Report

Following the study

performed at the request of

The Minister in Charge of the Department for Public Enterprise

on

the AER LINGUS VISCOUNT EI-AOM accident

occurred on March 24th, 1968

near TUSKAR ROCK

Ireland

VOLUME II: APPENDICES AND ANNEXES

TOME 1: APPENDICES

November 27, 2001

Yves LEMERCIER Manuel PECH   Colin TORKINGTON

CONTENTS OF VOLUME II

APPENDICES to the STUDY REPORT

Tome 1

Appendices 1: Complementary information to the "Introduction"

Appendices 1

1a: **Team Members Experience**

1b: **Data available to the International Team**

1c: **Glossaries**

Appendix 1a Team Members' Experience

1. **Yves Lemercier**

2. **Manuel Pech**

3. **Colin Torkington**

Yves LEMERCIER

4 Bd. Des Dunes
56260 LARMOR-PLAGE

- **Phone/fax (professional): 33 (02) 97 84 61 66**

Phone (home): 33 (0) 2 97 84 20 04

e-mail: expair@noos.fr

Born July 7th, 1933, in Brest

Married, 3 children

Education French Naval Academy 1956-1959

French Air Force Academy 1960

Background Fleet Air Army Pilot 1960-1990

Experience During a career of more than 30 years, he held various appointments including Aircraft Captain, Squadron leader, training operations training-operations-safety manager.
Logged 7000 flight hours as P.I.C. on 15 aircraft types operated in the Navy.

Level in the Profession

After having achieved the top positions in the Fleet Air Army:

- 1985-1987 - N.A.S. LANN-BIHOUE CO
- 1987-1989 - Head of Air Operations in the FR Western approach (Eastlant)
- 1989-1991 - Maritime Patrol Aviation C.O.

Retired with the rank of Rear-Admiral

Distinctions

Officier du Mérite Aéronautique

Officier du Mérite Maritime

Officier de la Légion d’Honneur

Commandeur de l’Ordre National du Mérite

- **Air Events Investigator:**

  - Joined the BEA (Bureau Enquêtes-Accidents) French equivalent to NTSB

  Getting the knowledge on the new generation aircraft (Boeing, Airbus, ATR), and having executed tens of investigations in France and in foreign countries:

  - CV640 Senegal – D0228 Tahiti – A320 Warzsawa and Orly
  - ATR 42 Morocco – ATR72 Chicago
  - A310 Orly and Romania
  - A310 Nepal – A300 N
  - A310 Nepal A300 Nagoya – DHC8 Roissy
  - A330 Toulouse – Gulf Stream Lyon
  - Super Puma Mexico – B707 Istres
  - DA20 Le Bourget – B747 Tahiti FAAA
  - A320 Air Inter, Mont St. Odile
  - Beech King Air, Bay of Quiberon
  - DO328, Chambery
  - Embraer 120, Clermont Ferrand

Was appointed as the Principal Officer in charge of managing accidents and serious incidents investigations

- Accredited Representative:

  Accredited representative to the NTSB in the ATR72 accident in Roselawn (Indiana), in October 1994. Expressed the disagreement of the French side, and elaborated the BEA's response to the NTSB conclusions in the US report.

- Today:

  Aeronautical associate expert, within the EXP'AIR Cabinet

Manuel PECH

36 Rue A. Pallu
78110 LE VESINET
France

Phone:	**33 (0) 1 30 15 09 79**
Mobile:	**33 (0) 6 13 57 84 07**
e-mail:	**expair@noos.fr**

Born October 7th, 1935 in NICE (06) France

Married, 3 children

Education

1952-1953	Baccalauréat
1954-1957	French Navy Officer – Ecole Navale
1960	Pilot Licence – French Naval Air Force
1966-1968	Engineer – Ecole Nationale Supérieure d'Aéronautique
1969	Technical Brevet in Upper Naval War College
1969-1971	Master's Degree in Economics (Montpellier University)

Experience

1954-1981 French Navy:

- Flight testing at the French Navy Test Center (5 years)
- Maritime Patrol Crew Captain (6 years)
- Project Officer for development of Atlantic 2 Program (5 years)
- 3500 flight hours as Crew Captain on 10 types of a/c operated in the French Navy

Retired as Captain in 1981

1981-1995 AEROSPATIALE – HELICOPTER DIVISION then EUROCOPTER

1981-1987 Naval Programs Director

1987-1995 International Deputy Director of the NH 90 program

1998 – today Aeronautical associate expert, within the EXP'AIR Cabinet

Colin Torkington

Colin Torkington is the Australian Nominee on the ICAO Air Navigation Commission and the Alternate Member for Australia on the ICAO Council based in Montreal. He is in the final year of a five-year posting.

He was born in Yorkshire and started his career in 1952 with Vickers-Armstrongs in the UK, where his final position was a Senior Stressman in the design office.

He obtained a Master of Science degree in Aeronautical Engineering from Cranfield and held a private pilot's licence and glider qualification.

Moving to Australia in 1961, he joined the Department of Civil Aviation as an Airworthiness Engineer, specialising in aircraft structures. He worked on several major accident investigations including Structures Group Leader in the investigation of two fatal Viscount accidents both involving structural failure in flight. During his career, he undertook 70 overseas assessments and certification visits covering Authorities, the Manufacturers and Operators in 30 countries. He became Head of Airworthiness and Operations in the Australian Civil Aviation Authority in Canberra; also Chairman of the ICAO Continuing Airworthiness Panel. He is the author and presenter of 25 papers, 17 of which have been published.

In 1997, he was appointed to a United States National Academy of Sciences, National Research Council Committee on Aircraft Certification Safety Management.

He is a Fellow of the Royal Aeronautical Society.

The work of the ICAO Air Navigation Commission encompasses standard setting on a wide range of issues from licensing, accident investigation, airworthiness and operations to air traffic management

APPENDIX 1 b

Data available to the International Team

1b.1 General documentation made available by the Irish

1b.2 List of data made available for the "Similarities Study"

- Viscount occurrences (1976-1997)
- Aircraft accident reports

1b.3 List of data made available for the technical analysis:

- From UK, CAA
- From ICAO, Montreal
- From BAe Systems
- From Brocklands Museum
- From Dowty Aerospace
- From others

1b.4 List of data made available for the operational analysis

- By Aer Lingus
- With respect to UK involvement

Appendix 1b

▪ LIST OF DATA MADE AVAILABLE TO THE INTERNATIONAL TEAM

The documentary evidence related to this accident is voluminous reaching as it includes the design, operation, maintenance and service history of the Viscount.

1b.1 General documentation made available by the Irish.

The two primary documents referred to are:

a) Department of Transport and Power AAP N° 6.
"Accident Viscount 803 Aircraft EI-AOM near Tuskar Rock, Co. Wexford on 24th March 1968"
Published 30 June 1970
There are 7 Appendices to the Report.

b) "Review of Irish & UK Files on the Loss of the Aer Lingus Viscount St. Phelim.
Registration EI-AOM on 24th March 1968"
Report undated but published in June 2000.
Compiles by officials of the Irish Department of Public Enterprise in association with UK officials:

A document of major interest is:

c) Aer Lingus Viscount Flight Crew Operating Manual (dated 21.3.68).

d) The AAIU made available to the International Team the 54 files of documents which were reviewed by them and their British colleagues between 1998 and 2000 (refer list of documents in the Review Report : P 20 – 21).

e) The list of Viscount crashes was abstracted from the "World Directory of Airliner crashes" by T. Dernham.

1b.2 List of data made available for the "Similarities Study"

▪ **"Viscount Occurrences", of UK registered Viscount, from January 1976 to September 1997 (CAA Data).**

▪ **Aircraft Accident Reports**

- **Viscount N 7462**

  Capital Airlines
  Near Charles City, Virginia,
  January 18, 1960

- **Viscount N 7430**

  United Airlines
  Near Ellicott City, Maryland,
  November 23, 1962

➢ **Viscount 708, F-BGNV**

  Air Inter,
  Tramoyes, France,
  August 12, 1963

➢ **Viscount VT-DIO**

  Indian Airlines,
  Near Agra, India,
  September 11, 1963

➢ **Viscount 701, PP-SRR**

  VASP Airlines,
  Nova Friburgo, Rio de Janeiro, Brazil,
  September 4, 1964

➢ **Viscount 804, SP GVA**

  LOT (Polish Airlines)
  Jenk, Limbourg, Belgium,
  August 20, 1965

➢ **Viscount 803, EI-AOF**

  Aer Lingus
  Near Ashbourne, Co. Meath,

June 22, 1967

- **Viscount G-ATFN**

  British Eagle International Airlines
  Langenbruck, Bavaria, Germany
  August 9, 1968

- **Vanguard G-APEC**

  British European Airways
  Aarsele, Belgium,
  October 2, 1971

- **Viscount 724, F-BMCH**

  Air Inter
  Viscontat, France,
  October 27, 1972

- **Viscount 802 G-AOHI**

  British European Airways
  Ben More, Scotland,
  January 19, 1973

- **Viscount 785, HK-1058**

  Taxi Aereo Opita
  San Cayetano, Norte de Santander, Columbia,
  June 8, 1974

- **Viscount 838, SE-FOZ**

  Skyline Sweden AB
  Stockholm Airport, Sweden,
  January 15, 1977

- **Viscount 812, PK-IVS**

  Bouraq Indonesia Airlines
  Near Djakarta, Indonesia,
  August 26, 1980

- **Viscount 813, G-OHOT**

  British World Airlines
  Near Uttoxeter, Staffordshire,
  February 25, 1994

1b.3 List of date made available for the technical analysis

1b.3.1 Data from UK, CAA

- British Civil Airworthiness Requirements (aeroplanes) Issue 4-16th March 1959
- Aircraft Specification No. A814 (REV 22) dated February 12, 1981
- Lists of CAA ADs for:
  - Vickers Viscount 700 series (issue 54 - September 1980)
  - Vickers Viscount 800/810 series (issue 53 – September 1980)
  - Rolls-Royce DART engines (issue 38 – August 1999)
  - Dowty Aerospace Propellers (issue 38 – May 2000)
- PTL 264 (issue 3 – 1.9.92) Tailplane – Inspection for cracking
- PTL 127 (issue 3 – 1.6.92) Tailplane – Inspection for cracking
- PTL 167 (issue 1 – 16.8.74) Tailplane – Inspection/modification of rear spar top forward booms
- BAe/MAN/VISC/EDD/15 and 16 (1966-92):
  Eddy current technique for examination of tailplane spar joint fittings-top
- Some copies made of individual pages from:
  - Complete set of Viscount Service Bulletin
  - 8 volumes of 800 Series Aircraft Manuals
  - Inspection and Repair Manuals

1b.3.2 Data from ICAO, Montreal

1	**Airclaims Viscount Accident Statistics (Sept. 2000)**	**Summary of 160 Viscount accidents, 139 of which were a total loss**
2	**ICAO Annex 13, Second Edition March 1966**	**Aircraft Accident Inquiry**
3	**South African Accident Report**	**Accident to Viscount 818 ZS-CVA in Indian Ocean, 13 March 1967**
4	**ICAO ADREP System**	**Briefs on all Viscounts accidents**
5	**ICAO ADREP Information**	**21 accident summaries involving door failure**

6	Accident Summary	Capital Airlines Viscount 744 N7404 Midway airport, 20 February 1956
7	Accident Summary	Accident to Boeing 747SR rear pressure bulkhead failure, Japan, 12 August 1985

1b.3.3. Data from BAe Systems

1b.3.3.1 Reports

1	Rotol Performance Office Report 1011 (February 1957)	Control and Performance Characteristics of Rotol propellers for Dart 510 engines in Viscount aircraft
2	BAe AL/Defects/1420/Viscount (19 April 1963)	Examination of a Tailplane Spar Joint Fitting removed from Viscount G-AMON
3	Aero/Loading Note 627 (Dec 1965)	Viscount 804 Data relating to crash of SP-LVA
4	BAe Aero/Loading Note 629 (7 Jan 1966)	Pitching manoeuvres used in the design of the Viscount
5	BAe SS/VIS /EJC/PJ/287 (July 1974)	Letter and campaign wires relating to Viscount 700 accident in Columbia (8 June 1974)
6	BAe SS/VIS/704-03/EJC/CER (14 October 1980)	Policy letter on Precautionary Inspections and Tailplane root end fittings following PK-IVS accident including magnetic particle inspection technique
7	DYN/BWP/SBW/2042 (November 1980)	Bouraq PK-IVS Analysis
8	US FAA Aircraft Specification No. A-814 (Rev 22) (February 1981)	TCDS Viscount
9	LER/V15/800/51 (April 1988)	Viscount 800 Series Life Extension Review
10	BK/AF 00001 Letter to AAIU Dublin dated 17 June 1998	Response to questions related to EI-AOM and PK-IVS
11	BAe letter 26 October 1992	Viscount Certification Standard
12	BB/SAH/001 (Oct 2000)	33 pages response to questions raised by Mr. Pech
13	BAe Operator Experience Date File Viscount (Dec 2000)	Occurrence data (22 pages)

