

AVRO AIRCRAFT LIMITED  
INTER-DEPARTMENTAL MEMORANDUM

7L. 113-58/02  
UNCLASSIFIED / NON CLASSIFIED

Ref. 5864/11/J  
Date February 1st, 1958  
To See Distribution  
From Mr. E.F. Burnett  
Subject ARROW 1 A/C 25201 WEIGHT & C.G. SUMMARY - Report # 7-0400-44 Iss. 14

Attached is a copy of Weight and C.G. Summary Report # 7-0400-44  
Iss. 14, date February 1st, 1958 for your retention.

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

Classification cancelled / changed to: UNCLASSIFIED

By authority of: DRDA 7/DARFT 5-8/DAS Eng 6-4-5

Date: 5 Nov 1992

Signature: *B. Buley*

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

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K. Wreghitt  
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G. Eves



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Date: February 1st, 1958  
Aircraft: ARROW 1, A/C 25201  
with J75 P3 Engines

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I N D E X

Sheet # 1

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| 1-1 to 1-5  | Introductory notes and explanations<br>of Weight Changes.                           |
| 2-1 to 2-2  | Weight & C.G. Summaries.  |
| 3           | Horizontal C.G. Envelopes for<br>Flight conditions with fuel<br>proportioners used. |
| 4-1 to 4-15 | I.B.M. Detail Sheets of Weights<br>& C.G.'s.  |

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

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### INTRODUCTION & WEIGHT CHANGES

The following is a Weight & C.G. Summary for the first Arrow 1 Aircraft # 25201, with J75 P3 Engines, based on the latest information available. All weight and C.G. changes are relative to Issue 13 of January 1st, 1958.

Note 1) This summary does not apply for A/C 25202 and 25203 which will have J75 P5 Engines, nor for Aircraft 25204 and 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 to be 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. (see also general note (j)). A statement for first flight will be issued later.

#### GENERAL:

- a) Pratt & Whitney J75 P3 Engines comprise the Power Plant for Aircraft # 25201. J75 P5 Engines, which are partially redesigned versions of the P3 Engines, are to be installed on Aircraft # 25202 and subsequent Arrow 1 Aircraft. (J75 P3 Engines = 6,175 lb each; J75 P5 Engines = 5,950 lb each).
- b) The Instrument Package containing Flight Instrumentation is installed, the package for Aircraft # 25201 to 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 installations amount to 1,457 lb (figure partially confirmed by Actual Weights of some cable assys.)

- c) Emergency lowering for the Landing Gear and additional Fire Protection to be installed in the first aircraft, are allowed for in the summary.
- d) An Interim Radio and Radar System with Minneapolis-Honeywell M.H 64 Damping System 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 ensuing weight changes will be:

Tailcones	+ 139.84 lb/A/C
Stinger	= 29.72
Net Change	+ 110.12 lb/A/C

- 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.

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## INTRODUCTION & WEIGHT CHANGES

### GENERAL:

f) (Continued)

The following weight penalties ensue:

Ailerons	+	11.68 lb/A/C
Elevators	+	11.07 lb/A/C
Rudder	+	8.78 lb
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 of sub-assemblies etc. However, equipment (excluding Engines and Gear Boxes) shows a consistent increase averaging about 11% over manufacturer's quotations or initial 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 the percentage of actual weight recorded within the report.

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

Structure	74.87%
Landing Gear	98.75%
Power Plant	92.97%
Flying Controls	56.18%
Equipment	23.48%

i.e. 70.52% of the Basic Weight of A/C 25201.

- 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 in the Radar Nose, and any further ballast requirements in the Observer's cockpit.

### 1. STRUCTURE

WEIGHT (lb)

#### a) Wings:

No Weight Changes.

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### INTRODUCTION & WEIGHT CHANGES

#### 1. STRUCTURE:

WEIGHT (lb)

##### b) Fin & Rudder

No Weight Changes.

##### c) Front Fuselage, fwd. Sta. 255"

Navigator's Canopy - addition of insulation batting	+ 0.24
Miscellaneous Items - addition of Stainless Steel Fairings at canopy hinges	+ 1.33
<u>Front Fuselage Increase</u>	<u>+ 1.57</u>

##### d) Centre Fuselage Sta. 255"-485"

Dorsal Fairings over Fuel Tanks - alterations to insulation etc.	- 0.90
Structure for Ram Air Turbine - deleted, currently no longer a requirement on A/C 25201	- 40.74
Electronics Bay Structure - items (eg Side Access Door) that would have been removed for R.A.T. installation now reinstated	+ 9.74
Dorsal Fairing Sta. 268"-315" - modifications to aft end, skin Al. was Mg. etc.	+ 0.82
Deflector Shield - addition rubber seal fwd. end	+ 0.16
C.F. Duct - addition of inner seal ring, .016 Al. at joint to floating duct, aerodynamic requirement	+ 0.82
<u>Centre Fuselage Decrease</u>	<u>- 30.10</u>

##### e) Duct Bay Sta. 485"-591.65"

No Weight Changes

##### f) Engine Bay Sta. 591.65"-742.5"

No Weight Change

##### g) Rear Fuselage Sta. 742.5" Aft.

No Weight Change.

