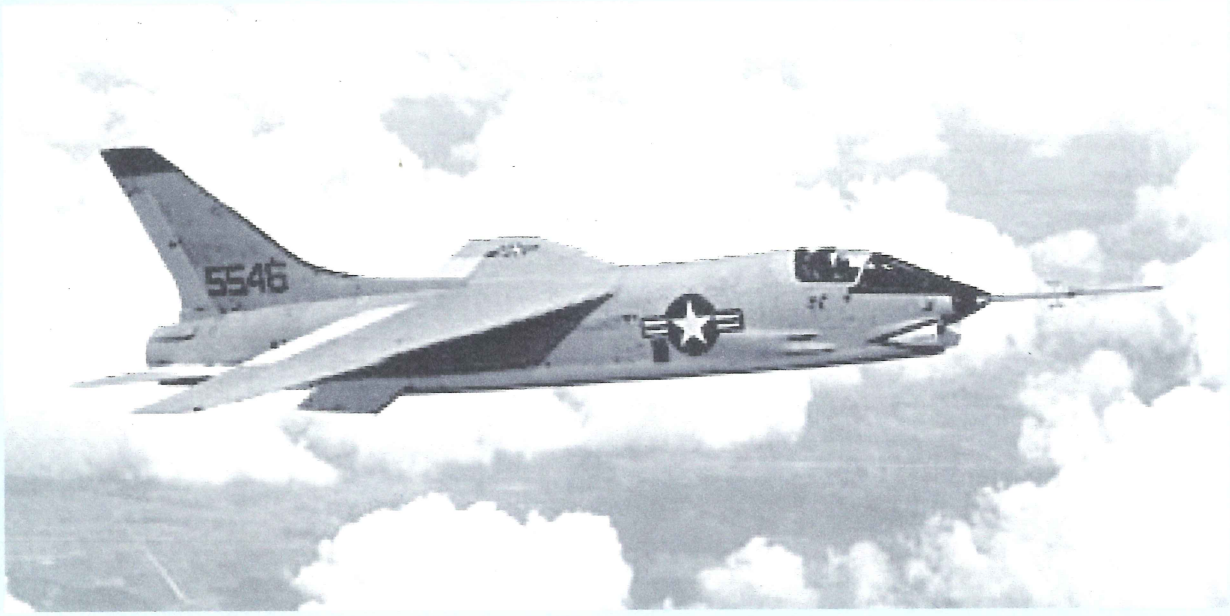
VOUGHT AERONAUTICS DIVISION



CARGO / TRANSPORT STATISTICAL WEIGHT ESTIMATION EQUATIONS

- 1968 -

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

SECTION 1

INTRODUCTION

INTRODUCTION

The purpose of this report is to present the results of a study conducted to develop a set of statistical weight estimating equations for cargo/transport aircraft. Equation forms developed for fighter/attack aircraft, Report No. 2-59320/8R-50475, were modified and used for this study. Ten data points were used in the statistical analysis and the C-5A was added as an extra point. Statistical analysis was performed using the recently developed routine for constrained regression analysis. Automatic data plotting was used to obtain graphical presentations of the equation results.

SECTION 2

WING

TABLE 2-1

WING WEIGHT EQUATIONS

Coeff. of Correl.		
99.82	(1)	$W_w = .0051 (W_{dg} N_z)^{.557} S_w^{.649} AR^{.500} (T/C)_r^{-.400} (1 + \lambda_{TR})^{.100} (\text{Cos SW})^{-1.000} S_{wcs}^{.100}$ Recommended
99.85	(2)	$W_w = .0056 (W_{dg} N_z)^{.562} S_w^{.631} AR^{.500} (T/C)_r^{-.400} (\text{Cos SW})^{-1.000} S_{wcs}^{.100}$
99.93	(3)	$W_w = .0051 (W_{dg} N_z)^{.633} S_w^{.597} AR^{.500} (T/C)_r^{-.414} (\text{Cos SW})^{-1.000}$
99.76	(4)	$W_w = .0076 (W_{dg} N_z)^{.651} S_w^{.613} AR^{.500} (\text{Cos SW})^{-1.000}$

Symbol Definition:

W_w	=	Wing Weight - lbs
W_{dg}	=	Flight Design Gross Weight - lbs
N_z	=	Ultimate Load Factor
S_w	=	Gross Wing Area - ft^2
AR	=	Wing Aspect Ratio
$(T/C)_r$	=	Wing Root Thickness Divided by Wing Root Chord
TR	=	Wing Taper Ratio
SW	=	Wing Sweep Angle at 25% Chord
S_{wcs}	=	Area of Wing Mounted Control Surfaces - ft^2

TABLE 2-2

EQUATION RESULTS-WING

AIRCRAFT	ACTUAL W_w	EQ. (1) W_w	EQ. (2) W_w	EQ. (3) W_w	EQ. (4) W_w
AC-1DH	3311	3535	3527	3444	3364
C-123B	5906	5995	5948	6201	6035
C-124C	18140	19760	19860	19400	20530
C-130B	11150	12730	12610	12760	13080
C-131B	5072	4169	4210	4266	4425
C-133A	27400	26750	26940	27110	27610
C-135A	25020	23490	23500	23800	24010
C-135B	25250	23680	23690	24020	24240
C-141A	34480	34500	34360	33290	30500
XC-142A	2633	2761	2763	2707	2665
C-5A	85750	91390	90240	83410	78350
Coefficient of Correlation		99.8	99.9	99.9	99.8

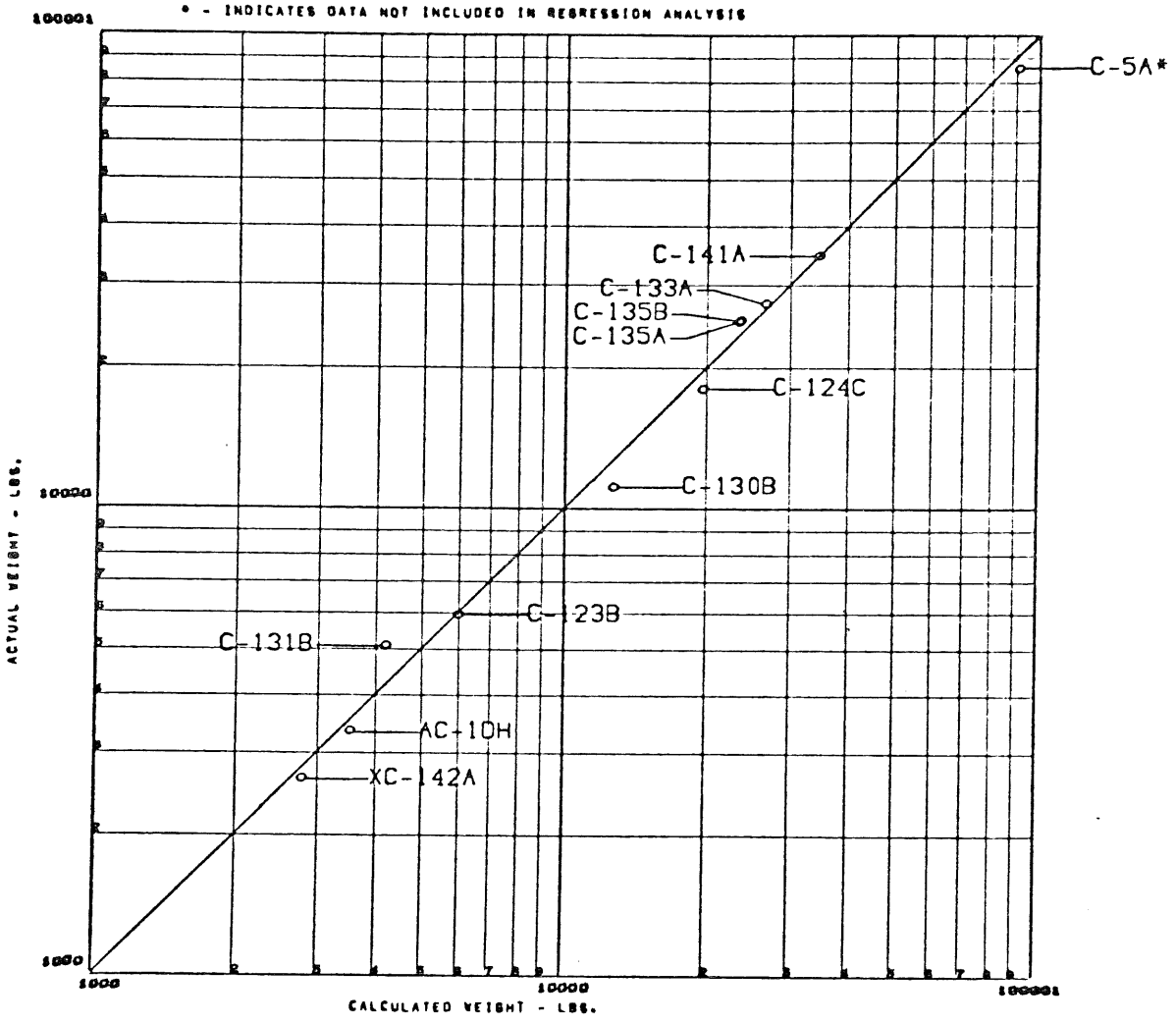
TABLE 2-3

CARGO/TRANSPORT - WING STATISTICAL DATA

AIRCRAFT	W_{dg}	N_z	S_w	AR	$(T/C)_r$	$(1+_{TR})$	SW	S_{wcs}	W_w
AC-1DH	26000	4.97	912	10.02	.175	1.48	0	285	3311
C-123B	54000	4.50	1223	9.89	.167	1.53	0	211	5906
C-124C	185000	3.75	2506	12.10	.190	1.24	0	654	18135
C-130B	135000	4.16	1745	10.08	.180	1.52	0	452	11145
C-131B	53200	3.15	920	12.06	.200	1.33	7°	231	5072
C-133A	275000	3.75	2673	12.07	.170	1.23	-.6°	640	27404
C-135A	270000	3.75	2433	7.04	.167	1.33	35°	615	25109
C-135B	274000	3.75	2433	7.04	.167	1.33	35°	615	25250
C-141A	316100	3.75	3228	8.00	.130	1.33	25°	1011	34475
C-5A	728000	3.75	6200	8.00	.130	1.34	25°	2343	85750
XC-142A	37474	4.50	534	8.53	.180	1.61	4°	397	2633

FIGURE 2-1

CARGO/TRANSPORT-WING WEIGHT



$$W_W = .0051\ (W_{DG}\ N_Z)^{.557}\ S_W^{.649}\ AR^{.500}\ (T/C)_R^{-.400}\ (1+TR)^{.100}\ (\cos SW)^{-1.000}\ S_{CS}^{.100}$$

COEFFICIENT OF CORRELATION= 99.83

SECTION 3

TAIL GROUP

TABLE 3-1

HORIZONTAL TAIL WEIGHT EQUATIONS

Coeff. of Correl.		
99.46	(1)	$W_{ht} = .0379\ K_{uht}\ (1 + FW/BH)^{-.250}\ W_{dg}^{.639}\ N_z^{.100}\ S_{ht}^{.750}\ L_t^{-1.000}\ K_y^{.704}\ (\text{Cos } S)_h^{-1.000}\ AR_h^{.166}\ (1 + SE/SHT)^{.100}$
		Recommended
99.47	(2)	$W_{ht} = .0429\ K_{uht}\ (1 + FW/BH)^{-.250}\ W_{dg}^{.609}\ N_z^{.100}\ S_{ht}^{.750}\ L_t^{-1.000}\ K_y^{.793}\ (\text{Cos } S)_h^{-1.000}\ AR_h^{.169}$
99.39	(3)	$W_{ht} = .0653\ K_{uht}\ (1 + FW/BH)^{-.250}\ W_{dg}^{.617}\ N_z^{.100}\ S_{ht}^{.715}\ L_t^{-1.000}\ K_y^{.782}\ (\text{Cos } S)_h^{-.727}$
99.22	(4)	$W_{ht} = .0521\ K_{uht}\ (1 + FW/BH)^{-.250}\ W_{dg}^{.693}\ N_z^{.100}\ S_{ht}^{.581}\ L_t^{-1.000}\ K_y^{.848}$

Symbol Definition:

W_{ht}	=	Horizontal Tail Weight - lbs
K_{uht}	=	Unit Horizontal Tail Constant -1.143 for UHT, 1.0 for Others
FW	=	Fuselage Width at Horizontal Tail Intersection - ft
BH	=	Horizontal Tail Span - ft
W_{dg}	=	Flight Design Gross Weight - lbs
N_z	=	Ultimate Load Factor
S_{ht}	=	Horizontal Tail Gross Area - ft^2
L_t	=	Tail Length - ft
S_e	=	Surface Area of Elevators - ft^2
K_y	=	Aircraft Pitching Radius of Gyration - ft
$(\text{Cos } S)_h$	=	Cosine of Sweep Angle of 25% Chord
AR_h	=	Horizontal Tail Aspect Ratio

TABLE 3-2

EQUATION RESULTS - HORIZONTAL TAIL

AIRCRAFT	ACTUAL W_{ht}	EQ. (1) W_{ht}	EQ. (2) W_{ht}	EQ. (3) W_{ht}	EQ. (4) W_{ht}
AC-1DH	302	352	352	350	345
C-123B	835	724	722	736	714
C-124C	1770	2005	1992	2004	2050
C-130B	2284	2019	2013	1991	2004
C-131B	705	567	571	565	578
C-133A	3709	3793	3803	3793	3936
C-135A	3295	3271	3278	3361	3202
C-135B	3441	3565	3572	3608	3401
C-141A	2916	2967	2965	2876	3004
XC-142A	426	488	488	488	498
C-5A	6566	7179	7335	7032	7416
Coefficient of Correlation		99.5	99.5	99.4	99.2

TABLE 3 - 3

CARGO/TRANSPORT - HORIZONTAL TAIL STATISTICAL DATA

AIRCRAFT	F_w/B_h	W_{dg}	N_z	S_{ht}	L_t	K_y	S	AR_h	S_e/S_{ht}	W_{ht}	S_e	UHT
AC-1DH	0.00	26000	4.97	229.6	40.2	12.13	0.0	5.64	.56	301.5	128	No
C-123B	.15	54000	4.50	345.5	40.7	12.74	13.1	4.44	.32	834.5	109	No
C-124C	.19	185000	3.75	680.5	74.3	21.24,	0.6	4.45	.49	1770.3	335	No
C-130B	.17	135000	4.16	545.0	43.6	16.33	8.5	5.10	.26	2284.4	144	No
C-131B	.15	53200	3.15	234.0	39.6	13.23	13.4	5.72	.25	705.3	59	No
C-133A	.15	275000	3.75	800.7	66.3	25.63	9.9	4.50	.43	3709.0	342	No
C-135A	.10	270000	3.75	500.0	61.0	21.49	35.0	3.15	.22	3295.3	110	Yes (2)
C-135B	.10	274000	3.75	545.0	61.0	21.49	35.0	3.39	.22	3441.0	120	Yes (2)
C-141A	0.00	316100	3.75	483.0	74.5	22.11	25.0	5.20	.25	2916.3 (1)	120	Yes (2)
C-5A	0.00	728000	3.75	965.8	129.0	38.53	24.6	4.89	.27	6566.2	259	Yes (2)
XC-142A	0.00	37474	4.50	163.5	24.3	8.36	11.0	5.93	0.00	426.5	0	Yes

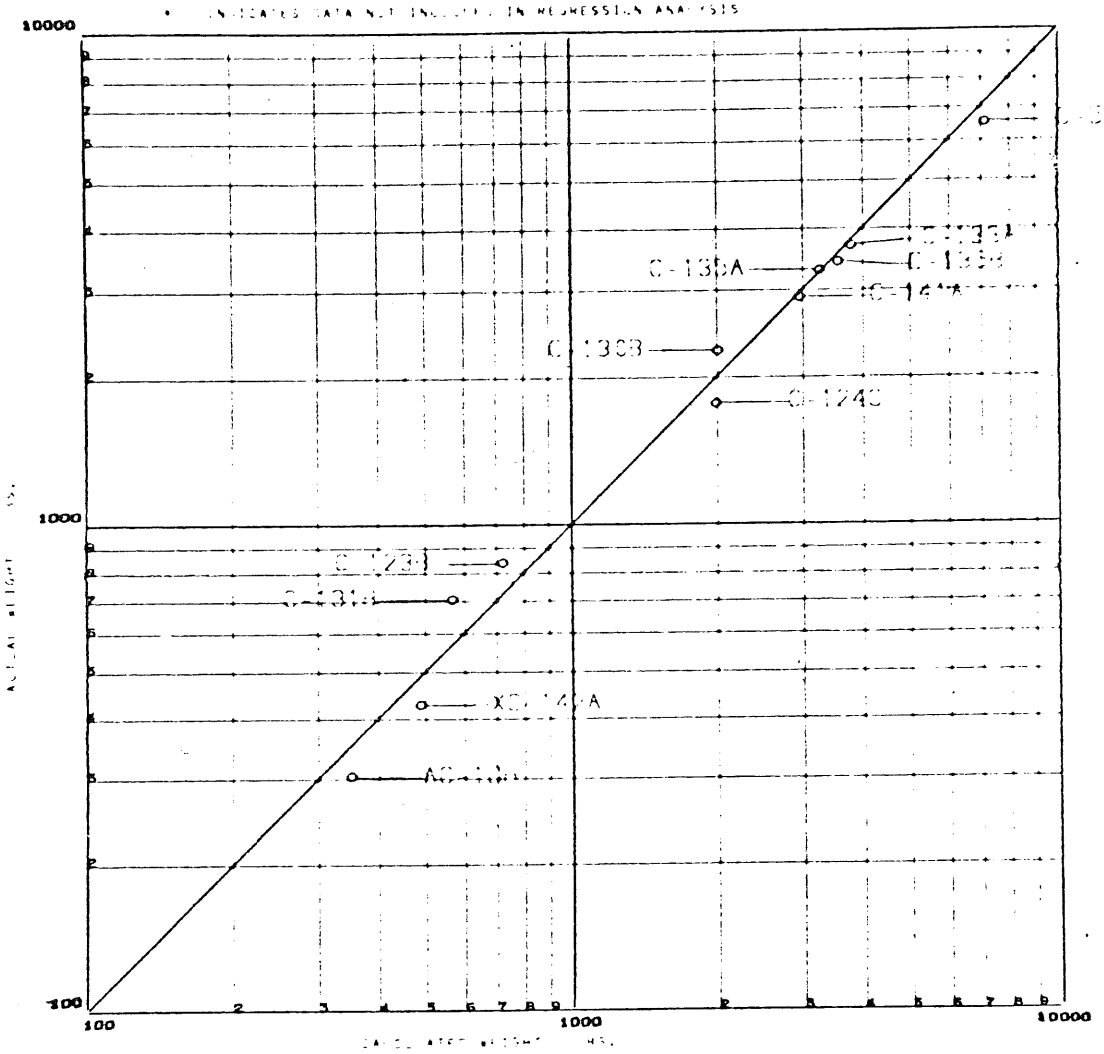
(1) Does not include 301.1 lbs of bullet

(2) Adjustable Stabilizer

$K_y = .1671\ L_f$

FIGURE 3-1

CARGO/TRANSPORT-HORIZONTAL TAIL



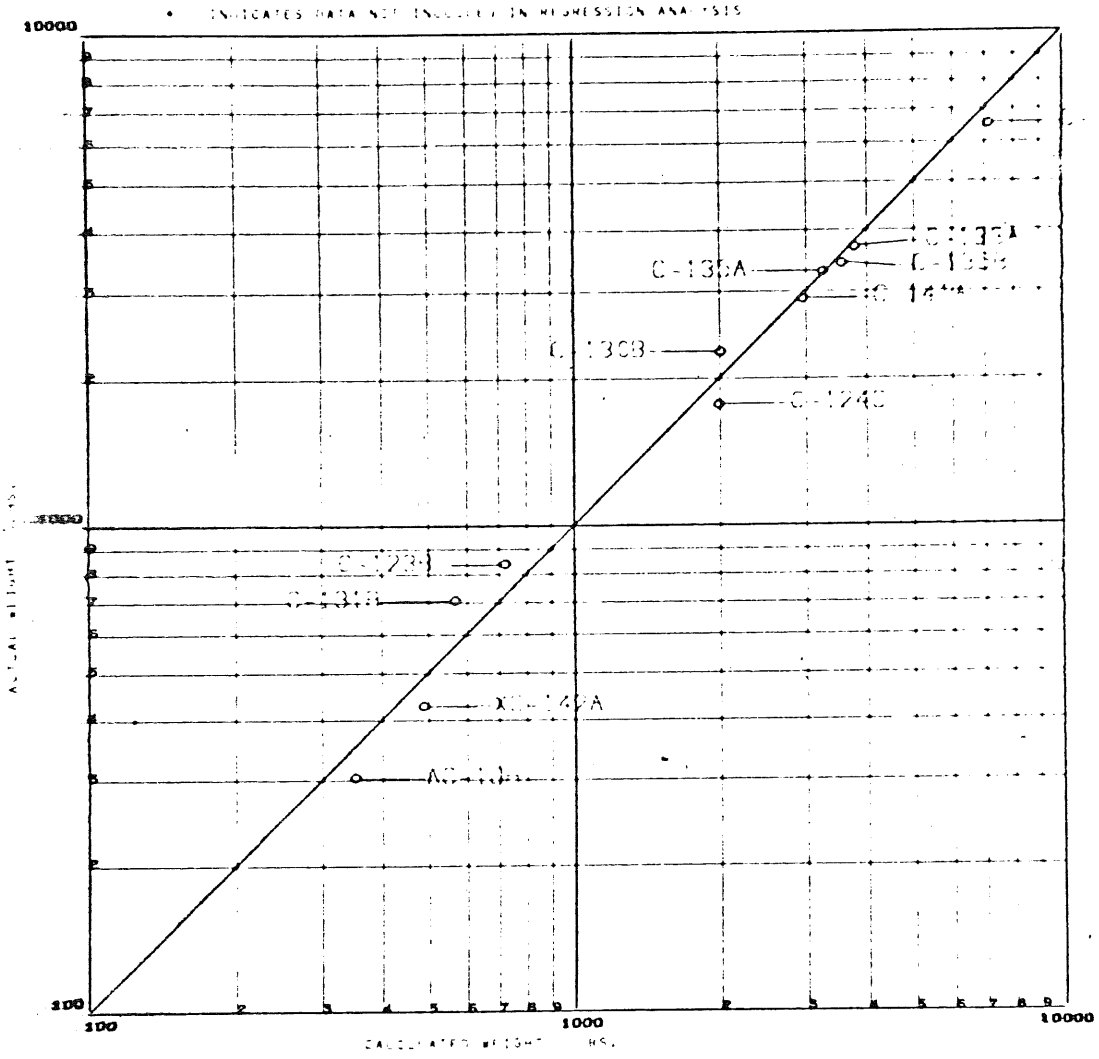
$$W_{HT} = .0372\ K_{HT}\ (1+FW/B_H)^{.250}\ W_{DG}^{.639}\ N_Z^{.100}\ S_{HT}^{.750}\ L_T^{-1.000}\ K_Y^{.704}$$

$$(COS\ \Lambda)_{HT}^{-1.000}\ AR_H^{.166}\ (1+SE/SH)^{.100}$$

CORRELATION COEFFICIENT = .99.46

FIGURE 3-1

CARGO/TRANSPORT HORIZONTAL TAIL



$$W_{HT} = .0379\ K_{uht}\ (1+FW/BH)^{.250}\ W_{DG}^{.639}\ N_Z^{.100}\ S_{HT}^{.750}\ L_T^{-1.000}\ K_v^{.204}$$

$$(CCS)_H^{-1.000}\ AR_H^{.166}\ (1+SE/SH)^{.100}$$

- COEFFICIENT OF CORRELATION= 99.4%

TABLE 3-4

VERTICAL TAIL WEIGHT EQUATIONS

Coeff. of Correl.		
99.81	(1)	$W_{vt} = .0038\ (1 + HT/HV)^{.023}\ W_{dg}^{.657}\ N_z^{.362}\ L_t^{-.837}\ S_{vt}^{.500}\ K_z^{.809}\ (\text{Cos } S)_v^{-1.000}\ AR_v^{.269}\ (T/C)_{rv}^{-.500}\ (1 + TR)_v^{1.000}$
99.62	(2)	$W_{vt} = .0026\ (1 + HT/HV)^{.225}\ W_{dg}^{.556}\ N_z^{.536}\ L_t^{-.500}\ S_{vt}^{.500}\ K_z^{.875}\ (\text{Cos } S)_v^{-1.000}\ AR_v^{.350}\ (T/C)_{rv}^{-.500}$ Recommended
98.28	(3)	$W_{vt} = .0159\ (1 + HT/HV)^{.070}\ W_{dg}^{.527}\ N_z^{.250}\ L_t^{-.500}\ S_{vt}^{.500}\ K_z^{.908}\ (\text{Cos } S)_v^{-1.000}\ AR_v^{.051}$
98.27	(4)	$W_{vt} = .0170\ (1 + HT/HV)^{.044}\ W_{dg}^{.529}\ N_z^{.250}\ L_t^{-.500}\ S_{vt}^{.500}\ K_z^{.895}\ (\text{Cos } S)_v^{-1.000}$
97.02	(5)	$W_{vt} = .0144\ (HHT/HV)^{.159}\ W_{dg}^{.626}\ N_z^{.250}\ L_t^{-.500}\ S_{vt}^{.500}\ K_z^{.661}$

