Arrow 2
Prod. A/C

Report: 7-0400-34
Issue : 20

WEIGHT & C.G. SUMMARY

E June/58

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Report no.: QCX-AVRO-CF105- R-7-0400-34 -Iss.20

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by (Name): Michel W. Drapeau

(Dept.): A/DND Coordinator, Access to Information

Date: Dec. 7, 1992

R. Auger
Signature

AVRO AIRCRAFT LIMITED
INTER-DEPARTMENTAL MEMORANDUM

Ref: 9354/11/J
Date: 1 June, 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 20

Attached is a copy of Weight and C.G. Summary Report 7-0400-34 Issue 20 dated June 1st, 1958, for your retention.

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

[signature]
E.F. Burnett

EFB/ag

Copies to:

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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 19 of May 1st, 1958.

Some early Arrow 2 Aircraft, serial numbers 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 test installations etc. Appropriate weight statements will be issued at a later date.

GENERAL:-

a) Orenda PS13 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 of the unit weight & C.G. breakdown is a weight statement received from R.C.A. dated October 4, 1957. No Sparrow III auxiliaries are carried in a production Aircraft. Where later weights have been received from Minneapolis-Honeywell, these have been incorporated.

All installation cables, junction boxes etc not R.C.A. supplied are now AVRO's responsibility weightwise and these have been recently reassessed.

A weight statement has been received from R.C.A. dated April 1, 1958, but this will not be used until several points have been clarified by R.C.A. Some weight increase is to be expected.

The Infra Red tracker system seeker head is installed in its fin pod location.

(Total weight of the installed system is 3,349.4 lb, including missile actuation and firing systems).

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

Arrow 2 A/C 25206 to 25208, and some later serial numbers will have the "Astra Minus" system (Navigational and Communication equipment only).

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GENERAL:- (Cont'd)

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 precentage actual weight recorded in the relevant item.

e) To increase the long range capabilities of the Aircraft a tailcone plug has been introduced to restrict the exhaust area. This plug will be used for ferrying missions only and its weight is recorded with the Max. Gross Weight see sheet 2-2.

1. STRUCTURE:- WEIGHT lb

a) Wings

I/W Centre Line Joints - Mk 2 prod. drg. est of joints Main Spar to Auxiliary Spar	+ 0.14
Elevators - Mk. 2 prod. drgs est, some redesign compared to Mk 1 - no allowance yet made for split control surfaces until design is finalized	- 6.98
Wing Weight Decrease	- 6.84

b) Fin & Rudder

No weight change.

c) Front Fuselage Fwd Sta. 255 ins

Navigator's Canopy* - Sierracin 880 replaces glass for the window	- 6.26
Windscreen* - addition of rear fairing apron	+ 1.55
addition of shims & alterations to hardware for installation	+ 0.51
Air Intakes - Subsequent to supersonic flight the .04 Mg outer side skins were found to be cracked. Repair scheme instituted, skins now .04 AL, stringer sections changed backing angles added etc.	+ 6.42
Front Fuselage Increase	+ 2.22

STRUCTURE (Cont'd) WEIGHT lb

N.B. *The use of Sierracin 880 and Sierracete in place of glass and thermapane is being investigated for the windscreen and pilots canopy. If it proves acceptable and NO change in overall thickness is made then there would be weight savings of approx.

a) 32 lb to Pilots Canopy
b) 38 lb to Windscreen
) Total 70 lb.