SS/VIS/705-03/EJC/CER **8886/647-ATA27**	**Campaign Wire details**
AL/MAT/3713A	**Airworthiness requirements arising from Bouraq Accident**
SS/VIS/GEN/EJC/CER/647	**Control Spigot Policy**
Dowty Control Maintenance Manual No. 945, Sections	**Leading Particulars**
Viscount 800/810 Aircraft Manual	**Chapter 2 Inspection Schedule**

1b.3.3.2 Abstract from the Engineering Manual

Rigging, symmetry and control surface check (23.12.53)

1b.3.3.3 Drawings

70120 Sheet 367	**Elevator lever Mounting (Iss. E)**
80233 Sheet 105	**Control Assy. Torque Tube Elevator (Iss. S)**
81033 Sheet 9	**G.A. of controls Rods in Rear Fuselage** **(Iss. G)**
81020 Sheet 103	**Assy. Of Port Elevator Covered Structure** **(Iss. W)**
81033 Sheet 39	**Controls Assy Torque Tube Elevator (Iss. W)**
70118 Sheet 231/232	**Tailplane Spar joint fitting top**
70118 Sheet 231 F/232 F	**Idem**
70120 Sheet 367	**Elevator lever mounting**

Abstracts from Viscount 800 series Aircraft Manual:

- Air conditioning system
- Electrical system: power distribution
  electrical equipment in fuselage
- Rudder and tab operating mechanism: overhaul
  maintenance

1b.3.4. Documents sighted and part copied at Brocklands Museum, Weybridge, UK

1. Taking the Viscount into the 21st Century (The Viscount Life Extension Review) Paper by A. Kitcheside Nov. 30, 1998
2. Viscount 700 D Life Extension Review, British Aerospace – Aug 1998
3. Viscount 800 Series Life Extension Review, British Aerospace – March 1999

4. Viscount Engineering Development Progress Bulletin No. 1 – Aug 1956

5. Viscount Engineering Development Progress Bulletin No. 8 – Sep 1958

6. Viscount Engineering Development Progress Bulletin No. 9 – Oct 1958

7. Viscount Engineering Development Progress Bulletin No. 10 – Feb 1959

The above have details of the tailplane static and fatigue tests.

1b.3.5 Data from Dowty Aerospace

- Performance Office Report No. 1011 dated Feb 57
- Abstract of Performance Manual Nr 945 (2.12.65)
- Drawings:
  - Theoretical circuit diagram of propeller operating system
  - Propeller operating system: hydraulic

1b.3.6 Data from others

Australian Department of Civil Aviation Aeronautical Engineering Report SM-51 (May 1969)	**Review of Fatigue Cracking in Viscount Spar booms**
Air Safety Investigation Branch DCA Australia	**Accident to Viscount 720C VH-RMQ, Port Headlang, 31 Dec 1968, Factual Report**
Aer Lingus – IRIS Memo	**Possibility of Frozen Elevator Controls – Viscount**
British European Airways Letter to BAe EP/T/WEC/1906 (18 March 1964)	**Viscount aircraft – flying controls**
French Navy	**Functioning of the fuel supply circuit of RR DART engine MK 21**
1. MC Ewan	**DART engine: Multiple on wing and/on potentially hazard**
1. MC Ewan	**Airplane Impact Angle vs DART engine damage caused by impact**
Rolls-Royce	**DART engine: left hand view right hand view**
1. MC Ewan	**Analysis of FCU capsule failures**

1b.4 List of data made available for the operational analysis

1.b.4.1 Data made available by AER LINGUS

Ref No.	Description
01	Press Cuttings
02	Tragedy at "Tuskar Rock" by Dermot Walsh published in 1983 by Mercier Press
03	Transcript of "5-7 Live" 3.3.98
04	Medical Reports
05	Operations Control Daily Report 24.3.68
06	Incident Signal
07	Description of Portion of Aircraft Wing with RAF Roundel recovered in South Trench – document not dated
08	Air Safety Officer's Log of Events at Rosslare from 2200hrs on 24.3.68
09	Folder containing ATC Reports, R/T transcripts, flight plan etc
10	A summary of accidents due to structural failure from various causes 15.7.66
11	Accident watch records
12	Letter from G.C. Wilkinson, Principal Inspector of Accidents AAIB to B. Murray, Air Safety Officer re Identification of Wing Structure 17.7.74
13	Letter from BAC regarding Viscount 700 Series Accident in Colombia 8.6.74
14	Memo from Customer Relations to Air Safety Office consisting of questions about Tuskar Rock Accident from Mr. Alan McCormack
15	Map of Search Area and Aircraft Flight Path
16	Map showing Location of Main Wreckage also showing Location of "Wing piece"
17	Aeronautical chart Ireland
18	Aeronautical Chart showing aircraft flight path with bearings from Tuskar Rock
19	Photographs of wreckage landed from "Uplifter" 23.7.68
20	Official accident investigation report Dept of Transport and Power 30.6.70

1b.4.2 With Respect to UK Involvement

1b.4.2.1 Irish questions related to mid-air collision theory

- Peter Lawson's mail
- Celtic League mail
- Victims relative's mail:

  Alan and Jerome McCormick

  Sven Gablin
- "Tragedy at Tuskar Rock"

1b.4.2.2 Documentation in support of the UK MOD's responses to the Irish questions raised during the 1998-2000 review

1b.4.2.2.1 Official RN reports of proceedings. Supporting papers to Doyle, O'Driscol & associates' Question 7

a) CinC Plymouth letter forwarding Op Tuskar Report dated 10 February 1969

b) HMS PENELOPE Report and picture dated 27 March 1968

c) HMS HARDY Report dated 29 March 1968

d) Senior Officer Search Force's Report dated 1 May 1968 (incomplete)

e) Senior Officer Search Force's Report dated 24 May 1968

f) Operation Order Tuskar 1/68 dated 11 June 1968

g) HMS NURTON Report dated 21 June 1968

1b.4.2.2.2 "The Report of the SAR and Salvage of Aer Lingus Viscount 712, 24 March-27 August, 1968: OPERATION TUSKAR" dated 10 February 1969

1.b.4.2.2.3 RNAS Brawdy Air Officer of the Day's Log for 24 March 1968. Supporting paper to Relatives' questions List A question 4

1b.4.2.2.4 Supporting papers to Relatives' questions list B question 5

1b.4.2.2.5 Supporting papers to Relatives' question list B question 7 and Celtic League question 7

a) DERDA Annex B: Weckage examined on the Fishguard/Rosslare Ferry at Fishguard

b) DERDA Annex E: Salvage of wreckage from Aer Lingus lost over Irish Sea

1b.4.2.2.6 DERA : RAE Aberporth/Llanbedr – Evidence of Closure on Sunday 24th March 1968. Supporting papers to Celtic League question 5 and Irish Government supplementary question 3

1b.4.2.2.7 DERA Annex F: Aberporth Danger Area Supporting papers to Celtic League question 9

1b.4.2.2.8 MOD comments on extracts from PRO supporting papers to question arising from 24 May meeting and referred to supplementary questions 1 and 2

1b.4.2.2.9 DERA: STILETTO including identification findings on target wing held by the Irish AAIU June 1999. Supporting papers on Stiletto

1b.4.2.2.10 Shorts Brothers of Belfast: STILETTO documents and MOD Summary sheets

1b.4.2.2.11 Operational Signals: SAR and Salvage Ops

1b.4.2.2.12 Comments From:

a) Capt of HMS HARDY

b) Capt of HMS PENELOPE

c) British Air Accident Investigation Branch Officer who

advised and assisted Irish Dept of Transport and Power during the investigation

1b.4.2.2.13 DERA: Review of UK anti-aircraft weapons 1968 Vintage – Performance Status and Aberporth/Llanbedr "Connection"

1b.4.2.2.14 Comments on Thunderbirds and the Royal Artillery/TA

1b.4.2.3 Responses to French Questions

1b.4.2.3.1 From DERA (5.6.01)

1b.4.2.3.2 From Army Historical Branch (31.5.01)

1b.4.2.3.3 From RAF Historical Branch (4.6.01)

1b.4.2.3.4 From RN Historical Branch

1b.4.2.3.5 From U.K Public Record Officer (PRO)

APPENDIX 1C: GLOSSARIES

1c.1 Glossary of Terms

1c.2 Glossary of Abbreviations

Glossary of Terms

Angle of Attack	The angle between the wing chord or other reference axis and local undisturbed airflow direction.
Attitude	The relationship between the axes of the aircraft (longitudinal, lateral and vertical) and that of a fixed reference such as the earth's horizon.
Centre of Gravity	The point within an aircraft about which all the moments trying to rotate the aircraft are balanced.
Certificate of Airworthiness	A document issued by the State of Registry of the aircraft and applicable to an industrial aircraft. This specifies compliance with the necessary airworthiness regulatory requirements for safe flight.
Corrosion	An electrochemical process in which sound metal is decayed into its chemical compounds. Examples are exfoliation (flaking), pitting and intercrystalline cracking.
Damage Tolerance	The ability of a structure to continue to carry normal flight loads for a specified period in the presence of flaws, cracks and other damage.
Decompression	The reduction in cabin air pressure to a level existing outside the aircraft. This may be caused by a catastrophic structural failure or a system malfunction or contained failure resulting in a safe descent.
Drag	Aerodynamic force in a direction opposite to that of flight due and the resistance of the atmosphere through which the aircraft passes.
Empennage	The tail unit of an aircraft consisting of a horizontal surface (tailplane or horizontal stabilizer) and a vertical surface (fan or vertical stabilizer) together with their associated control surfaces of elevators and rudder.
Fail-safe	Design concept in which the crack or failure of any single structural element will not result in catastrophic failure of the whole aircraft structure – refer to annex b 3 a.
Fatigue	Weakness on material because of changes in the crystalline structure caused by the repeated application of stress – refer to annex B 3.
Flight controls	Those governing the trajectory of the aircraft in flight i.e. elevators on the tailplane to control pitch; ailerons on the wing to control roll; and rudder on the vertical fan to control yaw.
Flutter	An aeroelastic self-excited vibration of which the external source of energy is the airstream.
Fuel control unit	Governs engine fuel supply in accordance with pilot demand, ambient conditions and engine limitations.
ICAO	International Civil Aviation Organisation. A United Nations agency based in Montreal, Canada.
Lift	An aerodynamic force acting perpendicular to the line of flight, caused by air flow over the aerofoil shape of the wing or tailplane – Refer to annex B 3(b)
Load	The force exerted upon the structure due to aerodynamic or other pressures.
Maintenance	Work required, scheduled or otherwise, for keeping the aircraft in a serviceable and airworthy condition.
Manufacturer	The Viscount was designed and constructed by Vickers Armstrongs (Aircraft) Ltd., Weybridge, England (Subsequently BAC, BAe and BAE systems). The engines were produced by Rolls-Royce Ltd., and the propellers by Dowty Rotol Ltd.
Pressurisation	A form of climate control where an engine driven air-compressor increases the pressure of air inside the cabin of a high flying aircraft to a value which allows the occupants to breathe normally without supplementary oxygen.
Pressure cabin	The portion of the fuselage of an aircraft which is sealed and pressurised in flight.
Pressure Bulkhead	A structural item designed to serve as a boundary to the pressurised section of the fuselage.
Propeller Pitch	The angle between the chord of a propeller blade and a plane perpendicular to the axis of rotation.
Propeller Feathering	Where the propeller blades are rotated so that the leading and trailing edges are as near as possible parallel to the aircraft flight path. This minimises drag and engine rotation.

