

72.113-58/110

AVRO AIRCRAFT LIMITED
INTER-DEPARTMENTAL MEMORANDUM

UNCLASSIFIED
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Ref: 4399/11/J
Date: 1 October, 1958
To: See Distribution
From: E.F. Burnett - Weight Supervisor
Subject: Arrow 2 - A/C 25206 Weight and C.G. Summary Report: 7-0400-82 Issue 2

Attached is a copy of Weight and C.G. Summary, Report: 7-0400-82 Issue 2 for your retention.

This report will be revised and issued monthly until an actual weighing of the aircraft has been obtained.

Classification cancelled / changed to: UNCLASSIFIED

By authority of: DRDA 7/DARFT 5-8/DAS Eng 6-4-5

Date: 5 Nov 1992

Signature: *Baulway*

Unit / Rank / Appointment: DSIS 3, Secretary CRAD HQ DRP

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58040

Aircraft: Arrow 2
A/C 25206
Date : 1 October, 1958

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Report 7-0400-82
Issue : 2

I N D E X

<u>Sheet</u>	<u>Content</u>
1-1 to 1-4	Introductory notes and explanations of weight changes relative to I.B.M. A/C 26206 defined in Weight Report 7-0400-82 Issue 1.
2-1 to 2-2	Weight & C.G. Summary
3-1	Horizontal C.G. Plot showing basic fixed points on flight envelope for ballasted Aircraft. The possible variations of C.G. with fuel used have 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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A/C 25206
Date : 1 October, 1958

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Report: 7-0100-82
Issue 1
Sheet 1-1
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Introduction & Weight Changes

The following is a Weight and C.G. Summary for Arrow 2 Aircraft No. 25206, based on the latest weight estimates available. All Weight and C.G. changes are relative to issue 1, of this report, dated September 1st, 1958.

Note:

1. This summary is for the Aircraft as at first flight. Future changes eg possible fitment of Weapons Pack etc. will be dealt with as Flight Test Statements at the applicable time, if required.
2. This statement is applicable to Aircraft 25206 only.

General:

- a) Orenda PS 13 Engines comprise the Power Plant. These will be early production versions, weight 4835 lb each, ref. Orenda Engines Ltd. letter AWS/SAW dated August 21, 1958.

- b) An Instrument package containing Flight Test Instrumentation is installed.

Only a preliminary estimate of the contents of the pack is yet available, however the pack will be weighed separately prior to flight and ballasted if necessary, to compensate for equipment shortages.

A reasonably detailed estimate of other Flight Test Installations throughout the Aircraft has been made, these amount to 517 lb.

- c) "Partial Astra" is fitted in this and some other early Mk 2 Aircraft. This comprises Navigational and Communication equipment only.

Minneapolis-Honeywell MH 64 Damping System is also installed.

- d) For early flights of A/C 25206 additional emergency fire extinguishing equipment will be installed.
- e) Where actual weights of Arrow 1 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 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.

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.

- f) This issue incorporates a Lucas-Rotax Electrical Power System and the Westinghouse components have been deleted.

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1. Structure

Weight lb

a) Wings

Structure Aft. of Rear Spar - deletion of shear plates and shear blocks	- 0.36
Dorsal Fairings - incorporation of actual weights	- 1.02
Rib 10 - Actual weight obtained	- 0.94
<u>Wing Weight Decrease</u>	<u>- 2.32</u>

b) Fin and Rudder - deletion of hinge bracket for damper	- 2.03
additional hardware and brackets	+ 1.07
addition seal for L/E & dorsal fairing brackets	+ 1.13
<u>Fin and Rudder Weight Increase</u>	<u>+ 0.34</u>

c) Fuselage Fwd Sta 255 ins

Cockpit Formers - addition of flying controls and electrical pick up brackets.	+ 1.37
Top Longerons F.F. - addition brackets and hardware	+ 2.01
Windscreen - addition fibre glass glare shield	+ 1.46
Pilots Canopy - addition of brackets	+ 0.53
Navigators Canopy - addition of hardware	+ 0.21
<u>Front Fuselage Increase</u>	<u>+ 5.58</u>

d) Centre Fuselage Sta 255 - 485 ins

No weight change.

e) Duct Bay Sta 485 - 591.65 ins

Lower Forward Side Panels - addition of clips and hardware	+ 0.44
Centre Panel Fwd - relative to Prod. A/C access door not hinged deletion of fuel vent	- 1.05
<u>Duct Bay Decrease</u>	<u>- 0.61</u>

f) Engine Bay Sta 591.65 - 742.5 ins No weight change.

