

72.113-58/04

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AVRO AIRCRAFT LIMITED
INTER-DEPARTMENTAL MEMORANDUM

Ref: 7718/11/J
Date: 1 April, 1958
To: See Distribution
From: E.F. Burnett - Weights Supervisor
Subject: ARROW 2 PRODUCTION A/C WEIGHT & C.G. SUMMARY - Report #7-0400-34 Issue 18

Attached is a copy of Weight and C.G. Summary Report # 7-0400-34 Issue 18 dated April 1st, 1958 for your retention.

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

Classification ~~cancelled / changed to:~~ ^{confirmed as} UNCLASSIFIED

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

Date: 5 Nov 1992

Signature: E. F. Burnett

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

E. F. Burnett
E.F. Burnett

EFB/ag

| | | |
|--------------------|----------------|--------------|
| Messrs. J.C. Floyd | F. Brame | D. Inglis |
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| C.V. Lindow | S. Kwiatkowski | G. Eves. |
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| D.N. Scard | J. Zurakowski | |
| J.P. Booth | A. Crust | (6) for RCAF |



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Aircraft: ARROW 2
Production A/C

Report 7-0400-34
Issue 18

I N D E X

| <u>Sheet</u> | <u>Content</u> |
|--------------|---|
| 1-1 to 1-5 | Introductory notes & explanation of weight changes |
| 2 | Details of wt. changes with reference to report system as listed on I.B.M. Sheets for Duct Bay Structure. |
| 3-1 to 3-3 | Wt. & C.G. Summaries |
| 4 | 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 estimated. |
| 5-1 to 5-15 | I.B.M. Detail sheets of Weights and C.G.'s. |

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R.E.I.
Report # 7-0400-34
Issue 18
Sheet 1-1

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 17 of March 1st, 1958.

The early Arrow 2 Aircraft 25206 onwards 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 installation. Appropriate weight statements for these aircraft 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 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 ~~is~~ 3,281.9 lb, 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 1 parts that apply to Arrow 2 Aircraft have been obtained, these weights have been recorded in the Arrow 2 weight 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 the relevant item.

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Aircraft ARROW 2
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Sheet # 1
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INTRODUCTION & WEIGHT CHANGES

1. STRUCTURE

WEIGHT (lb)

a) Wings:

| | | |
|--|---|------|
| I/W Spars - front spar estimated to Mk. 2 prod. drgs | + | 1.02 |
| I/W Skins - addition of brackets for dorsal fairings | + | 1.67 |
| hardware - now fully detailed on drawings | | |
| allowances made earlier based on Mk. 1 A/C | + | 7.36 |
| I/W Struct. for Main U/C - detailed est. to prod. drgs | + | 2.44 |
| I/W Struct M/S to R/S - prod. drg. ests. | - | 0.13 |
| I/W Struct F/S to M/S - redesign of refuelling door, | | |
| no inner skin | - | 0.91 |
| redesign of shut-off valve | | |
| operating mechanisms | + | 1.75 |

Wing Weight Increase

+ 13.20

b) Fins & Rudder:

No weight change

c) Front Fuselage Fwd Sta 255 ins.

| | | |
|---|---|------|
| Crews Bulkheads - Addition of stiffeners and angles | | |
| and increase in observers lower | | |
| seat fitting | + | 3.69 |
| Bulkhead Sta 255 ins. - incorp. of misc. E.C.N.s | | |
| alterations to bottom | | |
| diaphragm & stiffeners | + | 1.73 |
| Cockpit Floor - addition of observer's foot guards | | |
| to protect L.P. Pneumatic piping | + | 0.68 |
| Air Intakes - addition of splice straps, included | | |
| with the joint to F.F. previously | | |
| (see also Fuselage joints section h). | + | 3.25 |
| Stiffeners .025 Al were .020 Al | + | 1.73 |

