

UNCLASSIFIED
CONFIDENTIALAVRO AIRCRAFT LIMITED
INTER-DEPARTMENTAL MEMORANDUM

Ref: 3222/11/J
 Date: 1 September, 1958
 To: See Distribution
 From: E.F. Burnett - Weight Supervisor
 Subject: Arrow 2 Production A/C Weight and C.G. Summary Report: 7-0400-34 Issue 23

Attached is a copy of Weight and C.G. Summary Report 7-0400-34 Issue 23 dated September, 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/DARFT 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 per Key
 E.F. Burnett

EFB/ag

cc: Messrs. J.C. Floyd F. Brame D. Inglis
 R.N. Lindley W. Czerwinski D. Moore
 R. Marshall J. Lucas R. Cairns
 C.V. Lindow S. Kwiatkowski D. Brownridge
 J.W. Ames A. Cornish
 B.C. Alford T. Roberts
 D. Wade C. Marshall
 D.N. Scard J. Zurakowski
 A.R. Buley A. Crust (6 copies for R.C.A.F.)



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Prod. A/C
Date : 1 September, 1958

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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. 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.G.'s

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Introduction & Weight Changes

The following is a Weight & C.G. Summary of the Arrow 2 Production Aircraft, serial No. 25237 and subsequent, based on the latest weight estimates available. All Weight & C.G. changes are relative to Issue 22 of August 1st, 1958.

Early Arrow 2 Aircraft ie 25206 to 25236, will not be as this summary designates, but will be Flight Test Vehicles with Instrumentation, missile pack trials, some aircraft will have "Astra Minus" etc. etc. Appropriate weight statements will be issued at a later date.

General:

- a) Orenda PS13 Engines comprise the Power Plant (4,800 lb each, revised weight, excluding Nose Bullet, Input Frame and AVRO installed accessories).
- 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 unit weights quoted herein are as received from R.C.A. in their weight statement dated June 5th, 1958. This includes the Infra Red Tracker system seeker head installed in its Fin Pod location.

(Total weight of the installed system is 3336 lb, including Missile actuation and firing systems).

In addition to the above, Minneapolis-Honeywell MH64 Damping system is installed.

Arrow 2 Aircraft 25206 to 25208, and some later serial numbers will have the "Astra Minus" system (Navigational and 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 for Arrow 2 parts have also been obtained.

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

- e) To increase the long range capabilities of the Aircraft tailcone plugs have been introduced to restrict the exhaust area. Provision for carrying these plugs, which are jettisonable, will be made on all Mk 2 A/C. The plug may be installed for any mission, but would probably be jettisoned prior to combat. It is only recorded in this report for a ferrying mission.

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1. Structure

Weight lb

a) Wings

L/W F/Spar to M/Spar Struct - prelim. estimate of the wt.
increase due to increase in
Stringer gauges in the
redesign of tanks #3 & #4. + 12.00

Wing Weight Increase + 12.00

b) Fin & Rudder

No weight change.

c) Fuselage Fwd Sta 255 ins

Misc. Items F.F. - addition of foot guards beneath the
instrument panels to protect projecting
instruments. + 5.14

Crews Bulkheads - Nav. seat fitting now machined was
fabricated + 0.11

Additional stiffener & bracketry on Pilot's
bulkhead + 3.08

Jack retraction bracket now Steel was Alum. + 1.35

Front Fuselage Increase + 9.68

d) Centre Fuselage Sta 255 - 485 ins

Electronics Bay Struct. - Prodn. drgs est. of side doors in
which latches have replaced Camlocs + 1.86

Bulkhead Sta 485 ins - addn of brackets & clips for fuel
lines and electric cables + 0.75

Centre Fuselage Increase + 2.61

e) Duct Bay Sta 485-591.65 ins

Centre Panel Aft - misc. prodn. drg. changes to brackets,
stiffeners etc. + 0.46

Lower Panel Fwd - redesign for A/C 25209 & subsequent, alts.
to mtg. brkts. & fuel vent fairings + 2.30

