AVRO AIRCRAFT LIMITED
INTER-DEPARTMENTAL MEMORANDUM

Ref: 2632/11/J
Date: 1 August, 1958
To: See Distribution
From: E.F. Burnett - Weight Supervisor
Subject: Arrow 1 - A/C 25202 & 25203 - Weight and C.G. Summary Report 7-0400-64 Issue 4.

Attached is a copy of Weight and C.G. Summary Report 7-0400-64 Issue 4 dated 1 August, 1958, for your retention.

It was intended to conclude the Monthly Weight Reports for these Aircraft with Report 7-0400-64 Issue 3 dated July 1st, 1958. However, the experimentally obtained figures for Trapped and Residual Fuel were unacceptable due to the possibility of inaccuracies in the procedure and subsequent detailed investigation has resulted in new estimates for these items which are now incorporated in this issue of the subject report.

All future weight reporting will be done on the standard "Weight Statement for Flight Testing" form, as established for Arrow 25201.

E.F. Burnett

EFB/ag
cc: Messrs.

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CONFIDENTIAL

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N.B.

Work has been cancelled on the fuel C.G. management system for Arrow 1 aircraft due to the satisfactory functioning of the proportioners.

Aircraft: Arrow 1
A/C 25202 & 25203
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Introduction & Weight Changes

The following is a weight & C.G. summary for the second and third Arrow 1 Aircraft Nos. 25202 & 25203, with J75 P5 Engines, based on the latestinformation available. All weight & C.G. changes are quoted relative to 7-0400-64 Issue 3 of July 1st, 1958.

Note:

1) Issue 3 of July 1st, 1958, was intended to close the monthly weight statements for A/C 25202 & 25203, however, due to the fact that the experimentally determined trapped and residual fuel figures were not accepted, the report is being issued again, this issue being final. In future A/C 25202 & 25203 will be covered by Weight Statements for Flight Test.

2) Neither a dry nor a drained weighing has yet been obtained for Aircraft No. 25202. However, based on the good agreement shown between estimated and actual weights of A/C 25201 it is felt that this summary is completely representative of the subject Aircraft within ± 0.30%.

   It should be remembered that the figures shown here for Nose Ballast are theoretical requirements and NOT the ballast as installed on A/C 25202, see General note b) on the Instrument Package.

3) This summary will not apply for A/C 25204 and 25205 which are to be used for full Astra I Trial Installations. Reference Weights Report #7-0400-64 Issue 3.

4) After Phase I of the flight test programme A/C 25203 will be fitted with a weapons pack trial installation, in lieu of the instrumentation package recorded here.

5) In this summary the Aircraft is shown ballasted such that the aft C.G. shall not exceed 31% M.A.C. - which is the theoretical aft limit.

General:

a) Pratt and Whitney J75 P5 Engines comprise the Power Plant for A/C's 25202 & 25203. (5850 lb each, Pratt and Whitneys latest brochure weight with their installation kit, confirmed by P & W actual weight recorded in engine inspection records).

b) The Instrument Package containing Flight Instrumentation is installed. The Packages for A/C's 25201 to 25203 differ from those for A/C's 25204 and 25205.

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General:-

b) Cont'd

The weight recorded here is Flight Test Department's estimate of cable and instruments. An actual weight will be obtained as soon as a complete pack is available.

For early flights the package will not have complete instrumentation, but ballast will be installed to exactly simulate the completed weight and C.G.

A relatively detailed estimate of other proposed Flight Test Installations throughout the Aircraft has been made. These installations amount to 1457 lb (figure partially confirmed by actual weights of some cable assys).

c) In A/C 25201 for early flights additional emergency fire protection and additional emergency provisions for landing gear lowering were installed. These are no longer necessary in A/C's 25202 and 25203 and have been deleted from the weight records.

d) An Interim Radio & Radar System with Minneapolis-Honeywell MH64 Damping System is installed. Currently there is no Doppler or Tacan installation, though space provision for future installation of Doppler, which is not yet available, is made.

e) The Mk 1A Tailcones and Stinger are fitted. Possibly these may not be available for first flights of A/C 25202, however, they will be retrofit as soon as available.

f) On A/C 25202, the set of control surfaces modified structurally for "buzz damper" installation are fitted. The control boxes are already modified for all Mk 1 A/C. If it is decided to fit a trial installation of the "buzz damper" system there will be the following additional wt. to A/C 25202.....

