

AD-787 059

**AEROMECHANICAL ANALYSIS OF A TOW
TARGET SYSTEM INSTALLED ON THE A-4
AIRPLANE**

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Warminster, Pennsylvania**

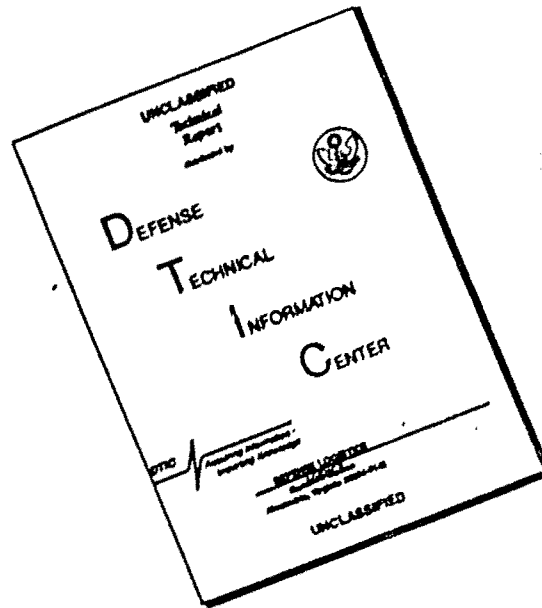
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The tow target system installation, analyzed in this report is intended for towing large towed targets for air-to-air and surface-to-air weapon training firing exercises. The system will also provide for the towing of smaller towed targets at towline lengths exceeding 6 miles. The analysis indicates that the installation is adequate, structurally, for target towing missions which are within the capability of the A-4 airplane. Flight test of the system is recommended to determine suitability for service use.		

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S U M M A R Y

This report provides the results of an aeromechanical analysis of the flight worthiness of a tow target system installation for the A-4 airplane.

The tow target system consists of a modified RMU-8/A reel-launcher installed on the centerline Aero 7A bomb rack, controlled by a panel mounted in the left hand console in the cockpit (forward cockpit of "T" models of the A-4), 0.182 inch-diameter 3 x 7 cable towline (10,800 feet stored on the reel-launcher spool) and a large profile fighter tow target such as the "FIGAT". This system configuration, which is analyzed herein is considered the "worst case" among configurations which would include long towlines, air-launched and other drag launched towed targets and the new RMK-19/A47U-3 reel-launcher.

The system installation is structurally sensitive to yaw and to side load factor; however, the installation is considered adequate for target towing missions which are within the capability of the A-4 airplane. Mission capability is dependent upon the installed engine.

A-4s with J65-W-20 or J52-P-6 engines will be limited to towing maneuvers less than 2G. A-4s with the J52-P-8 or higher thrust engines can provide towing maneuvers to 3G. These limitations are imposed as a result of target tracking and towline geometry characteristics during low airspeed, high G turns and do not reflect a structural problem.

The following recommendations are advanced:

1. Due to yaw and side load sensitivity, it is recommended that rolling pullouts, abrupt control displacement and yawed flight be prohibited.
2. It is recommended that flight test of the system be conducted with the guidance provided in this report, to determine suitability for service use.

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I N T R O D U C T I O N

Under reference (a) the NAVAIRDEVCON was tasked to develop a prototype large diameter power unit and a semi-automatic control system for the RMU-8/A reel-launcher. This development was successfully completed and tested on A-4 and F-4 airplanes as reported in reference (b).

The analysis generated for the purpose of prototype tests on the A-4 was not, however, adequate to justify tests for service suitability. This report provides the analysis considered necessary to justify service suitability tests.

D I S C U S S I O N

The tow target system installation, as shown in figure 1, consists of a RMU-8/A (modified with a 30 inch diameter power unit and semi-automatic control system) installed on the centerline Aero 7A bomb rack of the A-4 airplane. A control panel is installed in the left hand cockpit console (forward cockpit of "T" models of the A-4). The reel-launcher spool is loaded with 10,800 feet of 0.182 inch-diameter 3 x 7 cable towline which is used to tow a large drag launched target such as the "FIGAT". Very long stepped diameter towlines may be loaded in the reel-launcher spool for operation with air launched targets which provide sufficient ground clearance for take-off and landing.

The analysis which was performed is provided in Appendix A. Supporting investigation and analysis of the Aero 7A centerline rack is provided in Appendix B and an analysis of the bolt reactions at the rack-airplane interface is provided in Appendix C.

The flight worthiness of the system is constrained by A-4 engine performance, the sway brace strength of the Aero 7A rack and the airplane structure supporting the store suspension system.

For a tow target mission with the "FIGAT", excess thrust of 2,000-3,000 pounds is required with wing tanks and the reel-launcher installed. The availability of excess thrust must coincide with a minimum airspeed required to maintain target and towline tracking in a maneuver. In addition, clearance between the towline and the reel-launcher pod surfaces must be maintained. These tracking and geometry requirements are exclusive of structural considerations.

High sway brace loads result from airplane yaw and side load factor due to rolling pull-out maneuvers. For the Aero 7A rack, the store yaw angle also increases with yawing moment due to yaw shift of the store in the suspension hooks. For the reel-launcher installation, the worst combination occurs when the reel-launcher spool is full and there is no target installed. Store weight, center of gravity position and center of pressure position maximize sway brace load for this case.

In view of the sensitivity to side load factor and yaw, restriction of the maneuverability of the airplane is considered appropriate. All applicable

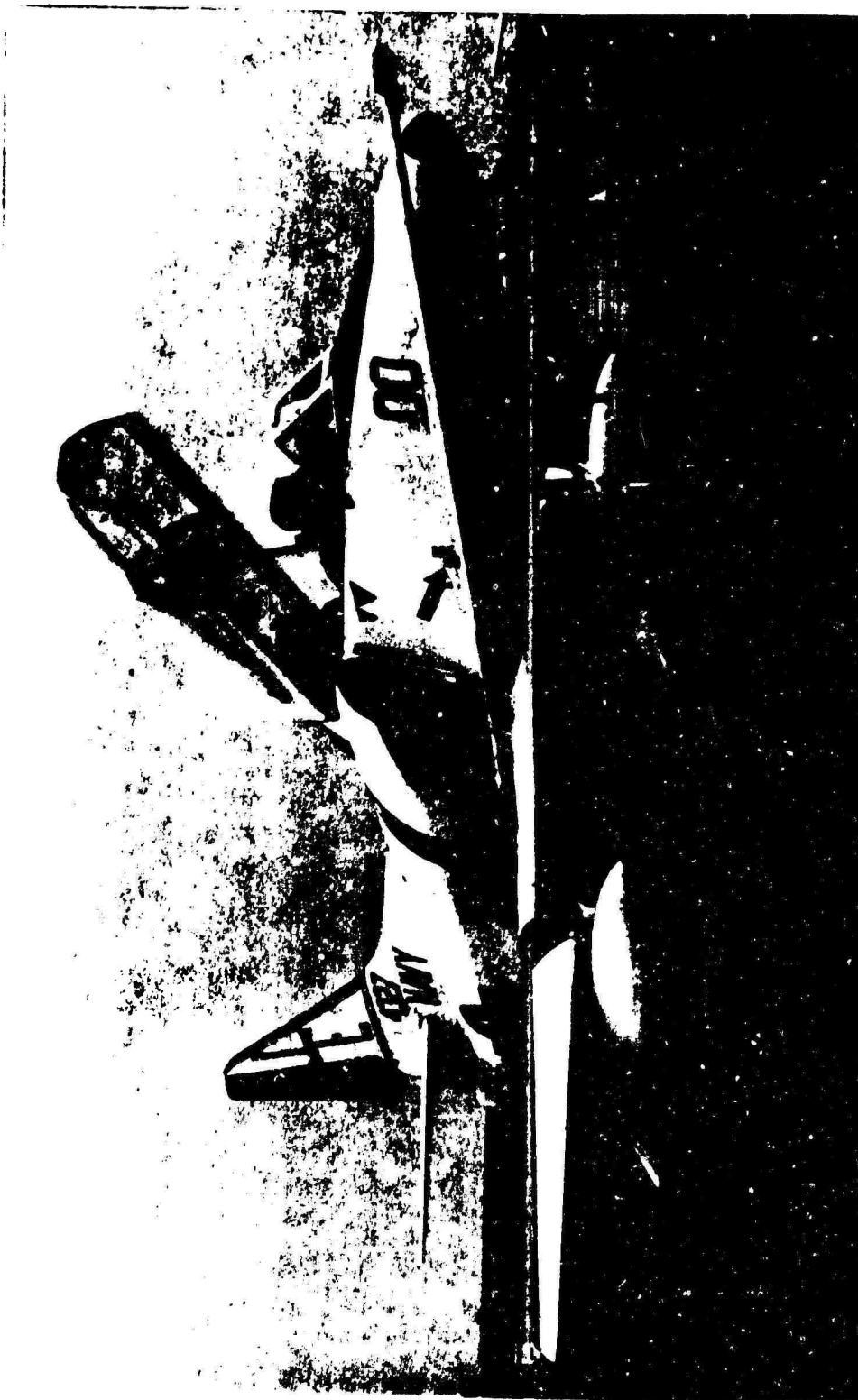


Figure 1. Modified RMU-8/A Installed on TA-4J
Airplane.

recommended flight limitations and system rigging data are provided in Appendix D. Reel-launcher operating instructions are provided in reference (b). It is to be noted, however, that structural damage to the installation is unlikely even if these restrictions are not strictly adhered to; and, the restrictions do not constrain the tow target mission.

The analysis specifically addresses the towing of large drag launched targets. The configuration of the system can be readily altered for the launch, towing and recovery of towed targets which fit within the ground clearance envelope. The effect of this change on the analysis is to reduce sway brace reactions and bolt side loads due to the rearward shift of store center of gravity and center of pressure (target attached at reel-launcher tow point). Towing loads are also reduced due to the use of lower strength towline. Due to lower weight and a center of gravity position further aft, the RMK-19/A47U-3 reel-launcher would also produce lower loads on suspension components.

C O N C L U S I O N S

The tow target system analysis indicates that, although the system installation is sensitive to yaw and side load, the installation is adequate for towing large drag launched targets under take-off flight and landing conditions appropriate to shore based towing missions, including field arrestments.

Ferry flight limitations are common to all A-4s. Towing missions are limited by airplane engine performance. A-4s with J65-W-20 or J52-P-6 engines will be limited to towing maneuvers less than 2G. A-4s with the J52-P-8 or higher thrust engines can provide maneuvers to 3G. Towing restrictions result from target tracking and towline geometry characteristics.

It is recommended that flight test of the system installation be conducted within the recommended limits provided in Appendix D in order to determine suitability for service use.

R E F E R E N C E S

- (a) AIRTASK A5355351-0014-4535000001.
- (b) D. W. Carroll, R. Rohman, F. X. Doyle, "Prototype Development of a Power Unit and Control System for a Towing Reel and Target Launcher," NADC Report No. NADC-73086-30, 2 Aug 1973.

A P P E N D I X A

TOW TARGET SYSTEM ANALYSIS

APPENDIX A

I. INTRODUCTION

This Appendix provides the detailed analysis performed to appraise the flight worthiness of a tow target system installed on the Navy A-4 airplane. The system consists of a modified RMU-8/A reel-launcher, 0.182 inch - diameter 3 x 7 steel cable towline and a large profile fighter type target such as the "FIGAT." The reel-launcher is installed on the centerline mounted AERO 7A bomb rack of the A-4.

The analysis examines the following aspects of the installation.

- A. A-4 Performance Data
- B. Profile Fighter Target (FIGAT) Data
- C. A-4 Performance Estimation
- D. Towing Loads for Continuous Turns
- E. Maneuvering Formulas (Appropriate for examination of loads and load factors in the airspace or on flight axes)
- F. Reel-launcher Store Characteristics
- G. Reel-Launcher Aero Loads
- H. Suspension System (Under ferry flight, field arrestment and towing conditions)

II ANALYSIS OF TARGET SYSTEM

A A-4 PERFORMANCE DATA

1. TOWING CONFIGURATION

2 FWD GEAR. MAIN GEAR

FORK-13/ACTU-7, 6P REEL-LINE OR TOWBAR ON 6

2. DATA SOURCE

USE NADC-73017-30 (A-4E) & NADC-73072-30 (A-4C)

FOR EXCESS THRUST AVAILABLE A-4 WITH J52-P-6

& J65-W-20 ENGINES

ADD 200 LBS FOR J52-P-6 ENGINE A-4s

3. TEST DATA

NADC NA-4C CONFIGURED AS ABOVE FOR

TOWLINE TEST - TO GW = 21,700 LBS

MARKER/TYPE { Δ TENSION = 1200-1500 LBS.

O TENSION = 700-1000 LBS

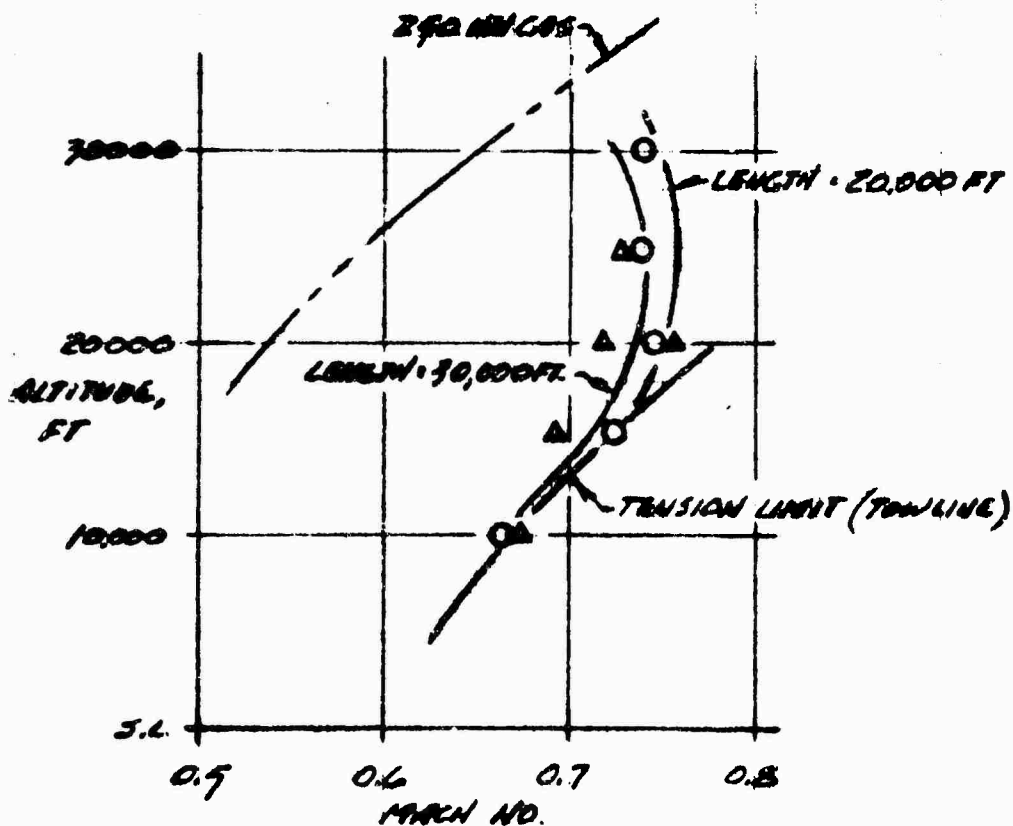
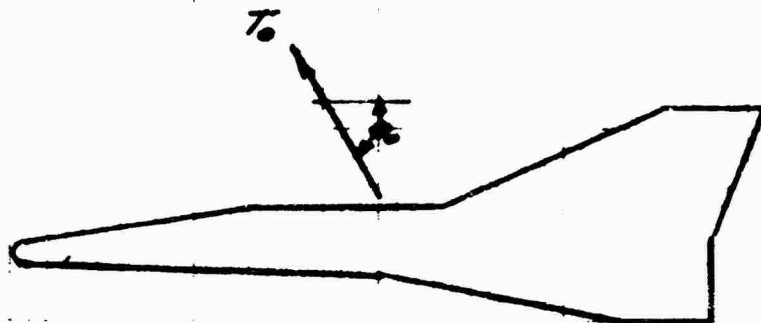


FIGURE A-1 TOWING TEST RESULTS - NADC NA-4C

B. PROFILE FIGHTER TARGET (FMAT) DATA

$$\alpha = \tan^{-1} [0.328 + (96.037 N_z / 2)]$$

$$T_0 = [4.3442 / \cos \alpha]$$

FOR TARGET + TOWLINE DRAG ESTIMATES, SEE
FIGURE A-2

C. A-6 TOWING SYSTEM PERFORMANCE ESTIMATION

DATA PROVIDED ON FIGURE A-3 CONSIDERING
ENGINE DIFFERENCES ONLY

TOWLINE LENGTH (L) 1000 FT, 2000 FT, 6000 FT,
10,000 FT, $N_z = 1$

THRUST WITH W-20 & P-6 ENGINE MARGINAL
FOR MANEUVER AT 20,000 FT, ALTITUDE

D. TOWING LOADS FOR CONTINUOUS TURNS**1. DATA SOURCE**

ORBITING PROGRAM DEVELOPED FROM
TALAMO; NADC-AM-6849, FOR NSTTS
SAMPLE IN-PUT, OUT-PUT PAGES A-73 THROUGH A-81.
DATA IN CYLINDRICAL CO-ORDINATES.
SEE MANEUVERING FORMULAS, PAGE A-8, FOR
CALCULATION OF INPUT DATA AND CONVERSION
TO ROLLED FLIGHT AXIS.

2. OUT-PUT DATA

SEE FIGURE A-4 FOR TOWING LOADS
SEE TABLE A-1 FOR DATA SUMMARY
 N_z & V' ARE TARGET N_z & TRUE AIRSPEED (KNOTS)

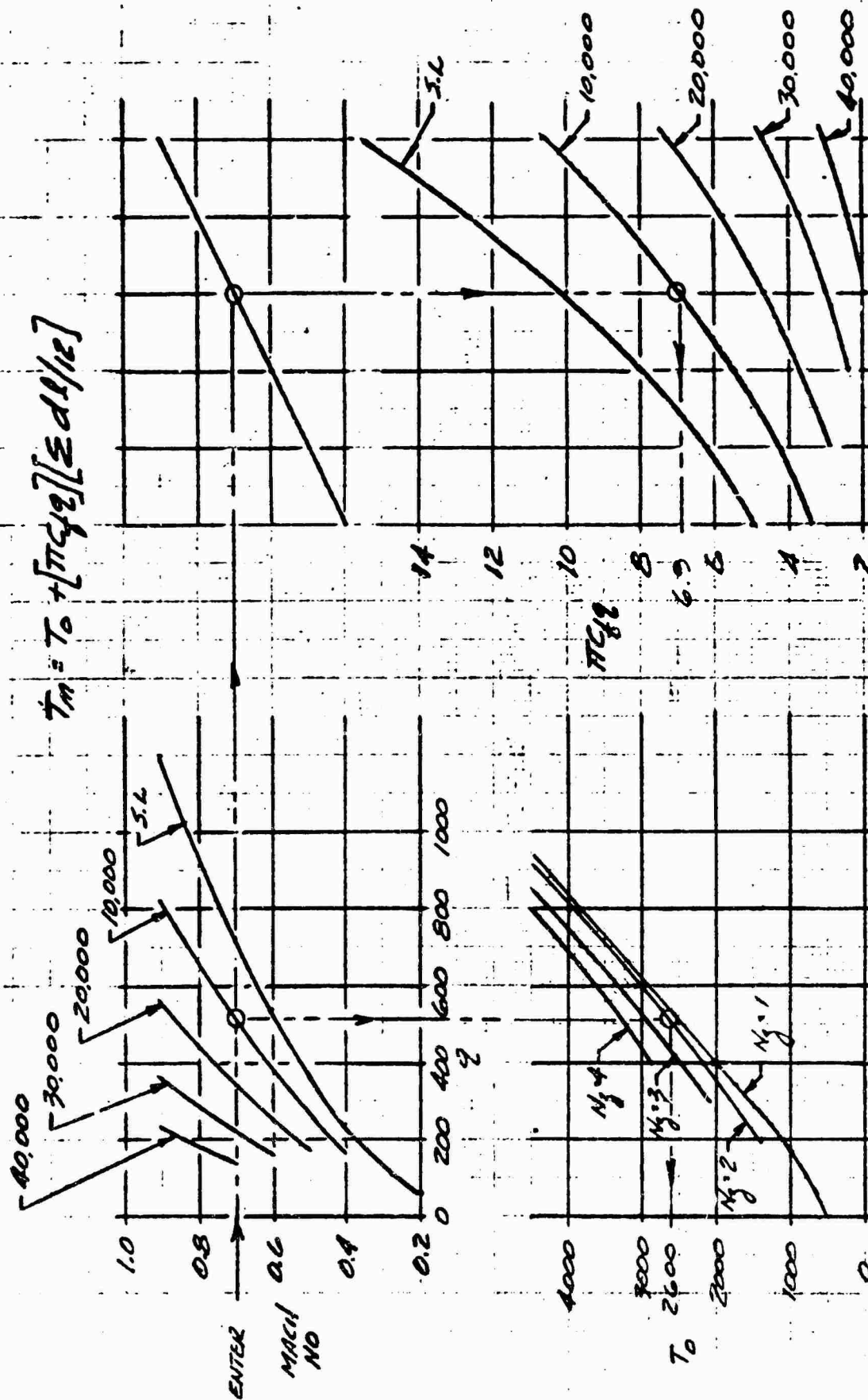


FIGURE A-2 TOWLINE TENSION AT TOWPLANE (T_m)
PRESSURE COEFFICIENT TOWED TARGET (FIGAT)

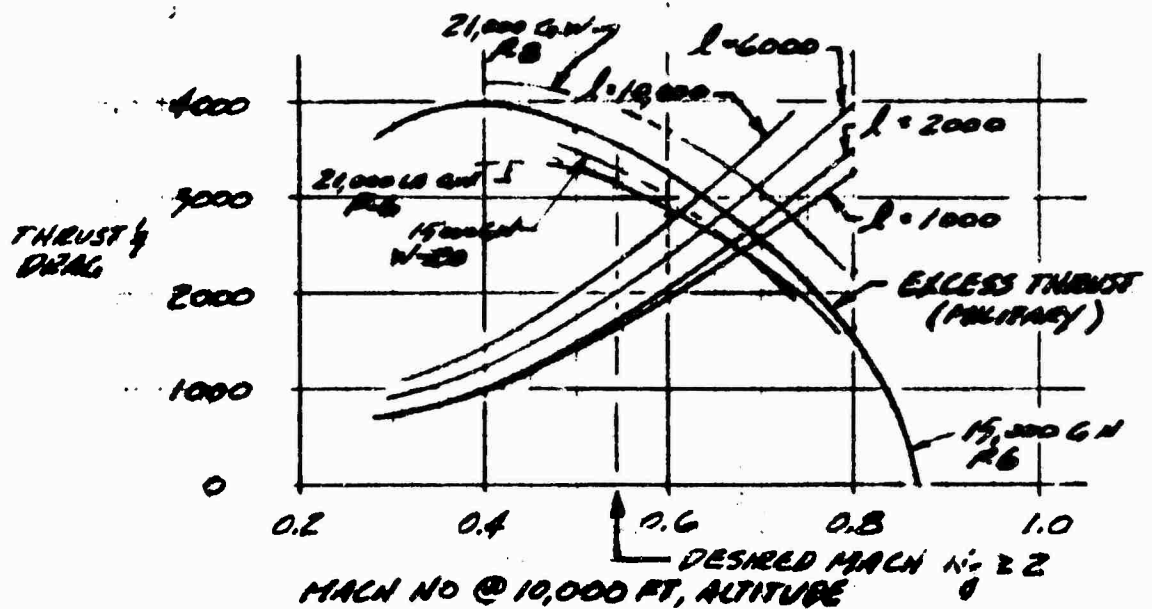
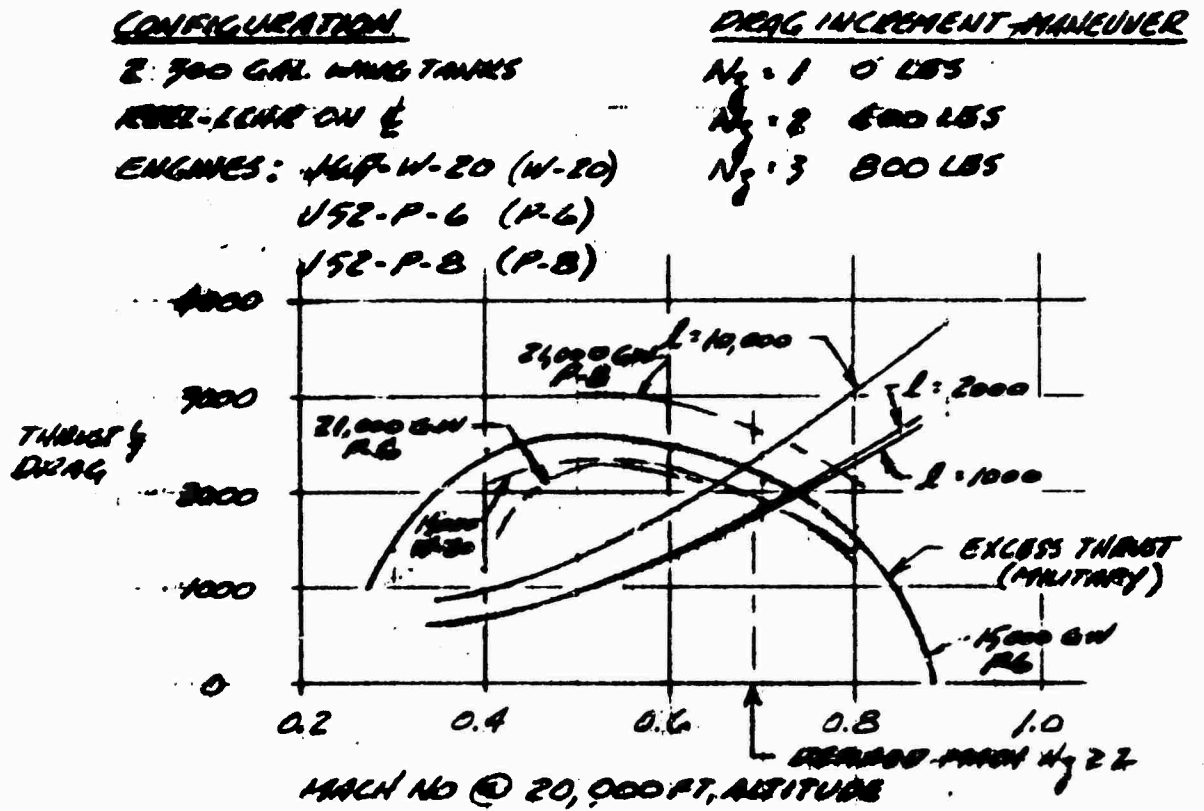


FIGURE A-3 A-4 TOWING SYSTEM PERFORMANCE
ESTIMATE - PROFILE FIGHTER TARGET (FIGAT)

E. MANEUVERING FORMULAS1. TURN RADIUS (KNTAS & N_g INPUT)

$$r_g = V^2 / g \tan \phi = 0.0087 (KNTAS)^2 / (N_g^2 - 1)^{0.5}$$

2. PULL-UP RADIUS (KNTAS & N_g INPUT)

$$r_g = V^2 / g (N_g - 1) = 0.0087 (KNTAS)^2 / (N_g - 1)$$

3. AIRSPEED (KNTAS) - N_g & r INPUT

$$(KNTAS) = 3.3539 [r (N_g^2 - 1)^{0.5}]^{0.5}$$

4. TOWLINE LOADS ON LAUNCHER (DATA FROM ORBITING PROGRAM)

P = TOWLINE LOAD VECTOR LENGTH

Δl = LAST LENGTH INCREMENT OF TOWLINE AT TOWPLANE

Δr = EQUIVALENT RADIUS INCREMENT

Δz = EQUIVALENT ALTITUDE INCREMENT

x, y, z ARE ROLLED FLIGHT AXES WITH (0,0,0)

AT REEL-LAUNCHER TOW POINT - POSITIVE FORCES ACTING AFT, DOWN & INTO TURN

$$P_z = \cos \left[\cos^{-1} \left(\frac{1}{N_g} \right) - \tan^{-1} \left(\frac{\Delta r}{\Delta z} \right) \right] (\Delta r^2 + \Delta z^2)^{0.5}$$

$$P_y = \sin \left[\cos^{-1} \left(\frac{1}{N_g} \right) - \tan^{-1} \left(\frac{\Delta r}{\Delta z} \right) \right] (\Delta r^2 + \Delta z^2)^{0.5}$$

$$RP_{xj} = \Delta l \cos \left[\sin^{-1} \left(\frac{P_y}{\Delta l} \right) \right]$$

$$P_x = \cos \left[\sin^{-1} \left(\frac{P_z}{RP_{xj}} \right) \right] RP_{xj}$$

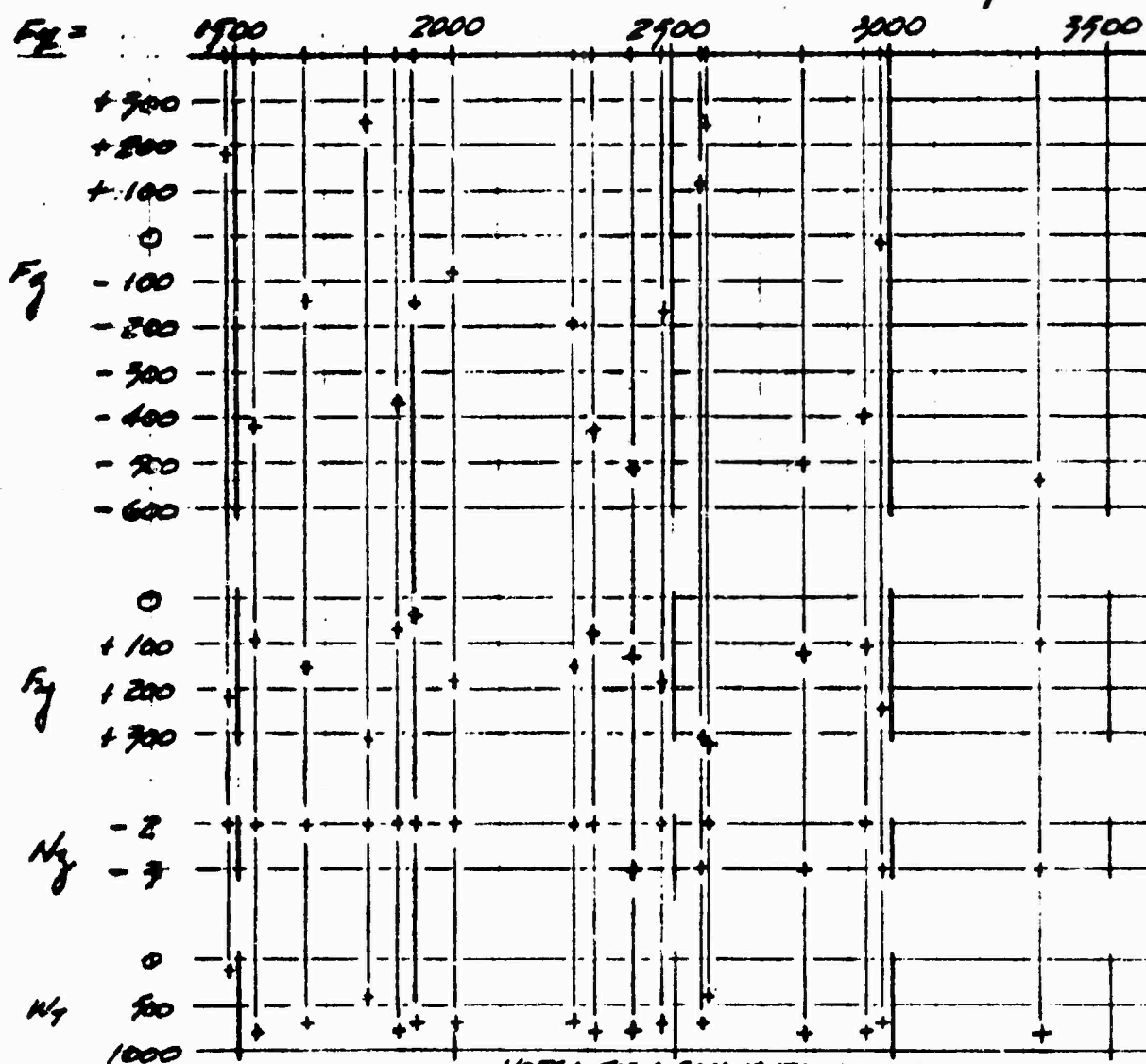
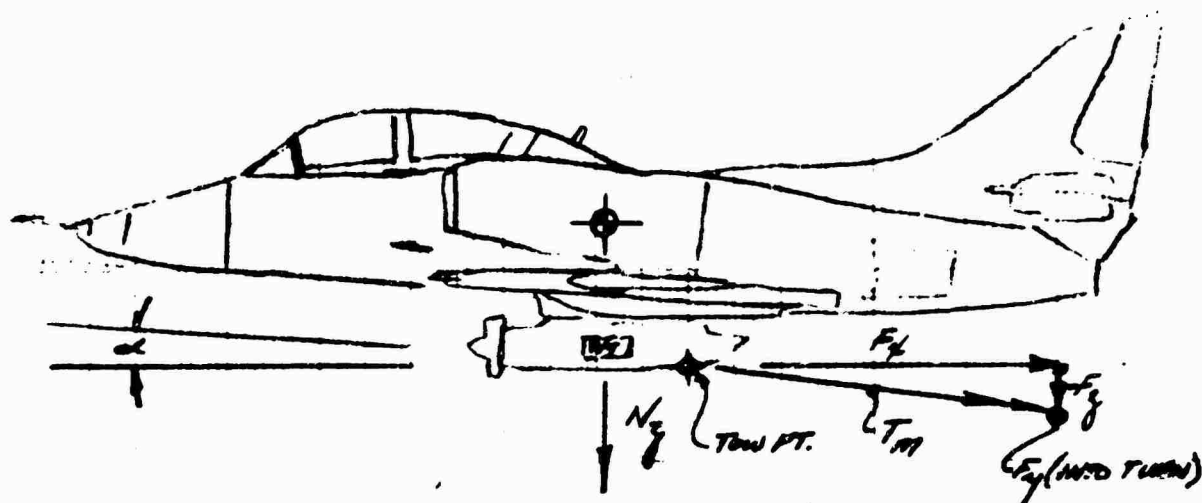
P = FRACTION OF TOWLINE LOAD EQUIVALENT TO VECTOR LENGTH

T_m = TOWLINE TENSION AT TOWPLANE

$$P = P / \Delta l$$

F = FORCE APPLIED BY TOWLINE

$$F = P T_m$$



NOTE: SIGN CONVENTION PER MIL-H-11-B591

FIGURE A-4 TOWING LOADS SUMMARY
 PROFILE FIGHTER TARGET (FKAT) & 0.182 3x7 CABLE

DATA SHEET
AND NADC 3000/11

TABLE A-1

TOWING LOADS SUMMARY - PROFILE FINDER TARGET (FPGAT)

INPUT DATA - ORBITING PROGRAM							OUTPUT DATA						
ALT.	MAN	PRG	SC.	TAS	N _g	r	l	T _m	P _g	P _g	P _g	N _g	V'
10,000	0.7	0.0135	1.64	447	3	6264	7000	3340	.1587	.0287	.9169	3.12	466
↓	0.6	0.0150	1.51	384	3	4622	↓	2141	.1748	.0442	.9232	3.19	411
	0.5	0.0170	1.40	319	3	3190	↓	2475	.2097	.0530	.9763	3.33	358
	0.7	0.0135	1.64	447	2	10225		2936	.1366	.0366	1.0000	2.04	458
	0.6	0.0150	1.51	384	↓	7548		2365	.1812	.0339	.9828	2.05	397
↓	0.5	0.0170	1.40	319		5209	↓	1718	.1989	.0376	.9601	2.09	338
10,000	0.4	0.0210	1.30	256		3355	1000	1603	.2632	.0559	.9631	2.17	285
20,000	0.7	0.0135	1.64	430		9465	2000	1755	.0846	.0666	.9942	2.06	446
20,000	0.6	0.0150	1.51	369	↓	6970	↓	1912	.2760	.0716	.9945	2.07	390
20,000	0.5	0.0170	1.40	307	2	4855		1667	.0860	.0829	.9960	2.15	337
↓	0.6	0.0150	1.51	384	3	4622		2986	.0079	.0821	.9766	3.22	415
10,000	0.5	0.0170	1.40	319	3	3190		2598	.0420	.1210	.9918	3.35	361
↓	0.6	0.0150	1.51	384	2	7368	↓	2491	.0673	.0766	.9971	2.06	400
	0.5	0.0170	1.40	319	↓	5209	2000	2019	.0417	.0916	.9949	2.11	341
	0.4	0.0210	1.30	384		3355	6000	2600	.0941	.1271	.9919	1.99	380
↓	0.5	0.0170	1.40	319	↓	5209	6000	1851	.1363	.1699	.9760	1.91	300
10,000	0.5	0.0170	1.40	319	2	5209	10,000	1509	.1212	.1462	.9818	1.65	241

NOTE: SIGN OF P_g ORIGIN OF MIL-A-8591

PLATE NO 1303R

F. REEL-LAUNCHER STORE CHARACTERISTICS

1. DATA SOURCES

a. ACTUAL WT & BALANCE RAN-2/A (S/N 022)

SEE FIGURE A-5

b. ACTUAL WT. REPORT (TRK-053B-36-1)

RAN-19/A67U-3 (FA-3)

SEE FIGURE A-6 FOR DIFFERENCE DATA

2. MOMENT OF INERTIA ESTIMATES FOR RAN-19/A (S/N 022)

$$I_{xx} = W'z'^2 + \Delta Wz^2 - Wz^2 + I'_{xx}$$

$$= (809.8)(1.6)^2 + (56.2)(-1.5)^2 - (866)(1.4)^2 + 35401$$

$$= 35903 \text{ LB} \cdot \text{IN}^2 - \text{USE } 36,000 \text{ LB} \cdot \text{IN}^2 (R=6.5)$$

$$I_{yy} = W'x'^2 + \Delta Wx^2 - Wx^2 + W'z'^2 + \Delta Wz^2 - Wz^2 + I'_{yy}$$

$$= (809.8)(62.3)^2 + (56.2)(8.4)^2 - (866)(58.8)^2 + (809.8)(1.6)^2 + (56.2)(-1.5)^2 - (866)(1.4)^2 + 821913$$

$$= 975,306 \text{ LB} \cdot \text{IN}^2 - \text{USE } 976,000 \text{ LB} \cdot \text{IN}^2 (R=33.6)$$

$$I_{zz} = W'y'^2 + \Delta Wy^2 - Wy^2 + I'_{zz}$$

$$= (809.8)(62.3)^2 + (56.2)(8.4)^2 - (866)(58.8)^2 + 816512$$

$$= 969,403 \text{ LB} \cdot \text{IN}^2 - \text{USE } 970,000 \text{ LB} \cdot \text{IN}^2 (R=33.5)$$

