION THEN CHECK THE TS & SF/SCREW.

$$T_L = \frac{1}{2} \left[ \frac{M}{\lambda} \right] \quad M = 6032 \text{ LBS} \times 1.875 \text{ INS} = 11,310 \text{ IN-LBS}$$

$$\lambda = 1.6875 \text{ INS.}$$

$$= .5 \left[ \frac{11,310 \text{ IN-LBS.}}{1.6875 \text{ INS}} \right]$$

$$= .5 \times 6702 \text{ LBS}$$

$$T_L = \underline{\underline{3,351 \text{ LBS}}} \quad \leftarrow$$

$$T_A = \underline{\underline{.0878 \text{ IN}^2}} \quad \leftarrow$$

$$T_S = \frac{T_L}{T_A}$$

$$= \frac{3,351 \text{ LBS}}{.0878 \text{ IN}^2}$$

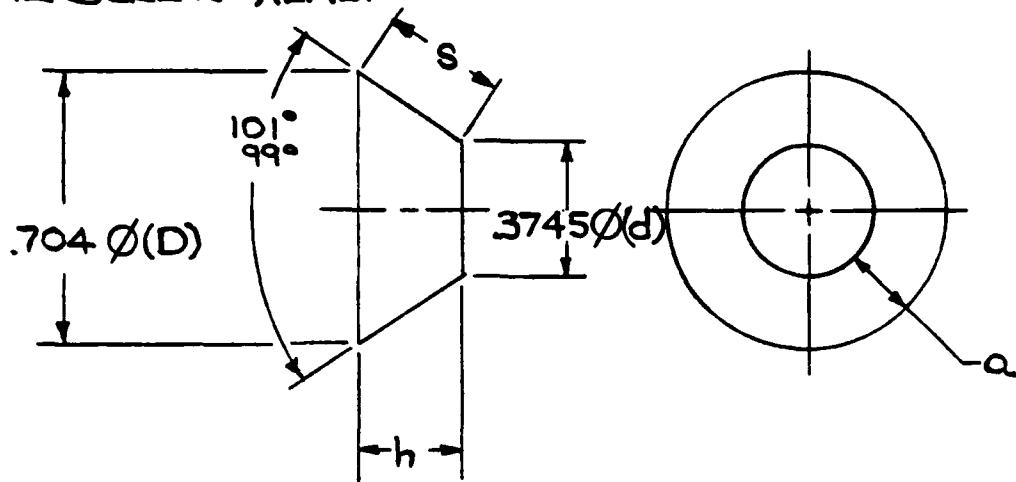
$$T_S = \underline{\underline{38,166 \text{ LBS/IN}^2}} \quad \leftarrow$$

$$\text{EXISTING SF} = \frac{6Y}{T_S}$$

$$= \frac{91,000 \text{ LBS/IN}^2}{38,166 \text{ LBS/IN}^2}$$

$$SF = \underline{\underline{2.38}} \quad \leftarrow$$

CONSIDER THE MAX. BEARING LOAD ON THE SKIN  
RESULTING FROM THE PROJECTED AREA UNDER  
THE SCREW HEAD.



## AREA OF CONICAL SURFACE( $\text{IN}^2$ ), FROM MACHINERY HANDBOOK

$$A = 1.5708 \cdot s(D+d) \quad s = \sqrt{a^2 + h^2} \quad a = \frac{1}{2}(D-d)$$

$$A = 1.5708(.2162)(.704 + .3745) \quad S = \sqrt{(.16475)^2 + (.140)^2} \quad a = .5(.704 - .3745)$$

$$A = 1.5708(2162)(1.0785) \quad S = \sqrt{.02714 + .0196} \quad a = .16475 \text{ INS.}$$

$$A = \underline{.3661 N^2} \leftarrow \quad S = \sqrt{.04674} \quad h = .160 - .020$$

$$S = .2162 \text{ INS.} \quad h = .140 \text{ INS.}$$

$B_L = T_L$   $T_L = 3,351 \text{ LBS}$  (FROM PAGE 16)

$$B_L = \underline{3,351 \text{ LBS}} \leftarrow$$

$$B_A = A \quad A = .3661$$

$$B_S = \frac{B_L}{B_A}$$

$$= \frac{3351 \text{ LBS}}{366 \text{ IN}^2}$$

$$B_s = \underline{9.155 \text{ LBS/IN}^2}$$

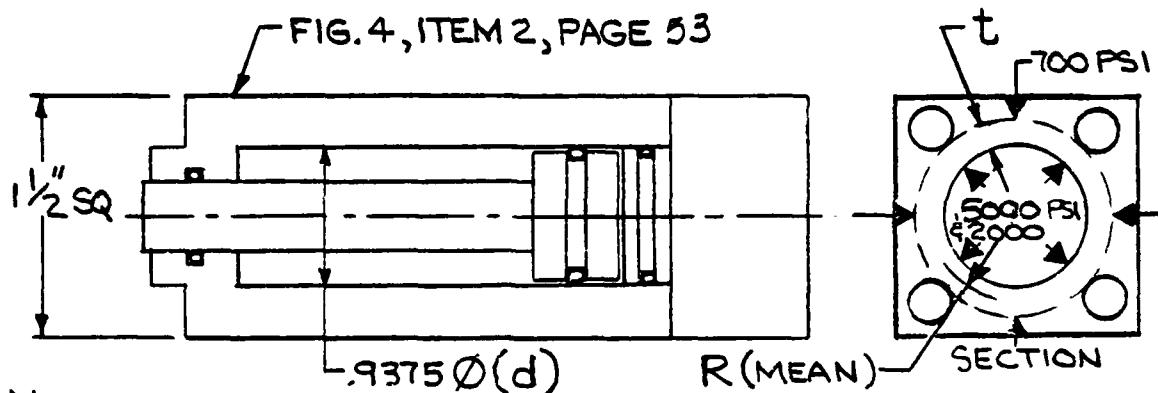
$$\text{EXISTING SF} = \frac{\sigma_{YB}}{B_s} = \frac{56,000 \text{ LBS}/\text{IN}^2}{9,155 \text{ LBS}/\text{IN}^2} = \underline{\underline{6.12}} \quad \leftarrow$$

### 3.0 WARM CABLE CUTTER ASSEMBLY

#### 3.1 PISTON HOUSING

MATERIAL: SEE TABLE 8.1, ITEM 1, PAGE 46

SOLVING FOR SF



NOTE:

THE PISTON HOUSING IS 1 1/2" SQUARE BUT BECAUSE OF 4 DRILLED HOLES THRU THE HOUSING ASSUME A CYLINDRICAL TUBE OF 1 5/32" O.D. X 15/16" I.D. FOR THE FOLLOWING CALCULATIONS.

STRESS FROM INTERNAL PRESSURES @  $P_x$  &  $\sigma_{ult}$

$$S_2 = \frac{P_x R}{t} \quad P_x = 5000 \text{ LBS/IN}^2, R = .5235 \text{ INS.}, t = .1094 \text{ INS.}$$

$$= \frac{5000 \text{ LBS/IN}^2 \times .5235 \text{ INS}}{.1094 \text{ INS}}$$

$$S_2 = \underline{\underline{23,926 \text{ LBS/IN}^2}} \quad \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_{ult}}{S_2}$$

$$= \frac{80,000 \text{ LBS/IN}^2}{23,926 \text{ LBS/IN}^2}$$

$$SF = \underline{\underline{3.34}} \quad \leftarrow$$

INTERNAL STRESS @  $R_y \neq \delta_y$ 

$$S_2 = \frac{P_y R}{t} \quad P_y = 2000 \text{ LBS/IN}^2, R = .5235 \text{ IN}, t = .1094 \text{ IN}$$

$$= \frac{2000 \text{ LBS/IN}^2 \times .5235 \text{ IN}}{.1094 \text{ IN}}$$

$$S_2 = 9570 \text{ LBS/IN}^2 \leftarrow$$

$$\text{EXISTING SF} = \frac{\delta_y}{S_2}$$

$$= \frac{30000 \text{ LBS/IN}^2}{9570 \text{ LBS/IN}^2}$$

$$\text{SF} = \underline{3.13} \leftarrow$$

STRESS FROM EXTERNAL PRESSURE @  $P_z$  &  $P'$ 

$$P' = \frac{t}{R} \left[ \frac{\delta_y}{1 + 4 \left( \frac{\delta_y}{E} \right) \left( \frac{R}{t} \right)^2} \right]$$

$$P' = \frac{.1094}{.5235} \left[ \frac{30 \times 10^3}{1 + 4 \left( \frac{30 \times 10^3}{28 \times 10^6} \right) \left( \frac{.5235}{.1094} \right)} \right]$$

$$P' = .2089 \left[ \frac{30 \times 10^3}{1 + 4.2857 \times 10^{-3} \times 4.785} \right]$$

$$P' = .2089 \left[ \frac{30 \times 10^3}{1.0205} \right]$$

$$P' = \underline{6141 \text{ LBS/IN}^2} \leftarrow$$

$$\text{EXISTING SF} = \frac{P'}{P_z} = \frac{6141 \text{ LBS/IN}^2}{700 \text{ LBS/IN}^2} = \underline{8.77} \leftarrow$$

3.2 FASTENERS, PISTON CLOSURE

MATERIAL : SEE TABLE 8.1, ITEM 3, PAGE 46

SOLVING FOR SFFASTENER; MS9706-35,  $\frac{1}{4}$ -28 UNF  $\times 2\frac{3}{4}$ " LONG,  
4 REQ'D., FIG. 4, ITEM 12, PAGE 53.CONSIDER THE SHEAR STRESS ON FASTENER THREADS

$$T_L = P_x A \quad A = \frac{\pi}{4} (d)^2 = .7854 (.9375)^2 = .690 \text{ IN}^2 \leftarrow$$

$$= 5000 \text{ LBS/IN}^2 \times .690 \text{ IN}^2$$

$$T_L = \frac{3450 \text{ LBS}}{4 \text{ BOLTS}} = \underline{862.5 \text{ LBS}} \leftarrow$$

$$T_A = \pi P_0 \left( \frac{P}{2} \right) (n) \quad P_D = .2225, P = .03571, n = 8.75$$

$$= 3.1416 \times .2225 \left( \frac{.03571}{2} \right) 8.75$$

$$= 3.1416 \times .2225 \times .017855 \times 8.75$$

$$T_A = \underline{.1092 \text{ IN}^2} \leftarrow -$$

$$\begin{aligned} T_S &= \frac{T_L}{T_A} \\ &= \frac{862.5 \text{ LBS}}{.1092 \text{ IN}^2} \end{aligned}$$

$$T_S = \underline{7898 \text{ LBS/IN}^2} \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_s}{T_S}$$

$$= \frac{57,500 \text{ LBS/IN}^2}{7,898 \text{ LBS/IN}^2}$$

$$\text{SF} = \underline{7.28} \leftarrow$$

CONSIDER TENSILE STRESS ON MINIMUM THREADED DIA.

$$T_L = \underline{862.5 \text{ LBS}} \leftarrow (\text{FROM PAGE 20})$$

$$T_A = \frac{\pi}{4} D^2 \quad D = \text{MINOR THREAD DIA} = .2062 \text{ IN.}$$

$$= .7854 (.2062)^2$$

$$= .7854 \times .04252$$

$$T_A = \underline{.0334 \text{ IN}^2} \leftarrow$$

$$T_S = \frac{T_L}{T_A}$$

$$= \frac{\underline{862.5 \text{ LBS}}}{.0334 \text{ IN}^2}$$

$$T_S = 25,823 \text{ LBS/IN}^2$$

$$\text{EXISTING SF} = \frac{\text{GULT}}{T_S}$$

$$= \frac{155,000 \text{ LBS/IN}^2}{25,823 \text{ LBS/IN}^2}$$

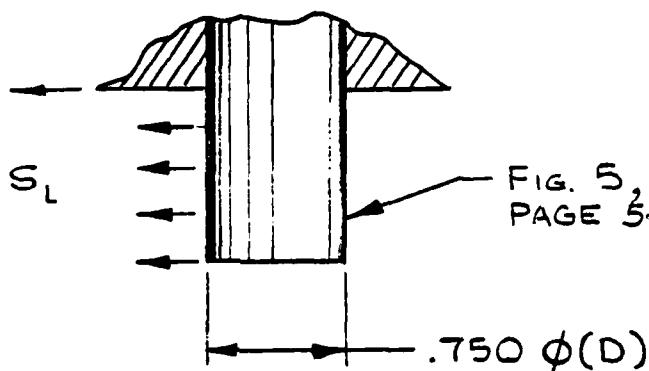
$$\text{SF} = \underline{6.00} \leftarrow$$