Front Fuselage Increase

+ 11.47

d) Centre Fuselage Sta. 255 - 485 ins

| | | |
|--|---|------|
| Longerons CF - Actual wt. of Mk. 1 longerons which | | |
| is applicable to Mk. 2 A/C. | + | 5.87 |
| Bulkhead Sta 485 ins - Minor changes to drop tank | | |
| release mtg. structure | + | 0.04 |
| Centre Fuselage Increase | + | 5.91 |

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INTRODUCTION & WEIGHT CHANGES

1. STRUCTURE (Cont'd)

WEIGHT (lb)

e) Duct Bay Sta 485 - 591.65 ins

This section has been entirely re-estimated to production drawings. Due to the advantages of conforming to the drawing office "call-up" system of panel sub-assemblies, for record purposes.

The entire weight reporting of this section has also changed. (for details regarding I.B.M. listing etc. see Section 2).

Resulting weight changes are as follows:-

| | | |
|---|---|-------------|
| Hydraulics access panel redesign | + | 0.70 |
| Pressure reducing doors - two new doors added | + | 4.01 |
| Side Skins D.B - cut-outs for new doors and addition of shield plates at doors | + | 0.92 |
| Miscellaneous other changes | + | 0.53 |
| <u>Duct Bay Increase</u> | + | <u>6.16</u> |

f) Engine Bay Sta 591.65 - 742.5 ins

| | | |
|---|---|-------------|
| Engine Shroud - entirely estimated to prod. drgs. | + | 0.06 |
| Engine Rails & Attachs. - rail seal plates now called up with shroud hardware changes | - | 0.51 |
| | + | 0.42 |
| <u>Engine Bay Decrease</u> | - | <u>0.03</u> |

g) Rear Fuselage Sta 742.5 "aft

| | | |
|--|---|-------|
| Engine Removal Doors - Insulation from Sta 768" aft not 742.5" as previously assumed | - | 4.65 |
| Tunnel Fixed RF - Insulation now from Sta. 768" aft not from Sta. 742.5" as previously assumed, greater air flow around engines was required & temperatures in this location do not necessitate insulation, hence removal of same | - | 23.84 |
| Centre Struct. & Stinger - initial est. to prod. drgs | - | 3.00 |
| Remove. Tailcones - addition of slinging points | + | 2.24 |
| addition of drain tube & seal angles at Sta 803 | + | 1.98 |
| Former Sta. 803.06 -prod drg. ests. plates added at latch datums, accurate est. of hardware etc. | + | 3.04 |
| Former Sta 808.5 - prod. drg. est. added angles at latch datums etc. | + | 2.08 |

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INTRODUCTION & WEIGHT CHANGES

1. STRUCTURE (Cont'd)

WEIGHT (lb)

g) Rear Fuselage (Cont'd)

| | | |
|--|---|--------------|
| Remove. Tailcones - Tunnel Skins - addition of patch plates at latch stations, more accurate rivet est. etc. | + | 3.86 |
| Miscellaneous other changes | + | 0.10 |
| <u>Rear Fuselage Decrease</u> | = | <u>18.19</u> |

h) Fuselage Joints

| | | |
|---|---|-------------|
| Joint Air Intakes to F. Fws - Mk. 2 prod. drgs est, splice plates now with component 55 structure (see also Fuselage Fwd Sta 255) | = | 2.89 |
| Joint at Sta. 742.5" - Mk. 2 prod drgs estimated, seal channels were previously included with the tunnel R.F. | + | 2.12 |
| <u>Fuselage Joints Decrease</u> | = | <u>0.77</u> |

| | | |
|----------------------------------|---|--------------|
| <u>TOTAL STRUCTURAL INCREASE</u> | + | <u>17.75</u> |
|----------------------------------|---|--------------|