SEE FIGURE A-7 FOR EQUIVALENT STORE DATA
APPLICABLE TO A-4 AERO-7A INSTALLATION

3. MOMENT OF INERTIA ESTIMATES FOR VARIABLE TOWLINE SPOOL LOADING

SEE TABLE A-II

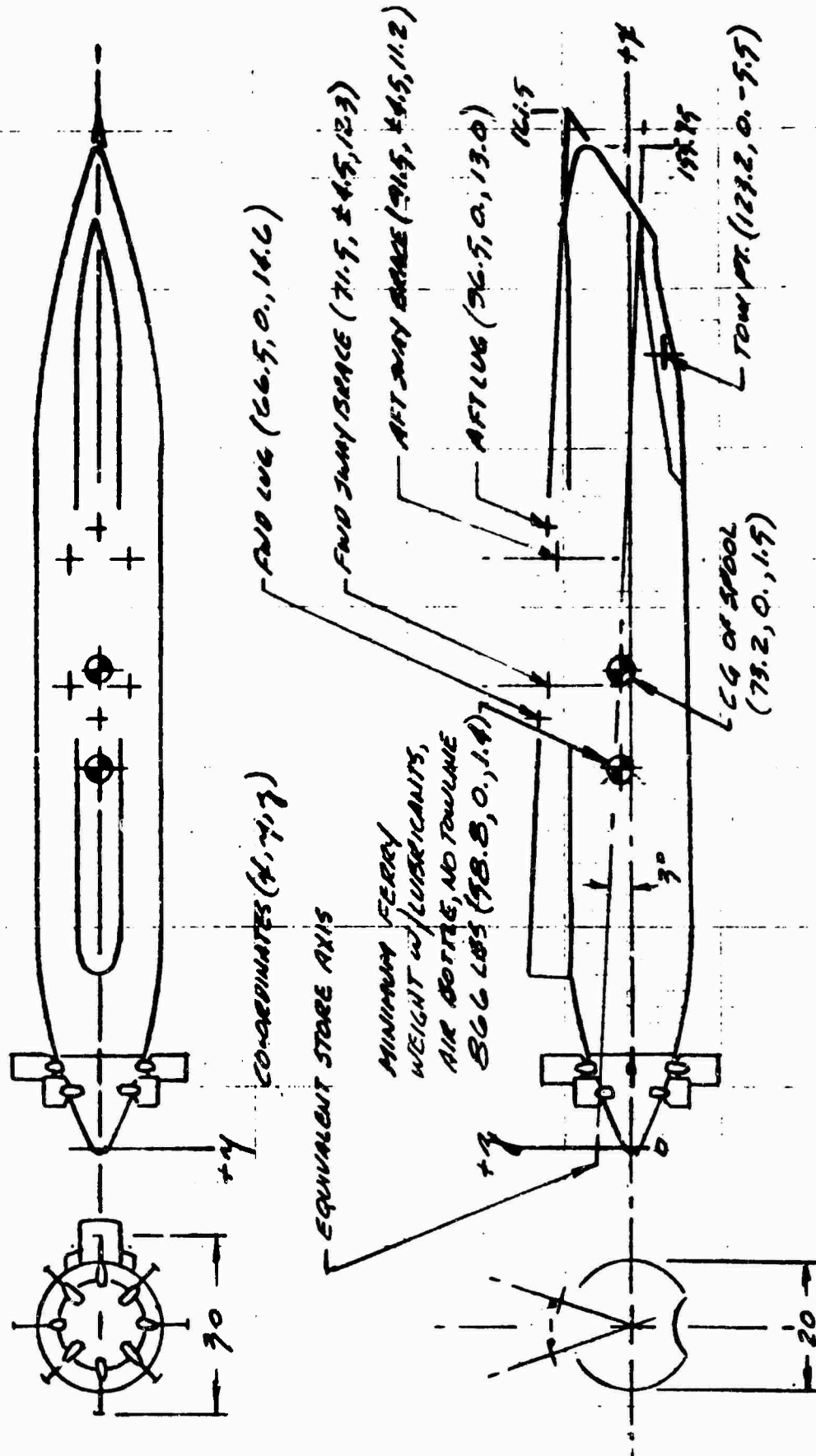


FIGURE A-5 DIMENSIONAL & WEIGHT & BALANCE DATA
RPMV-B/A S/N 022

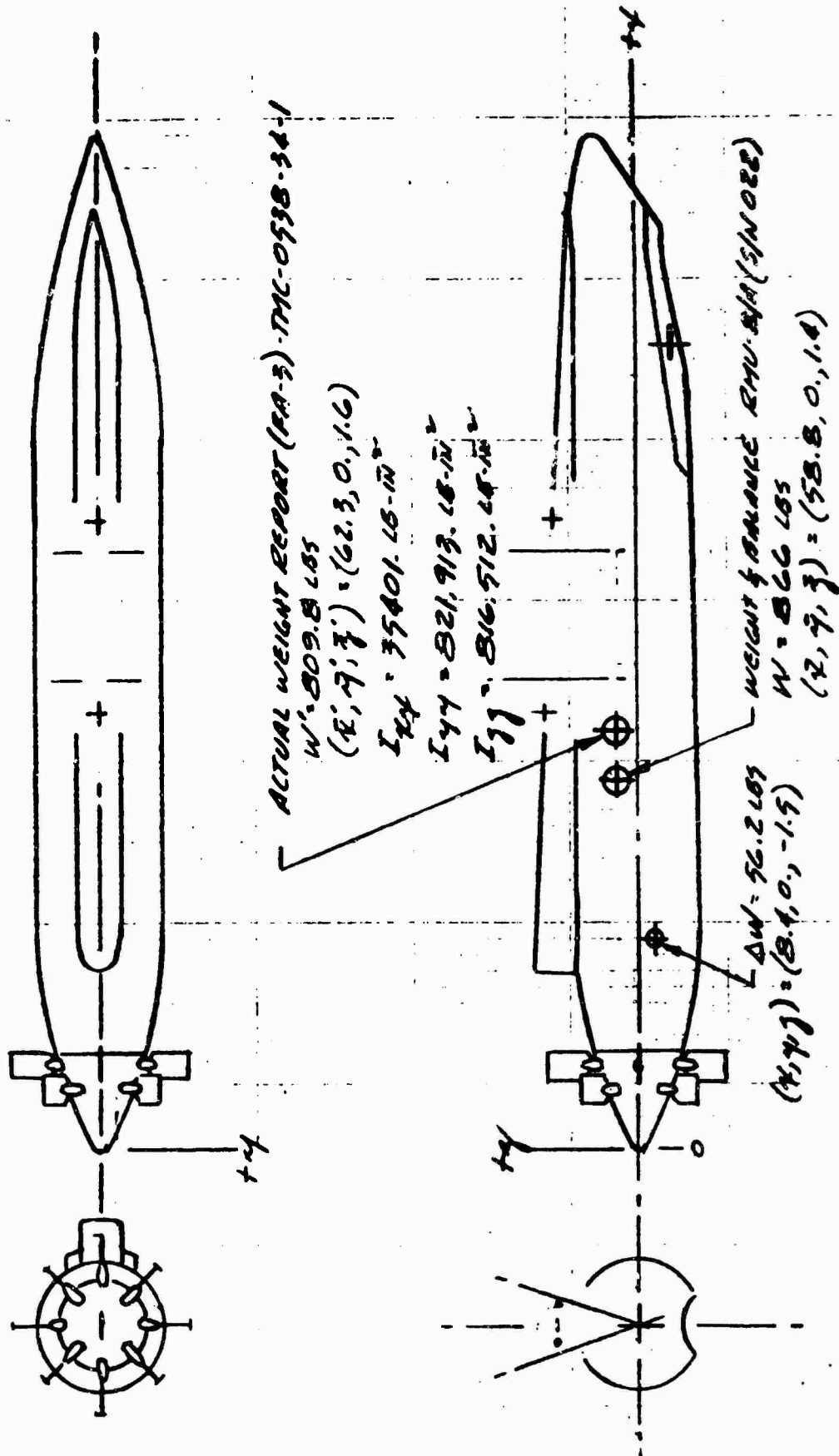


FIGURE A-6 DIFFERENCE DATA - RMU-19/ASU-3 & RMU-5/A

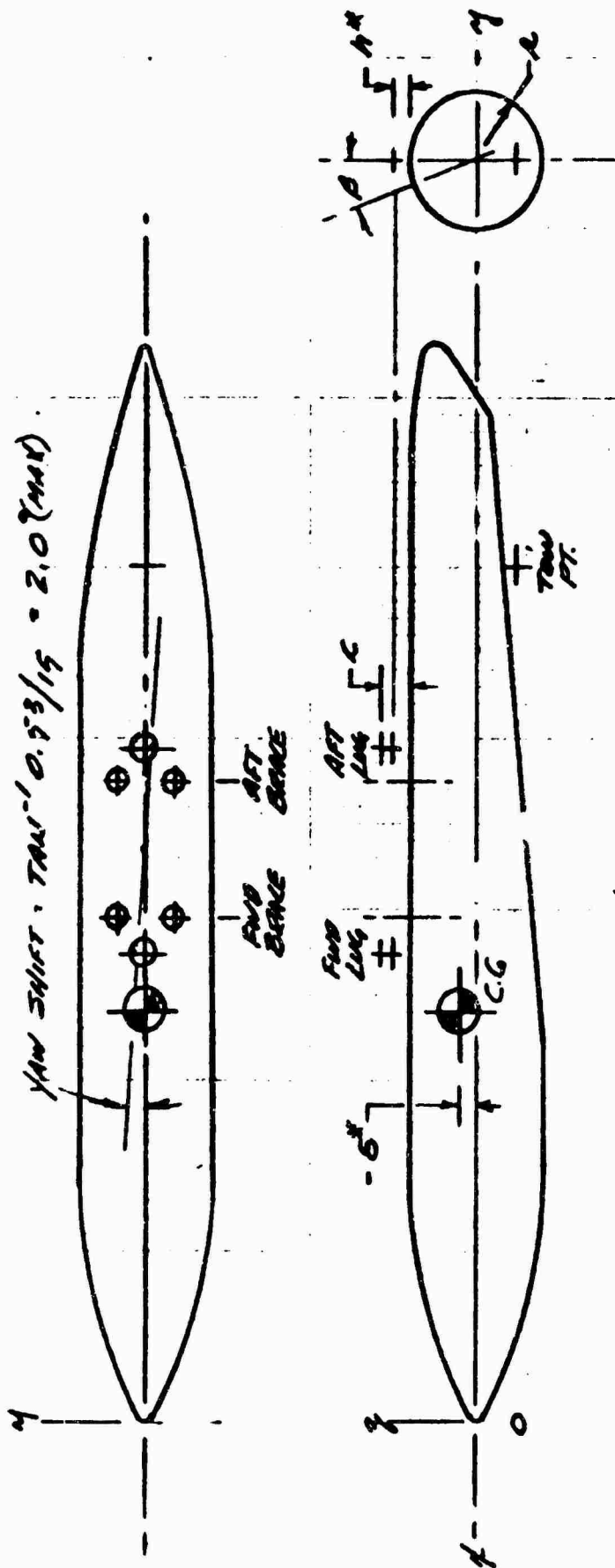


FIGURE A-7 RMU-8/A, RMK-19/ATU-3 EQUIVALENT STORE DATA

A/C TYPE	A-4	REEL TYPE	RMU-8/A
RACK TYPE	AERO 7A	REEL 3/N	022
DIMENSIONAL DATA			
FWD LUG	65.8	0	13.5
AFT LUG	95.8	0	13.5
FWD BRACE	70.8	±4.5	11.4
AFT BRACE	90.8	±4.5	11.4
TOW PT	123.6	0	-3.6
C.G. NO TOWING	98.8	0	0

I_{xx}	I_{yy}	I_{zz}
36,000	976,000	970,000

$\alpha = 12.3$ NOTE YAW SHIFT

$\epsilon = 1.6$

$\mu = 1.2$

$\beta = 21.5$

$\epsilon = 0.0$

$W = 866$
NO TOWING

G. REEL-LAUNCHER AERO LOADS

1. DATA SOURCE

TPC 059B-13-1

DATA IS CORRECTED FOR

- A. 30 IN-EM PWR UNIT
- B. CALCULATION ERRORS
- C. PYLON DRAG
- D. PWR UNIT $C_{N\alpha}$ & C_{NB}

2. AERODYNAMIC DERIVATIVES - DRAG

$$C_{D_{STORE}} = C_{D_0} + C_{D_p} + (\alpha^2 + \beta^2) + C_{D_{DF}}$$

$$C_{D_0} = 0.109, 0.4 \leq M \leq 0.9$$

$$C_{D_{DF}} = 0.0307$$

$$C_{D_p} = \text{PYLON DRAG COEFFICIENT}$$

$$= C_{D_{LROSS}} \frac{\text{ACROSS}}{\text{AREF}}$$

$$A_{REF} = 2.18 \text{ ft}^2$$

$$A_{LROSS} = (6.5)(9) + (2)(3)(3) = 76.5 \text{ ft}^2$$

$\uparrow$ MAX O.L.E. $\uparrow$ 5.8 PADS

$$C_{D_{LROSS}} = 5.3 \frac{1/c}{(M^2-1)} \cdot \frac{(5.3)(6.5)}{(12)^2(1.5^2-1)} = 0.191$$

$$C_{D_p} = \frac{(0.191)(76.5)}{(2.18)(144)} = 0.0466$$

$$C_{D_{STORE}} = 0.1823 + (\alpha^2 + \beta^2), 0.4 \leq M \leq 0.9$$

NOTE - OTHER ESTIMATE 0.1556 FOR RMU-8/A
WITH 26"-D UNIT BASED ON F-4 DRAG COUNTS

3. AERODYNAMIC DERIVATIVES - NORMAL FORCE

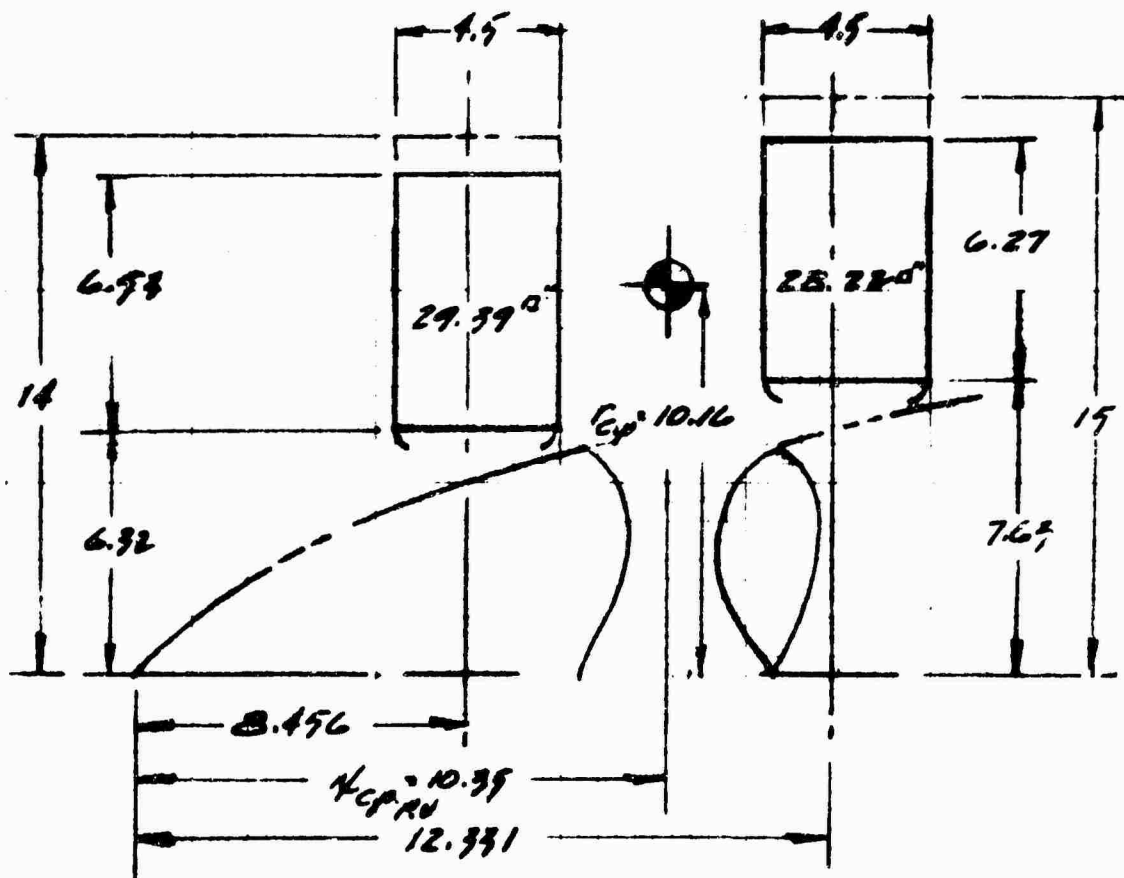
CONSIDER $C_{L_N} = C_{N_L} = C_{N_B} = C_{N_L(B)}$

POD ONLY

$$C_{N_L(B)}_{POD} = 2.00$$

PWR UNIT ONLY

(REF. TMC 5-1296)



Q = TORQUE, ' - #

A_{BLADES} = EFFECTIVE BLADE AREA

r_{cp} = TORQUE RADIUS, ' = 10.16/12

$C_{L_{BLADE}}$ = BLADE LIFT COEFFICIENT

$r_{cp_{PWR}}$ = CENTER OF PRESSURE FOR PWR. UNIT = 10.39 IN.

$$Q = C_L q A_{\text{WINGS}} r_{cp} = 2 Q_c q D^3$$

Q_c : TORQUE COEFFICIENT (NADC-73086-70)

$$D^3 : (30/12)^3 = 15.625 \text{ FT}^3$$

F_T : FORCE APPLIED AT RADIUS r_{cp}

$$F_T = \frac{2 Q_c q D^3}{r_{cp}} = 36.91 Q_c q$$

F_N : NORMAL FORCE APPLIED AT r_{cp} PU

$$F_N = F_T \left[\frac{2 + (4)(0.707)}{3} \right] = 22.28 Q_c q$$

SEE FIGURE A-8 FOR PLOTTED DATA

$$C_{N\alpha}(B)_{PU} = 1.59, 0 < \alpha(B) \leq 0.05$$

$$C_{N\alpha}(B)_{PU} = 1.64 + 2.26 \alpha(B), 0.05 < \alpha(B) \leq 0.25$$

NOTE - $C_{N\alpha}(B)_{PU}$ NOT CONSIDERED IN ANY
PREVIOUS ANALYSIS

4. AEROYNAMIC DERIVATIVES - FITTED & RAW MOMENTS

POD ONLY

$$C_{M\text{POD}} = C_{M\alpha}(B)_{\text{POD}} = \{ \eta_{M} \cdot \eta_{cp, \text{POD}} \} C_{N\alpha}(B)_{\text{POD}} \alpha(B)$$

$$l_{\text{POD}} = 155.75$$

$$\eta_{M} = \eta_{cg} / 155.75$$

$$\eta_{cp, \text{POD}} = 0.12 (\% l_{\text{POD}})$$

$$\eta_{cp, \text{POD}} = 0.12 (155.75) = 18.69$$

PWR UNIT

$$C_{M\text{PU}} = C_{M\alpha}(B)_{\text{PU}} = \{ \eta_{M} \cdot \eta_{cp, \text{PU}} \} C_{N\alpha}(B)_{\text{PU}} \alpha(B)$$

$$\eta_{cp, \text{PU}} = 10.35$$

Ref: NADC-73086-30



22.28 Q_c

22.28 $Q_c / 2.18 \alpha = C_{HL}(\beta)$ PER UNIT

$$C_{HL}(\beta) \text{ PER UNIT} = 1.93 \quad 0 < \alpha(\beta) < 0.05$$

$$= 1.68 - 2.26 \alpha(\beta) \quad 0.05 < \alpha(\beta) < 0.25$$

FIGURE A-8 NORMAL FORCE COEFFICIENTS FOR 30 IN. DIA PER UNIT

5. AERODYNAMIC DERIVATIVES - SUMMARY

SEE FIGURE A-9

APPROPRIATE FOR HEAVY DUTY REEL-LAUNCHER
(RML-19/A4W-3 & RML-8/A4W/30W-DIA PHE. UNIT)

6. FLIGHT CONDITIONS FOR AIRLOADS - A-4 TOW CONFIG.

A. FERRY - 0.8 M @ S.L., 530 KN (CAS)

$$q = 975 \text{ #/ft}^2$$

$$\alpha = 0^\circ, +5^\circ \text{ (2° TYPICAL FOR A-4)}$$

$$\beta_{\text{MC}} = \pm 2^\circ$$

B. TOWING - 0.65 M @ S.L., 430 KN (CAS)

$$q = 640 \text{ #/ft}^2$$

$$\alpha = 0^\circ, +8^\circ \text{ (4° TYPICAL FOR A-4)}$$

$$\beta_{\text{MC}} = \pm 3^\circ$$

7. STORE AIRLOAD CONDITIONS

SEE TABLE A-III

F1

$$q = 975 \text{ #/ft}^2$$

$$\alpha_s = -0.052 \text{ RADIANS}$$

$$\beta_s = -0.035 \text{ RADIANS}$$

F2

$$q = 975 \text{ #/ft}^2$$

$$\alpha_s = +0.035 \text{ RADIANS}$$

$$\beta_s = -0.035 \text{ RADIANS}$$

T1

$$q = 640 \text{ #/ft}^2$$

$$\alpha_s = -0.052 \text{ RADIANS}$$

$$\beta_s = -0.052 \text{ RADIANS}$$

T2

$$q = 640 \text{ #/ft}^2$$

$$\alpha_s = +0.087 \text{ RADIANS}$$

$$\beta_s = -0.052 \text{ RADIANS}$$

ALTERNATE CONDITIONS INCLUDE YAW SHIFT
IN RACK - SEE TABLE A-III

$$\tan^{-1} 0.53/15 = 2.0$$

$$\beta_s = -0.070 \text{ (F1A \& F2A)}$$

$$\beta_s = -0.087 \text{ (T1A \& T2A)}$$

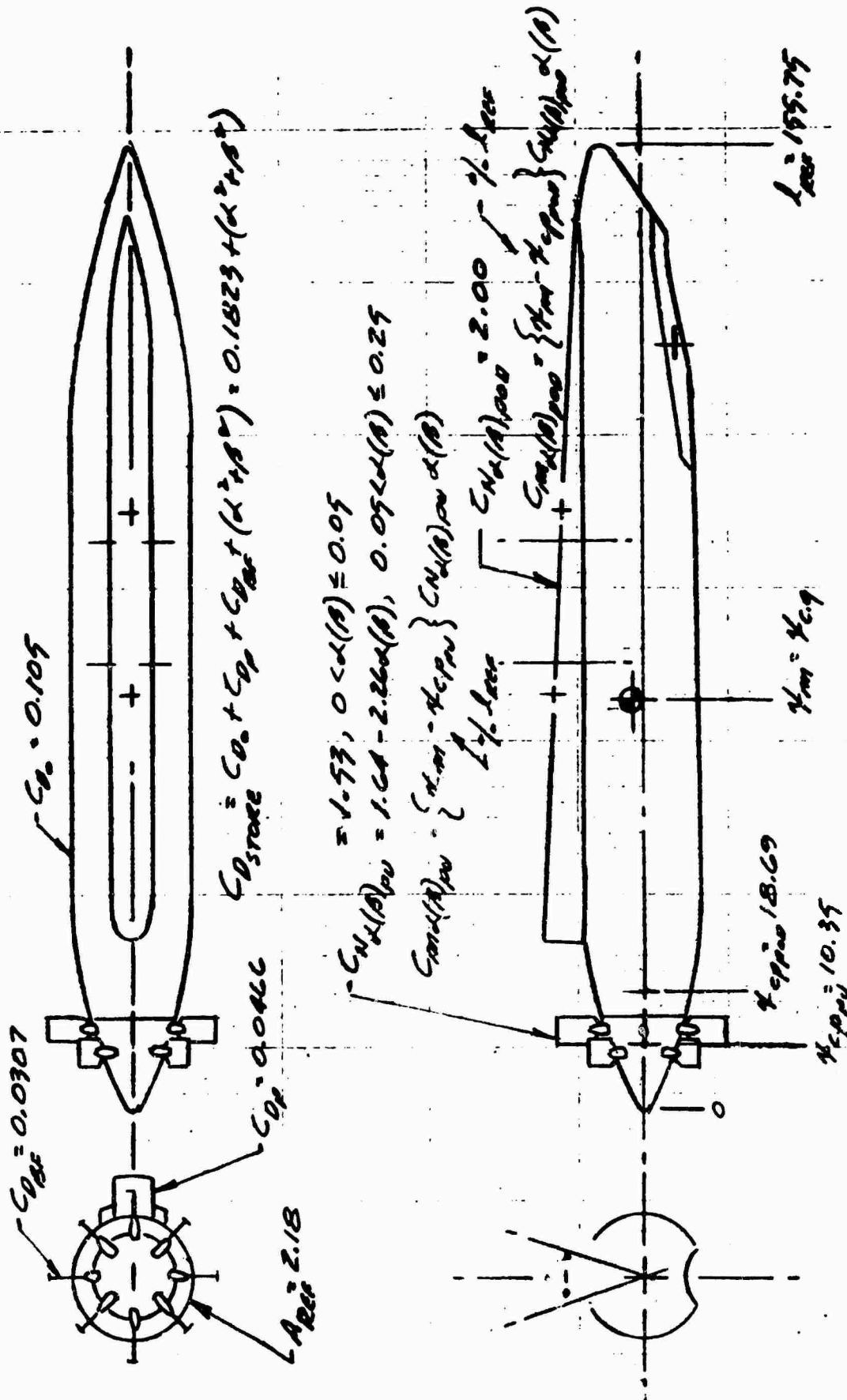


FIGURE A-9 AERODYNAMIC DERIVATIVES SUMMARY
HEAVY DUTY REEL LAUNCHER
 $0.4 \leq M \leq 0.9$

DATA SHEET
4ND-NADC-3980/11

TABLE A-III

RMU-8/A J/N 022-AA & INSTR. (ACCO 7A) - AIRCRAFTS $\beta_s = 2^\circ$

RMU-8/A 5/U 022 - A4 E INSTL. (ACCO 7A) - AIRCRAFT B, 2°									
Aircraft	Range (Miles)		Timing		Aircraft	Range (Miles)		Timing	
	F1	F2	T1	T2		F1	F2	T1	T2
CONO	975	975	640	640	CONO	396	393	262	269
Q	0.052	0.035	0.052	0.087	AP4	389	261	255	419
α_s	0.035	0.035	0.052	0.052	AP4	261	261	255	255
β_s	0.229	0.229	0.295	0.295	AM4	19532	13242	12821	20644
γ_s	0.353	0.353	0.348	0.348	AM4	13242	13242	12821	12821
δ_s	0.419	0.419	0.415	0.415					
ϵ_s	0.186	0.185	0.188	0.193					
ζ_s	0.104	0.070	0.104	0.174					
η_s	0.079	0.053	0.079	0.126					
θ_s	0.070	0.070	0.104	0.104					
ι_s	0.053	0.053	0.079	0.079					
κ_s	0.031	0.021	0.031	0.051					
λ_s	0.028	0.019	0.028	0.044					
μ_s	0.021	0.021	0.031	0.031					
ν_s	0.019	0.019	0.028	0.028					

DATA SHEET

GNO-NADC-2880/11

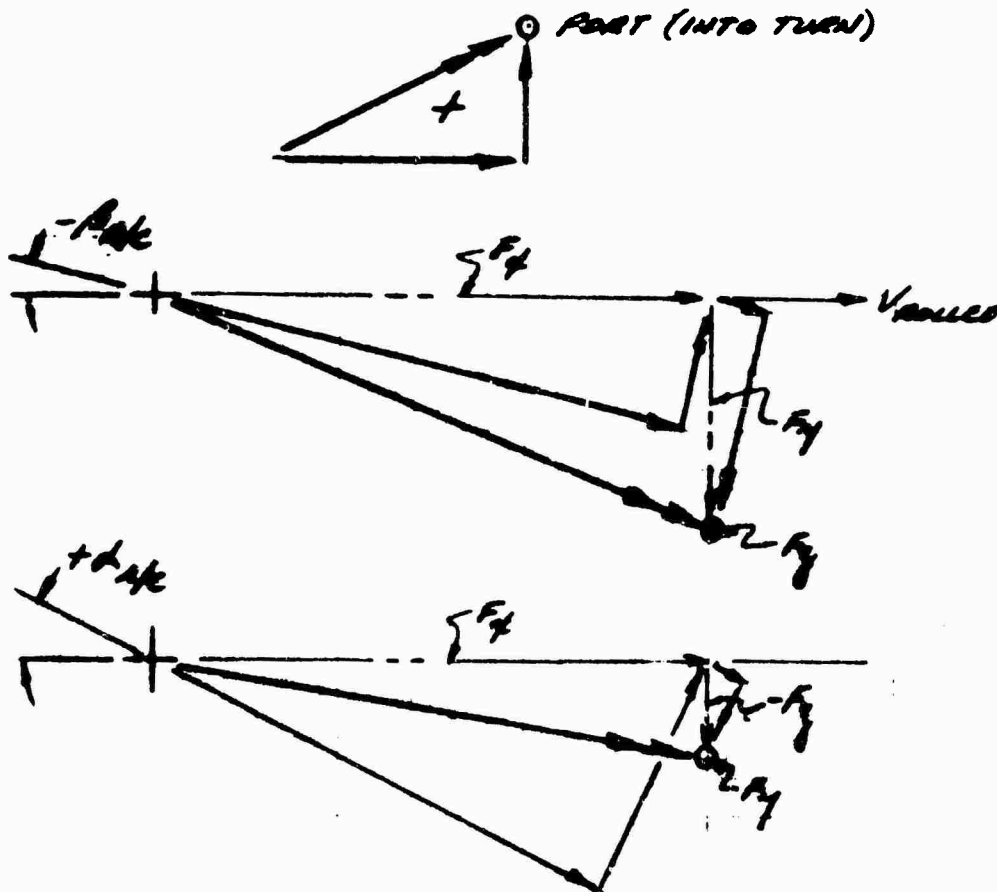
TABLE A-IV

EMU-B/A JW 022 - AD & INSTR. (NEED TA) - ALLIANCE, BS-4°									
Mission	Ferry (16 Tst)			Towing			Mission Ferry (16 Tst)		
	F1A	F2A	T1A	T2A			F1A	F2A	T1A
COND									
g	975	975	640	640			404	400	269
α_s	0.052	0.035	0.052	0.087			389	261	255
β_s	0.070	0.070	0.087	0.087			517	517	419
AM-4 (P)	0.299	0.299	0.295	0.295			19532	13242	12021
AM-4 (P)	0.353	0.353	0.348	0.348			25822	25822	20644
AM-4 (P)	0.419	0.419	0.415	0.415					
COs	0.190	0.188	0.193	0.197					
CH ₃ s	0.104	0.070	0.104	0.174					
CH ₄ s	0.079	0.053	0.079	0.126					
CH ₅ s	0.140	0.140	0.174	0.174					
CH ₆ s	0.103	0.103	0.126	0.126					
CH ₇ s	0.081	0.021	0.031	0.051					
CH ₈ s	0.028	0.019	0.028	0.044					
CH ₉ s	0.042	0.042	0.051	0.051					
CH ₁₀ s	0.036	0.036	0.044	0.044					

B. STORE AIRLOADS - DUE TO TOWLINE FORCES

SOLUTION FOR LOADS APPLIED PARALLEL & NORMAL TO AIRPLANE AXES OR EQUIVALENT STORE AXES (ROLLED, PITCHED & YAWED IN AIRSPACE) - DATA ON FIGURE A-4 IS ROLLED ONLY

SIGN CONVENTION PER MIL-A-8591



$$TP_x = F_x \cos \alpha_{AC} \cos \beta_{AC} + F_y \sin \alpha_{AC} \cos \beta_{AC} - F_z \sin \beta_{AC}$$

$$TP_y = F_y \cos \beta_{AC} + F_x \sin \beta_{AC}$$

$$TP_z = -F_z \cos \alpha_{AC} + F_x \sin \alpha_{AC}$$

H. SUSPENSION SYSTEM

1. DATA SOURCE

LOADS PROGRAM DEVELOPED FOR FUEL TANKS.
 SAMPLE IN-PUT, OUT-PUT PGS A-83 THROUGH A-97.
 CALCULATES MIL-A-8591 (D OR E VERSION).
 WHEN $MX = 0$, $SB = 1.0$, METHOD IS MIL-A-8591 D.
 AERO TA STRENGTH DATA DEVELOPED BY
 W. BOLLINGER (APPENDIX B).

2. AERO TA CHARACTERISTICS & LIMIT LOADS

CHARACTERISTICS -

SIDE LOAD REACTED BY SWAY BRACE.
 YAWING MOMENT REACTED BY
 SWAY BRACES UNTIL M_y IS SUFFICIENT
 TO SLIDE STORE - DEFLECTION
 REQUIRED IS EQUIVALENT TO $\bar{R}$ FOR

$$M_y = 65017$$

R_x IS REACTED BY RACK FRAME
 AND IS NOT CRITICAL

R_y IS SHARED BY TWO HOOKS

LIMIT LOADS -

$R_x \text{ MAX} = \text{NOT CRITICAL}$

$R_y \text{ MAX} = 0(SB = 1.00) - \text{EXPECTED}$
 $M_y \text{ MAX} < 65017$

$R_z \text{ MAX} = 37,000$, $M_z \text{ MAX} < 65017$

$\bar{R} \text{ MAX} = 19,192 / 1.5 \text{ (STORE PER FIG. A-7)}$
 $= 10,128$

APPROACH -

DEFINE LIMIT LOAD FACTOR
 ENVELOPES FOR $\bar{R} \text{ MAX} \leq 10,128$
 WITHOUT & WITH YAW SHIFT

3. LOADING CONDITION FLIGHT - FERRY $S_B = 1.00$

CRITICAL LOADING CASES - SEE FIGURES A-10 & A-11

FOR CONTRIBUTION OF COMPONENT LOADS,
USE LOADS PROGRAM - PGS A-43 THROUGH A-45

$$\bar{R}_R^1(N_x) = -(3750/8)N_x = -468.75N_x$$

$$\bar{R}_R^1(N_y) = -(8187/1.5)N_y = -5391.33N_y$$

$$\bar{R}_R^1(N_z) = (4115/4.0)N_z = 1028.75N_z$$

$$\bar{R}_R^1(\ddot{\theta}) = (794/12)\ddot{\theta} = 66.17\ddot{\theta}$$

$$\bar{R}_R^1(\ddot{\psi}) = -(2508/6)\ddot{\psi} = -418\ddot{\psi}$$

FL AIRLOADS EQUIVALENT TO LOAD FACTORS

$$AN_x = 396/1569 = 0.252$$

$$AN_y = -261/1569 = -0.166$$

$$AN_z = -389/1569 = -0.248$$

$$A\ddot{\theta} = (-19532)(386)/(1188667) = -6.343$$

$$A\ddot{\psi} = (-13242)(386)/(1188667) = -4.322$$

$$\bar{R}_R^1(F_1) = (-5391.33)(-0.166) + (-418)(-4.322) = 2702$$

F2 AIRLOADS EQUIVALENT TO LOAD FACTORS

$$AN_x = 333/1569 = 0.251$$

$$AN_y = -0.166$$

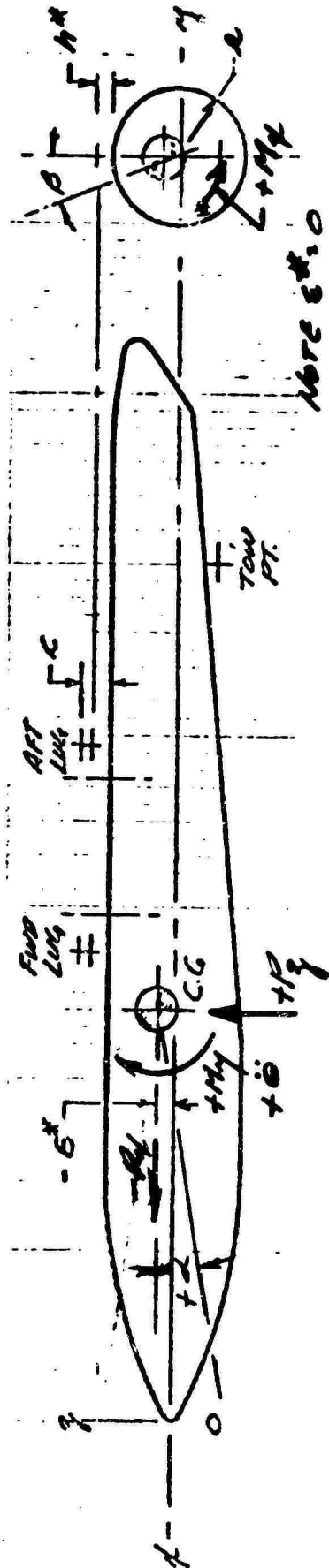
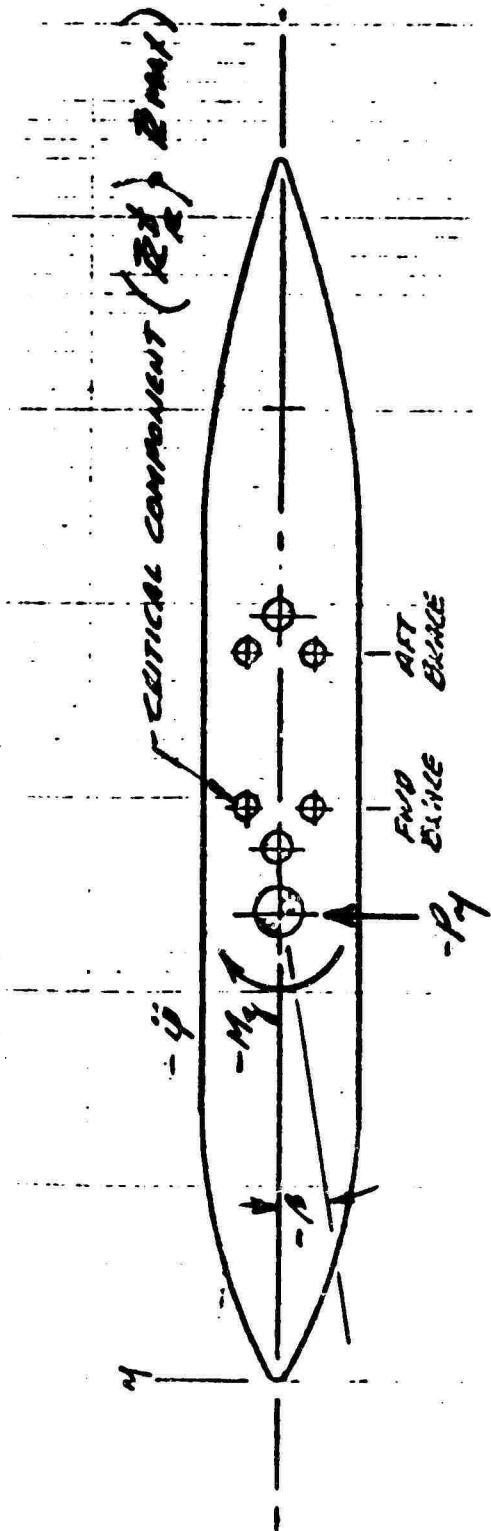
$$AN_z = 0.166$$

$$A\ddot{\theta} = (13242)(386)/(1188667) = 4.300$$

$$A\ddot{\psi} = -4.322$$

$$\begin{aligned} & (-468.75)(0.251) + (1028.75)(0.166) + (66.17)(4.300) \\ & = 338 \text{ (Xg PLANE LOAD)} \end{aligned}$$

$$\bar{R}_R^1(F_2) = 338 + 2702 = 3040$$



NOTE: $\dot{\phi} \dot{\psi} \neq 0$

$M_y \neq 0$ TOWING ONLY

FIGURE A-10 CRITICAL LOADING CASE - SWAY BRACES

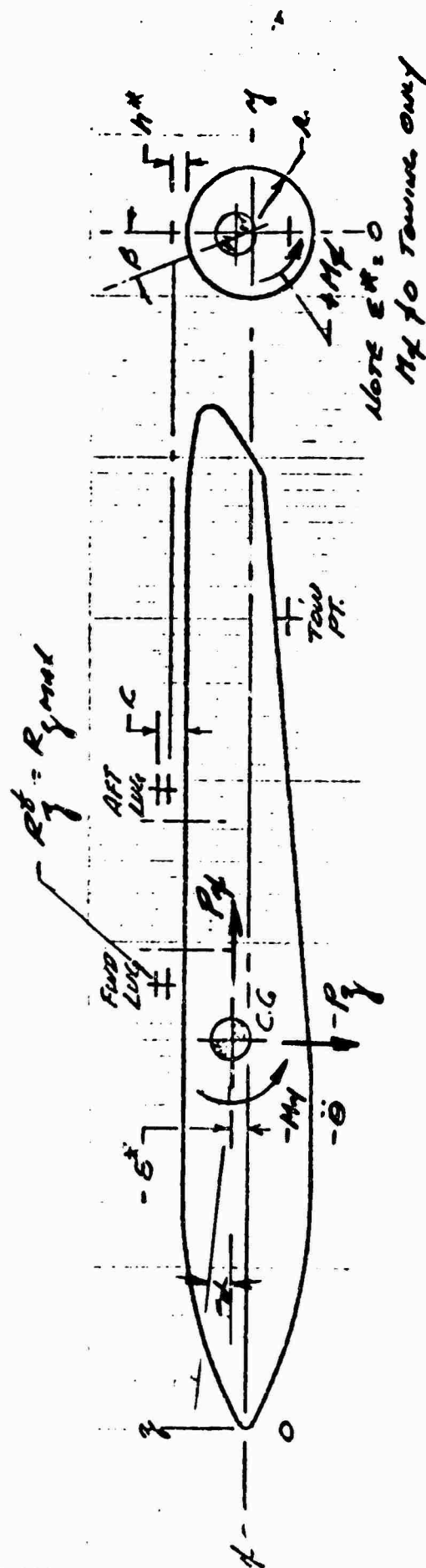
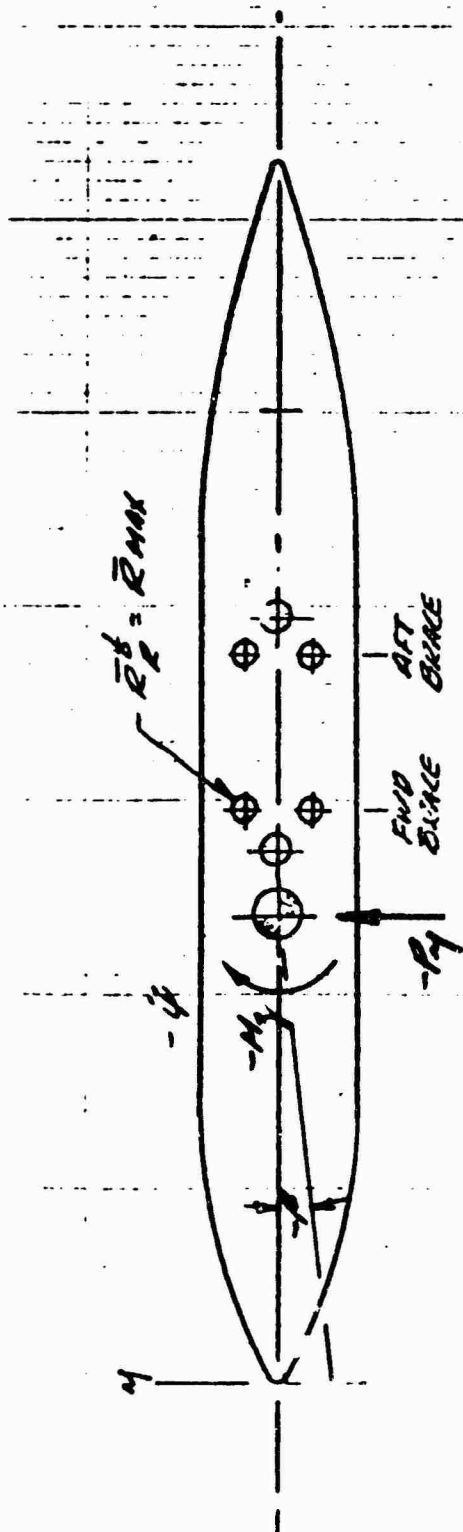