##### h) Fuselage "Marry-Up"

No Weight Change

#### TOTAL STRUCTURAL DECREASE

- 28.53

#### 2. LANDING GEAR

Main Landing Gear - Dowty quote actual weight of main leg assy.

+ 4.12

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### INTRODUCTION & WEIGHT CHANGES

		<u>WEIGHT (lb)</u>
2. <u>LANDING GEAR</u> (Continued)		
Nose Gear Door & Fairing - actual weight of Door obtained		+ 0.53
addition of aerodynamic fairing to door		+ 1.08
<u>TOTAL LANDING GEAR INCREASE</u>		<u>+ 5.73</u>
3. <u>POWER PLANT &amp; SERVICES</u>		
No Weight Changes		
4. <u>FLYING CONTROLS GROUP</u>		
Mechanical Controls - addition of self centring unit for elevator controls		+ 3.01
Flying Control Hydraulics Fuselage - addition of two surge damping accumulators in return lines		+ 13.40
addition of boosters to overcome friction in system plus associated values, filters and piping.		+ 77.06
<u>TOTAL FLYING CONTROLS INCREASE</u>		<u>+ 93.47</u>
5. <u>EQUIPMENT GROUP</u>		
Drag Chute - alteration to control mounting structure in cockpit and addition of inner race to release mechanism.		+ 0.21
Electrics F.F. - Actual Weight of Master Warning Control Box		+ 3.05
Air Conditioning System - incorporation of actual weights of engine manifolds, previously target weights used		+ 9.66
Ram Air Turbine Equipment - the system is deleted from A/C 25201 currently. Unit when tested failed to give expected output		- 91.35
Flight Test Instrumentation in Pack - revised weight estimate by Flight Test, main patch panel deleted, but increases in cables etc		+ 12.00
<u>EQUIPMENT GROUP DECREASE</u>		<u>- 66.43</u>

### SUMMARY

#### Weight Change - Aircraft Basic Weight

Structure	- 28.53 lb
Landing Gear	+ 5.73 lb
Flying Control	+ 93.47 lb
Equipment	- 66.43 lb
	+ 4.24 lb

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

#### UNBALLASTED CONDITION

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47,999.68 lb

48,003.92 lb

+ 4.24 lb

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INTRODUCTION & WEIGHT CHANGES

N. B. If Aircraft Ballasted such that the C.G. in the Flight Envelope, using correctly functioning fuel system proportioners, does not exceed 31% M.A.C., further 893 lb of ballast are necessary.

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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>
STRUCTURE	18,577.44	561.74	137.53
Wings:	9,963.50	642.82	142.26
Fin & Rudder	1,025.85	754.34	209.31
Fuselage Fwd. Sta. 255"	2,646.56	181.60	128.17
Sta. 255"-485"	1,652.04	379.71	130.79
Sta. 485" 591.65"	1,001.86	533.99	104.61
Sta. 591.65-742.5"	1,433.13	661.00	107.31
Sta. 742.5" Aft.	801.79	801.03	129.06
"Marry-Up"	52.71	469.18	103.86
LANDING GEAR - RETRACTED	2,606.56	488.21	134.89
Main Landing Gear	1,963.74	539.50	141.00
Main Gear Doors & Fairings	282.34	537.60	138.37
Nose Landing Gear	333.81	170.81	99.70
Nose Gear Door & Fairing	26.67	161.77	88.25
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 Engine	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	1,946.48	665.69	138.27
Mechanical Flying Controls	944.13	684.34	148.22
Hydraulic Flying Controls	1,002.35	648.12	128.90
EQUIPMENT FIXED & REMOVABLE	9,560.67	403.77	113.54
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	822.07	339.45	134.46
Surface Finish	100.00	591.52	140.20
Hydraulics Main System	641.97	504.41	117.78
Cockpit Insulation	14.31	187.48	132.00
Drag Chute	90.99	786.18	143.17
Electrical System	1,122.03	416.87	112.94
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)	3,048.00	394.00	95.00
Flight Test Installations	1,456.73	488.48	128.90
Additional Fire Protection	177.67	402.00	109.57
Emergency Landing Gear Lowering	12.91	458.83	128.60

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WEIGHT & C. G. SUMMARY

DESCRIPTION		WEIGHT lb	H. ARM ins.	V. ARM ins.	M.A.C %
AIRCRAFT BASIC WEIGHT	U/C Up	47,082.96	557.73	127.29	
	U/C Down		559.81	123.85	
USEFUL LOAD (less fuel)		921.02	366.58	132.34	
Crew		390.00	194.00	136.50	
Engine Fire Extinguishing 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		140.00	268.00	132.00	
Oil		134.23	608.92	115.68	
BALLAST		893.00	85.98	116.50	
Operational Weight Empty	U/C Up	48,896.98	545.51	127.19	30.25
	U/C Down		547.51	123.87	30.80
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	68,739.98	543.60	132.13	29.72
	U/C Down		545.02	129.77	30.11

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 BALLASTED condition such that the aft. C.G. on the horizontal C.G. Envelope does not exceed 31% M.A.C. i.e. 303 lb on Former Sta. 68.5 and 590 lb on the Shear Panel.