TABLE 3-4

VERTICAL TAIL WEIGHT EQUATIONS

Coeff. of Correl.		
99.81	(1)	$W_{vt} = .0038\ (1 + HT/HV)^{.023}\ W_{dg}^{.657}\ N_z^{.362}\ L_t^{-.837}\ S_{vt}^{.500}\ K_z^{.809}\ (\cos S)_v^{-1.000}\ AR_v^{.269}\ (T/C)_{rv}^{-.500}\ (1 + TR)_v^{1.000}$
99.62	(2)	$W_{vt} = .0026\ (1 + HT/HV)^{.225}\ W_{dg}^{.556}\ N_z^{.536}\ L_t^{-.500}\ S_{vt}^{.500}\ K_z^{.875}\ (\cos S)_v^{-1.000}\ AR_v^{.350}\ (T/C)_{rv}^{-.500}$ Recommended
98.28	(3)	$W_{vt} = .0159\ (1 + HT/HV)^{.070}\ W_{dg}^{.527}\ N_z^{.250}\ L_t^{-.500}\ S_{vt}^{.500}\ K_z^{.908}\ (\cos S)_v^{-1.000}\ AR_v^{.051}$
98.27	(4)	$W_{vt} = .0170\ (1 + HT/HV)^{.044}\ W_{dg}^{.529}\ N_z^{.250}\ L_t^{-.500}\ S_{vt}^{.500}\ K_z^{.895}\ (\cos S)_v^{-1.000}$
97.02	(5)	$W_{vt} = .0144\ (HHT/HV)^{.159}\ W_{dg}^{.626}\ N_z^{.250}\ L_t^{-.500}\ S_{vt}^{.500}\ K_z^{.661}$

Symbol Definitions:

W_{vt} = Vertical Tail Weight-lbs

HT = Height of Horizontal Tail Above Fuselage-ft

HV = Height of Vertical Tail Above Fuselage-ft

W_{dg} = Flight Design Gross Weight-lbs

N_z = Ultimate Load Factor

L_t = Tail Length-ft

S_{vt} = Gross Vertical Tail Area-ft^2

K_z = Yawing Radius of Gyration-ft

$(\text{Cos } S)_v$ = Cosine of Sweep Angle of Vertical Tail 25% Chord

AR_v - Vertical Tail Aspect Ratio

$(T/C)_{rv}$ = Vertical Tail Root Thickness Divided by Vertical Tail Root Chord

TR = Vertical Tail Taper Ratio

TABLE 3-5

EQUATION RESULTS - VERTICAL TAIL

AIRCRAFT	ACTUAL W_{vt}	EQ. (1) W_{vt}	EQ. (2) W_{vt}	EQ. (3) W_{vt}	EQ. (4) W_{vt}	EQ. (5) W_{vt}
AC-1DH	370	355	353	324	324	321
C-123B	504	502	499	500	508	500
C-124C	1254	1347	1328	1539	1536	1600
C-130B	1128	1085	1088	1151	1151	1183
C-131B	420	411	411	395	390	372
C-133A	2204	2281	2368	2384	2392	2490
C-135A	2046	1992	1969	1826	1828	1766
C-135B	2053	2012	1985	1840	1842	1783
C-141A	2394	2343	2337	2295	2285	2254
XC-142A	262	281	284	309	308	322
C-5A	5764	6984	6762	6685	6644	6429
Coefficient of Correlation:		99.8	99.6	98.3	98.3	97.0

TABLE 3 - 6

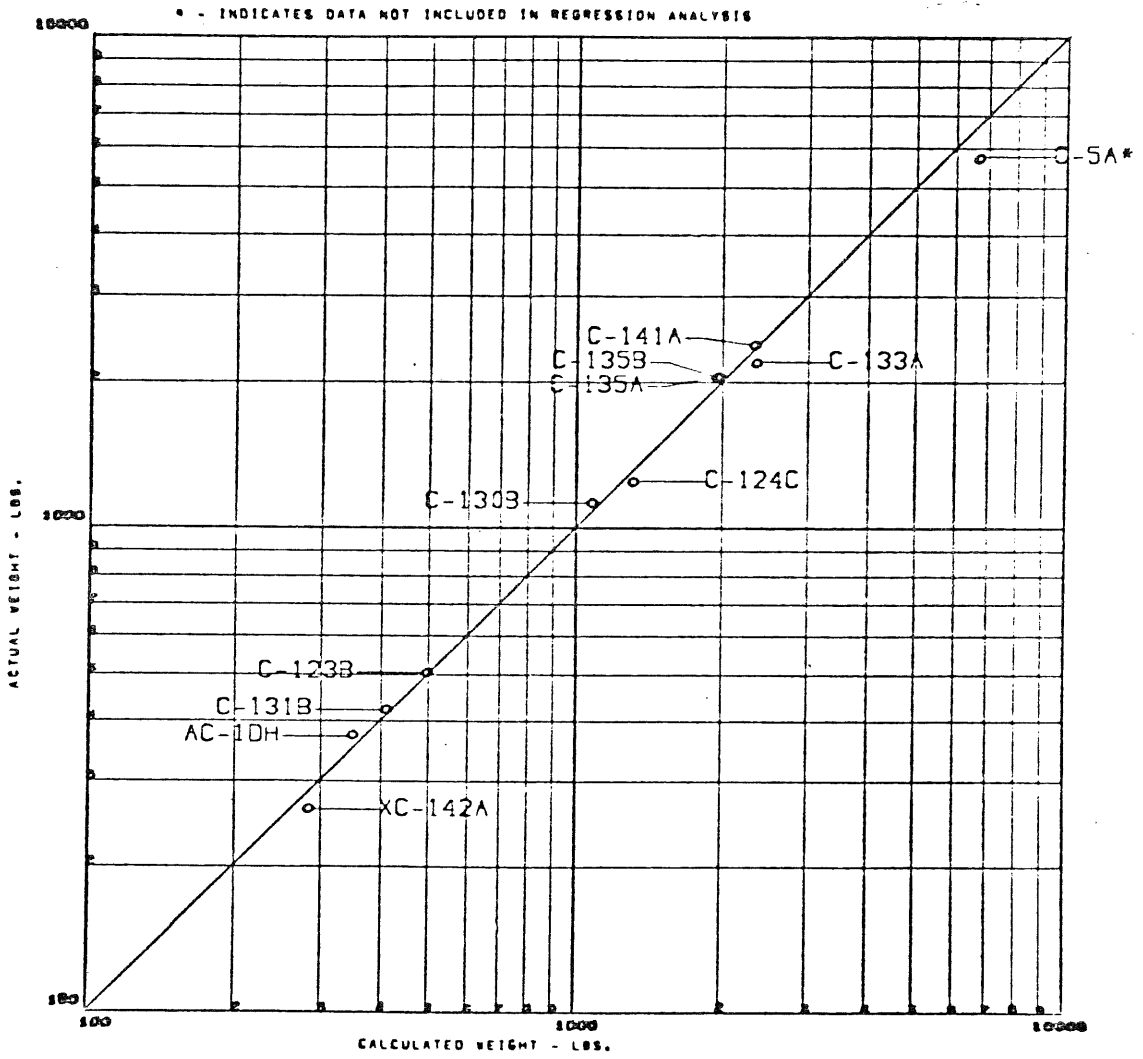
CARGO/TRANSPORT - VERTICAL TAIL STATISTICAL DATA

AIRCRAFT	H_t/H_v	W_{dg}	N_z	L_t	S_{vt}	S_r/S_{vt}	K_z	S	AR_v	$(T/C)_{rv}$	TR	W_{vt}
AC-1DH	.20	26000	4.97	40.20	211.0	.30	36.3	12	1.71	.12	.57	370
C-123B	.27	54000	4.50	40.70	187.0	.27	40.2	23	1.21	.12	.43	504
C-124C	0.00	185000	3.75	74.30	465.5	.38	65.1	7	1.75	.17	.53	1254
C-130B	0.00	135000	4.16	43.60	300.0	.26	49.8	18	1.78	.15	.30	1128
C-131B	0.00	53200	3.15	39.60	133.4	.32	39.9	23	2.35	.12	.33	420
C-133A	0.00	275000	3.75	66.30	536.7	.34	71.9	12	1.55	.12	.34	2204
C-135A	0.00	270000	3.75	60.97	353.8	.31	56.0	31	1.72	.11	.36	2046
C-135B	0.00	274000	3.75	60.97	353.8	.31	56.0	31	1.72	.11	.36	2053
C-141A	1.00	316100	3.75	74.50	394.0	.15	63.3	35	1.31	.13	.61	2394
C-5A	1.00	728000	3.75	113.20	961.1	.24	97.9	35	1.24	.13	.80	5764
XC-142A	.40	37474	4.50	24.33	130.0	.21	25.4	26	1.81	.18	.25	262

$$K_z = .2160\ (L_f + B_w)$$

FIGURE 3-2

CARGO/TRANSPORT-VERTICAL TAIL



$$W_{VT} = .0026\ (1+HT/HV)^{.225}\ W_{DG}^{.556}\ N_Z^{.536}\ L_T^{-.500}\ S_{VT}^{.500}\ K_Z^{.875}\ (\cos S)_V^{-1.000}\ AR_V^{.350}\ (T/C)_{RV}^{-.500}$$

COEFFICIENT OF CORRELATION= 99.63

SECTION 4

FUSELAGE

TABLE 4 - 1

FUSELAGE WEIGHT EQUATIONS

Coefficient of Correlation

99.73 (1) $W_f = .3353\ K_1\ K_2\ (W_{dg}\ N_z)^{.496}\ L_f^{.250}\ A_f^{.307}\ K_w^{.021}\ (1 + K_L)^{.054}\ (L_f/D_f)^{.100}$

99.73 (2) $W_f = .3280\ K_1\ K_2\ (W_{dg}\ N_z)^{.500}\ L_f^{.250}\ A_f^{.302}\ (1 + K_L)^{.040}\ (L_f/D_f)^{.100}$ Recommended

99.71 (3) $W_f = .3104\ K_1\ K_2\ (W_{dg}\ N_z)^{.526}\ L_f^{.250}\ A_f^{.268}\ (L_f/D_f)^{.100}$

99.81 (4) $W_f = .2965\ K_1\ K_2\ (W_{dg}\ N_z)^{.553}\ L_f^{.250}\ A_f^{.255}$

K_{door}

$K_1 = 1.06$ for 1 side-loading cargo door

$K_1 = 1.12$ for 2 side-loading cargo doors

$K_1 = 1.12$ for aft clamshell doors and ramp

$K_1 = 1.25$ for 2 side-loading doors and aft clamshell doors and ramp

K_{Lg}

	Eq.(1)	Eq.(2)	Eq.(3)	Eq.(4)	
K_2 =	1.11	1.12	1.11	1.10	for fuselage mounted main landing gear
K_2 =	1.00	1.00	1.00	1.00	for wing mounted main landing gear

Symbol Definition:

W_f = Weight of Fuselage - lbs (Unpressurized)

W_{dg} = Flight Design Gross Weight - lbs

N_z = Ultimate Load Factor

L_f = Fuselage Structural Length - ft

A_f = Fuselage Wetted Area - ft^2

K_w = Weight of Fuselage and Contents Divided by Design Gross Wt.

K_L = Wing Sweep Factor

D_f = Fuselage Structural Depth - ft

A_f May be estimated by; $A_f = 2.752\ L_f^{.950}\ B_f^{.500}\ D_f^{.576}$ (Figure 4-2)

$$K_L = 3/4 \left(\frac{1 + 2\lambda}{1 + \lambda}\right) \left(\frac{B_w \tan \Lambda}{L_f}\right)$$

λ = Wing taper ratio

B_w = Wing span - ft

Λ = Sweep angle of wing 25% chord

NOTE: The following weight penalties to the C-5A fuselage are not accounted for by the constants K_1 and K_2.

Floor Vehicle Loading	5096
Aft Torque Deck	2104
463L Cargo Loading System	3953
Landing Gear Kneeling	395
Excessive L.G. Cutouts	1000
Stabilizing Gear	680
Personnel Provisions (Aft)	532
Relief Crew Provisions	693
Main Power Plant	246
Paratroop Doors	477
Excessive Ramps and Extensions	3000
Total Excessive Penalty	18176 lbs.

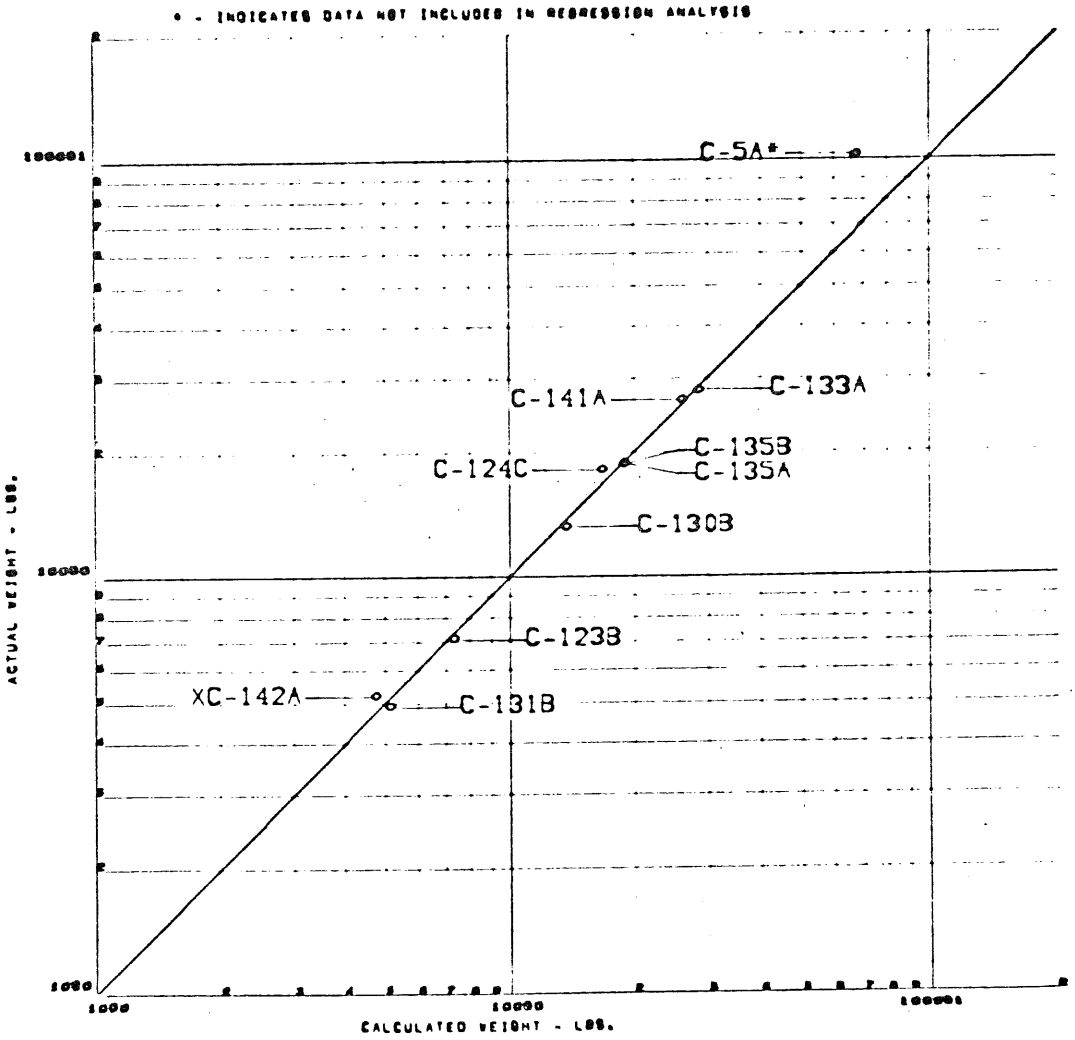
TABLE 4 - 2

EQUATION RESULTS - FUSELAGE

AIRCRAFT	ACTUAL W_f	EQ. (1) W_f	EQ. (2) W_f	EQ. (3) W_f	EQ. (4) W_f
C-123B	7073	7399	7391	7386	7366
C-124C	18070	16780	16780	16800	17290
C-130B	13220	13760	13790	13880	13910
C-131B	4873	5143	5148	5133	4988
C-133A	28070	28780	28750	28780	28350
C-135A	18750	18910	18880	18890	18890
C-135B	18800	19020	19020	19040	19040
C-141A	26620	26030	26050	25860	25670
XC-142A	5186	4750	4746	4749	4858
C-5A	102900	68510	68000	66800	67510
Coefficient of Correlation		99.7	99.7	99.7	99.8