g) Rear Fuselage Sta 742.5 in aft

Outer Skins - addition of pulley support for para. brake controls and hardware	+ 0.79
Tailcones - addition of skin stiffeners	+ 1.43
addition of conduit and clips for electrics	+ 1.98
Centre Struct & Stinger - addition of seal and door lock indication	+ 0.26
<u>Rear Fuselage Increase</u>	<u>+ 4.46</u>

h) Fuselage Joints

Joint Duct Bay to Engine Bay - addition of grounding pad & hardware	+ 0.25
Design change addition of heat exchanger mountings previously omitted	+ 7.05
<u>Fuselage Joints Increase</u>	<u>+ 7.30</u>
<u>Total Structural Increase</u>	<u>+ 14.75</u>

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2. Landing Gear

Weight lb

Main Gear - Design change heavy wheel assemblies now incorporated	+ 16.00
<u>Total Landing Gear Increase</u>	<u>+ 16.00</u>

3. Power Plant and Services

P.S. 13 Engines

a) Iroquois Engine - incorporated at 4835 lb each	+ 70.00
b) Structure - deletion of engine restrictor flaps	- 2.50
addition of minor brackets and hardware	+ 1.46
c) Inlet Frame & Nose Bullet - incorporation of Orenda estimate	- 28.00
d) Power Take-off Gear Box - previous weight assumed identical installation as for J75 engines - now only gear box to adapt diagonal drive shaft is required ref. Orenda.	- 79.55
e) Air Restrictor - Previously considered as an Avro Supplied item and included in Struct - now Orenda supplied.	+ 20.00
f) Pneumatic Starter - Orenda quotes target weight (23.0 lb)	+ 1.00
g) Anti-Icing Lines)	
h) Alternator Support) No previous allowance	+ 14.00
j) Alternator Drive Shaft)	
k) Tacho. Generator) Orenda Quotations	+ 8.00
l) L.P. High Temp. Tacho.)	
m) Installation Constant Speed Drives - both G.E. and Sundstrand quote 70.0 lb each.	- 7.00
n) Installation C.S.U. Oil Lines - first prod. dwg estimate	- 1.15
Accessories Gear Boxes on Fuselage - first prod. dwg. estimate	- 2.06
Starters and Gear Boxes on Engines see para. (d) above.	

<u>Total Power Plant Decrease</u>	<u>- 5.80</u>
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4. Flying Controls Group

Flying Controls Hyd. I/W - return lines now steel (CST 162) were alluminum alloy (CST 136) Pressure lines increased in wall thickness now CST 136 were CST 135.	+ 17.24
Flying Controls Hyd. O/W - Arrow 1 filters (steel) now fitted were Arrow 2 alluminum alloy.	+ 12.90
Return lines now steel were allum. alloy)	+ 1.70
Pressure lines increase wall thickness)	
Flying Cont. Hyd. Fin - filter element retainer now steel was al. alloy	+ 0.59
return lines now steel pressure lines increase in wall thickness	+ 1.16

The above changes necessitated by Stress requirements ref. Assignment X 74.4063.

<u>Total Flying Controls Increase</u>	<u>+ 33.68</u>
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5. Equipment Fixed and Removable

Weight lb

Oxygen System - first prod. estimate. Quantity gauge duplicated is error already included in Panel E22 Electrics Front Fuselage	-	1.24
Converter act. wt. 12.33 was based on Arrow 1 part (16,00)	-	3.67
Air Conditioning System - addition of cockpit silencers	+	9.91
Utility Hyd. Front Fuse. - incorporation of equip. & piping of the Nose U/C Door Sequencing	+	9.76
Nose U/C Door Sequencing Mech - this report is now cancelled see above	-	27.00

The large weight decrease (-17.24 lb) in the two combined report is due to design refinements and integration into basic Utility Hydraulic System. Previously an Arrow 1 "lash-up" allowance was carried.

Windscreen Demisting - first prod. estimate - deletion of cable allowance now contained in Electrics Cables	-	2.38
Electrics Centre Fus. - design change addition of 3 off Fire Detection Controls Units and resistor to Panel E 5	+	5.46
Elect. Duct Bay - Decrease in clipping	-	1.41
Design change - incorporated Lucas-Rotax Power system instead of Westinghouse Transformer	-	32.00
Rectifier Unit 164 lb (mfr. quote) was 196 lb (mfr. quote).		
Elect. Eng. Bay - design change addition of 2 off current transformer (Lucas-Rotax)	+	3.50
Electrics Wing - first production estimate	-	0.53
Electrics Rear Fus. - addition of clipping for cables associated with tailcone plug jettison circuits	+	0.40
Elect Tailcone Plug Jettison - new report incorporates equipment and wiring for actuation and indication circuits for the explosive bolts		

<u>Total Equipment Group</u>	<u>-</u>	<u>31.11</u>
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6. Tapped Fuel No weight change.

