

Date: June 1st, 1957
 Aircraft: C-105 MK 1 With
 J75 P3 Engines
 1st Aircraft.

Report # 7-0400-44 Iss. 6
 Prepared By: K. Griffin
 Approved By: E. Burnett

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I N D E X

<u>Sheet #</u>	<u>Content</u>
1-4 to 1-4	Introductory notes and brief explanation of Weight Changes to Aircraft.
2-1 to 2-4	Detailed Weight Changes related to Weights Department Reports as tabulated on I.B.M. Sheets.
3-1 to 3-2	Weight and C.G. Summaries.
4-1	Horizontal C.G. Envelopes for Flight Conditions with fuel proportioners used.
4-2	Horizontal C.G. Envelope for Flight Conditions with fuel sequencing for C.G. control used.
5-1 to 5-15	I.B.M. detail sheets of weight and C.G.'s.

Classification cancelled / changed to: UNCLASSIFIED

By authority of: DRDA 7/DARFT 5-5/DAS Eng 6-4-5

Date: 5 Nov 1992

Signature: B. Aubrey

Unit / Rank / Appointment: DSIS 3, Secretary CRAD HQ DRP



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Sheet # 1-1
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INTRODUCTION

The following is a Weight & C.G. Summary for the 1st C-105 Aircraft with J75 P3 Engines, based on the latest weight estimates currently available. All Weight and C.G. changes are relative to Issue 5 of May 1st, 1957.

Note: This summary does NOT apply for the 2nd and subsequent MK 1 Aircraft see context below.

GENERAL

- a) Pratt & Whitney J75 P3 Engines comprise the Power Plant for the 1st Aircraft. J75 P5 Engines, which are partially redesigned versions of the P3 Engines, are to be installed on the 2nd and subsequent MK 1 Aircraft.
(J75 P3 Engines = 6,175 lb each; J75 P5 Engines = 5,950 lb each)
- b) An Instrument Package carrying Flight Test Instrumentation is installed, this also varies between first and subsequent Aircraft. A preliminary estimate of other flight test installations has also been made, based on there being approximately 250 monitored points throughout the aircraft and that twin shielded wire (27 lb/1000 ft) is used, a tentative figure of 710 lb is now recorded. This will be fully checked when completed details are forthcoming.
- c) Emergency jettison for the pack, emergency lowering for the undercarriages and additional fire protection, all to be installed on the 1st Aircraft, are allowed for in this summary.
- d) An Interim Radio & Radar System is installed.
- e) It should be noted that due to material substitutions and concessions introduced by Planning or Production Departments there is a weight penalty to-date to the structure of 202 lb. This is all recorded in the structural weight breakdown. No account has been taken of variations on machinings etc. nor of shop repair schemes, since it is impossible to assess these.
- f) Pending Flight Test requirements a "Buzz Damping" system may be installed on the first Aircraft. Provisions for this installation are already included in the Structural Group as modifications to the Control Boxes. For the first flight the Control Surfaces will be unmodified - however, if the need for Dampers is proven, a modified set of Control Surfaces will be made available. The following weight penalties ensue:

Ailerons	+ 11.68 lb/A/C
Elevators	+ 11.07 lb/A/C
Rudder	+ 8.50 lb
Equipment & Inst.	+ 125.17 lb
	<u>+ 156.42 lb</u>
- g) A considerable number of actual weights have now been obtained. Structural weights are showing very insignificant deviations from the calculated weights, but equipment shows a consistent increase averaging about 11% over manufacturers quotations or Specification weights. Preceding the report titles, on the I. B. M. tabulation sheets, will be found a number varying from 0 to 100, this is a percentage actual weight recorded within the report.

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INTRODUCTION

GENERAL

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A summary of actual weights obtained so far is as follows:-

Structure	-	34.94%	Actual Weight
Undercarriage	-	64.60%	Actual Weight
Power Plant	-	4.87%	Actual Weight
Flying Controls	-	23.28%	Actual Weight
Equipment	-	17.38%	Actual Weight

i.e. 23.51% of the Basic Weight of the Aircraft.