Access Panels - redesign of electrics access door &
modification to refuel & limiter door - 0.85

Drop Tank Mtg Struct - redesign of main housing casting
error in earlier calculations - 1.12
- 1.80

Duct Bay Decrease - 1.01

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1. Structure (Cont'd)

Weight lb

f) Engine Bay Sta 591.65 - 742.5 ins

Bottom Panel Aft - added mtg brackets etc. prodn. drg reissues + 2.44
Heavy Formers - Prodn. drg. reissues + 0.12

Total Engine Bay Increase + 2.56

g) Rear Fuselage Sta 742.5 ins aft

Tunnel fixed R.F. - insulation is now .006 Al. foil on
outside & 9.6 lb/cu.ft. core was .002
+ .003 Steel foil & 5 lb/cu.ft. core + 3.24

Access Doors R.F. - insulation changed as above + 1.62

Centre Struct & Stinger, remov. - prodn. drg. ests. of
insulation core & foil also
seals, previously wt.
allowances + 4.15

Rear Fuselage Increase + 9.01

h) Fuselage Joints

No weight change.

Total Structural Increase + 34.85

2. Landing Gear

No weight change.

N.B. Early Mk 2 A/C will have a considerably heavier Main Gear (probably about + 55 lb/side) since existing forgings etc. are to be utilized. However for the Mk 2 consolidated design applicable to production A/C it is hoped to maintain the currently recorded wt. of 675 lb/leg (ie incl. drag. stay, less wheel assys.).

3. Power Plant & Services

Fuel System - increase in weight of fuselage bag tanks based on actual weights obtained for Mk 1 tanks. Manufacturer's quoted weights were previously recorded. + 13.18

Total Power Plant Group Increase + 13.18

4. Flying Controls Group

Mechanical Flying Controls - all prod. drg. ests revised to current issues - 0.05

Total Flying Controls Decrease - 0.05

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5. Equipment Group

Weight lb

Air Conditioning - addition of ducting for cooling IR seeker head in fin	+ 12.22
Instruments - 1st est. to Mk 2 data. Earlier ests. were based on Mk 1, all Radio & Radar Equip & elect. panels are included in their appropriate grouping elsewhere	- 11.46
Electrics F.F. - first est. to Mk 2 prod. drgs.	- 0.08
Electrics C.F. - first est. to Mk 2 prod. drgs	- 0.28
Anti-skid control unit was erroneously duplicated here.	- 13.50
Electrics Fin - first est. to Mk 2 prod. drgs	- 0.39
<u>Total Equipment Group Decrease</u>	<u>- 13.49</u>

6. Trapped Fuel

No weight change.

7. Operational Load

No weight change.

Summary

Wt Change - Aircraft Basic Weight

Structure	+ 34.85
Power Plant	+ 13.18
Flying Controls	- 0.15
Equipment	- 13.49
	<u>+ 34.49</u>

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

Issue 22

47,227.45

Issue 23

47,261.94

+ 34.49 lb

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Wt. & C.G. Summary Full Astra I Installed