FIGURE A-11 CRITICAL LOADING CASE
FWD LUG & SWAY BEAMS

$$(-468.75)(0.252) + (1028.75)(-0.248) + (66.17)(-6.343) \\ = -793 \text{ (X}_y \text{ PLANE LOAD FOR R1)}$$

ENVELOPE ESTIMATE - NO YAW SHUNT
FL & FZ AIRRAIDS

ESTIMATE $\bar{R}_R^f$ (FL)

$$\bar{R}_R^f = -468.75 N_x - 5391.33 N_y + 1028.75 N_z \\ + 66.17 \ddot{\theta} - 418 \ddot{\psi} - 793 + 2702$$

$$\bar{R}_R^f = -5391.33 N_y - 418 \ddot{\psi} + 2702 \\ - 7.08 N_x + 15.55 N_z + \ddot{\theta} - 11.98 \leq 0$$

ESTIMATE $\bar{R}_R^f$ (FZ)

$$\bar{R}_R^f = -468.75 N_x - 5391.33 N_y + 1028.75 N_z \\ + 66.17 \ddot{\theta} - 418 \ddot{\psi} + 338 + 2702$$

$$\bar{R}_R^f = -5391.33 N_y - 418 \ddot{\psi} + 2702 \\ - 7.08 N_x + 15.55 N_z + \ddot{\theta} + 5.11 \leq 0$$

CORNER PTS $\bar{R}_R^f = \bar{R}_{MAX} \leq 10128$

AT $N_y = 4$ (FZ CRITICAL)

$$N_x = -1.5, \ddot{\theta} = 4.0, \ddot{\psi} = -2 \\ -5391.33 N_y = 10128 - 8959 \quad N_y = -0.22$$

AT $N_y = 0$

$$N_y = 10128 - 4344 / 1028.75 = 7.14$$

$N_{y, max}, N_{y, min}$ (FZ CRITICAL)

$$N_x = -1.5, \ddot{\theta} = 4.0, \ddot{\psi} = -2$$

$$N_y = [(7.08)(-1.5) - 4 - 5.11] / 15.55 \\ = -1.27$$

$$N_y = 10128 - 3538 / -5391.33$$

$$N_y = -1.22$$

FIA AIRLOADS EQUIVALENT TO LOAD FACTORS

$$AN_x = 404/1569 = 0.258$$

$$AN_y = -517/1569 = -0.330$$

$$AN_z = -0.248$$

$$A\ddot{\theta} = -6.343$$

$$A\ddot{\psi} = (-25022)(306)/(1108667) = -8.428$$

$$\bar{R}_R(FIA) = (-5391.33)(-0.330) + (-418)(-8.428) = 5302$$

$$(-468.75)(0.258) + (1028.75)(-0.248) + (66.17)(-6.343) \\ = -796 \text{ (Kg FRAME LOAD FOR FIA)}$$

F2A AIRLOADS EQUIVALENT TO LOAD FACTORS

$$AN_x = 400/1569 = 0.255$$

$$AN_y = -0.330$$

$$AN_z = 0.166$$

$$A\ddot{\theta} = 4.300$$

$$A\ddot{\psi} = -8.428$$

$$(-468.75)(0.255) + (1028.75)(0.166) + (66.17)(4.300)$$

$$= 336 \text{ (Kg FRAME LOAD FOR F2A)}$$

$$\bar{R}_R(F2A) = 336 + 5302 = 5638$$

ENVELOPE ESTIMATE - WITH MAX SHIFTFIA & F2A AIRLOADSCOORDE PTS

$$N_y = 10128 - 11893/5391.33 = 0.33, N_z = 4.0,$$

$$N_x = -1.5, \ddot{\theta} = 4.0, \ddot{\psi} = -2 \text{ (F2A)}$$

$$N_y = 10128 - 7778/1028.75 = 2.28, N_z = 0,$$

$$N_x = -1.5, \ddot{\theta} = 4.0, \ddot{\psi} = -2 \text{ (F2A)}$$

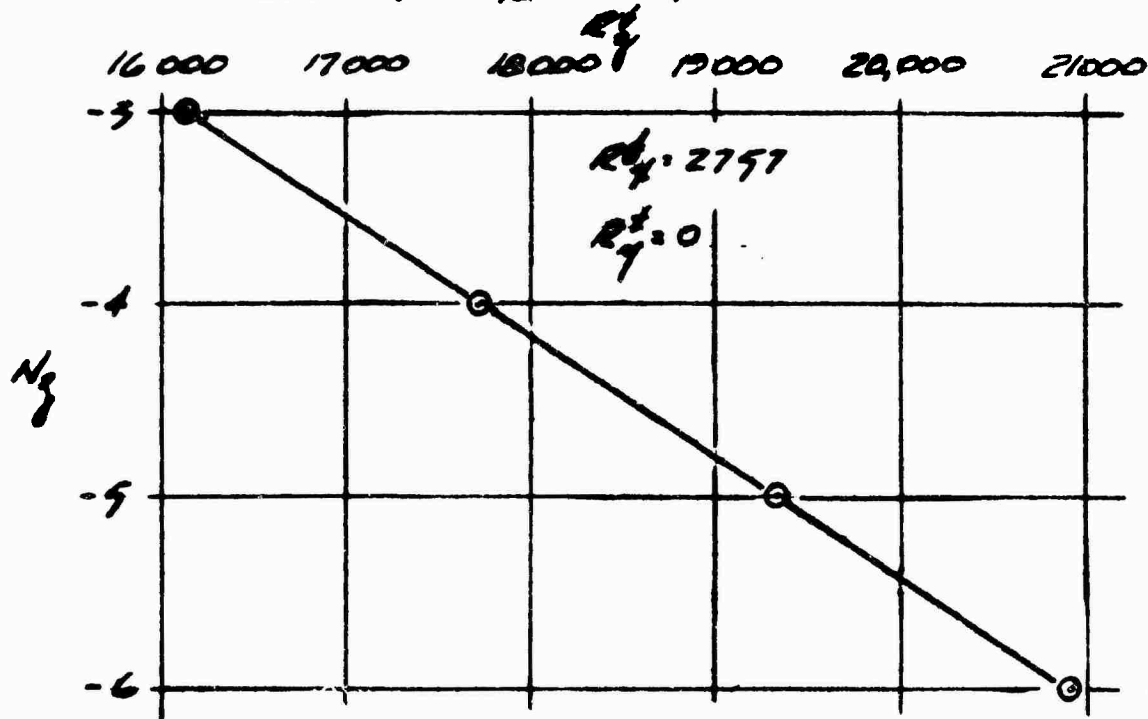
$$N_y = [(7.08)(-1.5) - 4 - 5.08]/15.55 = -1.27$$

$$N_y = 10128 - 6474/5391.33 = -0.678$$

LOADS TEST - SEE PGS A-46 THROUGH A-47

 N_{ymin}, N_{ymax} (FAR CRITICAL)BY LOADS TEST - $N_x = 1.5$; $N_y = -0.7$; $\ddot{\theta} = -4.0$ $\ddot{\psi} = -2.0$; $N_z = -3.0, -4.0, -5.0, -6.0$

SEE PGS A-48 THROUGH A-49



$$a + b N_z = c$$

$$a - 3b = 16121$$

$$a - 6b = 20906$$

$$b = (20906 - 16121) / 3 = -1595$$

$$a = 16121 - (-1595)(3) = 11336$$

$$N_{ymax} = (R_{ymax}^t - 11336) / -1595$$

$$R_{ymax}^t = 37000 \quad N_{ymax} = -16.09$$

LOADS TEST - SEE PG. A-50.

4. PARRY FLIGHT ENVELOPE - SEE FIGURE A-12 (SB-1.00)

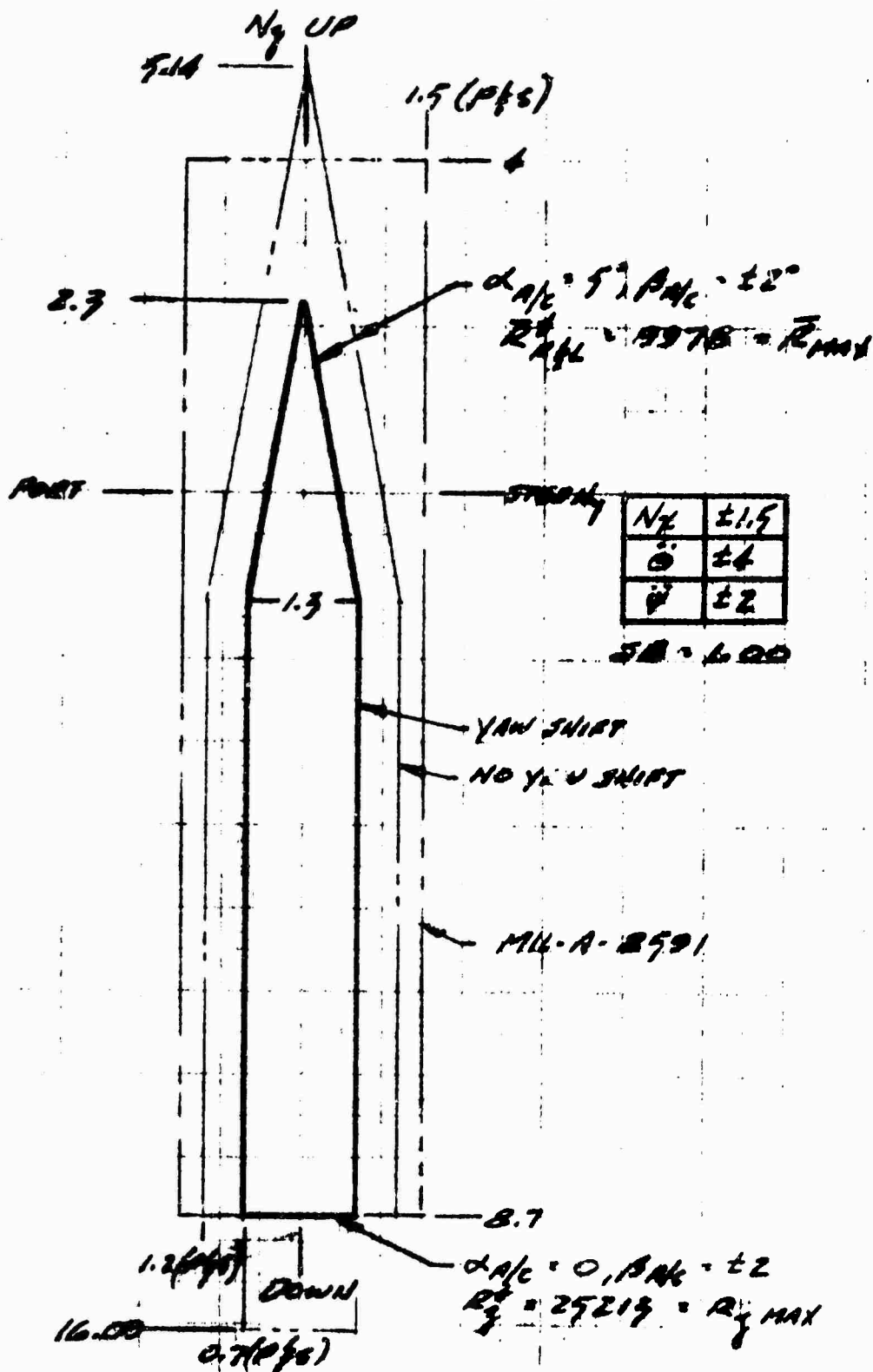


FIGURE A-12 FERRY FLIGHT ENVELOPE - A-4 A/C
 & RACK MOUNT, RMU-8/A (S/N 022)
 LIMIT LOADS AT 0.8M @ 5.L.

5. SWAY BRACE LIMIT REQUIRED FOR MIL-A-8591
COMPLIANCE FOR FERRY FLIGHT (SB=1.00)

$$N_x = -1.5; N_y = -1.5; N_z = 4.00; \ddot{\theta} = 4.00 \ddot{\psi} = -2.00$$

$$R_R^{\pm} = R_{max} = 11879 \pm (-1.5)(-5391.33) = 19,980$$

6. LUG LIMIT REQUIRED FOR MIL-A-8591
COMPLIANCE FOR FERRY FLIGHT (SB=1.00)

$$R_L^{\pm} = R_{Lmax} = 11396 - 1529 N_y$$

$$N_x = 1.5; N_y = -1.5; N_z = -8.7; \ddot{\theta} = -4.00 \ddot{\psi} = -2.00$$

$$R_L^{\pm} = R_{Lmax} = 25219$$

7. LOADING CONDITION - ARREST (FERRY ONLY, SB=1.00)

REDUCED PITCH & YAW ACCELERATION

$$N_z = \pm 2.0; \ddot{\theta} = \pm 6; \ddot{\psi} = \pm 3; R_{max} = 10,128$$

$$R_{ymax} = 37,000, R_{xmax} \text{ NOT CRITICAL}$$

$$\text{NO AIRLOAD; } \ddot{\theta} = 6; \ddot{\psi} = -3$$

$$R_{max} = R_R^{\pm} = 5391.33 N_y + 1254, \\ -7.08 N_x + 15.55 N_z + 6 \leq 0$$

$$N_y = \pm 8874 / 5391.33 = \pm 1.646$$

$$R_{max} = R_R^{\pm} = 468.75 N_x + 1022.75 N_z + 1691, \\ N_y = 0, -7.08 N_x + 15.55 N_z + 6 > 0$$

$$N_z = (8874 - 1022.75 N_x) / -468.75$$

N_y	-2	0	2
$N_x N_y = 1.646$	-3.95	0.85	5.24
$N_x N_y = 0$	-23.32	-18.93	-14.54

LOADS TEST PG A-51 & A-52.

B. FIELD ARRESTMENT ENVELOPE - SEE FIGURE A-13 (SB-100)

9. LOADING CONDITION - FLIGHT-TOW

EQUIVALENT LIMIT TOW @ 10,000 FT.

$$q = 640 \text{ lb/ft}^2$$

$$M = 0.78$$

$$TAS = 500 \text{ KNOTS}$$

$$A/C \text{ IN LEFT TURN } N_g = 3$$

$$r = 7840$$

$$TC_f = 0.0132$$

$$M_y$$

$$L = 2000$$

$$C_D = 1.66$$

SEE PG A-53 FOR ORBITING PROGRAM OUTPUT
PREDICTION FIGHTER (FIGAT) $\frac{1}{2}$ 0.182 IN-WA TOWLINE

$$T_{M} = 4065 \text{ LBS}$$

$$N_g' = 1/\cos[1.243 \times 360/2\pi] = 3.11$$

$$r' = 8196$$

$$V' = 520 \text{ KNTAS}$$

} TARGET CONDITIONS

$$\Delta L = 100$$

$$\Delta r = 2$$

$$\Delta y = 6 \quad \Delta r^2 + \Delta y^2 = 40$$

$$P_g = 5.06$$

$$P_y = 3.79$$

$$RP_{x'y'} = 99.93$$

$$P_{x'} = 99.80$$

$$P_{x''} = 0.998$$

$$F_x = 4057$$

$$P_{y'} = 0.038$$

$$F_y = 199$$

$$P_{y''} = 0.051$$

$$F_z = -208$$

(MIL-A-8591)

A/C NOSE UP & YAWED RIGHT

$$\alpha_{A/C} = 8^\circ, \beta_{A/C} = -3^\circ, \beta_s = -5^\circ$$

$$TP_x = 4049$$

$$TP_y = -58$$

$$TP_z = 359$$

$$TM_x = (-58)(-3.6) = 209$$

$$TM_y = (359)(64.6 - 123.6) + (4049)(-3.6) = -35758$$

$$TM_z = (-58)(64.6 - 123.6) = 3422$$

LOADS PROGRAM

$$MX = 209$$

$$ALOADX = 4049 + 275 = 4324$$

$$ALOADY = -58 - 419 = -477$$

$$ALOADZ = 359 + 419 = 778$$

$$XMM = -35758 + 20644 = -15114$$

$$XMN = 3422 - 20644 = -17222$$

$$N_z = -3$$

SEE WORST CASE PG A-54A/C NOSE UP & YAWED LEFT

$$\alpha_{A/C} = 8^\circ, \beta_{A/C} = 3^\circ, \beta_s = 5^\circ$$

$$TP_x = 4033$$

$$TP_y = 368$$

$$TP_z = 359$$

$$TM_x = -1325$$

$$TM_y = -35700$$

$$TM_z = -21712$$

$$ALOADX = 4308$$

$$ALOADY = 787$$

$$ALOADZ = 778$$

$$MX = -1325$$

$$XMM = -15096$$

$$XMN = -1068$$

$$N_z = -3$$

SEE WORST CASE PG A-55

A/C LEVEL & YAWED RIGHT

$$\angle A/C = 0^\circ, \beta_{A/C} = -3^\circ, \beta_3 = -5^\circ$$

TP ₄ = 4060	ALOADX = 4329
TP ₄ = -58	ALOADY = -477
TP ₃ = -208	ALOADZ = -463
TM ₄ = 209	MX = 209
TM ₄ = -2344	XMM = -15165
TM ₃ = 3422	XMN = -17222
	N ₃ = -3

SEE WORST CASE PG A-56

A/C LEVEL & YAWED LEFT

$$\angle A/C = 0^\circ, \beta_{A/C} = 3^\circ, \beta_3 = 5^\circ$$

TP ₄ = 4044	ALOADX = 4313
TP ₄ = 368	ALOADY = 787
TP ₃ = -208	ALOADZ = -463
TM ₄ = -1325	MX = -1325
TM ₄ = -2286	XMM = -15107
TM ₃ = -21712	XMN = -1068
	N ₃ = -3

SEE WORST CASE PG A-57

STORE LEVEL & NO YAW

$$\angle A/C = 3^\circ, \beta_{A/C} = 0^\circ, \beta_3$$

TP ₄ = 4063	AP ₄ = 255
TP ₄ = 155	ALOADX = 4318
TP ₃ = 5	ALOADY = 155
TM ₄ = -558	ALOADZ = 5
TM ₄ = -14922	MX = -558
TM ₃ = -9145	XMM = -14922
	XMN = -9145

SEE WORST CASE PG A-5B

10. CRITICAL LOADING CONDITION - FLIGHT-TOW

SEE FIGURE A-14

11. LOADING CONDITION - FLIGHT-TOW

(LESS THAN LIMIT AIRSPEED - TOWLINE FAILURE)

COMPONENT LOADS & LOAD CONTRIBUTION
(SEE TABLE I AND PGS A-59 THROUGH A-71)A/C LEVEL & NO YAW

DATA FROM TABLE A-1

$$\bar{R}_R^1(N_y) + \bar{R}_R^1(N_z) + \bar{R}_R^1(\delta) + \bar{R}_R^1(AN_y) + \bar{R}_R^1(A\delta) \leq 0$$

$$\bar{R}_R^1 = \bar{R}_R^1(N_y) + \bar{R}_R^1(\psi) + \bar{R}_R^1(AN_y) + \bar{R}_R^1(A\psi) + \bar{R}_R^1(AN_z)$$

$$AN_y = 0, AN_z, \bar{R}_R^1(\text{TOWLINE FAILURE}), \delta_y = 0, \psi (\bar{R}_R^1(TU))$$

$$TP_y = (4000)(PM_y)$$

$$TM_x = (-3.6)(TP_y)$$

$$TM_z = (4.9 - 123.6)(TP_y)$$

$$L = 1000 \text{ FT}$$

$$PM_y(MX) = 0.0559$$

$$TP_y = 335.4$$

$$TM_x = -1207.44$$

$$TM_z = -17553.82$$

$$AN_y = 0.214$$

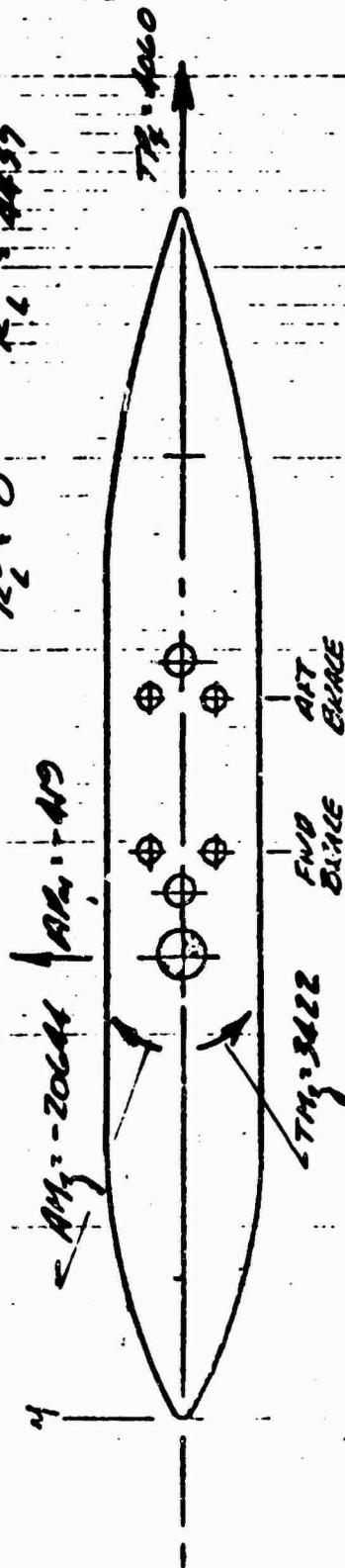
$$AN_z = TM_x = M_x$$

$$A\psi = -6.382$$

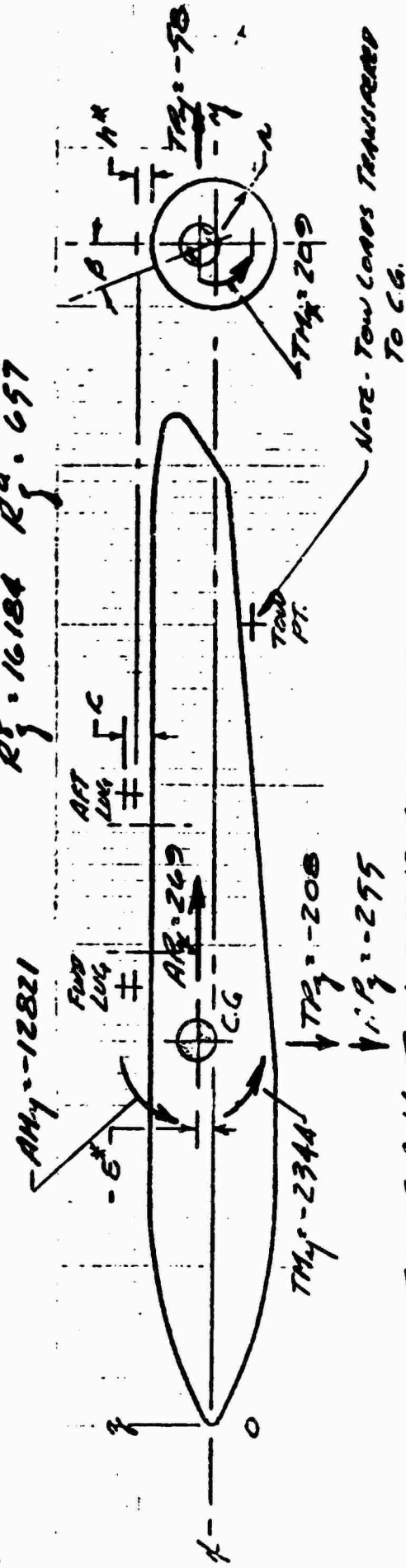
$$\begin{aligned} \bar{R}_R^1(TU) &= (-5391.33)(0.214) + (-418)(-6.382) + (-1207.44)(0.258) \\ &= 1802.41 \end{aligned}$$

SEE TABLE I FOR SUMMARY

$R_x^t = 8928$
 $R_x^a = 0$
 $R_y^t = 0$
 $R_y^a = 4435$



$R_x^t = 6487$
 $R_x^a = 0$
 $R_y^t = -16$
 $R_y^a = 1$
 $R_z^t = 16184$
 $R_z^a = 657$



Note - Tow Lines Transferred To CG.

FIGURE A-14 TOW FLIGHT CONDITIONS
 A/C LEVEL & YAWED RIGHT

DATA SHEET

4ND-NADC-3080/11

TABLE II

CONTRIBUTION OF COMPONENT LOADS VS. TOWLINE LENGTH FOR $E_{T_2} (R_{max})$										
L	2200	2000	6000	10000	X Factor	L	1000	2000	6000	10000
K_{CG}	65.3	64.6	62.7	59.7		$M_{T_2} (mm)$	0.0533	0.1210	0.1699	0.1612
N_{T_2}	48.75	48.0	352.25	274.25	N_{T_2}	T_{T_2}	335.4	726.0	1013.4	877.2
N_{T_1}	539.34	543.35	4520.	3894.67	N_{T_1}	$T_{M_{T_2}}$	1207.44	2613.6	3667.84	3157.92
N_{T_3}	1028.25	965.	838.75	712.25	N_{T_3}	$T_{M_{T_3}}$	1955.80	4283.4	6268.14	5205.08
$\ddot{\theta}$	66.17	64.75	60.42	55.5	$\ddot{\theta}$	$A_{M_{T_2}}$	0.216	0.505	0.865	0.956
$\ddot{\psi}$	418.	408.67	381.5	350.	$\ddot{\psi}$	$A_{M_{T_3}}$	$T_{M_{T_3}}$	—	—	—
M_{T_2}	0.258	0.265	0.284	0.314	M_{T_2}	$A_{\ddot{\psi}}$	6.382	14.297	22.196	21.553
$A_{M_{T_2}}$	1/1569	1/1439	1/1179	1/918	$A_{M_{T_2}}$	$E_{T_2} (in)$	1202.41	2552.77	3505.74	2933.60
$A_{M_{T_3}}$	1/1569	1/1439	1/1179	1/918	$A_{M_{T_3}}$					
$A_{N_{T_2}}$	1/1569	1/1439	1/1179	1/918	$A_{N_{T_2}}$					
A_{T_2}	1/3080	1/3011	1/2812	1/2581	A_{T_2}					
$A_{\ddot{\psi}}$	1/3064	1/2996	1/2797	1/2565	$A_{\ddot{\psi}}$					
$A_{M_{T_2}}$	1	1	1	1	$A_{M_{T_2}}$					

PLATE NO. 13036

WORST CASE IS TURNING GROUND WITH
PERMANENT FAULT IN 26 FOOT TURN AT
MAIN 0.9 (272 KNOTS), 10,000 FT ALT.

$$Q = 255 \text{ PSF (TABLE A-1 FOR LAM DATA)}$$

USE TI CONDITIONS (TABLE A-III) ADJUSTED
 FOR CG. @ 62.7 ($K_{m(p)} = 0.409$)

$$K_{m} = K_{cp} (\text{STORE, } p) = 0.295 + (0.415 - 0.409) = 0.307$$

$$K_{m} = K_{cp} (\text{PU, } p) = 0.348 + (0.415 - 0.409) = 0.360$$

$$C_D = 0.188$$

$$C_{N_z} = C_{N_y} = -0.104 + (-0.079) = -0.183$$

$$C_{M_z} = C_{M_y} = [(-0.104)(0.307) + (-0.079)(0.360)] = -0.060$$

$$AP_z = 105$$

$$AP_z = AP_y = -102$$

$$AP_z = AP_y = -5195$$

A/C LEVEL & YAWED RIGHT

$$\alpha_{Mc} = 0^\circ, \beta_{Mc} = -3^\circ, \beta_s = -5^\circ$$

$$TP_z = [(6000)(0.9760)(\cos 0^\circ)(\cos -3^\circ) - (6000)(0.1363) \\ (\sin 0^\circ)(\cos -3^\circ) - (6000)(0.1699)(\sin -3^\circ)]$$

$$= 5901$$

$$TP_y = [(6000)(0.1699)(\cos -3^\circ) + (6000)(0.9760)(\sin -3^\circ)]$$

$$= 712$$

$$TP_z = [(6000)(0.1363)(\cos 0^\circ) + (6000)(0.9760)(\sin 0^\circ)]$$

$$= 818$$

$$TM_y = (818)(62.7 - 123.6) + (5901)(-3.6) = -71060$$

$$TM_z = (712)(62.7 - 123.6) = -43361$$

$$TM_y = (712)(-3.6) = -2563$$

TOTAL AIRLOAD

$$ALOADX = 5901 + 105 = 6006$$

$$ALOADY = 712 - 102 = 610$$

$$ALOADZ = 848 - 102 = 746$$

$$MX = -2563$$

$$XMY = -71060 - 5195 = -76255$$

$$XMN = -43361 - 5195 = -48556$$

$$N_x = 1.5, N_y = -0.7, N_z = -2.0, \ddot{\theta} = -4.0, \ddot{\psi} = -2.0$$

LOADS TEST - SEE PAGE A-72

12 REACTIONS AT RACK MOUNTING BOLTS

SEE APPENDIX C

LOAD ANALYSIS MIL-A-8991 E

LOADING CONDITION INERTIA

LOAD FACTORS MX MY MZ THETA PSI

0.00 0.00 4.00 0.00 0.00

LOADING POINTS

LUG

FORWARD SWAY BRACE

AFT SWAY BRACE

FORWARD

AFT

LEFT

RIGHT

LEFT

RIGHT

(Z) 0. 1391.

4115.

4115.

0.

0.

(Y) 0. 0.

(X) 0. 0.

LOADING CONDITION INERTIA

LOAD FACTORS MX MY MZ THETA PSI

0.00 -1.50 0.00 0.00 0.00

LOADING POINTS

LUG

FORWARD SWAY BRACE

AFT SWAY BRACE

FORWARD

AFT

LEFT

RIGHT

LEFT

RIGHT

(Z) 6622. 2639.

0.

8197.

1766.

0.

(Y) 0. 0.

(X) 0. 0.

LOAD ANALYSIS MIL-A-8991 E

LOADING CONDITION INERTIA

LOAD FACTORS

MX	MY	MZ	TMETA	PSI
0.00	0.00	0.00	12.00	0.00

LOADING POINTS

LUG

FORWARD	AFT
(2) 0.	1478.
(1) 0.	0.
(4) 0.	0.

FORWARD SWAY GRACE

LEFT	RIGHT
794.	794.

AFT SWAY GRACE

LEFT	RIGHT
0.	0.

LOADING CONDITION INERTIA

LOAD FACTORS

MX	MY	MZ	TMETA	PSI
0.00	0.00	0.00	0.00	-0.00

LOADING POINTS

LUG

FORWARD	AFT
(2) 2333.	2333.
(1) 0.	0.
(4) 0.	0.

FORWARD SWAY GRACE

LEFT	RIGHT
0.	2508.

AFT SWAY GRACE

LEFT	RIGHT
2508.	0.

ANAL. CASE 120

PAGE 1

86/86/74 88-97-59.

CNC 6600 FTM V3.9-PTES OPT=1

PROGRAM LOGIC

PROGRAM LOGIC (INPUT, OUTPUT, TAPE6=OUT) OUT)

REAL M1, M2, M3

READ 1001, FL, AL, P, CS, ASB

WRITE(6, 99)

CALCULATIONS OF MOMENT ARMS

CG=65.7

XLB=AL-CG

XLF=CG-FL

XLSA=ASB-CG

XLP=CG-FL

XLSA=21.5/57.296

LOAD FACTORS TIMES WT OR MOMENT OF INERTIA

S=1.00

F1=8.

F2=1.60

F3=1.20

F4=12.3

F5=0.

F6=1138667.7386.

F7=1142867.7386.

F8=1569.

ALOGN=400.

ALOGN=-517.

ALOGN=261.

ALOGN=13262.

ALOGN=22.

10 READ 1002, A, B, C, D, E, L

DX=4*MT*ALOGN

DY=9*MT*ALOGN

DZ=9*MT*ALOGN

M1=0*Y*XM

M2=0*Y*XM

IF(L.NE.0) GO TO 601

TRIAL LOG REACTIONS

A=0*H-E1

VRF=((DY*(R+H)-M1)*XLB+SB*H*H)/(ARM*(XLB+XLSA)*TAN(BETA))

VRF=((DY*(R+H)-M1)*XLB+SB*H*H)/(ARM*(XLB+XLSA)*TAN(BETA))

VRF=8*SVME

VRF=8*SVME

VRF=8*SVME

VRF=((DY*(R+H)-M1)*XLB+SB*H*H)/(ARM*(XLB+XLSA)*TAN(BETA))

VRF=((DY*(R+H)-M1)*XLB+SB*H*H)/(ARM*(XLB+XLSA)*TAN(BETA))

TESTING FOR CASE TO BE USED

TF(RFP7, GE, 0.0, AND, RFP7, GE, 0.0) GO TO 21

TF(RFP7, GE, 0.0, AND, RFP7, LT, 0.0) GO TO 27

TF(RFP7, LT, 0.0, AND, RFP7, GE, 0.0) GO TO 34

TF(RFP7, LT, 0.0, AND, RFP7, LT, 0.0) GO TO 49

LOAD ANALYSIS MTL-A-8591 E

LOADING CONDITION FLIGHT>FERRY

LUG

	FORWARD	AFT
(Z)	0.	6493.
(Y)	0.	0.
(X)	0.	-1953.

LOAD FACTORS

LOADING POINTS

FORWARD SWAY BRACE		AFT SWAY BRACE	
LEFT	RIGHT	LEFT	RIGHT
117.	5274.	6767.	0.

NX	NY	NZ	THETA	PSY
-1.50	0.00	2.20	4.00	-2.00

LOAD ANALYSIS MTL-A-8591 F

LOADING CONDITION FLIGHT>FERRY

LUG

	FORWARD	AFT
(Z)	8552.	7594.
(Y)	0.	0.
(X)	-1953.	0.

LOAD FACTORS

LOADING POINTS

FORWARD SWAY BRACE		AFT SWAY BRACE	
LEFT	RIGHT	LEFT	RIGHT
0.	9978.	5571.	0.

NX	NY	NZ	THETA	PSY
-1.50	-0.70	-1.30	4.00	-2.00

TEST FOR 1/2

PAGE

00.33.93.

06/06/74

OPT=1

CUC 0600

FTM VJ.0-PJ36

PROGRAM

LOADING

PROGRAM LOADING (INPUT, OUTPUT, TAPE6=OUTPUT)

REAL M, N2, M1

READ 1001, FL, AL, FS, AS

WRITE (6, 33)

CALCULATIONS OF MOMENT ARMS

CG=05.3

XL=AL-JG

XL=CG-FL

XL=AL-AS

AL=CG-FS

AL=CG-FS

AL=CG-FS

AL=CG-FS

AL=CG-FS

AL=CG-FS

AL=CG-FS

AL=CG-FS

AL=CG-FS

AL=CG-FS

AL=CG-FS

AL=CG-FS

AL=CG-FS

AL=CG-FS

AL=CG-FS

LOAD FACTORS TIMES WT OR MOMENT OF INERTIA

SB=1.00

EL=0.

CA=1.60

M=1.20

R=12.3

MX=0.

XV=1144667.7386.

XZ=1142667.7386.

WT=1509.

ALOADX=404.

ALOADY=517.

ALOADZ=389.

XMX=19542.

XMY=25022.

XMZ=1107.4-N.C.D.F.1

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

9978.

LOADING CONDITION FLIGHT=FERRY

LOADING POINTS

FORWARD SHAY BRACE

LEFT

RIGHT

9978.

3.

9978.

9978.

9

LOAD ANALYSIS MIL-A-8591 E

LOADING CONDITION FLIGHT>FERRY

LUG

	FORWARD	AFT
(Z)	16121.	3442.
(Y)	0.	0.
(X)	2757.	0.

LOAD FACTORS

LOADING POINTS

FORWARD SWAY BRACE

	LEFT	RIGHT
(Z)	9970.	9970.

AFT SWAY BRACE

	LEFT	RIGHT
(Z)	9971.	0.

	NX	NY	NZ	THETA	PSI
(Z)	1.50	-0.70	-3.00	-0.00	-2.00

LOAD ANALYSIS MIL-A-8591 E

LOADING CONDITION FLIGHT>FERRY

LUG

	FORWARD	AFT
(Z)	17716.	3416.
(Y)	0.	0.
(X)	2757.	0.

LOAD FACTORS

LOADING POINTS

FORWARD SWAY BRACE

	LEFT	RIGHT
(Z)	9970.	9970.

AFT SWAY BRACE

	LEFT	RIGHT
(Z)	9971.	0.

	NX	NY	NZ	THETA	PSI
(Z)	1.50	-0.70	-4.00	-0.00	-2.00

LOAD ANALYSIS MIL-A-8591 E

LOADING CONDITION FLIGHT>FERRY

LUG

	FORWARD	AFT
(Z)	19311.	3390.
(Y)	0.	0.
(X)	2757.	0.

LOAD FACTORS

LOADING POINTS

FORWARD SWAY BRACE

	LEFT	RIGHT
(Z)	9970.	9970.

AFT SWAY BRACE

	LEFT	RIGHT
(Z)	9971.	0.

	NX	NY	NZ	THETA	PSI
(Z)	1.50	-0.70	-5.00	-0.00	-2.00

100-100000

Am. L.

18

(Y) 2757 0

100

1

ACCT - ab 785

PAGE

89.47.18.

86/00/70

SJC 8680 FTM V3.8-PJ36 OPT=1

LOADING

PROGRAM

PROGRAM LOONG (INPUT,OUTPUT,FAPEB=OUTPUT)

REAL M1,M2,MX

READ 1001,FL,AL,FS0,AS0

WRITE(6,99)

CALCULATIONS OF MOMENT ARMS

CG=65.2

XLA=AL-CG

XLF=CG-FL

XLD=AS0-CG

XL0F=CG-FS0

BETA=21.5/57.296

LOAD FACTORS TIMES WT ON MOMENT OF INERTIA

S0=1.00

S1=0.

CX=1.68

M=1.20

R=12.3

X1=118067./386.

X2=118207./386.

WT=1569.

AL0A0X=0.0

AL0A0Y=0.0

AL0A0Z=0.0

MX=0.