The above breakdown is for groups as designated on the Weights Summary Sheets.

1. STRUCTURE

a) Wing:

	<u>WEIGHT (lb)</u>
Structure fwd. M/Spar I/W - addition of bumper pads	+ 5
Ailerons - deletion of structural provisions for Buzz Dampers	- 6
Elevators - deletion of structural provisions for Buzz Dampers	- 7
Control Boxes - revised estimate of Damper structural provision	- 4
Actual weights of majority of Centre Joint, skin panels forward	
Main Spar, O/W Joint items, pump access door etc. etc.	+ 5
WEIGHT CHANGE DECREASE	- 7
<u>Ref 2-1</u>	

b) Fin & Rudder

Rudder - actual weight obtained unmodified for Dampers	+ 3
Deletion of Structural provision for Dampers	- 8
Fin - Revised estimate for Damper structural provisions	+ 1
WEIGHT CHANGE DECREASE	- 4
<u>Ref. 2-1</u>	

c) Fuselage Fwd. Sta. 255"

Top Longerons - machined packers Al replaces Mg.	+ 4
Windscreen - Actual weight casting	+ 2
Pilot's Canopy - Actual weight casting & glass	+ 4
Navigator's Canopy - Actual weight casting, glass & window frame	+ 5
WEIGHT CHANGE INCREASE	+ 15
<u>Ref. 2-2</u>	

d) Centre Fuselage Sta. 255" - 485"

Forward pack inflatable seal now with pneumatics in Equipment group

WEIGHT CHANGE DECREASE
Ref. 2-2

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INTRODUCTION

1. STRUCTURE (Continued)

WEIGHT (lb)

e) Duct Bay Sta. 485"-591.65"

Longerons - Actual weight of lower longeron and some re-
estimates

WEIGHT CHANGE DECREASE
Ref. 2-2

- 7
- 7

f) Engine Bay Sta. 591.65"-742.5"

No Weight Change.

g) Rear Fuselage Sta. 742.5 Aft.

Formers fixed R.F. - miscellaneous minor changes

WEIGHT CHANGE DECREASE
Ref. 2-2

- 3
- 3

h) Joints - Fuselage

No Weight Change

TOTAL STRUCTURAL WEIGHT DECREASE

- 9

2. LANDING GEAR

No Weight Change

3. POWER PLANT & SERVICES

Miscellaneous production drawing changes and minor revisions to
estimates of Nose Bullet, Mountings, piping etc.

POWER PLANT INCREASE
Ref. 2-2

+ 8
+ 8

4. FLYING CONTROLS GROUP

Mechanical Controls - redesign O/B Aileron Control rod etc.
Flying Control Hydraulics - miscellaneous design changes

FLYING CONTROLS INCREASE
Ref. 2-3

+ 4
+ 4
+ 8

5. EQUIPMENT GROUP

Ejector Seats - redesign Martin Baker 80ft/sec. Ejection Seat
Oxygen System - some piping changes etc.

Air Conditioning - Actual weights of boiler, valves etc.

Changes to piping & insulation

Additional valve

Utility Hydraulics - 200 cu. ins. accumulator replaces 80 cu. ins.
Wing Area - Increase in transformer, redesign panel

+ 76
+ 3
+ 27
+ 23
+ 7
+ 12
+ 12

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INTRODUCTION

5. EQUIPMENT (Cont'd.)

WEIGHT (lb)

Low Pressure Pneumatics - addition of fwd pack seal
Piping changes

+ 5
- 2
+ 163

EQUIPMENT INCREASE

Ref. 2-4

6. OPERATIONAL LOAD

Water - Trapped in Evaporator - no previous allowance

+ 15
+ 15

OPERATIONAL LOAD INCREASE

Ref. 2-4

SUMMARY

Weight Change - Aircraft Basic Weight

Structure	-	9 lb
Power Plant	+	8 lb
Flying Controls	+	8 lb
Equipment	+	163 lb
		<u>+ 170 lb</u>

Weight Change - Operational Load Less Fuel

Trapped Water - in
Air Conditioning + 15 lb

Weight Change - Operational Weight Empty (A/C less Fuel)

Issue 5

Issue 6

46,017 lb.

