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AVRO AIRCRAFT LIMITED
INTER-DEPARTMENTAL MEMORANDUM


Ref. 5049/11/J
Date January 1st, 1958
To See Distribution
From Mr. E. F. Burnett
Subject ARROW 2 PRODUCTION A/C WEIGHT & C.G. SUMMARY - Report # 7-0400-34 Iss. 15

Attached is a copy of Weight and C.G. Summary Report # 7-0400-34 Iss. 15, dated January 1st, 1958 for your retention.

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

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

amc.


E. F. Burnett
Weights Supervisor

cc: Messrs.	J.C. Floyd	N. Ring
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51853

Date: January 1st, 1958
Aircraft: ARROW 2
PRODUCTION A/C

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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 2-2	Weight & C.G. Summaries
3	Horizontal C.G. plot showing basic fixed points on flight envelope. The variation of C.G. with fuel used has been omitted until such time as a fully approved fuel sequencing is established.
4-1 to 4-15	I.B.M. Detail Sheets of Weights and C.G.'s.

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INTRODUCTION & WEIGHT CHANGES

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

All Weight & C.G. changes are relative to Issue 14 of December 1st, 1957.

The early Arrow 2 Aircraft # 25206 etc. will not be as this summary designates, but will be flight test aircraft with Instrumentation, "Astra Minus" Radar, Missile Pack Trial Installations, various equipment T.I.'s (e.g. Ram Air Turbine in Aircraft # 25206 and 25211) etc. Weight statements for these aircraft will be issued at a later date.

GENERAL:

- a) Orenda PS 13 Engines comprise the Power Plant (4,500 lb each, brochure weight, excluding Nose Bullet and 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, Weight & C.G. breakdown being to the latest information received from R.C.A. dated 4th October 1957. No Sparrow III Auxiliaries are carried in the production aircraft. Some Avro installed antennae have been added. The Infra-red Tracker System is allowed for in its proposed location at the Fin. (Total Weight = 2,881.8 lb)

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

Arrow 2 Aircraft # 25206 to 25208 will have the "Astra Minus" System (Navigation & Communication equipment only).

- d) A considerable number of Arrow 1 parts, assemblies and equipment have now been weighed. Where these weights apply to the Arrow 2 Aircraft, they have been recorded in the Arrow 2 records.

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

1. STRUCTURE

WEIGHT (lb)

a) Wing:

Ribs # 1 to # 9 I/Wing - redesign of Arrow 2 fabricated ribs, reductions in caps & Webs, also minor redesign in machined ribs	=	25.86
Spars I/Wing - production drawing estimates of C/Spar Aft F/Spar to M/Spar Struct I/W - redesign 2 point refueling door and gate valve operating mechanism	=	0.37
	+	3.27

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INTRODUCTION & WEIGHT CHANGES

1. STRUCTURE

WEIGHT (lb)

a) Wing: (Cont'd.)

Strut Pick-up Fittings I/W - production drawing estimates of Engine Mountings redesign Front Centre Mounting fitting	+ 9.22
Elevator Control Box - Actual Weights of some applicable Arrow 1 parts	+ 1.21
<u>Weight Decrease Wing</u>	<u>- 12.53</u>

b) Fin & Rudder:

No Weight Change

c) Front Fuselage Fwd. Sta. 255"

Cockpit Formers - Production drawing estimates now made	- 2.70
Crew's Bulkheads - first Arrow 2 production drawing estimates	- 0.32
Cockpit Floor - addition channel supports at U/C Uplocks	+ 0.55
Pilot's Canopy - addition of insulation batting	+ 0.54
Radar Nose Structure - Production drawing re-issues	+ 1.22
<u>Front Fuselage Weight Decrease</u>	<u>- 0.71</u>

d) Centre Fuselage Sta. 255"-485"

Equipment Bay Structure - revision of estimate of Mounting tray	+ 0.17
Electronics Bay Structure - initial Arrow 2 scheme drawing estimates	+ 5.25
<u>Centre Fuselage Weight Increase</u>	<u>+ 5.42</u>

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.