MY=0.0

MZ=0.0

10 READ 1002,A,B,C,D,E,L

PXA=MT*AL0A0X

PY=B*MT*AL0A0Y

PZ=C*MT*AL0A0Z

MT=D*AT*XM

MZ=E*Z*XM

IF(L.NE.0)GO TO 691

TRIAL LJG REACTIONS

ARM=0H-C1

V0E=((PY*(R+D)-MX)*XLD+30*MZ*ARM)/(ARM*(XLF+XLB)+TAN(BETA))

V0B=((PY*(R+D)-MX)*XLF+30*MZ*ARM)/(ARM*(XLF+XLB)+TAN(BETA))

V0F=ABS(V0E)

V0A=ABS(V0B)

RFPZ=(PXA*(X+C1)-PZ*XLA-MY*V0F)/(XLA*XLF+V0A*(XLB-XLA))/(XLA*XLF)

RAPZ=(MY-PX*(R+C1)-PZ*ALF+V0F)/(XLF+XLB)-V0F*(XLF-XLB)/(XLF+XLB)

TESTING FOR CASE TO BE USED

IF(MFPZ.GE.0.0.AND..KAPZ.GE.0.0) GO TO 21

IF(RFPZ.GE.0.0.AND..KAPZ.LT.0.0) GO TO 27

IF(MFPZ.LT.0.0.AND..KAPZ.GE.0.0) GO TO 36

IF(MFPZ.LT.0.0.AND..KAPZ.LT.0.0) GO TO 49

LOAD ANALYSIS MIL-A-8591 E

LOADING CONDITION ARREST>NO TGT

LUG

	FORWARD	AFT
(Z)	4554.	2668.
(Y)	0.	0.
(X)	5138.	0.

LOAD FACTORS

LOADING POINTS

FORWARD SADD BRACE		AFT SADD BRACE	
LEFT	RIGHT	LEFT	RIGHT
3.	8358.	2794.	0.

NX	MY	NZ	THETA	PSI
2.08	-1.38	2.08	6.00	-3.00

LOAD ANALYSIS MIL-A-8591 E

LOADING CONDITION ARREST>NO TGT

LUG

	FORWARD	AFT
(Z)	0.	9780.
(Y)	0.	0.
(X)	0.	-12552.

LOAD FACTORS

LOADING POINTS

FORWARD SADD BRACE		AFT SADD BRACE	
LEFT	RIGHT	LEFT	RIGHT
4023.	8012.	1043.	0.

NX	MY	NZ	THETA	PSI
-8.08	-0.58	2.08	6.00	-3.00

PROGRAM LOGNG (INPUT, OUTPUT, TAPE6=OUTPUT)
 REAL M,WT,MZ
 READ 1001,FL,AL,FSR,ASA
 WRITE(6,991)

4/2 2000 01/1 1/1

PROGRAM LOGNG

CDR 6888 CTN 03.0-0376 007-1 06700770 09.00.10. PAGE 1

PROGRAM LOGNG (INPUT, OUTPUT, TAPE6=OUTPUT)
 REAL M,WT,MZ
 READ 1001,FL,AL,FSR,ASA
 WRITE(6,991)

CALCULATIONS OF MOMENT ARMS

CG=54.6
 VL=AL-CC
 VL=FCG-FL
 VL=ASR-CC
 VL=CC-CCR
 MTA=21.5/37.296
 LOAD FACTORS TIMES WT OR MOMENT OF INERTIA
 CR=1.30
 CL=0.
 CV=1.50
 CM=1.29
 CM=12.3
 CM=200.
 VM=1152313./345.
 VZ=1156313./386.
 VT=1680.

ALONGIT=6326.
 ALONGIT=677.
 ALONGIT=778.
 VM=15116.
 VME=17222.

LOAD ANALYSIS MIL-A-8591 E

LOADING CONDITION "LIGHT" 10W

LOAD FACTORS

MX MY MZ THETA WT
 1.50 -0.70 -3.00 -0.00 -2.00

LOADING POINTS

LUG

FORWARD AFT
 (7) 14880. 711.
 (Y) -16. 1.
 (X) 6482. 0.

FORWARD SWAY SPACE

LEFT RIGHT
 0. 8520.

AFT SWAY SPACE

LEFT RIGHT
 0. 0.

LOAD ANALYSIS MIL-A-8591 E

1/2

[illegible]

01CE
COC 6600 FTM VJ.0-0336 OPT-01 06/00976 09.36.36.

PROGRAM LINDA

```
EQQ5E4M L00N5 (INPUT,OUTPUT,VAPE6=OUTPUT)
```

REAL NY, WZ, WX
DEAD 1001, FL, AL, FSQ, ASA
VOYF(6, 9a)

CALCULATIONS OF MOMENT ARMS

9-44-6

72-52571A
74-78667A

$$\gamma_L \rho_A = A^* \rho_A - C^*$$

9574=21.5/57.296

LOAD FACTORS TIMES W/ ON MOMENT OF INERTIA

59=1.00

$x = 0.50$
 $y = 1.50$

4=1.20
3=12.3

XY=11625

$\chi^2 = 1155.313$, 1360.
 $WT = 1439$.

ALOADX=6309.

ALCANTY=757.
ALCANT=779.

4YX-1325.
YMM-15086-

YMNZ-105A.

25A7 1002, A, 9, F, D, E, L
DX=8=WT+AL0A0X

100-100000-100000

NOT AHS, I 73

1

A-55

LOAD ANALYSIS MYL-A-0591 P

11

A/C cover & fuselage stress

PAGE 1

CDC 6500 FTM V3.0-P336 OPT=1 08/06/74 11.49.12.

PROGRAM LOGS

PROGRAM LOGGING (INPUT, OUTPUT, TAPES-OUTPUT)

REAL MY,MZ,MX
READ 1001,FL,AL,FSB,ASO
WRITE(6,99)

C CALCULATIONS OF MOMENT ARMS

CG=64.6
XLA=AL-CG
XLF=CG-FL
XLB=ASO-CG
XLB=CG-FSB
BETA=21.5/97.296

C LOAD FACTORS TIMES WT OR MOMENT OF INERTIA

S0=1.00
S1=0.
CX=1.60
C1=1.20
C2=12.3
AY=1152313./306.
XZ=1156313./306.
AT=1439.

ALOADX=4329.
ALOADY=-477.
ALOAIZ=-463.
IX=209.
XMY=-15165.
XMY=-1722.
10 READ 1002-A.R.C.D.E.

LOAD ANALYSIS MIL-A-8991 E

NX MY MZ THETA PSI
1.50 -0.70 -3.00 -4.00 -2.00

LOAD FACTORS

LOADING POINTS

AFT SWAY BRACE

LEFT RIGHT
4435. 0.

FORWARD SWAY BRACE

LEFT RIGHT
0. 8520.

LUG

FORWARD AFT
(Z) 16104. 657.
(Y) -16. 1.
(X) 6487. 0.

LOAD ANALYSIS MIL-A-8991 E

The following table shows the results of the regression analysis for the dependent variable "Number of children in the household" (N = 1,000). The independent variables are "Age of the head of household" (Age), "Gender of the head of household" (Gender), "Marital status of the head of household" (Marital), "Education of the head of household" (Education), "Income of the head of household" (Income), and "Number of children in the household" (Children). The table includes the coefficient estimates, standard errors, t-statistics, and p-values for each variable.

Page 5 of 7

REAL NY, MZ, MX
2507 1001, FL, AL, FS8, AS9
4277 (6, 99)

CG-54.6
XL 11AL-CG

73-97547A
73-97548A
73-97549A

Q: $\tau_1 = 21.5757$. 296

2
2
1
0
0

$y = 1.30$
 $x = 3$
 $y = 1.60$
 $x = 1.20$

Z=12.3
 XV=1152313./386.
 Y7=1156313./386.
 VT=1470.

AL04DX=6313.

$$\begin{aligned} \text{ALON} &= 797, \\ \text{ALAN} &= -463, \\ \text{AX} &= -1325, \\ \text{AM} &= -15107, \\ \text{AN} &= -1059. \end{aligned}$$

19 05A7 100Z,A,B,C,D,E,L
DX=0WT+ALUADY
DY=0WT+ALUADY
DZ=C0WT+ALUADZ
WY=0UYV+WHM

LOAD FACTORS

LOADING CONVIVION FLIGHT>YOW

LOADING POINTS

FORWARD SWAY SPACE AFT SWAY SPACE

	LEFT	RIGHT	LEFT	RIGHT
7436.	7436.	8.	7436.	3433.

LOAD ANALYSIS WIL-4-6591 E

PROGRAM LOTS: CMC 6600 FTM V3.0-P336 MP7.01 86/06/74 89.55.10. PAGE 1

STAND CORREL. 4.00

PROGRAM LOGIC (INPUT, OUTPUT, TAPE6=OUTPUT)

REAL M1,M2,M3
-RAN 1001,FL,AL,PS0,AS0
WRITE(M,99)

CALCULATIONS OF MOMENT ARMS

CG=64.6
XLB=AL-CG
YLB=CG-FL
XLR=AL-ACG
YLR=CG-PS0
M1A=21.5/97.246

LOAD FACTORS TIMES WT OR MOMENT OF INERTIA

SA=1.00
EA=0.
MA=1.60
WA=1.20
PA=12.3
VA=1162313./396.
X2=1156313./396.
Y2=1439.

ALOADX=6314.
ALOADY=155.
ALOADZ=5.
VMW=-14022.
VMW=-9145.
MX=550.

LOAD ANALYSIS MIL-A-8591 E

LOADING CONDITION "LIGHT" IN

LOAD FACTORS

LOADING POINTS

LUG

FORWARD APT
(Z) 12493.
(Y) 43.
(X) 4476.

FORWARD SWAY SPACE

LEFT 0.
RIGHT 4964.

APT SWAY SPACE

LEFT 3505.
RIGHT 744.

LOAD ANALYSIS MIL-A-8591 E

MX MY MZ THETA-PT
1.90 -.70 -3.00 -4.00 -2.00

A-59

PROGRAM LUGG (INPUT, OUTPUT, TAPE, OUTPUT)

PAGE 1

16.52.11.

06/24/76

CUC 6688 FTM VJ.0-PJ6 OPT=1

LOADING

PROGRAM

PROGRAM LUGG (INPUT, OUTPUT, TAPE, OUTPUT)

REAL MY, MZ, MX

READ 1001, FLIAL, FS0, ASJ

WRITE(6, Y9)

CALCULATIONS OF MOMENT ARMS

CG=64.6

ALA=AL-CG

ALF=CG-FL

ALBA=ASB-CG

ALGF=CG-FSB

DETA=21.5/57.296

LOAD FACTORS TIMES WT OR MOMENT OF INERTIA

SD=1.00

CI=0.

CA=1.60

MA=1.20

RA=12.3

XY=1162313.7386.

XZ=1155313.7386.

WT=1439.

ALOAX=0.0

ALOAY=0.0

ALOAZ=0.0

MX=0.

MY=0.0

MZ=0.0

18 READ 1002, A, B, C, 0, 0, 0, L

PA=A*WT*ALOAX

PY=B*WT*ALOAY

PZ=C*WT*ALOAZ

MY=0*MY*XMN

MZ=0*XZ*XMN

IF(L.NC.0) GO TO 691

TRIAL LUG REACTIONS

AMN=RM-E1

VBE=((PY*(X*H)-MX)*XLB0+SQ(MZ*ACN)/(AKN*(XLB0*XLBA)*TAN(BETA))

VBU=((PY*(R*H)-MX)*ALBF+SQ(MZ*ACN)/(AKN*(ALUF*XLBA)*TAN(BETA))

VBA=ABS(VBE)

RPZ=((PA*(R*CX)-PZ*XLA-MY*0.8*(XLA*XLBF)-VBA*(XLA-XLB))/(XLA*XLF)

RAPZ=((MY*PX*(R*CX)-PZ*ALF+VBU*(XLA*XLBA)-VBF*(XLB*XLF))/(XLA*XLF)

TESTING FOR CASE TO BE USED

IF(RFPZ.GE.0.0.ANJ.RAPZ.GE.0.0) GO TO 21

IF(RFPZ.GE.0.0.ANJ.RAPZ.LT.0.0) GO TO 27

IF(RFPZ.LT.0.0.ANJ.RAPZ.GE.0.0) GO TO 38

IF(RFPZ.LT.0.0.ANJ.RAPZ.LT.0.0) GO TO 49

LOAD ANALYSIS MIL-A-6591 E

LOADING CONDITION INERTIA

LUG
FORWARD AFT
(Z) 0. 8481.
(Y) 0. 0.
(X) 0. -11512.

LOAD FACTORS

LOADING POINTS

FORWARD SWAY BRACE
LEFT RIGHT
3443. 3448.
AFT SWAY BRACE
LEFT RIGHT
0. 0.

MX MY MZ THETA PSI
0.00 0.00 0.00 0.00 0.00

LOAD ANALYSIS MIL-A-6591 E

LOADING CONDITION INERTIA

LUG
FORWARD AFT
(Z) 6265. 2612.
(Y) 0. 0.
(X) 0. 0.

LOAD FACTORS

LOADING POINTS

FORWARD SWAY BRACE
LEFT RIGHT
3. 7715.
AFT SWAY BRACE
LEFT RIGHT
1020. 0.

MX MY MZ THETA PSI
0.00 -1.50 0.00 0.00 0.00

LOAD ANALYSIS MIL-A-6591 E

LOADING CONDITION INERTIA

LUG
FORWARD AFT
(Z) 0. 1427.
(Y) 0. 0.
(X) 0. 0.

LOAD FACTORS

LOADING POINTS

FORWARD SWAY BRACE
LEFT RIGHT
3463. 3600.
AFT SWAY BRACE
LEFT RIGHT
0. 0.

MX MY MZ THETA PSI
0.00 0.00 0.00 0.00 0.00

LOADING CONDITION INERTIA

LOAD FACTORS

LOADING POINTS

LUG

FORWARD AFT
(Z) 9. 1445.
(Y) 8. 0.
(X) 0. 0.

FORWARD SHAY BRACE
LEFT RIGHT
777. 777.

AFT SHAY BRACE
LEFT RIGHT
0. 0.

LOAD ANALYSIS MIL-A-8591 E

LOADING CONDITION INERTIA

LOAD FACTORS

LOADING POINTS

LUG

FORWARD AFT
(Z) 2281. 2281.
(Y) 3. 0.
(X) 0. 0.

FORWARD SHAY BRACE
LEFT RIGHT
). 2452.

AFT SHAY BRACE
LEFT RIGHT
2452. 0.

MX MY MZ INERTIA PSI
0.00 0.00 0.00 12.00 0.00

MX MY MZ INERTIA PSI
0.00 0.00 0.00 12.00 0.00

PAGE 1

15.11.20.

000 6610 FTM V3.8-P336 OPT=1 06/04/74

PROGRAM LOONG

PROGRAM LOONG (INPUT, OUTPUT, TAPE=OUTPUT)

REAL M1,M2,M3

READ 1001,FL,AL,FSB,ASD

WRITE(6,33)

CALCULATIONS OF MOMENT ARMS

CG=64.6

XLA=AL-CG

ALF=CG-FL

XLJA=ASB-CG

XLDF=CG-FSB

BETA=21.5/57.296

LOAD FACTORS TIMES WT OR MOMENT OF INERTIA

S3=1.00

L1=0.

CA=1.60

M=1.20

R=12.3

X1=1102313./386.

X2=1102313./336.

WT=1439.

ALUAX=0.0

ALOADY=0.0

ALOADZ=0.0

MX=1000.

MYN=0.0

MYN=0.0

-313 ANALYSIS MIL-A-6591 E

LOADING CONDITION ROLL ONLY

LOAD FACTORS

NX NY NZ T421A PSI
0.00 0.00 0.00 0.00 0.00

LOADING POINTS

LUS

FORWARD AFT

(Z) 215. 90.

(Y) -77. 3.

(X) 0. 6.

FORWARD SPAY BRACE

LEFT RIGHT

3. 265.

AFT SPAY BRACE

LEFT RIGHT

3. 3.

PROGRAM LOGGING (INPUT, OUTPUT, TAPES=OUTPU)

CDP 6408 PTM V3.0-9836 OPT=1 06/04/74 19.10.55.

PROGRAM LOGGING

REAL WT, X, Y

READ 1001, FL, AL, FSA, ASQ

WRITE(6,99)

CALCULATIONS OF MOMENT ARMS

CG=62.7

XL=AL-CG

YLF=CG-FL

YLB=ASQ-CG

YLF=CG-FSA

YLA=21.5/57.296

LOAD FACTORS TIMES WT OR MOMENT OF INERTIA

SQ=1.00

SL=7.

SY=1.50

SZ=1.20

Q=12.3

XY=10955596.7386.

YV=1079596.7386.

WT=1179.

ALOADX=0.9

ALOADY=0.0

ALOADZ=0.0

YX=0.

YV=0.0

YW=0.0

10 READ 1002, A, B, C, D, F, L

DX=AWT*ALOADX

DY=DWT*ALOADY

DZ=DWT*ALOADZ

IX=DX*WT*ALOADX

IY=DY*WT*ALOADY

IZ=DZ*WT*ALOADZ

TF(L, NE, 0) GO TO 691

TRIAL LOG REACTIONS

AD=DAW-E1

VX=(DY*(Q+Y)-XV)*XLGA+SW*W*ARM)/(AQ*(YLF+YLB)+TAN(BETA))

VY=(DX*(Q+Y)-YV)*YLF+SW*W*ARM)/(AQ*(YLF+YLB)+TAN(BETA))

VZ=AWT*(VX+VY)

VW=AWT*(VX+VY)

QDZ=(DX*(Q+Y)-YV)*YLF+SW*W*ARM)/(AQ*(YLF+YLB)+TAN(BETA))

QDZ=(DY*(Q+Y)-XV)*YLF+SW*W*ARM)/(AQ*(YLF+YLB)+TAN(BETA))

TESTING FOR CASE TO BE USED

IF (VX>0.0 AND VY>0.0) GO TO 21

IF (VX>0.0 AND VY<0.0) GO TO 22

IF (VX<0.0 AND VY>0.0) GO TO 23

IF (VX<0.0 AND VY<0.0) GO TO 24

IF (VX>0.0 AND VY>0.0) GO TO 25

IF (VX>0.0 AND VY<0.0) GO TO 26

IF (VX<0.0 AND VY>0.0) GO TO 27

IF (VX<0.0 AND VY<0.0) GO TO 28

LOAD ANALYSIS MYL-A-0591 E

LOADING CONDITION INERTIA

LUG

	FORWARD	AFT
(Z)	0.	5244.
(Y)	0.	0.
(X)	0.	-9432.

LOAD FACTORS

LOADING POINTS

	FORWARD SWAY SPACE	AFT SWAY SPACE
LEFT	RIGHT	RIGHT
2818.	2819.	0.

	MX	MY	MZ	THETA	PSI
	-9.00	0.00	0.00	0.00	0.00

LOAD ANALYSIS MYL-A-0591 E

LOADING CONDITION INERTIA

LUG

	FORWARD	AFT
(Z)	5580.	2507.
(Y)	0.	0.
(X)	0.	0.

LOAD FACTORS

LOADING POINTS

	FORWARD SWAY SPACE	AFT SWAY SPACE
LEFT	RIGHT	RIGHT
0.	6790.	0.

	MX	MY	MZ	THETA	PSI
	0.00	-1.50	0.00	0.00	0.00

LOAD ANALYSIS MYL-A-0591 E

LOADING CONDITION INERTIA

LUG

	FORWARD	AFT
(Z)	0.	1529.
(Y)	0.	0.
(X)	0.	0.

LOAD FACTORS

LOADING POINTS

	FORWARD SWAY SPACE	AFT SWAY SPACE
LEFT	RIGHT	RIGHT
3355.	3355.	0.

	MX	MY	MZ	THETA	PSI
	0.00	0.00	0.00	0.00	0.00

LOAD ANALYSIS MYL-A-0591 E

LOADING CONDITION INERTIA

LUG

	FORWARD	AFT
(I)	0.	1350.
(II)	0.	0.
(IX)	0.	0.

LOAD FACTORS

LOADING POINTS

FORWARD SWAY BRACE

	LEFT	RIGHT
	725.	729.

AFT SWAY BRACE

	LEFT	RIGHT
	0.	0.

NY	NY	WZ	THETA	PST
0.00	0.00	0.00	12.00	0.00

LOAD ANALYSIS MIL-A-8591 C

LOADING CONDITION INERTIA

LUG

	FORWARD	AFT
(I)	2130.	2130.
(II)	0.	0.
(IX)	0.	0.

LOAD FACTORS

LOADING POINTS

FORWARD SWAY BRACE

	LEFT	RIGHT
	0.	2209.

AFT SWAY BRACE

	LEFT	RIGHT
	2209.	0.

NY	NY	WZ	THETA	PST
0.00	0.00	0.00	0.00	-0.00

PROGRAM LOGWC CDC 6400 PTM V3.0-0336 001=1 06/06/76 19.16.23. PAGE 1

PROGRAM LOGWC

PROGRAM LOGWC (INPUT, OUTPUT, TAFES=OUTPUT)

REAL M, M2, M3
READ 1001, FL, AL, PSB, ASH
WRITE(4, 90)

C CALCULATIONS OF MOMENT ARMS

CG=52.7
XLA=AL-CG
XLF=CG-FL
XLR=ASB-CG
XLR=CG-PSB
MVA=21.5/57.286

LOAD FACTORS TIMES WT OR MOMENT OF INERTIA

CG=1.00
CI=0.
CY=1.60
CZ=1.20
D=12.5
VY=1005596./384.
VZ=1073596./386.
VT=1179.

ALOADX=0.0
ALOADY=0.0
ALOADZ=0.0
VM=0.0
VW=0.0
VN=0.0

10 READ 1002, A, B, C, D, E, L
WRITE(4, 1003)
STOP

LOAD ANALYSIS MIL-A-8991 E

LOADING CONDITION POLL ONLY

LOADING POINTS

LUG

FORWARD AFT
(2) 233. 109.
(4) -82. 9.
(6) 0. 0.

FORWARD SWAY BRACE

LEFT RIGHT
0. 204.

AFT SWAY BRACE

LEFT RIGHT
0. 0.

WY MY MZ THETA 991
0.00 0.00 0.00 0.00 0.00

LOAD ANALYSIS MIL-A-8591 E

LOADING CONDITION INERTIA

LUG

	FORWARD	AFT
(Z)	0.	4883.
(Y)	0.	0.
(X)	0.	-7366.

LOAD FACTORS

LOADING POINTS

FORWARD SWAY SPACE		AFT SWAY SPACE	
LEFT	RIGHT	LEFT	RIGHT
2194.	2194.	0.	0.

MX	MY	MZ	THETA	PSY
-2.18	0.00	0.00	0.00	0.00

LOAD ANALYSIS MIL-A-8591 E

LOADING CONDITION INERTIA

LUG

	FORWARD	AFT
(Z)	4853.	2523.
(Y)	0.	0.
(X)	0.	0.

LOAD FACTORS

LOADING POINTS

FORWARD SWAY SPACE		AFT SWAY SPACE	
LEFT	RIGHT	LEFT	RIGHT
0.	5862.	2085.	0.

MX	MY	MZ	THETA	PSY
0.00	-1.58	0.00	0.00	0.00

LOAD ANALYSIS MIL-A-8591 E

LOADING CONDITION INERTIA

LUG

	FORWARD	AFT
(Z)	0.	1570.
(Y)	0.	0.
(X)	0.	0.

LOAD FACTORS

LOADING POINTS

FORWARD SWAY SPACE		AFT SWAY SPACE	
LEFT	RIGHT	LEFT	RIGHT
2849.	2849.	0.	0.

MX	MY	MZ	THETA	PSY
0.00	0.00	0.00	0.00	0.00

LOAD ANALYSIS MIL-A-8591 F

LOADING CONDITION INERTIA

LUG

	FORWARD	AFT
(Z)	0.	1239.
(Y)	0.	0.
(X)	0.	0.

LOAD FACTORS

LOADING POINTS

	FORWARD SWAY SPACE	AFT SWAY SPACE
LEFT	666.	0.
RIGHT	666.	0.

	MX	MY	MZ	THETA	PSI
	0.00	0.00	0.00	12.80	0.00

LOAD ANALYSIS MIL-A-8591 E

LOADING CONDITION INERTIA

LUG

	FORWARD	AFT
(Z)	1054.	1954.
(Y)	0.	0.
(X)	0.	0.

LOAD FACTORS

LOADING POINTS

	FORWARD SWAY SPACE	AFT SWAY SPACE
LEFT	0.	2100.
RIGHT	2100.	0.

	MX	MY	MZ	THETA	PSI
	0.00	0.00	0.00	0.00	-6.00

PROGRAM LOGGING (INPUT, OUTPUT, TAPES=OUTPUT)
 READ MY, MZ, MY
 READ 1001, FL, AL, FSB, ASR
 WRITE(6, 99)

PROGRAM LOGGING

CDP 6488 CTN V3.0-P336 OPT=1 06/86774 19.24.36.

PAGE 1

5 C C

10

15 C C

20

25 C C

30

CALCULATIONS OF MOMENT ARMS

CG=94.7
 YL=AL-CG
 YLF=CG-FL
 YLR=ASR-CG
 YLRF=CG-FSR
 MET=21.5/57.295
 LOAD FACTORS TIMES MT OR MOMENT OF INERTIA
 S1=1.00
 S1=0.
 S2=1.60
 S2=1.20
 S3=12.3
 S4=906240./796.
 S5=906240./396.
 S6=918.

ALOADY=0.0
 ALNAY=0.0
 ALNAY=0.0
 YX=1000.
 YMY=0.0
 YMN=0.0

10 READ 1002, A, B, C, D, E, L
 EX=MY*ALOIDX
 EX=MY*ALOIDX

LOAD ANALYSIS MIL-A-8991 E

LOADING CONDITION ROLL ONLY

LUG

FORWARD ACT
 (Z) 261. 136.
 (Y) -89. 15.
 (X) 0. 0.

LOADING POINTS

FORWARD SWAY BRACE
 LEFT RIGHT
 0. 314.

AFT SWAY BRACE
 LEFT RIGHT
 112. 0.

MY MZ MYETA
 0.08 0.00 0.00 0.00

PAGE 1

CCC 6600 PTM VT.0-1336 OPT-1 06/11/76 09.39.47.

PROGRAM LOGS

PROGRAM LOONG (INPUT,OUTPUT,IAPE6=OUT=UT)

REAL NY, NY, NY
READ 1001, FL, AL, FSD, ASD
WRITE(6,99)

CALCULATIONS OF MOMENT ARMS

CG-62.7

X2A-A1-CG

74-93-57X

XL9A=AS9-C6

AL043CG-F5H
0F74329-5/5

LOAD FACTORS TIME

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 $\Sigma 1 \approx 0.$

$CM = 1.68$
 $W = 4.38$

0212-3
H=1.20

5806-AX
C-071-4

XZ=1079596./386.

WY-1179.

A1050Y - 5006

AL050X-5006.
AL050Y-510.

ALOADV=610.
ALOADZ=716.

MX=-2563.

XM43-76253.

95509-2411

LOAD ANALYSIS MYL-A-0991 E

LOADING CONDITION FLIGHT>TOW

LOAD FACT MS

NOI	NY	NZ	TNETA	PSI
.50	-.70	-.20	-.40	-.20

LOADING POINTS

267

FOMARO SHAY BRACE

AFT SNAY SPACE

FORWARD 157

LEFT RIGHT

RIGHT 1437

(Z) 15704. 222.

9. 7405.

7415

(Y) 209. -20.

(X) 7774. 1.

the authors found that the effectiveness of the intervention was significantly higher in the intervention group than in the control group.

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PRINT 1
PRINT 2, S, AZ, ZL, TML, T2, RPL, ZPL, RIMPZ
8 S = 505
10 Z = Z2 AT = T2 BR = AZ SRP = RPL STMP = TML SLP = ZPL BRK = 1
10 ZA = 0.5*(Z+Z2) STA = 0.5*(T+T2) SRA = 0.5*(R+R2)
10 PA = 0.5*(P+P2) ZPA = 0.5*(ZP+ZP2) RPA = 0.5*(R+R2)
10 MC = 0.00274*(1-0.00407)*Z/1000.1006.256
10 PASQ = IMPA*IMPA SRAQ = RAR2
10 Q = 0.5*ANO*RASQ*OMEGSQ*G
10 STAM = SMT*(1--RASQ*IMPASQ)
10 TRP = (TA*RA*IMPASQ-AMU*G*RA)*CHESQ*QU*RA*WPA*IMPA*STRTM)*OS*TRPZ
10 TRIMP = (-TA*WPA*IMPA*QU*STRTM)*J*0.5*RHOD*PICF*RA*SQ*OMEGSQ)*OS*TR
10 TRMPZ
10 ZP = (AMU*-QU*RA*IMPA*ZPA*STRTM)*OS*ZPZ
10 T1 = SURT(IMP*TRP*TRIMP*TRIM*ZP*ZP2)
10 RPI = TRP/11 SRI = ZL*(RPI*ZP2)*0.505
10 TPI = TRIMP/(11*SRI) SRI = ZP/11
10 Z1 = Z2*0.5*(ZP1+ZP2)*OS SRT4P1 = TRP1*RI
10 IM1 = IM*(IMP2+IMP1)*0.505
10 IF (ABS(Z1-Z2)/Z1) .GT. 0.001100, 101
101 IF (ABS(R1-R2)/R) .GT. 0.001100, 102
102 IF (ABS(T1-T2)/T) .GT. 0.001100, 103
103 IF (ABS(CT1-CT2)/CT) .GT. 0.001100, 104
104 IF (ABS(LT1-LT2)/LT) .GT. 0.001100, 105
105 GO TO 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787
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1, ZMRP, 18X, 2MRP, 9X, 4MRTP)
2 FORMAT (E12.4)
3 FORMAT (13M NOT CONVERGED)
1000 FORMAT (1M1, 14MRINDT CONVERGED)
1001 FORMAT (E12.4)
11010FORMAT (1M, 5MV(KNUT))=,E12.4,2X, 4MRPL=E12.4,2X,4MZPL=E12.4,2X,
1-MKZU=E12.4,2X,4MZU=E12.4)
1802 FORMAT (5X, E12.4)
1102 FORMAT (1M, 4MAUG=E12.4,2X, 4MAUSC=E12.4,2X, 7MCGURUC=E12.4)
1103 FORMAT (5X, 4E12.4, 1X, 2E9.2)
11030FORMAT (1M, 5MAUG=E12.4,2X, 4MO=E12.4,2X, 4MAL=E12.4,2X, 4MUOS=,
E12.4,2X, 5MPACF=E12.4,2X, 4M23=E12.4)
13010FORMAT (1M1, 2X, 4MRPL, 9X, 4MRJAG, 7X, 4MZPL, 9X, 5MZOROG, 7X,
13MSEP, 9X, 1M1, 11X, 4MRPL, 8X, 4MZPL, 8X, 4MTMPL)
1311 FORMAT (E12.4)
130 PRINT 2, 5, K1, Z1, 1M1, 11, MP1, 2P1, RTMPL
130 GO TO 5, J, 203, 1193)K
200 IF (ABS((Z1-ZPL)/ZPL)-J.010)202, 210, 210
202 GO TO (23, 240)K
203 IF (ABS((Z1-ZPL)-2000) 204, 204, 210
204 IF (ABS((R1-RPL)/RPL)-J.003) 206, 220, 220
206 GO TO (240, 200)K
210 K = 1
Z1 = Z0 + 0.6*(ZPL-Z1)
GO TO 5
220 GO TO (240, 515)K
510 URZU = 0.16*(RPL - R1)
GO TO 520
515 IF (ABS((R1-RSTORE)/RPL)- 0.002) 516, 516, 520
516 URZU = 0.2*(RPL - R1)
520 URZU = (RPL-R1)*URZU*.07/(R1-RSTORE)
525 IF (ABS(URZU)- 150.) 528, 523, 525
525 URZU = 150.*URZU/ABS(URZU)
GO TO 500
528 IF (ABS(URZU)- 5. ) 524, 529, 560
529 URZU = 5. *URZU/ABS(URZU)
560 K2 = R2U + URZU
K = K
RSTORE = R1
GO TO 5
540 PRINT 1000
GO TO 1193
240 K = 3
PRINT 1301
PRINT 1101, V, RPL, 2PL, RZD, Z20
PRINT 1102, AMG, AMASE, CUDRJC
PRINT 1103, AMUG, D, AL, DOS, P1CF, CD
PRINT 1203, PHI, INEFA, TOKOS
GO TO 5
140 STOP
END

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PROGRAM DATING CDC 6600 PFM VJ.9-P336 OPT-1 05/16/74 10.40.37. PAGE 4

CARD NO. SEVERITY DIAGNOSTIC

40 -1 22 00 49 TOTAL RECORD LENGTH IS GREATER THAN 137 CHARACTERS. IT MAY EXCEED THE I/O DEVICE CAPACITY.

35

PAGE 5

CDC 6600 YIM V3.0-P336 OPT-1 05/10/74 15.48.37.

PROGRAM ORBITING

SYMBOLIC REFERENCE MAP

ENTRY POINTS
4050 ORBITINGDEF LINE
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REFERENCES

VARIABLES SM TYPE RELOCATION

5187 A	REAL	39	45	DEFINED	30	61
5203 ABASE	REAL	27	37	DEFINED	26	26
5207 AL	REAL	29	90	DEFINED	20	20
5262 AMU	REAL	27	44	DEFINED	26	26
5262 AMUG	REAL	29	66	DEFINED	157	157
5311 ANZ	REAL	40	DEFINED	48	20	20
5312 A	REAL	43	45	DEFINED	42	42
5313 C	REAL	44	46	DEFINED	43	43
5272 CU	REAL	29	38	DEFINED	157	157
5264 CUOROG	REAL	27	37	DEFINED	26	26
5300 CUSQ	REAL	46	47	DEFINED	37	37
5260 U	REAL	29	64	DEFINED	157	157
5270 UUS	REAL	29	98	DEFINED	157	157
5364 ORZO	REAL	141	142	2*143	145	145
		137	140	1-1	143	143
		50	66	67	71	71
5277 US	REAL	34	82	64	86	86
		99	66	DEFINED	20	20
5247 G	REAL	36	79	88	100	100
5276 I	INTEGER	78	79	88	100	100
		100	79	88	100	100
5254 ITER	INTEGER	32	33	DEFINED	22	22
5273 K	INTEGER	103	127	129	132	132
		31	133	148	153	153
		106	100	DEFINED	59	59
5334 KK	INTEGER	34	DEFINED	34	66	66
5301 M	INTEGER	2*36	37	64	67	67
5308 UMEGA	REAL	37	38	64	67	67
5303 UMEGSO	REAL	36	58	51	150	150
5310 PHI	REAL	40	67	157	DEFINED	39
5250 PI	REAL	29	67	157	DEFINED	20
5271 PLOF	REAL	66	67	69	DEFINED	54
5340 QU	REAL	60	2*76	DEFINED	59	59
5330 R	REAL	2*63	3*64	69	DEFINED	107
5347 RA	REAL	64	65	67	DEFINED	53
5345 RASQ	REAL	94	67	DEFINED	62	62
5343 RMO	REAL	37	DEFINED	35	107	107
5302 XMOZ	REAL	61	DEFINED	59	107	107
5331 AP	REAL	66	67	DEFINED	61	61
5342 RPA	REAL	25	34	2*131	137	137
5256 RPL	REAL	155	23	2*131	137	137
		155	23	2*131	137	137
5322 RPZ	REAL	57	59	61	71	71
5354 RPI	REAL	71	101	104	107	107
		139	141	149	149	149
5305 RSTORE	REAL	139	141	149	149	149
5303 RIMP	REAL	100	DEFINED	55	55	55
5325 RIMPZ	REAL	57	DEFINED	55	55	55

PROGRAM			ONBITING		CDC 6600 FTM V3.0-PJ36 DPT-1		08/10/74		10.40.27.		PAGE		6	
VARIABLES	SM	TYPE	RELOCATION											
5361	ATMP1	REAL	REFS	184	184	126	DEFINED	55	73	59	59	60		
5375	42	REAL	REFS	237	36	54	DEFINED	55	57					
5268	42U	REAL	REFS	71	34	181	DEFINED	159	DEFINED	23	187	126		
5355	41	REAL	REFS	25	34	147	DEFINED	159	184	107				
			REFS	72	73	176	2*141	149						
			REFS	137	139	140								
5304	>	REAL	REFS	71	56	96	184	126						
			REFS	57	54		DEFINED	59	35	107				
5347	STRM	REAL	REFS	66	67	69	DEFINED	59						
5327	T	REAL	REFS	68	2*77	DEFINED	60	DEFINED	47					
5339	TA	REAL	REFS	66	51	52	150	138						
5315	TBRUG	REAL	REFS	50	51	51	52							
5314	IMETA	REAL	REFS	47	50	51	52							
5332	IMP	REAL	REFS	46	61	59	107	DEFINED	61					
5340	IMPASU	REAL	REFS	2*63	66	67	93	DEFINED	54	101				
5323	IMP2	REAL	REFS	55	68	61	74	DEFINED	72					
5350	IMP1	REAL	REFS	73	74	101	107	DEFINED	72					
5305	IMZ	REAL	REFS	57	74	102	36	74						
5302	IMI	REAL	REFS	102	104	126	DEFINED	54	192					
5358	IRP	REAL	REFS	2*70	71	182	DEFINED	54						
5313	IRP2	REAL	REFS	2*53	54	66	DEFINED	54						
5351	IRIMP	REAL	REFS	2*70	72	102	DEFINED	57	102					
5320	IRIMP2	REAL	REFS	2*53	54	67	DEFINED	52	102					
5321	IZ	REAL	REFS	3*54	57	59	58	DEFINED	53	101				
5352	I2P	REAL	REFS	2*70	72	102	DEFINED	59	102					
5317	I2P2	REAL	REFS	2*53	54	69	DEFINED	51	102					
5353	I1	REAL	REFS	71	2*72	77	101	184	107	126				
5255	V	REAL	REFS	70	25	34	155	DEFINED	23					
5251	XG	REAL	REFS	24	25	21	DEFINED	21						
5252	XCP	REAL	REFS	42	42	DEFINED	59	187						
5326	Z	REAL	REFS	60	2*75	68	DEFINED	59						
5335	ZA	REAL	REFS	62	2*75	68	DEFINED	59						
5254	ZCL	REAL	REFS	41	DEFINED	21	107							
5333	ZP	REAL	REFS	61	DEFINED	59								
5341	ZPA	REAL	REFS	69	DEFINED	61	134	135						
5257	ZPL	REAL	REFS	25	2*120	130								
5324	ZP2	REAL	REFS	23	59	61	73	DEFINED	84	101				
5357	ZP1	REAL	REFS	57	101	104	137	126						
5274	ZL	REAL	REFS	73	72	59	60	73						
5201	Z2D	REAL	REFS	35	57	101								
5300	Z1	REAL	REFS	34	101	134	155	DEFINED	23	134				
			REFS	25	34	104	187	126						
			REFS	75	101	104								
			REFS	134	73									
FILE NAMES	MODE		REFS	26	20	56	57	150						
0 INPUT	FMT		REFS	27	29	157								
2022 OUTPUT	FMT		REFS	155	156									
			REFS	151										

EXTERNALS				INTERNALS				DEF LINE REFERENCES				DEF LINE REFERENCES			
STATEMENT LABELS	TYPE	ARGS	DEF LINE	STATEMENT LABELS	TYPE	ARGS	DEF LINE	STATEMENT LABELS	TYPE	ARGS	DEF LINE	STATEMENT LABELS	TYPE	ARGS	DEF LINE
5110 1	REAL	1	110	5110 1	REAL	1	110	5110 1	REAL	1	110	5110 1	REAL	1	110
5110 2	REAL	1	111	5110 2	REAL	1	111	5110 2	REAL	1	111	5110 2	REAL	1	111
5110 3	REAL	1	112	5110 3	REAL	1	112	5110 3	REAL	1	112	5110 3	REAL	1	112
5110 4	REAL	1	113	5110 4	REAL	1	113	5110 4	REAL	1	113	5110 4	REAL	1	113
5110 5	REAL	1	114	5110 5	REAL	1	114	5110 5	REAL	1	114	5110 5	REAL	1	114
5110 6	REAL	1	115	5110 6	REAL	1	115	5110 6	REAL	1	115	5110 6	REAL	1	115
5110 7	REAL	1	116	5110 7	REAL	1	116	5110 7	REAL	1	116	5110 7	REAL	1	116
5110 8	REAL	1	117	5110 8	REAL	1	117	5110 8	REAL	1	117	5110 8	REAL	1	117
5110 9	REAL	1	118	5110 9	REAL	1	118	5110 9	REAL	1	118	5110 9	REAL	1	118
5110 10	REAL	1	119	5110 10	REAL	1	119	5110 10	REAL	1	119	5110 10	REAL	1	119
5110 11	REAL	1	120	5110 11	REAL	1	120	5110 11	REAL	1	120	5110 11	REAL	1	120
5110 12	REAL	1	121	5110 12	REAL	1	121	5110 12	REAL	1	121	5110 12	REAL	1	121
5110 13	REAL	1	122	5110 13	REAL	1	122	5110 13	REAL	1	122	5110 13	REAL	1	122
5110 14	REAL	1	123	5110 14	REAL	1	123	5110 14	REAL	1	123	5110 14	REAL	1	123
5110 15	REAL	1	124	5110 15	REAL	1	124	5110 15	REAL	1	124	5110 15	REAL	1	124
5110 16	REAL	1	125	5110 16	REAL	1	125	5110 16	REAL	1	125	5110 16	REAL	1	125
5110 17	REAL	1	126	5110 17	REAL	1	126	5110 17	REAL	1	126	5110 17	REAL	1	126
5110 18	REAL	1	127	5110 18	REAL	1	127	5110 18	REAL	1	127	5110 18	REAL	1	127
5110 19	REAL	1	128	5110 19	REAL	1	128	5110 19	REAL	1	128	5110 19	REAL	1	128
5110 20	REAL	1	129	5110 20	REAL	1	129	5110 20	REAL	1	129	5110 20	REAL	1	129
5110 21	REAL	1	130	5110 21	REAL	1	130	5110 21	REAL	1	130	5110 21	REAL	1	130
5110 22	REAL	1	131	5110 22	REAL	1	131	5110 22	REAL	1	131	5110 22	REAL	1	131
5110 23	REAL	1	132	5110 23	REAL	1	132	5110 23	REAL	1	132	5110 23	REAL	1	132
5110 24	REAL	1	133	5110 24	REAL	1	133	5110 24	REAL	1	133	5110 24	REAL	1	133
5110 25	REAL	1	134	5110 25	REAL	1	134	5110 25	REAL	1	134	5110 25	REAL	1	134
5110 26	REAL	1	135	5110 26	REAL	1	135	5110 26	REAL	1	135	5110 26	REAL	1	135

CDC 6606 FTM VJ.0-PJ16 OPT-1 05/10/76 10.43.27.