46,202 lb.

= + 185 lb.

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DETAILED WEIGHT CHANGES TO I.B.M.
TABULATED DETAILS OF May 1st, 1957.

WEIGHT CHANGES

Wing:

WEIGHT (lb)

-	7.52	Structure for Main U/C I/W - Actual weights of housing and shaft fork ends	
+	4.88	I/W Skins M/S to R/S - error in calcs., now actual weight, of pump access door	
+	17.33	Structure F/S to M/S - Addition of bumper pads	+ 5.48
		C/L rib now called up here (see joints)	+ 6.02
		Actual weights of skin panels	+ 5.54
		Miscellaneous changes, bracketery etc.	+ 0.29
			+ 17.33
-	2.75	A/C Centre Line Joints - Actual weights obtained of majority of parts, some hardware changes	+ 3.27
		Machined rib now in Structure F/S to M/S, see below	- 6.02
			- 2.75
-	1.58	O/W to I/W Joints - Incorporation of approximately 25% actual weights.	
-	17.48	Structural provisions for Buzz Damper - the control surfaces will not be modified on the first flying aircraft, only the Control Boxes, until the necessity for Dampers is proven, hence:-	
		Ailerons, less structural mods.	- 6.30
		Elevators, less structural mods.	- 7.40
		I/Wing - revision of earlier est.	- 3.08
		O/Wing - revision of earlier est.	- 0.70
			- 17.48
-	7.12		

Fin & Rudder

+	3.30	Rudder - Actual weight of a Rudder unmodified for Buzz Dampers	
+	0.65	Fin - Structural provisions for Buzz Dampers - estimate revised	
-	7.80	Rudder - Structural provisions for Buzz Dampers deleted	
		see Note (f) of Introduction.	
-	3.85		

Fuselage Fwd. Sta. 255"

+	3.75	Top Longerons F.F. - packing which requires machining has been changes from Mg. to Al.	
+	2.49	Windscreen - Actual weight of the casting, and some hardware alterations.	
+	3.56	Pilot's Canopy - Actual weight of machined castings & glass	+ 3.06
		First production drawing ests. of seal	+ 0.50
			+ 3.56
+	5.35	Navigator's Canopy - Actual weights of casting, glass and window frame	+ 2.56

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DETAILED WEIGHT CHANGES TO I.B.M.
TABULATED DETAILS OF May 1st, 1957.

WEIGHT CHANGES

WEIGHT (lb)

Fuselage Fwd. Sta. 255" (Cont'd.)

detailed estimate of hardware,
an allowance was made previously

+ 2.79
+ 5.35

+ 15.15

Centre Fuselage Sta. 255" - 485"

- 3.18 Pack mounting structure - forward inflatable seal now
called up with Low Pressure
Pneumatics (see Equip. group)

- 3.18

Duct Bay Sta. 485" - 591.65"

- 6.56 Longerons D.B. - Actual Weight of lower longerons
some duplication of parts at
Sta. 485"

- 3.93

- 2.63
- 6.56

- 6.56

Rear Fuselage Sta. 742.5" Aft.

- 2.89 Formers Fixed R.F. - miscellaneous production drawing changes,
also some duplication of stabilizers

- 2.89

Engine Group

- + 0.64 Engine Nose Bullet - production drawing changes
+ 0.74 Engines - production drawing changes to installations on
Engines.
+ 1.57 Engine Service Accessories - addition of Engine Oil Filler
Valve and Drain Valve.
+ 2.98 Engine Mountings - miscellaneous changes
Re-estimate of Front I/B Engine
Mounting
+ 1.91 Engine Mounting Accessories - production drawing changes
and re-estimates

+ 0.24

+ 2.74
+ 2.98

+ 7.84

Flying Controls Group

- + 3.56 Mechanical Flying Controls - redesign O/B Aileron Control Rod
addition of stick force transducer
Miscellaneous changes

+ 2.24
+ 1.00
+ 0.32

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DETAILED WEIGHT CHANGES TO I.B.M.
TABULATED DETAILS OF May 1st, 1957.