Description	Weight lb	H. Arm	V. Arm
Structure	19,212.09	566.62	137.30
Wings	10,041.11	642.92	142.18
Fin & Rudder	1,041.35	753.96	208.83
Fuselage Fwd Sta 255 ins	2,599.15	184.59	128.63
Sta 255 - 485 ins	1,714.59	375.78	129.90
Sta 485 - 591.65 ins	1,160.24	538.44	105.63
Sta 591.65 - 742.5 ins	1,576.20	659.72	110.71
Sta 742.5 ins aft	1,036.81	806.89	129.18
"Marry-Up"	42.64	466.91	109.85
Landing Gear - Retracted	2,681.98	489.14	135.04
Main Landing Gear	2,032.67	538.85	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	11,446.72	671.83	121.41
Engines Bare PS 13	9,600.00	689.94	121.25
Engine Accessories (Inlet frame etc)	303.04	607.92	119.29
Engine Controls	32.32	179.90	117.49
Gear Box & Drives on Fuselage	293.93	602.67	102.24
Gear Boxes & Starters on Engine	305.20	614.82	105.66
Fire Extinguisher System	73.58	686.35	131.21
Engine Mountings	75.39	671.91	141.52
Fuel System	763.26	529.78	135.19
Flying Controls Group	1,932.26	651.64	138.17
Mechanical Flying Controls	958.44	677.70	147.63
Hydraulic Flying Controls	973.82	626.00	128.86
Equipment Fixed & Remov.	9,110.73	332.34	114.28
Instruments	34.61	167.52	138.92
Probe	15.25	-23.71	108.00
Cockpit Pressure Sealing	5.00	186.00	130.00
Cabin Consoles	17.28	174.66	124.33
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	876.31	346.37	136.25
Cockpit Insulation	14.31	187.48	132.00
Hydraulics Utilities System	631.57	503.07	118.31
Sequencing of Nose U/C Door	27.00	200.00	115.00
Mech. Door Stops Main U/C Doors	3.02	516.00	120.00
Anti-skid Control System	37.68	480.00	113.97
Drag Chute	91.07	786.68	143.19
Electrical System	1,254.16	439.96	112.66
Low Pressure Pneumatics	50.08	394.63	126.02
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
Radas Door Actuation	10.00	268.00	95.00
Radio & Radar Remov.	2,110.48	212.15	108.76
Radio & Radar Fixed	880.04	216.54	114.59
MH64 Damping System	186.42	462.33	134.70
Sparrow Pack Structure	906.31	383.90	

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Description	Weight lb	H. Arm	V. Arm	M.A.C. %
Sparrow Pack Mechanisms	557.32	372.64	99.11	
Sparrow Pack Hydraulics	369.70	378.00	104.00	
" " Elec & Electronics Fixed	188.73	336.09	110.00	
Sparrow Pack Air Conditioning	5.21	305.50	102.50	
Sparrow Pack L.P. Pneumatics	24.45	386.92	103.50	
Sparrow Pack Electronics Remov.	186.80	326.19	100.00	
Trapped Fuel	213.80	548.26	141.79	
Aircraft Basic Weight U/C Up	44,597.58	544.70	128.44	
U/C Down		546.99	124.65	
Useful Load (Less usable Fuel)	2,664.36	363.22	101.81	
Crew	390.00	194.00	136.50	
Engine Fire Ext Fluid	25.00	730.00	129.00	
Oil	138.97	636.92	110.57	
Oxygen Charge	13.39	259.68	159.91	
Water for Air Conditioning	285.00	267.91	131.56	
Missiles	1,728.00	389.29	88.30	
Missile Cocoons	84.00	390.40	85.80	
Operational Weight Empty U/C Up	47,261.94	534.47	126.94	27.21
U/C Down		536.63	123.36	27.80
Normal Combat Mission Fuel ϕ (200 Nav miles - 2290 gals at 7.8 lb/gal)	17,864.00	-	-	
Normal Gross Weight	65,125.94	-	-	
Half Combat Mission Fuel (1145 gals at 7.8 lb/gal)	8,932.00	-	-	
Combat Weight ($\frac{1}{2}$ mission fuel)	56,193.94	-	-	
Max. Internal Fuel (2491 gals at 7.8 lb/gal)	19,433.00	541.85	144.16	
Gross Weight (Max Int. Fuel) U/C Up	66,694.94	536.62	131.96	27.80
U/C Down		538.15	129.42	28.22
Max External Fuel (500 gal @ 7.8 lb/gal + drop tank)	4,242.36	520.32	60.79	
Tailcone plugs *	252.00	857.07	128.60	
Max Gross Wt. (Int + Ext fuel) U/C Up	71,189.30	536.78	127.71	27.84
U/C Down		538.22	125.33	28.24

* Ref Note e) in Introduction.

