TOW-BAR, EXPEDITOR

STRESS ANALYSIS

1. GENERAL This analysis is based on the towing loads given in ANC-2 Chapt. 4. Due to the design of the tow-bar, the loads are applied to the aircraft tow points at an angle of 25.3° under all towing conditions. It is considered necessary to limit the tow-bar pull to a value such that the load at either tow point does not exceed the value specified in ANC-2. It may be expected that the maximum tow point load will occur when steering the aircraft with the tow-bar.

2. TOWING LOADS — Ref

Max. Take-Off weight, W_T = 9300 lb.

Towing Load $F_{tow} = 0.3\ W_T = 2790$ lb. ANC-2

Limit Load at each tow point
$= 0.75\ F_{tow} = 2095$ lb. ANC-2

Ultimate load at each tow point
$= 1.5 \times 2095 = 3140$ lb ANC-2

3. ALLOWABLE STRESSES

Material - Commercial mild steel.

F_{TU}	60000 psi
F_{TY}	33000
F_{SU}	40000
F_{bru}	80000
E	28×10^6

4. PIPE A (See Fig. 1)

The most critical condition for the pipe is buckling under compression load shown in fig. 1.

4.1. Section Properties and Critical Load

	Ref.
$A = 1.075$ in ^{2}	AISC
$r = 0.79$ in	AISC
$L = 164$ in	
$C = 1$	

Cont'd

L/r= 164/0.79 = 208 (an Euler column)

$f_{cr} = \pi^2 \times 28 \times 10^6/(208)^2 = 6400$

$P_{cr} = 6400 \times 1.075 = 6880$

M.S. = (6800/3140) - 1 = 1.19

5.0 Ring B

5.1 Section Properties (Fig. 2)

For section A-A:-

$I = (0.5 \times 1^3)/12 + (\pi \times .75^4)/64$

$= .0417 + .0155 = .0572$

$S = .0572/0.5 = 0.114$

5.2 Stress - Assume structure is a ring loaded as in Fig. 3. This distribution is conservative.

$P = W = 2 \times 3140 \times \cos 25.3^\circ = 5670$ (Ref. Fig. 1)

R = 2.00

Max. M = 0.3183 WR = Roark - Table VIII

$0.3183 \times 2.0 \times 5670 = 3620$

$f_b = 3620/0.114 = 31800$

M.S. (60000/31800) - 1 = 0.89

6. Bolt C - 5/8 diam. double shear (Fig. 4)

6.1 Shear Stress - 3140/(2 x .307) = 5110

MS = (40/5.11) - 1 = 6.82

6.2 Bearing stress = 3140/(2 x .625 x .375)
= 6700

MS = Large

6.3 Bending Stress

M = 3140 x (1.5/4) = 1180 in lb.

$S = \pi d^3/32 = (\pi \times .625^3)/32 = .0240$

Cont'd

f_b = 1180/.0240 = 49100

M.S. = (60000/49100 -1 = 0.22

7. CLEVIS D

Tension on net section.

f_t = 3140/ (2 x 2 x .50 x .375) = 4190

M.S. = large.