2. LANDING GEAR

No Weight Change

3. POWER PLANT & SERVICES

No Weight Change

4. FLYING CONTROLS GROUP

| | | |
|---|---|--------|
| Mechanical F/Controls - elevator feel & trim unit moved fwd, until Mk. 2 drgs are available a weight change is allowed for as in Mk. 1 A/C | + | 8.21 |
| F/Cont Hydraulics - Fuselage - addition of power boosters & all associated valves, filters etc. move elevator servos fwd etc. A weight increase similar to that entailed in Mk. 1 A/C will be made as a preliminary measure until Mk. 2 drawings become available | + | 125.55 |

| | | |
|---------------------------------|---|---------------|
| <u>FLYING CONTROLS INCREASE</u> | + | <u>133.76</u> |
|---------------------------------|---|---------------|

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INTRODUCTION & WEIGHT CHANGES

| <u>5. EQUIPMENT GROUP</u> | <u>WEIGHT (lb)</u> |
|--|--------------------|
| Sparrow Electrics - this item was the cable from the pack to the cockpit. Since these cables are now included with Radar fixed equip. this allowance will be deleted | - 3.14 |
| Electrics D.B. - Inertia crash switch deleted | - 2.30 |
| Changes to panel E28 | - 5.20 |
| Differential current protection - not required in Mk. 2 aircraft | - 9.21 |
| Ejector Seats - gas generation on seat was previously omitted - this was not installed on seat at time of weighing of seat | + 3.88 |
| Utility Hydraulics EB - Actual weight of pressure regulator valve obtained 10.22 lb target wt. was 5.5. lb | + 4.72 |
| redesign of p.r. valve installation | + 0.41 |
| alterations to piping runs and other miscellaneous changes | + 1.39 |
| <u>EQUIPMENT GROUP DECREASE</u> | <u>- 9.45</u> |

6. OPERATIONAL LOAD

No weight change

SUMMARY

Weight Change - Aircraft Basic Weight

| | |
|-----------------|-----------------|
| Structure | + 17.75 |
| Flying Controls | + 133.76 |
| Equipment | - 9.45 |
| | <u>+ 142.06</u> |

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

| <u>Issue 17</u> | <u>Issue 18</u> | |
|-----------------|-----------------|--------------------|
| 46,044.81 | 46,186.87 | <u>+ 142.06 lb</u> |

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SECTION 2

DETAILED WEIGHT CHANGES WITH REFERENCE TO REPORT SYSTEM AS LISTED IN I.B.M. SHEETS FOR ENGINE BAY STRUCTURE

Due to the Design Office method of "call-up" in panel sub-assys. the weight recording system has been changed to correspond.

| | | | <u>WEIGHT (lb)</u> |
|--|---|---|--------------------|
| Dive Brake Accomodations | } | These items are no longer considered separately & these reports are now DELETED | - 36.52 |
| Formers Lower Panel | | | - 74.16 |
| Longitudinal Beams | | | - 66.17 |
| Lower Panels Sides Fwd | } | New reports introduced in accordance with the drawing system | + 107.12 |
| Lower Panels Sides Aft | | | + 66.98 |
| Lower Panel Centre Fwd | | | + 23.72 |
| Lower Panel Centre Aft | | | + 25.63 |
| Side Skins D.B. - see section 1e. | | | + 0.92 |
| Access Panels D.B. - see section 1e. also some changes to content of report | | | + 7.01 |
| Lower Panel Assy - now contains only items of final assy. of panels listed above | | | - 48.37 |
| | | | <u>6.16</u> |
| | | <u>Duct Bay Increase</u> | <u>+ 6.16</u> |