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REPORT NO: T-9400-44-1A

DATE: Feb 1st 1958

BY: Kathleen J. [unclear]

SHEET: 3

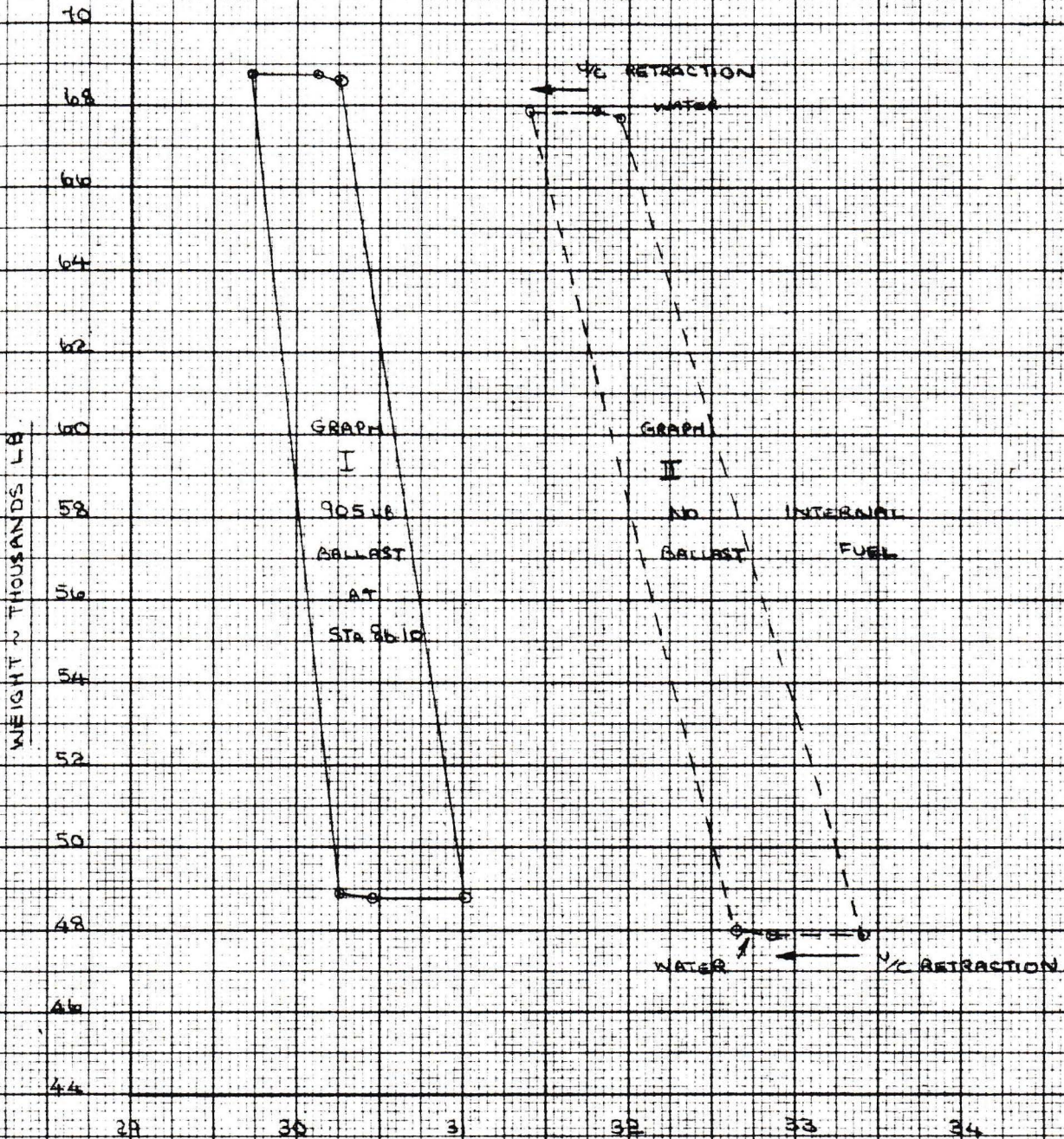
HORIZONTAL C.G. ENVELOPE

ARROW 1 =  $\frac{1}{2}$  B5201

NORMAL FLIGHT CONDITIONS

FUEL SYSTEM PROPORTIONERS USED

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HORIZONTAL C.G. POSITION -  $\frac{1}{2}$  M.A.C.