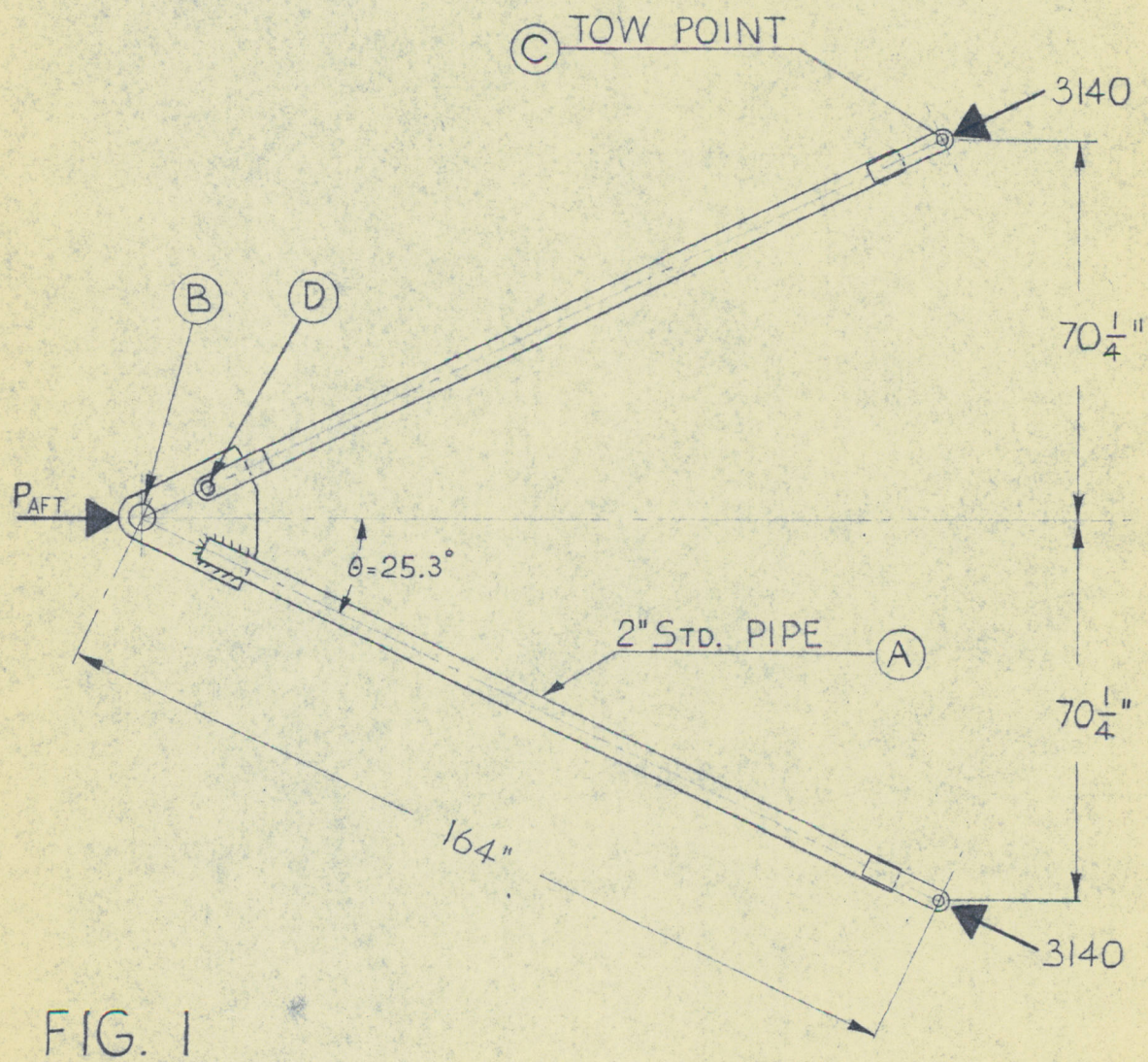
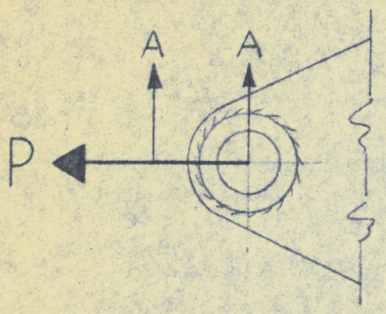
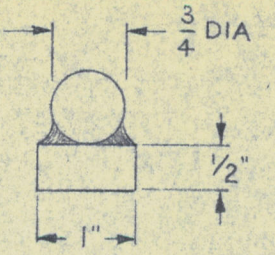


FIG. 1

FIG. 2





SECTION A-A

FIG. 3

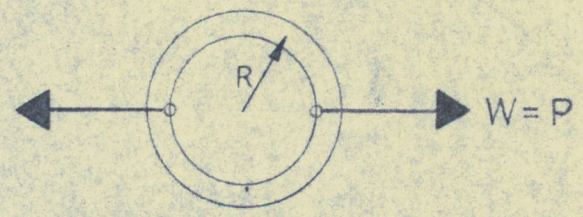


FIG. 4

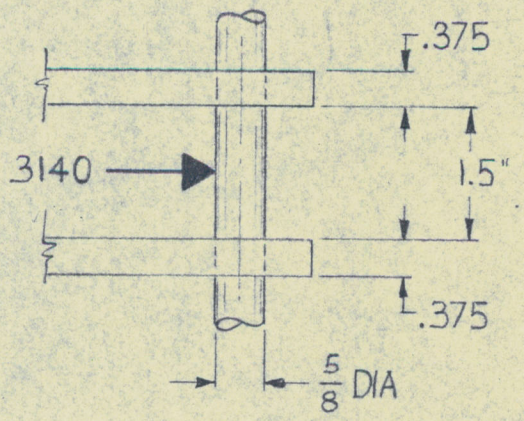


FIG. 5