(Sierracin = .045 lb/cu.in. Glass = .090 lb/cu.in.)

d) Centre Fuselage Sta. 255 -485 ins

Duct CF - due to a D.O. error the splice straps at Sta. 257.45 were originally shown as .032 instead of .050 AL. + 0.73

Centre Fuselage Increase + 0.73

e) Duct Bay Sta 485 - 591.65 ins

No weight change.

f) Engine Bay Sta. 591.65 - 742.5 ins

No weight change.

g) Rear Fuselage Sta. 742.5 ins aft

No weight change.

h) Fuselage "Marry-Up"

Joint Duct Bay to Eng. Bay - Mk. 1 weight was recorded here until Mk 2 drgs were available. The Mk. 1 joint drgs. included some of the heat exchanger area, not applicable to Mk 2 A/C - the weight was left in error. Mk 2 drgs now estimated - 10.87

Fuselage "Marry-Up" - 10.87

TOTAL STRUCTURAL DECREASE - 14.76

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		WEIGHT lb
2.	LANDING GEAR	
	Main Landing Gear - increase made to brake weight allowance assuming redesigned Mk 2 brakes to be simular to those for MK 1 A/C. There are probably further increases to wheels and brakes this is only a preliminary allowance until a definite design proposal is accepted. (Wt of ONE wheel, brake & tyre Assy. was 151.46 lb, now 165 lb allowed)	+ 54.16
	TOTAL LANDING GEAR INCREASE	+ 54.16
3.	POWER PLANT & SERVICES	
	Engine Controls - completely re-estimated to Mk. 2 prod. drgs.	- 0.11
	Fuel System - completely re-estimated to Mk 2 drgs - previously allowance based on Mk 1 and scheme drgs.	+ 0.81
	POWER PLANT & SERVICES DECREASE	+ 0.70
4.	FLYING CONTROLS GROUP	
	No weight change.	
5.	EQUIPMENT GROUP	
	Air Conditioning - first complete estimate made to Mk 2 prod. drgs, previously allowances etc based on Mk 1 system were carried. No attempt will be made to analyse the weight change which is relatively small	+ 8.09
	Electrics Duct Bay - Further details available on E28 panel - now fully estimated to prod. drgs.	+ 4.39
	Radio & Radar Fixed - deletion of 4 Radar Homer antennae complete re-estimate of cables, the weight prediction of which is now AVRO responsibility (see introd. note c)	+ 67.45
	Missile Pack Structure - addition of retraction guides misc E.C.N.'s incorporated	+ 6.49
	Missile Pack Hydraulics - pressure return lines now Steel were Aluminum, also CS-T-162 pipe replaces CS-T-135 throughout system	+ 5.46
	TOTAL EQUIPMENT GROUP INCREASE	+ 83.40

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SUMMARY

Weight Change - Aircraft Basic Weight

Structure	- 14.76
Landing Gear	+ 54.16
Power Plant	- 0.70
Equipment	+ 83.40
	+123.50

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

Issue 19	Issue 20	
46,229.54	46,353.04	+123.50 lb

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DESCRIPTION	WEIGHT lb	H. ARM ins	V. ARM ins
STRUCTURE	19,154.35	566.68	137.31
Wings	10,029.89	642.98	142.21
Fin & Rudder	1,039.01	735.84	208.90
Fuselage - Fwd Sta 255 ins	2,588.02	184.43	128.67
Sta 255 - 485 ins	1,700.93	376.01	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"	41.70	460.70	110.60
LANDING GEAR - RETRACTED	2,638.41	488.35	134.95
Main Landing Gear	1,989.10	538.89	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	10,801.37	671.45	121.35
Engine & Accessories PS13	9,186.78	687.95	121.16
Engine Nose Bullets (Orenda Supplied)	70.00	587.17	116.00
Engine Controls	32.32	379.90	117.49
Gear Box & Drives on Fuselage	281.84	601.70	102.49
Gear Box, Starter & Drives 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	717.14	531.46	134.96
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	9,033.59	331.29	114.21
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	864.09	341.68	135.33
Cockpit Insulation	14.31	187.48	132.00
Hydraulics Utilities system	647.33	505.17	117.69
Drag Chute	91.07	786.68	143.19
Electrical System	1,268.41	434.75	112.77
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
MH64 Damping System	184.72	464.22	135.05
Radio & Radar Removable	2,095.20	209.73	108.59
Radio & Radar Fixed	841.53	212.59	114.94
Sparrow Pack Structure	897.36	383.98	98.77
Sparrow Pack Mechanisms	553.32	372.85	99.13