STATISTICS

PROGRAM LENGTH	1320B	724
BUFFER LENGTH	4000B	2000

CORE MAP	18-48-54. NORMAL	CONTROL	000100	010126	000000	000000
TIME--LOAD MODE	--L2---	TPC	-----	CALL	-----	-----
FMA LOADER	054171	FMA TABLES	051145			
PROGRAM--ADDRESS--						
ENDING	000100					
GETBA	005470					
SYSTEMS	005597					
ALGOERS	005521					
INPUTS	005514					
KOJERS	006070					
KRAKERS	010304					
OUTPUTS	012031					
ALMOGE	012125					
ATANE	012104					
EXPE	012245					
SINGUSE	012311					
SURTC	012366					
RTORZ	012418					
SIO	012417					
ENTRY--ADDRESS--						
ORBITING	004150					
INPUTS	000100					
OUTPUTS	002122					
GETBA	005471	SIOB	012702			
FLSCH.	005513					
FLSCH.	005514					
ENTRY.	005515	ORBITING	004150			
END.	005532	ORBITING	005204			
EXIT.	005508					
STOP.	005504	ORBITING	005203			
ABNORM.	005573	ACGOERS	006525			
		INPUTS	006615			
		KOJERS	007777			
		KRAKERS	011336			
		OUTPUTS	012124			
				011407		
SYSTEME	005611					
SYSTEMS	005635					
SYSTEM.	005641					
SYSTEMZ	005676					
		ACGOERS	005524			
		INPUTS	006616			
		KOJERS	007743			
		KRAKERS	011144			
		OUTPUTS	012123			
				007761	007774	007776
				011101	011260	011205
				011404	011406	011406
						011413
SFSIX	005103					
		KRAKERS	011074			
SYSZX	006877	KRAKERS	011251			
LOIX	006312	KRAKERS	011254			
ERNFLG.	006260	KOJERS	007761			
		KRAKERS	011412			
			011413			
				007742	007773	007774
				011160	011160	011160
						011431
						011403
						011305
						011260
UBUFET.	006332					
ACGOEN.	006222	ORBITING	005046			
				005033	005013	004777
						004703
						004305

A-83

NAME: 013727
 BXSPRU. 013727
 ALVIN. 013727
 POSFI. 013727
 MVMU. 013727
 STSCAD. 013727

SYSTEMS 005243

INPUTS 005645

---UNSATISFIED EXTERNALS---

REFERENCES

VIKNOTI= .470E+03 ZPL= .624E+04 ZPL= .1000E+05 RZD= .624E+04 ZTD= .9000E+04
 ANU= .5000E+03 ABASE= .9675E+02 COORUC= .4500E-01
 ANU= .050E-01 U= .1517E-01 AL= .1000E+04 UCS= .1000E+03 P1CF= .1300E-01 CO= .1640E+01
 S 0. .020E+04 .9000E+04 0. .293E+04 .6306E+00 .227E+00 .743E+00
 .1000E+04 .590E+04 .992E+04 .154E+04 .318E+04 .1301E+00 .015E-01 .9001E+00
 S 0. .631E+04 .9000E+04 0. .293E+04 .6306E+00 .227E+00 .743E+00
 .1000E+04 .6917E+04 .992E+04 .154E+04 .318E+04 .1301E+00 .015E-01 .9001E+00
 S 0. .645E+04 .9000E+04 0. .293E+04 .6306E+00 .227E+00 .743E+00
 .1000E+04 .6105E+04 .992E+04 .154E+04 .318E+04 .1301E+00 .015E-01 .9001E+00
 S 0. .6517E+04 .9000E+04 0. .293E+04 .6306E+00 .227E+00 .743E+00
 .1000E+04 .6124E+04 .992E+04 .154E+04 .318E+04 .1301E+00 .015E-01 .9001E+00
 S 0. .6544E+04 .9000E+04 0. .293E+04 .6306E+00 .227E+00 .743E+00
 .1000E+04 .6240E+04 .992E+04 .154E+04 .318E+04 .1301E+00 .015E-01 .9001E+00

[illegible]

NOTICE
ALL USERS

OPERATING SYSTEM CHANGE TO VERSION AL

VERSION AL OF THE SCOPE 3.3 OPERATING SYSTEM WILL BE INSTALLED MONDAY MAY 13 1974. VERSION AL MAKES MANDATORY MANY OF THE CONTROL CARD PARAMETERS WHICH WERE OPTIONAL UNDER VERSION AK. IN PARTICULAR THE FOLLOWING FEATURES WILL EFFECT THE USER-

1. DEFAULT MAP PARAMETER CHANGED FROM "ON" TO "PART".
2. USER EDS ON THE MACHINE - 1450000.
3. USER EDS ON THE MACHINE - 1170000.
4. PK PARAMETER IS REQUIRED ON JOB CARD OF JOBS USING PACKS. THE PK PARAMETER CONTAINS THE NO. OF PRIVATE PACKS USED BY THE JOB. A PACK JOB WILL NOT BE RUN EXPRESS.

EXAMPLE - JOBNAMC.G050000,1200,MT1,PK2.

5. THE "DISPOSE" CARD, WHEN USED TO ROUTE THE FILE "OUTPUT" TO A SITE OTHER THAN THE ORIGINATION SITE, WILL RETURN A COPY OF THE DAYFILE TO THE ORIGINATION SITE.
6. RING STATUS MUST BE SPECIFIED ON "LABEL" CARDS USING THE "S" PARAMETER.

EXAMPLE - LABEL,TAPE1,,,S=RING,,,
OR

7. VOLUME SERIAL NUMBER (VSN) AND RING STATUS MUST BE SPECIFIED ON REQUEST CARDS.

EXAMPLE - REQUEST,LFM,MT. (3523/RING)
OR

REQUEST,LFM,MT. (X22576/NORING)

THE VSN AND RING STATUS MUST BE ENCLOSED IN PARENTHESES BUT CAN BE PLACED ANYWHERE FOLLOWING THE PERIOD ON THE REQUEST CARD.

8. A MAXIMUM FIELD LENGTH WHICH CAN BE SPECIFIED ON THE JOB CARD IS DEFINED.

MACHINE A - 300000

MACHINE B - 120000 (TEMPORARILY 130000 DUE TO -OADER)

USER IS PREVENTED FROM GAINING MORE MEMORY THAN IS SPECIFIED ON THE JOB CARD. MFL AND MEM WILL ADJUST THE

9. JOB WHEN MORE THAN THE JOB CARD FIELD LENGTH IS REQUESTED. OPERATIONS ARE PREVENTED FROM RUNNING JOBS WHICH HAVE PRIVATE PACKS ATTACHED TO THEM. THIS PROTECTS THE INTEGRITY OF THE PRIVATE PACK.

11. A NEW PARAMETER HAS BEEN ADDED TO THE REQUEST CARD 'NR' (NO RECOVERY). IT SHOULD BE USED WHEN ATTEMPTING TO READ A TAPE WHICH IS KNOWN TO BE marginally recovered. WHEN ENCOUNTERING PARITY ERRORS ON THE TAPE THE SYSTEM WILL MAKE NO FURTHER ATTEMPT TO READ THE BAD RECORD. DATA WILL BE DELIVERED AS READ AND PARITY ERROR STATUS RETURNED TO THE PROGRAM. A DAYFILE MESSAGE WILL BE ISSUED FOR EACH PARITY ERROR.

05/10/74 MAGC REAL TIME SYS VER AKJ 0 04/26/74
 10.00.35.NST155Z
 10.00.35.NST15.730.
 10.00.35.CHARGE,VT1201.CARROLL X2012.
 10.00.36.FINLR)
 10.00.49.00.
 10.01.01.MLFL 10290
 10.01.01.0P 003.454
 10.01.01.0P 011.000
 10.01.01.10 009.938
 10.01.04.STOP
 10.01.04.MASS STORAGE 000151 PRU
 10.01.04.0P 5.628 SEC.
 10.01.04.0P 11.935 SEC.
 10.01.04.10 .940 SEC.
 10.01.04.50 79.000 SEC.
 NST155Z /// END OF LIST /// EST62

五、本行在报告期内无其他重大事项。

[illegible]

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 104


```

PROGRAM          LOADING          205 8800 PTH 05:0-PJ06 OPT-1 10/11/76 11:02:26. PAGE 2
C
C      LOADING CONDITIONS CASE 1
21  RFZ=RFZ2
   RAZ=RAZ2
   IF (AFZ.GT.HAZ) GO TO JJ
   RXF=PX
   RXF=0.0
   GO TO 34
65  33  RXA=0.0
   RXF=PX
   34  CONTINUE
   RFY=((PY*E1-MX)*XLA-(1.0-S3)*M2*ARM)/((XLF*XLA)*AQH)
   RFA=((PY*E1-MX)*XLF-(1.0-S3)*M2*ARM)/((XLF*XLA)*AQH)
   IF (VBE) 6,6,6
70  6  RBFMAX=0.0
   RBFMIN=VBF/COS(BETA)
   GO TO 9
   8  RBFMAX=VBF/COS(BETA)
   RBFMIN=0.0
9  IF (VBE) 12,14,14
12  RBFMAX=0.0
   RBFMIN=VBF/COS(BETA)
   GO TO 33
80  14  RBAMAX=VBA/COS(BETA)
   RBAMIN=0.0
   GO TO 63
65  C      LOADING CONDITIONS CASE 2A
C
C      27  RFZ=(PX*(R+CX)-PZ*XLBA-MY*YB)*((XLB*XLBF)/(XLF*XLBA))
   RAZ=0.0
   RXF=PX
   RXA=0.0
   RFY=((PY*E1-MX)*XLA-(1.0-S3)*M2*ARM)/((XLF*XLA)*AQH)
   RFA=((PY*E1-MX)*XLF-(1.0-S3)*M2*ARM)/((XLF*XLA)*AQH)
   IF (VBE) 70,72,72
70  RBFMIN=VBF/COS(BETA)
   RBFMAX=0.0
   GO TO 73
72  RBFMAX=VBF/COS(BETA)
   RBFMIN=0.0
73  IF (VBE) 74,76,76
74  RBAMIN=(PZ*XLFP+PX*(R+CX)-MY*YB)/((XLB*XLBF)/(XLF*XLBA))
   141) *VBA/(2.*COS(BETA))
   RBAMAX=RBAMIN-VBA/COS(BETA)
   GO TO 63
76  RBAMAX=(PZ*XLFP+PX*(R+CX)-MY*YB)/((XLB*XLBF)/(XLF*XLBA))
   141) *VBA/(2.*COS(BETA))
   RBAMIN=RBAMAX-VBA/COS(BETA)
   GO TO 63
105 C      LOADING CONDITION 2B
C
C      36  PFZ=0.0
110

```

PAGE 3

J35 6638 PYM V3.6-PJ36 OPT-I 06/11/76 11.12.76.

PROGRAM LOUNG

RAZ=(MT-PX*(R+CX)-PZ*XLBF+J31*(XLBA*XLBF))/(XLA*XLBF)

RXF=0.0

RXA=PX

RFY=((P*E1-MX)*XLA-(1.0-S3)*MZ*ARM)/((XLF+XLA)*ARM)

RFA=((P*E1-MX)*XLF-(1.0-S3)*MZ*ARM)/((XLF+XLA)*ARM)

IF (VDE) 70,90,80

70 RBFMIN=(PZ*XLA-PX*(R+CX)+MT*BA*(XL3A-XLA))/(2.*COS(BETA))*XLA*XLB

1F)*PBF/(2.*COS(BETA))

RBFMAX=RBFMIN-VBF/COS(BETA)

GO TO 81

80 RBFMAX=(PZ*XLA-PX*(R+CX)+MT*BA*(XL3A-XLA))/(2.*COS(BETA))*XLA*XLB

1F)*VBF/(2.*COS(BETA))

RBFMIN=RBFMAX-VBF/COS(BETA)

81 IF (VDE) 82,84,84

82 RBFMIN=RBFMAX/COS(BETA)

RBFMAX=0.0

GO TO 63

84 RBFMAX=VBF/COS(BETA)

RBFMIN=0.0

GO TO 53

C LOADING CONDITION 3

C

49 RFZ=0.0

RAZ=0.0

RXF=0.0

RXA=PX

RFY=((P*E1-MX)*XLA-(1.0-S3)*MZ*ARM)/((XLF+XLA)*ARM)

RFA=((P*E1-MX)*XLF-(1.0-S3)*MZ*ARM)/((XLF+XLA)*ARM)

IF (VDE) 86,88,88

86 RBFMIN=(PZ*XLBA-MT*PX*(R+CX))/(2.*COS(BETA))*XLA*XLBF)

1COS(BETA))

RBFMAX=RBFMIN-VBF/COS(BETA)

GO TO 87

88 RBFMAX=(PZ*XLBA-MT*PX*(R+CX))/(2.*COS(BETA))*XLA*XLBF)

1COS(BETA))

RBFMIN=RBFMAX-VBF/COS(BETA)

87 IF (VDE) 90,92,92

90 RBFMIN=(PZ*XLBF-MT*PX*(R+CX))/(2.*COS(BETA))*XLA*XLBF)

1COS(BETA))

RBFMAX=RBFMIN-VBF/COS(BETA)

GO TO 63

92 RBFMAX=(PZ*XLBF-MT*PX*(R+CX))/(2.*COS(BETA))*XLA*XLBF)

1COS(BETA))

RBFMIN=RBFMAX-VBF/COS(BETA)

69 WRITE(3,200)

WRITE(6,201)

WRITE(6,204) A,B,C,D,E

WRITE(3,205)

WRITE(6,206)

WRITE(3,207)

WRITE(3,208) RFZ,RAZ,RBFMAX,RBFMIN,RBFMAX,RBFMIN

WRITE(3,214) RFX,RFA

WRITE(6,215) RFX,RFA

155=2BF1AX+RBFMIN

PROGRAM LDDMC 005 6688 FTM VJ.B-7536 OPT-1 10/11/76 11.12.28. PAGE

TSL=RBFINHQUANAX
TLL=RFZRAZ
GO TO 10

691 CONTINUE

99 FORMAT(1M1)

1001 FORMAT(10.2)

1002 FORMAT(10.1,110)

200 FORMAT(151X,27M LOAJ ANALYSIS MIL-A-0591 E,/))

201 FORMAT(131X,29MX NY V: THEFA PSID

204 FORMAT(13X,34M LOADING CONDITION FLIGHT>104 ,30X,12MLOAD FACTOR

154X,57.2,/))

205 FORMAT(50X,14MLOADING POINTS,/))

206 FORMAT(112X,3MLUG,30X,17M-0413 S4AY BRACE,20X,10MAFT SMAY BRACE,/))

207 FORMAT(5X,* FORWARD AFT,12X,*LEFT RIGHT*,21X,

1*LEFT RIGHT *,/))

208 FORMAT(12X,3M(2),F7.0,F7.0,20X,F7.0,20X,F7.0,19X,F7.0,7X,F7.0,7X,F7.0,/))

214 FORMAT(12X,3M(7),F7.0,24,F7.0,/))

215 FORMAT(12X,3M(4),F7.0,24,F7.0,/))

END

PROGRAM LOONE 105 6588 PFM 03.0-03J6 OPT=1 10/11/76 11.12.76. PAGE 3

SYMBOLIC REFERENCE MAP

ENTRY POINTS
4851 LOONE

VARIABLES	SM	TYPE	RELOCATION
5151 A	REAL		5123 A
5144 ALDAX	REAL		5145 A-DAX
5146 ALDAX2	REAL		5162 ARM
5125 ASB	REAL		5152 B
5133 BETA	REAL		5153 C
5126 CC	REAL		5136 C4
5154 D	REAL		5155 E
5135 E1	REAL		5122 FL
5124 FSB	REAL		5137 H
5150 L	INTEGER		5121 M
5137 MY	REAL		5120 M2
5157 PX	REAL		5160 P7
5161 P2	REAL		5160 R
5170 RAPZ	REAL		5172 RAZ
5201 RBANAX	REAL		5202 RJAMIN
5177 RBFMAX	REAL		5200 R3FMIN
5176 RFA	REAL		5157 RFPZ
5175 RFY	REAL		5171 R-Z
5173 RZA	REAL		5174 RZF
5134 SB	REAL		5165 TLL
5204 TSL	REAL		5203 T5R
5166 VBA	REAL		5164 V3B
5163 VBE	REAL		5155 V3F
5143 WT	REAL		5127 X-A
5131 XLHA	REAL		5132 XL8F
5130 XLF	REAL		5147 X4M
5150 XMN	REAL		5161 X7
5142 XZ	REAL		

FILE NAMES	MODE	2022 OUTPUT	2022 TAPES	FMT
0 INPUT	PMT			
EXTERNALS	TYPE	ARGS	TAN	REAL
GOS	REAL	1 LIBRARY		1 LIBRARY
INLINE FUNCTIONS	TYPE	ARGS		
ABS	REAL	1 INTRIN		

STATEMENT LABELS

0 6	INACTIVE	4313 0	4316 9
4125 10		0 12	4324 14
4263 21		4330 27	4271 31
4273 34		4436 36	4545 49
4072 09		0 70	4363 72
4366 73		0 74	4413 76
0 76	INACTIVE	4510 90	4533 81
0 82	INACTIVE	4541 84	0 86
4020 87		4605 88	0 90
			INACTIVE
			INACTIVE

8

000 6600 FTM V3-B-PJ36 OPT-1 06/11/76 11.12.76.

PROGRAM LODNG

STATEMENT LABELS

6651 92		6774 99	FMT	5003 200	FMT
5010 201	FMT	5015 206	FMT	5025 205	FMT
5031 206	FMT	5060 207	FMT	5050 208	FMT
5057 216	FMT	5063 215	FMT	6772 693	
6776 1001	FMT	5008 1032	FMT		

STATISTICS

PROGRAM LENGTH	11628	610
BUFFER LENGTH	40640	2006

[illegible]

-OLD ANALYSIS MIL-A-8591 E

LOADING CONDITION FLIGHT>10M

LOAD FACTORS

NX MY MZ 74ETA PSI
1.50 -0.70 -2.00 -6.60 -2.00

LOADING POINTS

FORWARD SHAY BRACE AFT SHAY BRACE

LEFT RIGHT LEFT RIGHT

LUG

FORWARD AFT

(Z) 15284. 222.

(Y) 289. -20.

(X) 7774. 0.

3. 7.85.

7416.

0.

06/11/76 NADC REAL TIME SYS VER AL7 B 05789776
 11.12.21.1.00N370
 11.12.22.1.00N5CM20488.710.
 11.12.22.CHARGE.VT1201.CARROLL X2012.
 11.12.28.FTM.
 11.12.42.LGO.
 11.12.53.MEMFL 13700
 11.12.53.2P 003.000
 11.12.53.8P 016.004
 11.12.53.10 000.050
 11.12.54.EMJ LOUNG
 11.12.54.MASS STORAGE 000120 PRJ
 11.12.54.2P 3.905 SEC.
 11.12.54.8P 16.217 SEC.
 11.12.54.10 .054 SEC.
 11.12.54.5EC 30.000 SEC.
 LOUNG70 /// END OF LIST /// EST62

A P P E N D I X B

AERO 7A BOMB RACK ANALYSIS

A P P E N D I X B

This Appendix provides the results of investigation and analysis to define the strength envelope of the AERO-7A Bomb Ejector Rack.

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DOUGLAS AIRCRAFT CO
AERO 7A BOMB EJECTOR
RACK - STRENGTH ENVELOPE

WILLIAM J. BOLLINGER
William J. Bollinger

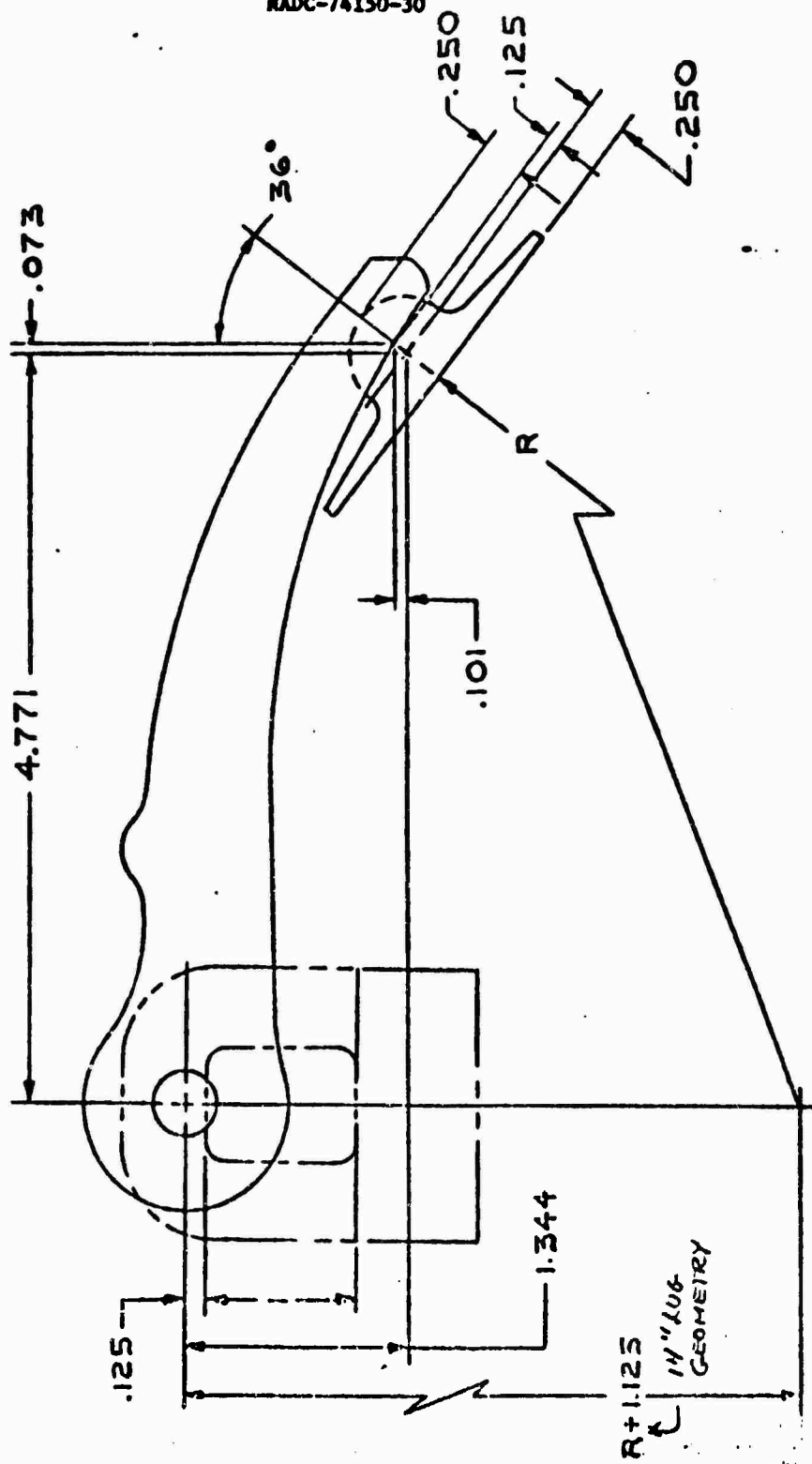
5 JUNE, 1974

AERO TA POND EXERTOR RACK ON THE A4 AIRCRAFT STRENGTH SUMMARY

THIS REPORT ESTABLISHES THE STRENGTH ENVELOPE OF THE AERO TA RACK BY INITIALLY CONVERTING THE MANUFACTURERS (DOUGLAS AIRCRAFT CO) STORE LOAD FACTORS INTO HOOK AND SWAY BRACE REACTION FOR COMPARISON WITH NAVAIRDEVCON TEST RESULTS AND THE RACK SPECIFICATION TEST REQUIREMENTS. A METHOD IS SUBSEQUENTLY DERIVED BY STRESS ANALYSIS AND INTERPRETATION OF TEST DATA FOR MODIFYING THE DOUGLAS RECOMMENDATIONS TO MORE REALISTIC VALUES. THE ANALYSIS CONTAINED IN THIS REPORT IS SUMMARIZED AS FOLLOWS.

PAGE	CONTENT
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3-9	CONVERSION OF DOUGLAS STRENGTH ENVELOPE TO EQUIVALENT HOOK AND BRACE LOADS
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13-20	ESTABLISHES 30 INCH SUSPENSION HOOK STRENGTH LIMIT
21-26	ESTABLISHES YAWING-MOMENT DISTRIBUTION BETWEEN BRACE AND HOOK SIDE LOAD REACTION
26-27	CONCLUSIONS REGARDING STRENGTH LIMITS OF THE RACK WHEN SUPPORTING SMALL AND LARGE DIAMETER STORES (T65 & T63)
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31	REFERENCES
32	RELATED AERO TA RACK IN-SERVICE FAILURES
33	COMPARABLE STORES CARRIED ON THE A4 CENTER LINE STATION AND ASSOCIATED AIRCRAFT PERFORMANCE LIMITATIONS AS SPECIFIED IN THE A4 TACTICAL MANUAL
34-35	CHECKING TEST DATA
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WADC-74150-30

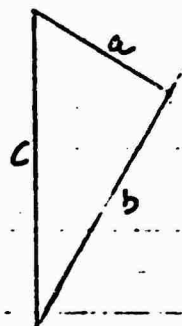
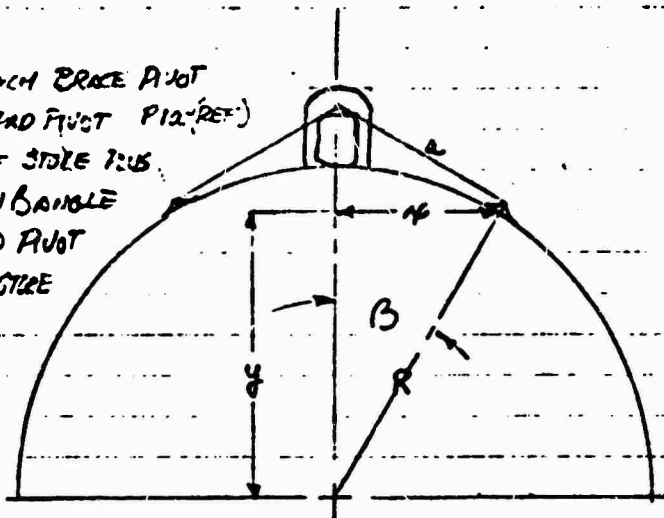


SWAY BRACE ANGLES - REF MAWHINNEY DERIVATION

2 = DISTANCE FROM BRACE PIVOT
TO ELONG TAD PIVOT P12 (REF)

b = RADIUS OF STORE TUB
ENTRANCE ON BAINBLE
TO ELONG TAD PIVOT

c = RADIUS OF STORE
FROM VERTICAL
DISTANCE TO
BRACE PIVOT



14" LUGS

$$\cos B = 1 - \frac{12.042}{R^2 + 1.375R + .2812}$$

$$a = 4.985$$

$$b = R + .250$$

$$c = R + c = R + 1.125$$

30" LUGS

$$R_{HC} = R + 1.50 + 0.63 = 1.56$$

STORE SURFACE TO BRACE PIVOT DISTANCE

MIL-A-8591D FIG 3 (30" LUG - 2000th WEIGHT CLASS - STORE SURFACE
TO HOOK CONTACT POINT = 1.350 + 1.250 TAN 7° ± 5°

$$1.350 + 1.250 \tan 12^\circ = 1.350 + .256 = 1.606$$

$$1.350 + 1.250 \tan 2^\circ = 1.350 + 0.44 = 1.394$$

$$\text{AVERAGE} = 1.350 + (.256 + 0.44) \frac{1}{2} = 1.50$$

$$a^2 = b^2 + c^2 - 2bc \cos B$$

$$a = 4.985 \text{ (REF)}$$

$$b = R + .250 \text{ (REF)}$$

$$c = R + 1.50 + 0.63 = R + 1.56 \quad 0.63 = \text{HOOK CENTERING SURFACE TO ELONG PIVOT (REF)}$$

$$4.985^2 = (R + .250)^2 + (R + 1.56)^2 - 2(R + .250)(R + 1.56) \cos B$$

$$24.850 = 2R^2 + 3.62R + 2.496 - (2R^2 + 3.62R + .78) \cos B$$

$$23.134 = 2R^2 + 3.62R + .78 - (2R^2 + 3.62R + .78) \cos B$$

$$\cos B = 1 - \frac{23.134}{2R^2 + 3.62R + .78} = 1 - \frac{11.567}{R^2 + 1.81R + .39}$$

SWAY BRACE ANGLES

(REF) DOUGLAS AIRCRAFT CO - STANDARD AIRCRAFT ARMAMENT
 CHARACTERISTICS - BOMB RACK EJECTOR - 4 HOOK-7A - 3600 LB
 DATED 1 JULY 1955

(REF REF) UPDATED NOV 1960 (TELECON JESS LOCKHART-DOUGLAS 5/7/74)

T63 STORE 30.5" DIA (14 INCH SUSPENSION) $R = 15.25$

$$\cos B = 1 - \frac{12.042}{R^2 + 1.375R + .2812} \quad W = 1700 \quad C = 1.125$$

$$\cos B = 1 - \frac{12.042}{15.25^2 + 1.375 \times 15.25 + .2812}$$

$$\cos B = 1 - .04745 = .95255 \approx .95257$$

$$B = 17^\circ 43' \quad \tan B = .31946 \quad \sin B = .30431$$

T65 STORE 14.5" DIA (30 INCH SUSPENSION) $R = 7.25$

$$\cos B = 1 - \frac{11.567}{R^2 + 1.81R + .39} \quad W = 3575 \quad C = 1.56$$

$$\cos B = 1 - .17507 = .82493 \approx .82495$$

$$B = 34^\circ 25' \quad \tan B = .68514 \quad \sin B = .56521$$

T63 STORE

$$x = R \sin B = 15.25 \times .30431 = 4.64$$

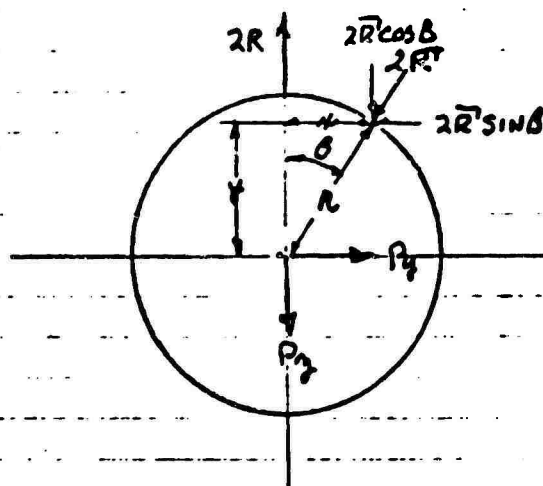
$$y = R \cos B = 15.25 \times .95257 = 14.527$$

T65 STORE

$$x = 7.25 \times .56521 = 4.10$$

$$y = 7.25 \times .82495 = 5.98$$

CHECKING HOOK AND BRACE REACTIONS AT POINTS GIVEN ON DOUGLAS STRENGTH ENVELOPE - REF



R = SINGLE HOOK LOAD
 R' = SINGLE BRACE LOAD
 $C-G$ = MIDPOINT BETWEEN HOOKS
 N = STORE RADIUS + C

$$\begin{aligned}
 \sum F_v &= 2R - 2\bar{R} \cos \beta - P_z = 0 \\
 \sum H_r &= y \cdot 2\bar{R} \cos \beta + (N-y) 2\bar{R} \sin \beta - N P_y = 0 \\
 \sum F_H &= P_y - 2\bar{R} \sin \beta = 0
 \end{aligned}
 \quad \left. \vphantom{\begin{aligned} \sum F_v \\ \sum H_r \\ \sum F_H \end{aligned}} \right\} 2\bar{R} \cos \beta = y P_y$$

T63 STORE 30.5 DIA 1700 LBS 14 INCH SUSPENSION

- ① $m_z = 38.5$ $m_y = 0$ $m_x = 0$ $M_z = 100,000 \text{ IN}^4$ $\beta = 17^\circ 43'$
 FOR THE 30.5" DIA STORE - ASSUME THAT THE BRACES ARE
 INEFFECTIVE IN YAW AND THAT ALL OF THE YAWING MOMENT
 IS REACTED AS SIDE LOAD ON THE HOOKS OR FRAME

$$\bar{R} = 0$$

$$R = 19.25 \times 1700 = \underline{32,725}^*$$

- ② $m_z = 17.5$ $m_y = 6.8$ $m_x = 0$ $M_z = 100,000 \text{ IN}^4$ (HOOKS OR FRAME)

$$2\bar{R} \cos \beta = y P_y$$

$$2 \times 4.64 \bar{R} \cos \beta = 14.527 \times 6.8$$

$$\bar{R} \cos \beta = 10.644$$

$$\bar{R} = \frac{10.644}{\cos 17^\circ 43'} = \frac{10.644}{.95257} = 11.174$$

$$2R = 2\bar{R} \cos \beta + P_z$$

$$2R = 2 \times 10.644 + 17.5 = 38.788$$

$$R = 19.394 \times 1700 = \underline{32970}^*$$

$$\bar{R}_{\text{max}} = 11.174 \times 1700 = \underline{18995.8}^*$$

CHECKING HOOK AND BRACE REACTIONS AT POINTS GIVEN
ON DOUGLAS STRENGTH ENVELOPE - REF (a) AERO 7A RACK
STRENGTH CHARACTERISTICS.

$$③ \quad m_z = 0 \quad m_y = 6.8 \quad m_x = 0 \quad M_z = 100,000 \text{ IN}^2 \text{ (HOOKS OR FRAME)}$$

$$\overline{R} \cos \beta = 10.644$$

$$\overline{R}'_{\text{REA}} = 11.174 \times 1700 = \underline{18995.8}$$

$$2R = 2 \times 10.644 = 0$$

$$R = 10.644 \times 1700 = \underline{18094.8}$$

T65 STORE 14.5" DIA 3575 LBS 30 INCH SUSPENSION

$$④ \quad m_z = 20.75 \quad m_y = 0 \quad m_x = 0 \quad M_y = 100,000 \text{ IN}^2 \text{ (HOOKS OR FRAME)}$$

$$\beta = 31^\circ 4'$$

ASSUME THE HOOK LOAD CAN BE DERIVED SIMILARLY TO THE T63 STORE CASE IN WHICH NO YAWING MOMENT WAS REACTED BY THE BRACES AND CONSEQUENTLY THE HOOK LOAD WAS COMPUTED FROM THE MAXIMUM VERTICAL LOAD. THE SUM OF THE HOOK LOADS UNDER THE T63 STORE CASE ADD UP TO $(2 \times 32,970 = 65,450)$ WHICH IS ABOUT EQUAL TO THE VALUE SPECIFIED AS THE YIELD LOAD UNDER THE OVERLOAD TEST IN MIL-R-22622 (AERO 7A RACK SPEC-ITEM 4.5.2). THIS VALUE CAN BE APPROXIMATELY DERIVED BY MULTIPLYING THE HOOK ULTIMATE LOAD BY FOUR (TWO HOOKS PER STATION) AND DIVIDING BY 1.5 AND MULTIPLYING BY 1.15 (SEE ITEM 4.4.3 OF SPEC)

$$14 \text{ INCH HOOK} = 20,000 \times 4 \times \frac{1.15}{1.5} = 61,333 \approx 65,000$$

$$30 \text{ INCH HOOK} = 25,000 \times 4 \times \frac{1.15}{1.5} = 76,666 \approx 74,000$$

THIS CONCLUSION INDICATES THAT DOUGLAS CONSIDERED THE MAXIMUM ALLOWABLE HOOK LOAD AS HALF OF THE VALUE SPECIFIED FOR THE OVERLOAD TEST OR ABOUT 32,500^{lb} ON THE 14 INCH HOOKS. IT CAN ALSO BE CONCLUDED BY ANALOGY THAT THE VALUE SPECIFIED IN THE SPEC FOR THE 30 INCH HOOK UNDER THE OVERLOAD TEST IS ALSO A LIMIT $(74,000/2 = 37,000 \text{ lb})$. FOR THE ZERO SIDE, ZERO DRAG CASE ON THE T65 STORE, THE HOOK REACTION TO MAXIMUM DOWN LOAD IS $20.75/2 \times 3575 = \underline{37,290}$. THIS RESULT AGAIN ILLUSTRATES THAT DOUGLAS DID NOT CONSIDER ANY OF THE YAWING MOMENT TO BE REACTED BY THE BRACES, EVEN IN THE SMALL DIA STORE, BECAUSE THE VERTICAL COMPONENT OF THE BRACE LOAD WOULD HAVE TO ADD TO THE HOOK LOAD TO MAINTAIN EQUILIBRIUM IN WHICH CASE THE HOOK ALLOWABLE WOULD BE EXCEEDED.

CHECKING HOOK AND BRACE REACTIONS AT POINTS GIVEN ON DOUGLAS STRENGTH ENVELOPE REF (a).