Safe Life	**A design philosophy whereby primary structural elements subjected to fatigue damage are replaced at a specific time – refer to annex B 3(a).**
Spin	**A sustained spiral descent with an angle-of-attack beyond the stalling angle.**
Stall	**A loss of lift caused by disruption and breakdown of airflow over the wing.**
Stress	**The loading on structural material per unit area.**
Tab	**A small, moveable control, hinged to the trailing edge of a primary flight control surface.**
Tail load	**The aerodynamic force produced by the tailplane moving through the air. Tail loads normally act downwards (negative lift) in order to give the aircraft longitudinal stability – refer to annex B 3 b.**
Thrust	**The aerodynamic force produced by a propeller or a turbojet engine as it forces a mass of air to the rear, behind the aircraft.**

Appendix 1c.2

Glossary of Abbreviations

A	**AAIB**	**Air Accident Investigation Branch**
	AAIU	**Air Accident Investigation Unit**
	AAN	**Airworthiness Approval Note**
	AAP	**Air Accident Publication**
	AAR	**Aircraft Accident Report**
	Ac, A/C	**Aircraft**
	AC	**Alternative Current**
	AD	**Airworthiness Directive**
	ADREP	**Advisory REPort**
	AIP	**Aeronautical Information Publication**
	ANO	**Air Navigation Order**
	AOC	**Air Operator Certificate**
	APP	**Approach Control**
	ARB	**Air Registration Board**
	ATC	**Air Traffic Control**
	ATC (O)	**Air Traffic Control Officer**
	ATS	**Air Traffic Service**
	ATSU	**Air Traffic Service Unit**
	AWY	**Airways**
B	**BAC**	**British Aircraft Corporation**
	BAe	**British Aerospace**
	BAe Systems	**British Aerospace – Systems Division**
	BCAR(s)	**British Civil Airworthiness Requirement(s)**
C	**CAA**	**Civil Aviation Authority**
	CAP	**Civil Aviation Publication**
	CB	**Cumulonimbus (Cloud)**
	CO	**Commanding Officer**
	CTA	**Control Terminal Approach**
	CVR	**Cockpit Voice Recorder**
D	**DA**	**Dangerous Area**
	DC	**Direct Current**
	DERA	**Defence Evaluation and Research Agency**
	DRA	**Defence Research Agency**
E	**E.ST**	**East Summer Time (in U.S.A.)**

	E. TA	Estimated Time of Arrival
F	FAA	Federal Aviation Administration (U.S.A.)
	FDAS	Flight Data Acquisition System
	FCOM	Flight Crew Operations Manual
	FCU	Flight Control Unit
	FIR	Flight Information Region
	FL	Flight Level
	FOI	Flight Operations Inspector
	Ft	Feet
G	GA	General Arrangement
	GMT	Greenwich Mean Time
	GS	Ground Speed
H	HFEC	High Frequency Eddy Current
I	IAC	Irish Air Corps
	IAS	Indicated Air Speed
	IFF	Identification Friend or Foc
	ICAO	International Civil Aviation Organisation
	ILS	Instrument Landing System
	IMC	Instrument Meteo Conditions
J	JAA	Joint Aviation Authority (Europe)
	JAR(s)	Joint Airworthiness Requirement(s)
K	Kts.	Knots
L	LATTC	London Air Traffic Control Centre
	LAAWC	Local Anti-Aircraft Warfare Co-ordinator
	LOC	Loss of Control
M	Mn	Minutes
	Mhz	Megahertz
	Mi	Statute Mile
	MOD	Ministry of Defense
	MSN	Manufacturer Serial Number
	(M) RCC	(Maritime) Rescue Coordination Center
N	NAS	Naval Air Station
	NDB	Non Directional Beacon
	Nm	Nautical Mile
	NOTAM	Notice to Air Men
	NTSB	National Transportation Safety Board
O	OTC	Officer Tactical in Command
	OM (FCOM)	Operations Manual
P	PCU	Propeller Control Unit
	PIC	Pilot in Command
	PRO	Public Record Office (UK)
	PTL	Preliminary Technical Leaflet

R	**RAE**	**Royal Aeronautical Establishment**
	RAF	**Royal Air Force**
	RCC	**Rescue Co-ordination Center**
	REG	**Regulation**
	REV	**Revision**
	RN	**Royal Navy**
	RNAS	**Royal Navy Air Station**
	RR	**Rolls-Royce**
	R/T	**Radio Transmissions**
S	**SAR**	**Search and Rescue**
	SB	**Service Bulletin**
	SMP	**Standard Maintenance Procedure**
	S/N	**Serial Number**
T	**TAS**	**True Air Speed**
	TCDS	**Technical C……..D…….Specification**
	TGT	**Turbine Gas Temperature**
	TWR	**Tower Control**
	TSN	**Time Since New**
	TU, (=Z,GMT)	**Temps Universel**
U	**UHF**	**Ultra High Frequencies**
V	**VFR**	**Visual Flight Rules**
	VHF	**Very High Frequency**
	VMC	**Visual Meteo Conditions**
Z	**Zulu Time (=GMT, TU)**	**Time in usage in the Greenwich Time Zone**

Appendices 3

3a: **Bird Migrations**

3b: **Sample of Ads Tail Related**

3c: **Detailed Comparison AOM-AOF**

Appendix 3a

« Birds Migrations to/from South Ireland »

Study by Captain M. Reynolds

3a.1 Monthly summary of weather (February-March 1968) – Extract from "Irish Meteorological Office"

3a.2 Data gathered from "Wildfowl and Wetlands Trust"

3a.3 Tracks of Swan Migrations (March 1968)
- **Bewick Swans**
- **Whooper Swans**

3a.1 Monthly Summary of Weather (February-March 1968)

supplied by *Irish Meteorological Office (I.M.O.)*

(Extract re-typed)

February, 1968

COOL, DRY AND SUNNY

From 1st to 4th a mainly westerly airflow covered Ireland and in this airflow troughs of low pressure crossed the country during 4th. There was dull rainy weather during the late evening of 3rd and at first on 4th. Otherwise there were showers and bright periods – some of the showers being thundery and of hail. During 5th a depression moved southeastwards to lie just to the west of Ireland by evening, with a trough to the east, resulting in a complex low pressure system which covered Ireland and England until it was superseded by a southeasterly airflow during 9th. There were fair periods and showers – occasionally of hail – on 5th, 6th and early on 7th, while for the rest of the time it was mainly cloudy or dull with periods of rain or snow. From 10th to 14th on extensive low pressure area to the southwest of Ireland maintained a south-easterly to easterly airflow over the country giving mainly cloudy or dull conditions with periods of rain and drizzle – mostly light – in many places. Between 15th and 28th, high pressure over or just to the north or Ireland gave mainly dry conditions – mostly cloudy until 19th and thereafter mainly fine or fair. During 29th a trough of low pressure approaching from the west gave generally dull weather with outbreaks of rain and drizzle especially in the west.

PRESSURE

Mean pressure for the month was below normal except in the extreme north. At 18h it was 1.8 millibars below normal at Birr, 3.6 millibars at Roche's Point and 4.2 millibars at Valentia Observatory. At Malin Head it was 0.1 millibars above normal.

Extreme mean sea level pressures recorded were, 1033.1 millibars at Clones on 27th and 984.0 millibars at Valentia Observatory on 6th.

PRECIPITATION

The rainfall for the country as a whole was 44% of normal. Rainfall was below normal everywhere. Parts of the east and midlands had less than 25% of the normal fall. The greatest daily fall 41.1mm, was recorded at Bantry, Co. Cork on 10th. Extreme monthly totals recorded were, 10.8mm, at Clonbulloge, Co. Offaly and 177.8mm, in the Kerry mountains.

WIND

Wind reached gale force in mean speed or in gusts on some days mainly in the first half of the month. Directions were mainly between northerly and southeasterly.

The highest gust, 76 miles per hour and the highest mean speed over 10 minutes, 55 miles per hour, were both recorded at Malin Head on 4th.

TEMPERATURE

Mean temperature varied between 4.5°C at Dublin (Upper O'Connell Street), Roche's Point, Rosslare and Valentia Observatory and 2.0°C at Ballinamore and Clones. It was below normal in all areas, varying from 1.5°C below normal at Rosslare to 2.7°C below normal at Markree Castle.

At many stations mean temperature was the lowest recorded for any month since February, 1963. Extreme temperatures recorded were 13.3°C at Tralee (Clash) on 12th and –9.5°C at Glenties on 6th. Extreme “grass-minimum” temperature recorded was –17.3°C at Glenties on 6th.

SUNSHINE

Mean daily duration of bright sunshine was over 125% or normal everywhere and varied between 4.2 hours at Carna, Co. Galway and 2.8 hours at Boora, Co. Offaly. At Belmullet, Claremorris and Malin Head mean duration was over 150% of normal. At Dublin Airport, Claremorris and Shannon Airport it was the sunniest February since records are available at these stations (Dublin Airport 1941; Claremorris 1944, Shannon Airport 1946). At Belmullet (159% of normal) the total duration for the month 116.3 hours, was the highest there for February since records are available (1957). The greatest daily duration of bright sunshine, 9.7 hours, was recorded at Kilkenny on 25th.

Extremes of total monthly duration of bright sunshine recorded were 122.3 hours at Carna and 80.5 hours at Boora.

FOG

Fog occurred at dawn in many places on about ten days between 6th and 21st and there were isolated occurrences on 24th, 26th, 27th and 29th. It was generally slow to clear, persisting in some places until afternoon.

SNOW

Falls of snow occurred in the period 1st - 9th and were widespread on 4th, 5th and 6th. Snow was reported in the southeast on 11th. Snow fell in the period 21st-25th and was general on 24th.

HAIL

Hail showers occurred in the periods 1st - 9th and 21st - 24th and also on 12th.

THUNDER

Thunderstorms were reported at Belmullet on 4th, Rosslare on 10th and Tralee (Clash) on 1st.

March, 1968

GENERALLY COLDER AND WETTER THAN NORMAL

From the 1st to 11th an anticyclone just to the west of Ireland dominated Irish weather – giving mostly dry conditions, apart from some scattered showers mainly in the west and northwest. Between 1st and 7th there were good sunny periods in most localities but from 8th to 11th it was mainly cloudy or dull. During 12th the anticyclone moved away southeastwards and from 13th to 21st there was established over the country a westerly to northwesterly airflow – the circulation round an intense low pressure area extending from south of Iceland to north of Scotland to west Norway. In this airflow several troughs of low pressure crossed Ireland. Weather throughout was mostly cloudy or dull, with periods or rain or showers in most districts.

The showers were of snow or hail at times and were heavy on occasion especially between 17th and 21st when thunderstorms were reported in some localities. Between 22nd and 25th a deepening depression to the west of Ireland moved northeastwards reaching the Hebrides by 25th and its associated troughs of low pressure crossed Ireland.

Mainly cloudy or dull weather with rain on 22nd and 23rd was replaced by showers and bright periods on 24th and 25th. Some of the showers were heavy, and of hail at times – thunderstorms occurring in several districts on 25th. From 26th to 28th a strong south-westerly airflow covered Ireland giving mostly dull weather with outbreaks of rain and drizzle prolonged in places. During 29th a trough of low pressure moved slowly southeastwards across Ireland and was succeeded by a northwesterly airflow. Mostly fair or fine conditions prevailed over the second half of 29th and also on 30th. Otherwise weather was generally dull with rain – the rain being prolonged and heavy in places in the northwest on 31st.

PRESSURE

Mean pressure for the month was above normal except in the extreme north. At 18h it exceeded normal by 2.3 millibars at Birr, 2.9 millibars at Roche's Points and 4.3 millibars at Valentia Observatory. At Malin Head it was 1.2 millibars below normal.
Extreme mean sea level pressures recorded were, 1037.7 millibars at Valentia Observatory on 4th and 982.1 millibars at Belmullet on 22nd.

PRECIPITATION

The rainfall for the country as a whole was 113% of normal. Rainfall was above normal except for parts of Leinster and south Munster. At Malin Head rainfall was 186% of normal but at Rosslare it was 64%. In most areas there was little rainfall in the period 1st-12th. At Dublin (Upper O'Connell Street), Kilkenny, Mullingar and Rosslare the period 25th February to 12th March constituted an absolute drought, i.e. a period of a least 15 consecutive days on each of which less than 0.2 mm of precipitation occurred. The greatest daily fall, 71.7 mm was recorded at the Gap of Dunloe, Co. Kerry. Extreme monthly totals recorded were, 25.4 mm at Dalkey, Co. Dublin and 315.0 mm in the Donegal mountains.

WIND

Wind reached gale force in mean speed or in gusts on over half the days of the month, mostly during 2nd and 3rd weeks. Directions lay predominantly between southeast through west and northwest to north.

The highest gust, 96 miles per hour, and the highest mean speed over 10 minutes, 55 miles per hour, were both recorded at Malin Head on 17th.

TEMPERATURE

Mean temperature varied between 7.8°C at Dublin (Trinity College) and 5.7°C at Lullymore (Agr. Inst.). It was below normal nearly everywhere ranging from 0.3°C above normal at Dublin (Glasnevin) to 1.0°C below normal at Valentia Observatory. The period 23rd-29th was mild, temperatures in excess of 12°C being recorded at most places. The highest temperature, 20.4°C, was recorded at Dublin (Rathfarnham Castle) on 28th. Lowest temperatures were recorded mainly in the period 1st-4th, 7th-8th and 21st when daily minimum values were near or below 0°C (freezing point). The lowest temperature, -4.9°C, was recorded at Clonsast on 7th.

