

AVRO AIRCRAFT LIMITED
INTER-DEPARTMENTAL MEMORANDUM

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Ref: 8542/11/J
Date: 1 May, 1958
To: See Distribution
From: E.F. Burnett - Weight Supervisor
Subject: ARROW 2 PRODUCTION A/C WEIGHT & C.G. SUMMARY - Report 7-0400-34 Issue 19

Attached is copy of Weight and C.G. Summary Report 7-0400-34 Issue 19 dated May 1st, 1958, for your retention.

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

Classification ^{confirmed as} ~~cancelled~~ / changed to: UNCLASSIFIED
By authority of: DRDA 7/DARET 5-8/DAS Eng 6-4-5
Date: 5 Nov 1992
Signature: B. Aubrey
Unit / Rank / Appointment: DSIS 3, Secretary CRAD HQ DRP

E.F. Burnett

EFB/ag

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I N D E X

<u>Sheet</u>	<u>Content</u>
1-1 to 1-4	Introductory notes and explanation of weight changes
2-1 to 2-3	Weight and C.G. Summary
3	Horizontal C.G. plot showing basic fixed points on flight envelope. The possible variations of C.G. with fuel used has been omitted until such time as fully approved fuel sequencing is established.
4-1 to 4-15	I.B.M. Detail sheet of Weight and C.Gs.

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INTRODUCTION & WEIGHT CHANGES

The following is a Weight and C.G. Summary of the Arrow 2 production Aircraft based on the latest weight estimates available.

All weight and C.G. changes are relative to Issue 18 of April 1st, 1957.

Some early Arrow 2 Aircraft, serial nos. in the Group 25206 to 25236, will not be as this summary designates, but will be Flight Test Aircraft with Instrumentation, "Astra Minus" or preproduction Astra I Radar, Missile pack trials and various equipment trial installations. Appropriate weight statements will be issued at a later date.

GENERAL:-

- a) Orenda PSL3 Engines comprise the Power Plant (4,500 lb each, excluding Nose Bullet & Input Frame).
- b) A package containing 4 "semi-submerged" Sparrow II missiles (432 lb each) forms the current Armament.
- c) The R.C.A. Astra I Radar System is installed. The basis for the Radar Weight & C.G. breakdown is the latest information received from R.C.A. dated Oct 4th, 1957 (A revised weight statement is expected shortly). No Sparrow III Auxiliaries are carried in the production aircraft.

Where later weights have been received from Minneapolis-Honeywell, these have been incorporated. Allowances have also been made for the missile firing system, junction boxes and some Avro installed antennae.

The Infra red Tracker System seeker head is allowed for in its Fin Pod location (Total weight of the installed system 3,281.9lb, including missile actuation & firing systems).

In addition to the above Minneapolis-Honeywell M.H. 64 Damping System is installed.

Arrow 2 Aircraft 25206 to 25208, and some later Aircraft will have the "Astra Minus" system (Navigational & Communication equipment only).

- d) Where actual weights of Arrow I parts that apply to Arrow 2 Aircraft have been obtained, these weights have been recorded in the Arrow 2 records. Some weights of Arrow 2 parts have also been obtained.

On I.B.M. sheets in this report, immediately preceeding the item title will be found a number varying from 0 to 100. This is percentage actual Weight recorded in the relevant item.

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WEIGHT (1b)

1. STRUCTURE

a) Wings

I/W Struct M/S to R/S - addition of mounting brackets for
 stable platform + 1.64

Wing Weight Increase + 1.64

b) Fin & Rudder

Fin & Joints to Wing - production drawings for Arrow 2 est.
 Mk.1 actual weights used where
 applicable + 4.26

Fin Weight Increase + 4.26

c) Front Fuselage Fwd Sta 255 ins

Formers FF - prod. drg. reissues, misc. bracketry added + 1.65
 Bulkhead Sta. 255 ins. - prod. drg reissues, hardware
 changes etc. - 0.33

Navigator's Canopy - addition of step to L.H. Canopy + 0.69
 Radome - addition of brackets to radome ring + 0.14

Radar Nose Structure - Prod. drg reissues, misc bracketry
 added + 0.40

Front Fuselage Increase + 2.55

d) Centre Fuselage Sta 255-485 ins

Skins CF - Top inner longeron split & splice fitting added
 at Sta. 393 ins + 0.62

Duct CF - Access panel added at rear of duct, + 1.26
 seal plates added on duct ring + 1.16

Pack Mtg. Struct - redesign of beam Sta 292 ins for Arrow 2 + 3.51
 Inflatable seal was allowed for here,
 but is already included in L.P.