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Aircraft: ARROW 2
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WEIGHT & C.G. SUMMARY

| DESCRIPTION | WEIGHT lb | H. ARM ins | V. ARM ins |
|--------------------------------------|-----------|---------------|---------------|
| STRUCTURE | 19,160.90 | 566.72 | 137.31 |
| Wings | 10,035.09 | 643.04 | 142.21 |
| Fin & Rudder | 1,034.75 | 754.31 | 209.80 |
| Fuselage - fwd Sta. 255 ins. | 2,583.25 | 184.48 | 128.75 |
| Sta. 255-485 ins | 1,706.64 | 375.19 | 130.35 |
| Sta. 485-591.65 ins. | 1,157.50 | 538.54 | 105.62 |
| Sta. 591.65 - 742.5 ins | 1,574.07 | 659.68 | 110.72 |
| Sta. 742.5" aft | 1,018.76 | 806.59 | 127.44 |
| "Marry Up" | 50.84 | 492.48 | 105.69 |
| 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 PS13 | 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 | 1,926.56 | 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 | 8,915.73 | 333.14 | 114.22 |
| 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 |
| Hydraulic Utility System | 647.33 | 505.17 | 117.69 |
| Cockpit Insulation | 14.31 | 187.48 | 132.00 |

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Aircraft: ARROW 2
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WEIGHT & C.G. SUMMARY

| DESCRIPTION (Cont'd) | WEIGHT lb | H. ARM | V. ARM |
|---|-----------|--------|--------|
| Drag Chute | 91.07 | 786.68 | 143.19 |
| 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 | 180.15 | 471.27 | 135.69 |
| Radio & Radar Remov. | 2,095.20 | 209.73 | 108.59 |
| Radio & Radar Fixed | 784.08 | 238.57 | 117.84 |
| Sparrow Pack Structure | 912.02 | 384.10 | 98.16 |
| Sparrow Pack Mechanisms | 553.32 | 372.85 | 99.13 |
| Sparrow Pack Hydraulics | 331.94 | 373.52 | 99.00 |
| Sparrow Pack Electronic Remov. | 185.50 | 331.91 | 100.00 |
| Sparrow Pack Electrics & Electronic Fixed | 217.11 | 335.24 | 110.00 |
| Sparrow Pack Air Conditioning | 5.21 | 305.50 | 102.50 |
| Aircraft Basic Weight U/C Up | 43,388.11 | 543.82 | 128.47 |
| U/C Down | | 546.05 | 124.78 |
| 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 | 389.29 | 88.30 |
| Oxygen Charge | 13.39 | 259.68 | 159.91 |
| Water for Air Conditioning | 285.00 | 267.91 | 131.56 |

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Date: April 1, 1958

WEIGHT & C.G. SUMMARY

| DESCRIPTION | WEIGHT lb | H. ARM | V. ARM | % M.A.C. |
|---|-----------|--------|--------|----------|
| U/C Up Operational Wt. Empty | 46,186.87 | 533.74 | 127.04 | 27.00 |
| U/C Down | | 535.84 | 123.58 | 27.58 |
| U/C Up Op. Wt. Empty Less Missiles | 44,458.87 | 539.35 | 128.55 | 28.55 |
| U/C Down | | 541.53 | 124.95 | 29.15 |
| Normal Combat Mission Fuel* (2,265 gals at 7.8 lb/gal) | 17,670.00 | - | - | |
| Normal Combat Weight * | 63,856.87 | | | |
| Half Combat Mission Fuel * (1,133 gals at 7.8 lb/gal) | 8,835.00 | | | |
| Combat Wt (half mission Fuel)* | 55,021.87 | | | |
| Max Internal Fuel (2492 gals at 7.8 lb/gal) | 19,438.00 | 541.85 | 144.16 | |
| U/C Up A.U.W. Max Int. Fuel | 65,624.87 | 536.14 | 132.11 | 27.67 |
| U/C Down | | 537.62 | 129.67 | 28.07 |
| Max. External Fuel (500 gal @ 7.8 lb/gal + drop tank) | 4,248.00 | 521.84 | 60.67 | |
| U/C Up A.U.W. Max. Int. & Ext. Fuel | 69,872.87 | 535.27 | 127.77 | 27.43 |
| U/C Down | | 536.66 | 125.48 | 27.81 |

N.B.

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

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

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