TGS STOPS:

⑤ $m_y = 20.75$ $m_z = 0$ $m_x = 0$ $M_y = 100,000 \text{ in}^2$ $\beta = 31^\circ 4'$

IF ALL OF THE YAWING MOMENT WAS REACTED BY THE BRACES; THE FOLLOWING REACTIONS WOULD RESULT

$$\bar{R}' \cos \beta = \frac{100,000}{20 \tan \beta} = 7300'' \quad \text{BRACE VERTICAL COMPONENT}$$

$$R = \frac{m_y \times 3575}{2} + 7300 = \frac{20.75 \times 3575}{2} + 7300 = 44,390$$

$$\bar{R} = 7300 / \cos \beta = 8850$$

THIS HOOK IS IN EXCESS OF THE HOOK ULT LOAD - RECOMMENDED BY DOUGLAS BUT DOES FALL WITHIN THE SPEC HOOK ULTIMATE LOAD ($25,000 \times 2 = 50,000''$ - MIL-R-22622 ITEM 444)

⑥ $m_y = 11.5$ $m_z = 5.7$ $m_x = 0$ $M_z = 100,000$ (HOOKS OR FRAME)

$$2 \times \bar{R} \cos \beta = y P_y$$

$$2 \times 4.10 \bar{R} \cos \beta = 5.98 \times 5.7$$

$$\bar{R} \cos \beta = 4.16$$

$$\bar{R} = \frac{4.160}{\cos 34^\circ 25'} = \frac{4.160}{.82495} = 5.043$$

$$2R = 2 \bar{R} \cos \beta + P_y$$

$$R = 4.16 + 5.75 = 9.91$$

$$R = 9.91 \times 3575 = 35,428''$$

$$\bar{R} = 5.043 \times 3575 = 18,029''$$

⑦ $m_y = 0$ $m_z = 6.9$ $m_x = 0$ $M_z = 100,000$ (HOOKS OR FRAME)

$$2 \times 4.10 \bar{R} \cos \beta = 5.98 \times 6.9$$

$$\bar{R} \cos \beta = 5.03$$

$$\bar{R} = \frac{5.03}{.82495} = 6.10$$

$$R = 6.10 \times 3575 = 21,807$$

$$2R - 2 \times 5.03 = 0$$

$$R = 5.03$$

$$R = 5.03 \times 3575 = 17,982$$

$$2 \bar{R} \sin \beta = 2 \times 21,807 \times .56521 = 24,651 = 6.943575 \quad \checkmark$$

CHECKING HOOK AND BRACE REACTIONS AT POINTS GIVEN ON DOUGLAS STRENGTH ENVELOPE (REF) DRAG CURVES

I 63 STORE $W = 1700$ $\beta = 17^\circ 43'$ $N = 15.25$

① $m_y = -32.5$ $m_x = \pm 5$ $m_y = 0$ $M_2 = \pm 100,000 \text{ in}^2$ (HOOKS & FRAME)
USING MIL-A-8591 D EQUATIONS. $N+C = N+1.125$

$$\bar{Y}^P = 0 \quad \bar{Y}^A = 0$$

$$R_z^P = \frac{5 \times 1700 (15.25 + 1.125) + 32.5 \times 1700 \times 7}{14} = \frac{139187 + 386750}{14} = +37566$$

$$R_z^A = \frac{-5 \times 1700 (15.25 + 1.125) + 32.5 \times 1700 \times 7}{14} = \frac{-247563}{14} = +17683$$

$$R_z^P = 37566 \quad R_z^A = 17683$$

$$\bar{R}_{MAX}^P = 0 \quad \bar{R}_{MAX}^A = 0$$

② $m_y = -11.5$ $m_x = +6.8$ $m_y = \pm 5$ $M_2 = \pm 100,000 \text{ in}^2$ (HOOKS & FRAME)

$$\bar{Y}^P = \frac{6.8 \times 10}{\tan 17^\circ 43' \times 20} = \frac{3.4}{.31946} = +10.64 \quad \bar{Y}^A = \frac{6.8 \times 10}{.31946 \times 20} = +10.64$$

$$R_z^P = \frac{+5 \times 1700 \times 16.375 + 11.5 \times 1700 \times 7 + 10.64 \times 1700 \times 17 - 10.64 \times 1700 \times 3}{14}$$

$$R_z^P = \frac{139187 + 136850 + 307496 - 54264}{14} = \frac{529269}{14} = +37804$$

$$R_z^A = \frac{-5 \times 1700 \times 16.375 + 11.5 \times 1700 \times 7 + 10.64 \times 1700 \times 17 - 10.64 \times 1700 \times 3}{14}$$

$$R_z^A = \frac{-139187 + 136850 + 307496 - 54264}{14} = \frac{250895}{14} = +17921$$

$$R_z^P = +37804 \quad R_z^A = +17921$$

$$\bar{R}_{MAX}^P = \frac{+10.64}{\cos \beta} = \frac{10.64}{.95257} = 11.17$$

$$\bar{R}_{MAX}^P = \bar{R}_{MAX}^A = 11.17 \times 1700 = 18989$$

CHECKING HOOK AND BRACE REACTIONS AT POINTS GIVEN ON DOUGLAS STRENGTH ENVELOPE REF (A) DRAG CURVES

T 63 STORE

⑩ $m_y = 0$ $m_y = 5.3$ $m_x = \pm 5$ $M_z = \pm 100,000$ (HOOKS & FRAME)

$$\bar{Y}^f = \frac{5.3 \times 10}{\tan 17^\circ 43' \times 20} = \frac{2.65}{.31946} = +8.29 \quad \bar{Y}^a = \frac{5.3 \times 10}{.31946 \times 20} = +8.29$$

$$R_z^f = \frac{5(16.375) + 8.29 \times 17 - 8.29 \times 3}{14} = \frac{81.75 + 140.93 - 24.87}{14} = +14.129$$

$$R_z^a = \frac{-5(16.375) + 8.29 \times 17 - 8.29 \times 3}{14} = \frac{-81.75 + 140.93 - 24.87}{14} = +2.45$$

$$R_z^f = +14.129 \times 1700 = 24,019 \quad R_z^a = 2.45 \times 1700 = 4165$$

$$\bar{R}_{MAX}^f = \bar{R}_{MAX}^a = \frac{8.29 \times 1700}{.95257} = 14,794$$

T 65 STORE

⑩ $m_y = -17.5$ $m_y = 0$ $m_x = \pm 5$ $M_z = 100,000$ in² (HOOKS OR FRAME)
 $\theta = 31^\circ 41'$ $N = 7.25$ $NTC = 9.38$ $W = 3575$

$$\bar{Y}^f = 0 \quad \bar{Y}^a = 0$$

$$R_z^f = \frac{3575 \times 5 \times 8.81 + 3575 \times 17.5 \times 15}{30} = \frac{(41.5 + 262.5) \times 3575}{30} = 36,530$$

$$R_z^a = \frac{-3575 \times 5 \times 8.81 + 3575 \times 17.5 \times 15}{30} = \frac{(213.6) \times 3575}{30} = 26,032$$

$$\bar{R}_{MAX}^f = 0 \quad \bar{R}_{MAX}^a = 0$$

$$R_z^f = +36,530 \quad R_z^a = 26,032$$

CHECKING HOOK AND BRACE REACTIONS AT POINTS GIVEN
ON DOUGLAS STRENGTH ENVELOPE REF (a) DRAG CURVES

T-65 STORE $R+C = 7.25 + 1.56 = 8.81$

② $m_z = -7.87$ $m_y = 6.1$ $m_H = \pm 5$ $M_E = 100,000 \text{ IN}^2$ (HOOKS & FRAME)

$\bar{V}^p = \frac{6.1 \times 10}{\tan 34^\circ 25' \times 20 \cdot 68514} = \frac{3.05}{68514 \times 20} = 4.45$ $\bar{V}^a = \frac{6.1 \times 10}{68514 \times 20} = 4.45$

$R_2^{p'} = \frac{5 \times 8.81 \times 3575 + 7.87 \times 15 \times 3575 + 4.45 \times 25 \times 3575 - 4.45(-5) \times 3575}{30}$

$R_2^{p'} = \frac{157,479 + 422,028 + 397,719 + 79544}{30} = \frac{1,056,770}{30} = 35,225$

$R_2^{a'} = \frac{-5 \times 8.81 \times 3575 + 7.87 \times 15 \times 3575 + 4.45 \times 25 \times 3575 - 4.45(-5) \times 3575}{30}$

$R_2^{a'} = \frac{-157,479 + 422,028 + 397,719 + 79544}{30} = \frac{741,812}{30} = 24,727$

$\bar{R}_{HOK}^{p'} = \bar{R}_{HOK}^a = \frac{4.45}{82495} = 5.39 \times 3 \cdot 15 = 19,269$ $R_2^p = 35,225$ $R_2^a = 24,727$

③ $m_z = -2.19$ $m_y = 6.6$ $m_H = \pm 5$ $M_E = 100,000 \text{ IN}^2$ (HOOKS & BRACES)

$\bar{V}^p = \frac{6.6 \times 10}{68514 \times 20} = 4.816$ $\bar{V}^a = 4.816$

$R_2^{p'} = \frac{5 \times 3575(8.81) + 2.19 \times 3575 \times 15 + 4.816 \times 3575 \times 25 - 4.816 \times 3575 \times (-5)}{30}$

$R_2^{p'} = \frac{157,479 + 117,425 + 430,430 + 86086}{30} = \frac{791,413}{30} = 26,381$

$R_2^{a'} = \frac{-157,479 + 117,425 + 430,430 + 86086}{30} = \frac{476,475}{30} = 15,882$

$\bar{R}_{HOK}^{p'} = \bar{R}_{HOK}^a = \frac{4.816}{82495} \times 3575 = 20,870$

$R_2^p = 26,381$ $R_2^a = 15,882$

CHECKING HOOK AND BRACE REACTIONS AT POINTS GIVEN ON DOUGLAS STRENGTH ENVELOPE REF (C.) DRAG CURVES.

T-65 STORE

(4) $m_y = 0$ $m_y = 5.7$ $m_x = 5.5$ $M_z = 5100,000 \text{ in}^2$ (HOOKS AND FRAME)

$$\bar{V}^p = \frac{5.7 \times 10}{.68514 \times 20} = 4.16 \quad \bar{V}^a = 4.16$$

$$R_z^A = \frac{5 \times 2.81 \times 2575 + 4.16 \times 25 \times 2575 - 4.16 \times (-) \times 3575}{30}$$

$$R_z^A = \frac{157,479 + 371,800 + 74,360}{30} = \frac{603,639}{30} = 20,121$$

$$R_z^W = \frac{-157,479 + 371,800 + 74,360}{30} = \frac{288,681}{30} = 9,623$$

$$\bar{R}_{MAX}^A = \bar{R}_{MAX}^W = \frac{4.16}{.82495} \times 3575 = 18,025$$

$$R_z^A = 20,121 \quad R_z^W = 9,623$$

HOOK & BRACE LOAD SUMMARY AS DERIVED FROM REFA

COND	m_y	m_y	m_x	M_{zz}	31-500		14-500		CRITICAL
					T-63 STORE HOOK	BRACE	T-65 STORE HOOK	BRACE	
1	-38.5	0	0	0	32,725	0			14" HOOK
2	-17.5	+6.8	0	0	32,970	18,976			14" HOOK
3	0	+6.8	0	0	18,095	18,996			BRACE
4	-20.75	0	0	0			37,020	0	30" HOOK
5	-20.75	0	0	100,000			44,590	8850	—
6	-11.5	+5.7	0	0			35,428	18,029	30" HOOK
7	0	+6.9	0	0			17,982	21,011	BRACE
8	-32.5	0	+5	0	37,566	0			14" HOOK
9	-11.5	+6.8	+5	0	37,814	18,959			14" HOOK
10	0	+5.3	+5	0	24,019	14,744			—
11	-17.5	0	+5	0			36,530	0	30" HOOK
12	-7.57	+6.1	+5	0			35,225	19,269	30" HOOK
13	-2.19	+6.6	+5	0			26,381	20,270	BRACE
14	0	+5.7	+5	0			20,121	18,025	—

CONCLUSIONS FROM CHECK OF DOUGLAS STRENGTH ENVELOPE (REF.),

DEFINITIONS FROM MIL-T-7743

LIMIT LOAD - THE MAXIMUM LOAD ANTICIPATED DURING NORMAL CONDITIONS OF OPERATION.

YIELD LOAD - $1.15 \times$ LIMIT LOAD. DEFORMATIONS REMAINING AFTER APPLICATION OF THE YIELD LOAD SHALL NOT ADVERSELY AFFECT EITHER THE AERODYNAMIC CHARACTERISTIC OR MECHANICAL OPERATION OF THE RACK.

ULTIMATE LOAD - $1.50 \times$ LIMIT LOAD. FAILURE SHALL NOT OCCUR AT THIS LOAD LEVEL.

THE FOREGOING ANALYSIS OF THE DOUGLAS AERO 7A BOMB RACK PRODUCED THE FOLLOWING ULTIMATE LOADS:

MAXIMUM BRACE LOAD = 21,807*

MAXIMUM 14" HOOK STATION LOAD = 37,804*

MAXIMUM 30" HOOK STATION LOAD = 37,090*

MAXIMUM YAWING MOMENT = 100,000 INCH-LBS.

HOOK LIMITS - AS A MEAN OF CHECKING THESE VALUES, LIMITING HOOK STATION LOADS WERE DERIVED FROM THE AERO 7A RACK SPEC (MIL-R-22622) OVERLOAD RACK AND ULTIMATE HOOK TESTS. THE OVERLOAD TEST IS CONDUCTED ON RANDOMLY SELECTED SAMPLES OF PRODUCTION RACKS BY APPLYING THE FOLLOWING SPECIFIED DOWN LOADS TO THE COMPLETE RACK STRUCTURE

30 INCH HOOKS - 74,000* (YIELD LOAD) = 37,000* PER HOOK STATION

14 INCH HOOKS = 65,000* (YIELD LOAD) = 32,500* PER HOOK STATION

THE HOOK ULTIMATE LOAD TEST IS CONDUCTED BY SUBJECTING INDIVIDUAL HOOKS TO THE FOLLOWING MINIMUM DOWN LOADS AND CONTINUING THE TEST UNTIL THE HOOK FAILS.

30 INCH HOOK = 25,000* MINIMUM

14 INCH HOOK = 20,000* MINIMUM

EACH HOOK STATION ON THE AERO 7A RACK CONTAINS TWO HOOKS WHICH OPEN IN OPPOSING DIRECTIONS. THE HOOK ULTIMATE LOAD TEST IS CONDUCTED BY APPLYING THE LOADS AT APPROXIMATELY THE TIP OF ONE OF THESE HOOKS. DURING ACTUAL CARRIAGE OF A STORE, THE LUG IS SO CONFINED BY THE RACK FRAME TO ASSURE NEARLY EQUAL SHARING OF THE TOTAL LUG LOAD BETWEEN THE HOOKS.

DERIVING THE ULTIMATE HOOK STATION DOWN STRENGTH FROM THE OVERLOAD TEST, WHICH IS THE MOST REALISTIC

CONCLUSIONS FROM CHECK OF DOUGLAS STRENGTH ENVELOPE REF. OF THE SPEC TESTS, PRODUCES THE FOLLOWING RESULTS.

$$30 \text{ INCH HOOK STATION} = 37000 \times \frac{4.5}{5} = 45,260^{\#}$$

$$14 \text{ INCH HOOK STATION} = 32,500 \times \frac{4.5}{5} = 42,390^{\#}$$

HOWEVER, SINCE THE HOOKS ARE ALSO SUBJECTED TO A SIDE LOAD WHICH IS NOT CONSIDERED IN THE SPEC. TESTS, THE MORE CONSERVATIVE DOWN LOADS FROM THE DOUGLAS STRENGTH ENVELOPE WILL BE ACCEPTED ~ 37,000[#].

BRACE LIMITS — THE BRACE LOADS DERIVED FROM THE DOUGLAS STRENGTH ENVELOPE ARE GREATLY IN EXCESS OF THOSE DEMONSTRATED BY NADC LABORATORY TESTING OF THE AERO 7A RACK AS REPORTED IN NADC REPORT NADC-AM-6739 OF 30 NOV 1967 — "UPGRADING OF THE AERO 7A EJECTOR BOMB RACK FOR THE AG-A AIRCRAFT. THESE TESTS WERE PLANNED TO SUBJECT THE SWAY BRACES TO FAILURE LOADS BY IMPOSING INCREASING INCREMENTS OF SIDE LOAD ON A MER BEAM CONFIGURATION. BRACE FAILURE OF THE UNMODIFIED RACK OCCURED AT 8,500 LBS SIDE LOAD WHICH WAS RESOLVED BY ANALYSIS INTO A 7,438 LB SWAY BRACE RESULTANT REACTION. HOWEVER, THE ASSUMPTION USED IN CALCULATING THIS BRACE REACTION ($\frac{2}{3}$ OF THE SIDE LOAD REACTED AT THE BRACES AND $\frac{1}{3}$ AT THE HOOKS) WAS FOUND TO BE CONSERVATIVE. CONSEQUENTLY, THE BRACE FAILURE LOAD WILL BE ADJUSTED IN THIS REPORT BY WHAT IS CONSIDERED TO BE A MORE REALISTIC ANALYSIS.

TEST SET-UP DIMENSIONS AND ANGLES WERE TAKEN FROM NOTES RECORDED BY CARL ACKER DURING THE TESTING INDICATED IN THE REPORT.

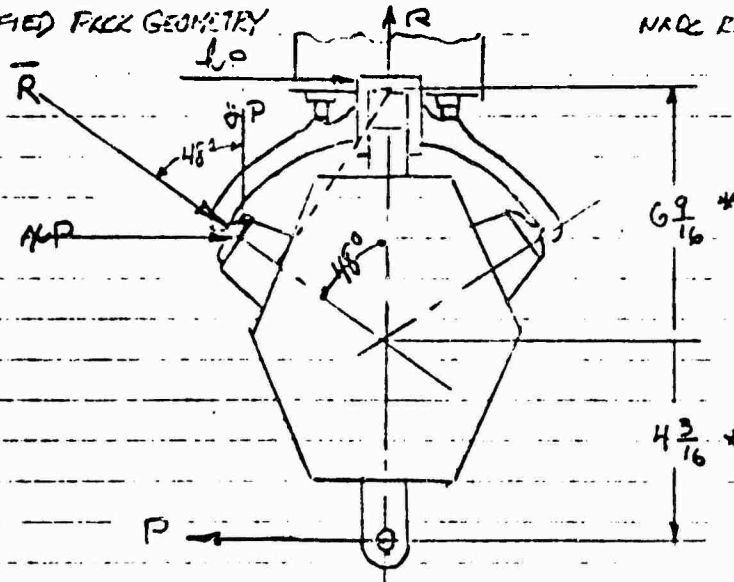
CONCLUSIONS. FROM CHECK ON DOUGLAS STRENGTH ENVELOPE

BRACE LIMITS

NADC TEST SET-UP - MER BEAM ON AN UNMODIFIED KERO 7% RACE

UNMODIFIED BRACE GEOMETRY

NADC REPORT # NADC-AH-6739/02



$$\cos 48^\circ = .66913$$

$$\sin 48^\circ = .74314$$

$$\tan 48^\circ = 1.1106$$

BOTH BRACES
ACTING AS SHOWN

* NOTE: IF THESE
DIMENSIONS CHANGE
TO 6 5/16 & 4 7/16
RESPECTIVELY
 $\beta = 48^\circ$

$$\sum M_{\text{HULL BEARING SURFACE}} = 10.75 P - \frac{N/P}{\sin \beta} \times 6.562 \sin \beta = 0$$

$$N = 1.638 P$$

$$\sum F_H = N/P + N/P - P = 0$$

$$N/P + 1.638 P - P = 0 \quad N = -.638 P$$

$$\sum F_V \quad R - yP = R - \frac{N/P}{\tan \beta} = 0 \quad R - \frac{1.638 P}{1.1106} = 0 \quad R = 1.475 P$$

$$\bar{R} = \frac{N/P}{\sin \beta} = \frac{1.638 P}{.74314} = 2.204 P$$

$$\bar{R} \text{ PER BRACE} = \frac{1}{2} \times 2.204 P = 1.102 P$$

AT THE FAILING SIDE LOAD OF 8500*

$$\bar{R} \text{ PER BRACE} = 1.102 \times 8500 = 9367^*$$

SINCE ULTIMATE LOAD IS DEFINED AT THE POINT JUST BEFORE FAILURE OCCURS, LET THE BRACE ULTIMATE LOAD = 9000*

CONCLUSIONS FROM CHECK ON DOUGLAS STRENGTH ENVELOPE BRACE LIMITS

RECALCULATING SWAY BRACE LOADS IN NADC REPORT NADC-AH-6739

EQUATIONS FOR NATC FIX (LARGE DIA STORE)

$$\sum M \text{ ABOUT ZEROSING SURFACE} = 10.75 P - \frac{NP}{\sin \theta} \times 6.3125 \sin \theta = 0$$

$$N = 1.703$$

$$\sum F_H = LP + NP - P = 0$$

$$L = .703$$

$$\sum F_V = R - \frac{NP}{\tan \theta} = R - \frac{1.703P}{1.1106} = 0 \quad R = 1.533P$$

$$\bar{R} = \frac{NP}{\sin \theta} = \frac{1.703P}{.74314} = 2.292P$$

$$\bar{R} \text{ PER BRACE} = \frac{1}{2} \bar{R} = 1.146P$$

TOTAL SIDE LOAD	UNMODIFIED RACK TABLE I - (REF)		NATC FIX TABLE III - (REF)		
	SWAY BRACE LOAD $\bar{R} = 1.102P$	DEFLECTION BRACE TO FRAME FWD END	SWAY BRACE LOAD $\bar{R} = 1.146P$	DEFLECTION BRACE TO FRAME FWD END	
0	0	0	0	0	
1000	1102	.012	1146	.018	
2000	2204	.043	2292	.051	
3000	3306	.075	3438	.084	
4000	4408	.110	4584	.119	
5000	5510	.151	5730	.150	
6000	6612	.205	6876	.185	
7000	7714	.266	8022	.217	
8000	8816	.364	9168	.258	
UNMODIFIED FAILURE $\rightarrow$ 8500	9367		10,314	.306	
NATC FIX FAILURE 14750		FAILURE $\rightarrow$	16,903	.356	DERIVED FROM CURVES FIG 6 NADC-AH -6739 IN DETAIL DATA

FOR A LARGE DIAMETER STORE ALT ULTIMATE BRACE LOAD = 16,500*

THE UNMODIFIED RACK REPRESENTS A SMALL DIAMETER STORE

THE NATC FIX REPRESENTS A LARGE DIAMETER STORE

FOR A SMALL DIAMETER STORE ALT ULTIMATE BRACE LOAD = 9000*

AS CAN BE OBSERVED FROM THE DATA THE FAILURE
LOAD FOR THE NATC FIX REPRESENTING A LARGE DIA STORE
IS CONSIDERABLY LARGER THAN THE FAILURE LOAD FOR
THE SMALL DIAMETER STORE (UNMODIFIED RACK DATA)

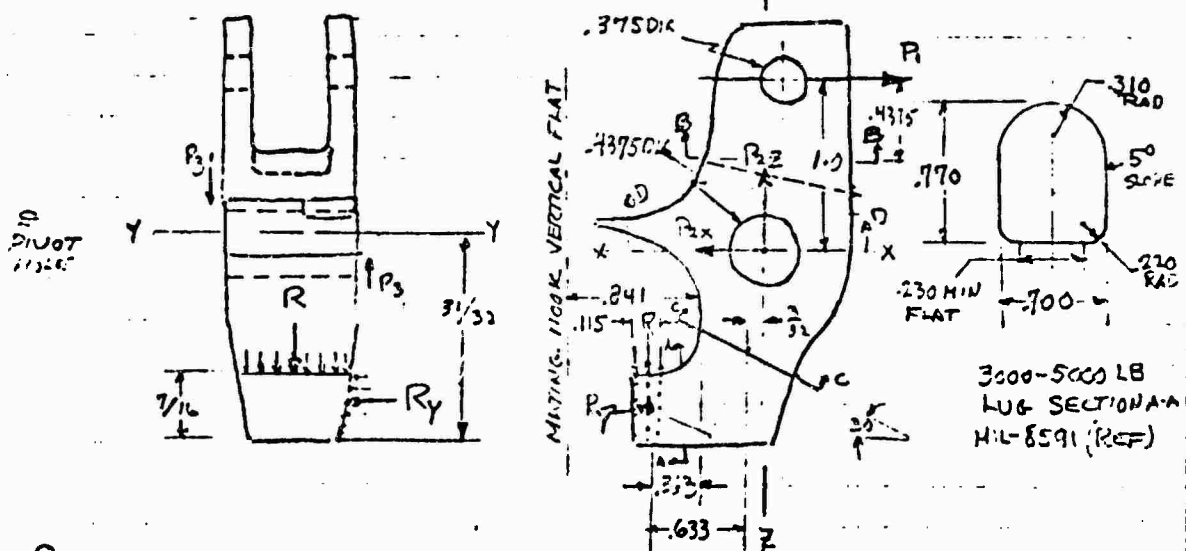
CONCLUSIONS FROM CHECK ON DOUGLAS STRENGTH ENVELOPE HOOK SIDE LOAD LIMITS

THE BRACE LOADS COMPUTED FROM THE DOUGLAS STRENGTH ENVELOPE WERE OF SUCH HIGH MAGNITUDE, WITHOUT CONSIDERING YAWING MOMENT, THAT IT BECAME APPARENT THAT YAWING MOMENT WAS REACTED BY SIDE LOADS ON THE HOOKS. BECAUSE OF THE LACK OF CONFIDENCE ESTABLISHED IN THE DOUGLAS ANALYSIS DUE TO THE UNREALISTICALLY HIGH BRACE LOADS, THE QUESTION ARISES AS TO THE STRUCTURAL ADEQUACY OF THE HOOKS TO REACT THIS SIDE LOAD IN ADDITION TO THE HIGH SIDE LOAD ALREADY IMPOSED IN THE STRENGTH ENVELOPE. SINCE NO TEST DATA IS AVAILABLE TO DEMONSTRATE THAT THE HOOKS CAN WITHSTAND THE SIDE LOAD IMPOSED BY THE SPECIFIED 100,000 IN.-IN. OF YAWING MOMENT, STRESS ANALYSIS OF THE HOOK WILL BE USED TO APPROXIMATE HOOK CAPABILITY.

THE 14 INCH HOOKS ARE NOT CONSIDERED IN THIS ANALYSIS.

30 INCH HOOKS

ALL DIMENSIONS ARE APPROXIMATE - SCALED FROM HOOK
LOAD POSITION ON HOOK = .78 FROM FIRST (MIL-R-22622) 2



$$\sum M_{\text{AWT}} = P_1 - (633 + 093) R = 0 \quad (\text{SIDE VIEW})$$

$$P_1 = .726 R$$

$$\sum F_x = P_1 - P_{2x} = 0 \quad P_{2x} = P_1 = .726 R$$

$$\sum F_z = P_{2z} - R = 0 \quad P_{2z} = R$$

$$\sum M_{\text{AWT}} = (31/32 - 7/32) R_y - 3/4 P_3 = 0 \quad B=20 \quad P_3 = R_y \quad (\text{FRONT VIEW})$$

CONCLUSIONS FROM CHECK ON DOUGLAS STRENGTH ENVELOPE HOOK SIDE LOAD LIMITS

CHECKING HOOK ULTIMATE STRENGTH AT CRITICAL
SECTION C-C (P13-REF) BASED ON SPEC MIL-R-22622
ULTIMATE LOAD TEST VALUES.

30" HOOKS 25,000 MINIMUM LOAD PER HOOK APPLIED
AT A POINT .78 FROM THE HOOK PIVOT.

DISTANCE TO CENTROID OF SECTION FROM LOAD = $.78 - .093 = .687$

$$M_{CC} = -.687 \times 25000 = 17,175 \text{ (ULT)}$$

$$T = 25,000 \cos 30^\circ = 25000 \times .866 = 21,650$$

$$S = 25,000 \sin 30^\circ = 25000 \times .500 = 12,500$$

$$I_{YY} = \frac{1}{12} b h^3 = \frac{1}{12} \times .750 \times .625^3 = .0152$$

$$f_{bm} = \frac{17,175 \times .3125}{.0152} = 353,104$$

INTRODUCE A FORM FACTOR OF 1.5 TO ACCOUNT
FOR REDISTRIBUTION OF BENDING STRESS DUE TO
ELASTICITY

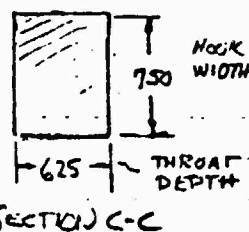
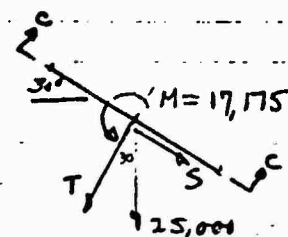
$$f_{bm} = 353,104 \times \frac{1}{1.5} = 235,402$$

$$f_{tm} = \frac{21,650}{.750 \times .625} = 46,186$$

$$f_{sm} = \frac{12,500}{.625 \times .750} = 26,666$$

$$f_{smax} = \sqrt{f_s^2 + (f_m/2)^2} = \sqrt{26,666^2 + (235,402/2)^2} = 143,300$$

$$f_{mmax} = \frac{f_m}{2} + f_{smax} = \frac{235,402}{2} + 143,300 = 264,094 \text{ psi}$$



RANDOMLY SELECTED PRODUCTION RACKS ARE
SUBJECTED TO THIS LOAD AND MOMENT, AND REQUIRED
TO SUSTAIN THEM AS A MINIMUM. - OBVIOUSLY, HOWEVER
THE COMPUTED STRESS IS IN EXCESS OF THE ULTIMATE
STRENGTH OF THE MATERIAL (180,000 psi). PRESTRESSING OF
THE HOOKS PRIOR TO TEST COULD CONCEIVABLY ACCOUNT
FOR THE DIFFERENCE, CONSEQUENTLY THESE COMPUTED
ULTIMATE STRESSES WILL BE USED AS REFERENCE STRESSES
IN EVALUATING HOOK STRENGTH.

CONCLUSION FROM CHECK ON DOUGLAS STRENGTH ENVELOPE HOOK SIDE LOAD LIMITS

SIDE LOAD MOMENT ARMS

$$(14 + y \tan 30) \cos 30 = .633$$

$$14^2 + y^2 = .75^2$$

$$.866x + .5y = .633$$

$$x + .577y - .730 = 0$$

$$(.730 - .577y)^2 + y^2 = .75^2$$

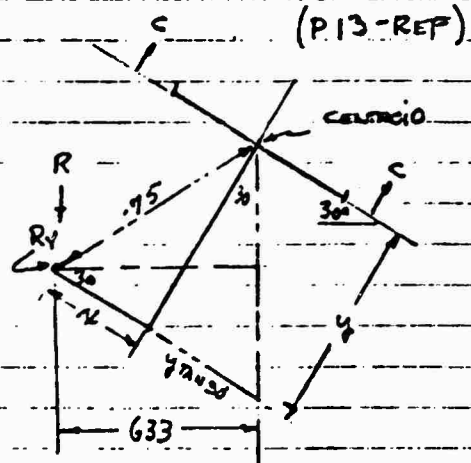
$$.533 - .842y + .333y^2 + y^2 = .5625$$

$$1.333y^2 - .842y - .0295 = 0$$

$$y^2 - .6316y - .022 = 0$$

$$y = \frac{.6316 \pm \sqrt{.3989 + .088}}{2} = \frac{.6316 + .6978}{2} = .6647$$

$$x = .730 - .577 \times .6647 = .3465$$



CHECKING SECTION C-C FOR WORST HOOK LOAD P.9 (REF)

T-65 STORE 30" HOOKS

HOOK DOWN LOAD PER STATION = 37,090 (ULT) SINGLE HOOK DOWN LOAD = 18,545

HOOK SIDE LOAD PER STATION = STORE YAWING MOMENT / HOOK SPACING
= 100,000 / 30 = 3333 (ULT) (DOUGLAS STRENGTH ENVELOPE)

SINGLE HOOK SIDE LOAD = 1666 (ULT)

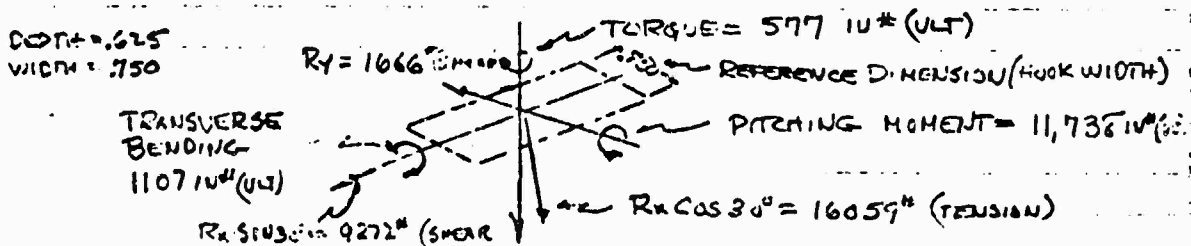
PITCHING MOMENT ON SECTION C-C = .633 x 18,545 = 11,735 in-lb (ULT) = MY

TORQUE ON SECTION C-C = Ry x x = 1666 x .3465 = 577 in-lb (ULT)

TRANSVERSE BENDING ON SECTION C-C = Ry x y = 1666 x .6647 = 1107 in-lb (ULT)

TENSION COMPONENT OF DOWN LOAD = Rx cos 30 = 18,545 x .866 = 16,059

SHEAR COMPONENT OF DOWN LOAD = Rx sin 30 = 18,545 x .500 = 9272



LOADS & MOMENTS ON SECTION C-C

CONCLUSIONS FROM CHECK ON DOUGLAS STRENGTH ENVELOPE HOOK SIDE LOAD LIMITS

$$f_{bM} = \frac{M_{1Y} C}{15 I_{YY}} + \frac{M_{2Z} C}{15 I_{ZZ}} + \frac{R_a \cos 30^\circ}{b h}$$

1.5 = FORM FACTOR
RECTANGULAR SECTION

$$f_{sM} = \frac{T_{TQAVE}}{2 b h^2} + \frac{R_y}{b h} + \frac{R \sin 30^\circ}{b h}$$

REF. LAM. - ADVANCED
MECHANICS OF MATERIALS
SEELY-SMITH-2ND ED.

$$f_{bM} = \frac{11,738 \times 212}{\frac{1}{2} \times 75 \times 625^3 \times 1.5} + \frac{11,071 \times 275}{\frac{1}{2} \times 625 \times 750^3} + \frac{16,059}{625 \times 750}$$

$$f_{bM} = \frac{36,622}{0152 \times 1.5} + \frac{415}{022 \times 1.5} + \frac{16,059}{.46} = 160,625 + 125,750 + 34,910$$

$$f_{bM} = 208,110$$

$$f_{sM} = \frac{577}{.208 \times 75 \times 625^2} + \frac{1666}{.625 \times 75} + \frac{9272}{.625 \times 75} = \frac{577}{.061} + \frac{13938}{.46}$$

$$f_{sM} = 9459 + 23778 = 33,237$$

$$f_{sMAX} = \sqrt{33.3 \times 10^3 + \left(\frac{208 \times 10^3}{2}\right)^2} \cdot 10^3 \sqrt{1109 + 10816} = 109,200 \text{ psi}$$

$$f_{sMAX} = \frac{208,110}{2} + 109,200 = 213,255$$

THESE STRESSES INDICATE A REASONABLE MARGIN WHEN COMPARED TO THE REFERENCE STRESSES COMPUTED ON PAGE 14.

HOWEVER, DUE TO THE UNCERTAINTY OF THE HOOK DIMENSIONS AND THE RELUCTANCE TO RELY ON THE THESE STRESSES, WHICH IS REALLY INTENDED TO PREDICT FATIGUE LIFE, IT IS RECOMMENDED THAT THE HOOK LOADS BE LIMITED TO THOSE WITHIN THE ULTIMATE TENSILE AND SHEAR STRENGTHS OF THE MATERIAL. THIS CAN BE ACHIEVED BY DECREASING THE HOOK DOWNLOAD. THE BENDING STRENGTH IS MODIFIED BY A FORM FACTOR TO INTRODUCE THE TRIANGULAR DISTRIBUTION OF STRESS WHICH IS ALLOWABLE BEYOND THE ELASTIC LIMIT.

$$F_{tM} = 150,000 \text{ psi} \quad F_{sM} = 106,000 \quad \text{DOUGLAS SIG #4430646 (REF.)}$$

CONCLUSIONS FROM CHECK ON DOUGLAS STRENGTH ENVELOPE HOOK SIDE LOAD LIMITS.

ASSUME HOOK DOWN LOAD PER STATION = 30,000# (ULT)

SINGLE HOOK DOWN LOAD = 15,000# (ULT)

HOOK SIDE LOAD PER STATION = 3333# (ULT)

SINGLE HOOK SIDE LOAD = 1666# (ULT)

$$\text{PITCHING MOMENT} = .633 \times 15000 = 9495$$

$$R_x \cos 30^\circ = 15000 \times .866 = 12990$$

$$R_x \sin 30^\circ = 15000 \times .500 = 7500$$

$$f_{bu} = \frac{9495 \times .312}{.0152 \times 1.5} + \frac{1107 \times .375}{.022 \times 1.5} + \frac{12990}{.46}$$

$$f_{bu} = 129,932 + 125,75 + 28,239 = 170,746 \text{ psi}$$

$$f_{su} = \frac{577}{.061} + \frac{1666}{.46} + \frac{7500}{.46}$$

$$f_{su} = 9459 + 19,926 = 29,385 \text{ psi}$$

$$f_{s \max} = \sqrt{(29.4 \times 10^3)^2 + \left(\frac{171}{2} \times 10^3\right)^2} = 13 \sqrt{864 + 7310} = 90,410 \text{ psi}$$

$$f_{a \max} = \frac{171,000}{2} + 90,410 = 175,910 \text{ psi}$$

$$M.S. = \frac{150}{175.9} - 1 = +0.2$$

SECTION A-A REF P-13

$$\text{PITCHING MOMENT} = R \left(.375 - \frac{11.5}{2} \right) = .3175R$$

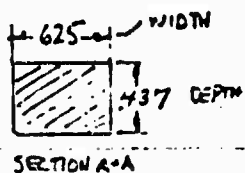
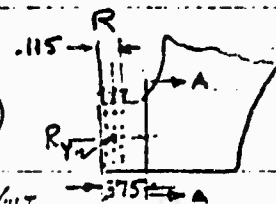
$$= .3175 \times 15000 = 4763 \text{ in}^{\circ} \text{ (ULT)}$$

$$\text{TRANSVERSE MOMENT} = .3175 \times R_y = .3175 \times 1666 = 529 \text{ in}^{\circ} \text{ (ULT)}$$

$$\text{TORSION} = 0$$

$$f_{bu} = \frac{4763 \times 2155}{\frac{1}{12} \times 625 \times 437^3 \times 1.5} + \frac{529 \times 3125}{\frac{1}{12} \times 437 \times 625^3 \times 1.5}$$

$$f_{bu} = \frac{1040}{.00435 \times 1.5} + \frac{16}{.0081 \times 1.5} = 159,386 + 12,359 = 171,745 \text{ psi (ULT)}$$



CONCLUSIONS FROM DOUGLAS STRENGTH ENVELOPE
 HOOK SIDE LOAD LIMITS
 SECTION A-A (CONT'D)

$$f_{SM} = \frac{15000 + 1666}{.625 \times .437} = \frac{16666}{.273} = 61047$$

$$f_{SMAX} = \sqrt{(61 \times 10^3)^2 + \left(\frac{172 \times 10^3}{2}\right)^2} = 10^3 \sqrt{3721 + 7396} = 10^3 \sqrt{11117} = 105,437 \text{ psi}$$

$$f_{MAX} = \frac{171,745}{2} + 105,437 = 191,309 \text{ psi}$$

$$MS = \frac{180}{191} - 1 = -0.58$$

DECREASE DOWN LOAD TO 14000 PER HOOK

$$f_{SM} = \frac{3175 \times 14000 \times .2185}{.00435 \times 1.5} + 12,359 = \frac{971.23}{.00653} + 12359$$

$$f_{SM} = 148,733 + 12,359 = 161,092$$

$$f_{SM} = \frac{14000 + 1666}{.273} = \frac{15666}{.273} = 57,384$$

$$f_{SMAX} = \sqrt{(57.4 \times 10^3)^2 + \left(\frac{161 \times 10^3}{2}\right)^2} = 10^3 \sqrt{3283 + 6480} = 98,650 \text{ psi}$$

$$f_{MAX} = \frac{161,092}{2} + 98,650 = 80,546 + 98,650 = 179,200$$

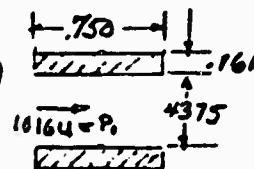
$$MS = \frac{180}{179.2} - 1 = +0.04$$

CONCLUSIONS FROM DOUGLAS STRENGTH ENVELOPES

HOOK SIDE LOAD LIMITS REF P-13

SECTION - B-B

$$\text{PITCHING MOMENT} = .4375 P_1 = .4375 \times 726 R \text{ (P13-REF)} \\ = .4375 \times 726 \times 14000 = 4446$$



$$f_{bx} = \frac{4446 \times 0.375}{2 \times \frac{1}{2} \times 0.161 \times 0.750 \times 1.5} = \frac{2223 \times 0.375}{0.0566 \times 1.5} = 93,190 \quad \text{SECTION B-B}$$

$$f_{sx} = \frac{10164}{2 \times 0.161 \times 0.750} = \frac{10164}{0.2415} = 42,086$$

$$f_{smax} = \sqrt[3]{(42.1)^2 + (119.1)^2} = \sqrt[3]{1772 + 2410} = 64,700$$

$$f_{mmax} = 49,100 + 64,700 = 113,800$$

$$M.S. = \frac{180}{114} - 1 = +.578$$

SHARP RADIUS AT THE CORNER OF THIS SECTION WILL PRODUCE STRESS CONCENTRATION BUT INFORMATION AVAILABLE ONLY TOUGHLY APPROXIMATES THE CASE

STRESS CONCENTRATION DESIGN FACTORS - PETERSON \

BAR WITH A SHOULDER FILLET IN BENDING FIG 60

$$\frac{r}{d} = \frac{0.03}{0.161} = 0.186 \quad \frac{D}{d} = \frac{0.750}{0.161} = 4.6 \quad K_t = 1.55$$

$$f_{mmax} = 1.55 \times 113,800 = 176,390$$

$$M.S. = \frac{180}{176} - 1 = +0.2$$

CONCLUSIONS FROM DOUGLAS STRENGTH ENVELOPE HOOK SIDE LOAD LIMITS REF P13

SECTION D-D

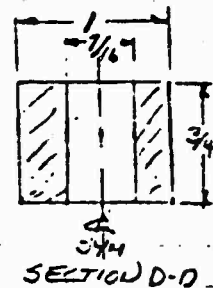
$$\text{PITCHING MOMENT} = 14000 \times (.633 + .093) = 10,164 \text{ IN}^2(\text{ULT})$$

$$\text{TRANSVERSE MOMENT} = 1666 \left(\frac{2}{3} \cdot \frac{1}{32} - \frac{1}{32} \right) = 1250 \text{ IN}^2(\text{ULT})$$

$$\text{TORQUE} = 1666 (.633 + .093) = 1210 \text{ IN}^2 \text{ ULT}$$

$$\text{TENSION COEFFICIENT OF DOWN LOAD} = R = 14,000$$

$$\text{SHEAR DUE TO SIDE LOAD} = R_T = 1666$$



SECTION D-D

$$f_{bm} = \frac{10,164 \times .5}{\frac{1}{2} \times 750 (1^2 - .4375^2) \times 1.5} + \frac{1250 \times .375}{\frac{1}{2} \times .5625 \times .750^3 \times 1.5} + \frac{14000}{.75 (5625)}$$

$$f_{bm} = \frac{10,164 \times .5}{.0573 \times 1.5} + \frac{1250 \times .375}{.020 \times 1.5} + \frac{14000}{.422}$$

$$f_{bm} = 59,127 + 15,625 + 33,175 = 107,927$$

$$f_{sm} = \frac{1210}{.205 \times .75 \times .625} + \frac{1666}{.75 \times .5625}$$

$$f_{sm} = \frac{1210}{0609} + \frac{1666}{.422} = 19,868 + 3945 = 23,815$$

$$f_{smax} = 103 \sqrt{(23.8)^2 + (54)^2} = 103 \sqrt{566 + 2916} = 59,000 \text{ psi (ULT)}$$

$$f_{mmax} = 54,000 + 59,000 = 113,000$$

$$M_s = \frac{180}{71.3} - 1 = +.59$$

SECTION A-A

TIGHT PIN

$$P_{12} = R = 14,000$$

P13HS-REF

$$P_3 = R_T = 1666$$

P13 & P15-REF

$$P_{2v} = .726 R = .726 \times 14000 = 10164 \text{ P13 REF}$$

ASSUME PIN IS TIGHT FITTING IN HOOK PIVOT

HOLE AND AGAINST BACK FRAME SO THAT NO ENDING EXISTS

$$f_{sm} = \frac{\sqrt{(7000 + 1666)^2 + (5282)^2}}{.1503} = \frac{\sqrt{(8666)^2 + (5282)^2}}{.1503} = \frac{10^3 \sqrt{75.1 + 25.8}}{.1503} = 10,050$$

$$f_{sm} = 66,866 \text{ psi}$$

$$M_s = \frac{106}{66.4} - 1 = +.58$$

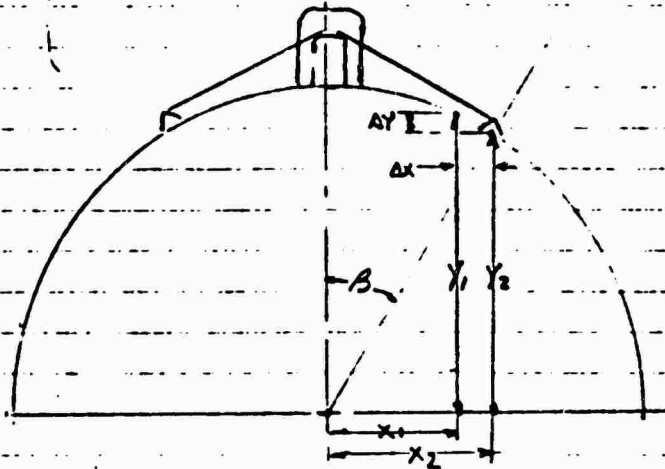
CONCLUSIONS FROM DOUGLAS STRENGTH ENVELOPE YAWING MOMENT DISTRIBUTION

THIS REPORT HAS DEMONSTRATED THAT THE AERO 7A RACK LOADS SPECIFIED IN THE DOUGLAS STRENGTH ENVELOPE ARE GREATLY IN EXCESS OF THOSE WHICH THE RACK CAN SAFELY SUSTAIN. AS INDICATED ON PAGE 4, DOUGLAS EVIDENTLY ALSO ASSUMED, IN THE DERIVATION OF THE STRENGTH ENVELOPE, THAT THE YAWING MOMENT WAS REACTED BY HOOK SIDE LOAD RATHER THAN BY THE SWAY BRACES. THIS ASSUMPTION WILL BE CHECKED IN THE FOLLOWING ANALYSIS.