Pneumatics - 5.41

Integral Fuel Tank - fitting added at aft end of longeron + 0.58
 addition of insulator connectors etc + 0.83

Electronic Bay Struct - side doors fasten with camlocs not
 latches as was previously assumed - 2.26
 - prod. drg est.

prod. drg. ests of structural panels,
 R.C.A. supply some mtgs previously
 allowed for - 2.54

Doppler mtg - allowance deleted - 1.56

Mtg. tray - prod. drg ests + 0.09

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d) <u>Centre Fuselage Sta 255-485 ins Cont'd</u>	<u>WEIGHT (lb)</u>
Access Door Sta 255" - 292" - side seals added around doors .06 rubber strips & .01 steel angles	+ 0.93
Inner skin .04 mg was .032 Al	- 0.41
Latches - Hartwell - initial allowance too high	- 0.55
allowance for Radar cover panel not required	- 2.06
misc. changes & earlier error in hinge wts	- 0.63
<u>Centre Fuselage Decrease</u>	<u>- 6.44</u>
e) <u>Duct Bay Sta 485"-591.65"</u>	
Centre Panel Fwd - T.R. Unit mtg added	+ 2.15
Misc. prod. drg changes	- 0.26
Floating Duct - addition of plate seals at Sta 558"	+ 1.86
<u>Duct Bay Increase</u>	<u>+ 3.75</u>
f) <u>Engine Bay Sta 591.65" - 742.5"</u>	
No weight change.	
g) <u>Rear Fuselage Sta 742.5 aft</u>	
Rudder Fairing fixed R.F. - electrics service panel added	+ 0.39
slit line fairing added between para brake doors & dorsal fairing	+ 0.33
<u>Rear Fuselage Increase</u>	<u>+ 0.72</u>
h) <u>Fuselage Joints</u>	
Joint F.F. to C.F. - Mk. 2 prod drgs now estimated aft skin Sta 246-268", stringer #15 to longerons no longer called-up here	- 1.69
addition of air condit. transition duct joint	+ 3.46
Misc. other changes	- 0.04
<u>Fuselage Joints Increase</u>	<u>+ 1.73</u>
2. <u>LANDING GEAR</u>	<u>TOTAL STRUCTURAL INCREASE</u>
No weight change	<u>+ 8.21</u>

3. POWER PLANT & SERVICES

No weight change

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4. FLYING CONTROLS GROUP

WEIGHT (lb)

No weight change.

5. EQUIPMENT GROUP

Damping System - alteration to wiring associated with shift fwd of elevator feel and trim units and servos	+ 4.57
Missile Pack Hydraulics - first estimate made to drawings - previously only allowances were carried for piping etc.	
Actual wt obtained of fwd jack fwd missile	+ 1.80
Six valve manifold assy. quoted at 21 lb, actual wt obtained of 34 lb	+13.00
Filter - allowance initially too high (actual wt.)	- 3.33
Compensating valves - 4 off - initially quoted at 4.75 lb each - test specimens act wt. 12 lb, production valve with wt saving incorporated allowance increased to 6.5 lb each	+ 7.00
Piping, fairleads etc. - now est. in detail	+ 9.64
Missile Pack Structure - Pack sealing now detailed on prod drgs	
Fwd and aft missile fairings - no longer required	- 6.93
Door & missile seals - est in detail	+ 2.35
Side seal - called up with Pneumatics (see below)	-14.48
Fwd inflatable seal, not located on pack	- 4.69
Misc. drg reissues & ECNs incorporated	+ 1.08
Missile Pack Pneumatics - new wt report to cover all pneumatic items in pack ie inflatable side seals & associated piping etc (see also above)	+24.45
<u>Equipment Group Increase</u>	<u>+34.46</u>