WEIGHT CHANGES

WEIGHT (lb)

Flying Controls Group (Cont'd.)

+	0.33	Flying Controls Hydraulics Rudder - Miscellaneous minor changes.	
+	3.62	Flying Controls Hydraulics I/W - Jarry hoses replaced by Steel tube	+ 1.66
		increase in jack installation hardware	+ 1.00
		Miscellaneous alterations to valves etc.	+ 0.96
			+ 3.62
+	7.51		

Equipment Fixed and Removable:

+	98.42	Ejector Seats - redesign Martin Baker seat, weights quoted by manufacturer	+ 76.00
		Emergency oxygen system included with seat (see Oxygen System)	+ 22.42
			+ 98.42
-	19.85	Oxygen System - Emergency system with Seats (above) redesign piping in cockpit	- 20.28
			+ 0.43
			- 19.85
+	56.81	Air Conditioning - estimates completely revised to current data.	
		Actual weight of Heat Exchanger was manufacturer's quote previously	+ 21.50
		Actual weight of Boiler	+ 1.69
		Miscellaneous equipment actual weights	+ 3.90
		Addition of Nomalair Valve	+ 6.50
		Insulation changes, the three 0.5" layers of Thermacousti before compression, weigh 2 lb/cu.ft. not 0.6 lb/cu.ft. as previously. Also insulation on cold pipes CSI-123 in lieu of CSI-103	+ 14.67
		Other changes to piping etc. etc.	+ 8.55
			+ 56.81
+	11.60	Utility Hydraulics D.B. - 200 cu. ins. accumulator replaces 80 cu. ins.	
+	12.00	Windscreen De-misting - Increase in size of transformer (target weight now 18.0 lb)	+ 10.00
		Panel E 40 redesigned in association with above	+ 2.00
			+ 12.00

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DETAILED WEIGHT CHANGES TO I.B.M.
TABULATED DETAILS OF May 1st, 1957.

WEIGHT CHANGES

WEIGHT (lb)

Equipment Fixed and Removable (Cont'd.)

+ 3.85 Low Pressure Pneumatics - addition of forward pack
inflatable seal (see also
C.F. Structure)
Alterations to pitot system etc.

+ 5.28
- 1.43
+ 3.85

+ 162.83

Operational Load

+ 15.00 Water Trapped in Air Conditioning - no allowance made
previously for that water trapped
in Evaporator