Buzz Damping Equipment + 124 lb.

This weight report incorporates the modified surfaces as on A/C 25202, however, if A/C 25203 does not have a "buzz damper" installation then the following changes ensue:-

Elevators	- 11.07 lb/A/C
Ailerons	- 11.68 lb/A/C
Rudder	- 8.78 lb
	- 31.53 lb

When the split control surfaces are introduced a further weight increase will result:-

Elevators	+ 4.36 lb/A/C
Rudder	+ 2.34 lb
	+ 6.70 lb

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General: (Cont'd)

g) Due to material substitutions and concessions introduced by Planning and Production Departments, there is a structural weight penalty of 72 lb approx. 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. Major repair shcemes e.g. cracked outer skin on Air Intakes have been assessed and recorded.

h) 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. (see also note 2) on sheet 1-1).

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.

k) No further work is being proceeded with in the fuel management system for Arrow 1 Aircraft. The fuel proportioners are functioning satisfactorily and it is not considered necessary to fit the fuel sequencing system.

		Weight lb
1.	Structure	
	No weight change	
2.	Landing Gear	
	No weight change	
3.	Power Plant Group	
	Fuel System - actual weight of pressure regulator valves 5.13 lb each, Spec. wt. 3.25 lb each	+ 3.76
	Total Power Plant Increase	+ 3.76
4.	Flying Controls Group	
	No weight change	
5.	Equipment Group	
	No weight change	

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6. Trapped Fuel

	Weight lb
The figures established last month were deemed unacceptable due to possible inaccuracies in the method of obtaining them. Now detailed estimates, partially supported by test rig results reveal that the trapped fuel in the system is probably 238.2 lb. Hence a decrease in wt is shown here (372 lb July 1st, 1958)	- 133.80
(See also Operational Load for note pertaining to residual fuel)	
*	
Total Trapped Fuel Decrease	- 133.80

7. Operational Load

Residual Fuel - On July 1st the weight of this item was quoted from an experimental determination. However, since the method had some possible inaccuraces the figures have been checked by detailed calculations. Similar weights are applicable to the Mk 2 A/C, but in these A/C it is proposed to modify the fuel no-air valves, and to introduce a sump in tank #5 such that the fuel is recoverable. Thus if the Mk 1 A/C fuel system were similarly modified it would be possible to regain 287 lb of currently unusable fuel. Wt Change	+ 2.00
*	
Total Operational Load Increase	+ 2.00

N.B.

* Thes figures have not influenced the Gross Weight of the Aircraft, see also note following WT. and C.G. Summary Sheet 2-2.