4.0 DETENT ASSEMBLY4.1 DETENT PIN

MATERIAL: SEE TABLE 8.1, ITEM 2, PAGE 46

SOLVING FOR SF ON HANDLING SHEAR

42 181 200 382 100 383 5 SQUARE  
 44 182 200 383 100 384 5 SQUARE  
 46 183 200 384 100 385 5 SQUARE  
 48 184 200 385 100 386 5 SQUARE  
 50 185 200 386 100 387 5 SQUARE  
 52 186 200 387 100 388 5 SQUARE  
 54 187 200 388 100 389 5 SQUARE  
 56 188 200 389 100 390 5 SQUARE  
 58 189 200 390 100 391 5 SQUARE  
 60 190 200 391 100 392 5 SQUARE  
 62 191 200 392 100 393 5 SQUARE  
 64 192 200 393 100 394 5 SQUARE  
 66 193 200 394 100 395 5 SQUARE  
 68 194 200 395 100 396 5 SQUARE  
 70 195 200 396 100 397 5 SQUARE  
 72 196 200 397 100 398 5 SQUARE  
 74 197 200 398 100 399 5 SQUARE  
 76 198 200 399 100 400 5 SQUARE  
 78 199 200 400 100 401 5 SQUARE  
 80 200 200 401 100 402 5 SQUARE  
 82 201 200 402 100 403 5 SQUARE  
 84 202 200 403 100 404 5 SQUARE  
 86 203 200 404 100 405 5 SQUARE  
 88 204 200 405 100 406 5 SQUARE  
 90 205 200 406 100 407 5 SQUARE  
 92 206 200 407 100 408 5 SQUARE  
 94 207 200 408 100 409 5 SQUARE  
 96 208 200 409 100 410 5 SQUARE  
 98 209 200 410 100 411 5 SQUARE  
 100 210 200 411 100 412 5 SQUARE  
 102 211 200 412 100 413 5 SQUARE  
 104 212 200 413 100 414 5 SQUARE  
 106 213 200 414 100 415 5 SQUARE  
 108 214 200 415 100 416 5 SQUARE  
 110 215 200 416 100 417 5 SQUARE  
 112 216 200 417 100 418 5 SQUARE  
 114 217 200 418 100 419 5 SQUARE  
 116 218 200 419 100 420 5 SQUARE  
 118 219 200 420 100 421 5 SQUARE  
 120 220 200 421 100 422 5 SQUARE  
 122 221 200 422 100 423 5 SQUARE  
 124 222 200 423 100 424 5 SQUARE  
 126 223 200 424 100 425 5 SQUARE  
 128 224 200 425 100 426 5 SQUARE  
 130 225 200 426 100 427 5 SQUARE  
 132 226 200 427 100 428 5 SQUARE  
 134 227 200 428 100 429 5 SQUARE  
 136 228 200 429 100 430 5 SQUARE  
 138 229 200 430 100 431 5 SQUARE  
 140 230 200 431 100 432 5 SQUARE  
 142 231 200 432 100 433 5 SQUARE  
 144 232 200 433 100 434 5 SQUARE  
 146 233 200 434 100 435 5 SQUARE  
 148 234 200 435 100 436 5 SQUARE  
 150 235 200 436 100 437 5 SQUARE  
 152 236 200 437 100 438 5 SQUARE  
 154 237 200 438 100 439 5 SQUARE  
 156 238 200 439 100 440 5 SQUARE  
 158 239 200 440 100 441 5 SQUARE  
 160 240 200 441 100 442 5 SQUARE  
 162 241 200 442 100 443 5 SQUARE  
 164 242 200 443 100 444 5 SQUARE  
 166 243 200 444 100 445 5 SQUARE  
 168 244 200 445 100 446 5 SQUARE  
 170 245 200 446 100 447 5 SQUARE  
 172 246 200 447 100 448 5 SQUARE  
 174 247 200 448 100 449 5 SQUARE  
 176 248 200 449 100 450 5 SQUARE  
 178 249 200 450 100 451 5 SQUARE  
 180 250 200 451 100 452 5 SQUARE  
 182 251 200 452 100 453 5 SQUARE  
 184 252 200 453 100 454 5 SQUARE  
 186 253 200 454 100 455 5 SQUARE  
 188 254 200 455 100 456 5 SQUARE  
 190 255 200 456 100 457 5 SQUARE  
 192 256 200 457 100 458 5 SQUARE  
 194 257 200 458 100 459 5 SQUARE  
 196 258 200 459 100 460 5 SQUARE  
 198 259 200 460 100 461 5 SQUARE  
 200 260 200 461 100 462 5 SQUARE  
 202 261 200 462 100 463 5 SQUARE  
 204 262 200 463 100 464 5 SQUARE  
 206 263 200 464 100 465 5 SQUARE  
 208 264 200 465 100 466 5 SQUARE  
 210 265 200 466 100 467 5 SQUARE  
 212 266 200 467 100 468 5 SQUARE  
 214 267 200 468 100 469 5 SQUARE  
 216 268 200 469 100 470 5 SQUARE  
 218 269 200 470 100 471 5 SQUARE  
 220 270 200 471 100 472 5 SQUARE  
 222 271 200 472 100 473 5 SQUARE  
 224 272 200 473 100 474 5 SQUARE  
 226 273 200 474 100 475 5 SQUARE  
 228 274 200 475 100 476 5 SQUARE  
 230 275 200 476 100 477 5 SQUARE  
 232 276 200 477 100 478 5 SQUARE  
 234 277 200 478 100 479 5 SQUARE  
 236 278 200 479 100 480 5 SQUARE  
 238 279 200 480 100 481 5 SQUARE  
 240 280 200 481 100 482 5 SQUARE  
 242 281 200 482 100 483 5 SQUARE  
 244 282 200 483 100 484 5 SQUARE  
 246 283 200 484 100 485 5 SQUARE  
 248 284 200 485 100 486 5 SQUARE  
 250 285 200 486 100 487 5 SQUARE  
 252 286 200 487 100 488 5 SQUARE  
 254 287 200 488 100 489 5 SQUARE  
 256 288 200 489 100 490 5 SQUARE  
 258 289 200 490 100 491 5 SQUARE  
 260 290 200 491 100 492 5 SQUARE  
 262 291 200 492 100 493 5 SQUARE  
 264 292 200 493 100 494 5 SQUARE  
 266 293 200 494 100 495 5 SQUARE  
 268 294 200 495 100 496 5 SQUARE  
 270 295 200 496 100 497 5 SQUARE  
 272 296 200 497 100 498 5 SQUARE  
 274 297 200 498 100 499 5 SQUARE  
 276 298 200 499 100 500 5 SQUARE

FIG. 5, ITEM 3,  
PAGE 54

$$S_L = P_H = \underline{25,000 \text{ LB}} \quad \leftarrow$$

$$\begin{aligned} S_A &= \frac{\pi}{4} D^2 \\ &= (.785)(.750)^2 \\ &= (.7854)(.5625) \\ &= \underline{.4418 \text{ IN}^2} \quad \leftarrow \end{aligned}$$

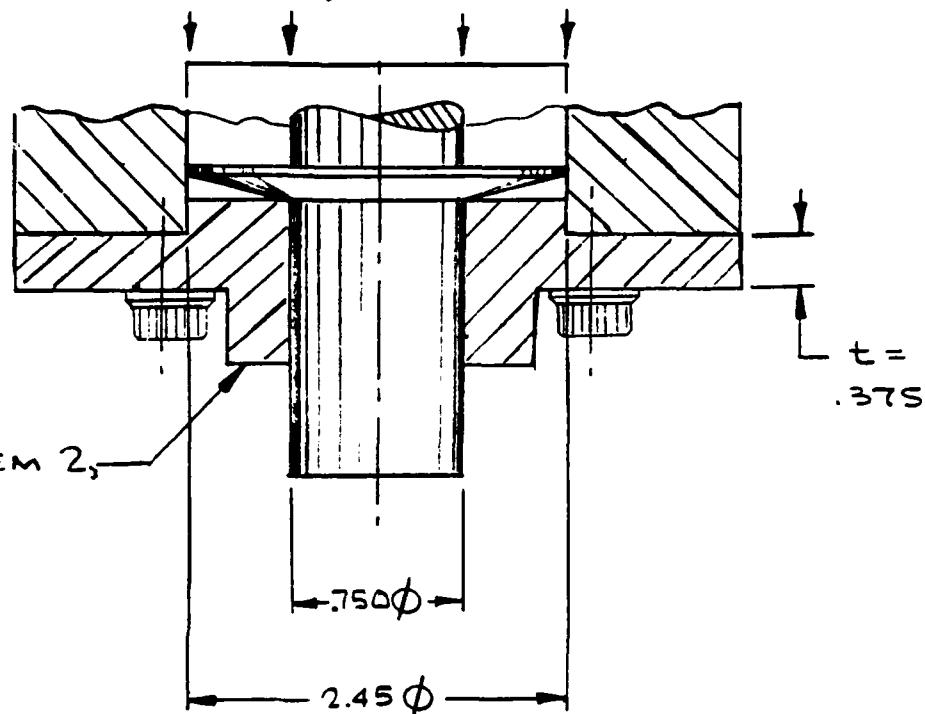
$$S_S = \frac{S_L}{S_A} = \frac{25,000}{.4418} = \underline{56,587 \text{ LBS/IN}^2} \quad \leftarrow$$

$$\begin{aligned} SF &= \frac{\sigma_s}{S_S} \\ &= \frac{72,500 \text{ LBS/IN}^2}{56,587 \text{ LBS/IN}^2} \end{aligned}$$

$$SF = \underline{1.28} \quad \leftarrow$$

4.2 COVERSOLVING FOR DEFLECTION

MATERIAL: SEE TABLE 8.1, ITEM 1, PAGE 46



$$\text{MAX } y \text{ AT } P_x = \frac{3(P_x)(m^2 - 1)}{16 m^2 E t^3}$$

$$\therefore \text{MAX } y = \frac{(3)(5000)[\left(\frac{1}{.26}\right)^2 - 1]}{16 \left(\frac{1}{.26}\right)^2 (28 \times 10^6) (.375)^3}$$

$$= \frac{(3)(5000)[(3.8462)^2 - 1]}{16 (3.8462)^2 (28 \times 10^6) (.0527)}$$

$$= \frac{(3)(5000)(13.7933)}{(12.4818)(28 \times 10^6)}$$

$$= \frac{206899.5}{349.4906 \times 10^6} = \underline{\underline{.000592 \text{ INS.}}}$$

$$\text{MAX } y \text{ AT } P_Y = \frac{(3) P_Y (13.7933)}{349.4906 \times 10^6}$$

$$= \frac{(3)(2000)(13.7933)}{349.4906 \times 10^6}$$

$$= \frac{82759.8}{349.4906 \times 10^6} = .0002368 \text{ INS} \leftarrow$$

#### 4.3 FASTENERS, COVER (4 REQ'D)

MATERIAL: SEE TABLE 8.1, ITEM 6, PAGE 46

12 SHEETS 100 EASY 200 SQUARE  
42 369 200 SHEETS 100 SQUARE

FIG 5, ITEM 2,  
PAGE 54

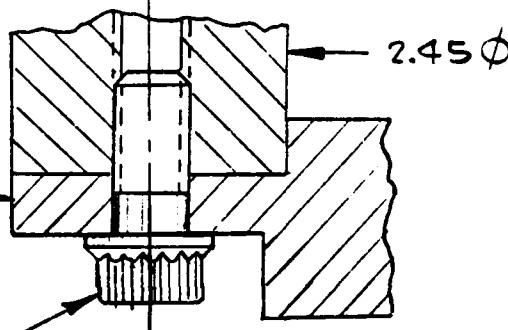


FIG. 5, ITEM 11, PAGE 54  
(3/8 - 24)

T<sub>L</sub>

SOLVING FOR SF AT P<sub>X</sub> & σ<sub>ULT</sub> AND P<sub>Y</sub> & σ<sub>y</sub>:

$$T_A = .0878 \text{ IN}^2 \text{ (MACHINERY'S HANDBOOK)}$$

$$T_L \text{ AT } P_X = \frac{\pi}{4}(2.45)^2(P_X)$$

$$= (.7854)(6.0025)(5000) = \underline{23,572 \text{ LB}} \leftarrow$$

$$T_L \text{ AT } P_Y = \frac{\pi}{4}(2.45)^2(P_Y)$$

$$= (.7854)(6.0025)(2000) = \underline{9,429 \text{ LB}} \leftarrow$$

$$T_s \text{ AT } P_x = \frac{T_L}{(4)(T_A)} = \frac{23,572}{(4)(.0878)}$$

$$= \frac{23,572}{.3512} = \underline{\underline{67,118 \text{ LBS/IN}^2}} \leftarrow$$

$$\therefore SF \text{ AT } P_x \text{ & } \sigma_{ULT} = \frac{\sigma_{ULT}}{T_s}$$

$$= \frac{175,000 \text{ LBS/IN}^2}{67,118 \text{ LBS/IN}^2}$$

$$SF = \underline{\underline{2.61}} \leftarrow$$

$$T_s \text{ AT } P_y = \frac{T_L}{(4)(T_A)} = \frac{9429}{(4)(.0878)}$$

$$= \frac{9429}{.3512} = \underline{\underline{26,848 \text{ LBS/IN}^2}}$$

$$\therefore SF \text{ AT } P_y \text{ & } \sigma_y = \frac{\sigma_y}{T_s}$$

$$= \frac{115,000 \text{ LBS/IN}^2}{26,848 \text{ LBS/IN}^2}$$

$$SF = \underline{\underline{4.28}} \leftarrow$$

#### 4.4 HOUSING :

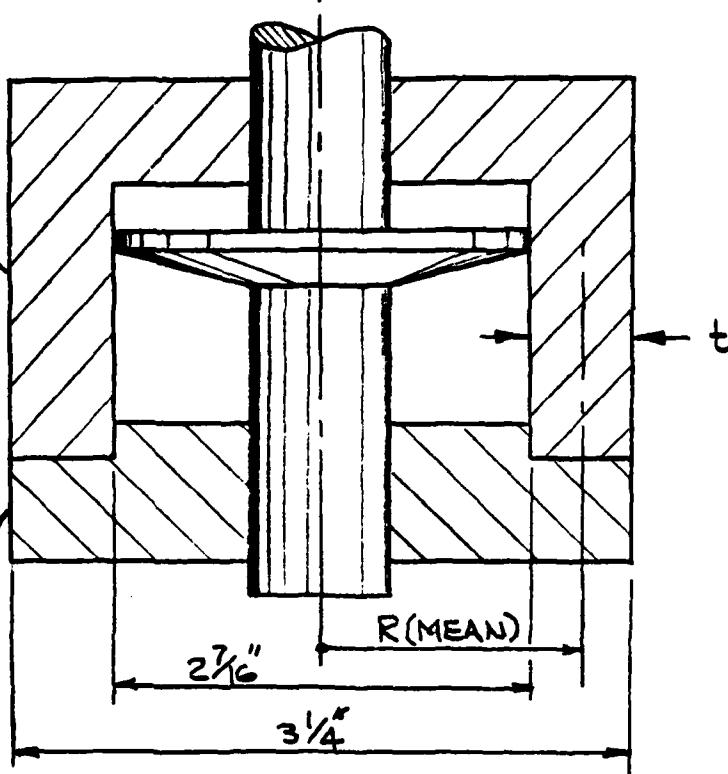
MATERIAL : SEE TABLE B.1, ITEM 1, PAGE 46

SOLVING FOR SF

NOTE: ALTHOUGH THE DETENT HOUSING IS RECTANGULAR  
THE FOLLOWING CALCULATIONS WILL BE BASED  
ON A CYLINDRICAL SHAPE OF 3<sup>1</sup>/<sub>4</sub>" O.D. X 2<sup>7</sup>/<sub>16</sub>" I.D.