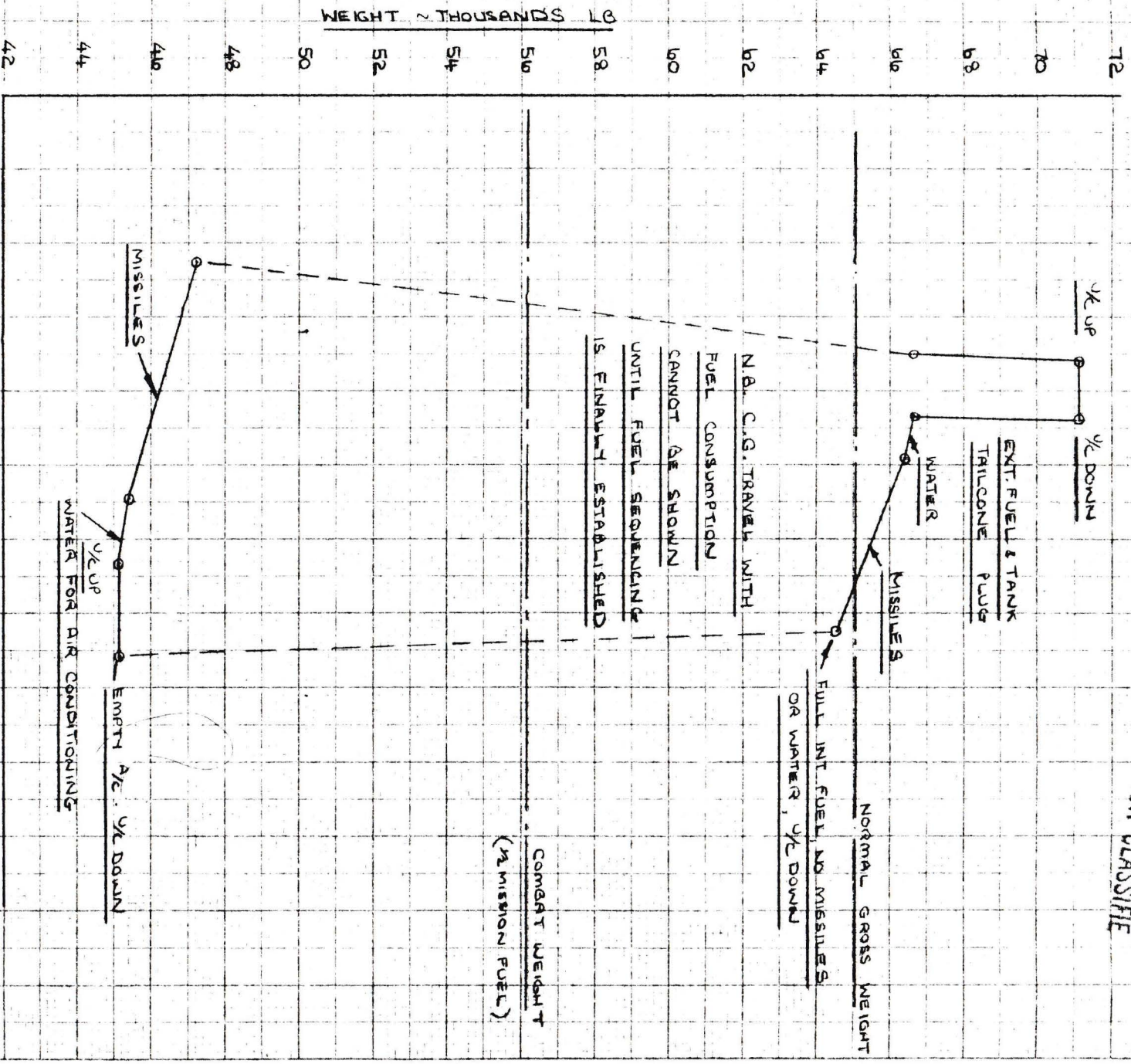
ϕ Fuel weights in accordance with latest data issued by Performance group dated November 19th, 1957. Centres of Gravity have temporarily been omitted until a fuel sequencing system is finally established.

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

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BY: Karlsen gylw

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HORIZONTAL C.G. POSITION % M.A.C.