FIGURE 4-1

CAGRO/TRANSPORT-FUSELAGE WEIGHT

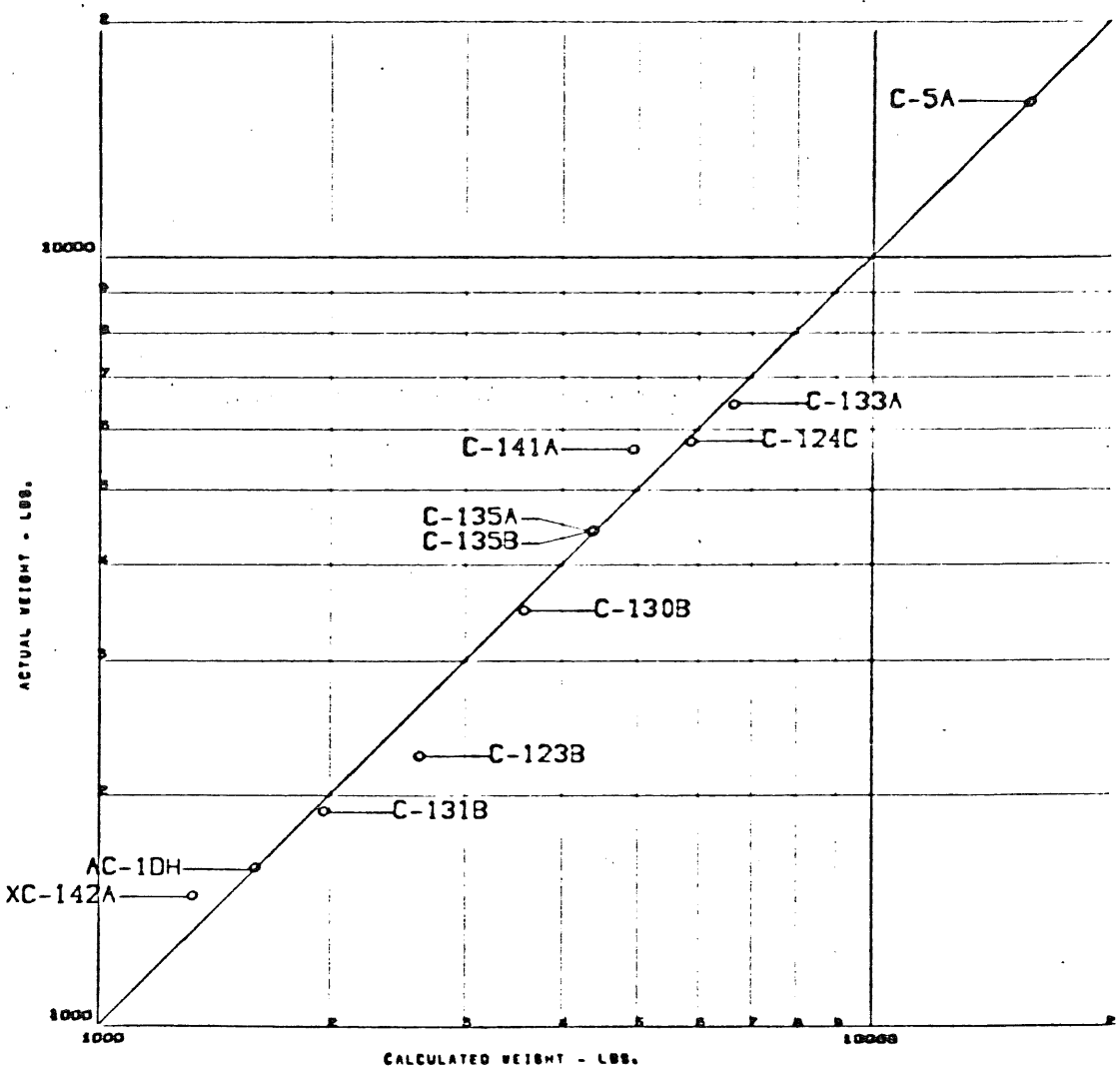


$$W_F = .3280\ K_1\ K_2\ (W_{DG}\ N_Z)^{.499}\ L_F^{.250}\ A_F^{.302}\ (1+K_L)^{-.039}\ (L_F/D_F)^{.100}$$

COEFFICIENT OF CORRELATION= 99.73

FIGURE 4-2

FUSELAGE WETTED AREA - CARGO/TRANSPORT



$$A_F = 2.752\ L_F^{.950}\ B_F^{.500}\ D_F^{.576}$$

COEFFICIENT OF CORRELATION= 99.79

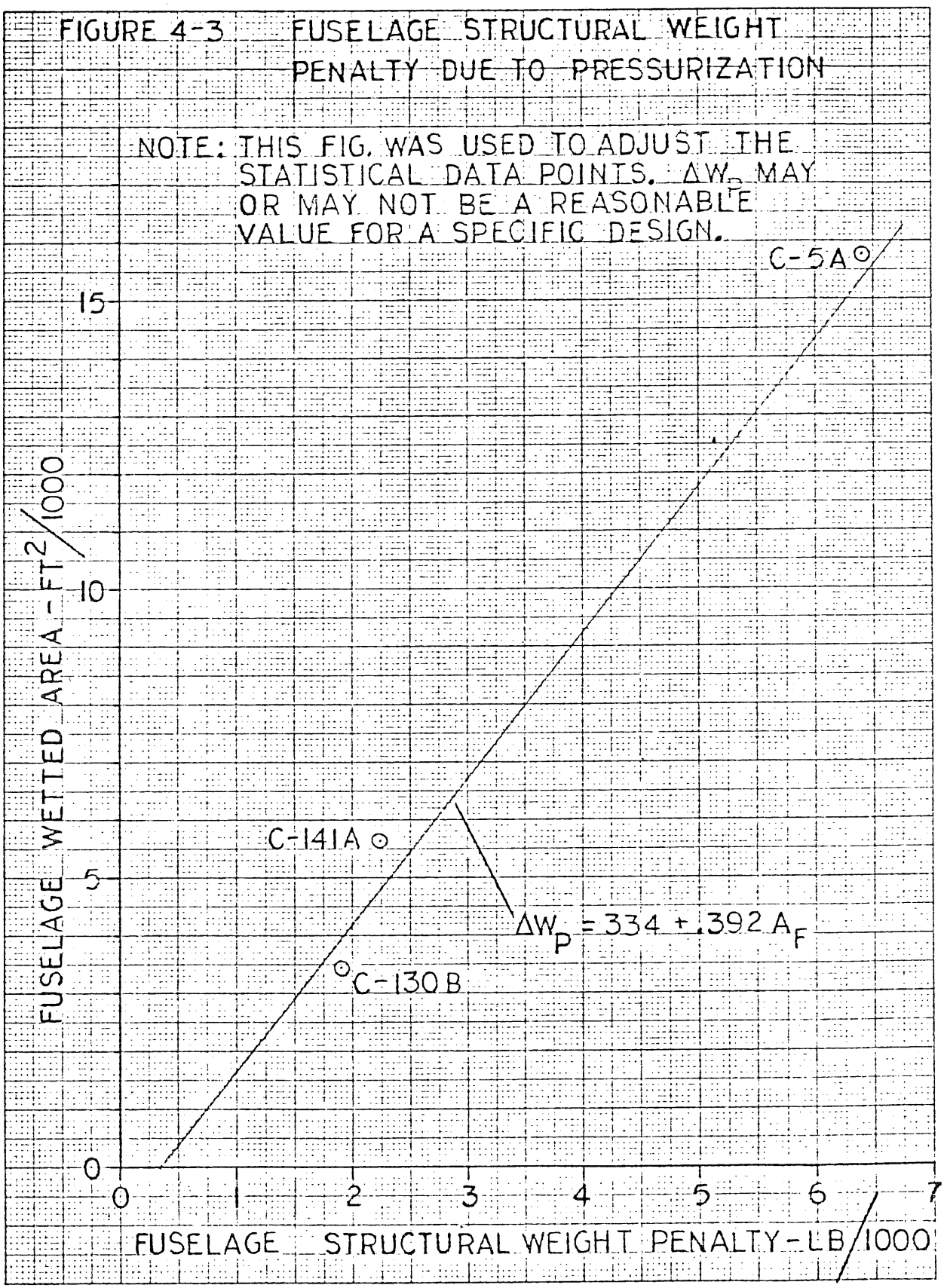


FIGURE 4-3 FUSELAGE STRUCTURAL WEIGHT PENALTY DUE TO PRESSURIZATION

SECTION 5

LANDING GEAR

TABLE 5 - 1

MAIN LANDING GEAR WEIGHT EQUATIONS

Coeff. of Correl.		
99.87	(1) $W_{mlg} = .0106\ K_{mp}\ K_x\ W_l^{.888}\ N_l^{.250}\ L_m^{.400}\ N_{mw}^{.321}\ N_{mss}^{-.500}\ V_{st}^{.100}$	Recommended

K_{mp} = 1.126 for kneeling main gear
= 1.00 for others

K_x = .536 for XC-142 Type
= 1.00 for others

99.50 (2) $W_{mlg} = .0610\ K_{mp}\ K_x\ W_l^{.853}\ N_l^{.276}\ N_{mw}^{.519}\ N_{mss}^{-.500}\ V_{st}^{.100}$

K_{mp} = 1.126 for kneeling main gear
= 1.00 for others

K_x = .619 for XC-142 type
= 1.00 for others

99.26 (3) $W_{mlg} = .0178\ K_{mp}\ K_x\ W_l^{1.000}\ N_l^{.349}\ V_{st}^{.100}$

K_{mp} = 1.126 for kneeling main gear
= 1.00 for others

K_x = .606 for XC-142 type
= 1.00 for others

EQUATIONS (cont.)

99.08 (4) $W_{mlg} = .0288\ K_{mp}\ K_x\ W_l^{1.000}\ N_l^{.319}$

K_{mp} = 1.126 for kneeling main gear
= 1.00 for others

K_x = .606 for XC-142 type
= 1.00 for others

97.17 (5) $W_{mlg} = .0401\ K_{mp}\ K_x\ W_l^{1.000}$

K_{mp} = 1.126 for kneeling main gear
= 1.00 for others

K_x = .618 for XC-142 type
= 1.00 for others

Symbol Definition:

W_{mlg} = Weight of Main Landing Gear - lbs

K_{mp} = Constant for Kneeling Main Gear

K_x = Constant for 142-type Gear

W_l = Landing Design Gross Weight - lbs

N_l = Landing Load Factor

L_m = Length of Main Landing Gear-inches

N_{mw} = Number of Main Gear Wheels

N_{mss} = Number of Main Gear Shock Struts

V_{st} = Stall Speed-knots

TABLE 5 - 2

EQUATION RESULTS - MAIN LANDING GEAR

AIRCRAFT	ACTUAL W_{mlg}	EQ. (1) W_{mlg}	EQ. (2) W_{mlg}	EQ. (3) W_{mlg}	EQ. (4) W_{mlg}	EQ. (5) W_{mlg}
AC-1DH	1157	970	1074	1044	1087	1043
C-123B	1877	2157	2064	2236	2227	2059
C-130B	4045	3667	3716	4396	4404	4732
C-131B	1728	1745	1842	1946	1935	1897
C-135A	9523	9612	9178	8362	8218	8020
C-135B	9613	9612	9178	8362	8218	8020
C-141A	9210	9124	10010	9161	9181	10330
XC-142A	929	1053	929	929	929	929
C-124C	9749	6734	5642	7250	7188	6737
C-133A	8983	11630	11500	10960	1077	9824
C-5A	33230	28740	34610	29830	2930	28710
Coefficient of Correlation:		99.9	99.5	99.3	99.1	97.2

TABLE 5 - 3

MAIN LANDING GEAR DESIGN AND WEIGHT DATA

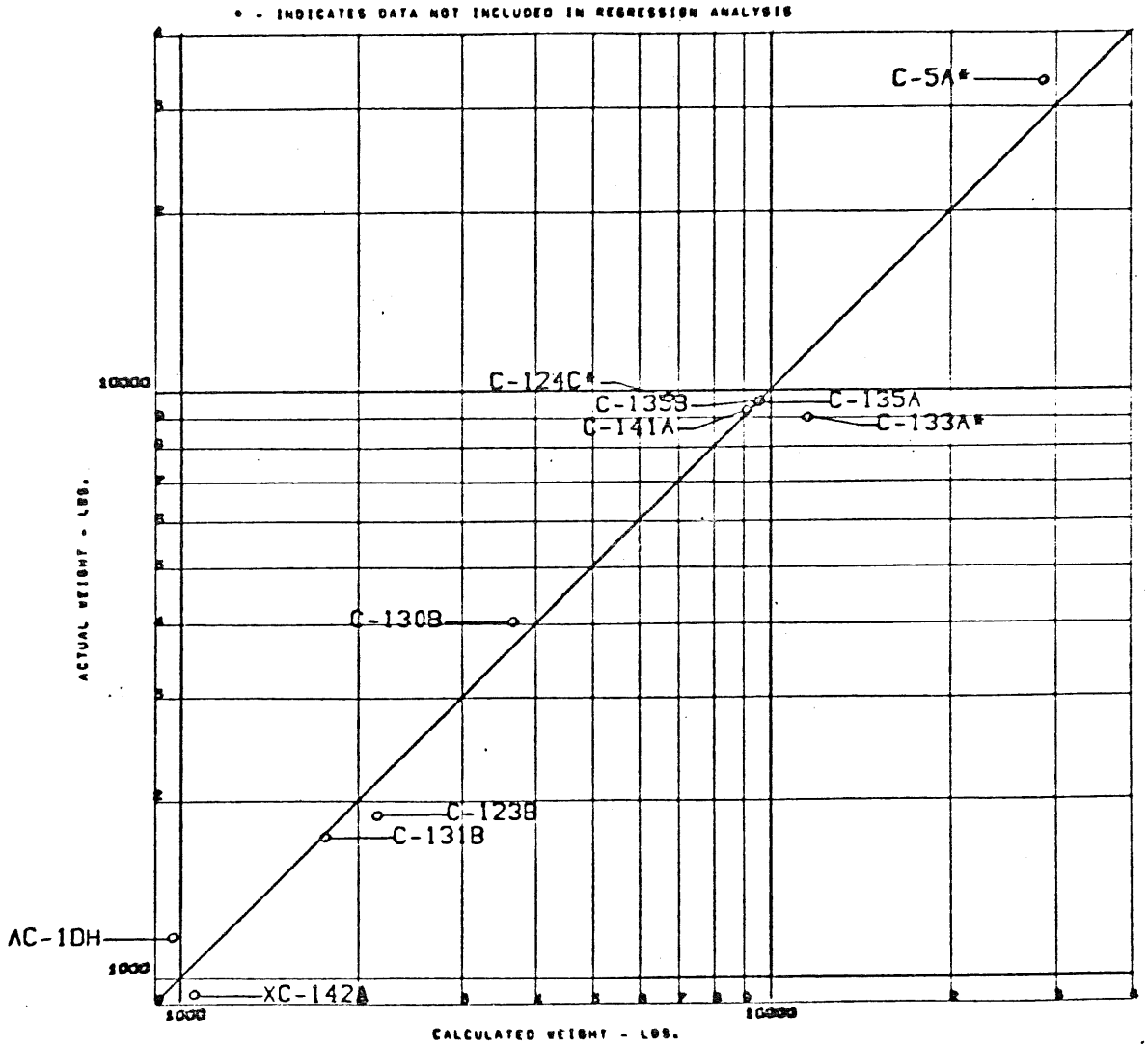
Aircraft	W_{mlg}	W_l	N_l	L_m	N_{mw}	N_{mss}	V_{st}	Rolling Assembly	Structure	Controls
AC-1DH	1157	26000	3.21	54.0	4	2	56.0	312	781	64
C-123B	1877	51350	3.60	73.9	4	2	84.0	708	993	176
C-124C	9749	168000	3.45	92.6	4	2	89.0	4563	4541	645
C-130B	4045	118000	2.25	57.7	4	2	91.2	1989	1255	801
C-131B	1758	47300	3.00	57.5	4	2	90.0	737	847	174
C-133A	8983	245000	3.75	84.0	8	2	95.0	4002	4172	809
C-135A	9523	200000	3.04	91.9	8	2	101.0	3557	5007	959
C-135B	9613	200000	3.04	91.9	8	2	101.0	3622	5030	961
C-141A	9210	257500	1.95	61.7	8	2	95.0	3816	4579	815
C-5A*	33230	635850	3.00	80.0	24	4	102.0	8494	18915	5821
XC-142A**	929	37474	3.00	131.5	4	2	85.0	320	455	154

* C-5A has kneeling landing gear

** XC-142A has tripod-type gear

FIGURE 5-1

CARGO TRANSPORT-MAIN LANDING GEAR



$$W_{MLG} = .0106\ W_L^{.888}\ N_L^{.250}\ L_M^{.400}\ N_{MW}^{.321}\ N_{MSS}^{-.500}\ V_{STALL}^{.100}\ K_P\ F_X$$

COEFFICIENT OF CORRELATION= 99.87

TABLE 5 - 4

NOSE LANDING GEAR WEIGHT EQUATIONS

Coeff of Correl.		
95.37	(1)	$W_{nlg} = .0075\ K_{np}\ W_l^{.570}\ N_l^{.200}\ L_n^{.500}\ N_{nw}^{.450}\ V_{st}^{.518}$
96.41	(2)	$W_{nlg} = .0320\ K_{np}\ W_l^{.646}\ N_l^{.200}\ L_n^{.500}\ N_{nw}^{.450}$ Recommended
97.10	(3)	$W_{nlg} = .1782\ K_{np}\ W_l^{.663}\ N_l^{.242}\ N_{nw}^{.450}$
95.73	(4)	$W_{nlg} = .2815\ K_{np}\ W_l^{.646}\ N_{nw}^{.450}$
95.73	(5)	$W_{nlg} = .3852\ W_l^{.646}$

Symbol Definition:

W_{nlg} = Nose Landing Gear Weight-lbs

K_{np} = Constant for Kneeling Nose Gear
= 1.15 for Kneeling Nose Gear
= 1.00 for Single Position Nose Gear

W_l = Landing Design Gross Weight-lbs

N_l = Ultimate Landing Load Factor

L_n = Nose Gear Length-inches

N_{nw} = Number of Nose Wheels

V_{st} = Stall Speed-knots

TABLE 5 - 5

EQUATION RESULTS - NOSE LANDING GEAR

AIRCRAFT	ACTUAL W_{nlg}	EQ. (1) W_{nlg}	EQ. (2) W_{nlg}	EQ. (3) W_{nlg}	EQ. (4) W_{nlg}	EQ. (5) W_{nlg}
AC-1DH	241	258	295	275	275	275
C-123B	457	385	375	445	428	428
C-130B	713	694	690	689	732	732
C-131B	493	460	429	403	406	406
C-133A	1440	1323	1362	1267	1175	1175
C-135A	921	1110	1090	1053	1030	1030
C-135B	930	1110	1090	1053	1030	1030
C-141A	1147	981	1014	1118	1213	1213
XC-142A	337	363	343	345	349	349
C-124C	1933	1225	1267	969	920	920
C-5A	4350	3362	3588	3553	3419	2176
Coefficient of Correlation:		95.4	96.4	97.1	95.7	95.7

TABLE 5 - 6

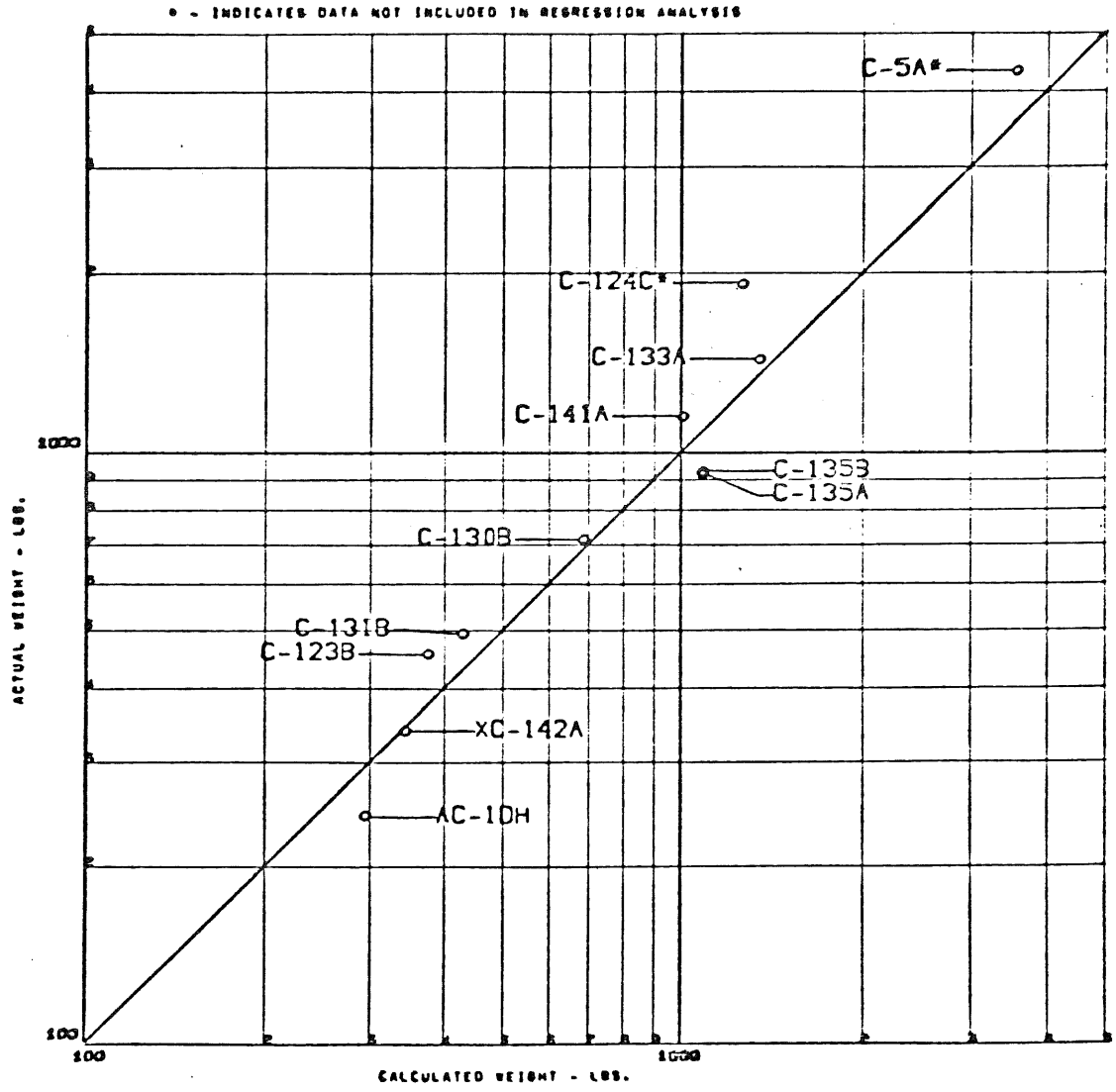
NOSE LANDING GEAR DESIGN AND WEIGHT DATA

Aircraft	W_{nlg}	W_l	N_l	L_n	N_{nw}	V_{st}	Rolling Assembly	Structure	Controls
AC-1DH	241	26000	3.21	55.7	2	56	67	165	9
C-123B	457	51350	3.60	35.7	2	84	169	186	102
C-124C	1933	168000	3.45	89.3	2	89	459	1188	286
C-130B	713	118000	2.25	49.8	2	91	248	332	133
C-131B	493	47300	3.00	56.0	2	90	112	312	69
C-133A	1440	245000	3.75	61.5	2	95	297	946	197
C-135A	921	200000	3.04	55.7	2	101	247	376	298
C-135B	930	200000	3.04	55.7	2	101	256	376	298
C-141A	1147	257500	1.95	41.5	2	95	282	617	248
C-5A*	4350	635850	3.00	55.1	4	102	989	2008	1353
XC-142A	337	37474	3.00	48.3	2	85	71	168	98

* C-5A has kneeling nose gear

FIGURE 5-2

CARGO TRANSPORT-NOSE LANDING GEAR



$$W_{NLG} = .0320\ W_L^{.646}\ N_L^{.200}\ L_N^{.500}\ N_{NW}^{.450}\ K_P$$

COEFFICIENT OF CORRELATION= 96.41

SECTION 6

SURFACE CONTROLS

Flight controls, not surface itself

TABLE 6 - 1

SURFACE CONTROLS WEIGHT EQUATIONS

Coeff. of Correl.		
99.79	(1)	$W_{sc} = 127.2\ N_f^{.605}\ (1 + N_m/N_f)^{-1.0}\ (1 + N_e/N_f)^{-.369}\ S_{cs}^{.200}\ I_y^{.083}$
99.65	(2)	$W_{sc} = 145.9\ N_f^{.554}\ (1 + N_m/N_f)^{-1.0}\ S_{cs}^{.200}\ I_y^{.070}$ Recommended
99.58	(3)	$W_{sc} = 176.4\ N_f^{.542}\ (1 + N_m/N_f)^{-1.0}\ S_{cs}^{.200}\ I_p^{.064}$
89.21	(4)	$W_{sc} = 145.6\ N_f^{1.00}\ I_p^{.188}$

Symbol Definition:

(1)

- W_{sc} = Weight of Surface Controls - lbs
- N_f = Number of Functions Performed by Surface Controls Group
- N_m = Number of Mechanical Functions
- N_e = Number of Electrical Functions
- S_{cs} = Area of Control Surfaces (Wing + Tail Controls) - ft^2
- I_p = Aircraft Pitching Inertia - $lb\text{-}ft^2/10^6$ ← normally used slug-ft^2
- I_y = Aircraft Yawing Inertia - $lb\text{-}ft^2/10^6$
- I_r = Aircraft Roll Inertia - $lb\text{-}ft^2/10^6$

(1) W_{sc} includes the weight of the hydraulics necessary to operate the three primary flight control functions. These hydraulics are referred to as primary hydraulics or power controls. Also included is the autopilot weight. Table 6-3 shows the weight adjustments to make all of the data points compatible in these respects.