Extreme "grass minimum" temperature recorded was –12.0° at Phoenix Park on 8th.

SUNSHINE

Mean daily duration of bright sunshine ranged from 5.0 hours at Rosslare to 2.6 hours at Glencolumbkille. It was above normal in Leinster and Munster and below normal in Connaught and Ulster. In parts of the south and southeast, mean duration was between 121% and 132% of normal but at Malin Head it was only 78%.

Extremes of total monthly duration of bright sunshine recorded were, 155.6 hours at Rosslare and 81.7 hours at Glencolumbkille. The greatest daily duration of bright sunshine recorded was 10.8 hours at Phoenix Park on 28th.

FOG

Fog occurred on only a few occasions during the month notably in the period 1st-3rd and on 8th, 15th, 16th and 29th.

SNOW

Snow or sleet was general in the period 15th-22nd and there were isolated falls on 14th, 23rd and 25th.

HAIL

Hail showers were reported from most places in the period 15th -25th and there were well scattered showers on 2nd and 3rd.

THUNDER

Thunderstorms were reported on 18th at Belmullet, Shannon Airport and Tralee (Caherweesheen), on 19th at Malin Head, on 21st at Ballybritta, Ballygagin, Roche's Point and Rosslare, on 22nd at Ballygagin and on 25th were reported in most areas except the west and north.

(Extract ended)

3a.2 **<u>DATA ON BIRDS MIGRATIONS</u>**

gathered by Captain M. Reynolds from <u>"Wildfowl and Wetlands Trust"</u>

(Extract re-typed)

3a.2.1

DATA GATHERED

FROM

"WILDFOWL AND WETLANDS TRUST"

W.W.T. was founded by the late Sir Peter Scott and is still managed by Lady Phillipa Scott and her daughter Daphela. Their Trust has been very co-operative and their employees are enthusiastic and helpful.

They searched their computer records to ascertain the 1968 departure dates of swans. They also patiently explained to me the movements of birds leaving Ireland on transists to England and Wales across the Irish Sea.

Swans are unlike geese in their selection of departure dates inasmuch as the local weather has an influence. Colder winter = later departure. Therefore I secure the Irish Met Temperature Summary for 1967-68 to establish similar departure dates for Irish birds. (Summary enclosed).

Whooper Swans head for Iceland, Bewick's Swans head for Siberia, etc. Irish birds of both breeds make en route stops in various parts of England, Wales and North Ireland to top up their fuel (fat) at feeding wetlands.

<u>ALTITUDE RECORD</u>

W.W.T. have numerous reports from aircrew of swans at 20,000 feet. **In an eerie coincidence,** the actual <u>all-time record</u> was made on the incoming late – 1967 flight by the Irish Whoopers **<u>who were the same birds who left Ireland in March 1968</u>**. They were tracked above the Outer Hebrides in December 1967 at an altitude of 8,200 **metres**. All of this is confirmed on bottom of p.2 at: www.bbc.co.uk/education/archive/heading_south/whooperfaq.htm

3a2.2

<u>U.K. DEPARTURE DATES – 1968</u>

W.W.T transferred Sir Peter Scott's old hand-written notebooks to their computer database. They searched on my behalf. Because of the cold winter, flocks of swans were still taking-off on 22nd March 1968, and this continued until the last birds left on 27th March. (Confirmation: 1453890333-Extension 183-Swan Office – Ms. Jenny Earle).

<u>IRISH DEPARTURE DATES – 1968</u>

W.W.T. advise me that <u>unless the 1967-68 Irish winter was warmer than usual</u> the Irish swans would depart at about the same time as the U.K. birds. I examined the Irish Met Records for the final two months of the feeding regime in Ireland (enclosed) and the following are salient extracts:-

February 1968: "Temperatures below normal in all areas, varying from 1.5 degrees C below normal at Rosslare to 2.7 degrees C below normal at Markree Castle. At many stations mean temperature was the lowest recorded for any month since February 1963".

March 1968: "Temperature was below normal nearly everywhere. Lowest temperatures were recorded mainly in the period 1st-4th, 7th-8th, and on the 21st, when daily minimum values were near, or below, 0 degrees C".

This indicates departure dates similar to the U.K. cold winter.

ROUTES BY IRISH SWANS – 1968

Some Irish swans leaving Kerry, Cork, Galway, River Shannon, etc. stop at Slimbridge (Gloucestershire) en route to Siberia and Russia.

Birds from the southeast extremities of Ireland can head a short distance to sea to orientate their navigation systems with the coastline profile. Those, which stop at Slimbridge are unlikely to climb above 2,000 feet, and many even, stay close to sea level, because of the relatively short distance. However, W.W.T. advise me that many flocks of Irish Bewick's overshoot Slimbridge altogether and head for Welney, in Norfolk. This is near the east coast of England, in the Fenlands close to the River Ouse washes.

These birds have a higher rate of climb for the longer haul, which puts them on collision course, and possibly at collision altitude, above St. George's Channel and the south Irish Sea. Whooper Swans en route to Iceland keep alternate "airfields" close to their track in case the weather deteriorates, or energy is sapped. They do not head in a straight line for Iceland. (This is like ETOPS operations by twin-engined aircraft on the Atlantic route. e.g. Azores, Reykjavik, etc alternates). Again, W.W.T. advise that departing Irish Whoopers follow the reciprocal of the track, which they used, on their Iceland-Ireland Journey in December. They leave Iceland from breeding grounds between 15 degrees W and 20 degrees W and head southeast for the nearest landfall.

Routes (Continued)

They cross the Outer Hebrides before turning south at 5 degrees W. (In fact, it was above the Outer Hebrides that a crew reported an "air-miss" with Ireland-bound swans at an altitude of 8,200 metres in 1967).

Irish Whoopers from the far southern extremities of our island can also swing seaward for an orientation period, entering coastline waypoints in their little-understood navigation systems.

Ms. Earle of W.W.T. has advised me that some of these flocks head for a place called Martin Mere, near Ormskirk in the Southport region of Lancashire. Their landing place is on the southern side of the estuary of the River Ribble. From there they head northwards to the Outer Hebrides again, and thence northwest to Iceland.

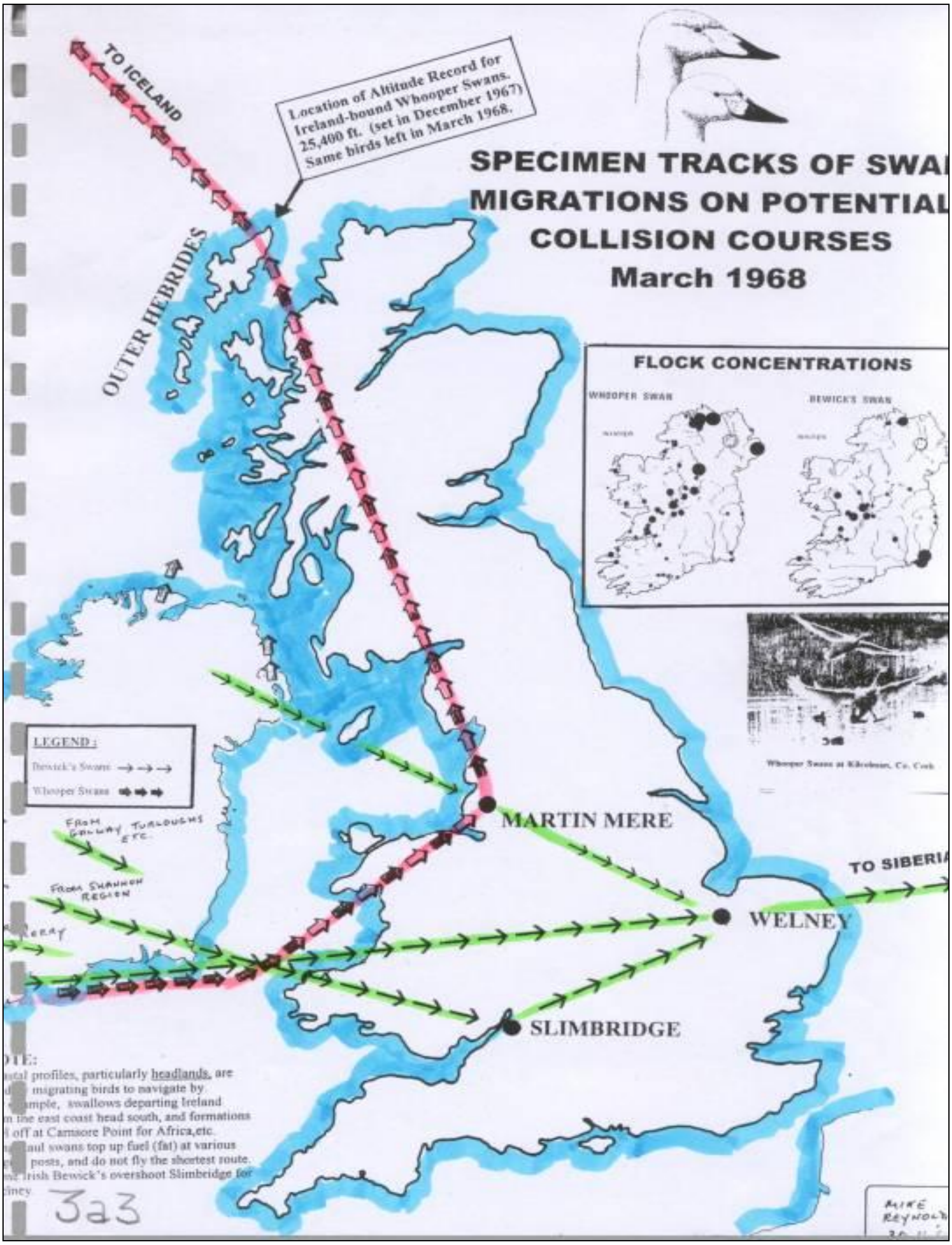
There seems little doubt that swan migrations from Kerry, Shannon, Galway, etc., were on collision courses with the track of EI-AOM.

3a.3 Tracks of Swan Migrations

- Bewick Swans

- Whooper Swans

It may be noted that both types of Swan concentrate in and migrate over Cork and Dungarvan areas.



APPENDIX 3B

Sample of ADs Viscount Tail related

3b.1 Introduction

3b.2 ADs

3b.3 Conclusion

Sample created by **Captain M. Reynolds**

3b.1 Introduction

Section 3.11 "Regulatory Action" explains the issue of mandatory Continuing Airworthiness requirements for Viscount aircraft. There are many hundreds of such documents.

The United States Federal Aviation Administration (FSS) issued many Airworthiness Directives (ADs) on the 700 and 810 Series Viscount aircraft. These were the only Series certificated in the U.S. All these ADs were based upon prior UK mandatory action.

Because of their concise presentation a small sample of FAA ADs is presented in this Appendix. These are not meant to be definitive but merely to give a feel for the kind of service problems encountered in the tailplane region over the range of Viscounts Models.

3b.2 : ADs

- AD 55 – 22 – 04
- AD 57 – 08 – 06
- AD 60 – 11 – 10
- AD 66 – 20 – 04
- AD 68 – 15 – 02
- AD 68 – 15 – 03
- AD 75 – 13 – 06
- AD 75 – 13 – 06
- AD 76 – 19 – 01
- AD 80 – 21 – 51
- AD 91 – 26 – 01
- AD 92 – 14 – 06
- AD 95 – 15 – 08
- AD 95 – 19 – 11, together with the presentation notice

Airworthiness Directives

▼ Header Information

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

AD 55 – 22 – 04

Airworthiness Directives: Vickers-Armstrong Model 745D Aircraft

► Preamble Information

▼ Regulatory Information

55-22-04 VICKERS-ARMSTRONG: Applies to all **Viscount** Model 745D Aircraft

Compliance required as indicated.

Cracks have been found in the tailplane centre section main spar extending along the lines of rivets attaching the web plate.

Accordingly, Vickers-Armstrong (Aircraft) Ltd. issued Preliminary Technical Leaflet No. 52 dated August 19, 1955, covering this subject. The British Air Registration Board considers Modification D.1384, the initial and repetitive inspections recommended therein mandatory in which the FAA concurs.

Aircraft complying with the limitations specified in PTL No. 52 will be considered serviceable.

►Footer Information

►Federal Register Information

►Comments

Airworthiness Directives

▼ Header Information

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

AD 57 – 08 – 06

Airworthiness Directives: Vickers-Armstrong Model 744 and 745 Aircraft

►Preamble Information

▾Regulatory Information

57 – 08 – 06 Vickers: Applies to **Viscount** 744 and 745 Type Aircraft

Compliance required as indicated.