7. Useful Load

Eng. & Acces. Gear Box Oil - addition of separate oil sys. for constant units	+	23.04
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<u>Total Useful Load Increase</u>	<u>+</u>	<u>23.04</u>
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SUMMARY

Weight Change - Aircraft Basic Weight	
Structure	+ 14.75
Landing Gear	+ 16.00
Power Plant	- 5.80
Flying Controls	+ 33.68
Equipment	- 31.11
Total	+ 27.52 lbs

Weight Change Operational Weight Empty Operational Load Increase 23.04 lb

Issue 1
45,585.20

Issue 2
45,756.76

+ 171.56 lb

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Weight & C.G. Summary

Description	Weight lb	H. Arm ins	V. Arm ins
Structure	19,216.10	566.50	137.24
Wings	10,038.79	642.93	142.18
Fin and Rudder	1,030.94	754.65	209.00
Fuselage Fwd Sta 255 ins	2,604.20	184.54	128.61
Sta 255 - 485 ins	1,715.13	375.74	129.90
Sta 485 - 591.65 ins	1,159.63	538.46	105.66
Sta 591.65 - 742.5 ins	1,576.20	659.72	110.61
Sta 742.5 in aft	1,041.27	806.98	129.18
"Marry-Up"	49.94	483.56	107.06
Landing Gear - Retracted	2,807.98	491.66	135.31
Main Landing Gear	2,158.67	539.23	141.00
Main Gear Doors & Fairings	287.98	538.52	138.40
Main Landing Gear	333.81	170.81	99.70
Nose Gear Door & Fairing	27.52	162.22	88.66
Power Plant & Services	11,540.92	675.41	121.79
Engines Bare PS 13	9,670.00	690.47	121.21
Engine Accessories (Inlet Frame etc)	388.05	683.99	121.73
Engine Instrumentation (Orenda supplied)	100.00	690.00	121.25
Engine Controls	32.32	379.90	117.49
Gear Box & Drives on Fuselage	291.87	608.57	103.28
Gear Box & Starter on Engine	146.45	601.97	113.57
Fire Extinguisher System basic	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	1,965.94	652.84	138.24
Mechanical Flying Controls	958.14	677.70	147.62
Hydraulic Flying Controls	1,007.50	629.19	129.32
Equipment Fixed and Removable	7,539.63	397.82	114.56
Instruments	34.61	167.52	138.92
Probe	15.25	-23.71	108.00
Cockpit Pressure Sealing	5.00	186.00	130.00
Oxygen System	21.16	259.40	156.88
Cabin Consoles	17.28	174.66	124.33
Ejector Seats	342.94	204.50	134.11
Air Conditioning System	874.00	339.80	135.32
Cockpit Insulation	14.31	187.48	132.00
Hydraulic Utility System	641.33	498.85	118.15
Mechanical Door Stops Main U/C Doors	3.02	516.00	120.00
Anti-skid controls system	37.68	480.00	113.97
Drag Chute	91.07	786.68	143.19
Electrical System	1,235.29	433.94	113.07
Low Pressure Pneumatics	50.08	394.66	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
MH 64 Damping System	99.08	450.83	140.34
Partial Astra System	689.00	343.65	118.32
Instrument Pack Structure	692.00	384.86	93.56
Pack Instrumentation	1,726.00	393.40	95.00
Flight Test Installations	517.00	499.27	130.44
Additional Fire Protection	180.61	398.87	108.63

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Description	Weight lb	H. Arm ins	V. Arm ins	MAC %
Trapped Fuel	213.80	548.26	111.79	
U/C Up		565.13	129.11	
Aircraft Basic Weight	43,284.37			
U/C Down		567.60	125.05	
Useful Load (Less usable fuel)	875.39	316.60	130.30	
Crew	390.00	194.00	136.50	
Engine Fire Ext. Fluid	25.00	730.00	129.00	
Oil	162.00	638.31	110.89	
Oxygen	13.39	259.68	159.91	
Water for Air Conditioning	285.00	267.91	131.56	
BALLAST	1,597.00	100.00	114.00	
U/C Up		544.14	128.61	29.87
Operational Weight Empty	45,756.76			
U/C Down		546.48	124.76	30.52
Max. Internal Fuel (2491 gals @ 7.8 lb/gal)	19,433.00	541.85	144.16	
U/C Up		543.46	133.25	29.68
Gross Weight (Max. Int. Fuel)	65,189.76			
U/C Down		545.10	130.54	30.14
Max External Fuel (500 gal. @ 7.8 lb/gal + drop tank)	4,242.36	520.32	60.79	
Tailcones Plugs	252.00	857.07	128.60	
U/C Up		543.18	128.82	29.61
Max. Gross Weight (Int. +Ext Fuel)	69,684.12			
U/C Down		544.72	126.29	30.03

- N.B.
1. Aircraft datum = 120 in above arbitrarily chosen ground line.
 2. Aircraft is ballasted with 1597 lbs at H.A. = 100 in, such that the aft C.G. on a typical flight envelope, excluding any effects of fuel sequencing (see note on sheet 3) does not exceed 31% M.A.C.