TABLE 6 - 2

EQUATION RESULTS - SURFACE CONTROLS

AIRCRAFT	ACTUAL W_{sc}	EQ. (1) W_{sc}	EQ. (2) W_{sc}	EQ. (3) W_{sc}	EQ. (4) W_{sc}
AC-1DH	713	777	782	789	936
C-123B	845	798	803	802	876
C-124C	1557	1607	1553	1534	1672
C-130B	1795	1741	1724	1717	1117
C-131B	776	770	777	781	865
(1) C-133A	1804	1266	1227	1224	1547
C-135A	2318	2322	2362	2370	2541
C-135B	2326	2337	2378	2386	2537
(1) C-141A	4161	2887	2825	2800	2256
XC-142A	2384	2315	2284	2278	1966
(1) C-5A	7986	4431	4087	4065	3790

(1) These data points not used in the statistical analysis.

TABLE 6 - 3

SURFACE CONTROLS STATISTICAL DATA

106

AIRCRAFT	(1) N_f	(1) N_m	(1) N_e	(2) S_{cs}	I_y	I_p	I_r	(3) W_{sc}
AC-1DH	5	5	0	477	34.3	3.82	2.87	713
C-123B	4	3	0	372	87.3	8.76	6.56	845
C-124C	5	2.5	0	1164	784.0	83.45	62.57	1557
C-130B	4	0	0	672	297.6	32.06	24.03	1795
C-131B	4	3	0	333	74.8	8.22	6.16	776
(4) C-133A	4	3	0	1166	1421.8	180.64	135.49	1804
C-135A	7	1.5	1.5	1225	876.5	129.07	96.79	2318
C-135B	7	1.5	1.5	1270	870.2	128.15	96.09	2326
(5) C-141A	6	0	0.5	1553	1274.0	155.46	116.55	4161
XC-142A	11	1	0.5	588	27.7	2.98	2.23	2385
C-5A	7	0	0	3540	6977.0	1080.78	810.55	7968

(1) See Table 6 - 6

(2) See Table 6 - 5

(3) See Table 6 - 4 for weight adjustments

(4) The C-133A was not used in the statistical analysis due to excessive weight in the cockpit controls and autopilot area with no apparent explanation.

(5) The C-141A was not used in the statistical analysis due to excessive weight in the spoiler controls.

TABLE 6 - 4

SURFACE CONTROLS WEIGHT DATA

AIRCRAFT	REPORTED W_{sc}	LESS UTILITY HYD	PLUS PRIMARY HYD	PLUS AUTOPILOT	ADJUSTED W_{sc}
AC-1DH	467.1	-	-	+246.0	713.1
C-123B	598.9	-	-	+246.0	844.9
C-124C	1493.0	-	+64.0	-	1557.0
C-130B	1648.3	-	+146.8	-	1795.1
C-131B	776.0	-	-	-	776.0
C-133A	1804.0	-	-	-	1804.0
C-135A	2147.4	-	+171.0	-	2318.4
C-135B	2154.4	-	+171.5	-	2325.9
C-141A	3713.7	-	+447.6	-	4161.3
XC-142A	2716.7	-332.0	-	-	2384.7
C-5A	6543.1	-	+1424.6	-	7967.7

TABLE 6 - 5

CARGO/TRANSPORT - SURFACE CONTROL AREA

AIRCRAFT	WING MOUNTED SURFACES	RUDDER	UHT	ELEVATOR	TOTAL
AC-1DH	285	63	-	129	477
C-123B	211	50	-	111	372
C-124C	654	177	-	333	1164
C-130B	452	78	-	142	672
C-131B	231	43	-	59	333
C-133A	640	182	-	344	1166
C-135A	615	110	500	(1)	1225
C-135B	615	110	545	(1)	1270
C-141A	1011	59	483	(1)	1553
XC-142A	397	27	164	-	588
C-5A	2343	231	966	(1)	3540

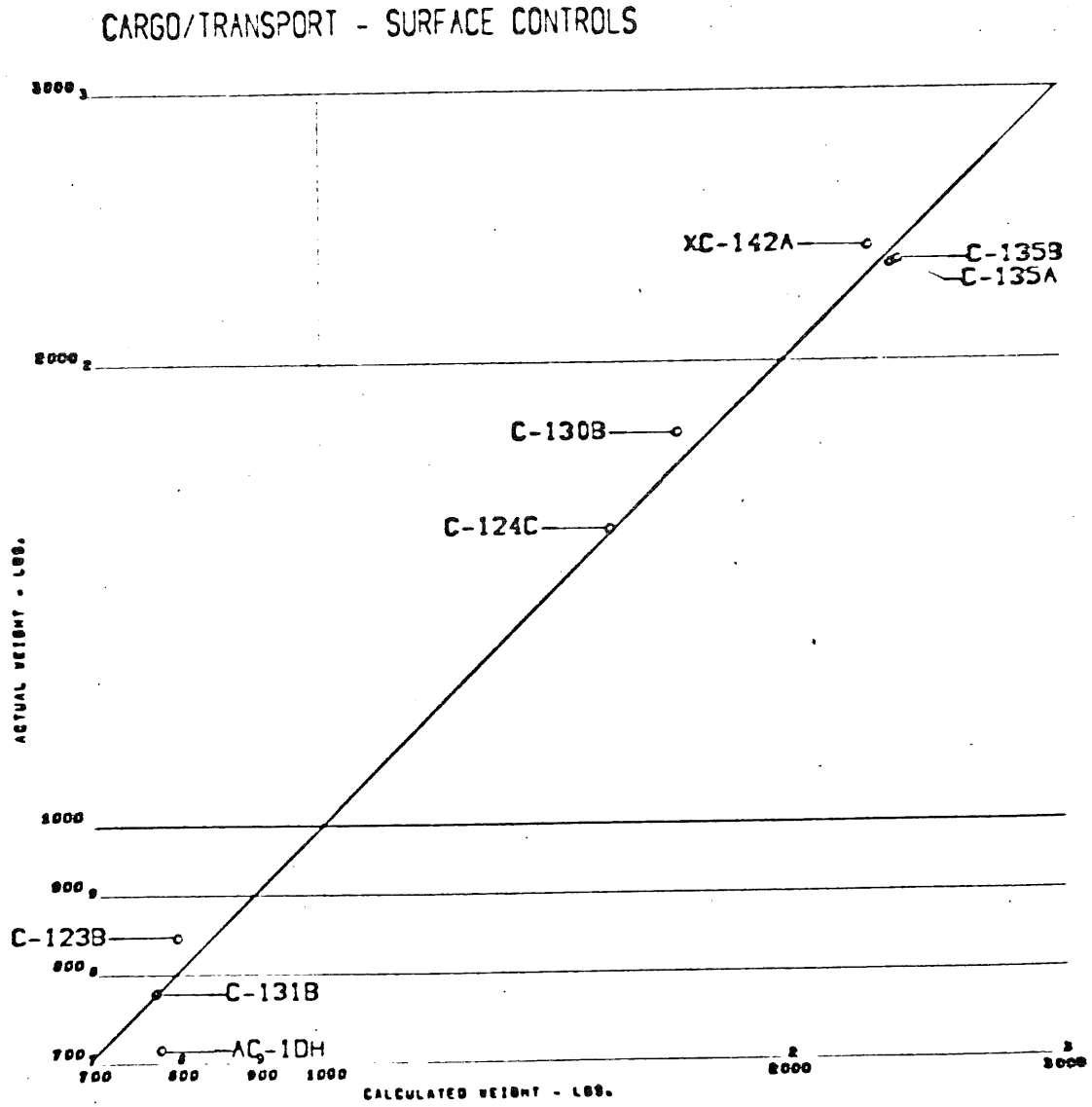
(1) These aircraft have adjustable horizontal tails with elevators.

TABLE 6 - 6

CARGO/TRANSPORT - SURFACE CONTROL SYSTEMS ACTUATION METHODS

SURFACE CONTROL SYSTEM	AC-1DH	C-123B	C-124C	C-130B	C-131B	C-133A	C-135A	C-135B	C-141A	XC-142A	C-5A
L.E. Flaps or Slats	M	-	-	-	-	-	H	H	-	H	H
T.E. Flaps	M	H	H	H	H	H	H	H	H	H	H
Aileron	M	M	H/M	H	M	M	M	M	H	H	H
Elevator Or UHT	M	M	M	H	M	M	E/M	E/M	H	H	H
Rudder	M	M	M	H	M	M	H	H	H	H	H
Snubber	-	-	H	-	-	-	-	-	-	-	-
Spoilers	-	-	-	-	-	-	H	H	H	-	H
Stabilizer Trim	-	-	-	-	-	-	E	E	H/E	-	H
Wing Incidence	-	-	-	-	-	-	-	-	-	H	-
Longitudinal	-	-	-	-	-	-	-	-	-	H	-
Lateral	-	-	-	-	-	-	-	-	-	H	-
Directional	-	-	-	-	-	-	-	-	-	H	-
Rotating Prop	-	-	-	-	-	-	-	-	-	H/E	-
Tail Rotor	-	-	-	-	-	-	-	-	-	M	-
N_f	5	4	5	4	4	4	7	7	6	11	7
N_m	5	3	2.5	0	3	3	1.5	1.5	0	1	0
N	0	0	0	0	0	0	1.5	1.5	.5	.5	0

FIGURE 6-1



$$W_{SC} = 145.9\ N_F^{.554}\ (1+NM/NF)^{-1.000}\ S_{CS}^{.200}\ I_Y^{.070}$$

COEFFICIENT OF CORRELATION= 99.65

SECTION 7

ENGINE SECTION

does not include engine

TABLE 7 - 1

ENGINE SECTION WEIGHT EQUATIONS

Coeff. of Correl.		
98.84	(1)	$W_{ng} = .4836\, K_{ng}\, N_{lt}^{.100}\, N_d^{.100}\, N_w^{.337}\, N_z^{.100}\, W_{e+c}^{.499}\, N_e^{.900}\, S_n^{.258}\, T_e^{.100}\, P_l^{.100}\, P_h^{.100}$
98.99	(2)	$W_{ng} = .6535\, K_{ng}\, N_{lt}^{.100}\, N_d^{.100}\, N_w^{.239}\, N_z^{.111}\, W_{e+c}^{.608}\, N_e^{.969}\, S_n^{.221}$
99.06	(3)	$W_{ng} = .6724\, K_{ng}\, N_{lt}^{.100}\, N_w^{.294}\, N_z^{.119}\, W_{e+c}^{.611}\, N_e^{.984}\, S_n^{.224}$ Recommended
98.80	(4)	$W_{ng} = .3866\, K_{ng}\, N_z^{.153}\, W_{e+c}^{.655}\, N_e^{.927}\, S_n^{.400}$

Symbol Definition:

W_{ng} = Nacelle Group Weight - lbs, includes complete AN group, one engine per nacelle assumed

K_{ng} = Nacelle Type Constant

K_{ng} = 1.00 for prop driven aircraft with wing mounted nacelle

For pylon mounted pure jet engines:

	EQ.(1)	EQ. (2)	EQ. (3)	EQ. (4)
K_{ng}	.667	1.040	1.017	1.012

N_{lt} = Nacelle Length - ft

N_d = Nacelle Depth - ft.

N_w = Nacelle Width - ft.

N_z = Ultimate Load Factor

(1) W_{e+c} = Engine and Contents Weight - lbs, per nacelle

N_e = Number of Engines

TABLE 7 - 1

Symbol Definition (Continued):

② S_n = Nacelle Wetted Area - ft^2

T_e = Thrust Per Engine - Lbs

P_l = Pylon Length - ft

P_h = Pylon Height - ft

① May be estimated by,

$$W_{e+c} = 2.331\ W_e^{.901}\ K_p\ K_{tr}$$

W_e = Engine Weight - lbs

K_p = Prop. Factor

1.4 for engines with props

1.0 for engines without props

K_{tr} = Thrust reverser factor

1.18 for engines with thrust reversers

1.0 for engines without thrust reversers

② May be estimated by,

$$S_n = 5.983\ N_{lt}^{.812}\ N_w^{.750}$$

TABLE 7 - 2

EQUATION RESULTS - ENGINE SECTION

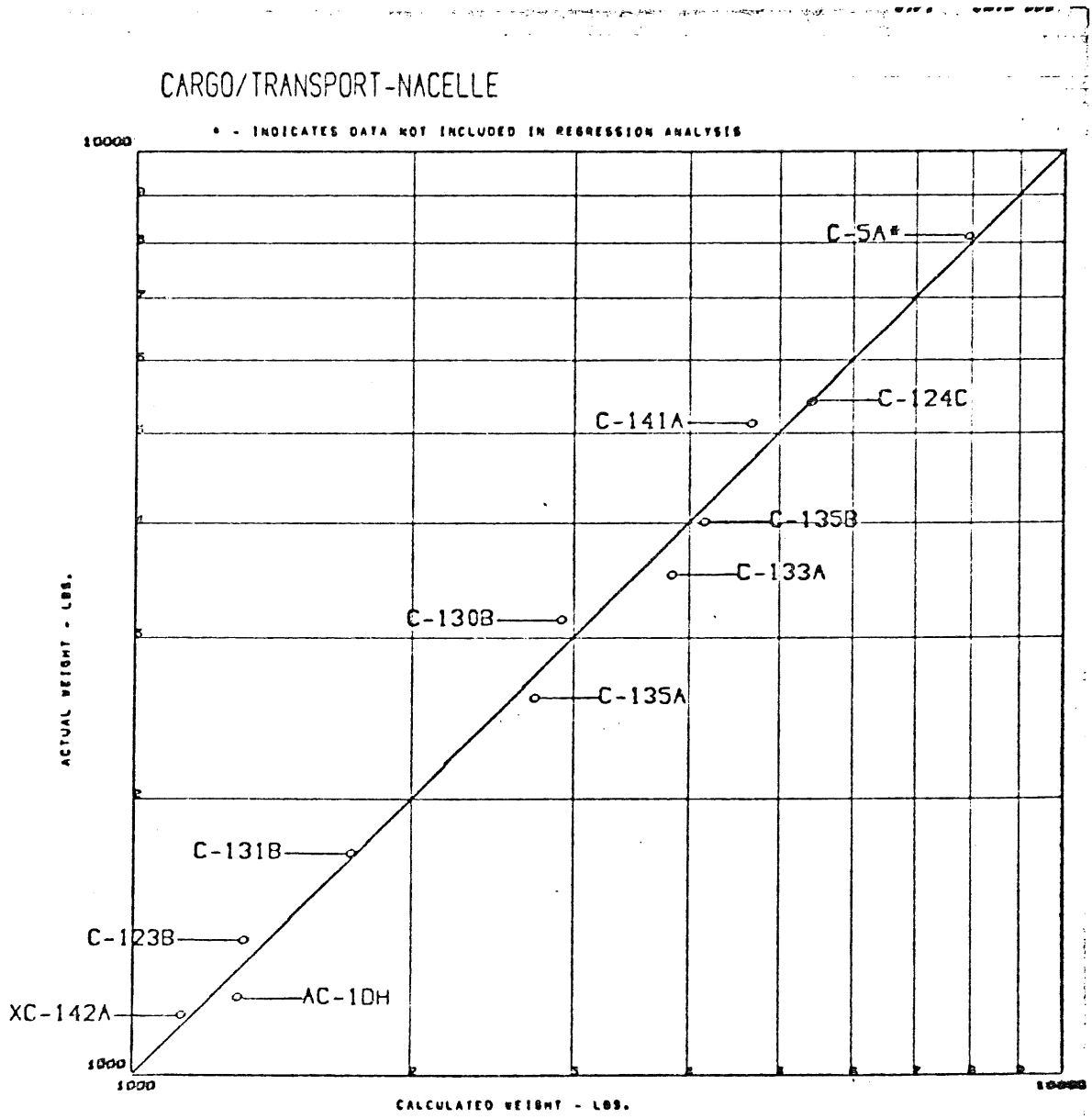
AIRCRAFT	ACTUAL W_{ng}	EQ.(1) W_{ng}	EQ.(2) W_{ng}	EQ.(3) W_{ng}	EQ.(4) W_{ng}
AC-1DH	1211	1344	1305	1302	1268
C-123B	1400	1256	1315	1316	1344
C-124C	5423	5257	5411	5426	5039
C-130B	3125	2757	2888	2907	3151
C-131B	1739	1684	1718	1720	1730
C-133A	3512	3841	3875	3842	3896
C-135A	2573	2724	2725	2724	2674
C-135B	4015	4385	4161	4163	4245
C-141A	5124	4902	4669	4668	4664
XC-142A	1155	1157	1135	1134	1111
C-5A	8151	9594	8106	7973	7463

TABLE 7 - 3

ENGINE SECTION - STATISTICAL DATA

AIRCRAFT	N_{lt}	N_d	N_w	N_z	W_{e+c}	N_e	S_n	T_e	P_l	P_h	W_{ng} Nacelle Group
AC-1DH	18.5	6.1	5.2	4.97	2257	2	218.0	6075	-	-	1211
C-123B	7.3	5.6	4.8	4.50	3380	2	135.0	5625	-	-	1400
C-124C	25.4	7.9	7.3	3.75	5349	4	373.5	7875	-	-	5423
C-130B	20.0	5.0	3.5	4.16	3209	4	256.0	9112	-	-	3125
C-131B	20.5	5.7	5.1	3.15	3622	2	260.0	5625	-	-	1739
C-133A	24.2	6.7	4.5	3.75	4282	4	282.5	13500	-	-	3512
C-135A	9.5	4.4	3.8	3.75	4277	4	107.0	13750	9.3	16.6	2573
C-135B	18.7	4.9	4.5	3.75	5212	4	246.0	18000	9.3	16.6	4015
C-141A	16.2	5.6	5.6	3.75	5471	4	287.5	21000	7.2	14.2	5124
XC-142A	8.3	4.8	3.1	4.50	1214	4	90.0	10260	-	-	1155
C-5A	26.0	8.5	8.5	3.75	8318	4	469.3	41100	6.0	25.3	8151