In view of a recent horizontal stabilizer buckling incident compliance with the following is required:

1. Effective immediately the following placard must be installed in full view of the pilot:

"TURBULENT AIR PENETRATION-165-KNOTS-FLAPS UP-LANDING GEAR UP"
(This placard required regardless of compliance with item 2).

2. Compliance required by August 31, 1957, with Vickers Modification D 1906. This modification introduces new horizontal stabilizer skin panels of 18 gage, Specification L.73 material between Station 34.36 and 99.13 in lieu of the 20-gage panels of Specification L.72

►Footer Information

►Federal Register Information

►Comments

Airworthiness Directives

▾ Header Information

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

AD 60 – 11 – 10

Airworthiness Directives: Vickers-Armstrong Model 745D and 810 Series Aircraft

► Preamble Information

▾ Regulatory Information

60 – 11 – 10 VICKERS: Amdt. 148 Part 507 Federal Register May 10, 1960. Applies to All Viscount Model 745 D Aircraft (Pre-modification D.2013 Parts (C) (I) (D) and (K) (Standard) and all **Viscount** 810 Series Aircraft (Pre-modification FG.237 Parts (D) and (K) (Standard).

Compliance required at next removal of rudder trim tab and/or elevator spring tab, but not later than June 1, 1961.

To preclude the possibility of inadvertent interchange of Pre-mod. D.2013 and FG.237 rudder trim tab and elevator spring tab torque tube assemblies, Vickers Modification D.2918 (700 Series) and FG.1671 (800/810 Series) must be incorporated. This modification insures that the upper rudder trim tab torque tube assembly cannot be connected to the elevator spring tab and the elevator spring tab torque assembly cannot be connected to the rudder trim tab in the upper position. Incorporation of this modification on 700 Series aircraft is accomplished by installation of a nuissance bracket, P/N 70123-359 or equivalent, fitted to the tabs at the point of attachment of the relevant short (Pre-mod. D.2013) skewbars.

On Model 810 Series aircraft, the long skewbar introduced by Mod. FG.237 is incorporated in the basic design of the right elevator trim tab. The left elevator anti-balance tab and the spring tab are operated by an external rod system to which Mod. FG.237 is not applicable. Since the rudder tab has a short skewbar, of Pre-mod. FG.237 standard, fitted at the upper position, it is required that installation of the nuisance bracket of Mod. FG.1671 or equivalent be made as a positive safeguard against incorrect assembly. (Vickers-Armstrongs Modification Bulletins D.2918 (700 Series) and FG.1671 (800/810 Series) cover this subject).

►Footer Information

► Federal Register Information

►Comments

Airworthiness Directives

▼Header Information

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

Amendment 39-304; AD 66 – 29 – 04

Airworthiness Directives: VICKERS- Models 744, 745D and 810 Series Airplanes.

►Preamble Information

Regulatory Information

66 – 29 – 04 VICKERS: Amdt. 39-304 Part 39 Federal Register November 9, 1966. Applies to **Viscount** Models 744, 745D and 810 Series Airplanes.

Compliance required within the next 100 hours' time in service after the effective date of this AD, unless already accomplished.

To prevent fouling between the trailing edge of the elevator hinge beam shroud and the elevator skin lap joint, accomplish the following:

(a) Visually inspect top and bottom shrouds on elevator hinge beam assemblies to ensure that clearance between trailing edge of shroud and forward edge of elevator skin lap joints or rivet heads is not less than 0.20 inch throughout full range of elevator movement.

(b) If clearance is less than 0.20 inch, cut back trailing edge of hinge beam shroud to provide clearance of at least 0.20 inch but less than 0.25 inch throughout full range of elevator movement.

(British Aircraft Corporation (B.A.C.) Ltd. Preliminary Technical Leaflet (PTL) No. 263, Issue 1, (700 Series) and No. 126, Issue 1) (800/810 Series) pertain to this subject).

This directive effective November 19, 1966.

►Footer Information

►Federal Register Information

►Comments

-

Airworthiness Directives

▾Header Information

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

Amendment 39-623; AD 68 – 15 – 02

Airworthiness Directives; BRITISH AIRCRAFT CORPORATION Models 744, 745D and 810 Series Airplanes.

▸Preamble Information

▾Regulatory Information

68 – 15 – 02 BRITISH AIRCRAFT CORPORATION: Amendment 39-623. Applies to **Viscount** Models 744, 745D and 810 Series Airplanes.

Compliance required as indicated.

To detect and repair cracks in the elevator root and ribs P/Ns 60920-65, 60920-63, 72420-11 for Models 744 and 745D and 81020 Shts. 81 and 83 Model 810, accomplish the following:

(a) For airplanes that have accumulated 7850 or more landings, inspect in accordance with paragraph (c) within the next 150 landings after the effective date of this AD and thereafter at intervals not to exceed 475 landings from the last inspection.

(b) For airplanes that have accumulated less than 7850 landings, inspect in accordance with paragraph (c) prior to the accumulation of 8000 landings and thereafter at intervals not to exceed 475 landings from the last inspection.

(c) Visually inspect the root end ribs for cracks in accordance with British Aircraft Corporation Preliminary Technical Leaflet No. 274 Issue 1 (700 Series) or No. 138 Issue 1 (800/810 Series) or later ARB-approved issues or an FAA-approved equivalent.

(d) If cracks are detected during the inspection specified in paragraph (c), within the next 10 landings incorporate the Repair/Reinforcement scheme in accordance with British Aircraft Corporation Preliminary Technical Leaflet No. 274 issue 1 (700 Series) or No. 138 Issue 1 (800/810 Series) or later ARB-approved issues or an equivalent approved by the Chief, Aircraft Certification Staff, FAA, European Region.

(e) If not already accomplished under paragraph (d), within the next 3,000 landings after the effective date of this AD, incorporate the Repair/Reinforcement Scheme in accordance with British Aircraft Corporation Preliminary Technical Leaflet No.274 Issue 1 (700 Series) or No. 138 Issue 1 (800/810 Series) or later ARB-approved issues or equivalent approved by the Chief, Aircraft Certification Staff, FAA, European Region.

(f) After incorporation of the Repair/Reinforcement Scheme in accordance with either paragraph (d) or (e), repeat the visual inspection specified in paragraph (c) prior to the next takeoff after each occurrence of severe nosewheel shimmy, or at intervals not to exceed 3,000 landings from the last inspection , whichever occurs earlier.

(g) For the purpose of complying with the AD, subject to acceptance by the assigned FAA maintenance inspector, the number of landings may be determined by dividing each airplane's hours' time in service by the operator's fleet average time from takeoff to landing for the airplane type.

This amendment becomes effective July 23, 1968.

►Footer Information

►Federal Register Information

►Comments

Airworthiness Directives

▼ Header Information

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

Amendment 39-621; AD 68 – 15 – 03

Airworthiness Directives, BRITISH AIRCRAFT CORPORATION Models 744 and 745D Airplanes.

►Preamble Information

▼Regulatory Information

68-15-03 BRITISH AIRCRAFT CORPORATION: Amendment 39-621. Applies to **Viscount** 744 and 745D airplanes.

Compliance required as indicated, unless already accomplished.

To prevent fatigue damage to the horizontal stabilizer top spar root joint fittings, P/N 70118-231/232 (Pre Mod. D. 3190), and P/N 70118-671/672 (Post Mod.D.3190), accomplish the following:

(a) Inspect the horizontal stabilizer top spar root joint fittings for cracks in accordance with British Aircraft Corporation PTL No. 264, Issue 2, Dated February 12, 1968 (700 Series) or later ARB-approved issue, or an FAA-approved equivalent, as follows:

(1) For fittings which have been involved in 11,500 or more landings on the effective date of this AD, within the next 500 landings, unless already accomplished within the last 2,500 landings, and thereafter at intervals not to exceed 3,000 landings for the last inspection.

(2) For fittings which have been involved in less than 11,500 landings on the effective date of this AD, prior to the accumulation of 12,000 landings and thereafter at intervals not to exceed 3,000 landings from the last inspection.

(b) After each inspection under paragraph (a), replace all cracked fittings with new fittings of the same part number before further flight.

(c) For the purpose of complying with this AD, subject to acceptance by the assigned FAA maintenance inspector, the number of landings may be determined by dividing each airplane's hours' time in service by the operators fleet average time from takeoff to landing for the airplane type.

This superseded Amendment 39-371 (32 F.R. 4306), AD 67-9-5.

This amendment becomes effective August 15, 1968.

►**Footer Information**

►**Federal Register Information**

►**Comments**

Airworthiness Directives

▼Header Information

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

Amendment 39-2236; AD 75 – 13 – 06

Airworthiness Directives: BRITISH AIRCRAFT CORPORATION Model 700 Series Airplanes.

►Preamble Information

▼Regulatory Information

75-13-06 BRITISH AIRCRAFT CORPORATION: Amendment 39-2236. Applies to **Viscount** Model 700 Series airplanes, certificated in all categories.

Compliance required as indicated.

To prevent the possible in-flight fatigue failure of the horizontal stabilizer, accomplish the following:

(a) For horizontal stabilizer rear spars with more than 25,000 landings on the effective date of this AD, comply with paragraphs (c) and (d) of this AD within the next 10 landings or 50 hours time in service, whichever occurs first, unless already accomplished.

(b) For all horizontal stabilizer rear spars not covered in paragraph (a) of this AD, comply with paragraphs (c) and (d) of this AD before the accumulation of 20,000 total landings or the lesser of 100 landings or 300 hours time in service after the effective date of this AD, whichever occurs later, unless already accomplished.

(c) Inspect the rear spar of the left and right horizontal stabilizer for cracks and corrosion, and repair or replace as necessary, in accordance with CAA-approved British Aircraft Corporation (BAC) Alert Preliminary Technical Leaflet (PTL) No. 298 Issue 1, dated August 16, 1974, or an FAA-approved equivalent.

(d) Accomplish BAC Modification Leaflet D.3268 or D.3269, or an FAA-approved equivalent of either, as provided in BAC PTL No. 298, Issue 1.

(e) Spar booms on which the corrosion damage exceeds the limits set forth in BAC PTL No. 298, Issue 1, may not be returned to service unless the repair of such damage is approved by the Chief, Aircraft Certification Staff, Europe, Africa, and Middle East Region of the FAA.

(f) The service life limitation of the rear spar assembly of a spar boom modified in accordance with BAC Modification Leaflet D.3268, or an FAA-approved equivalent, is 2000 landings after modification or 30,000 total pre-modification and post modification landings, whichever occurs first.

(g) The service life limitation of the rear spar assembly of a spar boom modified in accordance with BAC Modification Leaflet D.3269, or an FAA-approved equivalent, is 30,000 total pre-modification and post-modification landings.

(h) For the purpose of this AD, the number of landings may be determined by actual count, or, subject to the acceptance of the assigned FAA maintenance inspector, by dividing the horizontal stabilizer spar total time in service by an average flight time determined from the airplane log book to be representative for that airplane. Operators who have not kept records of landings or time in service for individual horizontal stabilizers must substitute total number of airplane landings or time in service in place thereof.

This amendment becomes effective June 6, 1975.

►Footer Information

►Federal Register Information

►Comments

Airworthiness Directives

Header Information

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

Amendment 39-2723; AD 76 – 19 – 01

Airworthiness Directives: BRITISH AIRCRAFT CORPORATION Model 744, 745D and 810 Series Airplanes.

►**Preamble Information**

▼**Regulatory Information**

76–19-01 BRITISH AIRCRAFT CORPORATION: Amendment 39-2723. Applies to **Viscount** Model 744, 745D and 810 Series airplanes, certificated in all categories.

Compliance required as indicated.

To prevent possible failure of the elevator spring servo tab control mechanism, accomplish the following:

(a) Replace the spigot bracket, P/N 70120-367, that attaches the elevator spring tab system bellcrank to the left elevator torque tube with a new bracket of the same part number as follows:

(1) If neither paragraph (b) or (c) of AD 71-4-2 has been complied with prior to the effective date of this AD, replace the bracket within the next 100 hours time in service after the effective date of this AD or prior to the accumulation of 12,000 hours total time in service on the bracket, whichever occurs later.

(2) If Paragraph (b) or (c) of AD 71-4-2 has been complied with prior to the effective date of this AD, replace the bracket at the latest of the following:

(i) Within the next 50 hours time in service after the effective date of this AD.

(ii) Within 1000 hours time in service after complying with AD 71-4-2 if the bracket was not replaced in complying with that AD.

(iii) Prior to the accumulation of 12,000 hours total time in service on the bracket.

(3) After complying with paragraph (a)(1) or (a)(2) of this AD, as appropriate, continue to replace the brackets prior to the accumulation of 12,000 hours total time in service after installation.