Longerons Fixed R.F. - production drawing estimates	- 1.71
Removable Tailcones - previously estimated in Aug./57 to verbal information re gauges etc. now stress approved schemes and production drawings available. Outer skins and gauges increased from .025 to .032 and from .018 to .025 etc. also longeron cap strips changes from titanium to N155 etc. etc.	+ 39.34

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WEIGHT (lb)

INTRODUCTION & Weight CHANGES

1. STRUCTURE

g) Rear Fuselage Sta. 742.5" Aft. (Cont'd.) Removable Tailcones - Cont'd

Inner Skins - some gauge changes e.g. .025 to .028 for Aft Skins etc.	+	11.08
Latches - addition of 7 shear latches/ tailcone with associated structure.	+	12.20
Aft Ring - an extruded ring has now been added at the aft end.	+	29.42
Former Sta. 808.25 was .02 N155 channel section now .04 with .051 capping and doubler added.	+	23.12
Former Sta. 814 now .04 was .02, doubler added	+	6.70
changes to other formers, diaphragms, kink members, intercostals etc. too many to enumerate.	+	7.24
Total Weight change to Tailcones	+	129.10
<u>Rear Fuselage Increase</u>	+	<u>127.39</u>

h) Fuselage "Marry-Up"

No Weight Change.

TOTAL STRUCTURAL INCREASE

+ 119.57

2. LANDING GEAR

No Weight Change

3. POWER PLANT & SERVICES

No Weight Change

4. FLYING CONTROLS GROUP

Flying Control Hydraulics I/Wing - addition of surge dampers to Elevator jacks (mod. to jack)	+	1.50
Flying Controls Hydraulics O/W - addition of surge dampers to Aileron jacks.	+	1.50
Flying Controls Hydraulics Fin - addition of surge damper to Rudder jack	+	0.75
<u>FLYING CONTROLS GROUP INCREASE</u>	+	<u>3.75</u>

5. EQUIPMENT GROUP

Electrics Air Intakes - Arrow 2 Production Drawing estimates	-	1.90
Electrics D.B. - Westinghouse proposal for Transformer- rectifier unit greater than previously re- corded Lucas Rotax Unit	+	9.00

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INTRODUCTION & WEIGHT CHANGES

<u>5. EQUIPMENT GROUP</u>	<u>WEIGHT (lb)</u>
Electrics E.B. - Westinghouse proposal for Alternator Wt. = 87 lb, Lucas Rotax was 82 lb	+ 10.00
Utility Hydraulics I/Wing - Dowty increase in weight of Main U/C Door jacks	+ 2.00
Radio & Radar Fixed Equipment - latest R.C.A. estimate	+ 54.00
Radio & Radar Removable Equipment - latest R.C.A. estimate, increase due primarily, so they state, to the fwd. nose estimate now backed by 85% Actual Weight.	+ 103.80
Missile Auxiliaries in Pack - latest R.C.A. estimate	- 12.50
Electrics & Electronics fixed in Pack - first complete estimate made for production pack, partially based on test pack information. (additional to R.C.A. equipment.) Actuation System	+ 4.20
Firing System - not previously included	+ 85.20
Missile Pack Mechanisms - addition of nylon liners in telescopic links	+ 2.77
Modifications to door actuation levers	+ 0.51
First detailed estimate of all installation details	+ 19.65
Production drawing estimates of launchers (approximately 61.5 lb each, previously 75 lb was allowed.)	- 54.38
<u>EQUIPMENT GROUP INCREASE</u>	<u>+ 222.35</u>

SUMMARY

Weight Change - Aircraft Basic Weight

Structure	+ 119.57 lb
Flying Controls	+ 3.75 lb
Equipment	+ 222.35 lb
	<u>+ 345.67 lb</u>

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

<u>Issue 14</u>	<u>Issue 15</u>	
<u>45,263.82 lb</u>	<u>45,609.49 lb</u>	+ <u>345.67 lb</u>