FIG 5, ITEM 1  
PAGE 54

FIG 5, ITEM 2  
PAGE 54



STRESS FROM INTERNAL PRESSURES

$$S_2 w/R = \frac{P_y R}{t} \quad P_y = 2000 \text{ LBS/IN}^2, R = 1.4219 \text{ INS.}, t = .4062 \text{ INS.}$$

$$= \frac{2000 \text{ LBS/IN}^2 \times 1.4219 \text{ INS}}{.4062 \text{ INS.}}$$

$$S_2 = \underline{7000 \text{ LBS/IN}^2} \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_y}{S_2}$$

$$= \frac{30,000 \text{ LBS/IN}^2}{7,000 \text{ LBS/IN}^2}$$

$$\text{SF} = \underline{4.29} \leftarrow$$

$$S_2 w/R_x = \frac{P_x R}{t} \quad P_x = 5000 \text{ LBS/IN}^2, R = 1.4219 \text{ IN.}, t = .4062 \text{ IN.}$$

$$= \frac{5000 \text{ LBS/IN}^2 \times 1.4219 \text{ IN.}}{.4062 \text{ IN.}}$$

$$S_2 = \underline{17,502 \text{ LBS/IN}^2} \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_{\text{ULT}}}{S_2}$$

$$= \frac{80,000 \text{ LBS/IN}^2}{17,502 \text{ LBS/IN}^2}$$

$$SF = \underline{4.57} \leftarrow$$

### STRESS FROM EXTERNAL PRESSURE

$$\begin{aligned} P' &= \frac{t}{R} \left[ \frac{\delta Y}{1 + 4 \left( \frac{\delta Y}{E} \right) \left( \frac{R}{t} \right)^2} \right] \\ &= \frac{.4062}{1.4219} \left[ \frac{30 \times 10^3}{1 + 4 \left( \frac{145 \times 10^3}{28 \times 10^6} \right) \left( \frac{1.4219}{.4062} \right)^2} \right] \\ &= .2856 \left[ \frac{30 \times 10^3}{1 + 2.0714 \times 10^{-2} (12.2534)} \right] \\ &= .2856 \left[ \frac{30 \times 10^3}{1.25382} \right] \end{aligned}$$

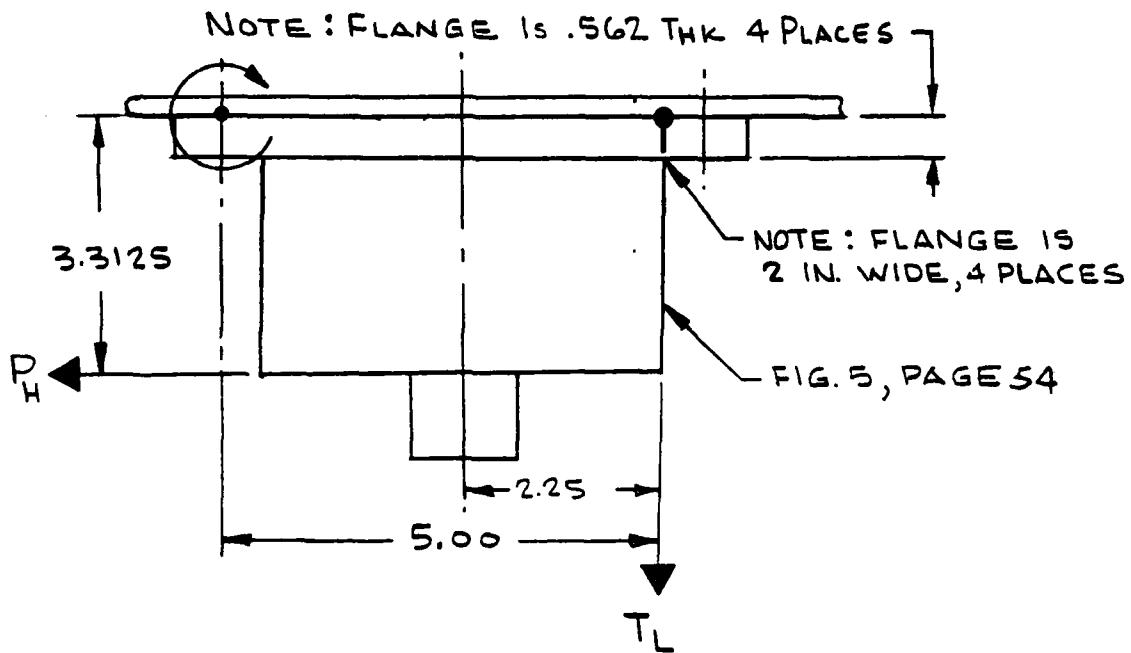
$$P' = \underline{6,833 \text{ LBS/IN}^2} \leftarrow$$

$$\text{EXISTING SF} = \frac{P'}{P_Z}$$

$$= \frac{6,833 \text{ LB/IN}^2}{700 \text{ LBS/IN}^2}$$

$$SF = \underline{9.76} \leftarrow$$

NOTE : CHECK THE SHEAR STRESS ON THE HOUSING FLANGE USING THE HANDLING LOAD ( $P_H$ ).



$$T_L = \frac{M}{l}, M = (P_H)(ARM) = (25,000)(3.3125) = 89062.5 \text{ IN-LB}$$

$$l = 5.00 \text{ IN.}$$

$$T_L = \frac{89,062.5 \text{ IN-LB}}{5.00 \text{ IN.}}$$

$$T_L = \underline{17,813 \text{ LB}} \leftarrow$$

$$T_A = .5625 \text{ IN.} \times 2.00 \text{ IN.} \times 2 \text{ FLANGES}$$

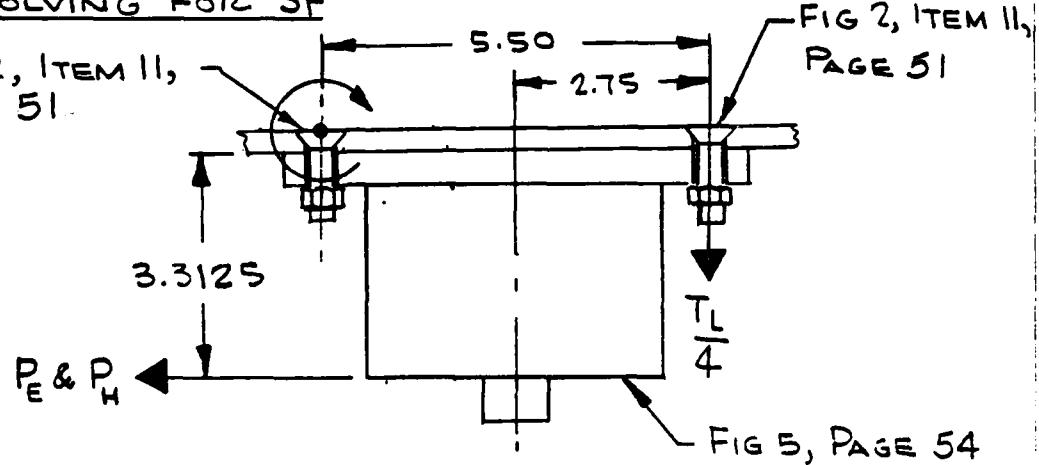
$$T_A = \underline{2.250 \text{ IN}^2} \leftarrow$$

$$T_S = \frac{T_L}{T_A} = \frac{17,813 \text{ LB}}{2.250 \text{ IN}^2} = \underline{7,917 \text{ PSI}} \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_s}{T_S} = \frac{15,000 \text{ PSI}}{7,917 \text{ PSI}} = \underline{\underline{1.89}} \leftarrow$$

4.5 FASTENERS, MOUNTING

MATERIAL : SEE TABLE 8.1, ITEM 4, PAGE 46

SOLVING FOR SFFIG. 2, ITEM 11,  
PAGE 51

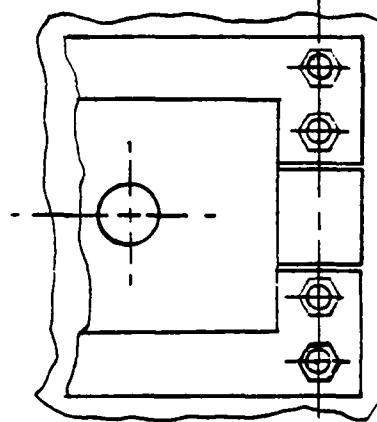
12 301  
22 302  
32 303  
42 304  
52 305  
62 306  
72 307  
82 308  
92 309  
102 310  
112 311  
122 312  
132 313  
142 314  
152 315  
162 316  
172 317  
182 318  
192 319  
202 320

$$P_E = 6,032 \text{ LB}$$

EJECTION LOAD

$$P_H = 25,000 \text{ LB}$$

HANDLING LOAD



NOTE: IN THE FOLLOWING CALCULATIONS CONSIDER ONE SIDE FREE & THE OTHER SIDE HINGED WITH 4 SCREWS TAKING THE TOTAL LOAD IN TENSION THEN CHECK THE TS & SF PER SCREW USING  $P_E$  &  $P_H$ .

$$T_L w/P_E = \frac{1}{4} \left[ \frac{M}{l} \right] M = P_E \times ARM = 6032 \text{ LBS} \times 3.3125 \text{ IN} = 19,981 \text{ IN-LBS}$$

$l = 5.50 \text{ IN.}$

$$= .25 \left[ \frac{19,981 \text{ IN-LBS}}{5.50 \text{ IN.}} \right]$$

$$= .25 \times 3633 \text{ LB}$$

$$T_L = \underline{908.75 \text{ LBS}} \quad \longleftarrow$$

$$T_A = \underline{.0878 \text{ IN}^2} \quad \longleftarrow (\text{FROM MACHINERY HANDBOOK})$$

$$T_S = \frac{T_L}{T_A}$$

$$= \frac{908.75 \text{ LBS}}{.0878 \text{ IN}^2}$$

$$T_S = \underline{10,345 \text{ LBS/IN}^2} \quad \longleftarrow$$

$$\text{EXISTING SF} = \frac{\delta_Y}{T_S}$$

$$= \frac{91,000 \text{ LBS/IN}^2}{10,345 \text{ LBS/IN}^2}$$

$$SF = \underline{8.80} \quad \longleftarrow$$

$$T_L w/P_H = \frac{1}{4} \left[ \frac{M}{l} \right] M = P_H \times ARM = 25000 \text{ LBS} \times 3.3125 \text{ IN} = 82812 \text{ IN-LBS}$$