(b) Operators who have not kept records of total hours time in service on individual spigot brackets, P/N 70120-367, must substitute in lieu thereof the total hours time in service of the airplane.

This supersedes Amendment 39-1154 (36 FR 2562), AD 71-4-2.

Footer Information

Federal Register Information

Comments

Airworthiness Directives

Header Information

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

Amendment 39-4205; AD 80 – 21 – 51

Airworthiness Directives: BRITISH AEROSPACE **Viscount** Model 744, 745D and 810 Airplanes.

►Preamble Information

▼Regulatory Information

80 – 21 - 51 BRITISH AEROSPACE (FORMERLY VICKERS ARMSTRONG AIRCRAFT LMITED): Amendment 39-4205. Applies to all **Viscount** Model 744, 745D and 810 airplanes certificated in all categories.

Compliance required as indicated, unless already accomplished.

To prevent failure of the elevator control system, accomplish the following:

(a) Before further flight, determine the time in service on spigot fitting P/N 70120-367. Replace each spigot fitting with a serviceable part in accordance with the following schedule, and thereafter continue to replace the spigot fittings at intervals not to exceed 3,000 hours time in service:

(1) If spigot fitting has 12,000 hours or more time in service since new, or the total time in service is unknown, replace before further flight.

(2) If spigot fitting has less than 12,000 but more than 3,000 hours time in service on the effective date of this AD:

(i) Before further flight, unless already accomplished, inspect for cracks using the magnetic flaw detection saturation method and 5X magnification in accordance with item 4 of the British Aerospace Weybridge Bristol Division Campaign Wire REF SS/749/V, dated September 5, 1980, or an FAA-approved equivalent. If any crack or cracks are found, replace spigot fitting before further flight.

(ii) If no cracks are found, replace spigot fitting within 300 hours time in service after the effective date of this AD, or prior to the accumulation of 12,000 hours time in service, whichever occurs first, except as provided in paragraph (a)(4) of this AD.

(3) If spigot fitting has 3,000 hours time in service or less on the effective date of this AD, replace prior to the accumulation of 3,000 hours time in service or within 300 hours time in service, whichever occurs later.

(4) Spigot fittings with more than 3,000 hours time in service on the effective date of this AD must be replace prior to September 15, 1981.

(b) Before further flight, unless already accomplished, inspect the spring servo tab operating mechanism for security by examining the inboard tab on the LH elevator and its attachment to the elevator together with connecting linkage through to "bellcrank" lever, P/N 70133-567, and its associated spigot fitting, P/N 70120-367, on the inner end of the LH elevator torque tube. In addition, the control circuit must be checked from this point through to the adjustment spring located on the inner end of the subject torque tube. If defects are found, repair as necessary and return to service.

(c) When replacing spigot fitting, P/N 70120-367, insure that the twin center bearing assembly in the control lever, P/N 70133-567, is free to move. If defects are found, repair as necessary and return to service.

(d) For **Viscount** Type 810, prior to the accumulation of 10,000 flights or within 50 hours time in service after the effective date of this AD, whichever occurs later, inspect the right and left hand tailplane top root end fittings, P/N's 81018-227 and 81018-228, in accordance with British Aerospace Technique AL/MAT/3713, dated September 26, 1980, or an FAA-approved equivalent. Cracked fittings must be replaced prior to further flight.

(e) If an FAA-approved equivalent is used in complying with this AD, that equivalent must be approved by the Chief, Aircraft Certification Staff, FAA, Europe, Africa and Middle East Office. Report defects found to the Chief, Aircraft Certification Staff, FAA, Europe, Africa and Middle East Office, c/o American Embassy, Brussels, Belgium. Reporting approved by the Office of Management and Budget OMB No. 04/R0174.

The manufacturer's specifications and procedures identified and described in this directive are incorporated herein and made a part hereof pursuant to 5 U.S.C. 552(a)(1). All persons affected by this directive who have not already received these documents from the manufacturer may obtain copies upon request to British Aerospace, Aircraft Group, Weybridge-Briston Division, Brooklands Road, Weybridge, Surrey, England KT13 OSF. These documents may be examined at FAA Headquarters, Room 916, 800 Independence Avenue, SW., Washington, D.C. 20591.

This amendment becomes effective August 27, 1981, as to all persons except those persons to whom it was made immediately effective by telegraphic AD T80-21-51, issued October 2, 1980, which contained this amendment.

►Footer Information

►Federal Register Information

►Comments

Airworthiness Directives

Header Information

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

Docket No. 91-NM-117-AD; Amendment 39-8112; AD 91 – 26 – 01

Airworthiness Directives: BRITISH AEROSPACE **Viscount** Model 744, 745D and 810 Airplanes.

►Preamble Information

▼Regulatory Information

91 – 26 - 01 BRITISH AEROSPACE: Amendment 39-8112. Docket No. 91-NM-117-AD. Applicability: All **Viscount** Model 744, 745D and 810 Series airplanes, certificated in any category.

Compliance: Required as indicated, unless previously accomplished.

To prevent reduced controllability of the airplane, accomplish the following:

(a) Within 180 days after the effective date of this AD, and thereafter at intervals not to exceed 4 years, perform a visual inspection of the elevators to detect corrosion of the mild steel balance weights and of the forward face of the leading edge members in accordance with British Aerospace Preliminary Technical Leaflet (PTL) No. 324 (for **Viscount** Model 744 and 745D Series airplanes), Issue 1, or PTL No. 193 (for **Viscount** Model 810 series airplanes), Issue 1, both dated February 10, 1990, as applicable.

(1) If corrosion is found in the mild steel balance weights, prior to further flight, repair in accordance with the applicable PTL.

(2) If corrosion is found in the forward face of the leading edge members, prior to further flight, repair in accordance with the applicable PTL. If corrosion exceeds the limits specified in the PTL, prior to further flight, replace the members in accordance with the PTL.

(b) An alternative method of compliance or adjustment of the compliance time, which provides an acceptable level of safety, may be used when approved by the Manager, Standardization Branch, ANM-113, FAA, Transport Airplane Directorate.

NOTE: The request should be forwarded through an FAA Principal Maintenance

Inspector, who may concur or comment and then send it to the

Manager,Standardization Branch, ANM-113.

(c) Special flight permits may be issued in accordance with FAR 21.197 and 21.199 to operate airplanes to a base in order to comply with the requirements of this AD.

(d) The inspection and repair requirements shall be done in accordance with British Aerospace Preliminary Technical Leaflet (PTL) No. 324 (for **Viscount** Model 744 and 745D series airplanes) Issue 1, dated February 10, 1990; or PTL No. 193 (for **Viscount** Model 810 series airplanes), Issue 1, dated February 10, 1990; as applicable. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. Copies may be obtained from British Aerospace, PLC, Librarian for Service Bulletins, P.O. Box 17414, Dulles International Airport, Washington, D.C. 20041-0414. Copies may be inspected at the FAA, Transport Airplane Directorate, Renton, Washington; or at the Office of the Federal Register, 1100 L Street N.W., Room 8401, Washington, D.C.

(e) This amendment (39-8112, AD 91-26-01) becomes effective on March 23, 1992.

►Footer Information

►Federal Register Information

►Comments

Airworthiness Directives

▼Header Information

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

Docket No. 92-NM-24-AD; Amendment 39-8288; AD 92 – 14 – 06

Airworthiness Directives: BRITISH AEROSPACE Model **Viscount** 810 Series Airplanes.

►Preamble Information

▼Regulatory Information

92 –14- 06 BRITISH AEROSPACE: Amendment 39-8288. Docket No. 92-NM-24-AD. Applicability: Model **Viscount** 810 series airplanes, certificated in any category.

Compliance required as indicated, unless previously accomplished.

To prevent loss of elevator structural integrity and reduced controllability of the airplane, accomplish the following:

(a) Within 60 days after the effective date of this AD, visually inspect the external surface of the left and right elevator lower skins for skin quilting, corrosion, and delamination, in accordance with British Aerospace **Viscount** Alert Preliminary Technical Leaflet (PTL) 196, dated March 1991.

(b) As a result of the inspection required by paragraph (a) of this AD, accomplish the procedures specified in either paragraph (b)(1) or (b)(2) of this AD, as applicable, in accordance with British Aerospace **Viscount** Alert PTL 196, dated March 1991:

(1) If no discrepancies are detected, apply water displacing fluid and anti-corrosion protective treatment to the inner surfaces of the elevator lower skins, and rebalance the elevators.

(2) If any discrepancies are detected, prior to further flight, replace quilted, corroded, or delaminated skins with a single thickness skin, apply water displacing fluid and anti-corrosion protective treatment to the inner surfaces of the elevator lower skins, and rebalance the elevators.

(c) Repeat the visual inspection of the elevator skins required by paragraph (a) of this AD, and inspect the condition of the corrosion protective treatment inside the elevators, at intervals not to exceed 850 hours time-in-service or 12 months, whichever occurs first. Replace any quilted, corroded, or delaminated skins, and renew any deteriorated corrosion protective treatment, prior to further flight, in accordance with British Aerospace **Viscount** Alert Preliminary Technical Leaflet (PTL) 196, dated March 1991.

(d) An alternative method of compliance or adjustment of the compliance time, which provides an acceptable level of safety, may be used when approved by the Manager, Standardization Branch, ANM-113, FAA, Transport Airplane Directorate. The request shall be forwarded through an FAA Principal Maintenance Inspector, who may concur or comment and then send it to the Manger, Standardization Branch.

NOTE: Information concerning the existence of approved alternative methods of compliance with this airworthiness directive, if any, may be obtained form the Standardization Branch.

(e) Special flight permits may be issued in accordance with FAR 21.197 and 21.199 to operate the airplane to a location where the requirements of this AD can be accomplished.

(f) The inspection and replacement shall be done in accordance with British Aerospace **Viscount** Alert Preliminary Technical Leaflet (PTL) 196, dated March 1991. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552 (a) and 1 CFR Part 51. Copies may be obtained from British Aerospace PLC, Librarian for Service Bulletins, P.O. Box 17414, Dulles International Airport, Washington, D.C. 20041-0414. Copies may be inspected at the FAA, Transport Airplane Directorate, 1601 Lind Avenue SW., Renton, Washington; or at the Office of the Federal Register, 1110 L Street NW., Room 8401, Washington D.C.

(g) This amendment becomes effective on August 20, 1992.

►Footer Information

►Federal Register Information

►Comments

Airworthiness Directives

▾Header Information

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39 [60 FR 37818 No. 141 7/24/95]

Docket No. 94-NM-166-AD; Amendment 39-9311; AD 95- 15- 08

Airworthiness Directives: British Aerospace Model **Viscount** 744, 745D and 810 Airplanes.

►Preamble Information

▾Regulatory Information

95–15-08 BRITISH AEROSPACE REGIONAL AIRCRAFT LIMITED (Formerly British Aerospace Commercial Aircraft Limited, Vickers-Armstrongs Aircraft Limited): Amendment 39-9311. Docket No. 94-NM-166-AD.

Applicability: All Model **Viscount** 744, 745D and 810 airplanes, certificated in any category.

NOTE 1: This AD applies to each airplane identified in the preceding applicability provision, regardless of whether it has been modified, altered, or repaired in the area subject to the requirements of this AD. For airplanes that have been modified, altered, or repaired so that the performance of the requirements of this AD is affected, the owner/operator must use the authority provided in paragraph (b) of this AD to request approval from the FAA. This approval may address either no action, if the current configuration eliminates the unsafe condition; or different actions necessary to address the unsafe condition described in this AD. Such a request should include an assessment of the effect of the changed configuration on the unsafe condition addressed by this AD. In no case does the presence of any modification, alteration, or repair remove any airplane from the applicability of this AD.

Compliance: Required as indicated, unless accomplished previously.

To prevent cracking or corrosion of the main spar forward booms or the upper root joint attachment fitting, which consequently could lead to the failure of the tailplane assemblies and reduce the controllability of the airplane, accomplish the following:

(a) Prior to the accumulation of 8 years since date of manufacture of this airplane, or within 18 months after the effective date of this AD, whichever occurs later, perform an inspection to detect corrosion of the tailplane assemblies, in accordance with British Aerospace Regional Aircraft Limited **Viscount** Alert Preliminary Technical Leaflet (PTL) 182, Issue 2, dated August 7, 1992 (for Model **Viscount** 810 airplanes), or **Viscount** PTL 313, Issue 2, dated February 1, 1993 (for Model **Viscount** 744, 754D, airplanes), as applicable. If corrosion is detected during the inspection, prior to further flight, correct the discrepancies in accordance with the service bulletin. Thereafter, repeat the inspection at intervals not to exceed 8 years.