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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	19,044.15	566.37	137.35
Wings	10,012.03	642.54	142.22
Fin & Rudder	1,024.00	754.25	209.28
Fuselage - fwd. Sta. 255"	2,572.87	183.01	128.43
Sta. 255"-485"	1,691.83	375.38	130.60
Sta. 485"-591.65"	1,119.04	538.28	105.41
Sta. 591.65"-742.5"	1,550.20	661.04	110.51
Sta. 742.5 Aft.	1,021.85	805.37	128.62
"Marry-Up"	52.33	467.60	103.84
LANDING GEAR - RETRACTED	2,542.31	487.09	134.78
Main Landing Gear	1,901.62	539.31	141.00
Main Gear Doors & Fairings	282.34	537.60	138.37
Nose Landing Gear	333.81	170.80	99.70
Nose Gear Door & Fairing	24.54	162.24	88.23
POWER PLANT & SERVICES	10,800.67	671.41	121.32
Engines & Accessories PS 13	9,186.78	687.95	121.16
Gear Box & Drives on Fuselage	281.84	601.70	102.49
Engine Controls	32.43	375.76	118.61
Gear Box, Starter & drives on Engine	315.45	615.98	105.24
Engine Nose Bullet (Orenda Supplied)	70.00	587.17	116.00
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	1,792.80	683.95	140.43
Mechanical Flying Controls	944.53	684.69	148.25
Hydraulic Flying Controls	848.27	683.13	131.72
EQUIPMENT FIXED & REMOVABLE	8,640.80	335.93	115.30
Instruments	46.07	163.68	138.70
Probe	15.00	38.14	108.00
Cockpit Pressure Sealing	5.00	186.00	130.00
Oxygen System	26.07	240.54	156.70
Ejector Seats	339.06	204.43	134.10
Air Conditioning System	856.00	333.49	134.98
Hydraulics Main System	640.81	504.22	117.77
Cockpit Insulation	14.31	187.48	132.00
Drag Chute	91.07	786.68	143.19
Electrical System	1,276.26	434.44	112.66
Low Pressure Pneumatics	56.94	421.96	128.47
Surface Finish	100.00	591.52	140.20
Intake De-icing Boots	88.00	195.82	118.00
Canopy Actuation	64.92	221.99	154.35
Cabin Consoles	17.38	174.63	124.32
Radar Door Actuation	10.00	268.00	95.00
MH64 Damping System	180.15	471.27	135.69
Radio & Radar Removable	2,011.30	213.06	114.24
Radio & Radar Fixed	685.00	236.96	118.63
Sparrow Pack Structure	890.19	381.67	97.60
Sparrow Pack Mechanisms	551.12	374.40	99.12
Sparrow Pack Hydraulics	331.94	373.52	99.00
Sparrow Pack Electronics Removable	185.50	331.91	100.00
Sparrow Pack Electrics & Electronics fixed	153.50	340.74	95.00
Sparrow Pack Air Conditioning	3.21	305.50	102.50

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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>
AIRCRAFT BASIC WEIGHT U/C Up	42,820.73	546.58	128.83	
U/C Down		548.81	125.13	
USEFUL LOAD (less fuel)	2,788.76	377.69	104.73	
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	389.29	88.30	
Oxygen Charge	13.39	259.68	159.91	
Water for Air Conditioning	275.00	268.00	131.75	
Operational Weight Empty U/C Up	45,609.49	536.25	127.36	27.70
U/C Down		538.35	123.89	28.28
Operational Weighing Empty U/C Up	43,881.49	542.04	128.89	29.29
Less Missiles U/C Down		544.22	125.28	29.89
Normal Combat Mission Fuel * (2,227 gal. @ 7.8 lb/gal.)	17,370.00	-	-	-
Normal Combat Weight	62,979.49	-	-	-
Half Combat Mission Fuel * (1,113 gal. @ 7.8 lb/gal.)	8,685.00	-	-	-
Combat Weight * (half Mission Fuel)	54,294.49	-	-	-
Maximum Internal Fuel (2,492 gal. @ 7.8 lb/gal.)	19,438.00	541.85	144.16	
A.U.W. Maximum Internal Fuel U/C Up	65,047.49	537.92	132.38	28.16
U/C Down		539.39	129.95	28.56
Maximum External Fuel (500 gal. @ 7.8 lb/gal + Drop Tank)	4,248.00	521.84	60.67	
A.U.W. Maximum Internal and U/C Up	69,295.49	536.93	127.98	27.88
External Fuel U/C Down		538.31	125.70	28.26

N.B. 1) Aircraft Datum = 120" above an arbitrarily chosen ground line.

2) * Fuel weights in accordance with latest data issued by Aerodynamics November 19th, 1957. Centres of Gravity have temporarily been omitted until a fuel sequencing system is finally established.

3) With the increase of 344.40 lb in Operational Weight Empty the Normal Combat Mission Fuel has increased by 90 lb.

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REPORT: 7-0400-34-15

BY: Kathleen Symon

DATE: JAN 15 1958

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

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