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DESCRIPTION	WEIGHT lb	H. ARM ins	V. ARM ins	% M.A.C.
Sparrow Pack Hydraulics	365.51	378,03	103.89	
Sparrow Pack Electronics Remov.	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	
U/C Up		542.82	128.45	
Aircraft Basic Weight	43,554.28			
U/C Down		545.13	124.64	
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 Ext. 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	285.00	267.91	131.56	
U/C Up		532.83	127.02	26.75
Operational Weight Empty	46,353.04			
U/C Down		535.00	123.44	27.35
U/C Up		538.39	128.52	28.29
Op. Wt. Empty less Missiles	44,625.04			
U/C Down		540.64	124.80	28.91
Normal Combat Mission Fuel* (200 N. Mile = 2,254 gal at 7.8lb/gl)	17,580.00	-	-	
Normal Gross Weight	63,933.04	-	-	
Half Combat Mission Fuel (1,127 gals at 7.8 lb/gal)	8,790.00	-	-	
Combat weight (half mission fuel	55,143.04	-	-	
Max. Internal Fued (2492 gals at 7.8 lb/gal)	19,438.00	541.85	144.16	
U/C Up		535.49	132.08	27.49
Gross Weight (Max. int. Fuel)	65,791.04			
U/C Down		537.02	129.56	27.91
Max External Fuel (500 gal at 7.8lb/gal + Drop Tank)	4,242.36	520.32	60.79	
Tailcone Plugs	252.00	857.07	128.60	
U/C Up		535.73	127.76	27.55
Max. Gross Weight (Int & Ext fuel)	70,285.40			
U/C Down		537.16	125.41	27.95

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 19th, 1957. Centres of gravity have temporarily been omitted until a fuel sequencing system is finally established.

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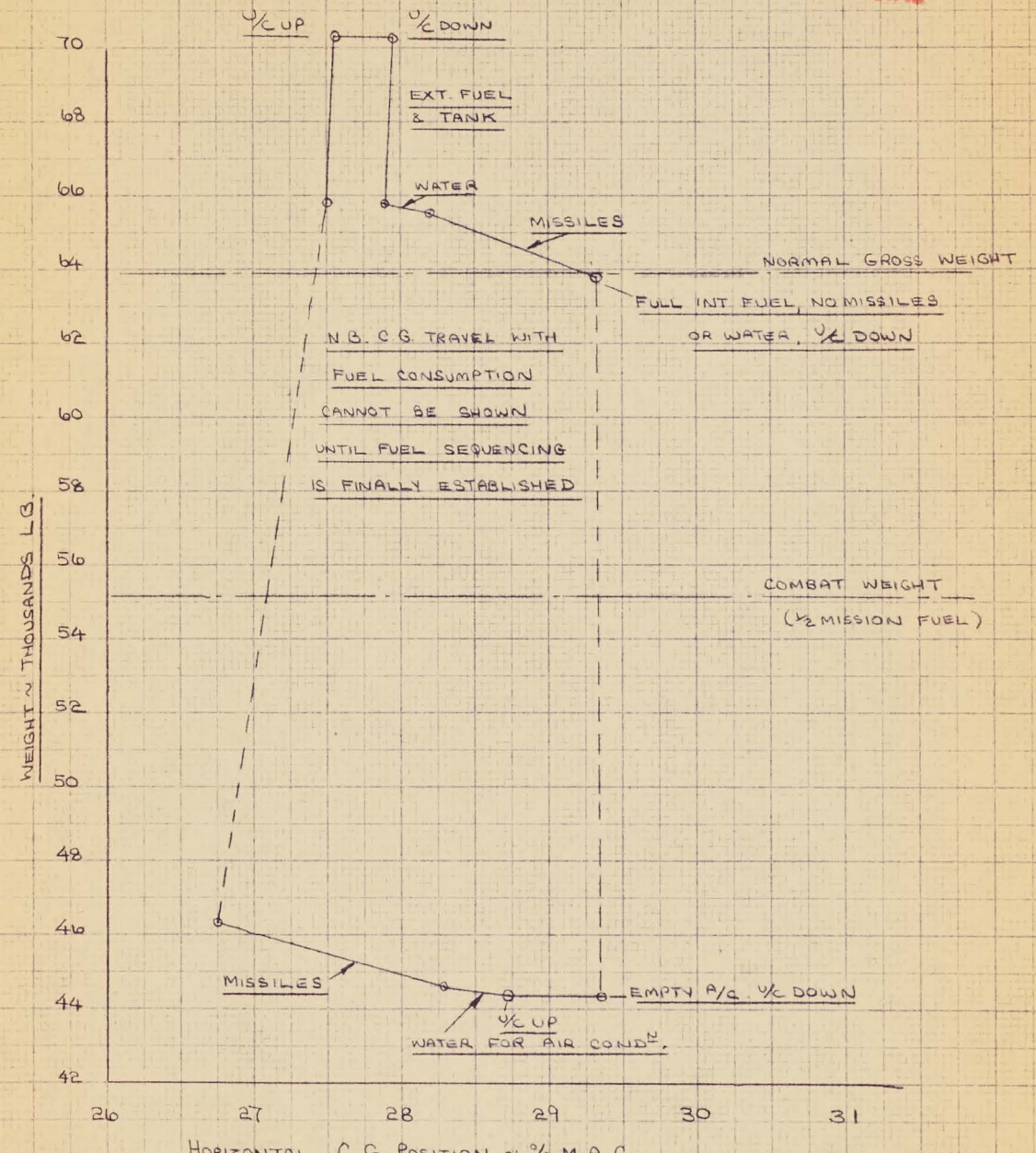
BY : Kathleen Griffin