NOTE 2: The inspection procedures described in **Viscount** Alert PTL's 182 and 313

include correction of any cracking found [ref. Paragraph D.(6) of the PTL's] and

application of corrosion protective treatment [ref. Paragraph E.(3) of the PTL's]

(b) An alternative method of compliance or adjustment of the compliance time that provides an acceptable level of safety may be used if approved by the Manager, Standardization Branch ANM-113, FAA, Transport Airplane Directorate. Operators shall submit their requests through an appropriate FAA Principal Maintenance Inspector, who may add comments and then send it to the Manager, Standardization Branch, ANM-113.

NOTE 3: Information concerning the existence of approved alternative methods of compliance with this AD, if any, may be obtained from the Standardization Branch, ANM-113.

(c) Special flight permits may be issued in accordance with sections 21.197 and 21.199 of the Federal Aviation Regulations (14 CFR 21.197 and 21.199) to operate the airplane to a location where the requirements of this AD can be accomplished.

(d) The inspection shall be done in accordance with British Aerospace Regional Aircraft Limited **Viscount** Alert Preliminary Technical Leaflet (PTL) 182, Issue 2, dated August 7, 1992; or **Viscount** PTL 313, Issue 2, dated February 1, 1993; as applicable. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552 (a) and 1 CFR part 51. Copies may be obtained from British Aerospace Regional Aircraft Ltd., Engineering Support Manager, Military Business Unit, Chadderton Works, Greengate, Middleton, Manchester M24 1SA, England. Copies may be inspected at the FAA, Transport Airplane Directorate, 1601 Lind Avenue, SW., Renton, Washington; or at the Office of the Federal Register, 800 North Capitol Street, NW., Suite 700, Washington, D.C.

(e) The amendment becomes effective on August 23, 1995.

►Footer Information

►Federal Register Information

►Comments

Airworthiness Directives

▼Header Information

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39 (60 FR 48634 No. 182 9/20/95)

Docket No. 94-NM-111-AD; Amendment 39-9373; AD 95 -19 -11

Airworthiness Directives: British Aerospace Model **Viscount** 744, 745D and 810 Airplanes.

►Preamble Information

▼Regulatory Information

95-19-11 BRITISH AEROSPACE REGIONAL AIRCRAFT LIMITED (Formerly British Aerospace Commercial Aircraft Limited, Vickers-Armstrongs Aircraft Limited): Amendment 39-9373. Docket No. 94-NM-111-AD.

Applicability: All Model **Viscount** 744, 745D, and 810 airplanes, certificated in any category.

NOTE 1: This AD applies to each airplane identified in the preceding applicability provision regardless of whether it has been modified, altered or repaired in the area subject to the requirements of this AD. For airplanes that have been modified, altered or repaired so that the performance of the requirements of this AD is affected, the owner/operator must use the authority provided in paragraph (d) of this AD to request approval from the FAA. This approval may address either no action, if the current configuration eliminates the unsafe condition; or different actions necessary to address the unsafe condition described in this AD. Such a request should include an assessment of the effect of the changed configuration on the unsafe condition addressed by this AD. In no case does the presence of any modification, alteration, or repair remove any airplane from the applicability of this AD.

Compliance: Required as indicated, unless accomplished previously.

To prevent structural degradation of the attachment of the horizontal stabilizer to the fuselage, accomplish the following:

(a) For Model **Viscount** 744 and 745D airplanes: Within 3,000 landings or 3 years after the effective date of this AD, whichever occurs first, perform a high frequency eddy current (HFEC) inspection to detect cracking of the bolt holes on the top fittings of the root joint of the tailplane spar, in accordance with British Aerospace Alert Preliminary Technical Leaflet (PTL) 264, Issue 3, dated September 1, 1992. Repeat the inspection thereafter at intervals not to exceed 3,000 landings or 3 years, whichever occurs first.

(b) For Model **Viscount** 810 airplanes: Within 1,000 landings or 1 year after the effective date of this AD, whichever occurs first, perform an HFEC inspection to detect cracking of the bolt holes on the top fittings of the root joint of the tailplane spar, in accordance with British Aerospace Alert PTL 127, Issue 3, dated June 1, 1992. Repeat the inspection thereafter at intervals not to exceed 3,000 landings or 3 years, whichever occurs first.

(c) If any cracking is found during the inspections required by paragraph (a) or (b) of this AD, prior to further flight, replace the cracked fitting with a serviceable part, in accordance with British Aerospace Alert PTL 264, Issue 3, dated September 1, 1992 (for Model 744 and 745D airplanes), or Alert PTL 127, Issue 3, dated June 1, 1992 (for Model 810 airplanes), as applicable.

(d) An alternative method of compliance or adjustment of the compliance time that provides an acceptable level of safety may be used if approved by the Manager, Standardization Branch, ANM-113, FAA, Transport Airplane Directorate. Operators shall submit their requests through an appropriate FAA Principal Maintenance Inspector, who may add comments and then send it to the Manager, Standardization Branch, ANM-113.

NOTE 2: Information concerning the existence of approved alternative methods of compliance with this AD, if any, may be obtained from the Standardization Branch, ANM-113.

(e) Special flight permits may be issued in accordance with section 21.197 and 21.199 of the Federal Aviation Regulations (14 CFR 21.197 and 21.199) to operate the airplane to a location where the requirements of this AD can be accomplished.

(f) The inspection and replacement shall be done in accordance with British Aerospace Alert Preliminary Technical Leaflet (PTL) 264, Issue 3, dated September 1, 1992; or British Aerospace Alert PTL 127, Issue 3, Dated June 1, 1992, as applicable.

This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from British Aerospace Regional Aircraft Ltd., Engineering Support Manager, Military Business Unit, Chadderton Works, Greengate, Middleton, Manchester M24 1SA,England. Copies may be inspected at the FAA, Transport Airplane Directorate, 1601 Lind Avenue, SW., Renton, Washington; or at the Office of the Federal Register, 800 North Capitol Street, NW., Suite 700, Washington, D.C.

(g) This amendment becomes effective on October 20, 1995.

►Footer Information

►Federal Register Information

►Comments

3b.3 Conclusion

Such examples, related to this part of the Viscount which was not recovered from the wreckage, tend to question the statement of the Investigation Committee Accident Report that:

“Failure of the basic airframe Structure contra-indicated”.

This sample has been created to give an idea on how complex was the follow-on of the Viscount technical situation.

The presentation note of the 95-19-11 AD is an example, stating that the 800 series Viscount tailplane spar fittings were “loaded to higher stress levels, which make them more susceptible to fatigue cracking that the fittings of the Model Viscount 744 and 745 D airplanes”.

[Federal Register: May 1, 1995]

DEPARTMENT OF TRANSPORTATION

14 CFR Part 39

[Docket No. 94-MN-111-AD] (AD95-19-11)

Airworthiness Directives; British Aerospace Model Viscount Model 744, 745D and 810 Airplanes.

AGENCY: Federal Aviation Administration, DOT

ACTION: Notice of proposed rulemaking (NPRM)

SUMMARY*:* This document proposes the adoption of a new airworthiness directive (AD) that is applicable to all British Aerospace Model Viscount Model 744, 745D and 810 airplanes. This proposal would require inspections to detect cracking of certain fittings of the tailplane spar, and replacement of the fittings with serviceable parts, if necessary. This proposal is promoted by reports of fatigue cracking of certain fittings in the tailplane spar. The actions specified by the proposed AD are intended to prevent such cracking, which could result in structural degradation of the attachment of the horizontal stabilizer to the fuselage.

DATES*:* Comments must be received by June 12, 1995

ADDRESSES*:* Submit comments in triplicate to the Federal Aviation Administration (FAA), Transport Airplane Directorate, AM-103, Attention: Rules Docket No. 94-NM-111-AD, 1601 Lind Avenue, SW., Renton, Washington 98055-4056. Comments may be inspected at this location between 9:00am and 3:00pm, Monday through Friday, except Federal holidays.

The service information referenced in the proposed rule may be obtained from British Aerospace Regional Aircraft Ltd., Engineering Support Manager, Military Business Unit, Chadderton Works, Greengate, Middleton, Manchester M24 1SA, England. This information may be examined at the FAA, Transport Airplane Directorate, 1601 Lind Avenue, SW., Renton Washington.

For Further Information Contact:

William Schroeder, Aerospace Engineer, Standardization Branch, ANM-113, FAA, Transport Airplane Directorate, 1601 Lind Avenue, SW., Renton, Washington 98055-4056; telephone:- (206) 227-2148; fax:- (206) 227-1320.

SUPPLEMENTARY INFORMATION*:*

Comments Invited

Interested persons are invited to participate in the making of the proposed rule by submitting such written data, views, or arguments, as they may desire. Communications shall identify the Rules Docket number and be submitted in triplicate to the address specified above.

All communications received on or before the closing date for comments, specified above, will be considered before taking action on the proposed rule. The proposals contained in this notice may be changed in light of the comments received.

Comments are specifically invited on the overall regulatory, economic, environmental, and energy aspects of the proposed rule. All comments submitted will be available, both before and after the closing date for comments, in the Rules Docket for examination by interested persons. A report summarising each FAA-public contact concerned with the substance of this proposal will be filed in the Rules Docket.

Commenters wishing the FAA to acknowledge receipt of their comments submitted in response to this notice must submit a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket Number 94-NM-111-AD". The postcard will be date stamped and returned to the commenter.

AVAILABILITY OF NPRMs*:*

Any person may obtain a copy of this NPRM by submitting a request to the FAA, Transport Airplane Directorate, ANM-103, Attention: Rules Docket No. 94-NM-111-AD, 1601 Lind Avenue, SW., Renton, Washington 98055-4056. [Page 21057].

DISCUSSION:

The Civil Aviation Authority (CAA), which is the airworthiness authority for the United Kingdom, recently notified the FAA that an unsafe condition may exist on all British Aerospace Model Viscount Model 744, 745D and 810 airplanes. The CAA advises that it has received reports of fatigue cracking of certain attach fittings of the tailplane spar on these airplanes. The cracking was found in the top fitting of the tailplane spar at the junction of the chamfer and the innermost hole of the bolt group through the top flange. Such fatigue cracking, if not detected and corrected in a timely manner, could result in structural degradation of the attachment of the horizontal stabilizer to the fuselage.

British Aerospace has issued Alert Preliminary Technical Leaflet (PTL) 264, Issue 3, dated September 1, 1992 (for Model Viscount 744, and 745D airplanes), and Alert PTL 127, Issue 3, dated June 1, 1992 (for Model Viscount 810 airplanes).

These Alert PTL's describe procedures for performing repetitive high frequency eddy current (HFEC) inspections to detect cracking of the bolt holes on the top fittings of the tailplane spar, and replacement of cracked fittings with serviceable parts.

The CAA classified these Alert PTL's as mandatory in order to assure the continued airworthiness of these airplanes in the United Kingdom.

These airplane models are manufactured in the United Kingdom and are type certificated for operation in the United States under the provisions of Sec. 21.29 of the Federal Aviation Regulations (14 CFR 21.29) and the applicable bilateral airworthiness agreement. Pursuant to this bilateral airworthiness agreement, the CAA has kept the FAA informed of the situation described above.

The FAA has examined the findings of the CAA, reviewed all available information, and determined that AD action is necessary for products of this type design that are certificated for operation in the United States.

Since an unsafe condition has been identified that is likely to exist or develop on other airplanes of the same type design registered in the United States, the proposed AD would require repetitive HFEC inspections to detect cracking of certain fittings of the tailplane spar, and replacement of the fittings with serviceable parts, if necessary. The actions would be required to be accomplished in accordance with the Alert PTL's described previously.

Operators should note that the proposed compliance time for the initial inspection of the fittings on Model Viscount 810 airplanes is shorter than that proposed for the Model Viscount 744 and 745D airplanes because the fittings on Model Viscount 810 airplanes are of a different configuration. The fittings on Model Viscount 810 airplanes are loaded to higher stress levels, which makes them more susceptible to fatigue cracking than the fittings on the Model Viscount 744 and 745D airplanes.

As a result of recent communications with the Air Transport Association (ATA) of America, the FAA has learned that, in general, some operators may misunderstand the legal effect of AD's on airplanes that are identified in the applicability provision of the AD, but that have been altered or repaired in the area addressed by the AD. The FAA points out that all airplanes identified in the applicability provision of an AD are legally subject to the AD. If an airplane has been altered or repaired in the affected area in such a way as to affect compliance with the AD, the owner or operator is required to obtain FAA approval for an alternative method of compliance with the AD, in accordance with the paragraph of each AD that provides for such approvals. A note has been included in this notice to clarify this long-standing requirement.