ASSUME THAT THE STORE IS SUBJECTED TO YAWING MOMENT ONLY, AND THAT THE STORE ROTATES IN THE HORIZONTAL PLANE TO ALLOW THE LUGS TO JUST BEGIN TO BEAR AGAINST THE SIDES OF THE HOOKS. FOR THE STORE TO ACHIEVE THIS POSITION THE SWAY BRACES MUST DEFLECT SUFFICIENTLY TO ALLOW THE STORE TO SLIP UNDERNEATH THEM. THE VERTICAL DEFLECTION OF THE BRACES (ΔY) IS DERIVED AS A FUNCTION OF THE DISTANCE THAT THE STORE ROTATES LATEROALLY (ΔX). JUST AT HOOK CONTACT. ΔY IS THEN CONVERTED INTO A RESULTANT BRACE DEFLECTION AND COMPARED TO THE DEFLECTION RECORDED DURING TESTING TO OBTAIN THE RESULTANT BRACE LOAD IMPARTING THE TEST DEFLECTION. THIS BRACE LOAD WHICH IS ACTING AT HOOK-LUG CONTACT IS THEN ASSUMED TO BE THE LIMITING BRACE REACTION TO YAWING MOMENT WHILE THE REMAINDER IS REACTED BY HOOK SIDE LOAD.

THE TEST DATA, EXTRACTED FROM NADL REPORT # NADL-AM-6739 (TABLE III-BRACE TO GROUND, AFT END) IS ASSUMED TO REPRESENT A LOAD DEFLECTION CURVE FOR THE RACK-BRACE COMBINATION. THE ANALYSIS DOES NOT CONSIDER ROTATION OF THE STORE DUE TO SIDE LOAD.

CONCLUSIONS FROM DOUGLAS STRENGTH ENVELOPE
 YAWING MOMENT DISTRIBUTION
 DERIVING $\Delta X = f \Delta Y$



X_2 & Y_2 ARE THE COORDINATES OF THE BRACE RELATIVE TO THE STORE IN ITS ORIGINAL POSITION.

X_1 & Y_1 ARE THE COORDINATES OF THE BRACE RELATIVE TO THE STORE

AFTER THE STORE SLIPS BENEATH THE BRACES DUE TO YAWING MOMENT.

ΔX = DISTANCE STORE MOVES HORIZONTALLY RELATIVE TO THE BRACE

ΔY = DISTANCE BRACE MOVES VERTICALLY.

$$X_1^2 + Y_1^2 = R^2$$

$$\Delta Y = Y_1 - Y_2$$

$$\Delta X = X_2 - X_1$$

$$Y_1 = \sqrt{R^2 - X_1^2}$$

$$\Delta Y = Y_1 - Y_2 = \sqrt{R^2 - X_1^2} - Y_2$$

$$X_1 = X_2 - \Delta X$$

$$\Delta Y = \sqrt{R^2 - (X_2 - \Delta X)^2} - Y_2$$

CONCLUSIONS FROM DOUGLAS STRENGTH ENVELOPE YAWING MOMENT DISTRIBUTION

HORIZONTAL DIMENSION OF LUG-HOOK OPENING MIL-A-8591D
FIG 283 1000 & 2000th WEIGHT CLASSES

T65 30" LUG 1.125 $\pm .030$ MAX = 1.155 FIG 3
T63 14" LUG .72 $\pm .030$ MAX = .75 FIG 2

HOOK WIDTH

T65 30" HOOK = .625
T63 14" HOOK = .500

ΔX = CLEARANCE = LUG-DIMENSION - HOOK-DIMENSION

T65 30" = 1.155 - .625 = .530
T63 14" = .750 - .500 = .250

T63 STORE 14" SUSPENSION $\beta = 17043'$ $R = 15.25'$

$X_2 = R \sin \beta = 15.25 \times .30431 = 4.64$ P2-REF

$Y_2 = R \cos \beta = 15.25 \times .95257 = 14.527$ P2-REF

T65 STORE 30" SUSPENSION $\beta = 34026'$ $R = 7.25'$

$X_2 = 7.25 \times .56521 = 4.10$

$Y_2 = 7.25 \times .82495 = 5.98$

T63 STORE

$\Delta Y = \sqrt{R^2 - (X_2 - \Delta X)^2} - Y_2$ P22-REF

$\Delta Y = \sqrt{(15.25)^2 - (4.64 - .250)^2} - 14.527$

$\Delta Y = \sqrt{232.5 - 19.27} - 14.527$

$\Delta Y = \sqrt{213.23} - 14.527 = 14.602 - 14.527 = .0754$

T65 STORE

$\Delta Y = \sqrt{(7.25)^2 - (4.10 - .530)^2} - 5.98$

$\Delta Y = \sqrt{52.563 - 12.745} - 5.98$

$\Delta Y = \sqrt{39.818} - 5.98 = 6.31 - 5.98 = .33$

CONCLUSIONS FROM DOUGLAS STRENGTH ENVELOPE

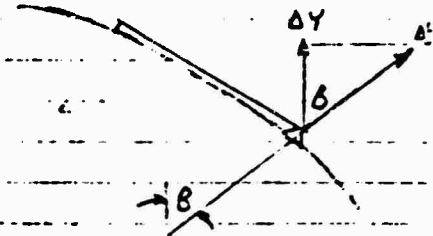
YAWING MOMENT DISTRIBUTION

CONVERTING THIS DEFLECTION TO A RESULTANT AT $\theta = 45^\circ$ FOR COMPARISON WITH TEST DATA.

$$\text{RESULTANT DEFLECTION OF BRACE} = \frac{\Delta Y}{\cos \theta}$$

$$\text{T63 STORE } \Delta B = \frac{.0754}{.66913} = .112$$

$$\text{T65 STORE } \Delta B = \frac{.33}{.66913} = .493$$



COMPARING THESE VALUES OF RESULTANT BRACE DEFLECTION WITH THOSE DERIVED ON P 120 (NAAC REPORT NAACAM-6739-RELEST III-REF) IDENTIFIES A SWAY BRACE LOAD. THIS IS THE LOAD REQUIRED TO DEFLECT THE BRACE STRUCTURE ALONE TO A DISTANCE ΔY WHICH IS LARGE ENOUGH TO ALLOW THE STORE TO SHIFT LATERALLY AND MAKE HOOK-HUG CONTACT. AFTER THIS OCCURS THE BRACES ARE NO LONGER EFFECTIVE IN RESISTING YAWING MOMENT AND ALL OF THE YAWING MOMENT COMES OUT AS SIDE LOAD ON THE HOOKS. THE LOAD DEFLECTION CURVES IN TABLE I & II UNDER BRACE TO FRAME (FWD END) ARE USED AS A DEFINITION OF BRACE DEFLECTION.

THE YAWING MOMENT CAPACITY OF THE BRACES IS DICTATED BY THE REQUIREMENT FOR THE BRACES TO CLIMB AN INCLINE PRESENTED BY THE STORE AS IT ROTATES IN THE HORIZONTAL PLANE. REGARDLESS OF WHAT OTHER LOADS ARE APPLIED TO THE BRACES, THIS SAME REQUIREMENT IS PRESENTED TO THE BRACE AS ANY ATTEMPT IS MADE TO YAW THE STORE. FOR INSTANCE, IF THE BRACE IS LOADED BY STORE SIDE LOAD IT WILL DEFLECT BUT WHEN AN ATTEMPT IS THEN MADE TO YAW THE STORE IT MUST DEFLECT THE BRACES BY THE ADDITIONAL INCREMENT REQUIRED TO CLIMB THE STORE INCLINE. DOWN LOAD WOULD TEND TO RELIEVE THIS SITUATION, BUT IN THIS CASE THE RELIEF IS OFFERED BY THE DEFLECTION OF THE HOOKS WHICH ALLOW THE STORE SURFACE TO MOVE AWAY FROM THE BRACES. HOWEVER, SINCE THE HOOKS ARE MORE RIGID THAN THE BRACES, THIS EFFECT IS NOT AS SIGNIFICANT AS BRACE DEFLECTION. PITCHING MOMENT CAN ALSO RELIEVE A BRACE AND FACILITATE SLIPPAGE UNDER YAW BUT THIS ALSO DEMANDS DEFLECTION OF THE

CONCLUSIONS FROM DOUGLAS STRENGTH ENVELOPE YAWING MOMENT DISTRIBUTION

OF THE MORE RIGID HOOKS. THE BOMB RACK STRUCTURE IS SUCH THAT YAWING MOMENT MOST EFFECTIVELY SUBS THE STORE UNDER THE BRACES. IF THE BRACE LOAD SUPPLIED BY YAWING MOMENT IS ONLY HIGH ENOUGH ON ONE BRACE TO ALLOW SLIPPAGE TO THE POINT WHERE THE HOOK WILL FEEL SIDE LOAD, THEN THE STORE WILL TEND TO PIVOT ABOUT THE BRACE WITH THE LEAST LOAD.

REFERRING TO PAGE 120.

T62 STORE 30.5" DIA 14" SUSPENSION

THE NATE FX DATA (TABLE III) IS USED FOR COMPARATIVE PURPOSES.

AT .112 DEFLECTION

$$\frac{.112 - .084}{.119 - .084} (4584 - 3438) = \frac{.028}{.035} \times 11'' = 917 \quad \bar{R}_{470} = 3438 + 917 = 4355$$

$$\bar{R}_{470} = \frac{R_1 \sin \beta_1}{R_2 \sin \beta_2} = \frac{4355 \times 6.312 \times .74314}{16.375 \times .30431} = 4099 \quad \left\{ \begin{array}{l} \text{TP25a (REF)} \\ \text{P12 REF} \\ \text{P2 REF} \end{array} \right.$$

T65 STORE 14.5" DIA 30" SUSPENSION

THE UNMODIFIED FX DATA (TABLE I) IS USED FOR COMPARATIVE PURPOSES.

AT .493 DEFLECTION

THIS DEFLECTION IS BEYOND THE FAILURE LIMIT OF THE BRACE.

THE SIGNIFICANCE OF THIS RESULT IS THAT ON THE T63 STORE (LARGE DIAMETER) THE BRACES WILL REACT A YAWING MOMENT = $20 \times 4099 \sin \beta = 20 \times 4099 \times .30431 = 24947 \text{ IN}''$

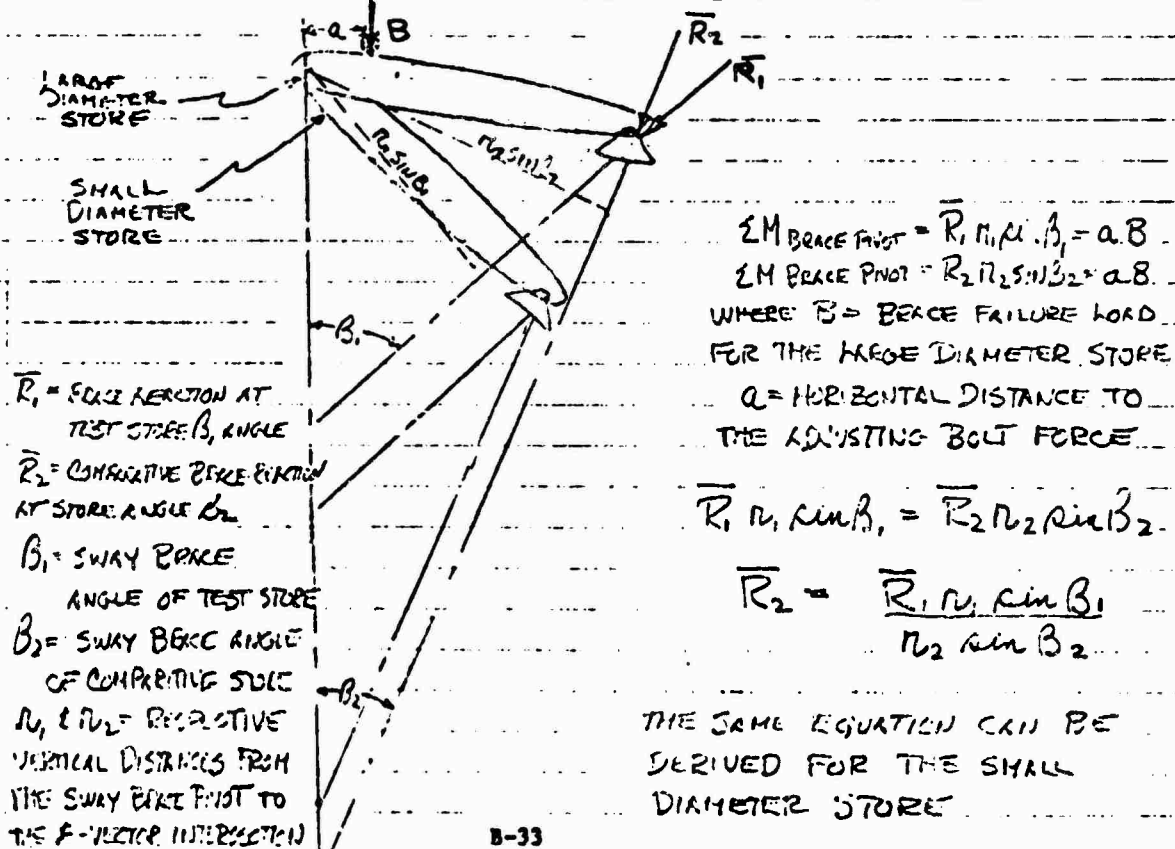
BEFORE THE STORE LOGS CONTACT THE SIDES OF THE HOOKS. ON THE T65 STORE (SMALL DIAMETER) THE BRACES WILL REACT YAWING MOMENT UNTIL A BRACE FAILURE OCCURS.

THIS CONCLUSION CONCURS WITH PREVIOUS EXPERIENCE AND WORK DONE ON OTHER RACKS IN WHICH LARGE DIAMETER STORES WERE PRONE TO SLIPPAGE UNDER YAWING MOMENT WHILE SMALL DIAMETER STORES WERE NOT. THIS IS ALSO APPARENT FROM THE BASIC BRACE GEOMETRY.

TRACTION OF YAWING MOMENT ON THE BRACES SHOULD ALLOW AN ADJUSTMENT ON THE HOOK DOWNLOAD (P17 CRITICAL SECTION) SINCE IT WAS ASSUMED THAT ALL OF THE YAWING MOMENT WAS REACTED BY SIDE LOAD ON THE HOOKS. CHANGE NOTED IN CONCLUSIONS P26.

CONCLUSIONS FROM DOUGLAS STRENGTH ENVELOPE YAWING MOMENT DISTRIBUTION

A CORRECTION HAS TO BE MADE TO THE DATA EXTRACTED FROM NADC REPORT NADC-AM-6739 BECAUSE THE TESTS SPECIFIED WERE MADE ON A STORE HAVING A β ANGLE OF 45° . THE RESULTANT FORCE ACTING ON THE SWAY BRACE ADJUSTING BOLT, WHICH DETERMINES THE FAILURE POINT OF THE RACK, IS SIGNIFICANTLY INFLUENCED BY BOTH THE DIRECTION OF THE FORCE VECTOR ACTING ON THE SWAY BRACE AND THE STORE DIAMETER. THE INFLUENCE OF THE STORE DIAMETER CAUSES THE ADJUSTING BOLT TO FAIL AS A COLUMN WHEN IT IS ADJUSTED TO CONTACT A SMALL DIAMETER STORE OR FOR THE RACK FRAME TO FAIL IN SHEAR WHEN THE BOLT IS RETRACTED TO ACCOMMODATE A LARGE DIAMETER STORE. HOWEVER THE DATA ALSO HAS TO BE CORRECTED TO COMPENSATE FOR THE ANGLE AT WHICH THE FORCE VECTOR ACTS ON THE BRACE PAD. THIS ANGLE CHANGES THE MAGNITUDE OF THE REACTION AT THE ADJUSTING BOLT.



CONCLUSIONS FROM DOUGLAS STRENGTH ENVELOPE YAWING MOMENT DISTRIBUTION

THE LIMITING YAWING MOMENT DERIVED FOR THE LARGE DIAMETER WAS BASED ON A 14" SUSPENSION USING THE SMALLER LUG SPECIFIED IN MIL-A-8591D. CONSIDERING THE LARGE DIAMETER STORE WITH A 30" LUG RESULTS IN THE FOLLOWING LIMITATION.

T63 STORE 30.5 DIA 30" SUSPENSION

$$AX = 1.155 - 625 = .530 \quad P23 (REF)$$

$$AY = \sqrt{R^2 - (X_2 - AX)^2} - Y_2 \quad P22 (REF)$$

$$AY = \sqrt{15.25^2 - (4.64 - .530)^2} - 14.527 \quad P23 (REF)$$

$$AY = \sqrt{232.5 - 16.89} - 14.527 = \sqrt{215.61} - 14.527$$

$$AY = 14.683 - 14.527 = .1566$$

$$AB = \frac{.1566}{.66913} = .234$$

REFERRING TO THE NADC FIX DATA (TABLE II) FOR COMPARATIVE PURPOSES. (P120-REF)

$$\frac{.234 - .217}{.258 - .217} (9168 - 8022) = \frac{.017}{.041} \times 1146 = 475 \quad R_{45} = 8022 + 475 = 8497$$

$$\bar{R}_{1743} = \frac{8497 \times 6.312 \times 74214}{16.375 \times 30431} = 7998 \quad P25a (REF)$$

$$\text{LIMITING YAWING MOMENT} = 20 \times 7998 \times \sin 3 = 159,760 \times .30431 = 48,616 \text{ IN}^2$$

CONCLUSIONS

30" SUSPENSION

LARGE DIAMETER STORE (T63)

LIMITING BRACE YAWING MOMENT = 48,616 IN² (ULT)

YAWING MOMENT RESTRICTED BY HOOK SIDE LOAD = 51,384 (ULT)

HOOK DOWN LOAD = 14000 # (ULT) PER SINGLE HOOK WHEN YAWING MOMENT > 48,616
= 28000 # (ULT) PER HOOK STATION

DECREASE IN SIDE LOAD SHOULD ALLOW APPROX 100% INCREASE IN DOWN LOAD (NOT CALCULATED)

$$\text{BRACE LOAD } (\bar{R}_{MAX}) = \frac{12,500 \times 6.312 \times 74214}{16.375 \times 30431} = 15,532 \quad P121 & P25a (REF)$$

CONCLUSIONS FROM DOUGLAS STRENGTH ENVELOPE

CONCLUSIONS

30" SUSPENSION

SMALL DIAMETER STORE

LIMITING BRACE YAWING MOMENT = BRACES RESIST ALL YAWING
MOMENT TO FAILURE WITHOUT
HOOK CONTACT

HOOK DOWN LOAD = 18,500[#] PER SINGLE HOOK P11 (REF)
37,000[#] PER HOOK STATION

BRACE LOAD ($\bar{R}_{MAX}$) = $\frac{9000 \times 6.562 \times 74314}{8.81 \times 56521} = 8813^{\#}$ (P11 & 25 & 35)

14" SUSPENSION

LARGE DIA STORE

LIMITING BRACE YAWING MOMENT = 24,947[#] (ULT)

YAWING MOMENT RESISTIBLE BY HOOKS - NOT ANALYZED

HOOK DOWN LOAD - NOT ANALYZED

BRACE LOAD ($\bar{R}_{MAX}$) = 15,532[#] (ULT)

SMALL DIA STORE

NOT ANALYZED

RMU-8 TOW REEL

THE PURPOSE OF THIS ANALYSIS IS TO DEFINE THE STRENGTH LIMITS OF THE REPAIR EJECTOR BOMB RACK WHEN SUPPORTING AN RMU-8 TOW REEL. THE PRECEDING ANALYSIS HAS BEEN CONFINED TO THE T63 AND T65 STORES AS A MEANS OF EVALUATING THE DOUGLAS STRENGTH ENVELOPE AND DEVELOPING A METHOD FOR ANALYZING RACK STRENGTH AS A FUNCTION OF STORE DIAMETER. THE FOLLOWING ANALYSIS APPLIES THAT METHOD TO THE RMU-8 TOW REEL.

RMU-8 TOW REEL CHARACTERISTICS

12.3" RADIUS $\beta = 21.5^\circ$ $\sin \beta = .36650$ $\cos \beta = .93042$
 $C = 1.6$ NO ECCENTRICITY
 $L = 1.2$
 FWD LUG 65.8" FROM NOSE OF TOW REEL (STA 0)
 AFT LUG 95.8 " " " " "
 $CG(EMPTY) = 86.6" = 58.8$ " " " " "
 $CG(WARDED) = 156.9" = 65.3$ FROM NOSE OF TOW REEL (STA 0)

LOADING HICKEL DISTRIBUTION

30" SUSPENSION

$$X_2 = 1.155 - 625 = .530 \quad P 23 (REF)$$

$$X_2 = R \sin \beta = 12.3 \times .36650 = 4.508$$

$$Y_2 = R \cos \beta = 12.3 \times .93042 = 11.444$$

$$\Delta Y = \sqrt{R^2 - (X_2 - AX)^2} - Y_2 \quad P 22 (REF)$$

$$\Delta Y = \sqrt{(12.3)^2 - (4.508 - .530)^2} - 11.444$$

$$\Delta Y = \sqrt{151.29 - 15.82} - 11.444 = \sqrt{135.47} - 11.444 = 11.64 - 11.44 = .20$$

$$\Delta B = \frac{.200}{.538} = \frac{.200}{.66913} = .298$$

REFERRING TO THE NATC FIX DATA (TABLE III) FOR COMPARATIVE PURPOSES: P-120 (REF)

$$\frac{.298 - .258}{.356 - .258} (10,314 - 9165) = \frac{.040}{.098} \times 1146 = 467$$

$$\bar{R}_{PER \text{ FORCE}} = 9165 + 467 = 9635$$

$$\bar{R}_{PER \text{ INERTIA}} = \frac{9635 \times 6.312 \times 74214}{13.9 \times 36650} = 8870 \quad P. 254 (REF)$$

RMU-S TOW PEEL

$$\text{LIMITING YAWING MOMENT} = 8870 \times 20 \times 36650 = 65017$$

$$\text{YAWING MOMENT REACTED BY HOOK SIDE LOAD} = 100,000 - 65017 = 34983$$

$$\text{SIDE LOAD PER HOOK STATION} = 34983 / 30 = 1166$$

$$\text{SIDE LOAD PER SINGLE HOOK} = 1166 / 2 = 583$$

HOOK STRENGTH - CRITICAL SECTION @ 17 & 18 (REF)

INCREASE DOWN LOAD TO 15,000" SIDE LOAD = 583

$$f_{bm} = \frac{3175 \times 15000 \times 2185}{00435 \times 1.5} + \frac{3175 \times 583 \times 3125}{0089 \times 1.5}$$

$$f_{bm} = 159,387 + 4333 = 163,720$$

$$f_{sm} = \frac{15000 + 583}{2.73} = 57,080$$

$$f_{smax} = 10^3 \sqrt{(58)^2 + (52.0)^2} = 10^3 \sqrt{3364 + 6724} = 10^3 \sqrt{11088} = 100,500$$

$$f_{wmax} = \frac{163,720}{2} + 100,500 = 182,360 \text{ psi}$$

$$MS = \frac{182}{182} - 1 = -0.11$$

USE DOWN LOAD = 14,500" OR 29,000" PER HOOK STATION.

IF THE APPLIED YAWING MOMENT IS LESS THAN THE
SPACE CAPACITY THEN THE HOOKS WILL NOT BE

SUBJECTED TO SIDE LOAD AND DOWN LOAD CAN BE
INCREASED TO THE VALUE SPECIFIED ON PAGE 11

DOWN LOAD PER SINGLE HOOK = 18,500" (ULT)

DOWN LOAD PER HOOK STATION = 37,000" (ULT)

DRAG LOAD IN ALL CASES IS ASSUMED TO BE REACTED
BY BEARING OF THE LUG SURFACE AGAINST THE
BOMB RACK FRAME AND IS NOT CONSIDERED CRITICAL
ON THE RACK WITHIN THE LIMITS OF MIL-R-8591.

RHU-8 TOW REELBRACE LIMITING STRENGTH

$$\bar{R}_2 = \frac{\bar{R}_1 n_1 \sin \beta_1}{n_2 \sin \beta_2} \quad P 25a \text{ (REF)}$$

$$\bar{R}_2 = \frac{16,500 \times 6.312 \times .74314}{13.9 \times .36650} = 15,192$$

CONCLUSION RHU-8 STORE (TA RACK STRENGTH LIMITS)

- 1- LIMITING BRACE YAWING MOMENT = 65,017 IN-# (P29-REF)
ABOVE THIS VALUE THE HOOKS REACT YAWING MOMENT AS SIDE LOAD
- 2- HOOK DOWN LOAD
 - (a) YAWING MOMENT > 65,017 IN-# < 100,000 IN-#
HOOK DOWN LOAD PER STATION = 29,000 (ULT) (P29-REF)
 - (b) YAWING MOMENT ≤ 65,017 IN-#
HOOK DOWN LOAD PER STATION = 37,000# (P29-REF)
- 3- BRACE LOAD ($\bar{R}$) = 15,192 (ULT) (P-30-REF)
- 4- DRAG NOT CRITICAL (P29-REF)

RECOMMENDATIONS - IT IS RECOMMENDED THAT THE FOLLOWING INSPECTION OF THE REEL TA RACK BE MADE BEFORE AND AFTER EACH FLIGHT

- 1- TIGHTEN THE SURRY BRACE ADJUSTING BOLTS IN ACCORDANCE WITH THE PROCEDURE SET FORTH IN THE MK108 MANUAL
- 2- INSPECT THE SURRY BRACE ADJUSTING BOLTS FOR BRINELLING AT THE POINT WHERE IT CONTACTS THE BRACE
- 3- CHECK TO SEE THAT THE SURRY BRACE ADJUSTING BOLT CAN BE ROTATED IN ITS MATING THREAD
- 4- CHECK FOR BULGES OR CRACKS AT THE CUTBORD AND UPPER PORTIONS OF THE FRAME IN THE AREAS OF THE ADJUSTING BOLT INSTALLATIONS
- 5- IF THE ADJUSTING BOLT IS LOOSE OR THE FRAME BULGED OR CRACKED, THE RACK SHOULD BE REPLACED.

RETIREES

7 MAY 1974

MR JESS LOCKHART MC CONNELL DOUGLAS AIRCRAFT CO
LONG BEACH CAL PHONE 1-213-593-4759

CALLED MR LOCKHART TO INQUIRE ABOUT THE AERO
7A EJECTOR BOMB RACK STRENGTH ENVELOPE. HE
GAVE ME INFORMATION FROM A PUBLICATION ENTITLED
"STANDARD AIRCRAFT ARMAMENT CHARACTERISTICS (BOMB
RACK - 4 HOOK - AERO 7A - 3600 LB) DATED NOV 1960:
THIS DATA EXACTLY CONCURRED WITH THE CURVES
PUBLISHED IN AN IDENTICAL PUBLICATION AVAILABLE
AT NADC BUT DATED 1 JULY 1955.

REFERENCES

- A4/TR-4 TACTICAL MANUAL (CONF) NAVAIR-01-40AV-17
- NA404 FLIGHT MANUAL (A4M) NAVAIR-01-40AVUM-1
- AIRBORNE WEAPONS/STORES LOADING MANUAL NAVAIR CI-40AV-75
- AIRCRAFT, BOMBS, FUSES AND ASSOCIATED COMPONENTS NAVWEPS OP2216
- DOUGLAS AIRCRAFT CO STANDARD AIRCRAFT ARMAMENT CHARACTERISTICS
BOMB EJECTOR RACK - 4 HOOK - AERO 7A - 3600 LB
- NADC REPORT NADC-44-6739 OF 20 NOV 1967 - "UPGRADING
OF THE AERO 7A EJECTOR BOMB RACK FOR THE A6A
AIRCRAFT"
- NADC REPORT NADC 72136-VI OF 31 DEC, 1972 - "DETERMINATION
OF THE LUG AND SWAY BEYOND RECTIONS FOR THE MKU-9/A
BOMB RACK"
- MIL-A-8591 - "AIRBORNE STORES AND ASSOCIATED
EQUIPMENT; GENERAL DESIGN CRITERIA FOR"
- MIL-R-22622 (NEP) "RACK, BOMB EJECTOR AIRCRAFT;
AERO 7A SERIES"
- MIL-T-7743 "TESTING, STORE SUSPENSION EQUIPMENT,
GENERAL SPEC FOR"
- DEXTON T. BROWN INC CHURCH STREET, BOMEMIK N.Y.
TEST REPORT DTB 02R73-1517 - "MODIFIED AERO 7A-1
BOMB EJECTOR RACK INVESTIGATION"
- NARF (NORFOLK VA) REPORT SERIAL NO 99-72 of 7 APRIL 72

RELATED ZERO 7A PACK IN-SERVICE FAILURES

A NUMBER OF UNSATISFACTORY REPORTS HAVE BEEN FILED CONCERNING FAILURES OF THE ZERO 7A PACK IN SERVICE. THE FOLLOWING DESCRIPTION OF A TYPICAL UR WAS TAKEN FROM NARF (NORFOLK VA) REPORT SERIAL NO 99-72 OF 7 APRIL 72.

"DURING AN ABRUPT FULL DEFLECTION RIGHT AILERON ROLL OF THE F8 AIRCRAFT AT 390 KIAS AND 15,000 FT MSL, BOTH THE PORT AND STARBOARD MERS WITH 4 INERT MK20 (ROCKEYE II) STORES ON EACH MER SEPARATED FROM THE WING PYLONS (ZERO 7A PACKS) WITH THE STARBOARD MER AND ORDNANCE STRIKING THE AIRCRAFT. THERE WAS NO INDICATION OF IMPENDING FAILURE DURING THE PREVIOUS ROLLS UTILIZING LESS THAN FULL DEFLECTION INPUTS."

"THE DAMAGE TO THE SWAY BRACE ADJUSTING SCREW P/N 66452850 OR 2444722, AND THE SWAY BRACE ADJUSTING SCREW BOLT (FRAME) IS VERY SIMILAR TO DAMAGE IN PREVIOUS INCIDENTS WHICH WERE INVESTIGATED AT THIS FACILITY. FINDINGS OF PREVIOUS INVESTIGATIONS HAVE BEEN THAT THE ZERO 7A WAS SUPPORTING AN ASYMMETRICALLY LOADED MER OR TER (THAT IS THE MER OR TER WAS LOADED HEAVIER ON ONE SIDE THAN ON THE OTHER) WHICH CAUSED A GRAVITATIONAL TORQUE TO BE TRANSFERRED FROM THE MER OR TER TO THE ZERO 7A, THROUGH THE HOOKS AND BRACES. CONCLUSIONS WERE THAT THIS TORQUE WHEN MAGNIFIED BY THE AIRCRAFT PULLING SEVERAL G'S WAS GREAT ENOUGH TO CAUSE COMPRESSIVE YIELD OF THE PACK HOUSING IN THE SWAY BRACE SCREW AREA, OR IN THE SWAY BRACE SCREW ITSELF."

THE CONCLUSIONS OF THE NARF REPORT WERE THAT THE FAILURE WAS INITIATED BECAUSE THE KAC520 SPACERS RECOMMENDED IN NADC REPORT NADC-RM-6739 WERE NOT INSTALLED REQUIRING EXTENSION OF THE SWAY BRACE ADJUSTING SCREWS TO CONTACT THE MER AS A SMALL INCHETER STORE. AS INDICATED IN THIS ANALYSIS THIS CONDITION SIGNIFICANTLY DEPLETES PACK STRENGTH. THE ASYMMETRIC LOADING (SIDE LOAD, ROLLING MOMENT, OFFSET DOWN LOAD) TO WHICH THE SPACERS ARE MOST SENSITIVE COMPOUNDED THE SITUATION UNDER ABRUPT AIRCRAFT MANEUVERS.

COMPARATIVE STORES

THE FOLLOWING STORES WITH THE ASSOCIATED AIRCRAFT PERFORMANCE LIMITATIONS SPECIFIED IN THE R4 TACTICAL MANUAL (NAVAIR-01-400V-1T OF 1 AUG 1970) (CONFIDENTIAL) ARE LISTED HERE FOR COMPARISON WITH THE RHU-8 TOW REEL DIAMETER AND WEIGHT AS A FURTHER MEANS OF ASSESSING AIRCRAFT CAPABILITY.