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



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WEIGHT AND C. OF G BY FUNCTIONAL G
COMPONEN

PROJECT_____

DESCRIPTION	REFERENCE NO.	COMP. NO.	WEIGHT	H. A
FIN AND RUDDER GROUP	2000000			
13 FIN	2010000	83	R55967	47
FIN TO WING MARRY UP	2010001		48306	8
FIN POD FOR IR TRACKER	2010002	83	10757	6
			91501	
95 RUDDER	2020000	84	12400	81
			12400	

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WEIGHT AND C. OF G BY FUNCTIONAL COMPONE

PROJECT_____

	DESCRIPTION	REFERENCE NO.	COMP. NO.	WEIGHT	H.
	TOTAL FUSELAGE GROUP	3000000			
	RADAR NOSE STRUCTURE	3010000			
	RADOME	3010001	51	15958	3
	RADAR NOSE STRUCTURE C A	3010002		270	12
	RADAR NOSE STRUCTURE R N	3010003	51	17032	9
				33260	
	FRONT FUSELAGE STRUCTURE	3020000			
	SKIN F F	3020001	52	8264	19
	COCKPIT FORMERS	3020002	52	10426	18
	LOWER LONGERONS F F	3020003	52	6772	18
38	TOP LONGERONS F F	3020004	52	18746	19
66	NOSE U C SUPPORT STRUCT	3020005	52	3343	21
	CREW BULKHEADS	3020006	52	12609	20
	BULKHEAD STA 120	3020007	52	2980	12
	BULKHEAD STA 255	3020008	52	10921	25
	COCKPIT FLOOR	3020009	52	5864	17
	SHEAT PANEL BELOW NAV ARCH	3020010	52	2001	25
	MISC STRUCTURE F F	3020011	52	552	18
	LOWER SHEAR PANEL	3020012	52	31562	3
	CANOPY ARCHES	3020013	52	8632	2
58	WINDSCREEN	3020014	52	13139	13
				107416	
	CENTRE FUSELAGE STRUCTURE	3030000			
	SKIN C F	3030001	54	22105	36
	FORMERS C F	3030002	54	28749	37
5	BULKHEAD STA 485	3030003	54	12740	48
66	LONGERONS C F	3030004	54	14453	41
	STR BELOW LOWER LONGERONS	3030005	54	4421	27
	RADAR ACCESS DOOR	3030006	54	2358	27
	AIRCOND BAY STRUCTURE	3030007	54	6005	28
	FWD DORSAL FAIRING	3030008	54	2969	28
	DEFLECTOR SHIELD	3030009	54	2045	33
	DORSAL OVER FUEL TANK	3030010	54	4138	41
	PACK MTG STRUCTURE	3030011	54	2280	29
	SEALING MISSILE BAY	3030012	54	559	29
	MISC ITEMS C F	3030013	54	374	37
	ARMAMENT BAY ROOF	3030014	54	12418	38
	FUSELAGE FUEL TANK	3030015	54	22665	39
	DUCT C F	3030016	54	31867	35
				170146	
	DUCT BAY STRUCTURE	3040000			