FIGURE 7-1

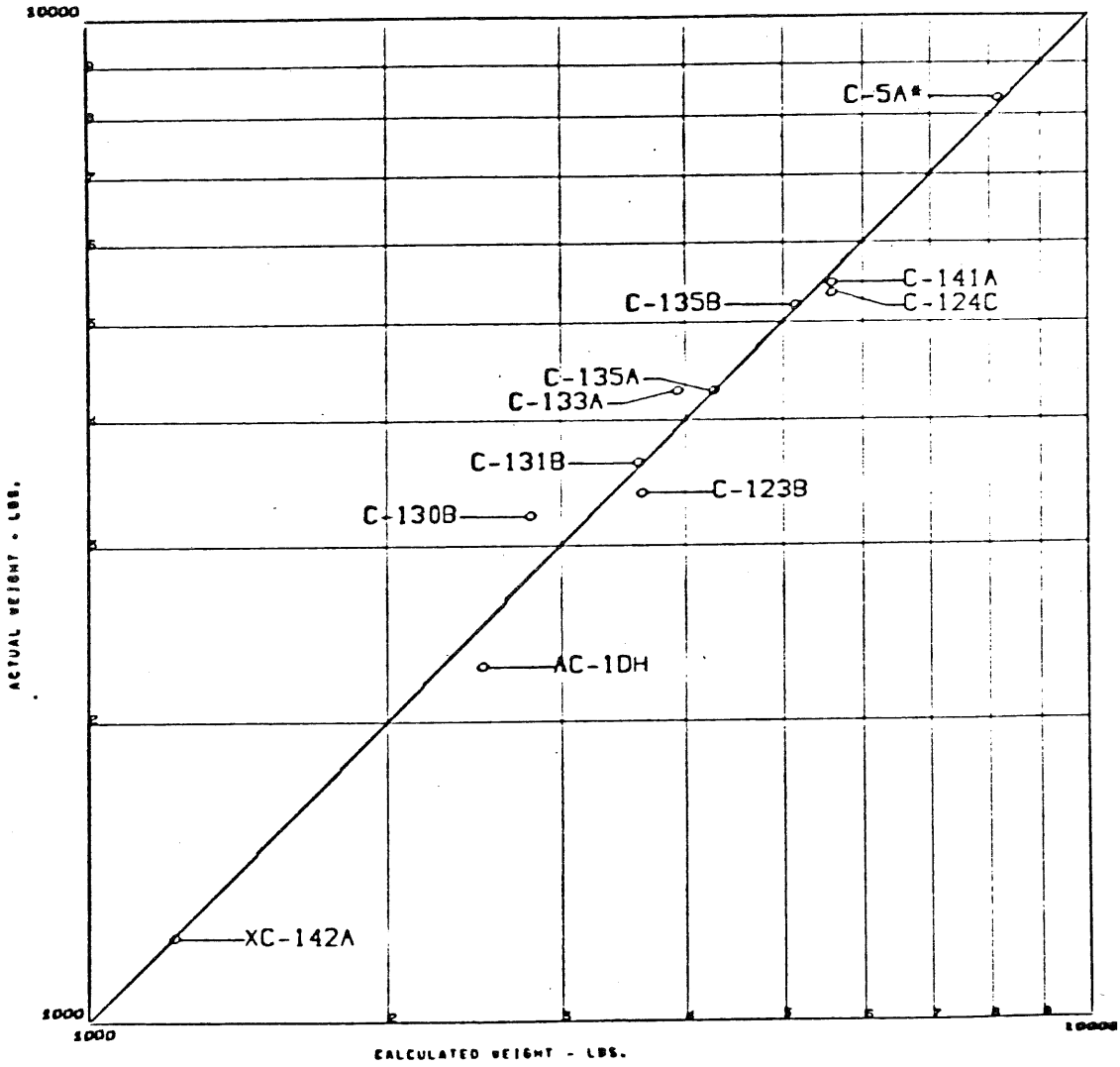


$$W_{NG} = .6724\ K_{NG}\ N_{LT}^{.100}\ N_W^{.293}\ N_Z^{.119}\ W_{E+C}^{.610}\ N_E^{.984}\ S_N^{.223}$$

COEFFICIENT OF CORRELATION= 99.06

FIGURE 7-2

WEIGHT OF ENGINE+NACELLE CONTENT

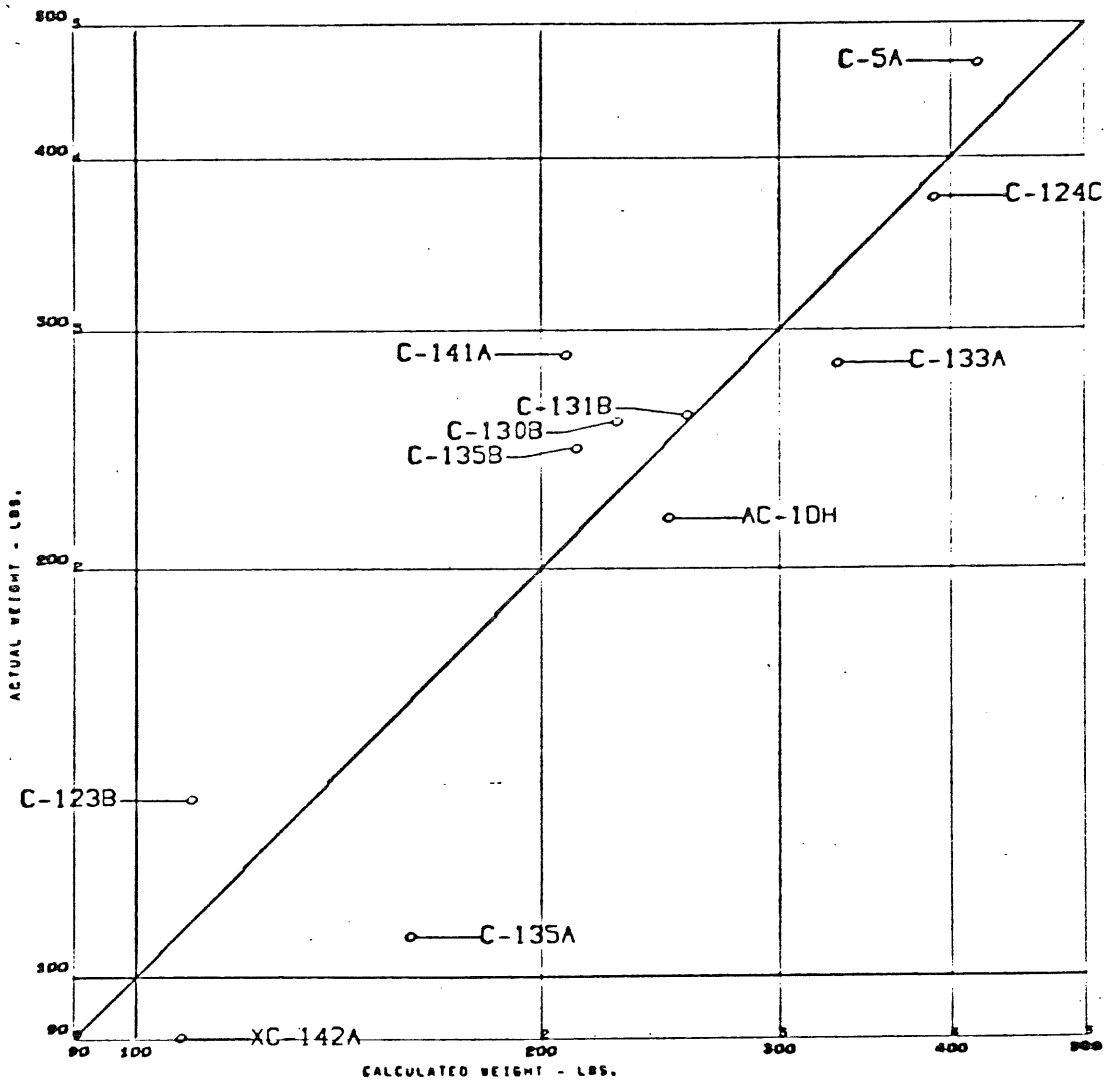


$$W_{E+NC} = 2.331 \; E_W^{.901} \; F_P \quad F_{TR}$$

COEFFICIENT OF CORRELATION= 99.28

FIGURE 7-3

NACELLE WETTED AREA-CARGO/TRANSPORT



$S_N = 5.983\ N_L^{.812}\ N_W^{.750}$

COEFFICIENT OF CORRELATION= 92.78

SECTION 8.0

PROPULSION GROUP

Due to the variation in design concepts used, the propulsion group does not lend itself to statistical analysis. A statistical equation was developed for the fuel system and an equation for the engine controls which gives a rough approximation was derived. Weight summaries and pertinent design data are presented for the other components to serve as an aid to the Weight Control Engineer in making weight estimates of these components. Table 8 - 1 is a weight summary of the entire propulsion group for the data points investigated.

TABLE 8 - 1

PROPULSION GROUP WEIGHT SUMMARY

	Engine Instl.	Air Induction	Exhaust System	Cooling System	Lub. System	Fuel System	Water Injection	Engine Controls	Starting System	Prop Instl.	Misc.	Thrust Reverser	Total Propulsion Group
AC-1DH	3170	7	306	-	211	389	-	51	59	919	4	-	5116
C-123B	4780	86	180	-	442	1413	91	94	132	1486	-	-	8704
C-142C	15551	461	918	-	1397	4059	166	294	126	4047	-	-	27019
C-130B	7190	177	123	-	521	1875	-	378	328	4496	-	-	15088
C-131B	4756	50	976	-	295	295	69	150	66	1247	-	-	7904
C-133A	10470	325	576	-	729	1338	96	157	198	5403	-	-	19292
C-135A	16687	-	-	-	246	3895	585	73	348		①179	-	22013
C-135B	17072	-	-	-	87	3850	-	212	217		①149	3348	24935
C-141A	18759	79	⑤1616	③144	212	1380	-	237	320	-	-	1961	24708
C-5A	28594	-	289	④124	9	2359	-	182	226	-	-	3980	35763
XC-142A	2872	152	63	-	204	463	-	135	16	1617	②2878	-	8400

① Engine Accessories

② Drive System 2870 lbs, 8 lbs drains

③ Shutters, Scoop & Ducts 121 lbs, Controls & Operating Mechanism 23

④ Shutters, Scoops & Ducts 119 lbs, Piping, Vents, Clamps, etc. 5

⑤ Appears to Include Part of Thrust Reverser

TABLE 8 - 2

AIR INDUCTION SYSTEM WEIGHT AND DESIGN DATA

AIRCRAFT	TOTAL SYSTEM WEIGHT	AIR DUCTING AND SHROUDING	INTAKE DOORS AND OPERATING CONT.	AIR FILTERS	MISC.	NUMBER OF ENGINES	TYPE OF ENGINE	THRUST OR EQUIVALENT THRUST PER ENGINE
AC-1DH	7	7	-	-	-	2	Recip.	6075
C-123B	86	29	44	11	(1) 2	2	Recip.	5625
C-124C	461	288	121	35	(2) 17	4	Recip.	7875
C-130B	177	155	-	-	(3) 22	4	Turbo Prop	9112
C-131B	50	32	18	-	-	2	Recip.	5625
C-133A	325	325	-	-	-	4	Turbo Prop	13500
C-135A	-	-	-	-	-	4	Jet	13750
C-135B	-	-	-	-	-	4	Jet	18000
C-141A	79	-	-	-	(4) 79	4	Jet	21000
C-5A	-	-	-	-	-	4	Jet	411000
XC-142A	153	106	-	-	(1) 47	4	Turbo Prop	10260

(1) Screens and Controls

(2) Blower Controls

(3) Generator Blast Tubes

(4) Vortex Suppressors 36 lbs, Nose Dome 43 lbs.

TABLE 8 - 3

EXHAUST SYSTEM WEIGHT AND DESIGN DATA

AIRCRAFT	TOTAL SYSTEM WEIGHT	EXHAUST STACKS	EXHAUST COLLECTORS	COLLECTOR OR ENG.SHROUD	TAIL PIPE	TAIL PIPE SHROUD & INSULATION	MISC.	NUMBER OF ENGINES	TYPE OF ENGINE	PER ENGINE THRUST OR EQUIV. THRUST
AC-1DH	306	153	-	-	(1) 146	-	(2) 7	2	Recip.	6075
C-123B	180	-	163	-	-	-	(2) 17	2	Recip.	5625
C-124C	918	881	-	-	-	-	(2) 37	4	Recip.	7875
C-130B	123	-	-	-	86	37	-	4	Turbo Prop	9112
C-131B	976	-	292	88	(1) 545	51	-	2	Recip	5625
C-133A	576	-	-	-	374	202	-	4	Turbo Prop	13500
C-135A	-	-	-	-	-	-	-	4	Jet	13750
C-135B	-	-	-	-	-	-	-	4	Jet	18000
C-141A	1616	-	-	-	376	17	(3) 1223	4	Jet	21000
C-5A	289	-	-	-	-	-	(4) 289	4	Jet	41100
XC-142A	63	-	-	-	63	-	-	4	Turbo Prop	10260

(1) Augmentor Tubes

(2) Supports, Brackets, etc.

(3) Bifurcated Duct 391 lbs, Aft Cowl 320 lbs, Exhaust 512 lbs

(4) Tail Cone 238 lbs, Recoup System 51 lbs.

TABLE 8 - 4

LUBRICATING SYSTEM WEIGHT AND DESIGN DATA

AIRCRAFT	TOTAL SYSTEM WEIGHT	TANKS	TANK SUPTS & PADDING	OIL COOLING	DIST. SYST.	VENT SYST.	CSD	OIL DILUTION SYSTEM	FILLING SYSTEM	MISC	NUMBER OF ENGINES	TYPE OF ENGINE	THRUST OR EQUIV.THRUST PER ENGINE
AC-1DH	211	63	-	82	39	18	-	5	-	(3) 4	2	Recip.	6075
C-123B	442	180	-	182	66	5	-	2	7	-	2	Recip.	5625
C-124C	1396	419	-	785	176	-	-	16	-	-	4	Recip.	7875
C-130B	521	129	18	188	129	-	-	-	-	-	4	Turbo Prop	9112
C-131B	295	47	14	176	-	8	-	4	11	(4) 35	2	Recip.	5625
C-133A	729	100	92	405	132	-	-	-	-	-	4	Turbo Prop	13500
C-135A	246	-	-	135	-	32	(1) 79	-	-	-	4	Jet	13750
C-135B	87	-	-	-	-	14	(2) 73	-	-	-	4	Jet	18000
C-141A	212	-	-	212	-	-	-	-	-	-	4	Jet	21000
C-5A	9	-	-	-	-	-	-	-	-	(5) 9	4	Jet	41100
XC-142A	204	74	-	92	36	-	-	-	2	-	4	Turbo Prop	10260

(1) Tanks & Supports - CSD 37 lbs, plumbing - CSD 31 lbs, air ejector system 11 lbs

(2) Oil Filter-CSD 8 lbs, tanks & supports - CSD 40 lbs, Plumbing-CSD 25 lbs

(3) Emergency Shutoff Valve

(4) Breather 12 lbs, warning system 20 lbs, drains 3 lbs.

(5) Ducts

TABLE 8 - 5

FUEL SYSTEM WEIGHT EQUATIONS

Coeff. of Correl.		
99.17	(1)	$W_{fs} = 2.493\ V_t^{.579}\ (1 + V_i/V_t)^{-1.0}\ (1 + V_p/V_t)\ N_t^{.50}\ (T \times SFC/1000)^{.100}$
99.33	(2)	$W_{fs} = 2.405\ V_t^{.606}\ (1 + V_i/V_t)^{-1.0}\ (1 + V_p/V_t)\ N_t^{.50}$ Recommended
96.93	(3)	$W_{fs} = 0.877\ V_t^{.835}\ (1 + V_i/V_t)^{-1.0}\ (1 + V_p/V_t)^{1.01}$
96.66	(4)	$W_{fs} = 1.644\ V_t^{.773}\ (1 + V_i/V_t)^{-1.0}$
81.59	(5)	$W_{fs} = 4.981\ V_t^{.611}$

Symbol Definition:

W_{fs} = Weight of Fuel System (excluding in-flight refueling) - lbs

V_t = Total Fuel Volume - gallons

V_i = Integral Fuel Volume - gallons

V_p = Volume of Fuel Protected by Self-Sealing - gallons

N_t = Number of Fuel Tanks

T = Thrust per Engine - lbs

SFC = Specific Fuel Consumption

TABLE 8 - 6

EQUATION RESULTS - FUEL SYSTEM

AIRCRAFT	ACTUAL W_{fs}	EQ. (1) W_{fs}	EQ. (2) W_{fs}	EQ. (3) W_{fs}	EQ. (4) W_{fs}	EQ. (5) W_{fs}
C-133A	1337	1181	1206	1423	1460	1854
C-135A	3[illegible]	3731	3678	3229	3191	2669
C-135B	3850	3622	3678	3229	3191	2669
C-141A	1380	1715	1684	1933	1938	2320
XC-142A	463	468	466	447	444	418
C-130B	1875	707	725	816	882	1114
C-5A	2259	3013	2911	3625	3468	3676
Coefficient of Correlation		99.2	99.3	96.9	96.7	81.6

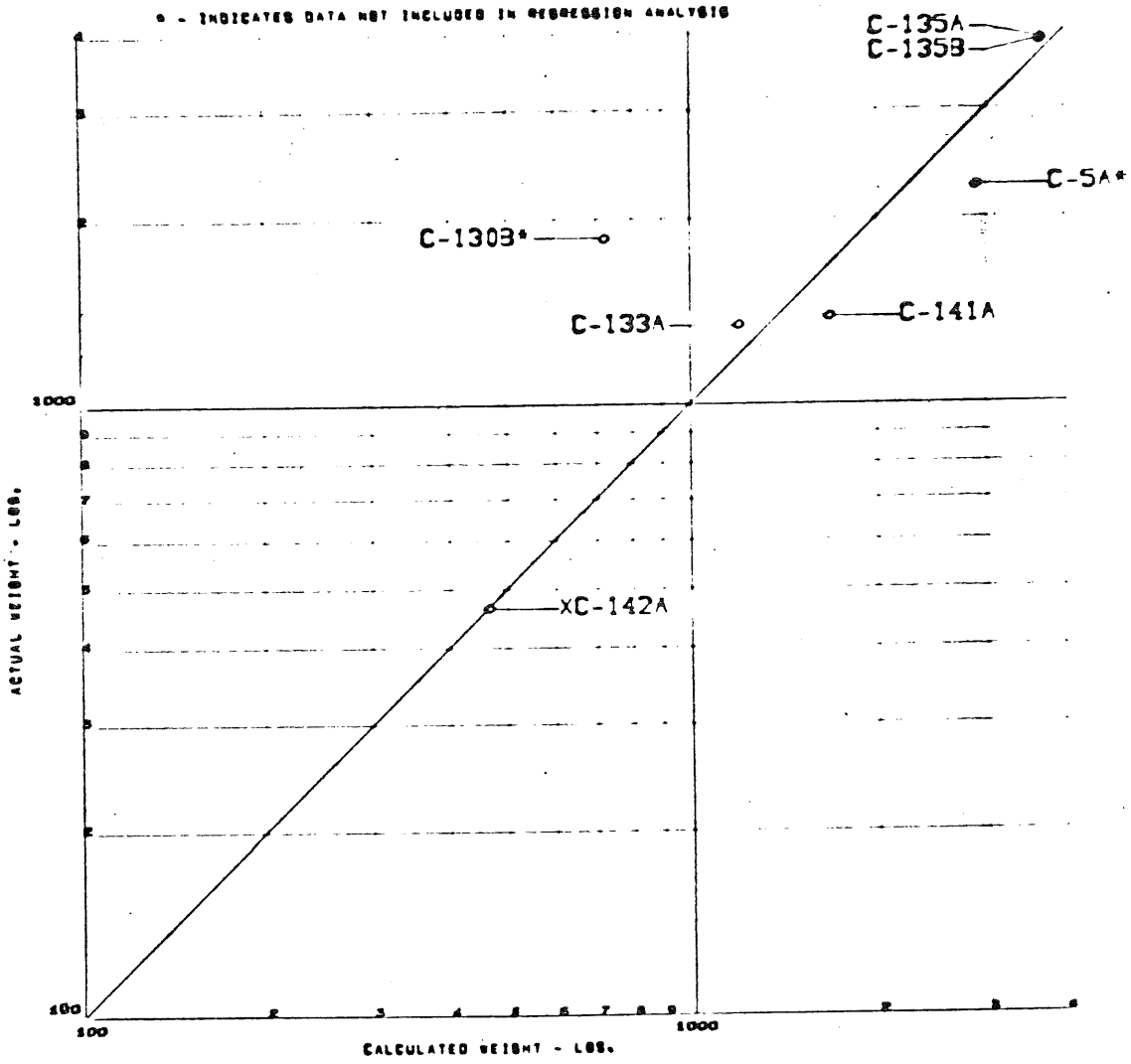
TABLE 8 - 7

FUEL SYSTEM DESIGN AND WEIGHT DATA

AIRCRAFT	V_t	V_i	V_p	N_t	T	SFC	(T.SFC/1000)	W_{fs}
C-133A	16000	16000	-	8	14811	.53	7.85	1337
C-135A	29026	13026	-	19	13750	.95	13.05	3894
C-135B	29026	13026	-	19	18000	.54	9.72	3850
C-141A	23080	23080	-	10	21000	.61	12.81	1380
XC-142A	1400	-	277	4	10260	.50	5.13	463
C-130B	6960	5150	-	6	12000	.50	6.00	1875
C-5A	49000	49000	-	12	41100	.45	18.49	2259

FIGURE 8-1

FUEL SYSTEM-CARGO/TRANSPORT.



$$W_{FS} = 2.405 \; V_T^{.606} \; (1+VI/VT)^{-1.000} \; (1+VP/VT)^{1.000} \; N_T^{.500}$$

COEFFICIENT OF CORRELATION= 99.34

TABLE 8 - 8

ENGINE CONTROLS WEIGHT AND DESIGN DATA

AIRCRAFT	TOTAL SYSTEM WEIGHT	THROTTLE CONTROLS	IGNITION	MIXTURE	EMERGENCY SHUTDOWN	SUPERCHARGER CONTROLS	MISC.	EST. W_{ec} *	N_e	L_{ec}
AC-1DH	51	-	-	-	-	-	-	61	2	64
C-123B	94	47	14	27	-	6	-	68	2	73
C-124C	294	68	56	49	-	-	(1) 121	235	4	269
C-130B	377	369	-	2	-	-	(2) 6	286	4	332
C-131B	150	76	31	28	-	3	(3) 12	70	2	75
C-133A	157	157	-	-	-	-	-	322	4	378
C-135A	73	73	-	-	-	-	-	268	4	310
C-135B	212	210	-	-	-	-	(4) 2	268	4	310
C-141A	236	185	-	-	23	-	(5) 28	213	4	241
C-5A	182	112	-	-	70	-	-	596	4	720
XC-142A	134	123	2	-	-	-	(6) 9	126	4	132

*$W_{ec} = 5\ N_e + .80\ L_{ec}$ (See Figure 8 - 2)

(1) General Supports

(2) Negative Torque Systems

(3) Augmentor 6 lbs. Junction Box 4 lbs, Fairleads 2 lbs.