+ 15.00

+ 184.73 TOTAL WEIGHT CHANGES

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WEIGHT & C.G. SUMMARY

Description	WEIGHT lb.	H. ARM ins.	V. ARM ins.
STRUCTURE	18,501.24	562.00	137.59
Wing	9,975.30	642.96	142.24
Fin & Rudder	1,025.85	754.34	209.31
Fuselage fwd. Sta. 255"	2,615.50	181.48	128.14
Sta. 255"-485"	1,647.24	379.60	130.81
Sta. 485"-591.65"	997.30	533.97	104.59
Sta. 591.65"-742.5"	1,418.18	660.80	107.30
Sta. 742.5 Aft.	769.29	800.60	129.11
'Marry-up'	52.58	468.91	103.89
UNDERCARRIAGE - Retracted	2,609.77	488.51	134.93
Main Undercarriages	1,959.62	539.48	141.00
Main U/C Doors & Fairings	291.80	537.10	138.40
Nose Undercarriage	333.81	170.81	99.70
Nose U/C Door & Fairing	24.54	162.24	88.23
POWER PLANT & SERVICES	14,310.35	653.10	120.24
Engines & Accessories J75 P3	12,560.22	664.92	119.78
Gear Box Installation on Fuselage	275.54	601.39	102.98
Gear Boxes and Starters on Engines	259.65	591.55	104.52
Engine Controls	32.43	375.76	118.62
Engine Nose Bullet	71.01	562.74	115.07
Fire Extinguisher System	70.46	702.44	134.83
Engine Mountings	203.64	609.88	123.63
Fuel System	837.40	536.65	136.07
FLYING CONTROLS GROUP	1,827.07	686.88	140.02
Mechanical Flying Controls	946.48	687.84	148.61
Hydraulic Flying Controls	880.59	685.84	130.78
EQUIPMENT - Fixed & Removable	7,969.80	399.85	111.92
Instruments	46.07	163.68	138.70
Probe	18.50	40.00	108.00
Cockpit Pressure Sealing	5.00	186.00	130.00
Oxygen System	23.59	253.72	156.43
Air Conditioning System	794.82	336.05	134.34
Surface Finish	100.00	591.52	140.20
Hydraulics Main System	609.09	500.86	117.57
Cabin Insulation	14.31	187.48	132.00
Brake Parachute	62.38	769.41	143.24
Electrical System	1,117.89	417.17	112.83
Low Pressure Pneumatics	53.15	427.62	124.55
Intake De-icing Boots	1.84	197.02	118.00
Canopy Actuation	62.05	222.11	154.47
Cabin Consoles	62.45	174.76	124.34
Ejector Seats	284.42	202.80	136.25
Interim Radio & Radar	690.98	322.67	123.64
Radome Anti-icing	8.88	51.49	125.00
Instrument Pack Structure	684.80	385.90	94.71
Pack Instrumentation 1st A/C	2,447.00	389.50	95.00
Flight Test Installations	710.50	570.00	120.00
Additional Fire Protection 1st A/C	154.17	425.05	102.89
Emergency Landing Gear Lowering	12.91	458.83	128.60
AIRCRAFT BASIC WEIGHT	45,218.23	563.06	127.52

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WEIGHT & C.G. SUMMARY

<u>Description</u>	<u>WEIGHT</u> <u>lb.</u>	<u>H. ARM</u> <u>ins.</u>	<u>V. ARM</u> <u>ins.</u>	<u>M.A.C.</u> <u>%</u>
USEFUL LOAD (less Fuel)	983.02	353.44	132.63	
Crew	430.00	194.00	136.50	
Oil	134.23	608.92	115.68	
Alcohol - radome de-icing	22.00	93.00	138.00	
Engine Fire Extinguisher Fluid	25.00	730.00	129.00	
Residual Fuel	218.40	553.98	134.04	
Oxygen Charge	13.39	259.69	159.91	
Water for Air Conditioning Usable	140.00	268.00	132.00	
Operational Weight Empty				
U/C Up		558.60	127.63	33.86
U/C Down	46,201.25	560.72	124.13	34.44
Maximum Internal Fuel (2,544 gals. @ 7.8 lb/gal.)	19,843.00	538.88	144.32	
A.U.W. Maximum Internal Fuel				
U/C Up		552.68	132.64	32.23
U/C Down	66,044.25	554.16	130.19	32.63

N.B. 1) Aircraft Datum is considered to be 120" above an arbitrarily chosen ground line.

2) The above figures are for the Aircraft in the unballasted condition.

If the most aft point on the C.G. Envelope is to be ballasted to 31% M.A.C. then 1,355 lb of ballast are necessary on Former 68.5 and the Shear Panel, i.e. 27 lb less than currently designed.