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PROJECT_____

DESCRIPTION	REFERENCE NO.	COMP. NO.	WEIGHT	H.
AIR INTAKES	3080001	55	77026	21
			77026	
FUSELAGE JOINTS	3090000			
JOINT AIR INTAKES TO F F	3090001		66322	
JOINT F F TO C F	3090002		102825	
JOINT D B TO C F	3090003		42847	
JOINT D B TO E B	3090004		142158	
JOINT AT STA 742 50	3090005		63074	
			4170	
CANOPIES	3100000			
PILOTS CANOPIE	3100001	53	24431	17
NAVIGATORS CANOPY	3100002	53	16616	23
			41047	

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PROJECT_____

DESCRIPTION	REFERENCE NO.	COMP. NO.	WEIGHT	H.
UNDERCARRIAGE UP POSITION	4000000			
MAIN UNDERCARRIAGE GROUP	4010000			
MAIN UNDERCARRIAGE	4010100	92	19891053	
			198910	
50 MAIN U C DOORS FAIRINGS	4010200	62	2879853	
			28798	
NOSE UNDERCARRIAGE GROUP	4020000			
100 NOSE UNDERCARRIAGE	4020100	91	3338117	
			33381	
NOSE U C DOOR AND FAIRING	4020200	52	27521	6
			2752	

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DESCRIPTION	REFERENCE NO.	COMP. NO.	WEIGHT	H.
SP PACK ELECTRONICS REMOV	8050500	94	18550	33
			18550	
SPARROW PACK PNEUMATICS	8050600	94	2445	38
			2445	
MISSILE AIRCONDITIONING	8070000	94	521	30
			521	
COCKPIT EQUIPMENT	8080000	52	600	18
			600	

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PROJECT_____

DESCRIPTION	REFERENCE NO.	COMP. NO.	WEIGHT	H
OPERATIONAL LOAD	9000000			
CREW MEMBERS	9010000	52	39000	19
			39000	
ENGINE OIL	9020000			
ENGINE OIL DRAINABLE	9020001		9290	68
ENGINE OIL TRAPPED ENG	9020002		1773	61
ENGINE OIL TRAPPED D B	9020003	56	1925	58
ENGINE OIL TRAPPED E B	9020004	58	909	59
			13897	
SPARROW MISSILES	9030000	94	172800	38
			172800	
OXYGEN CHARGE	9040000			
OXYGEN CHARGE F F	9040001	52	72	20
OXYGEN CHARGE C F	9040002	54	1267	26
			1339	
ENGINE FIRE EXT FLUID	9060000		250	73
			2500	
RESIDUAL FUEL	9070000			
RESIDUAL FUEL C F	9070001	54	468	39
RESIDUAL FUEL I W	9070002	62	1716	59
			21840	
WATER FOR AIR CONDITIONING	9100000	54	2600	26
UNUSABLE WATER FOR AIRCOND	9100001	54	250	26
			28500	