SUMMARY

Weight Change - Aircraft Basic Weight

Structure	+ 8.21
Equipment	+34.46
	+42.67

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

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46,186.87

46,229.54

+ 42.67 lb

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DESCRIPTION	WEIGHT lb.	H. ARM ins	V. ARM ins
STRUCTURE	19,169.11	566.80	137.29
Wings	10,036.73	643.02	142.21
Fin & Rudder	1,039.01	753.84	208.90
Fuselage - Fwd Sta 255 ins	2,585.80	184.45	128.74
Sta 255 - 485 ins	1,700.20	376.06	130.59
Sta 485 - 591.65 ins	1,161.25	538.59	105.63
Sta 591.65 - 742.5 ins	1,574.07	659.68	110.72
Sta 742.5 ins aft	1,019.48	806.57	127.46
"Marry - Up"	52.57	485.08	106.65
LANDING GEAR - RETRACTED	2,584.25	487.74	134.82
Main Landing Gear	1,934.94	539.49	141.00
Main Gear Doors & Fairings	287.98	538.52	138.40
Nose Landing Gear	333.81	170.81	99.70
Nose Gear Door & Fairing	27.52	162.22	88.66
POWER PLANT & SERVICES	10,800.67	671.41	121.32
Engines & Accessories PS 13	9,186.78	687.95	121.16
Engine Nose Bullet (Orenda supplied)	70.00	587.17	116.00
Engine Controls	32.43	375.76	118.61
Gear Box & Drives on Fuselage	281.84	601.70	102.49
Gear Box, Starter & Drivers on Engines	315.45	615.98	105.24
Fire Extinguishing System	65.46	700.45	134.21
Engine Mountings	132.38	666.82	136.52
Fuel System	716.33	530.91	134.48
FLYING CONTROLS GROUP	1,926.56	650.93	138.14
Mechanical Flying Controls	952.74	676.42	147.63
Hydraulic Flying Controls	973.82	626.00	128.86
EQUIPMENT FIXED & REMOVABLE	8,950.19	333.38	114.45
Instruments	46.07	163.68	138.70
Probe	15.25	-23.71	108.00
Cockpit Pressure Sealing	5.00	186.00	130.00
Oxygen System	26.07	240.54	156.70
Cockpit Equipment	6.00	187.50	145.00
Ejector Seats	342.94	204.50	134.11
Air Conditioning System	856.00	333.49	134.98
Cockpit Insulation	14.31	187.48	132.00
Hydraulics Utility System	647.33	505.17	117.69
Drag Chute	91.07	786.68	143.19

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DESCRIPTION	WEIGHT lb	H. ARM ins	V. ARM ins.
EQUIPMENT FIXED & REMOVABLE (Cont'd)			
Electrical System	1,264.02	434.54	112.85
Low Pressure Pneumatics	56.94	421.96	128.47
Surface Finish	100.00	591.52	140.20
Intake Deicing Boots	88.00	195.82	118.00
Canopy Actuation	64.92	221.99	154.35
Cabin Consoles	17.28	174.66	124.33
Radar Door Actuation	10.00	268.00	95.00
MH 64 Damping System	184.72	464.22	135.05
Radio and Radar Removable	2,095.20	209.73	108.59
Radio and Radar Fixed	784.08	238.57	117.84
Sparrow Pack Structure	889.35	384.10	98.80
Sparrow Pack Mechanisms	553.32	372.85	99.13
Sparrow Pack Hydraulics	360.05	377.89	104.06
Sparrow Pack Electronics Removable	185.50	331.91	100.00
Sparrow Pack Electrics & Electronics Fixed	217.11	335.24	110.00
Sparrow Pack Air Conditioning	5.21	305.50	102.50
Sparrow Pack L.P. Pneumatics	24.45	386.92	103.50
Aircraft Basic Weight	43,430.78	U/C Up 543.74	128.50
		U/C Down 545.97	124.82
USEFUL LOAD (less fuel)	2,798.76	377.29	104.80
Crew	390.00	194.00	136.50
Oil	138.97	636.92	110.57
Engine Fire Extinguishing Fluid	25.00	730.00	129.00
Residual Fuel	218.40	553.98	134.04
Missiles	1,728.00	398.29	88.30
Oxygen Charge	13.39	259.68	159.91
Water for Air Conditioning	285.00	267.91	131.56

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DESCRIPTION	WEIGHT lb	H. ARM ins	V. ARM ins	% M.A.C.
Operational Weight Empty U/C Up	46,229.54	533.67	127.07	26.98
U/C Down		535.77	123.61	27.56
Op. Wt. Empty Less Missiles U/C Up	44,501.54	539.28	128.58	28.53
U/C Down		541.46	124.98	29.13
Normal Combat Mission Fuel * (2,249 gals. at 7.8 lb/gal)	17,540.00	-	-	
Normal Gross Weight *	63,769.54	-	-	
Half Combat Mission Fuel * (1,124 gals at 7.8 lb/gal)	8,770.00			
Combat Weight (half mission fuel) *	54,999.54			
Max Internal Fuel (2,492 gals at 7.8 lb/gal)	19,438.00	541.85	144.16	
Gross Weight (Max. internal fuel) U/C Up	65,667.54	536.09	132.13	27.65
U/C Down		537.57	129.69	28.06
Max. External Fuel (500 gal at 7.8 lb/gal + drop tank)	4,238.00	520.29	60.75	
Max. Gross Weight (Int.+Ext. Fuel) U/C Up	69,905.54	535.13	127.80	27.39
U/C Down		536.52	125.51	27.77

N.B.
 1) Aircraft Datum = 120 ins above an arbitrarily chosen ground line
 2) * Fuel weights in accordance with latest data issued by Performance Group dated November 19, 1957. Centres of Gravity have temporarily been omitted until a fuel sequencing system is finally established.

DATE: MAY 1ST 1958

SHEET: 3

BY: Kathleen G. G. G.

HORIZONTAL C.G. PLOT OF
FIXED POINTS ON ARROW 2
FLIGHT ENVELOPE

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