

S E C R E T

ARROW FLIGHT DEVELOPMENT

Report No. 70/ENG PUB/7

1 May 1958

Project Management Services

5551

ARROW FLIGHT DEVELOPMENT1.0 INTRODUCTION

This report is a summary of the activities of the first ARROW aircraft (#25201) covering the period from its first flight on 25 March 1958, to 30 April 1958.

2.0 PHASE 1 FLIGHT TESTING

Phase 1 testing, which is to be conducted by AVRO, began with the first flight of the ARROW, and is intended to check the handling of the aircraft and the functioning of its systems. Up to and including the ninth flight, 8 hours and 10 minutes flying time has been achieved, of which about 5 hours can be credited to the estimated 150 useful flying hours required to complete Phase 1 testing.

2.1 AIRCRAFT FLIGHTS2.1.1 1st FLIGHT

Date	-	25 March 1958	
Duration	-	35 minutes	
Flight Data	-	Maximum speed	- 250 knots
	-	Maximum altitude	- 11,000 feet

TEST RESULTS

The main object of this flight was the preliminary assessment of handling qualities of the aircraft, which were found to be satisfactory for further development flights.

The flying control yaw axis damper system was set at standby during take-off and both NORMAL and EMERGENCY modes were tested during flight. The aircraft was landed with the damper system in NORMAL engagement. It was noted during this flight that the NORMAL Mode was more effective than the EMERGENCY mode.

FLIGHT SNAGSACTION

- | | |
|---|--|
| (a) No "Up and Locked" display of main and nose landing gear. | Micro-switches were adjusted |
| (b) The equipment air conditioning temperature controller failed to function during flight. | A faulty temperature controller in the equipment bay was replaced. |
| (c) Buffeting when landing gear doors are open in flight. | A design change is under consideration, whereby the doors would close after the leg is extended. |

2.1.2 2ND FLIGHT

Date	-	2 April 1958
Duration	-	50 minutes
Flight Data	-	Maximum speed - 250 knots (M = .45)
	-	Maximum altitude - 30,000 feet

TEST RESULTS

The object of this flight was to extend the pilot's preliminary assessment of the handling qualities of the aircraft, but due to the failure of the nose landing gear door to retract, the pilot restricted the aircraft to Mach .45 at 30,000 feet instead of the planned Mach .95 at this altitude. The pilot encountered some difficulty with lateral control, although it was somewhat improved with engagement of the control dampers in both NORMAL and EMERGENCY mode.

The operation of afterburners did not effect lateral pitching or rolling of the aircraft.

Buffet was not severe with airbrakes extended.

Temperatures up to 240°F were measured in the engine shroud. These are considered satisfactory.

FLIGHT SNAGS

ACTION

- | | |
|--|---|
| (a) Air conditioning warning light came on at 25,000 feet. | Cooling turbine now disconnected in an attempt to improve cockpit air conditioning. |
| (b) Failure of landing gear "Up and Locked" display during flight. | Micro-switches re-adjusted. |
| (c) Failure of UHF transmitter 10 minutes after take-off. | UHF checked out on ground o.k. |

2.1.3 3RD FLIGHT

Date	-	3 April 1958
Duration	-	1 hour 5 minutes
Flight Data	-	Maximum speed - M = 1.1 at 40,000 ft.
	-	Maximum altitude - 40,000 ft.

TEST RESULTS

This flight was to assess the aircraft handling qualities at higher speeds and altitudes. It was noted that oscillations in pitch, at speeds of about 250 knots, could be eliminated by releasing the control column; while at speeds of 400 knots and above, the oscillations could be prevented by firmly holding the control column. Efforts to excite aileron flutter under various conditions were unsuccessful.

FLIGHT SNAGS

ACTION

- | | |
|---|--|
| (a) The UHF transmitter failed to operate at altitudes above 20,000 feet. | Transmitter and interphone control panel replaced. |
|---|--|

FLIGHT SNAGS (cont'd.)

ACTION

- | | |
|---|--|
| (b) At 32,000 ft. max engine power was only 93% of max rpm. with jet pipe temperature between 510 and 520° F. | Under investigation. |
| (c) After a pull-up manoeuvre of approximately 1½g, the cockpit indicator falsely indicated that the left hand landing gear was unlocked. | Micro-switch has been repositioned to give a more positive indication. |
| (d) Fluctuations of the airflow of cockpit air conditioning were noted. | System is know to be faulty - waiting for redesigned hardware. |

2.1.4 4TH FLIGHT

Date	-	15 April 1958
Duration	-	1 hours 15 minutes
Flight Data	-	Maximum speed - M = .9 at 40,000 ft.
	-	Maximum altitude - 46,000 ft.

TEST RESULTS

This flight was intended to assess the aircraft handling qualities at speeds up to Mach 1.5 but the flight plan was changed about 10 minutes after take-off due to the failure of a transformer-rectifier unit. The failure of this unit meant automatic failure of d-c power to the instrumentation in the aircraft. This flight was then utilized for flight familiarization at the pilot's discretion.