$l = 5.50 \text{ IN.}$

$$= .25 \left[ \frac{82,812 \text{ IN-LBS}}{5.50 \text{ IN.}} \right]$$

$$= .25 \times 15,057 \text{ LBS}$$

$$T_L = \underline{3764.3 \text{ LBS}} \quad \longleftarrow$$

$$T_A = \underline{.0878 \text{ IN}^2} \quad \longleftarrow (\text{FROM MACHINERY HANDBOOK})$$

$$T_S = \frac{T_L}{T_A}$$

$$T_s = \frac{3764.3 \text{ LB}}{.0878 \text{ IN}^2}$$

$$T_s = \underline{42,874 \text{ LBS/IN}^2} \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_y}{T_s}$$

$$= \frac{91,000 \text{ LBS/IN}^2}{42,874 \text{ LBS/IN}^2}$$

$$\underline{\underline{\text{SF} = 2.12}} \leftarrow$$

CONSIDER THE MAX. BEARING STRESS ON THE SKIN  
RESULTING FROM THE PROJECTED AREA UNDER  
THE SCREW HEAD USING  $T_{LW}/P_E = 908.25 \text{ LB}$  &  $T_{LW}/P_H = 3764 \text{ LB}$

$$A = \underline{.366 \text{ IN}^2} \leftarrow \text{(FROM PAGE 22)}$$

$$B_L = T_{LW}/P_E$$

$$B_L = \underline{908.25 \text{ LB}} \leftarrow$$

$$B_A = A, A = .366 \text{ IN}^2$$

$$B_A = \underline{.366 \text{ IN}^2} \leftarrow$$

$$B_S = \frac{B_L}{B_A}$$

$$= \frac{908.25 \text{ LB}}{.366 \text{ IN}^2}$$

$$B_S = \underline{2482 \text{ LBS/IN}^2} \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_y}{B_S}$$

$$= \frac{56,000 \text{ LBS/IN}^2}{2482 \text{ LBS/IN}^2}$$

$$\underline{\underline{\text{SF} = 22.56}} \leftarrow$$

$$B_L = T_L w / P_H$$

$$B_L = \underline{3764.3 \text{ LB}} \leftarrow$$

$$B_A = A \quad A = .366 \text{ IN}^2$$

$$B_A = \underline{.366 \text{ IN}^2} \leftarrow$$

$$B_S = \frac{B_L}{B_A}$$

$$= \frac{3764.3 \text{ LB}}{.366 \text{ IN}^2}$$

$$B_S = \underline{10,285 \text{ LBS/IN}^2} \leftarrow$$

$$\text{EXISTING SF} = \frac{\sigma_{YB}}{B_S}$$

$$= \frac{56,000 \text{ LBS/IN}^2}{10,285 \text{ LBS/IN}^2}$$

$$\text{SF} = \underline{\underline{5.44}} \leftarrow$$

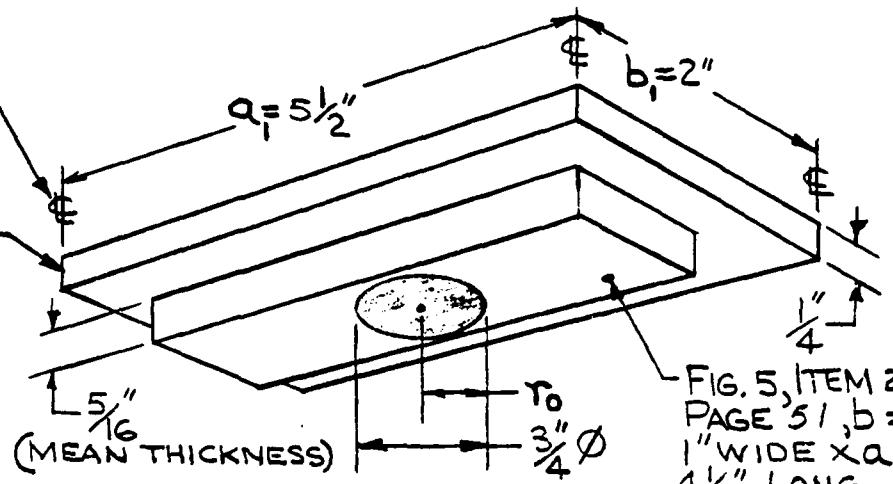
## 5.0 LOCKOUT BAR, DETENT

MATERIAL: SEE TABLE 8.1, ITEMS 1 &amp; 5, PAGE 46

SOLVING FOR DEFLECTION (Y).

43 182 30 SHEETS 3 SQUARE  
 42 186 100 SHEETS 3 SQUARE  
 41 188 100 SHEETS 3 SQUARE

**INSIDE BOLT THRU SKIN @ 4 CORNERS.**  
**FIG. 2 ITEM 5, PAGE 51**



**FIG. 5, ITEM 29  
PAGE 51, b = 1" WIDE x a = 4 1/2" LONG**

**NOTE:** CONSIDER ALL EDGES SUPPORTED WITH UNIFORM LOAD OVER SMALL CONCENTRIC CIRCULAR AREA OF RADIUS  $T_0$ .

LOCKOUT BAR  $b = 1$ " WIDE,  $a = 4 \frac{1}{2}$ " LONG,  $t = \frac{5}{16}$ " MEAN THICKNESS

$$Y = \frac{0.203 T_S b^2 (m^2 - 1)}{m^2 E t^3 (1 + 0.462 \alpha^4)} \quad \text{WHERE: } T_S = \frac{T_L}{T_A}$$

$$T_S = \frac{T_L}{T_A} \quad T_L = P_x \left[ \frac{\pi}{4} (2.4375)^2 - \frac{\pi}{4} (.750)^2 \right]$$

$$T_A = 5000 [4.6664 - 4.418] \quad T_L = 21,123 \text{ LBS} \leftarrow$$

$$T_A = \frac{\pi}{4} (.750)^2$$

$$= .7854 \times .5625$$

$$T_A = .442 \text{ IN}^2 \leftarrow$$

$$T_S = \frac{21,123 \text{ LBS}}{.442 \text{ IN}^2}$$

$$T_S = 47,789 \text{ LBS/IN}^2 \leftarrow$$

$$b = 2.00 \text{ INS}$$

$$m = 3.846 \text{ (STEEL)}$$

$$= 2.778 \text{ (ALUMINUM)}$$

$$E = 28 \times 10^6 \text{ (STEEL)}$$

$$= 10 \times 10^6 \text{ (ALUMINUM)}$$

$$t = .3125 \text{ (LOCKOUT BAR)}$$

$$= .250 \text{ (SKIN, TUBE)}$$

$$\alpha = \frac{b}{a} = \frac{1}{4.5} = .222 \text{ (LOCKOUT BAR)}$$

$$\frac{b}{a} = \frac{2}{5.5} = .3636 \text{ (SKIN)}$$

LOCKOUT BAR - DEFLECTION(Y)

$$Y = \frac{0.203(47,789)(1.0)^2(3.846^2 - 1)}{3.846^2(28 \times 10^6) \cdot 3125^3(1 + 0.462 \times .2224)}$$

$$= \frac{0.203 \times 47,789 \times 13.79}{14.79 \times 28 \times 10^6 \times 0.0305 \times 1.0011}$$

$$= \frac{133,779}{12,644,553}$$

$Y = .01058 \text{ INS} \leftarrow \text{DEFLECTION ON LOCKOUT BAR}$

TUBE  $b_1 = 2'' \text{ WIDE}, a_1 = 5\frac{1}{2}'' \text{ LONG}, t = \frac{1}{4}'' \text{ THICK}$

$$Y = \frac{0.203 T_S b_1^2 (m^2 - 1)}{m^2 E t^3 (1 + 0.462 \alpha^4)} \text{ WHERE; } T_S = \frac{T_L}{T_A}$$

$$T_S = \frac{T_L}{T_A} \quad T_L = 21,123 \text{ LBS} \leftarrow (\text{PAGE 32})$$

$$T_A = a \times b$$

$$= \frac{4.50 \text{ IN.} \times 1.00 \text{ IN.}}{4.50 \text{ IN}^2} \leftarrow$$

$$T_S = \frac{21,123 \text{ LBS}}{4.50 \text{ IN}^2}$$

$$T_S = 4694 \text{ LBS/IN}^2 \leftarrow$$

$$Y = \frac{0.203(4694)(2.0)^2(2.778^2 - 1)}{2.778^2(10 \times 10^6) \cdot 250^3(1 + 0.462 \times .36364)}$$

$$Y = \frac{0.203 \times 4694 \times 4 \times 6.7173}{7.7173 \times 10 \times 10^6 \times 0.0156 \times 1.008}$$

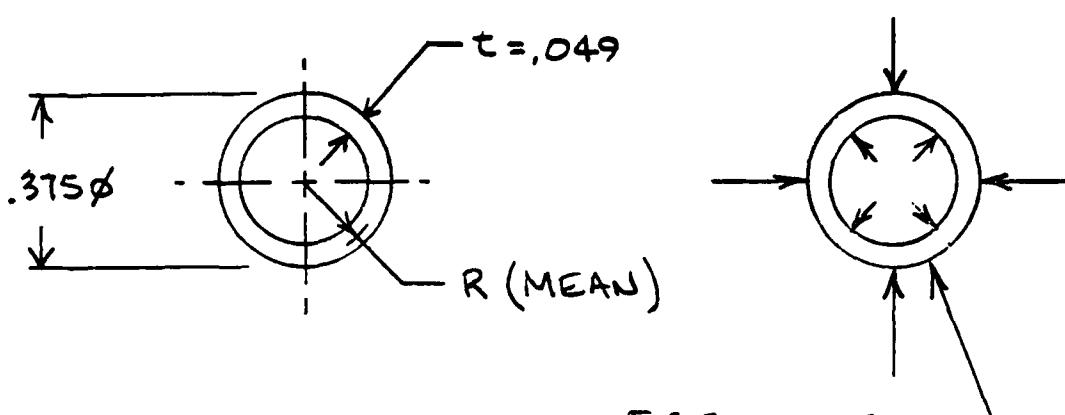
$$Y = \frac{25.603}{1,213,530}$$

$Y = .02109 \text{ INS.} \leftarrow \text{DEFLECTION ON TUBE}$

NOTE: THE DETENT PIN HAS A TOTAL ENGAGEMENT DEPTH IN THE MOSS OF .50 INCHES. THE MAXIMUM DEFLECTION IS .02109 INCHES, THEREFORE THE DETENT PIN CANNOT BECOME DISENGAGED.

## 6.0 PLUMBING LINES

MATERIAL: SEE TABLE B.1, ITEM 1, PAGE 46  
SOLVING FOR SF

FIG 2, ITEM 23,  
PAGE 51STRESS FROM INTERNAL PRESSURES

$$\sigma_y = 2000 \text{ LBS/IN}^2, R_{\text{MEAN}} = .163 \text{ IN.}, t = .049 \text{ IN}$$

$$S_z = \frac{\sigma_y R}{t} = \frac{(2000)(.163)}{.049}$$

$$S_z = \underline{6,653 \text{ LBS/IN}^2} \leftarrow$$

$$\begin{aligned} \text{EXISTING SF} &= \frac{\sigma_y}{S_z} \\ &= \frac{30000 \text{ LBS/IN}^2}{6,653 \text{ LBS/IN}^2} \end{aligned}$$

$$SF = \underline{\underline{4.50}} \leftarrow$$

$$P_x = 5000 \text{ LBS/IN}^2, R_{\text{MEAN}} = .163 \text{ IN.}, t = .049 \text{ IN}$$

$$S_z = \frac{P_x R}{t} = \frac{(5000)(.163)}{.049}$$

$$\underline{S_z = 16,632 \text{ LBS/IN}^2} \quad \leftarrow$$

$$\text{EXISTING SF} = \frac{\delta_{\text{ULT}}}{S_z}$$

$$= \frac{30,000 \text{ LBS/IN}^2}{16,632 \text{ LBS/IN}^2}$$

$$\underline{SF = 4.81} \quad \leftarrow$$

### STRESS FROM EXTERNAL PRESSURE

$$P' = \frac{t}{R} \left[ \frac{6Y}{1+4\left(\frac{6Y}{E}\right)\left(\frac{R}{t}\right)^2} \right]$$

$$P' = \frac{.049}{.163} \left[ \frac{30 \times 10^3}{1+4\left(\frac{30 \times 10^3}{28 \times 10^6}\right)\left(\frac{.163}{.049}\right)^2} \right]$$

$$\underline{P' = 8610 \text{ LBS/IN}^2} \quad \leftarrow$$

$$\text{EXISTING SF} = \frac{P'}{P_z}$$

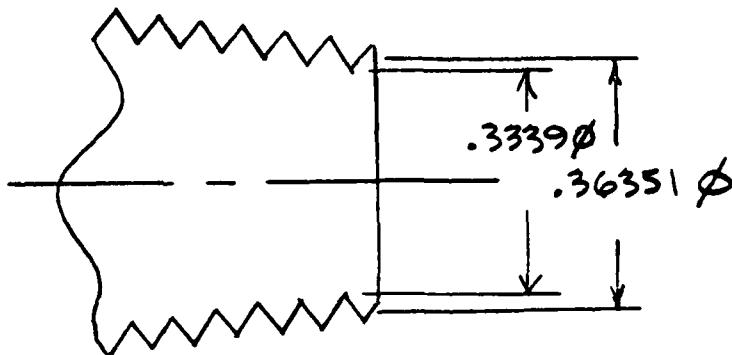
$$= \frac{8,610 \text{ LBS/IN}^2}{700 \text{ LBS/IN}^2}$$

$$SF = \underline{12.30} \quad \leftarrow$$

## 7.0 PIPE AND TUBE FITTINGS

MATERIAL: SEE TABLE B.1, ITEM 1, PAGE 46  
SOLVING FOR SF

1/8-27 NPT PLUG:



TENSILE STRESS ON THREADS

$$P_D = .36351\phi, P = .03704, n = 6.75$$

$$T_A = \pi P_D \left(\frac{P}{2}\right) n = (3.1416)(.36351)\left(\frac{.03704}{2}\right) 6.75$$

$$T_A = \underline{.14276 \text{ IN}^2} \quad \leftarrow$$

$$T_L = P_z(A)$$

$$= (5,000 \text{ LBS/IN}^2) \cdot 0873 \text{ IN}^2$$

$$T_L = \underline{436.5 \text{ LBS}} \quad \leftarrow$$

$$A = \frac{\pi D^2}{4} = \underline{(3.1416)(.3339)^2} \quad \leftarrow$$

$$A = \underline{.0873 \text{ IN}^2} \quad \leftarrow$$

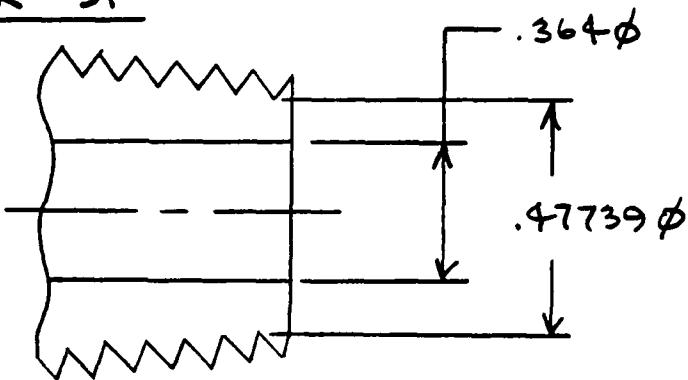
$$T_s = \frac{T_L}{T_A} = \frac{436.5 \text{ LBS}}{.14276 \text{ IN}^2} = \underline{3,056 \text{ LBS/IN}^2} \quad \leftarrow$$

$$SF = \frac{\sigma_s}{T_s} = \frac{15,000 \text{ LBS/IN}^2}{3,056 \text{ LBS/IN}^2}$$

$$SF = \underline{4.91} \quad \leftarrow$$

MATERIAL: SEE TABLE B.1, ITEM 1, PAGE 46  
SOLVING FOR SF

$\frac{1}{4}$  NPT FITTING



$$T_A = \frac{\pi}{4} [(.47739)^2 - (.364)^2] = .0749 \text{ IN}^2 \leftarrow$$

$$T_L = P_Z(A)$$

$$= 5000 \text{ LBS/IN}^2 (.1041 \text{ IN}^2)$$

$$T_L = \underline{520.5 \text{ LBS}} \leftarrow$$

$$A = \frac{\pi D^2}{4} = \frac{(3.1416)(.364)^2}{4}$$

$$A = \underline{.1041 \text{ IN}^2} \leftarrow$$

$$T_S = \frac{T_L}{T_A} = \frac{520.5 \text{ LBS}}{.0749 \text{ IN}^2} = \underline{6949 \text{ LBS/IN}^2} \leftarrow$$

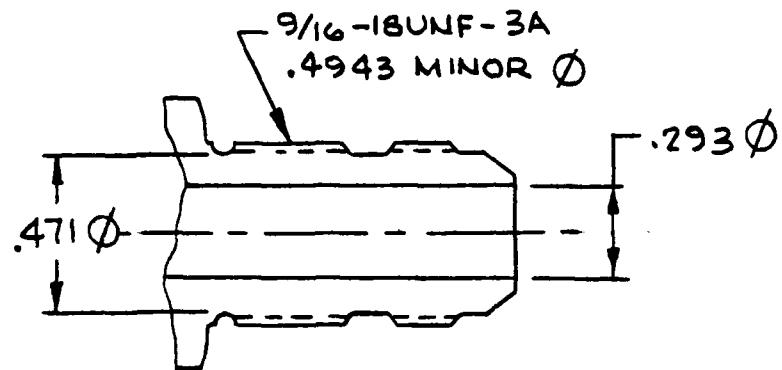
$$SF = \frac{S_{ULT}}{T_S}$$

$$SF = \frac{80,000 \text{ LBS/IN}^2}{6,949 \text{ LBS/IN}^2}$$

$$SF = \underline{11.51} \leftarrow$$

MATERIAL: SEE TABLE 8.1, ITEM 1, PAGE 46  
SOLVING FOR SF

FLARED TUBE FITTING FOR 3/8" TUBE IN ACCORDANCE  
 WITH MS33657-6



$$T_A = \frac{\pi}{4} [( .471 )^2 - (.293)^2] = .1068 \text{ IN}^2 \quad \leftarrow$$

$$\begin{aligned} T_L &= P_z(A) \\ &= 5,000 \text{ LBS/IN}^2 (.067 \text{ IN}^2) \\ T_L &= \underline{337 \text{ LBS}} \quad \leftarrow \end{aligned}$$

$$\begin{aligned} A &= \frac{\pi}{4} D^2 = \frac{3.1416 (.293)^2}{4} \\ A &= \underline{.067 \text{ IN}^2} \quad \leftarrow \end{aligned}$$

$$T_S = \frac{T_L}{T_A} = \frac{337 \text{ LBS}}{.1068 \text{ IN}^2} = \underline{3,155 \text{ LBS/IN}^2} \quad \leftarrow$$

$$SF = \frac{80,000 \text{ LBS/IN}^2}{3,155 \text{ LBS/IN}^2}$$

$$SF = \underline{25.35} \quad \leftarrow$$

## 8.0 SUMMARY

THE RESULTS OF THIS ANALYSIS SHOW A CONSERVATIVE MARGIN OF SAFETY IN MOST CASES. IN CERTAIN CASES DEFLECTION WAS CALCULATED ON THE ASSUMPTION THAT IF THE DEFLECTION VALUE WAS VERY SMALL, FAILURE WOULD NOT OCCUR.

MAXIMUM LOAD VALUES SHOWN IN TABLE 8.2, PAGES 47-49, THAT DIFFER FROM THOSE LISTED IN THE INTRODUCTION ARE THE RESULTANTS OF APPLIED DESIGN LOADS.

42 SHEETS 1 SQUARE  
42 SHEETS 100 SQUARE  
42 SHEETS 200 SQUARE

14 150 160 170 180 190 200  
 21 150 160 170 180 190 200  
 32 150 160 170 180 190 200

TABLE B.1 MECHANICAL PROPERTIES

ITEM NO.	MATERIAL OR DESCRIPTION	MATERIAL SPEC. NO.	ULTIMATE TENSILE (PSI)	YIELD (PSI)	SHEAR (PSI)	ULTIMATE YIELD (PSI)	BEARING (PSI)	MODULUS OF
								ELASTICITY (PSI $\times 10^6$ )
1	300 SERIES CRES	QQ-S-763	80,000	30,000	15,000	15,000	28	28
2	17-4 PH CRES, (OND II	MIL-C-24111	155,000	145,000	72,500	72,500	28	28
3	CRES ( $\frac{1}{4}$ -28) BOLT, MACH.	AMSS5708	175,000	115,000	57,500	57,500	28	28
4	CRES NAS1597	140,000	91,000	49,000	35,000	17,500	80,000	10
5	SCREW, FLAT HEAD, 100° ALY, EXTRUDED	QA-A-200/8	38,000	35,000	17,500	80,000	56,000	10
6	CRES ( $\frac{3}{8}$ -24) BOLT, MACH.	AMSS5708	175,000	115,000	57,500	57,500	28	28

8.2 DATA SUMMARY TABLE

PART DESCRIPTION	FIG. NO.	ITEM NO.	MATERIAL	FAILURE MODE	MAXIMUM LOAD	SAFETY FACTOR
TUBE	2	5	3061-T6	COLUMN COMPRESSION	15,000 LB	16.72
CYLINDER	3	1	304 CRES	HOOP TENSION HOOP TENSION HOOP COMP. TENSION	5,000 PSI 2,000 PSI 100 PSI 5,000 PSI	2.74 2.57 6.41 3.84
CYLINDER HEADS	3 & 4	304 CRES		THD SHEAR TENSION TENSION	5,000 PSI 5,000 PSI 2,000 PSI	2.49 3.55 3.32
TRACTION ROD	3	5	17-4 PH CRES	THD SHEAR TENSION SHEAR	6,032 LB 6,032 LB 6,032 LB	4.44 1.91 1.806
PIN ROD END	3	7	17-4 PH CRES			
ROD END, THREADED	3	6	304 CRES	TENSION	6,032 LB	1.87
CYLINDER CAP	3	4	304 CRES	TENSION	6,032 LB	2.93
JAM NUT	3	16	304 CRES	THD SHEAR	6,032 LB	2.19
BRACKET, CYLINDER	3	10	17-4 PH CRES	BENDING	6,032 LB	1.64

8.1 DATA SUMMARY TABLE CONT.

PART DESCRIPTION	FIG. NO.	ITEM NO.	MATERIAL	FAILURE MODE	MAXIMUM LOAD	SAFETY FACTOR
SCREWS, MOUNTING, BRACKET	2	11	NAS1591 COND. F	TENSION BEARING	38,166 PSI 9,155 PSI	2.38 6.12
HOUSING, PISTON	4	2	304 CRES	HOOP TENSION HOOP TENSION HOOP COMP.	5,000 PSI 2,000 PSI 700 PSI	3.34 3.13 8.77
FASTENERS, PISTON CLOSURE	4	12	AMS7471	THD SHEAR TENSION	5,000 PSI 5,000 PSI	7.78 6.00
PIN, DETENT	5	3	17-4 PH CRES	SHEAR	25,000 LB	1.78
COVER	5	2	304 CRES	DEFLECTION DEFLECTION	5,000 PSI 2,000 PSI	0.00059 IN. 0.00024 IN.
FASTENERS, COVER	5	11	AMS7471	TENSION	5,000 PSI 2,000 PSI	2.61 4.28
HOUSING	5	1	304 CRES	HOOP TENSION HOOP TENSION HOOP COMP. SHEAR	5,000 PSI 2,000 PSI 700 PSI 25,000 LB	4.57 4.29 9.76 1.89

8.2 DATA SUMMARY TABLE CONT.

PART DESCRIPTION	FIG. NO.	ITEM NO.	MATERIAL	FAILURE MODE	MAXIMUM LOAD	SAFETY FACTOR
FASTENERS MOUNTING	2	11	NAS 1597 COND F	TENSION TENSION BEARING BEARING	4,032 LB 25,000 LB 5,000 LB 25,000 LB	8.80 2.12 22.56 5.44
LOCKOUT BAR	5	4	17-4 PH CRES	DEFLECTION	5,000 PSI	.01058 IN.
TUBE, EXTERNAL	2	5	6061-T6 AL ALY	DEFLECTION	5,000 PSI	.02109 IN.
PLUMBING LINES	2	23	304 CRES	HOOP TENSION HOOP TENSION HOOP COMP.	5,000 PSI 1,000 PSI 100PSI	4.81 4.50 12.30
PLUG , PIPE (1/8 NPT)	5	10	316 CRES	THD SHEAR	5,000 PSI	4.91
FITTING PIPE (1/4 NPT)	2	17	316 CRES	TENSION	5,000 PSI	11.51
FITTING TUBE (3/8 TUBE)	2	-	304 CRES	TENSION	5,000 PSI	25.35

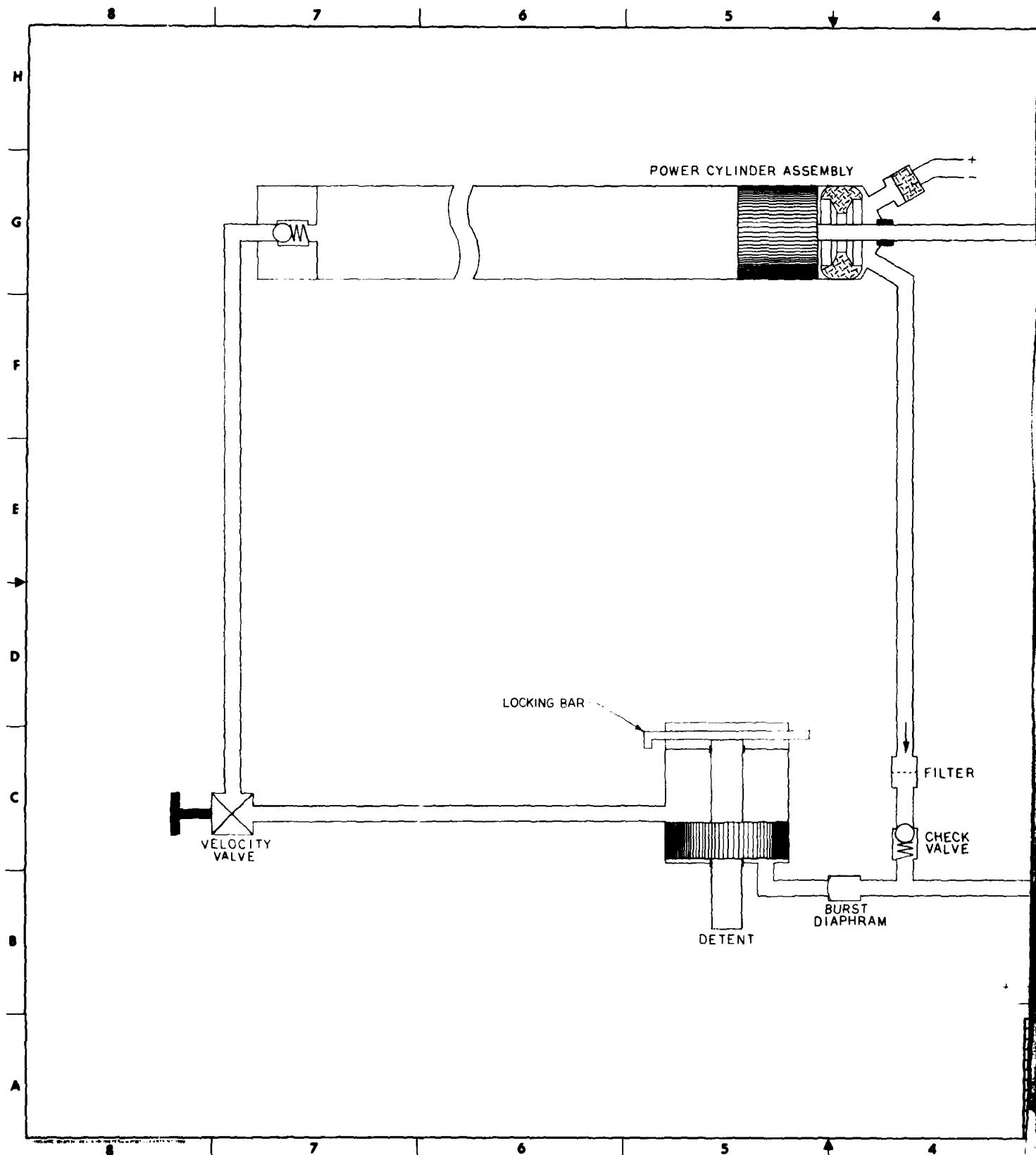


FIGURE 1.