(4) Thrust Reverser Controls

(5) Main Surge Bleed

(6) RPM Controls

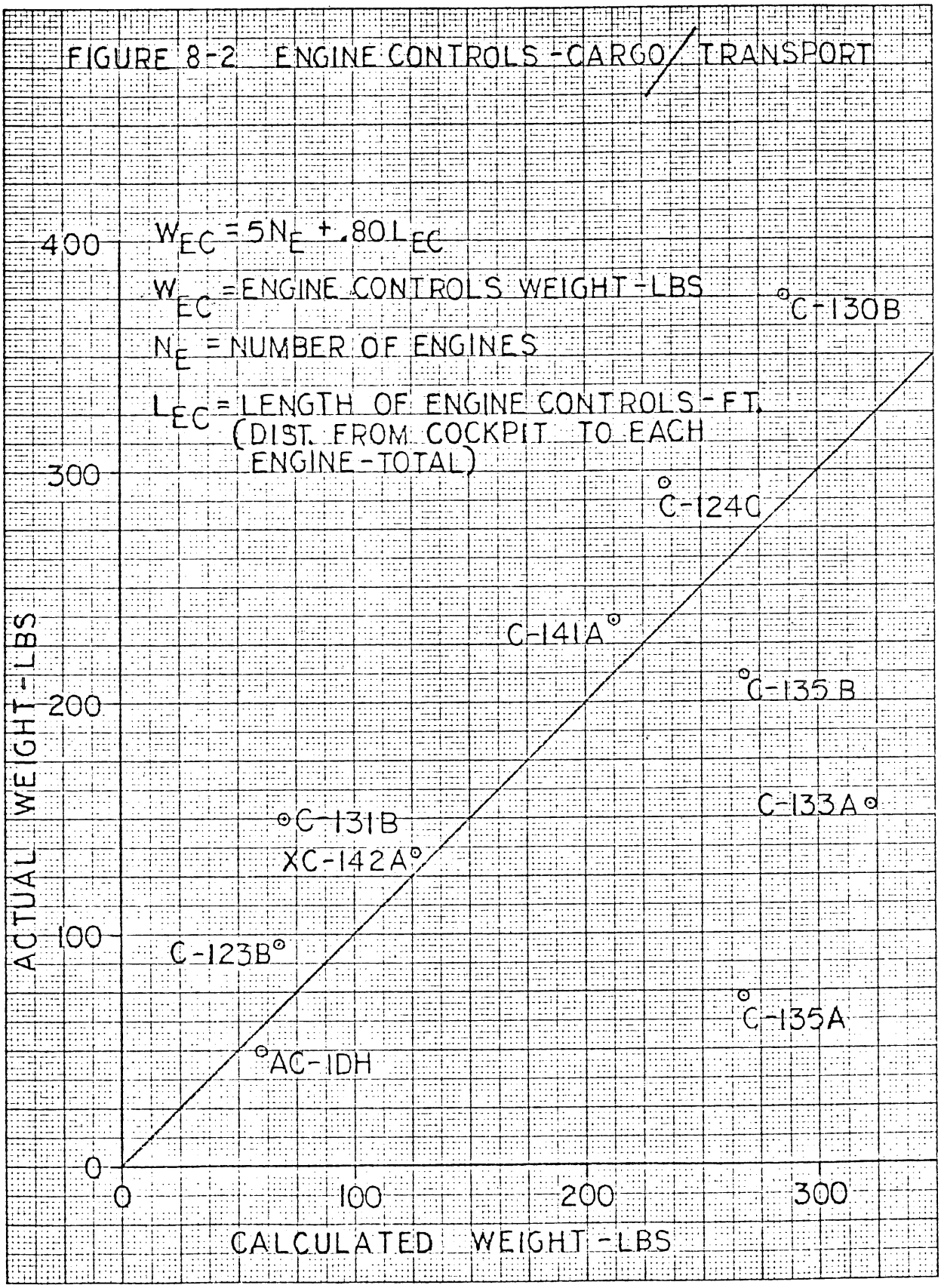


TABLE 8 - 9

STARTING SYSTEM WEIGHT AND DESIGN DATA

AIRCRAFT	TYPE	TOTAL SYSTEM WEIGHT	STARTER	CONT.	DUCTS	EMERG. START. SYST.	PRIMER & PIPING	CIRC.	MISC	NO. OF ENG.	TYPE OF ENG.	THRUST OR EQUIV. THRUST PER ENGINE
AC-1DH	-	59	-	-	-	-	-	-	-	2	Recip.	6075
C-123B	-	132	60	5	-	-	2	26	(4) 40	2	Recip.	5625
C-124C	Electric	125	105	-	-	-	5	15	-	4	Recip.	7875
C-130B	Pneumatic	328	100	25	106	-	-	68	(5) 29	4	Turbo Prop.	9112
C-131B	-	66	53	3	-	-	-	10	-	2	Recip.	5625
C-133A	Pneumatic	198	101	68	29	-	-	-	-	4	Turbo Prop.	13500
C-135A	Pneumatic	348	113	-	19	(1) 216	-	-	-	4	Jet	13750
C-135B	Pneumatic	217	74	17	20	(2) 102	-	-	4	4	Jet	18000
C-141A	Pneumatic	319	149	-	103	-	-	46	(5) 21	4	Jet	21000
C-5A	Air Turbine	225	136	26	-	-	-	58	(5) 5	4	Jet	41100
XC-142A	(3) -	16	-	-	-	-	-	5	(6) 11	4	Turbo Prop	10260

(1) Fuel-Air Starter Instl.
(2) Cartridge Starter Instl.
(3) Hydraulic Pump/Starter with Power from APU
(4) Hot Fuel Priming
(5) Nacelle Preheat
(6) Starter Cover 8 lbs, Regulator 3 lbs.

TABLE 8 - 10

WATER INJECTION SYSTEM

	C-123B	C-124C	C-131B	C-133A	C-135A
Total System Weight	(91)	(167)	(70)	(96)	(585)
Tanks	41	74	17	54	125
Pumps	14	24	9	-	131
Metering Unit	1	-	-	-	-
Valve & Plumbing	30	48	38	21	155
Controls	5	21	6	21	-
Vents	-	-	-	-	5
Drains	-	-	-	-	5
Filler Neck & Cap	-	-	-	-	3
Supports	-	-	-	-	50
Sight Gage & Quantity Gage	-	-	-	-	2
Pneumatic Ducting	-	-	-	-	31
Temperature Cont. Provisions	-	-	-	-	78
Water Inj. Fluid-Useful Load	214	456	165	-	5500
	28 Gal.	60 Gal.	22 Gal.		
		(1)		(2)	

(1) Two 30 Gallon Tanks

(2) One 100 Gallon Tank

SECTION 9

AUXILIARY POWER PLANT

AUXILIARY POWER PLANT GROUP WEIGHT DATA

AIRCRAFT	C-123B	C-124C	C-130B	C-133A	C-141A	C-5A	XC-142A
APU Model Manufacturer	D-2	GTPU 7249 Solar	85-65 AiResearch	-	GTCP 85-106 AiResearch	380594	T-62-T
Group Weight	(187)	(410)	(451)	(1203)	(555)	(966)	(178)
Engine or Power Unit	139	254	200	742	254	448	74
Engine Supports	4	12	-	-	31	51	4
Air Induction System	2	8	12	-	17	46	-
Exhaust System	-	24	-	-	41	53	5
Cooling System	-	1	-	-	-	-	-
Lubricating System	-	-	22	-	12	10	6
Fuel System	7	3	7	45	7	23	3
Controls	6	108	18	84	24	48	3
Starting System	8	-	-	-	102	134	78
Supports	21	-	26	-	7	2	-
Misc.	-	-	-	-	-	-	-
Insulation Blankets & Instl.	-	-	39	-	60	151	-
Internally Actuated G.T.C. Doors	-	-	7	-	-	-	-
Ducting	-	-	51	-	-	-	-
Air Turbine Motor (Incl.Fan)	-	-	69	-	-	-	-
Protective Lining	-	-	-	58	-	-	-
Engine Preheat	-	-	-	44	-	-	-
Circuitry	-	-	-	-	-	-	1
Fire Shield	-	-	-	-	-	-	4
Installation Factor (Avg. = .94)	.35	.61	1.26	.62	1.19	1.16	1.41
W_{APU} = 1.94 (Uninstalled APU Weight)	270	493	388	1439	493	869	144

SECTION 10

INSTRUMENTS AND NAVIGATIONAL GROUP

TABLE 10 - 1

INSTRUMENT GROUP WEIGHT EQUATIONS

Coeff. of Correl.

92.54 (1) $W_i = 4.540\ K_r\ K_{tp}\ N_{cs}^{.463}\ N_e^{.865}\ N_t^{.100}\ (L_f + B_w)^{.500}$

K_r = 1.207 for reciprocating engines
= 1.00 for others

K_{tp} = .872 for turboprop engines
= 1.00 for others

94.46 (2) $W_i = 4.509\ K_r\ K_{tp}\ N_{cs}^{.541}\ N_e^{1.000}\ (L_f + B_w)^{.500}$ Recommended

K_r = 1.133 for reciprocating engines
= 1.00 for others

K_{tp} = .793 for turboprops
= 1.00 for others

90.75 (3) $W_i = 11.96\ K_r\ K_{tp}\ N_{cs}^{1.000}\ (L_f + B_w)^{.475}$

K_r = .778 for reciprocating engines
= 1.00 for others

K_{tp} = .803 for turboprops
= 1.00 for others

86.55 (4) $W_i = 169.4\ K_r\ K_{tp}\ N_{cs}^{1.000}$

K_r = .694 for reciprocating engines
= 1.00 for others

K_{tp} = .717 for turboprops
= 1.00 for others

Symbol Definition:

W_i = Instrument Group Weight-lbs (Basic Inst. only-See Table 10-4)

K_r = Constant for Reciprocating Engines

K_{tp} = Constant for Turboprop Engines

N_{cs} = Number of Crew Stations

N_e = Number of Engines

N_t = Number of Fuel Tanks

$L_f + B_w$ = Length of Fuselage Plus Length of Wingspan-ft

TABLE 10 - 2

EQUATION RESULTS - INSTRUMENT GROUP

AIRCRAFT	ACTUAL W_i	EQ. (1) W_i	EQ. (2) W_i	EQ. (3) W_i	EQ. (4) W_i
AC-1DH	115	191.3	192.8	212.7	235.3
C-123B	268	201.2	202.8	223.3	235.3
C-124C	769	768.9	750.9	561.3	470.6
C-130B	391	453.4	459.8	510.0	486.0
C-131B	250	200.1	201.7	222.1	235.3
C-133A	578	561.1	552.9	607.7	486.0
C-135A	473	541.9	526.5	504.3	508.3
C-135B	466	541.9	526.5	504.3	508.3
C-141A	822	617.1	653.8	712.5	677.7
XC-142A	254	225.6	225.7	185.2	243.0
C-5A	888	781.7	813.3	876.9	677.7

TABLE 10 - 3

INSTRUMENTS AND NAVIGATIONAL EQUIPMENT GROUP WEIGHT SUMMARY

AIRCRAFT	TOTAL	FLIGHT INSTRUMENTS	ENGINE INST.	MISC. INST.	INST.POWER SYSTEM	NAVY EQUIP.	MISC.	GYROSYN COMPASS
AC-1DH	(132)	58	32	25	-	17	-	-
C-123B	(311)	86	154	28	-	2	(1) 41	-
C-124C	(769)	163	548	58	-	-	-	-
C-130B	(742)	138	207	46	351	-	-	-
C-131B	(250)	52	157	18	-	-	-	23
C-133A	(578)	71	328	30	-	-	(2) 149	-
C-135A	(547)	113	212	41	-	74	-	107
C-135B	(540)	105	213	41	-	74	-	107
C-141A	(1122)	480	491	60	-	42	(3) 49	-
C-5A	(1036)	465	458	40	-	73	-	-
XC-142A	(353)	146	169	38	-	-	-	-

(1) Inverter

(2) Compass

(3) integrated converter 40 lbs, Transformer 9 lbs

TABLE 10 - 4

INSTRUMENT GROUP WEIGHT ADJUSTMENTS

AIRCRAFT	REPORTED WEIGHT	WEIGHT ADJUSTMENTS					ADJUSTED WEIGHT
		NAVIGATIONAL EQUIPMENT	FLIGHT DIRECTOR	CONTROL AIR DATA COMPUTER	POWER CONVERSION	POWER SYSTEM	
AC-1DH	132	17	-	-	-	-	115
C-123B	311	2	-	-	41	-	268
C-124C	769	-	-	-	-	-	769
C-130B	742	-	-	-	-	351	391
C-131B	250	-	-	-	-	-	250
C-133A	578	-	-	-	-	-	578
C-135A	547	74	-	-	-	-	473
C-135B	540	74	-	-	-	-	466
C-141A	1122	42	134	75	49	-	822
C-5A	1036	73	-	75	-	-	888
XC-142A	353	-	99	-	-	-	254

TABLE 10 - 5

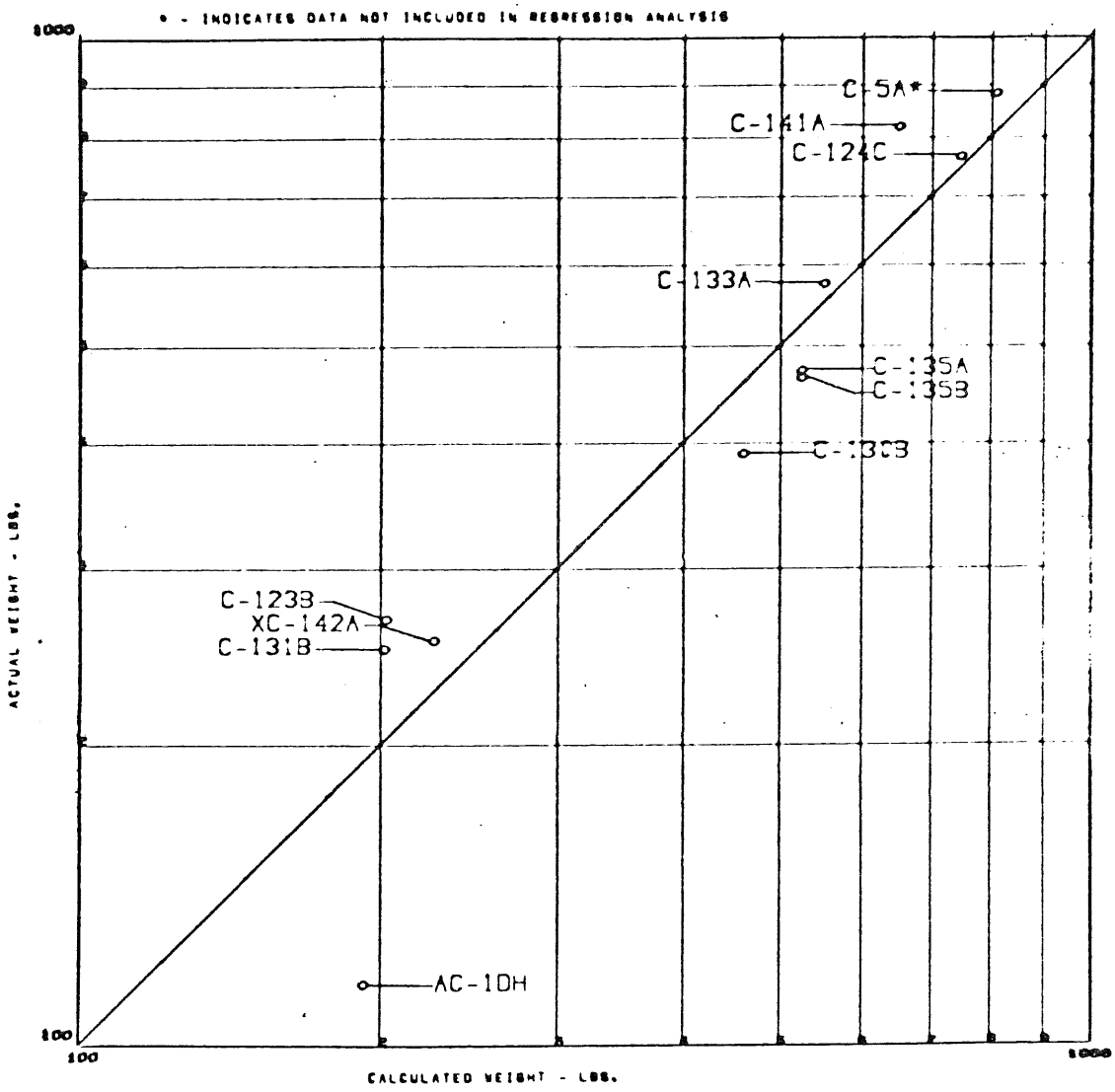
INSTRUMENT GROUP DESIGN DATA

AIRCRAFT	W_i *	$L_f + B_w$	ENGINE TYPE	NO. OF FUEL TANKS	NO. OF ENGINES	NO. OF CREW STATIONS
AC-1DH	115	168.2	Recip.	2	2	2
C-123B	268	186.2	Recip.	2	2	2
C-124C	769	301.2	Recip.	12	4	4
C-130B	391	230.3	Turbo Prop	6	4	4
C-131B	250	184.2	Recip.	2	2	2
C-133A	578	333.0	Turbo Prop	8	4	4
C-135A	473	259.4	Jet	19	4	3
C-135B	466	259.4	Jet	19	4	3
C-141A	822	293.0	Jet	10	4	4
C-5A	888	453.3	Jet	12	4	4
XC-142A	254	117.5	Turbo Prop	4	4	2

* Instrument Weight has been adjusted to include no navigational equipment and only basic instruments. See Table 10-4.

FIGURE 10-1

CARGO/TRANSPORT - INSTRUMENT WEIGHT



$$W_I = 4.509\ N_{CS}^{.541}\ N_E^{1.000}\ (L_F + B_W)^{.500}\ K_R\ K_{TP}$$

COEFFICIENT OF CORRELATION= 94.47

SECTION 11
HYDRAULICS AND PNEUMATICS

TABLE 11 - 1

HYDRAULIC SYSTEM WEIGHT EQUATIONS

Coeff. of Correl.	
95.18	$W_{hs} = .2673\ N_f^{1.0}\ (L_f + B_w)^{.937}$

Symbol Definition:

* W_{hs} = Utility Hydraulics Weight - lbs

N_f = Number of Functions for which the Utility Hydraulic System Provides Power

L_f = Fuselage Length - ft.

B_w = Wing Span - ft.

* W_{hs} includes only utility hydraulics. Pneumatics, power controls and emergency hydraulics are not included. See Table 11 - 4 for weight adjustments.

TABLE 11 - 2

HYDRAULIC GROUP DESIGN DATA AND EQUATION RESULTS

AIRCRAFT	N_f	$L_f + B_w$	ACTUAL W_{hs}	EQ. W_{hs}
AC-1DH	6	168.2	153	196
C-123B	7	186.2	208	251
C-124C	8	301.2	458	451
C-130B	9	230.3	440	395
C-131B	9	184.2	239	320
C-133A	8	333.0	368	496
C-135A	12	259.4	694	588
C-135B	13	259.4	743	637
C-141A	14	293.0	1041	769
XC-142A	15	117.5	463	350
C-5A	21	453.3	2603	1737

TABLE 11 - 3

HYDRAULIC SYSTEM FUNCTIONS

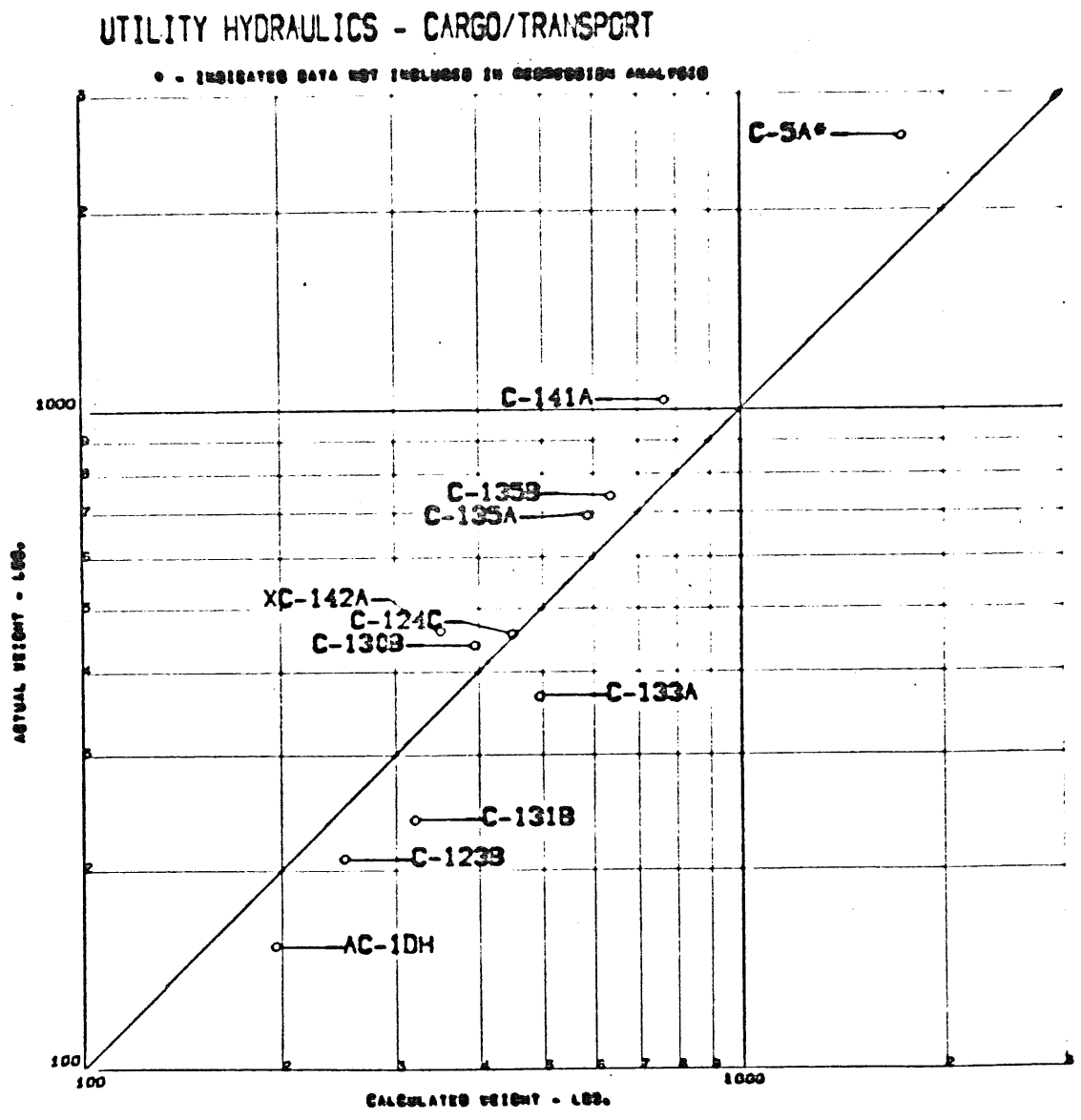
	AC-1DH	C-123B	C-124C	C-130B	C-131B	C-133A	C-135A	C-135B	C-141A	XC-142A	C-5A
1. Main Landing Gear Retraction	X	X	X	X	X	X	X	X	X	X	X
2. Main Landing Gear Brakes	X	X	X	X	X	X	X	X	X	X	X
3. Main Landing Gear Door Operation	X	-	-	-	-	-	X	X	-	X	X
4. Nose Landing Gear Retraction	X	X	X	X	X	X	X	X	X	X	X
5. Nose Landing Gear Brakes	-	-	-	-	-	-	-	-	-	-	X
6. Nose Landing Gear Door Operation	X	-	-	-	-	-	X	X	-	X	X
7. Nose Wheel Steering	X	X	X	X	X	X	X	X	X	X	X
8. Leading Edge Flaps	-	-	-	-	-	-	X	X	-	X	X
9. Trailing Edge Flaps	-	X	X	X	X	X	X	X	X	X	X
10. Spoilers	-	-	-	-	-	-	X	X	X	-	X
11. Generator C.S.D.	-	-	-	-	-	-	X	X	-	X	X
12. Stabilizer Trim	-	-	-	-	-	-	-	-	X	X	X
13. Deflector Doors	-	-	-	-	-	-	-	-	X	-	-
14. Aft Pressure Doors	-	-	-	X	-	-	-	-	X	-	X
15. Aft Ramp	-	X	-	X	-	X	-	-	X	X	X
16. Cargo Doors	-	X	X(2)	X(2)	X	X(2)	X	X	X(2)	X(2)	X
17. Emergency Generator	-	-	-	-	-	-	X	X	X	-	X
18. Thrust Reversers	-	-	-	-	-	-	-	X	X	-	X
19. APU Starter	-	-	-	-	-	-	-	-	-	X	X
20. Air Compressor	-	-	-	-	-	-	-	-	-	-	X
21. Wing Incidence	-	-	-	-	-	-	-	-	-	X	-
22. Entrance/Stairway	-	-	-	-	X	-	-	-	-	-	-
23. Bumper	-	-	-	-	X	-	-	-	-	-	-
24. Engine Preheat	-	-	-	-	X	-	-	-	-	-	-
25. Snubbers	-	-	X	-	-	-	-	-	-	-	-
26. Aerial Refueling	-	-	-	-	-	-	-	-	-	-	X
27. Air Compressor	-	-	-	-	-	-	-	-	-	-	X
N_f	6	7	8	9	9	8	12	13	14	15	21

TABLE 11 - 4

HYDRAULIC SYSTEM WEIGHT DATA

AIRCRAFT	REPORTED W_{hs+p}	LESS PNEUMATIC	LESS PRIMARY HYD.	LESS EXCESS FLUID	LESS EMER. HYD.	PLUS UTILITY HYD.	ADJUSTED WEIGHT
AC-1DH	157.2	-	-	-	-3.6	-	153.6
C-123B	233.8	-	-	-	-26.1	-	207.7
C-124C	582.2	-	-64.0	-	-60.2	-	458.0
C-130B	708.4	-	-146.8	-	-121.9	-	439.7
C-131B	264.1	-3.8	-	-	-20.9	-	239.4
C-133A	2678.5	-2202.0	-	-100.0	-8.0	-	368.5
C-135A	912.6	-	-171.5	-	-47.0	-	694.1
C-135B	963.6	-	-171.5	-	-49.0	-	743.1
C-141A	1488.9	-	-447.6	-	-	-	1041.3
C-5A	4195.4	-	-1424.6	-	-168.0	-	2602.8
XC-142A	241.3	-	-	-	-110.2	+332.0	463.1

FIGURE II-1



$$W_{HS} = .2673 \; N_F^{1.000} \; LF+BW^{.937}$$

COEFFICIENT OF CORRELATION= 95.18

SECTION 12

ELECTRICAL GROUP

TABLE 12 - 1

ELECTRICAL GROUP WEIGHT EQUATION

Coeff. of Correl.		
96.67	(1) $W_{el} = 7.291\ R_{kva}^{.782}\ L^{.346}\ N_g^{.100}$	Recommended

Symbol Definition:

* W_{el} = Electrical Group Weight-lbs

R_{kva} = System Rating - KVA

L = Distance from Generators to Avionics Bay + Distance from Avionics Bay to Cockpit-ft

N_g = Number of Generators

* W_{el} will give the weight of a AC generation system with C.S.D. units. No batteries or emergency generation is included. See Table 12-3 for weight adjustments to make data points compatible.