FLIGHT SNAGS

ACTION

- | | |
|---|--------------------------------------|
| (a) Failure of transformer-rectifier unit | Replaced Transformer Rectifier Unit. |
|---|--------------------------------------|

2.1.5 5TH FLIGHT

Date	-	17 April 1958
Duration	-	1 hour 10 minutes
Flight Data	-	Original flight plan aborted (see below)

TEST RESULTS

This flight was intended to assess the aircraft handling qualities at speeds up to Mach 1.5. The flight plan was changed about 20 minutes after take-off due to a landing gear retraction failure. The flight events leading up to the change in the original flight plan, were as follows: Following a 2.5 g left hand turn, the left hand landing gear indicator indicated an unlocked up condition. The pilot then selected "Landing gear down" which was performed successfully. Following this, up retraction was selected but retraction was not achieved. At this point the original flight plan was changed and the pilot decided to carry out angle of attack measurements for various speeds and altitudes, within the limitations imposed by the extended landing gear.

FLIGHT SNAGS

ACTION

(a) Unreliable up-lock indication and failure of landing gear retraction.	Re-adjustment to micro-switches and actuator arms.
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2.1.6 6TH FLIGHT

Date	-	18 April 1958
Duration	-	55 minutes
Flight Data	-	Maximum speed - M = 1.2 at 42,000 ft.
	-	Maximum altitude - 42,000 ft.

TEST RESULTS

This flight was to assess the flight handling qualities up to a limit of

Mach 1.5. The aircraft was flown to Mach 1.2 at 42,000 feet without adverse handling characteristics. No attempt was made to reach the planned Mach 1.5 due to an indicated lack of fuel remaining at that stage of the flight. During the flight, a number of damper system checks were made.

FLIGHT SNAGS

No major snags were reported on this flight.

2.1.7 7TH FLIGHT

Date	-	18 April 1958
Duration	-	50 minutes
Flight Data	-	Maximum speed - M = 1.52 at 49,000 ft
	-	Maximum altitude - 50,000 ft.

TEST RESULTS

This was the second flight in one day and established the maximum level flight speed so far obtained with this aircraft. This high speed run was carried out at 49,000 feet. The greatest altitude was also obtained during this flight; i.e. 50,000 feet. These are not necessarily the ultimate speeds or altitudes obtainable from this aircraft, but the best the pilot has attempted during these preliminary test flights.

Following this flight, F/L J. Woodman (C.E.P.E. Test Pilot) made a high speed taxi run in the ARROW and at one point lifted the nose wheel off the ground, but did not attempt to take-off.

FLIGHT SNAGS.

- (a) Some intake duct vibrations became evident at about 450 knots.
- (b) The test fuel gauges, are still suspected to be unreliable.

ACTION

Investigations into the cause are being conducted.

Aircraft system is to be installed during the first grounding of the aircraft.

2.1.8 8TH FLIGHT

Date	-	22 April 1958
Duration	-	45 minutes
Flight Data	-	Maximum speed - M = 1.4
	-	Maximum altitude - 45,000 ft.

TEST RESULTS

This was a familiarization flight for F/L J. Woodman, the first RCAF pilot to fly the ARROW. Further tests of the flying control damper system were made.

FLIGHT SNAGS

ACTION

- | | |
|--|---|
| (a) Engines still showing decreasing RPM with increasing altitude. | Still under investigation |
| (b) On landing, right forward main wheel seized, with consequent damage to brake pads, discs and rims etc. | Caused by faulty brake |
| (c) Excessive use of oxygen. | Test show that the leak rate was ten times higher than normal.
Suggest pilot did not have anti-g hose connected. |

2.1.9 9TH FLIGHT

Date	-	23 April 1958
Duration	-	45 minutes
Flight Data	-	Maximum speed - M = 1.2 at 34,000 ft.
	-	Maximum altitude - 40,000 ft.

TEST RESULTS

This was a familiarization flight for "Spud Potocki", while at the same time giving further checks of the handling and stability of this aircraft. Maximum speed during this flight was Mach 1.2 at 34,000 feet. Although the pilot was cleared to fly at $M = 1.7$ and up to an altitude of 50,000 feet, the high speed run was cancelled due to rapidly deteriorating weather conditions. Mild manoeuvres up to 1.5 'g' turns were carried out. Part of the flight was made with the afterburners lit.

FLIGHT SNAGS

(a) Warning lights indicated left hand
a-c and d-c power failure.

ACTION

Left hand constant speed drive unit
unit replaced.

1958 PROGRAM

GROUND TEST

PRE-FLIGHT TESTING AND MODIFICATION

PHASE I - PRE-FLIGHT TESTING

AND COMPLETE MODELS

PHASE I - PART 2 PRE-FLIGHT TESTING

STREET

13-F-118HT

PILOTS' FAMILY CARIZATION

9510HT8-8183 61111 *

ESB0113011-1106-13574

123456789 F01G1T9

5-49-8 HOURS

EMERGENCY YAT MODE

NORMAN

NORMAL YAW AND ROLL

COPIES AVAILABLE

SEVEN DAYS

SYSTEMS MONITORING

PHASE 2 PARTY 2

STABILITY AND CONTROL

SYSTEMS TESTING: FLYING CONTROLS

ENGINE AND STRUCTURAL COOLING

WIRCE FOLLOWING

TELECOMMUNICATIONS AND ANTENNA

五、

WHEELS WITH WORTH

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STRUCTURAL AND MECHANICAL CHARACTERISTICS

STRUCTURAL MONITORING

AEROELASTIC CHARACTERISTICS

PERFORMANCE

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