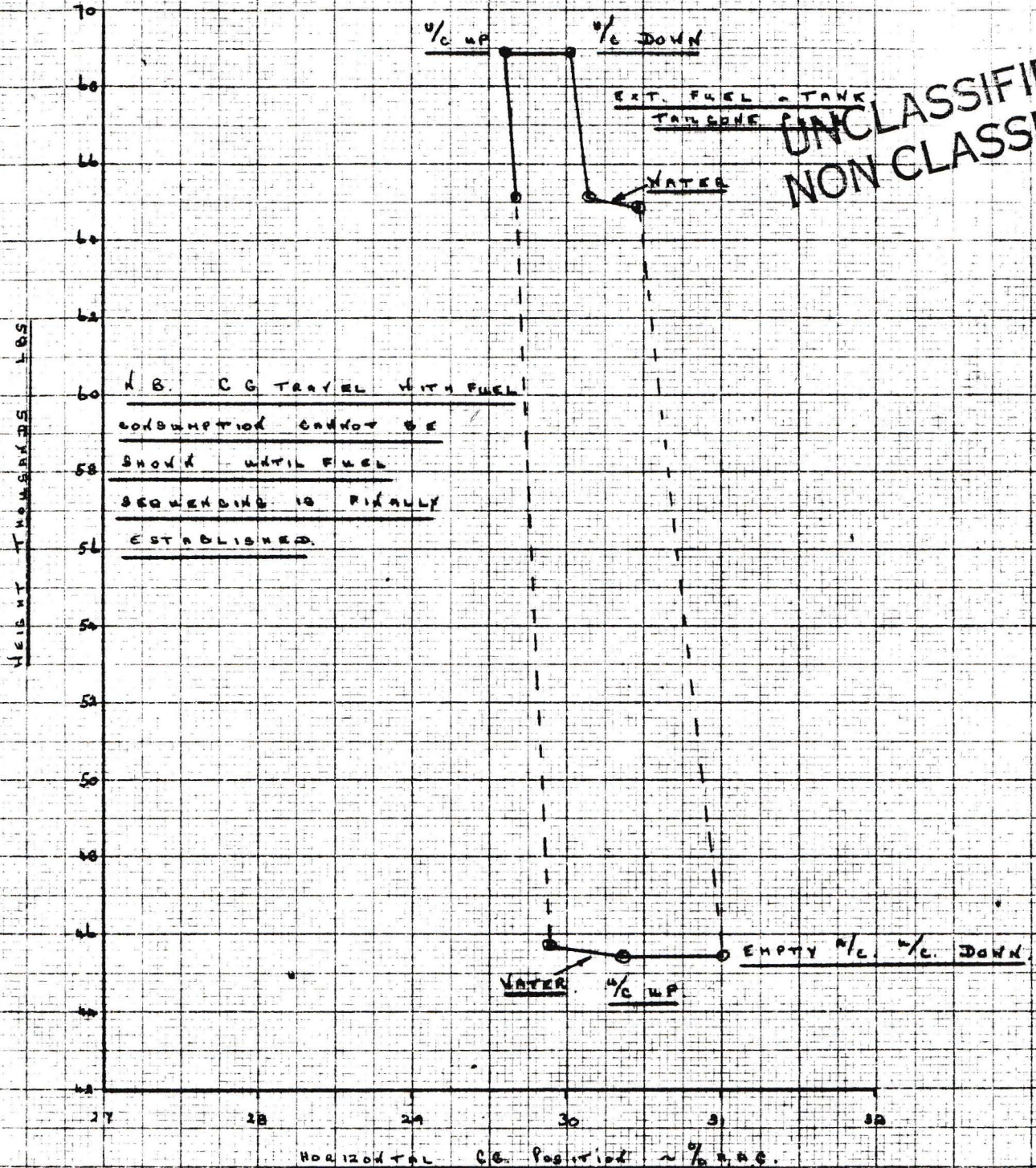
DATE Oct 1 1961

SHEET 3

BY P. J. Smith

HORIZONTAL CG PLOT OF FIXED
POSITIVE ON ACROW 2 1/2 25206
FLIGHT ENVELOPE

A/C WITH 1597 LB BALLAST AT STD. 100 WTS.



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