52

3

2

1

## REVISIONS

DATE	APPROVED

H

G

F

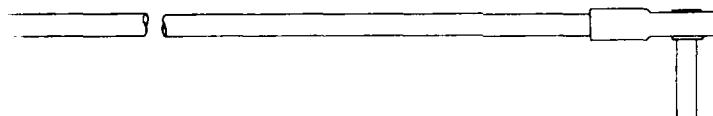
E

D

C

B

A

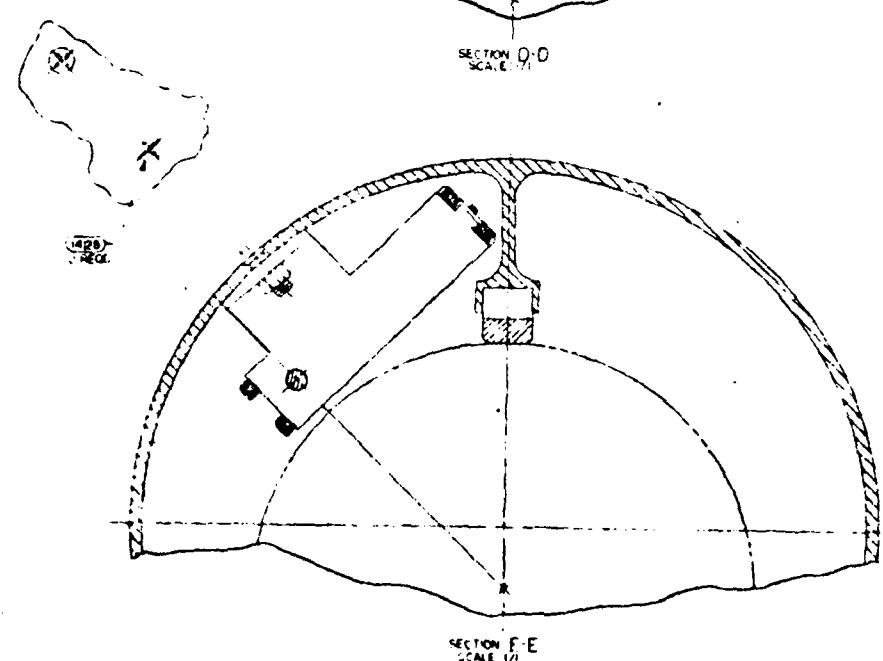
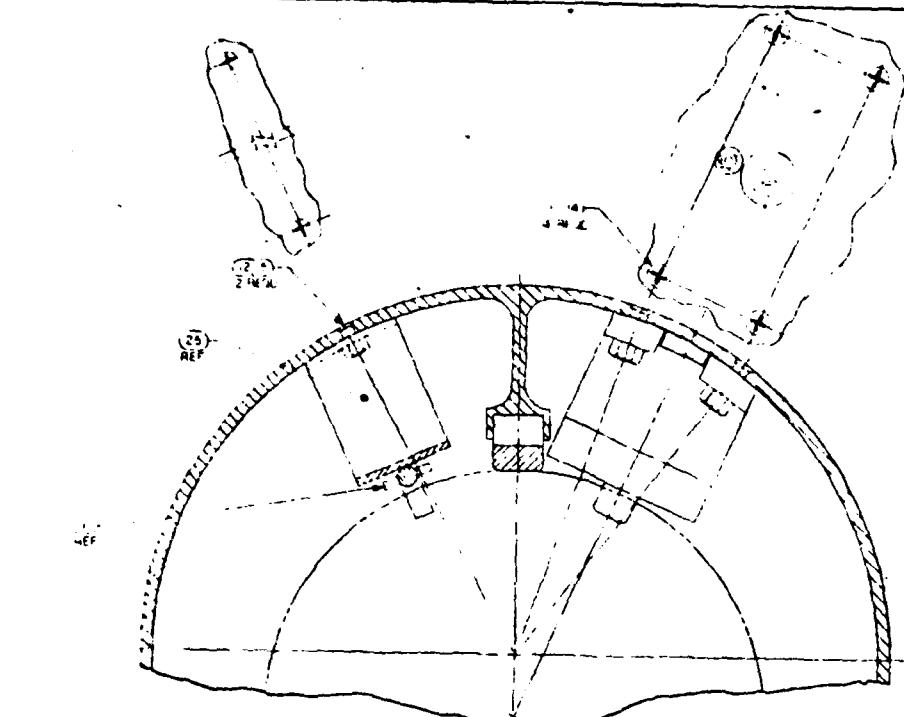


WARM CABLE CUTTER

3	2	1												
<table border="1"> <tr> <td>UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ANGLES + DEGREES + DECIMAL + PART SHALL BE FREE OF BLURRS ALL THREADS TO SIZE .0625 MAX. FILLETS .005 MAX. SURFACE REQUIREMENTS</td> <td>INHAL WEAPONS CENTER CHINA LAKE, CALIF 93501 DEPARTMENT OF THE NAVY WASHINGTON, D.C. 20380</td> <td>DP LAUNCHER INNER TUBE ACTUATION SYSTEM DIAGRAM</td> </tr> <tr> <td>DO NOT SCALE THIS DRAWING</td> <td>APPROVED FOR</td> <td>HP</td> </tr> <tr> <td>APPLICATION</td> <td>INSTRUMENT APPROVED IN ACCORDANCE WITH SRM 970-100</td> <td>F</td> </tr> <tr> <td>3</td> <td>2</td> <td>1</td> </tr> </table>			UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ANGLES + DEGREES + DECIMAL + PART SHALL BE FREE OF BLURRS ALL THREADS TO SIZE .0625 MAX. FILLETS .005 MAX. SURFACE REQUIREMENTS	INHAL WEAPONS CENTER CHINA LAKE, CALIF 93501 DEPARTMENT OF THE NAVY WASHINGTON, D.C. 20380	DP LAUNCHER INNER TUBE ACTUATION SYSTEM DIAGRAM	DO NOT SCALE THIS DRAWING	APPROVED FOR	HP	APPLICATION	INSTRUMENT APPROVED IN ACCORDANCE WITH SRM 970-100	F	3	2	1
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ANGLES + DEGREES + DECIMAL + PART SHALL BE FREE OF BLURRS ALL THREADS TO SIZE .0625 MAX. FILLETS .005 MAX. SURFACE REQUIREMENTS	INHAL WEAPONS CENTER CHINA LAKE, CALIF 93501 DEPARTMENT OF THE NAVY WASHINGTON, D.C. 20380	DP LAUNCHER INNER TUBE ACTUATION SYSTEM DIAGRAM												
DO NOT SCALE THIS DRAWING	APPROVED FOR	HP												
APPLICATION	INSTRUMENT APPROVED IN ACCORDANCE WITH SRM 970-100	F												
3	2	1												