Summary

Weight Change - Aircraft Basic Weight

Power Plant	+ 3.76
Trapped Fuel	- 133.80
	- 130.04

Weight Change - Operational Load

Residual Fuel	+ 2.00

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

Issue 3	Issue 4	
48,069.15	47,941.11	- 128.04 lb

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Description	Weight lb	H. Arm ins	V. Arm ins
Structure	18,797.46	563.30	137.45
Wings	10,007.76	643.06	142.24
Fin & Rudder	1,034.63	754.84	209.36
Fuselage Fwd Sta 255 ins	2,669.92	181.78	128.17
Sta 255 - 485 ins	1,670.36	380.23	130.70
Sta 485 - 591.65 ins	1,010.63	533.81	104.49
Sta 591.65 - 742.5 ins	1,437.47	660.98	107.30
Sta 742.5 ins aft	912.38	807.53	128.96
"Marry-Up"	54.31	462.81	104.25
Landing Gear - Retracted	2,661.39	488.88	135.01
Main Landing Gear	2,018.57	538.99	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	13,774.42	652.51	120.36
Engines & Accessories J75 P5	11,913.81	665.32	119.78
Gear Box & Drives on Fuselage	276.70	603.71	103.24
Gear Box & Starters on Engines	286.80	589.18	105.54
Engine Controls	33.35	375.79	118.49
Engine Nose Bullets	75.61	526.69	115.11
Fire Extinguishing System	65.53	700.45	134.21
Engine Mountings	206.21	635.04	127.71
Fuel System	916.41	538.53	135.54
Flying Controls Group	2,007.99	652.17	137.19
Mechanical Flying Controls	953.45	675.98	147.72
Hydraulic Flying Controls	1,054.54	630.64	127.67
Equipment -Fixed & Removable	9,472.03	403.28	113.61
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	342.94	204.50	134.11
Oxygen System	22.40	252.82	156.03
Air Conditioning System	822.07	339.45	134.46
Surface Finish	100.00	591.52	140.20
Cockpit Insulation	14.31	187.48	132.00
Brake Chute	90.99	786.18	143.17
Low Pressure Pneumatics	54.65	433.33	129.37
Electrical System	1,126.18	415.86	112.91
Intake De-icing Boots	88.00	195.82	118.00
Canopy Actuation	65.86	222.01	154.36
Console Panels	17.45	174.76	124.34
MH64 Damping	99.08	450.83	140.34
Interim Radio & Radar	648.68	342.30	124.04
Hydraulics Utilities System	654.93	503.19	117.65
U/C Doors - Sequencing	66.89	345.66	116.36
Instrument Pack Structure	686.80	385.81	94.68
Pack Instrumentation	3,048.00	394.00	95.00
Flight Test Installations	1,456.73	488.48	128.90

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Description	Weight lb	H. Arm ins	V. Arm ins	M.A.C. %
Trapped Fuel	238.20	553.66	141.42	
U/C Up		556.72	127.50	
Aircraft Basic Weight	46,951.49			
U/C Down		558.88	123.94	
Useful Load	989.62	366.28	132.83	
Crew	390.00	194.00	136.50	
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	
Fire Extinguisher Fluid	25.00	730.00	129.00	
Residual Fuel	287.00	508.14	135.33	
Ballast	765.00	84.48	116.50	
U/C Up		545.43	127.44	30.23
Operational Wt. Empty	48,706.11			
U/C Down		547.52	124.00	30.80
Max. Int. Fuel (2468 * at 7.8 lb/gal)	19,253.00	540.80	144.09	
U/C Up		544.12	132.16	29.87
Gross Weight (Max. Int. Fuel)	67,959.11			
U/C Down		545.62	129.69	30.28

N.B. 1) A/C Datum = 120 ins 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, using fuel proportioners, does not exceed 31% M.A.C. ie 303 lb on Former Sta. 68.5 ins and 462 lb on the Shear Panel.

These figures are theoretical requirements only and are not to be confused with full nose ballast as normally installed (1397 lb total + possible additional 500 lb).

* 3) The trapped and residual fuel figures have now been calculated in detail (the experimentally determined figures of July 1st, 1958, being deemed unacceptable - see notes in text of report).

Figure obtained by actual weighing	657 lb
Revised calculated figure	525.2 lb
Decrease in trapped + residual fuel	-131.8 lb

Hence since the trapped + residual fuel have decreased by approx. 132 lb the usable fuel has increased by a similar amount, it not being considered desirable to alter the total estimated fuel within the Aircraft at this time.

It is hoped, in the near future, to make an accurate check on the total volumes contained in each tank, since currently only calculated figures are available.

REPORT NO : 7-0400-64 ISSUE 4

DATE : Aug 1st 1958

SHEET : 3

BY : Kathleen Griffin

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HORIZONTAL C.G. ENVELOPE
ARROW I ~ A/C 25202 & 25203
NORMAL FLIGHT CONDITIONS
FUEL PROPORTIONERS USED

GRAPH I ~ A/C BALLASTED SUCH THAT HORIZ^N C.G. DOES NOT EXCEED 31% MAC

GRAPH II ~ NO BALLAST