THE AIRCRAFT LIMITATIONS, WHICH ARE CLASSIFIED AS CONFIDENTIAL, ARE NOT SPECIFIED SO THAT THIS REPORT CAN REMAIN UNCLASSIFIED

STORE	WEIGHT LBS	DIAMETER INCHES	RACK	AIRCRAFT STATION	TACTICAL MANUAL LIMITATION(REF)
RHU-8 TOW REEL	1569 (LOADED)	24.6 (EQUIVALENT)	7A	CENTER LINE	—
MK 84	2020	18	7A	" "	PAGE 1-98
MK 40	1057	22.8	7A	" "	" 1-106
MK 4 GUN POD	1400	22.5	7A	" "	" 1-118
TER WITH 3 M117 DEMOLITION	2469		7A	CENTER LINE	PAGE 1-100

CHECKING NADC-SH-672.9 DATA

THE β ANGLES MEASURED ON THE MER DURING THE TESTS CONDUCTED ON THE UNMODIFIED RACK AND THOSE CONDUCTED ON THE NATC FIX SHOULD HAVE VARIED SLIGHTLY. HOWEVER DUE TO THE DIFFICULTY IN PHYSICALLY MEASURING THIS ANGLE ON THE MER, THE DIFFERENCE IN β , AFTER INSERTING A 1.375 INCH SPACER FOR THE NATC FIX SET-UP, WAS NOT DETECTABLE. CONSEQUENTLY, THE β ANGLE IN BOTH CASES WAS RECORDED AS 45° . THE FOLLOWING ANALYSIS IS INTENDED TO CHECK THIS RESULT AND TO MEASURE ITS INFLUENCE ON THE CALCULATED RACK STRENGTH:

$$a^2 = b^2 + c^2 - 2bc \cos \beta$$

$$4.985^2 = b^2 + 6.562^2 - 2 \times 6.562 \times b \times 0.66913$$

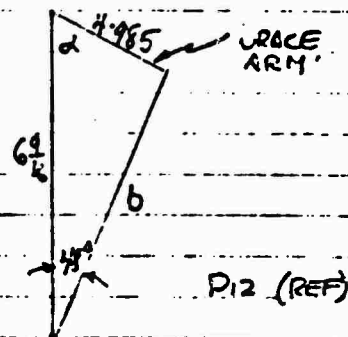
$$24.850 = b^2 + 43.05 - 8.785b$$

$$b^2 - 8.785b + 18.2 = 0$$

$$b = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$b = \frac{8.785 \pm \sqrt{77.09 - 72.8}}{2} = \frac{8.785 \pm 2.24}{2}$$

$$b = \frac{8.785 - 2.07}{2} = 5.425 \text{ or } 3.358$$



UNMODIFIED RACK

MER BRACE GEOMETRY

$$\sin \alpha = \frac{b \sin \beta}{c} = \frac{5.425 \times 0.74314}{6.562} = 0.6193 \quad \alpha = 53^\circ 59'$$

ADDING A 1.375" SPACER TO THE b DIMENSION

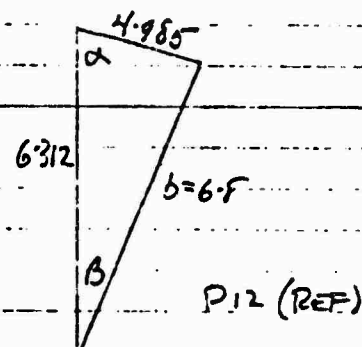
$$b_1 = 5.425 + 1.375 = 6.8$$

$$4.985^2 = 6.8^2 + 6.312^2 - 2 \times 6.8 \times 6.312 \cos \beta$$

$$24.850 = 46.24 + 39.841 - 85.843 \cos \beta$$

$$-6.231 = -85.843 \cos \beta$$

$$\cos \beta = 0.71329 \quad \beta = 44^\circ 30'$$



NATC FIX

MER BRACE GEOMETRY

$$\sin \alpha = \frac{6.8 \times 0.70091}{6.312} = 0.75611 \quad \alpha = 72^\circ 58'$$

CHECKING NADC-RH-6739 DATA

INFLUENCE OF β CHANGE ON RACK STRENGTH:

$$\Delta\beta = \frac{200}{\cos\beta} = \frac{200}{.71329} = .281 \quad P28(REF)$$

REFERRING TO THE NATF FIX DATA (TABLE III) FOR COMPARATIVE PURPOSES. P-12Q(REF)

$$\frac{.281 - .258}{.356 - .258} (10,314 - 9168) = \frac{.023}{.098} \times 1146 = 269$$

$$R_{44034} = \text{PER BRACE} = 9168 + 269 = 9436^*$$

$$R_{21.5^\circ} = \frac{R_{44034} \sin\beta_1}{n_2 \sin\beta_2} = \frac{9436 \times 6.312 \times .703291}{13.9 \times .36650} = 8195^* \quad P252(REF)$$

$$\text{LIMITING YRNING MOMENT} = 8195 \times 20 \times .36650 = 60070$$

BRACE LIMITING STRENGTH

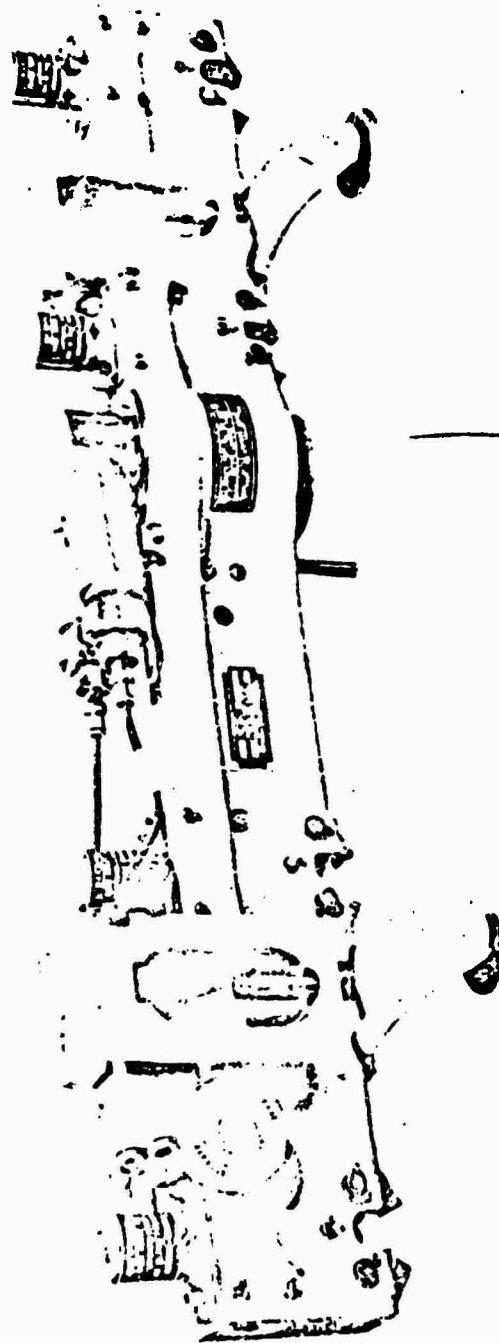
$$R_L = \frac{16,500 \times 6.312 \times .70091}{13.9 \times .36650} = 14,330$$

PERCENTAGE CHANGE

$$\text{LIMITING YRNING MOMENT} = \frac{65017 - 60070}{65017} = -7.6\% \quad P29(REF)$$

$$\text{LIMITING BRACE STRENGTH} = \frac{15,192 - 14332}{15,192} = 5.6\% \quad P30(REF)$$

SINCE THESE CHANGES ARE WITHIN THE EXPECTED ACCURACY OF THE TEST DATA, NO CHANGES WILL BE MADE TO THE CONCLUSIONS GIVEN ON P 30



56170020

STANDARD AIRCRAFT ARMAMENT CHARACTERISTICS BOMB EJECTOR RACK - 4-HOOK - AERO 7A - 3600 LB.

DOUGLAS AIRCRAFT COMPANY, INC., EL SEGUNDO DIVISION

1 JULY 1955

APPROX. EJECTOR RACK

DESCRIPTION	ACCOMMODATIONS															
The Douglas Aero 7A 4-hook ejector rack combines in a single lightweight unit, a 14-inch 2-hook rack, a 30-inch 2-hook rack and an ejector. Low-drag sway braces are incorporated in the rack. The ejector (telescoping piston type) is mounted 3½ inches off center aft for maximum tail-down moment. One Mk. 1 Mod. 2 cartridge and one Mk. 2 Mod. 0 cartridge, each with a separate firing circuit, are normally used, although two Mk. 2 Mod. 0 cartridges may be used for reduced force. The Mk. 2 Mod. 0 circuit is used for emergency jettison. Both cartridges are ignited by either circuit. A manual release is provided for ground operation or as required by specifications. The individually self-latching hooks simplify the loading of stores. A removable adapter is available for double-hoisting of stores. The four-bolt attachment makes the rack easily removable and interchangeable with either the Aero 61B 3-hook rack or the Aero 8A 3-hook ejector rack. The Aero 7A rack has completed a 250-shot life test and has passed static tests to the design loads. Functional and environmental tests are underway at the contractor's plant. Complete evaluation tests are being conducted at NADC Johnsville. This rack is also available in a 2-hook, 30-inch configuration (14-inch hooks and sway braces eliminated) for aircraft incorporating integral sway braces.	G. P. Bombs 100# thru 2000# Mark 80 Series Bombs - (streamlined) 250# thru 2000# Practice Stores T63 T64 T65 T66 Rocket Launchers All launchers that can be carried on standard Navy 14- and 30-inch suspension systems with lugs in accordance with MIL-A-8591A (AER). Torpedoes Mk. 13, Mk. 34, Mk. 41 Mines Mk. 25, Mk. 10 - 9, Mk. 36, 1A-4A, XO-3A, Mk. 50 Special Equipment 150 Gal. Fuel Tank 300 Gal. Fuel Tank Spray Tanks Practice Bomb Containers Fragmentation Bombs Incendiary Bombs Depth Bombs Chemical Bombs															
DEVELOPMENT	WEIGHTS															
Designed and developed for the A4D-1 airplane under Contracts NOa(s) 52-1011C, NOa(s) 53-381, NOa(s) 53-382, and NOa(s) 54-316. 25 experimental 4-hook ejectors have been built and distributed to different manufacturers. The rack is now in production for several different operational Naval and Air Force models with total quantities exceeding 2000.	Weights for a typical installation are as follows: <table><thead><tr><th></th><th>4-HOOK</th><th>2-HOOK</th></tr></thead><tbody><tr><td>BASIC RACK</td><td>49.0</td><td>37.0</td></tr><tr><td>PAIRING</td><td>12.5</td><td>12.5</td></tr><tr><td>ATTACHMENT PARTS</td><td>1.3</td><td>1.3</td></tr><tr><td>TOTAL INSTALLED WEIGHT</td><td>62.8 lbs.</td><td>50.8 lbs.</td></tr></tbody></table>		4-HOOK	2-HOOK	BASIC RACK	49.0	37.0	PAIRING	12.5	12.5	ATTACHMENT PARTS	1.3	1.3	TOTAL INSTALLED WEIGHT	62.8 lbs.	50.8 lbs.
	4-HOOK	2-HOOK														
BASIC RACK	49.0	37.0														
PAIRING	12.5	12.5														
ATTACHMENT PARTS	1.3	1.3														
TOTAL INSTALLED WEIGHT	62.8 lbs.	50.8 lbs.														

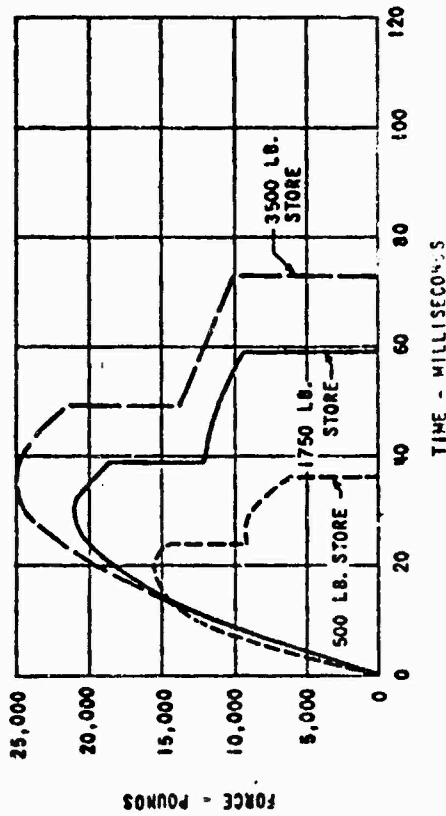
1 JULY 1955

AERO 7A EJECTOR RACK

EJECTOR CHARACTERISTICS

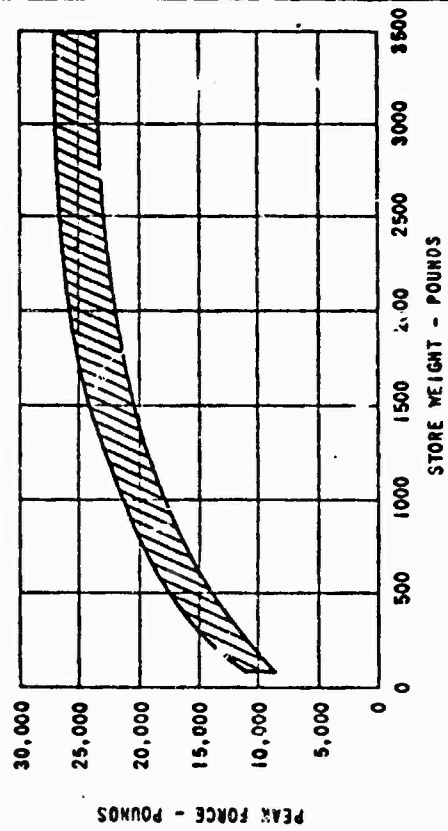
FORCE VS. TIME

ONE MK.2 MOD.0 AND ONE MK.1 MOD.2 CARTRIDGE



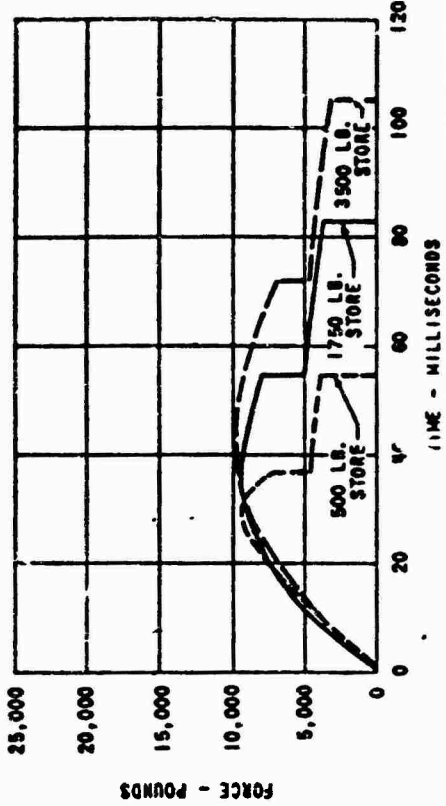
PEAK FORCE VS. STORE WEIGHT

ONE MK.2 MOD.0 AND ONE MK.1 MOD.2 CARTRIDGE



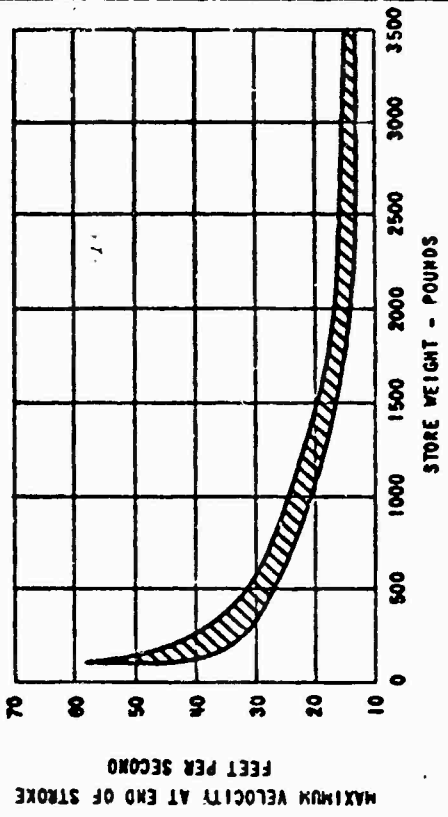
FORCE VS. TIME

TWO MK.2 MOD.0 CARTRIDGES



MAXIMUM VELOCITY VS. STORE WEIGHT

ONE MK.2 MOD.0 AND ONE MK.1 MOD.2 CARTRIDGE



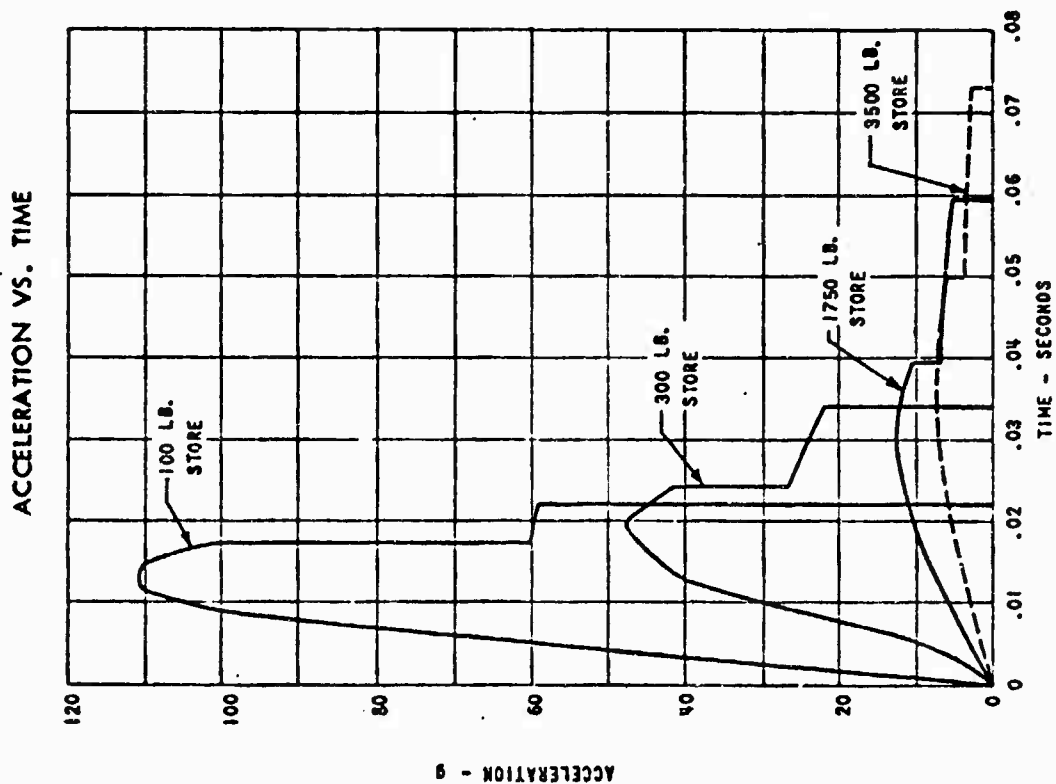
1 JULY 1955

AERO 7A EJECTOR RACK

EJECTOR CHARACTERISTICS

NADC-74150-30

CHART BASED ON ONE MK.2 MOD.0
AND ONE MK.1 MOD.2 CARTRIDGE.



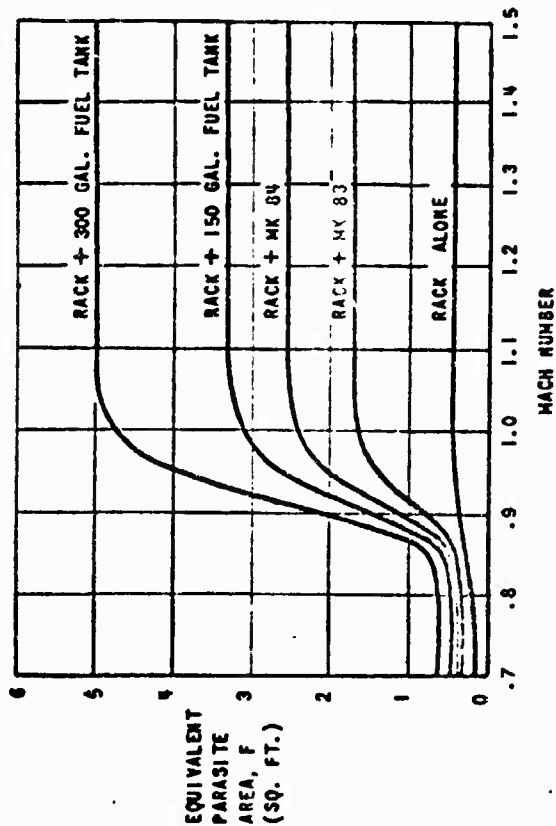
B-48

1 JULY 1955

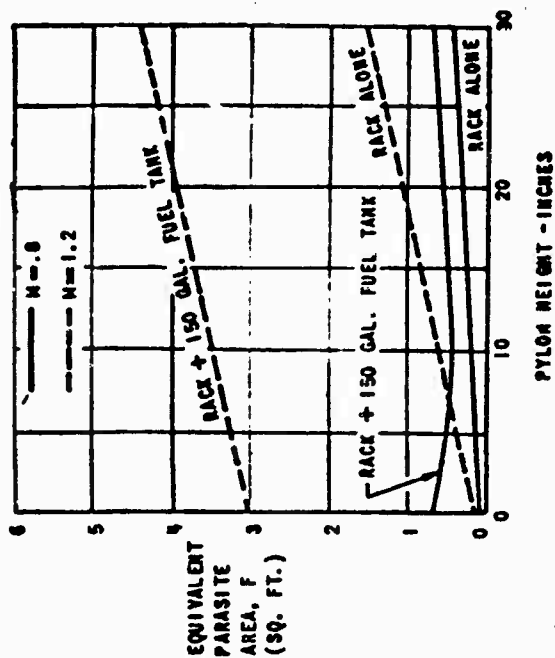
AFRO 7A F IFCTOR RACK

AERODYNAMIC CHARACTERISTICS

DRAG RISE OF TYPICAL STORE INSTALLATIONS



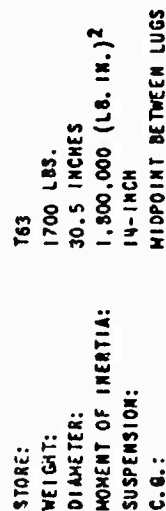
EFFECT OF PYLON HEIGHT ON DRAG OF TYPICAL STORE INSTALLATION



NOTE: DATA BASED ON RACK MOUNTED IN TYPICAL PYLON FAI 'N6.

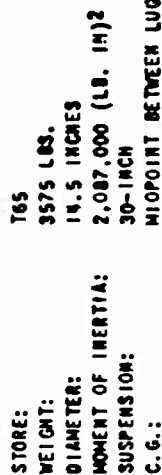
FLYING - 30" HOOPS
65,000th - 14" HOOPS

ULTIMATE STRENGTH ENVELOPES



NOTE: 100,000"YAWING MOMENT MAY BE COMBINED WITH ALL CONDITIONS

BY 10-86-25-6
OFFICIAL USE



NOTE: 100,000"YAWING MOMENT MAY BE COMBINED WITH ALL CONDITIONS

REDUCED VERTICAL
LOAD BY 20%¹⁴

A P P E N D I X C

SUSPENSION SYSTEM BOLT REACTIONS

APPENDIX C

I. INTRODUCTION

This Appendix presents results of analysis of bolt reactions at the A-4 centerline fuselage surface due to the worst case store loadings obtained from Appendix A. The program utilized for this purpose was developed as a tool for the design of a hard-mount pylon for the RMK-19/A47U-3 real-launcher by Carl Reitz. A copy of the author's comments regarding the analytical technique is provided on page C-9.

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II ANALYSIS OF BOLT/STUD REACTIONS

A DEFINITIONS & ASSUMPTIONS

1. DEFINITIONS

SEE FIGURE C-1

SIGN CONVENTION PER MIL-A-8931

D = REACTION TO DRAG LOAD

S = REACTION TO SIDE LOAD

V = REACTION TO VERTICAL LOAD

Q = TOTAL SHEAR LOAD

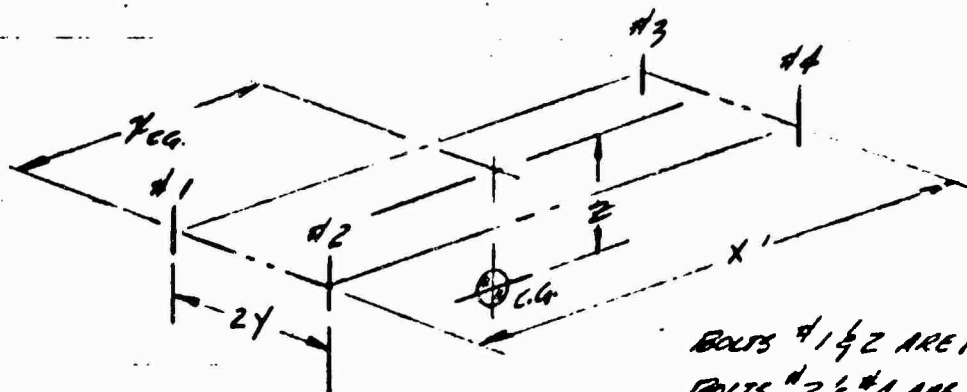
2. SYMMETRY ASSUMPTIONS

$$\textcircled{1} D_f = D_f' = D_a = D_a'$$

$$\textcircled{2} S_f = S_f' ; S_a = S_a'$$

$$\textcircled{3} V_i = (-1)^{i+1} \frac{z}{2x} P_x + (-1)^i \frac{z}{4y} P_y + \left[(-1)^i \left(\frac{1}{4} - \frac{x_{CG}}{2x} \right) - \frac{1}{4} \right] P_z \\ + (-1)^i \frac{M_x}{4y} + (-1)^i \frac{M_y}{4x}$$

$$\text{WHERE: } i=1 \Rightarrow V_f \quad 1.0 \Rightarrow V \\ i=2 \Rightarrow V_a \quad 1.1 \Rightarrow V'$$



BOLTS #1 & #2 ARE FWD
BOLTS #3 & #4 ARE PRIME

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B ANALYSIS DATA & RESULTS

1. LOADS - SEE TABLE C-1

2. REACTIONS - SEE PAGE C-10

C. MS 20012-34 BOLT STRENGTH (MIL-B-7838)

ULTIMATE TENSILE STRENGTH • 63,200

ULTIMATE DOUBLE SHEAR STRENGTH • 83,900

FATIGUE LOADING - LOW TENSION LOAD • 2920

FATIGUE LOADING - HIGH TENSION LOAD • 29200

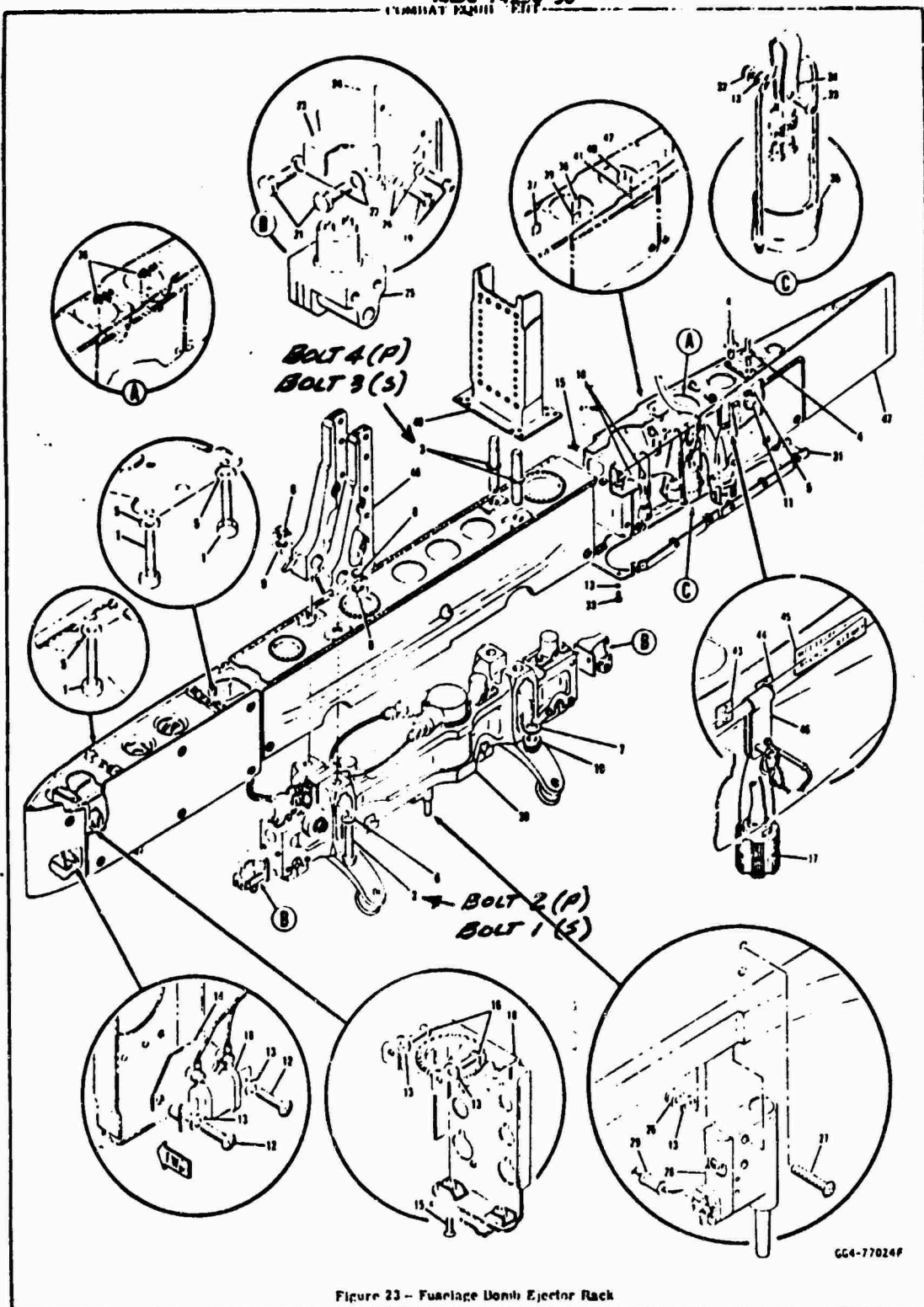


Figure 23 - Fuelage Unit Ejector Rack

FIGURE C-1

Changed 15 March 1968

TABLE C-1

SUMMARY OF WORST CASE SUSPENSION LOADS

[illegible]

13 June 1974

C. O. Rabin

VIA: 385
3830

Tow Reel Mounting Reaction; solution of

1. A FORTRAN computer program has been coded to compute the reactive forces associated with an airframe store suspended from four (4) belts. The program is intended to provide design data for the tow reel to aircraft mount being developed under NITIS (Naval Standard Tow Target System). Approximately forty (40) man-hours have been expended generating the subject program.

2. The reel to aircraft mount represents a statically indeterminate structure. Symmetry assumptions with respect to the belt reactions permitted a statically determinate solution which is sufficient for preliminary design. An indeterminate analysis of the structure may be required after the configuration of the mount is known.

3. A memorandum describing the derivation and use of the subject program will be generated as time permits.

C. O. RABIN

Copy to:

385

3830 (MC)

C. Rabin/act/6-13-74/12833

FOUR BOLT REACTIONS FOR SUSPENDED L303S
(STATISTICALLY DETERMINANT SUBJECT TO SYMMETRY ASSUMPTIONS)

LOAD CASE	P(X) LB	P(Y) LB	P(Z) LB	1(C) IN/L	M(Y) IN/LB	M(Z) IN/LB
1	2756.0	-1616.0	-1404.0	0.0	-31850.0	-31950.0
2	-12552.0	-740.0	3130.0	0.0	18477.0	-9192.0
3	6488.0	-1495.0	-4700.0	209.0	-27218.0	-23240.0
4	7775.0	-216.0	-1042.0	-2563.0	-87505.0	-54150.0

BOLTS LOCATED AT STORE STATIONS 70.500 AND 90.500

BOLTS ARE 1.508 INCHES FROM FORE-AFT CENTER LINE
CG OF STORE IS 21.990 INCHES BELOW BOLT PLANE

CENTER OF GRAVITY OF STORE IS AT STATION 55.300, XCG = -5.500

BOLT 1 ... FWD, RIGHT
BOLT 3 ... AFT, RIGHT

BOLT 2 ... FWD, LEFT
BOLT 4 ... AFT, LEFT

LOAD CASE	BOLT	1 - LB	2 - LB	3 - LB	4 - LB	1 - LB	2 - LB
1	1	-830.	1020.	1020.	2130.	1955.	1955.
1	2	-830.	1020.	1020.	17155.	1955.	1955.
1	3	-830.	-1020.	-1020.	-10135.	1232.	1232.
1	4	-830.	-1020.	-1020.	1332.	1632.	1632.
2	1	3130.	730.	730.	-12205.	3222.	3222.
2	2	3130.	730.	730.	-5433.	3222.	3222.
2	3	3130.	-330.	-330.	4900.	3150.	3150.
2	4	3130.	-330.	-330.	10631.	3150.	3150.

CENTER OF GRAVITY OF STORE IS AT STATION 54.500, XCG = -6.200

BOLT 1 ... FWD, RIGHT
BOLT 3 ... AFT, RIGHT

BOLT 2 ... FWD, LEFT
BOLT 4 ... AFT, LEFT

LOAD CASE	BOLT	1 - LB	2 - LB	3 - LB	4 - LB	1 - LB	2 - LB
3	1	-1622.	1550.	1550.	1370.	2240.	2240.
3	2	-1622.	1550.	1550.	12709.	2246.	2246.
3	3	-1622.	-811.	-811.	-10359.	1013.	1013.
3	4	-1622.	-811.	-811.	412.	1013.	1013.

CENTER OF GRAVITY OF STORE IS AT STATION 52.700, XCG = -8.100

BOLT 1 ... FWD, RIGHT
BOLT 3 ... AFT, RIGHT

BOLT 2 ... FWD, LEFT
BOLT 4 ... AFT, LEFT

LOAD CASE	BOLT	1 - LB	2 - LB	3 - LB	4 - LB	1 - LB	2 - LB
4	1	-1944.	1500.	1500.	5482.	2459.	2459.
4	2	-1944.	1500.	1500.	8810.	2459.	2459.
4	3	-1944.	-1597.	-1597.	-7333.	2394.	2394.
4	4	-1944.	-1597.	-1597.	-5501.	2394.	2394.

A P P E N D I X D

TOW TARGET SYSTEM FLIGHT TEST

INSTALLATION CHECK & TEST REQUIREMENTS

OPERATING LIMITATIONS

FLIGHT LIMITATIONS

AIRSPEED & ALTITUDE RESTRICTIONS

A P P E N D I X D

This Appendix provides aeromechanical data required to operate the tow target system on the A-4 airplane. The data provided herein is proposed for flight test purposes.

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TOW TARGET SYSTEM FLIGHT TEST

TEST No.		VC-2
FLIGHT TEST DATE	TIME	
TEST A/C TYPE	NO	154327
CHASE A/C TYPE	NO	
TEST A/C PILOT		
RIO		
CHASE A/C PILOT		
BASE COMMUNICATIONS		
FIELD COMMUNICATIONS		
RADIO FREQUENCIES		
T.O. TIME	LAND TIME	
NOTES		

INSTALLATION CHECK & TEST REQUIREMENTS

TEST No.		VC-2
MAX. IN ANGLE, DEGREES	45	0-2
MIN IN ANGLE, DEGREES	5	0-2
MAX OUT ANGLE, DEGREES	45	0-2
MIN OUT ANGLE, DEGREES	0	1-1
TARGET PRELOAD, POUNDS		
AIR PRESSURE, PSI	2000	MINIMUM
TOW TARGET SYSTEM CONFIGURATION		
TARGET, IN POUNDS	FIGAT	
TOWLINE, IN POUNDS	0.182 3X7 AIRLINE 11/64 AIRLINE	
REELING, IN POUNDS	022 K-MU-5/A 30IN-DIA PWR UNIT SEMI-AUTO CONTROL	
CABLE, IN POUNDS	DVS-CR4 PER-S4 MODIFIED FOR SEMI-AUTO CONTROL	

NOTE-Tension Meter on 1'EX-S4 READS ONE HALF ACTUAL TENSION

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OPERATING LIMITATIONS

TEST NO. VC-2

MAX. TOWLINE LENGTH, FT. SEE NOTE 1.

MAX. TENSION/ POUNDS NOTE 2.

REELING RATE FT./MIN. MAX. 2000

BEGUN FINAL RECOVERY, FT. 500

CAUTION

BOTH IN ANGLE AND OUT ANGLE LIGHTS MUST BE OUT, WITHOUT TARGET, TARGET STOWED OR TOWING, WITH BRAKE ON TO PREVENT OVERLOAD OF POWER UNIT DRIVE SHAFT.

NOTES

1. TO BE FILLED IN PRIOR TO EACH FLIGHT
MAX TOWLINE LENGTH = LENGTH ON SPOOL MINUS 500 FEET
2. MAX. TENSION 0.182 3X7 = 4000
11/64 ARMR = 2800
3. SCHEDULE 500 AT 500 FEET
STREAMED DOWN TO 100 AT LESS THAN 200 FEET STREAMED

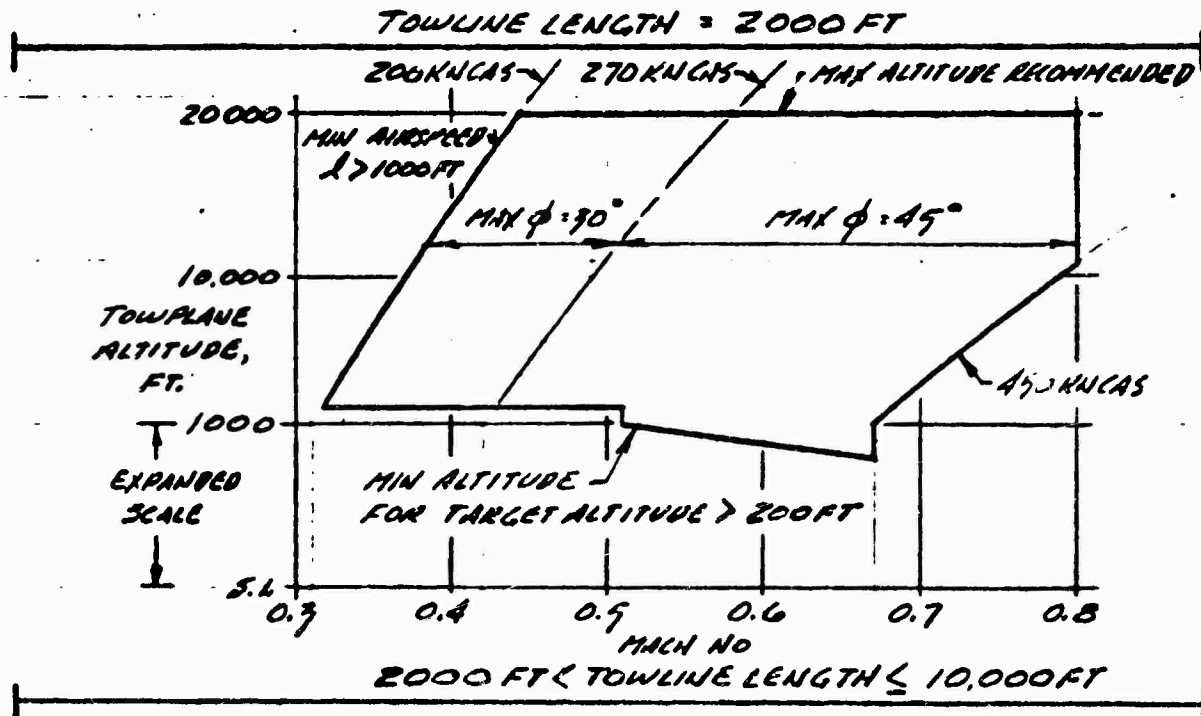
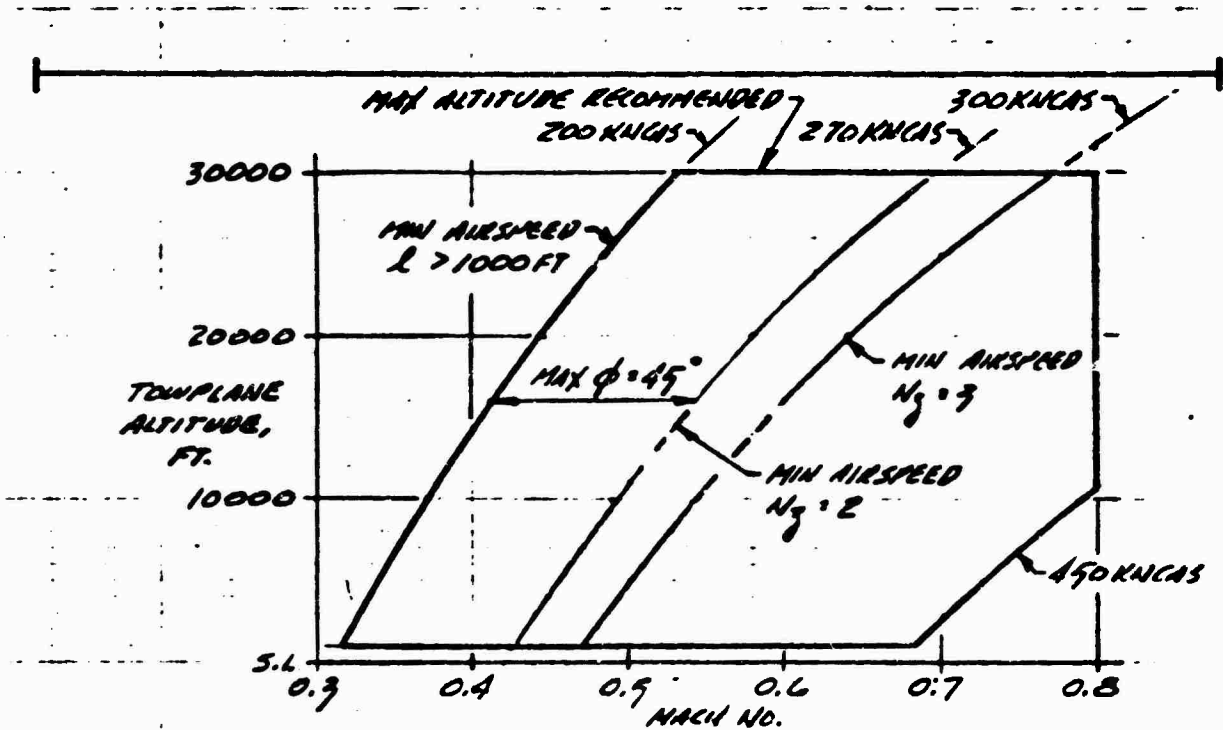
FLIGHT LIMITATIONS - TO BE REVIEWED FOR ADAPT FLIGHT TEST

TEST NO. VC-2

WITHOUT TARGET, TOWING LIMITS APPLY

STOWED	500 (Start Tow)
LAUNCH	
LOCK ON	
REEL-OUT	300
TOWING	450
REEL-IN	300
FINAL RECOVERY	500
STOWED	0.5
REELING	0.5
TOWING	0.5
LAUNCH	AS L29'D
RECOVERY	AS L29'D
STOWED	60 (Start Tow)
LAUNCH & RECOVERY	30
REELING	30
TOWING	70 (1 < N < 3) *

* SUBJECT TO MIN ARMWELD RESTRICTION AS ATTACHED. WITHOUT TARGET, 0 < N < 4
ADAPT CONTROL DEFLECTION & YAW PROVIDED



AIRSPEED & ALTITUDE RESTRICTIONS
FOR MANEUVERING FLIGHT-TOWING
PROFILE FIGHTER (FIGAT) TARGET