TABLE 12 - 2

EQUATION RESULTS - ELECTRICAL GROUP

AIRCRAFT	ACTUAL W_{el}	EQ. (1) W_{el}
C-130B	2332	2495
C-133A	2123	2080
C-135A	2640	2698
C-135B	2507	2698
C-141A	2942	2541
XC-142A	580	583
C-5A	3728	2929
Coefficient of Correlation:		96.7

TABLE 12 - 3

ELECTRICAL GROUP WEIGHT AND DESIGN DATA

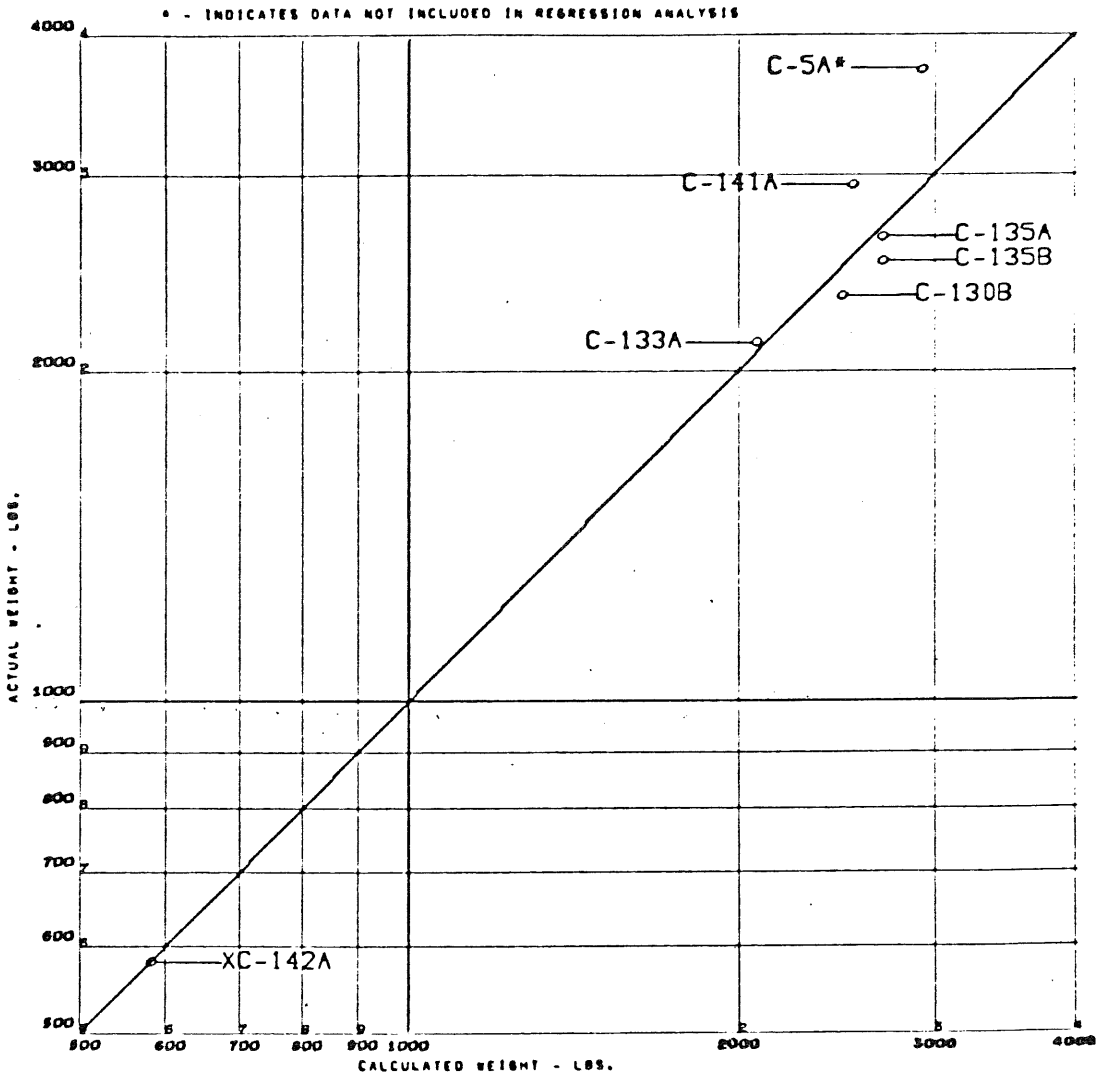
Aircraft	A.C. System						D.C. System						Total W_{EL}	L ft.	N_G	R_{KVA}
	Power Generator	Power Convr	Pwr Dist & Control	Lights & Signal Dev	Equip Supports	$W_{EL_{AC}}$	D.C. Battery	Power Convr	Pwr Dist & Control	Lights & Signal Dev	Equip Supports	$W_{EL_{DC}}$				
C-130B	774.0(1)	68.2	871.0(2)	218.4(3)	142.1	2073.7	-(4)	-(5)	159.6(2)	54.0(3)	44.9	258.5	2332.2	146	4	160
C-133A	451.1(6)	-	711.9	278.0	203.1	1644.1	-(7)	128.7	269.4	41.8	39.5	479.3	2123.5	202	2	120
C-135A	572.8	159.0	1213.7	154.1	121.9	2221.5	-(8)	-	410.2	-	8.5	418.7	2640.2	183	4	160
C-135B	504.8	159.0	1192.3	143.1	109.9	2109.1	-(9)	-	389.2	-	8.5	397.7	2506.8	183	4	160
C-141A	820.5(10)	24.0	1438.6	411.1	53.1	2747.3	-(11)	69.5	106.7	18.9	-	195.1	2942.4	154	4	160
XC-142A	235.0	18.2	244.7	27.8	29.1	554.8	-	-	9.2	15.6	-	24.8	579.6	37	2	50
C-5A	760.4	24.1	1412.5	758.5	601.3	3556.8	-(12)	76.0	87.3	5.3	2.7	171.3	3728.1	232	4	160

NOTES:

1. C-130B - +336 for addition of CSD units (4 x 84)
2. C-130B - 94.0 transferred from D.C. system to A.C. - Coding Correction
3. C-130B - 177.0 transferred from D.C. system to A.C. - Coding Correction
4. C-130B - -103.0 for battery removed
5. C-130B - -192.0 for removal of inverter and rectifier - complimentary to addition of CSD's
6. C-133A - +208.0 for addition of CSD units (2 x 104)
7. C-133A - -88.0 for battery removed
8. C-135A - -68.3 for battery removed
9. C-135B - -68.3 for battery removed
10. C-141A - +336.0 portion of CSD units transferred from Propulsion Group - Coding Correction
11. C-141A - -44.1 for battery removed
12. C-5A - -43.0 for battery removed

FIGURE 12-1

ELECTRICAL GROUP-CARGO/TRANSPORT



$$W_{EL} = 7.291 \; R_{KVA}^{.782} \; L^{.346} \; N_G^{.100}$$

COEFFICIENT OF CORRELATION= 96.67

SECTION 13

ELECTRONICS

TABLE 13 - 1

ELECTRONIC WEIGHT EQUATIONS

Coeff. of Correl.		
99.27	(1)	$W_{av} = .9407\ W_{eq}^{.901}\ L_f^{.250}$
98.79	(2)	$W_{av} = 1.730\ W_{eq}^{.983}$ Recommended
98.77	(3)	$W_{av} = 1.548\ W_{eq}^{1.000}$

Symbol Definition:

W_{av} = Electronics or Avionics Installed Equipment Weight-lbs

W_{eq} = Uninstalled Electronics or Avionics Equipment Weight-lbs

L_f = Length of Fuselage-ft

TABLE 13 - 2

EQUATION RESULTS - ELECTRONICS

AIRCRAFT	ACTUAL W_{av}	EQ.(1) W_{av}	EQ.(2) W_{av}	EQ.(3) W_{av}
AC-1DH	364	359	353	345
C-123B	546	562	568	560
C-124C	1864	1763	1720	1726
C-130B	2229	2154	2298	2318
C-131B	1046	1050	1111	1107
C-133A	2016	1955	1829	1838
C-135A	2023	2177	2158	2174
C-135B	2233	2372	2369	2390
C-141A	2333	2254	2224	2242
C-5A	4358	4417	3983	4053
XC-142A	807	870	1027	1022

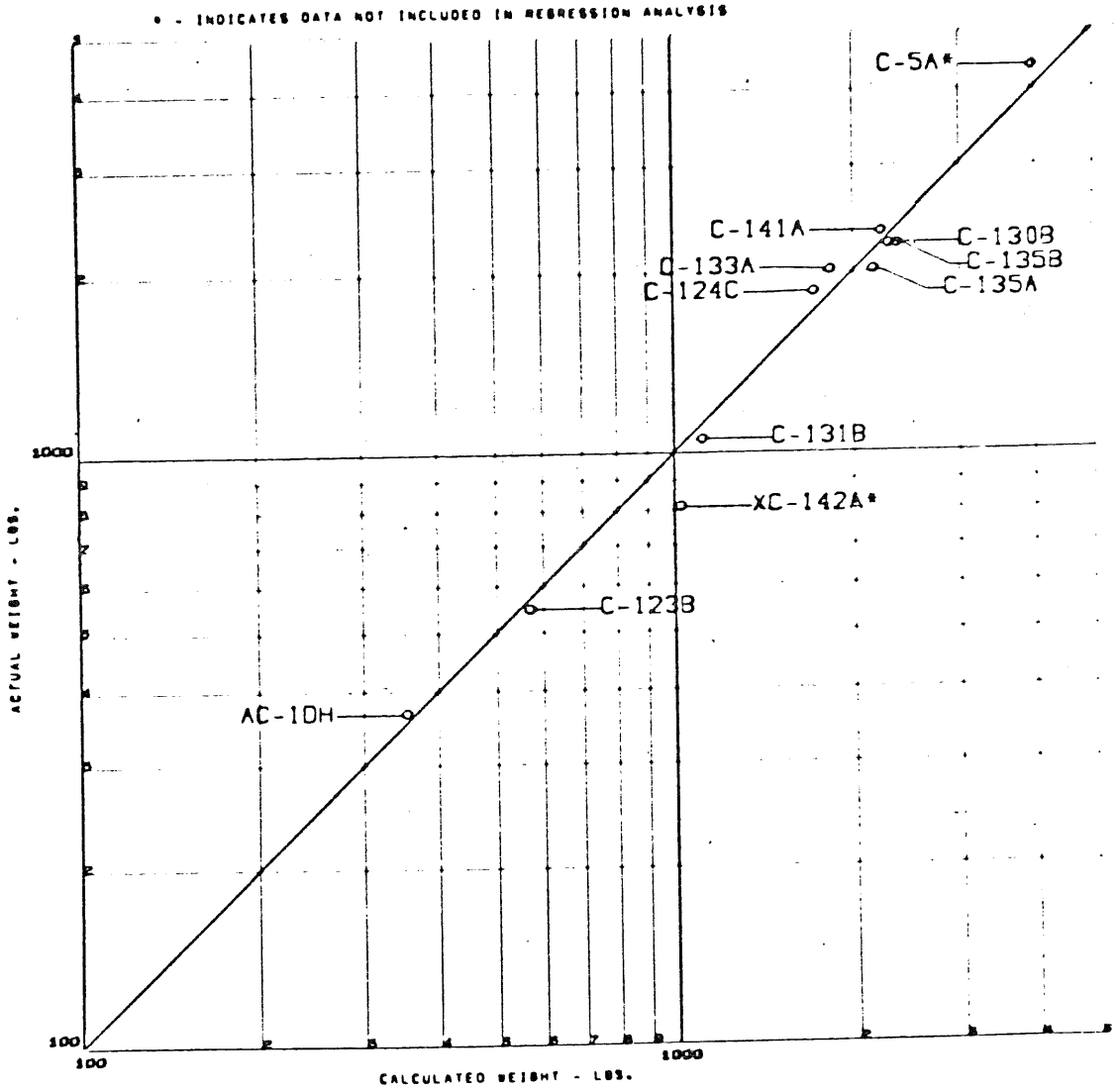
TABLE 13 - 3

ELECTRONICS WEIGHT AND DESIGN DATA

AIRCRAFT	REPORTED W_{av}	WIRE & CONNEC.	MISC. SUPTS.	RACKS & SHELVES	NOT INCLUDED			INSTL. WEIGHT	W_{eq}	ADJUSTED W_{av}	L_f
					INSTL. PROV.	COOLING PROV.	MISC.				
AC-1DH	383	13	76	52	19	-	-	(141)	(223)	[364]	72.6
C-123B	577	126	35	23	31	-	-	(184)	(362)	[546]	76.3
C-124C	1886	577		172	22	-	-	(749)	(1115)	[1864]	127.1
C-130B	2229	508		224	-	-	-	(732)	(1497)	[2229]	97.8
C-131B	1046	286	-	45	-	-	-	(331)	(715)	[1046]	79.2
C-133A	2047	829			31	-	-	(829)	(1187)	[2016]	153.4
C-135A	2115	425	58	136	42	46	4	(619)	(1404)	[2023]	128.6
C-135B	2290	461	87	141	7	46	4	(689)	(1544)	[2233]	128.6
C-141A	2347	605	158	122	14	-	-	(885)	(1448)	[2333]	132.3
C-5A	4358	1206	197	337	-	-	-	(1740)	(2618)	[4358]	230.6
XC-142A	807		147		-	-	-	(147)	(660)	[807]	50.0

FIGURE 13-1

CARGO/TRANSPORT-ELECTRONICS WEIGHT



$W_{AV} = 1.730\ W_{EQ}^{.983}$

COEFFICIENT OF CORRELATION= 98.79

SECTION 14

FURNISHINGS AND EQUIPMENT GROUP

TABLE 14 - 1

FURNISHINGS AND EQUIPMENT GROUP WEIGHT EQUATIONS

Coeff. of Correl.		
95.36	(1) $W_{f+e} = 3.796\ A_f^{.750}$	
96.52	(2) $W_{f+e} = .0211\ W_c^{.307}\ A_f^{1.000}$	
95.99	(3) $W_{f+e} = .0577\ N_c^{.100}\ W_c^{.393}\ A_f^{.750}$	Recommended
87.56	(4) $W_{f+e} = 2.023\ N_c^{.500}\ A_f^{.750}$	

Symbol Definition:

* W_{f+e} = Furnishings and Equipment Weight-lbs.

N_c = Number of Crew

W_c = Maximum Cargo Weight-lb

A_f = Fuselage Wetted Area-ft^2

* W_{f+e} does not include cargo handling equipment or personnel seats. See Table 14-3 for weight adjustments to make data points compatible.

TABLE 14 - 2

EQUATION RESULTS - FURNISHINGS AND EQUIPMENT GROUP

AIRCRAFT	ACTUAL W_{f+e}	EQ. (1) W_{f+e}	EQ. (2) W_{f+e}	EQ. (3) W_{f+e}	EQ. (4) W_{f+e}
AC-1DH	526	958	463	446	722
C-123B	910	1240	934	912	935
C-124C	3920	2513	3515	3308	2995
C-135A	3445	2058	3090	3159	2193
C-135B	3314	2058	3075	3139	2193
C-141A	3918	2472	3690	3683	3486
XC-142A	455	901	528	574	832
C-130B	3132	1716	1833	1840	1829
C-131B	1431	1093	722	747	1008
C-133A	2952	2739	4956	4725	2919
C-5A	6109	5345	15490	12950	6368
Coefficient of Correlation:		95.5	96.5	96.0	87.6

TABLE 14 - 3

FURNISHINGS AND EQUIPMENT GROUP DATA

Aircraft	Total Reported Weight	ACC. for Personnel			Misc. Eq. & Furnishings				Emergency Equipment	Adjusted $W_F + E$ (4)	N_C	Max. Number Personnel	W_C	A_F
		Accomod.	Oxygen	Total	Misc. Eq.	Cargo Hand.	Furn.	Total						
AC-1DH	732	291	8	(299)	33	0	286	(319)	(114)	526 (3)	2	32	5000	1595
C-123B	1005	287	28	(315)	390	95	52	(537)	(153)	910	2	0	16000	2250
C-124C	7539	1128	358	(1486)	435	3619	1222	(5276)	(777)	3920	5	200	55643	5770
C-130B	4646	2361 (2)	299	(2660)	525	416	627	(1568)	(418)	3132	4	92	35000	3469
C-131B	1433	290	50	(340)	80	2	787	(869)	(224)	1431	3	40	12000	1900
C-133A	3631	549	158	(707)	460	679	973	(2112)	(812)	2952	4	0	117162	6472
C-135A	3445	570	142	(712)	346	0	2254	(2600)	(133)	3445	4	126	87105	4420
C-135B	4376	571	1204 (1)	(1775)	346	0	2123	(2469)	(132)	3314	4	126	85685	4420
C-141A	3320	1064	243	(1307)	387	402	833	(1622)	(391)	2918	7	154	70000	5645
C-5A	7204	1704	378	(2082)	270	699	3707	(4676)	(446)	6109 (3)	5	360	262664	15779
XC-142A	691	297	42	(339)	124	54	46	(224)	(128)	455 (3)	3	0	10000	1470

NOTES: (1) Transfer 1062 lbs. to useful load to make compatible with C-135A

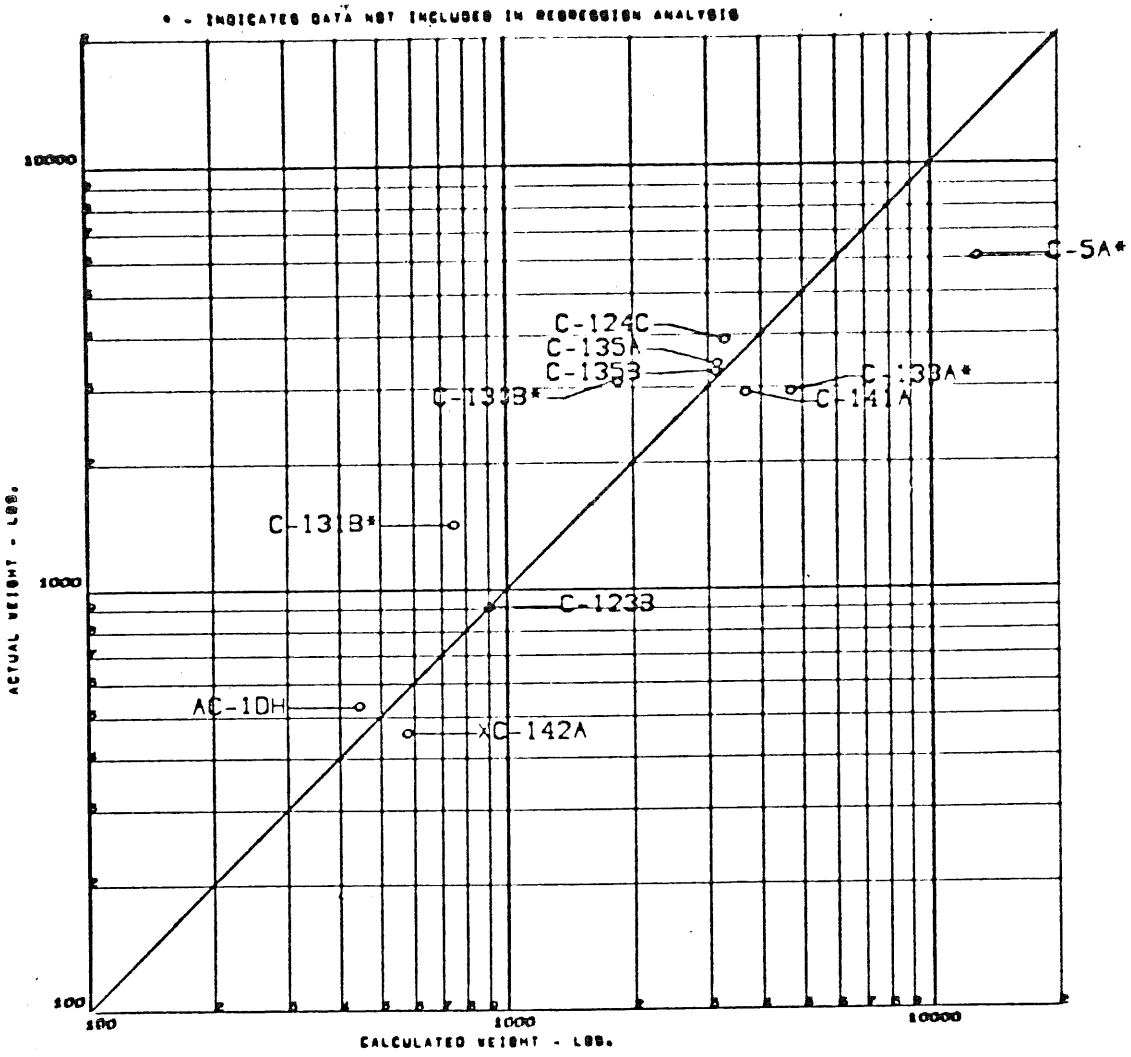
(2) 1098 lbs. for 7 troops - removed

(3) Personnel Seats Removed: AC-1DH 32 @ 206 lb.
C-5A ? @ 396 lb.
XC-142A 31 @ 182 lb.

