TL. 113-57/12

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AVRO AIRCRAFT LIMITED
INTER-DEPARTMENTAL MEMORANDUM

Ref. 4450/11/J
Date December 1st, 1957
To See Distribution
From Mr. E.F. Burnett
Subject ARROW 1 A/C 25201 WEIGHT & C.G. SUMMARY - Report # 7-0400-44 Iss. 12

Attached is a copy of Weight and C.G. Summary, Report # 7-0400-44 Issue 12, dated December 1st, 1957 for your retention.

This report is revised monthly and is issued complete on the 1st of each month.

E. F. Burnett
Weights Supervisor

amc.

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By authority of: DRDA 7/DARFT 5-8/DAS Eng 6-4-5
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ARROW 1 A/C 25201 with
J75 P3 Engines.

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I N D E X

N. B. The C.G. Envelopes for A/C 25201 with fuel sequencing has been omitted until a fully approved sequencing is established.

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ARROW 1 A/C 25201 With
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INTRODUCTION & WEIGHT CHANGES

The following is a Weight and C.G. Summary for the first Arrow 1 Aircraft # 25201, with J75 P3 Engines, based on the latest information currently available. All Weight and C.G. changes are relative to Issue 11 of November 1st, 1957.

Note: 1) This Summary does not apply for Aircraft 25202 & 25203 which will have J75 P5 Engines, nor for Aircraft 25204 & 25205 which are for full Astra I trial installations etc.

2) The statement herein is for the Aircraft complete to drawings and not necessarily in the condition encountered for first flight.

For early flights there may be some shortages in non-essential equipment, some flight test installations will probably be incomplete etc. A Statement for first flight will be issued later.

GENERAL:

a) Pratt & Whitney J75 P3 Engines comprise the Power Plant for the first Aircraft. J75 P5 Engines, which are partially redesigned versions of the P3 Engines, are to be installed on Aircraft 25202 and subsequent MK 1 Aircraft.
(J75 P3 Engines = 6,175 lb each; J75 P5 Engines = 5,950 lb each).

b) An Instrument Package containing Flight Instructions is installed, this also varies, the package for Aircraft 25201 to Aircraft 25203 differing from those for Aircraft 25204 and Aircraft 25205 (Astra I Trial Installations.)

A relatively detailed estimate of other proposed Flight Test Installations throughout the Aircraft has been made. These installation amount to 1,398 lb. (figure partially confirmed by actual weights of cable assys.).

c) Emergency lowering for the Undercarriages and additional fire protection, to be installed in the first Aircraft, are allowed for in the summary. There is no provision to jettison any or all of the Instrument Package in an emergency.

d) An Interim Radio & Radar System, with Minneapolis-Honeywell M.H.64 Damping is installed. Currently there is no Doppler or Tacan installation, although provisions for future installation of Doppler, which is not yet available will be made.

e) The original design of tailcones and stinger are recorded, the redesigned versions will be recorded at a later date, when they are available for retrofit. The ensueing weight changes will be:-

Tailcones	+ 127.3 lb/A/C
Stinger	- 29.7 lb
Net Change	+ 97.6 lb/A/C.

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INTRODUCTION & WEIGHT CHANGES

GENERAL:

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 penalaties ensue:

Ailerons	+	11.68 lb/A/C
Elevators	+	11.07 lb A/C
Rudder	+	8.78 lb A/C
Equipment	+	123.97 lb
	+	155.50 lb

g) It should be noted that due to material substitutions and concessions introduced by Planning & Production Departments there is a structural weight penalty of 203 lb to-date. 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, except where actual weights have been obtained.

h) A considerable number of Actual Weights have now been obtained. Structural weights are checking within 0.5% of estimates on sub-assemblies etc. However, equipment (excluding Engines and Gear Boxes) shows a consistant increase averaging about 11% over manufacturer's quotations or initial specification weights. Preceeding the report titles on the I.B.M. Tabulation Sheets, will be found a number varying from 0 to 100, this is the percentage of actual weight recorded within the report.

A Summary of Actual Weights obtained so far is as follows:

Structure	-	74.81%
Landing Gear	-	97.86%
Power Plant	-	92.97%
Flying Controls	-	59.13%
Equipment	-	23.22%

i.e. 70.51% of the Basic Weight of the first Aircraft.

j) The Aircraft is ballasted such that the C.G. on a flight envelope (using fuel proportioners) does not travel Aft of 31% M.A.C.

For first flight the Aft restriction is 30% M.A.C., this may be achieved by installing maximum ballast.

C.G. Envelopes showing fuel sequencing have currently been omitted until a fully approved sequencing is established.

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INTRODUCTION & WEIGHT CHANGES

1. STRUCTURE	WEIGHT (lb)
a) Wings:	
No Weight Change.	
b) Fin & Rudder	
No Weight Change.	
c) Fuselage Fwd. Sta. 255"	
Radome - actual weight of complete assy.	+ 3.72
Crews' Bulkheads- addition of miscellaneous equipment.	+ 0.78
Additional Stiffeners	+ 2.01
Upper Shear Panel - miscellaneous minor changes	+ 0.02
Weight Increase Front Fuselage	+ 6.53
d) Centre Fuselage Sta. 255"-485"	
No Weight Change.	
e) Duct Bay Sta. 485"-591.65"	
No Weight Change.	
f) Engine Bay Sta. 591.65" - 742.5"	
No Weight Change.	
g) Rear Fuselage Sta. 742.5" Aft.	
Skin fixed R.F. - Cover plate added to upper skin for M.H.64 Damping Cables	+ 0.21
Weight Increase Rear Fuselage	+ 0.21
h) Fuselage 'Marry-Up'	
No Weight Change.	
TOTAL STRUCTURAL INCREASE	+ 6.74
2. LANDING GEAR	
No Weight Change	
3. POWER PLANT & SERVICES	
Engine Nose Bullet - actual weight obtained	- 0.43

continued.