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BY: Kathleen Griffin

DATE: June 1st 1957

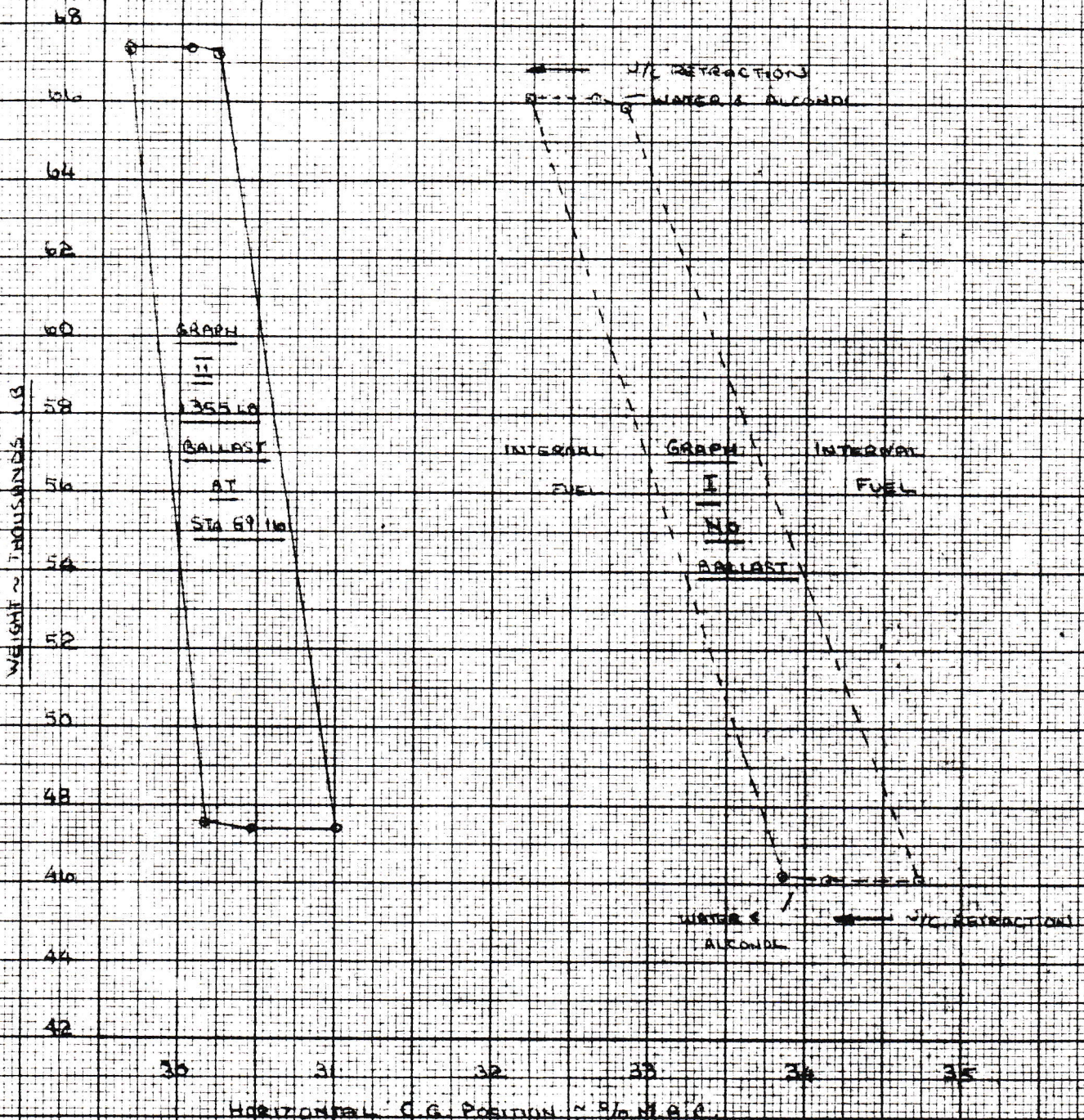
SHEET: 4-1

HORIZONTAL C.G. ENVELOPE

C108 MK I 1/2 FLIGHT CONDITIONS

WITH 3 J15 P3 ENGINES (2.0 & SUBSEQUENT AT ITS P5)

- 1) INTERIM RADIO & RADAR
- 2) INSTRUMENT PACK & FLIGHT TEST INSTALLATIONS
- 3) FUEL SYSTEM PROPORTIONERS



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SHEET: 4-2

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SEQUENCING ORDER (w/ PLTS 12)

R. L. S. 2 1 5 2 8 4 7 51 (NOTED R. R. 11)

11.8. ~ 8, 7, 6, 3, 4, 2, 5 (NOTED L₈, L₇ etc)

2/12 EXTENDED

U/C RETRACTED



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