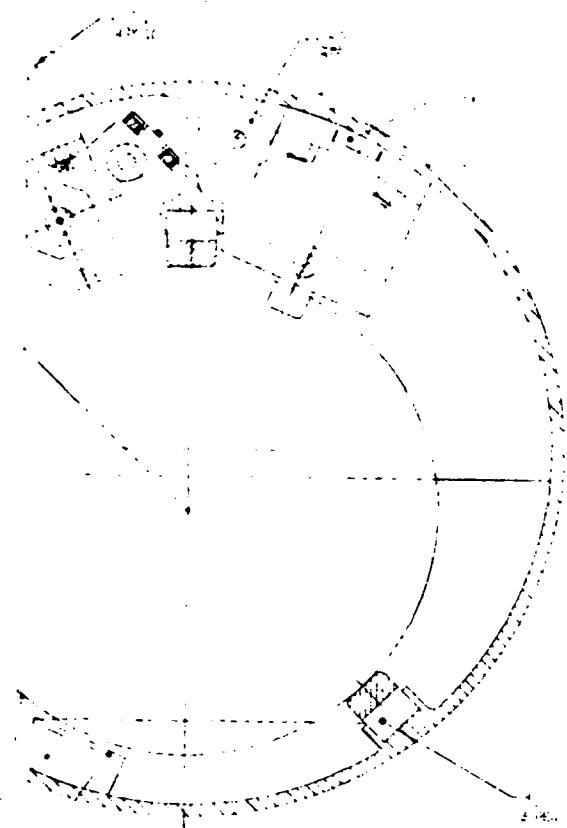
53

NWC TM 3358

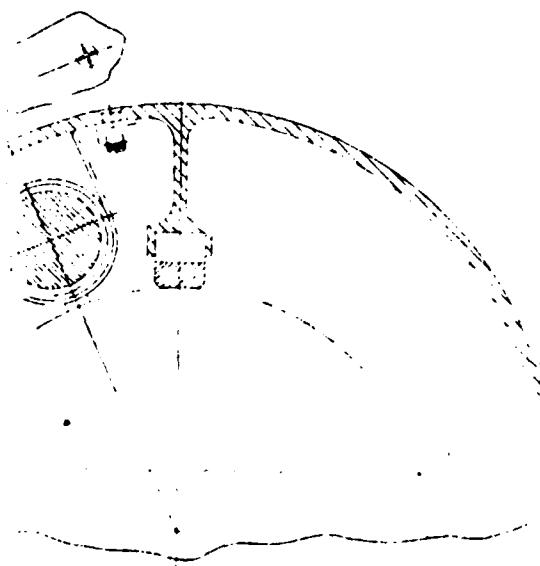


THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDC

Sheet 2 of

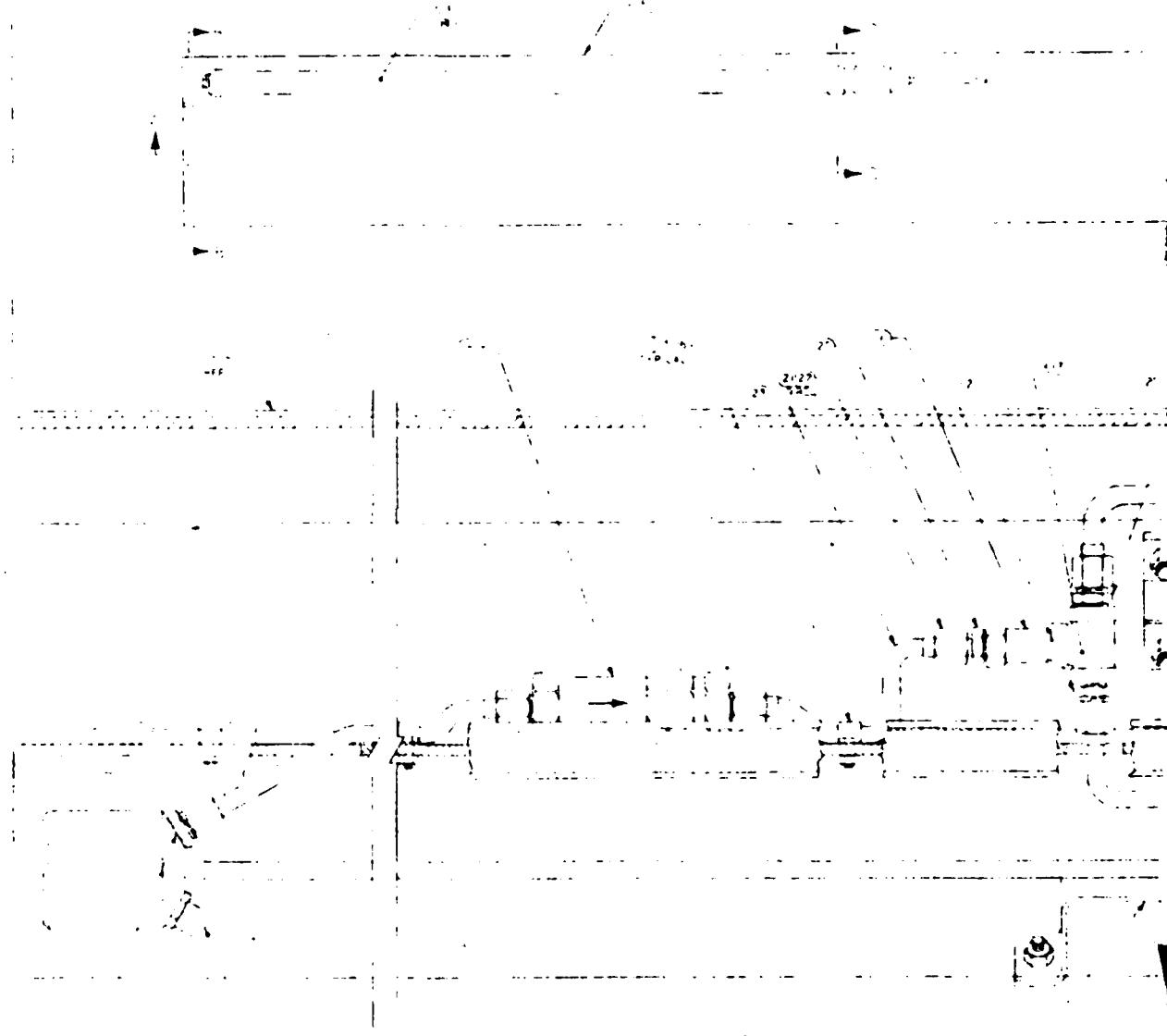


SECTION B-B



SECTION C-C

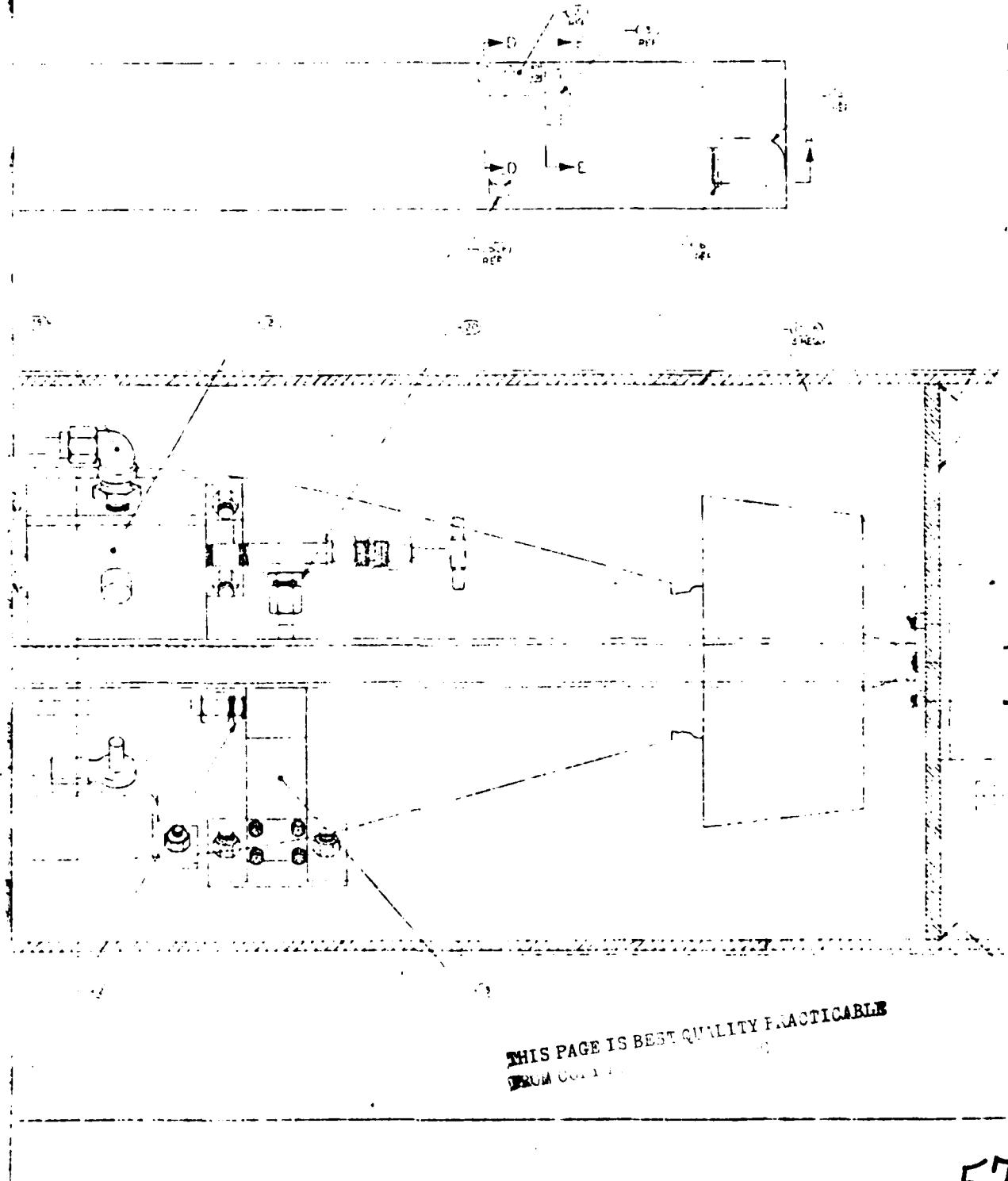
THIS PAGE IS NOT QUALITY PRACTICABLE  
FROM COPIER



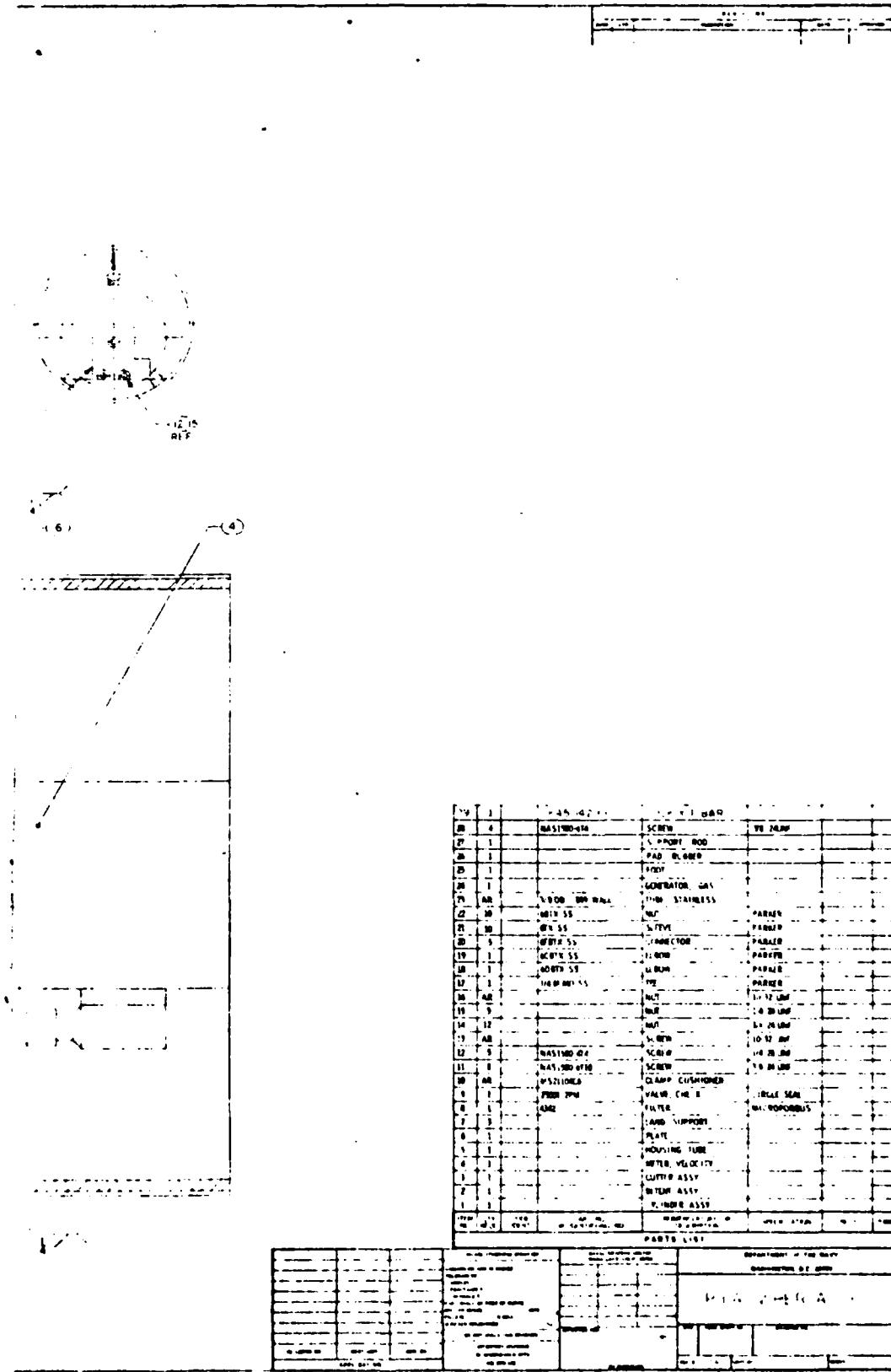
THIS PAGE IS FOR QUALITY PRACTICABLE  
FROM U.S.A.

ACM-A

FIGURE 2.



Sheet 5 of 5



THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM CURTIS & CO. LTD 10 DDC

58

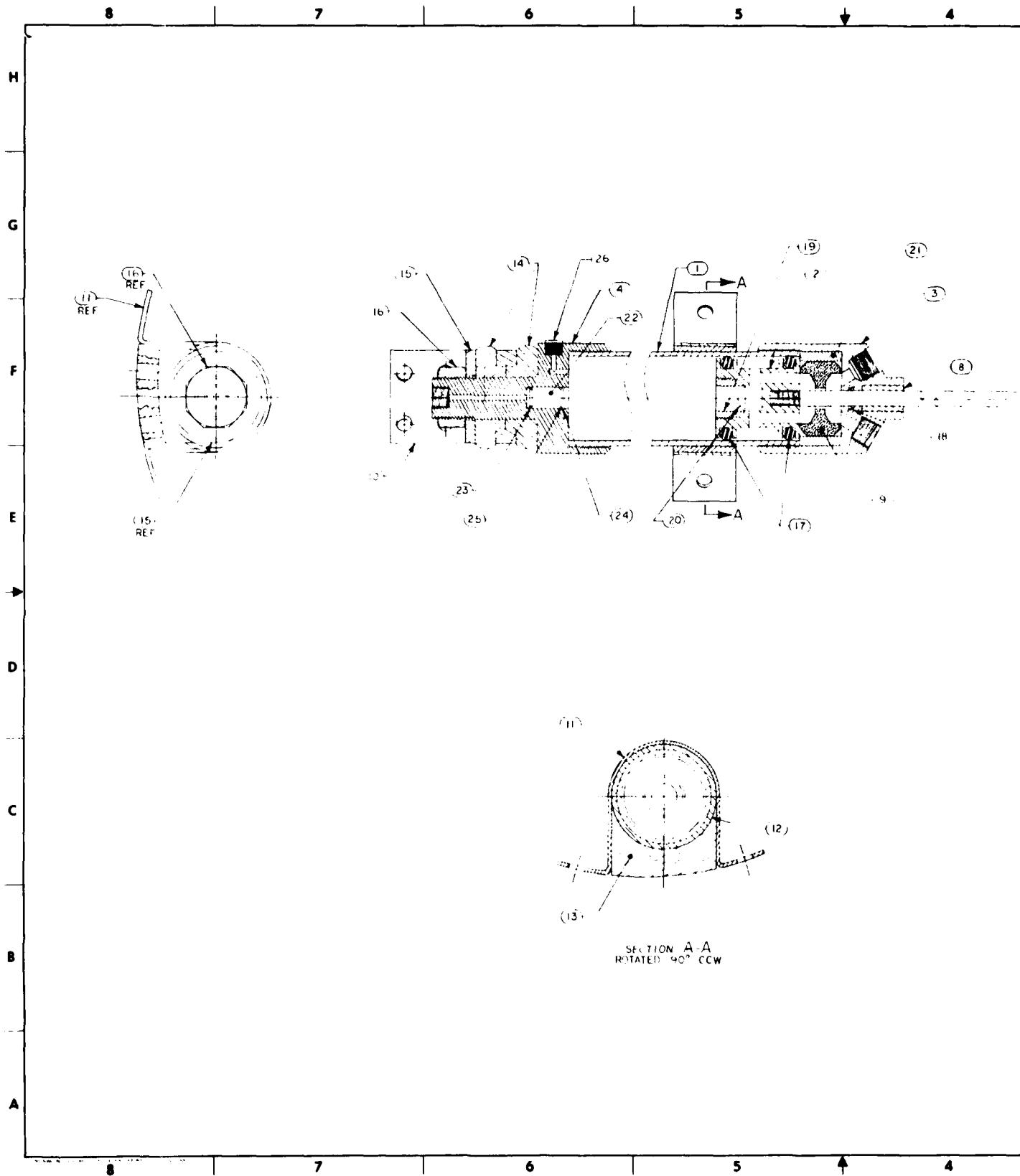


FIGURE 3.