(4) Does not include cargo handling or wt. removed by (1), (2), & (3)

FIGURE 14-1

CARGO/TRANSPORT - FURNISHINGS AND EQUIPMENT WEIGHT



$$W_{F+E} = .0577 \; N_C^{.100} \; W_C^{.393} \; A_F^{.750}$$

COEFFICIENT OF CORRELATION= 95.99

SECTION 15

AIR CONDITIONING AND ANTI-ICING

Due to differences in design concepts and requirements, it was not possible to develop a meaningful statistical weight equation for anti-icing. Table 15-5 is presented as an aid in assisting the weight engineer in making an estimate for this system.

TABLE 15 - 1

AIR CONDITIONING SYSTEM EQUATIONS

Coeff. of Correl.			
99.96	(1)	$W_{acs} = 39.58\ N_p^{.250}\ (V_p/1000)^{.652}\ \Delta_p^{.125}\ W_{eq}^{.100}$	Recommended
98.27	(2)	$W_{acs} = 62.36\ N_p^{.250}\ (V_p/1000)^{.604}\ W_{eq}^{.100}$	
98.35	(3)	$W_{acs} = 130.9\ N_p^{.250}\ (V_p/1000)^{.599}$	
96.24	(4)	$W_{acs} = 301.2\ (V_p/1000)^{.767}$	

Symbol Definition:

W_{acs} = Air Conditioning System Weight - lbs

N_p = Maximum Number of Personnel

V_p = Pressurized Volume - Ft^3

Δ_p = Cabin Ultimate Design Pressure Differential - psi

W_{eq} = Weight of Uninstalled Electronic Equipment - lbs

TABLE 15 - 2

EQUATION RESULTS - AIR CONDITIONING SYSTEM

AIRCRAFT	ACTUAL W_{acs}	EQ. (1) W_{acs}	EQ.(2) W_{acs}	EQ.(3) W_{acs}	EQ. (4) W_{acs}
C-130B	1382	1382	1457	1456	1495
C-135A	1679	1691	1638	1631	1605
C-135B	1688	1675	1623	1631	1605
C-141A	2208	2208	2232	2232	2245
* C-5A	3360	7951	7499	7007	7466

TABLE 15 - 3

AIR CONDITIONING SYSTEM EQUATION PARAMETERS

AIRCRAFT	N_p	$V_p/1000$	Δ_p	W_{eq}	W_{acs}
C-130B	103	8.07	11.30	1497	1382
C-135A	130	8.85	21.50	1404	1679
C-135B	130	8.85	21.50	1544	1688
C-141A	160	13.70	12.90	1448	2208
* C-5A	365	65.60	12.45	2618	3360

* C-5A not used in statistical analysis

TABLE 15 - 4

AIR CONDITIONING SYSTEM WEIGHT SUMMARY

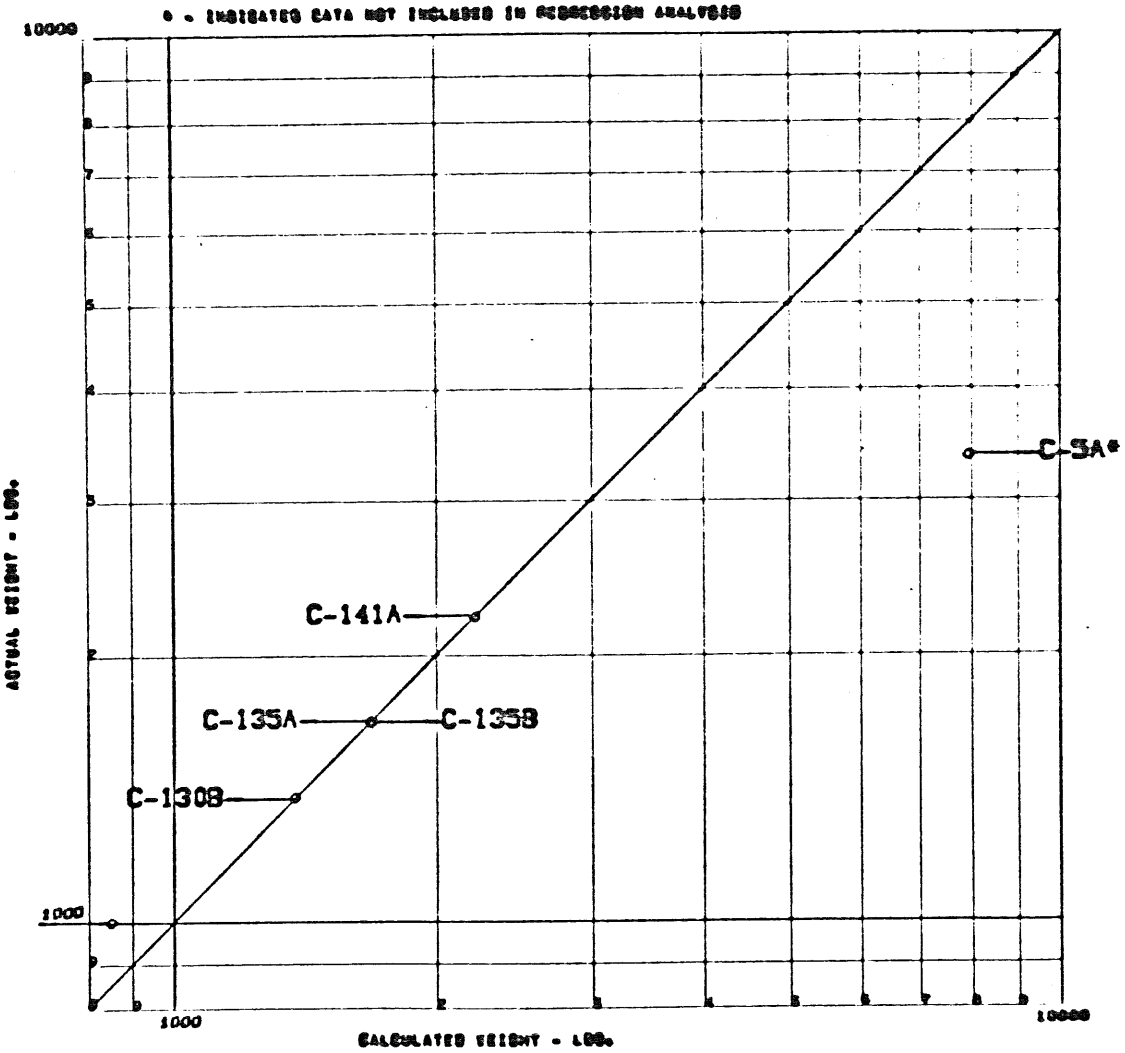
Aircraft	Heat Exchange Refrigerators	Air Cycle Machine	Ground Air Cooling	Water Separator	Regulators	Misc. Valves	Scoops	Ducting	Mufflers & Risers	Electrics	Structural Provisions	Insulation	Press. Sealing	Electronic Cooling Provisions	Total W_{ACS}
① AC-1DH	136.0	-	-	-	-	6.5	-	79.7	-	5.9	5.6	-	-	-	233.7
① C-123B	218.1	40.2	-	-	-	68.4	27.9	224.0	-	44.7	12.5	-	-	-	635.8
① C-124C	111.0	95.8	-	-	-	24.5	13.1	567.8	-	200.6	43.2	-	-	-	1056.0
C-130B	133.2	-	-	25.1	8.1	154.3	15.0	427.9	-	-	81.6	223.0	314.0	-	1382.2
① C-131B	62.5	217.8	-	18.5	-	71.3	7.0	263.3	-	31.9	37.0	33.5	41.8	-	784.6
C-133A	441.4	-	-	-	-	18.8	94.6	857.5	-	170.9	-	-	163.9	-	1747.1
C-135A	228.0	64.4	74.6	25.0	93.2	137.8	62.1	503.2	103.3	9.5	341.7	-	-	45.5	1642.8
C-135B	228.0	64.0	77.6	25.0	93.2	139.8	68.1	507.2	103.3	9.5	317.7	-	-	45.5	1676.9
C-141A	292.6	19.0	-	25.2	84.1	245.1	39.3	928.1	-	128.0	126.1	65.1	200.0	-	2207.6*
① XC-142A	33.3	15.0	-	-	-	8.2	1.1	57.4	-	14.3	8.5	-	-	-	137.8
C-5A	258.6	150.3	-	33.4	64.6	270.9	36.7	1854.1	-	169.3	271.4	-	251.0	-	3360.3

* C-141A - 55 lbs. transferred from ducting to anti-icing.

① These data points were not used in statistical analysis

FIGURE 15-1

AIR CONDITIONING SYSTEM-CARGO/TRANSPORT



$$W_{ACS} = 39.58\ N_P^{.230}\ V_P^{.651}/1000\ D_P^{.124}\ W_{EQ}^{.100}$$

COEFFICIENT OF CORRELATION= 99.96

TABLE 15 - 5

DE/ANTI-ICING WEIGHT AND DESIGN DATA

	STATISTICAL WEIGHT DATA												SYSTEM TYPES				
AIRCRAFT	WING	TAIL	PROPELLER	CANOPY AND WINDSHIELD	AIR INDUCTION SYSTEM	MISC. CARB.ETC.	NACELLE	PITOT	RADOME	WNDSHD. WIPER & WASHER	CONSUMABLE FLUIDS (2)	TOTAL ANTI-ICING	WING	TAIL	PROP	CANOPY	AIR I /NACE
AC-1DH	197.1	71.1	23.6	-	-	-	-			13.2	111.0	416.0	Boots	Boots	Fluid	-	-
C-123B	195.3	102.0	57.3	46.6	14.4					11.9		427.5	H.Air	H.Air	Elec.	H.Air	Ele
C-124C	1368.2	421.0	110.6	154.3		52.5 (3)				47.0	66.0	2219.6	H.Air	H.Air	Elec.	Elec.	-
C-130B	380.1	178.5	112.6	67.9	159.9	25.6				17.4		942.0	H.Air	H.Air	Elec.	Elec.	H.A
C-131B	224.2	88.6	83.2	28.8	-			(1) 1.6		9.5	165.0	600.9	H.Air	H.Air	Elec. Fluid	Elec.	-
C-133A	630.5	233.5	103.5		122.9				78.9	87.1		1256.4	H.Air	Boots	Elec.	-	H.Ai
C-135A	17.9	8.9	-				79.0			104.3		210.1	H.Air	Elec.	-	-	H.Ai
C-135B	17.9	8.9	-				104.0			104.3		235.1	H.Air	Elec.	-	-	H.Ai
C-141A	173.3	140.5	-	39.8	82.4					153.3		589.3	H.Air	Boots	-	Elec.	H.Ai
XC-142A	58.9	47.0	14.5	5.2	57.9					14.6		198.1	Boots	Boots	Elec.	Elec.	H.Ai
C-5A	238.9		-	44.0			184.6			30.6		498.1	H.Air	-	-	Elec.	H.Ai

(1) Electrical

(2) Weight is normally carried in useful load

(3) Separate heater unit for carb.-fluid type

TABLE 15 - 5 (Cont'd)

DE/ANTI-ICING WEIGHT AND DESIGN DATA

1. Windshield Wiper and Washer Assembly - Average value of (7) similar installations = 20.5 # per installation

2. Propeller De-Icing

A. Fluid Systems:

AIRCRAFT	NO.OF PROPS	WEIGHT OF PROP DE-ICING	WT.OF FLUID	TOTAL	
AC-1DH	2	23.6	111.0	134.6	
C-131B	2	9.0	165.0	174.0	(Blades Only)

B. Elec. Systems:

AIRCRAFT	NO.OF PROPS	WT.OF INSTL	WT/PROP	
C-123B	2	57.3	28.6	Average value of (5) five similar installations = 26.8# per prop.
C-124C	4	110.6	27.5	
C-130B	4	112.6	28.2	
C-131B	2	47.0	23.5	
C-133A	4	103.5	25.8	
XC-142A	4	14.5 (light rings in hubs)	3.6	- Minimum equip. carried

3. Canopy & Windshield De-Icing Elec.Systems:

AIRCRAFT	WIDTH OF FUSE.	WT.OF INST.
C-124C	13.75	154.3
C-130B	14.16	67.9
C-131B	9.4	28.8
C-141A	14.1	39.8
XC-142A	9.1	5.2
C-5A	23.8	44.0

NOTES: - C-124C has independant Elec system with separate alternator therefore notoriously heavy system

C-130B has unique "NE3A" system

XC-142 has minimum amount of De-icing capability as test and evaluation type vehicle

The remaining 3 (Three) airplanes will fit into the simple equation as follows:
W = 22.0 + 0.9 Fuse. Width

TABLE 15 - 5 (Cont'd)

DE/ANTI-ICING WEIGHT AND DESIGN DATA

4. Air induction/Nacelle De-Icing

A. Elec. Systems

AIRCRAFT	ENG.DIA(in)	NO.OF ENG.	WT.OF INST.
C-123B	53.0	2	14.4

B. Hot Air System

AIRCRAFT	ENG.DIA(in)	NO.OF ENG.	WT.OF INST.	WT.PER ENG.	$35 + \sqrt{\text{Eng.Dia}}$	
C-130B	39.0	4	159.9	40.0	40.2	
C-133A	33.7	4	122.9	30.7	39.0	
C-135A	39.0	4	150.0	38.0	40.2	(+ 71.0 transferred from air conditioning)
C-135B	53.0	4	198.0	49.5	41.0	(+ 94.0 transferred from air conditioning)
C-141A	53.0	4	137.4	34.5	41.0	(+ 55.0 transferred from air conditioning)
XC-142A	20.1	4	57.9	14.5	38.0	(not included as minimum anti-icing carried)
C-5A	100.0	4	186.6	46.65	44.0	

5. Tail De-Icing

A. Boots

AIRCRAFT	WT.OF INST.
AC-1DH	71.1
C-133A	233.5
C-141A	140.5
XC-142A	47.0

B. Hot Air System

AIRCRAFT	WT.OF INST.	CORRECTED WT.		H/TAIL	V/TAIL	H + V	
C-123B	102.0	102.0		39.0	17.5	56.5	Lack of correlation due to inconsistancy in de-icing areas and lack of detailed knowledge of these areas.
C-124C	421.0	278.0	Independant blower & heater removed (143)	55.0	28.5	83.5	
C-130B	178.5	148.9	Insulation removed (29.6)	52.7	23.1	75.8	
C-131B	88.6	88.6		36.5	16.8	53.3	

TABLE 15 - 5 (Cont'd)

DE/ANTI-ICING WEIGHT AND DESIGN DATA

6. Wing De-Icing

A. Boots

AIRCRAFT	WT.OF INST.	
AC-1DH	197.1	
XC-142A	58.9	(Minimum precautions for test vehicle)

B. Hot Air System

(1) Slats only

AIRCRAFT	SLAT SPAN(ft)	WT.OF INST.	
C-135A	35'	122.9	
C-135B	35'	122.9	Average value 3.7 # per ft. slat length
C-5A	58'	238.9	

(2) Wing De-Icing Various

AIRCRAFT	WING SPAN	WT.OF INST.	
C-123B	110'	195.3	Basic provisions L.E.
C-124C	174'	743.7	No L.E. Devices. (1368.2 less heater 163.0; blower 124.8; tip heater 336.7)
C-130B	132'	380.1	No L.E. Devices. Additional Inner skins and L.E. ducting
C-131B	105'	224.2	Some Nacelle included in this number. No L.E. devices
C-133A	180'	630.5	No L.E. Devices. Additional inner skins
C-141A	161'	173.3	No L.E. Devices.

7. Liquid De-Icing System

T.K.S. system - for protection of L.E. Assemblies of Wing and Tail

Weight Estimate (1) portion of system mandatory on each airplane:

(figures based on C-5A installation of 3 O/B Slats)

Pump	1		4.6
Filter	1		2.1
Proportioners 1 per slat or 1 per 10' run L.E.		Say 6	1.1
Nylon Pipeline			
	5/16" O/D reservoir to proportioners	Say 300'	5.8
	3/16" O/D proportioners to distributors	Say 145'	1.1
Couplings	as required		0.5
Non-return valve		1	0.1
		Sub Total	15.3

TABLE 15 - 5 (Cont'd)

DE/ANTI-ICING WEIGHT AND DESIGN DATA

7. Liquid De-Icing System (Continued)

Weight Estimate (2) Remainder of System

Stagnation Point Range for Distributors

	1"	2"	3"
Weight of Distributors (For a 35 in Span Panel)	37.8	52.9	67.8

Add:- Electric System:- wiring from cockpit/pump/ice detector

Fluid @ 9.2 lb/gallon (Aeroshell Compound 7)

Fluid Requirements 1 pint per ft^2/hr (distributor area)

Reservoir - capacity as required.

SECTION 16

AUXILIARY GEAR GROUP

TABLE 16 - 1

AUXILIARY GEAR GROUP WEIGHT DATA

AIRCRAFT	HANDLING					ATO			TOTAL AUX.GEAR
	JACKING FITTINGS	MOORING FITTINGS	TOWING FITTINGS	TIEDOWN FITTINGS	HOISTING FITTINGS	HOOKS	FIRING CONTROLS	BOTTLES	
AC-1DH	-	-	-	-	-	-	-	-	-
C-123B	-	-	-	-	-	-	-	-	-
C-124C	101.3	3.0	-	-	-	-	-	-	104.3
C-130B	-	-	-	6.4	-	11.2	38.3	6.7	62.6
C-131B	33.8	-	-	-	-	-	-	-	33.8
C-133A	113.5	3.2	-	-	-	-	-	-	116.7
C-135A	-	-	-	-	-	-	-	-	-
C-135B	-	-	-	-	-	-	-	-	-
C-141A	71.0	-	10.0	-	14.3	-	-	-	95.3
C-5A	271.0	-	16.0	-	21.2	-	-	-	308.2
XC-142A	0.1	-	-	-	7.2	-	-	-	7.3
	W_{ag} May be estimated by, $W_{ag} = .0006\ W_{dg}$								

The above table is presented as an aid in making a weight estimate of the Auxiliary Gear Group.

SECTION 17

463L CARGO LOADING SYSTEM

A weight summary of the 463L cargo loading system as installed on the C-5A is presented in Table 17.1. This summary is intended to be an aid for establishment of the weight penalty for installation of this system. None of the data points used in the statistical analysis had this system installed so a penalty must be added to the equation weight for fuselage and furnishings.

TABLE 17.1

463L CARGO LOADING SYSTEM (BASED ON C-5A INSTALLATION)

	WEIGHT	LBS/FT^2	(1) LBS/RUNNING FT.	LBS/PALLET	
Included in Fuselage Structure:					C-5A cargo floor extends from fuselage station 550 to fuselage station 2000 (125 ft) and provisions are included for two rows of 11 full size cargo pallets (108" x 88'), 22 total.
Ramp Fwd. & Aft					
Tie Down Rings	21.8	.049	.470	-	Cargo Floor Area = 2300.9 ft^2
Rollers & Conveyors	474.0	1.075	10.216	-	
Side Rails	83.8	.190	1.806	-	Fwd. Ramp Area = 186.1 ft^2, Length = 9.8 ft.
Center Rails	101.2	.230	2.181	-	
Mechanism	28.2	.064	.608	-	Aft Ramp Area = 254.6 ft^2, length = 13.4 ft.
Tie Down Receptacles	65.5	.194	1.412		
	(774.5)	(1.757)	(16.692)		
Cargo Floor (2)					(1) Based on a single row of pallets
Tie Down Rings	166.2	.072	.665	7.555	(2) Structural provisions for fittings are included in cargo floor weight at a total of 905 lb penalty. (3.62 lbs per running ft for a single row or .393 lbs per ft^2 of cargo floor area)
Rollers & Conveyors	643.0	.279	2.572	29.227	
Side Rails	450.2	.196	1.801	20.464	
Center Rails	451.8	.196	1.807	20.536	
Mechanism	151.8	.066	.607	6.900	
Tie Down Receptacles	409.8	.178	1.639	18.627	
	(2272.8)	(.987)	(9.091)	(103.309)	
Included in Furnishings & Equipment:					
Cargo Handling Equipment					
Aerial Delivery System	107.5				
Winch	312.1				
Paratroop Provisions	24.7				
Gear Stowage	254.5				
	(698.8)				
Included in Useful Load:					
Pallets (300 lb ea.)	AR				
Pallet Nets (75 lb ea.)	AR				
Tiedown Devices (22 pallets)	(1750.0)				
Total 463L Loading System	[5496.1]				