INTRODUCTION & WEIGHT CHANGES

3. POWER PLANT & SERVICES (Continued)	WEIGHT (lb)
Gear Boxes and Starter on Engine - addition of reinforcing can to constant speed drive unit on A/C 25201 only	+ 26.65
TOTAL POWER PLANT GROUP INCREASE	+ 26.22
4. FLYING CONTROLS GROUP	
Mechanical Controls - extensive actual weighing of components carried out	- 7.92
TOTAL FLYING CONTROLS DECREASE	- 7.92
5. EQUIPMENT GROUP	
Oxygen System - new type converter installed	- 2.00
Alterations to piping, addition of flexible hose etc.	+ 4.48
Low Pressure Pneumatics - addition of small flexible hoses	+ 0.26
De-icing Boots - first quotation of weights received from Messrs. Goodyear manufacturers of same	+ 36.16
Ram Air Turbine - Dowty supplied actual Weight of swivel assembly	+ 0.94
Interim Radio & Radar - deletion of Ice Detector and noise filter, since radome de-icing is no longer a requirement	- 3.72
Flight Test Installations - addition of piping for Bristol "Sniffers"	+ 16.43
Emergency Fire Protection - redesign of bottle mountings, whereas previously the pack members were utilized now a complete frame is mounted from fuselage	+ 23.50
TOTAL EQUIPMENT INCREASE	+ 76.05

SUMMARY:

Weight Change - Aircraft Basic Weight

Structure	+ 6.74 lb
Power Plant	+ 26.22 lb
Flying Controls	- 7.92 lb
Equipment	+ 76.05 lb
	+ 101.09 lb

continued.

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INTRODUCTION & WEIGHT CHANGES

SUMMARY (Continued)

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

Issue 11	Issue 12	
47,837.01 lb	47,938.10 lb	+ 101.09 lb

N.B. If Aircraft Ballasted such that the C.G. in the flight envelope, using fuel system proportioners, does not exceed 31% M.A.C., a further 929 lb of ballast are necessary.

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Aircraft: ARROW 1
A/C 25201

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WEIGHT & C.G. SUMMARY

DESCRIPTION	WEIGHT lb	H. ARM ins.	H. ARM ins.
STRUCTURE	18,592.53	561.52	137.47
Wings	9,963.50	642.82	142.26
Fin & Rudder	1,025.85	754.34	209.31
Fuselage: Fwd. Sta. 255"	2,634.95	181.57	128.15
Sta. 255"-485"	1,682.14	377.80	130.20
Sta. 485"-591.65"	998.59	534.01	104.59
Sta. 591.65"-742.5"	1,433.13	661.00	107.31
Sta. 742.5" Aft.	801.79	801.03	129.06
'Marry-Up'	52.58	468.91	103.89
LANDING GEAR - RETRACTED	2,600.31	488.39	134.91
Main Landing Gear	1,959.62	539.48	141.00
Main Gear Doors & Fairings	282.34	537.60	138.37
Nose Landing Gear	333.81	170.81	99.70
Nose Gear Door & Fairings	24.54	162.24	88.23
POWER PLANT & SERVICES	14,391.81	652.82	120.34
Engines & Accessories J75 P3	12,562.29	664.92	119.78
Gear Box & Drives on Fuselage	275.54	601.39	102.98
Gear Box & Starters on Engines	286.30	589.08	105.59
Engine Controls	32.43	375.76	118.62
Engine Nose Bullets	70.58	562.75	115.07
Fire Extinguishing System	65.46	700.45	134.21
Engine Mountings	206.21	635.04	127.71
Fuel System	893.00	536.67	136.12
FLYING CONTROLS GROUP	1,849.26	685.38	139.56
Mechanical Flying Controls	941.12	686.14	148.31
Hydraulic Flying Controls	908.14	684.60	130.50
EQUIPMENT FIXED AND REMOVABLE	9,583.23	403.51	113.49
Instruments	46.07	163.68	138.70
Probe	15.00	-38.14	108.00
Cockpit Pressure Sealing	5.00	186.00	130.00
Ejector Seats	339.06	204.43	134.10
Oxygen System	26.07	240.54	156.70
Air Conditioning System	812.41	335.87	134.32
Surface Finish	100.00	591.52	140.20
Hydraulics Main System	639.97	504.37	117.71
Cockpit Insulation	14.31	187.48	132.00
Drag Parachute	90.78	786.65	143.16
Electrical System	1,118.98	417.54	112.96
Low Pressure Pneumatics	54.65	433.30	129.37
Intake De-icing Boots	88.00	195.82	118.00
Canopy Actuation	64.92	221.99	154.35
Console Panels	17.45	174.76	124.34
M.H.64 Damping System	99.08	450.83	140.34
Interim Radio & Radar	631.89	340.18	124.23
Instrument Pack Structure	686.80	385.81	94.68
Pack Instrumentation (A/C 25201)	3,036.00	395.45	95.00
Flight Test Installations	1,414.86	491.73	129.66
Additional Fire Protection	177.67	402.00	109.57
Emergency Landing Gear Lowering	12.91	458.83	128.60
Ram Air Turbine Equipment	91.35	336.08	104.74

REPORT NO: 7-0400-66-12

DATE: Dec 1st 1957

BY: Kathleen Griffin

SHEET: 3

HORIZONTAL C.G. ENVELOPE

ARROW I A/C NO 25201

NORMAL FLIGHT CONDITIONS

FUEL SYSTEM PROPORTIONERS USED

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