3

2

1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

1

6

1

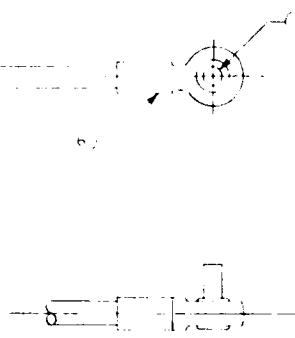
1

1

1

1

1



26	1	U8 HHP SS	PLUG	PARKER			
25	1		WASHER				
24	1	MS16625 4050	RETAINER				
23	1		O RING				
22	1	C24954Q	VALVE, CHECK	CIRCLE SEAL			
21	1		SLEEVE, PROPELLANT				
20	1		DISC, RUPTURE				
19	1		PLUG				
18	1		O-RING				
17	2		O-RING				
16	1		NUT				
15	1		WASHER				
14	2		BUSHING				
13	1		CUSHION				
12	AR		SLEEVE, RUBBER				
11	1		CLAMP				
10	1		BLACKET				
9	1		GRAIN, PROPELLANT				
8	1		BEARING				
7	1	3750 DIA X 1 125 LONG	PIN				
6	1	2 DREF 6	END, ROD	SOUTHWEST PRODUCTS CO			
5	1		ROD				
4	1		CAP				
3	1		HEAD				
2	1		PISTON				
1	1		CYLINDER				
ITEM NO.	QTY	CODE IDENT	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	NOTE	ZONE

		UNLESS OTHERWISE SPECIFIED	RIVET WEAPONS CENTER CHINA LAKE, CALIF 93506	DEPARTMENT OF THE NAVY WASHINGTON D.C. 20380
DRAWINGS ARE IN INCHES				
INCHES = 1				
DECIMALS = 1				
PARTS SHELL BE PRINTED ON BLMRS				
PRINT IN INCHES				
TITLE: 8 MM				
SURFACE ROUGHNESS		<input checked="" type="checkbox"/>	APPROVED FOR	DATE
DO NOT SCALE THIS DRAWING			107	CODE IDENT NO.
DIFFERENT DRAWING IN ACCORDANCE WITH				DRAWING NO.
MIL-STD-146				
APPLICATION			REVISION	SCALE 1/1
			UNIT SET	SHEET

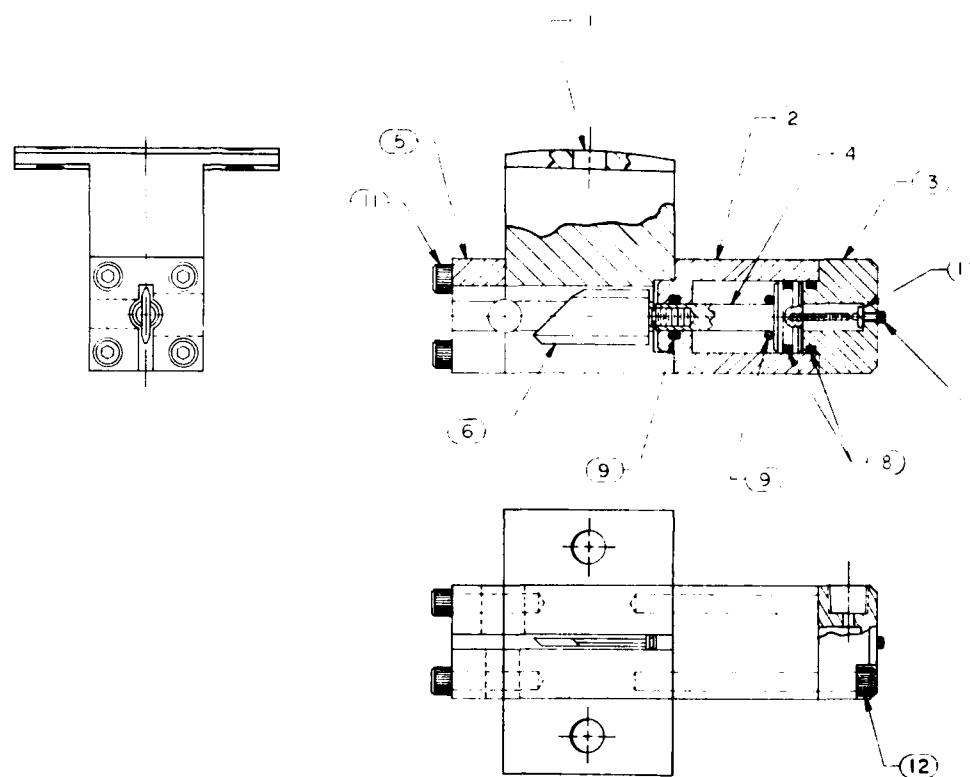
3

2

1

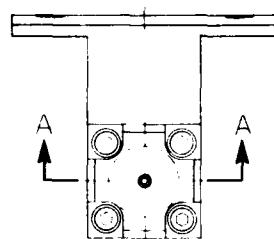
60

14 | 13 | 12 | 11 | 10 | ↓ | 8 | 7

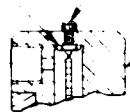


14 | 13 | 12 | 11 | 10 | ↑ | 8 | 7

6	5	4	3	2	1
REVISIONS					
SONG	LTR	DESCRIPTION	DATE	APPROVED	



(1) REF



(3) RE

SPEC 1 IN 1000

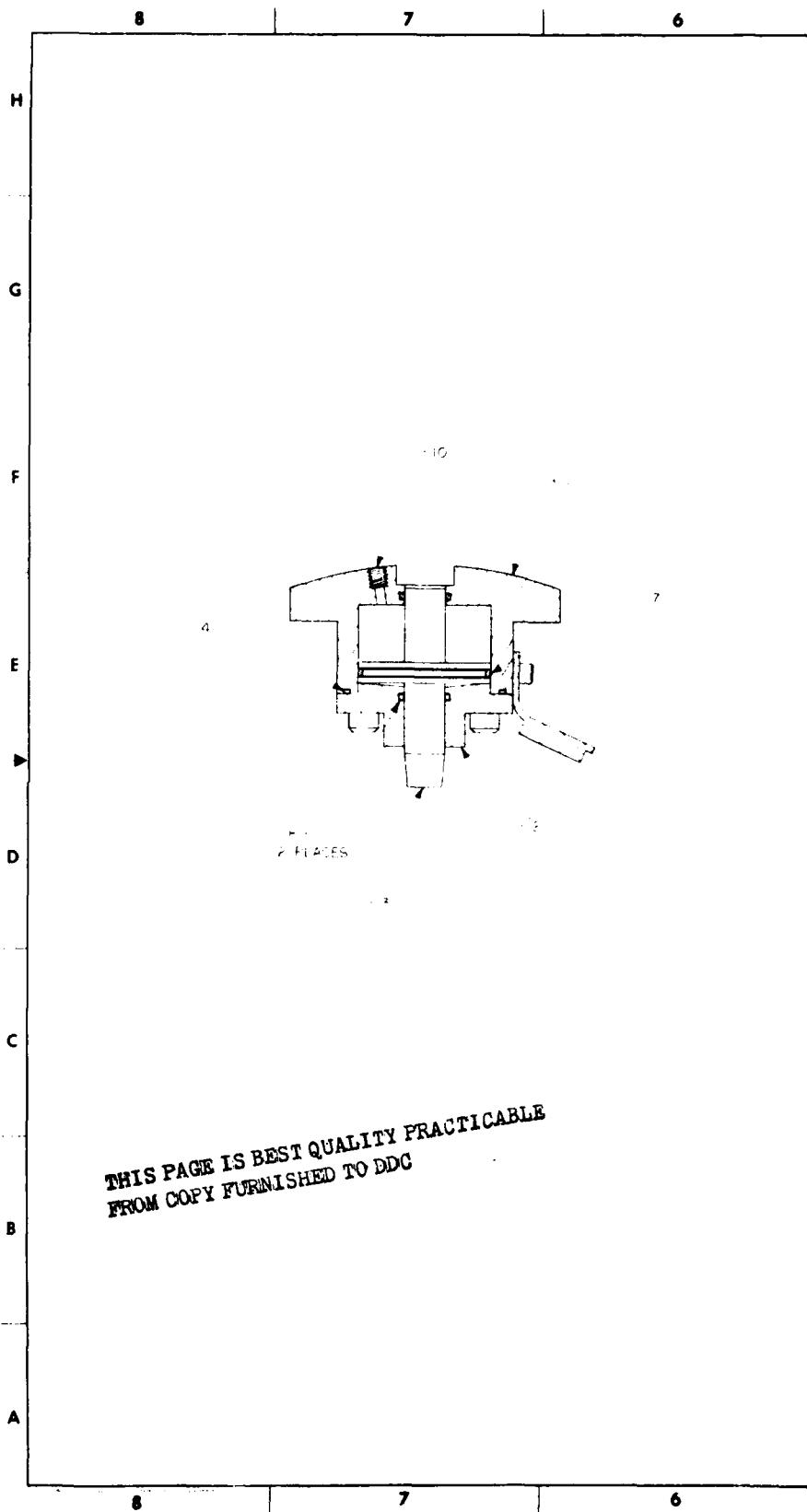
12	4	MS9706-35	SCREW	1/4-28 UNF								
11	4	MS16996-24	SCREW	1/4-28 UNF								
10	1	MS35649-244	NUT	4-40 UNC								
9	2		O-RING									
8	2		O-RING									
7	1		BREAKAWAY SCREW	4-40 UNC								
6	1	X3167818	KNIFE									
5	1		END BLOCK									
4	1		PISTON									
3	1		PISTON CLOSURE									
2	1		PISTON HOUSING									
1	1		MOUNTING BLOCK									
ITEM NO.	QTY REQD	CODE IDENT	PART NO. OR IDENTIFYING NO.	MENOMELATURE OR DESCRIPTION	SPECIFICATION	NOTE	ZONE					

## PARTS LIST

UNLESS OTHERWISE SPECIFIED	NAVAL WEAPONS CENTER CHINA LAKE, CALIF 93548	DEPARTMENT OF THE NAVY WASHINGTON, D.C. 20380		
DIMENSIONS ARE IN INCHES				
TOLERANCES				
FRACTIONAL				
DECIMALS				
PART SHALL BE FREE OF BURRS				
BROKEN EDGES				
PILLETS				
SURFACE ROUGHNESS				
DO NOT SCALE THIS DRAWING	APPROVED FOR	107	SIZE	CODE IDENT NO.
BY				DRAWING NO.
67 ASSY	USED ON			
CATION	INTERPRET DRAWING IN ACCORDANCE WITH MIL-STD-100		SCALE 1/1	UNIT WT.
				SHEET

6 5 4 3 2 1

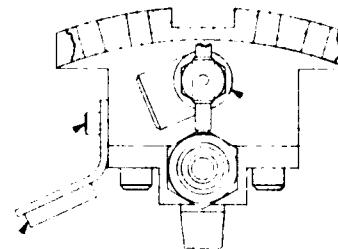
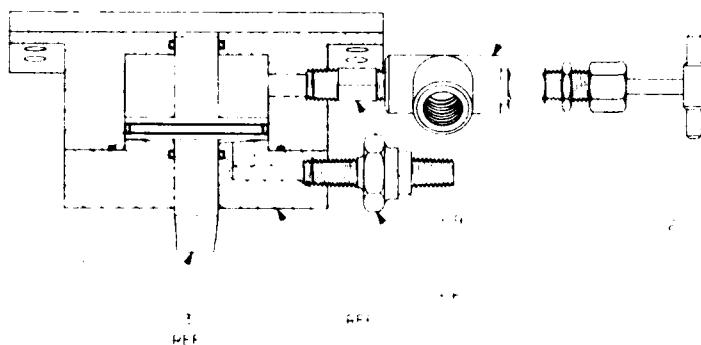
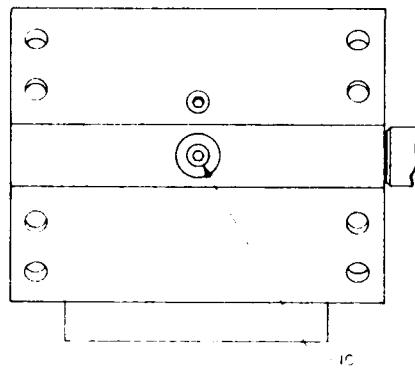
62



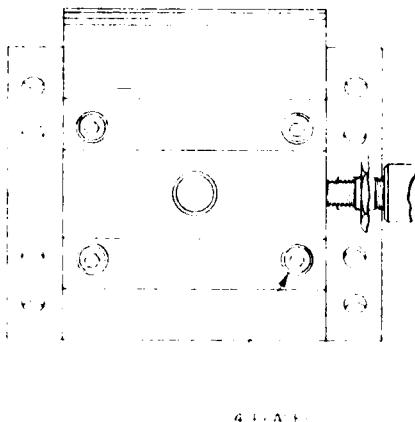
THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDC

5                  4                  |                  3                  |                  2                  |                  1

REVISIONS				
DATE	LTD	DESCRIPTION	DATE	APPROVED



THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDC



ITEM NO.	QTY	DESCRIPTION	BRACKET	SCREW, CAP	SCREW, CAP	SCREW, CAP
13	1					
12	2	MS16995-4B				
11	4	MS16996-4D				
10	2	1RHP-SS	SCREW, CAP			
9	1	4 INN-112	PLUG			
8	2		NIPPLE			
7	2		O RING			
6	1	S1210G	O RING			
5	1	SS-MR14	UNIT RUPURE			
4	1	MS2875-149	VALVE, VELOCITY			
3	1		O RING			
2	1		ROD DETENT			
1	1		COVER			
			HOUSING			
ITEM NO.	QTY	DESCRIPTION	BRACKET	SCREW, CAP	SCREW, CAP	SCREW, CAP

FIGURE 5.

64