The FAA estimates that 29 airplanes of U.S. registry would be affected by this proposed AD, that it would take approximately 4 work hours per airplane to accomplish the proposed actions, and that the average labor rate is $60 per work hour. Based on these figures, the total cost impact of the proposed AD on U.S. operators in estimated to be $6,960, or $240 per airplane.

The total cost impact figure discussed above is based on assumptions that no operator has yet accomplished any of the proposed requirements of this AD action, and that no operator would accomplish those actions in the future if this AD were not adopted.

The regulations proposed herein would not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this proposal would not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

For the reasons discussed above, I certify that this proposed regulation (1) is not a "significant regulatory action " under Executive Order 12866; (2) is not a "significant rule" under the DOT Regulatory Policies and Procedures (44 FR 11034, February 26, 1979); and (3) if promulgated, will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act. A copy of the draft regulatory evaluation prepared for this action is contained in the Rules Docket. A copy of it may be obtained by contacting the Rules Docket at the location provided under the caption ADDRESSES.

List of Subjects in 14 CFR Part 39

Air transportation, Aircraft, Aviation safety, Safety

The Proposed Amendment

Accordingly, pursuant to the authority delegated to me by the Administrator, the Federal Aviation Administration proposes to amend part 39 of the Federal Aviation Regulations (14 CFR part 39) as follows:

PART 39 – AIRWORTHINESS DIRECTIVES

1. The authority citation for part 39 continues to read as follows:

Authority: 49 U.S.C. App. 1354(a), 1421 and 1423; 49 U.S.C. 106(g); and 14 CFR 11.89.

Sec. 39.13 [Amended]

2. Section 39.13 is amended by adding the following new airworthiness directive:

British Aerospace Regional Aircraft Limited (Formerly British Aerospace Commercial Aircraft Limited, Vickers-Armstrongs Aircraft Limited); Docket 94-M-111.AD

Applicability: All Model Viscount 744, 745D and 810 airplanes certificated in any category.

Note1: This AD applies to each airplane identified in the preceding applicability provision, regardless of whether it has been modified, altered, or repaired in the area subject to the requirements of this AD. For airplanes that have been modified, altered, or repaired so that the performance of the requirements of this AD is affected, the owner/operator must use the authority provided in paragraph (d) to request approval from the FAA.

This approval may address either no action, if the current configuration eliminates the unsafe condition; or different actions necessary to address the unsafe condition described in this AD. Such a request should include an assessment of the effect of the changed configuration on the unsafe condition addressed by this AD. In no case does the presence of any modification, alteration, or repair remove any airplane form the applicability of this AD.

Compliance: Required as indicated, unless accomplished previously. (Page 21058).

To prevent structural degradation of the attachment of the horizontal stabilizer to the fuselage, accomplish the following:

(a) For Model Viscount 744 and 745D airplanes: Within 3,000 landings or 3 years after the effective date of this AD, whichever occurs first, perform a high frequency eddy current (HFEC) inspection to detect cracking of the bolt holes on the top fittings of the root joint of the tailplane spar, in accordance with British Aerospace Alert Preliminary Technical Leaflet (PTL) 264, Issue 3, dated September 1, 1992. Repeat the inspection thereafter at intervals not to exceed 3,000 landings or 3 years, whichever occurs first.

(b) For Model Viscount 810 airplanes: Within 1,000 landings or 1 year after the effective date of this AD, whichever occurs first, perform an HFEC inspection to detect cracking of the bolt holes on the top fittings of the root joint of the tailplane spar, in accordance with British Aerospace Alert PTL 127, Issue 3, dated June 1, 1992. Repeat the inspection thereafter at intervals not to exceed 3,000 landings or 3 years, whichever occurs first.

(c) If any cracking is found during the inspections required by paragraph (a) or (b) of this AD, prior to further flight, replace the cracked fitting with a serviceable part, in accordance with British Aerospace Alert PTL 264, Issue 3, Dated September 1, 1992 (for Model 744 and 745D airplanes), or Alert PTL 127, Issue 3, dated June 1, 1992 (for Model 810 airplanes); as applicable.

(d) An alternative method of compliance or adjustment of the compliance time that provides an acceptable level of safety may be used if approved by the Manager, Standardization Branch, ANM-113, FAA, Transport Airplane Directorate. Operators shall submit their requests through an appropriate FAA Principal Maintenance Inspector, who may add comments and then send it to the Manager, Standardisation Branch, ANM-113.

Note 2: Information concerning the existence of approved alternative methods of compliance with this AD, if any, may be obtained from the Standardisation Branch, ANM-113.

(e) Special flight permits may be issued in accordance with Secs. 21.197 and 21.199 of the Federal Aviation Regulations (14 CFR 21.197 and 21.199) to operate the airplane to a location where the requirements of this AD can be accomplished.

Issued in Renton, Washington, on April 25, 1995

James V. Devany,

Acting Manager, Transport Airplane Directorate,

Aircraft Certification Service.

[FR Doc. 95-10587 Filed 4-28-95; 8:45am]

BILLING CODE 4910-13-U

APPENDIX 3C: DETAILED COMPARISON AOF-AOM

(Contents page)

APPENDIX 3C: DETAILED COMPARISON AOF-AOM

1. IDENTIFICATION OF SIMILARITIES BETWEEN AOF AND AOM DURING THE PERIOD OF DISABLED FLIGHT

1.1 With Respect To Engines

1.1.1 AOF: chronologically

- Loud but engines sounded normal
- Sound of engine power going on and off erratically
- Pushing black smoke as the engines revved up
- Some propellers stopped: two of the propellers were stopped, or turning very slowly
- The loud noise of engines
- All propellers were rotating
- Occasional bursts of power

1.1.2 AOM: chronologically

- A single loud sound
- (Nr 3 engine) propeller was bent in towards the plane (feathered or coarse pitch)
- It was bent towards the place
- I did not notice anything wrong with the propellers
- The sound of the engines was peculiar: they seemed to be labouring
- ……making a funny noise
- ……pulling hard and making a dreadful noise
- ……heard a heavy sound getting louder and louder
- Its sound was enormous: no variations in its continuous sound, all propellers rotating……
- ……heard a noise……saw 3 small black clouds. I did not notice a particular alteration in the noise

- ……it was funny noise……very loud, rough and like the noise of a Hoover finishing up…… it was making a particular noise, like if it had a motor bike inside
- ……the plane sounded normal
- ……the noise of this plane appeared to be normal
- ……the noise cut out, suddenly……so fast that I didn't think it was distance away from caused it
- ……I could not give my opinion as to the noise of it
- ……I heard a loud bang, like an explosion blowing up a quarry. It died away like thunder
- ……I heard a very very heavy noise
- ……I heard an unusual sound
- ……I heard noise like thunder
- ……I heard a heavy noise like thunder
- ……I heard a noise like thunder but short, rather like a tyre burst
- ……I heard a heavy bang like thunder, short and sharp like a tyre burst, but heavier

1.1.3 Comments

Similar Sequence

- Engines sounding normal
- Propeller(s) feathered, then unfeathered
- Louder and louder noise
- Occasional bursts of power (AOF), with small black clouds (AOM)

but AOF does not present any separation in flight, and the noise emitted by the crash has not been observed since the observers concentrated their attention on the aircraft crashing.

1.2 WITH RESPECT TO AIRCRAFT ATTITUDE

1.2.1 AOF: Chronologically

- Very low
- Flying just below the cloud-base

Inspector's Comments

The Viscount was sufficiently under control to be climbed again at least to an altitude at which it would not arouse particular attention on the ground (from 7.10 to 7.27)

- Flying close overhead and circling
- Flying erratically ("fluttering")
- Flying so low that it very nearly hit roofs….

Inspectors Comments

The pilot, whilst trying to maintain visual contact with the ground, was forced to re-enter cloud to avoid the possibility of collision with ground objects.

Flying very low….going in and out of cloud

Approaching very low…as if to land, then power was applied, and it climbed away, turning right all the time

A right hand turn was made

Still very low over the ground, but not at all times beneath the very low cloud base prevailing

The ground track appears to have been erratic and to have included a change of direction (on the right)

The aircraft was descending…the left wing was "drooping" (left bank in an intended turn?)… it was "zig-zagging"

…" drop down vertically in what "(could have been an incipient spin)

1.2.2 AOM: chronologically

- ……I saw an aircraft flying very low……it was circling round……it did this about twice
- ……It appeared to be weaving or going in a zig-zag manner
- ……at low altitude, slightly climbing, steadily……

- ……turning left, quite fast and descending……it was descending, unsteady in roll, down to a height so low that the grass was bent by the air flow
- ……steep turn on the right,……climbing steady
- ……it dived suddenly……very steep by the right
- ……the plane seemed well under control
- ……climbing slowly steadily……
- ……seemed to me to be unsteady and apparently descending……
- ……what drew my attention was the abrupt change of course……it turned to the right with a very sharp angle of bank
- ……it was turning back to the right……

1.2.3 Comments

- both aircraft are unsteady when descending or levelled at very low altitude, zig-zagging or steep right turning
- more steady when climbing, but difficult to observe for AOF since the low altitude of the clouds basis
- both aircraft gave the impression "as if to land", without success

1.3 TRACKS RECONSTRUCTION

Both "disabled flights" present similar characteristics:

- Similar duration
- Same lateral instability, in particular steep right turns
- Same longitudinal instability, pitch down tendency possibility countered by increased engine power

2. CONSEQUENCES ON EVIDENCES AND PROBABILITES

The identification of similarities between AOF and AOM during the period of disabled flight may give further light on the technical evidence and the probabilities stated in the 1968 final report of AOF accident.

2.1 ENGINES

2.1.1 AOF

- Engines revving up and down
- Unusual engine noises
- Occasional bursts of power
- Two propellers stopped, or turning very slowly, being observed during the "disabled flight"
- None of the 4 propellers feathered at the time of impact

Wreckage Examination: "Report on the condition of the engines" (R-R)

- The oil filters were free from any metallic deposits, but they had been contaminated with white sludge deposits (id for 3 of the engines, the Nr 4 engine being not contaminated)
- Samples of the sludge found in the oil filters have been laboratory examined, and the chemical analysis was found to be:-
  - 2% oil
  - 28% magnesium corrosion products
  - the majority of the remainder being sodium, carbonate and water
- It is considered (by R-R) that the oil system contaminated was undoubtedly caused after impact, primarily during the fire fighting operations. In any case, the engines could not possibly have operated for the time that this aircraft had been airborne, with an oil system contaminated in this way, without showing considerable distress if not complete failure of all main line bearings.
- No comment has been introduced in the R-R report about the FCUs.

2.1.2 AOM

- Engines labouring
- (Nr 3 engine) propeller bent towards the plane
- Unusual engine noises
- Small black clouds

- Non of the 4 propeller feathered at the time of impact

- All engines were lit at the time of impact

Wreckage Examination – Appendix 4b Part 1 (R-R)

- The LP fuel filter contained a white gelatinous substance (engine Nr 1, Nr 2, Nr 3)

- The results of the analysis of this substance if an analysis has been made, are not available

- The technical advice about the presence of this gelatinous substance is not available

- No FCU was recovered

2.1.3 Comments

- The observations reported by the witnesses, with respect to feathering/unfeathering, sounding, crash conditions are identical

- The wreckage examination, by R-R, concluded in both cases for normal operating conditions of the engines, at the time of the impact. However, it may be observed that:-

    - No comments on the FCU functioning have been made

    - A white gelatinous substance was observed on the oil filters of AOF, and found (and possible analysed, but not referred to in the report) in the fuel filters of AOM

2.2 AIRFRAME

Most of the conclusions reached by the investigation of the airframe wreckage relate to "no evidence", which does not mean that there is evidence of the opposite.

In particular, in 1968, the problems relating to the spigot of the tabs had not arisen. So the substantiation of no control surface malfunction or no overstressing in flight is to be re-assessed.

It may be of interest to observe that AOF crashed 27mn after the initial event, after the same time flown by AOM when it lost its elevator. It is possible that a single experienced pilot fighting for 27mn to keep its aircraft airborne be more tired that the 2 crew of EI-AOM, and gave up to crash.

The statement that the "radio-telephony" (was) capable of being used is not evidenced in the report: the substantiation of this statement is also, today, of interest.

With reference to 2.1.8: Summary of Probabilities (on the case of AOF)

2.1.8.2: Engine or Propeller Trouble

2.1.8.4: Inadvertent Spin

The statement that "automatic feathering (with consequent stopping of engine and propeller) could have occurred during the practising of recovery from stalls, as happened in the incident of 12 June……" is supporting the assumption given as contributing factor of the first loss of control of EI-AOM: both events presented a period of negative accelerations, which could explain the conditions of the initial dive, the necessity of a recovery manoeuvre which may result in an overstress of some flight control surfaces and associated components (transmission, spigot……).

With respect to argument that Captain O'Keefe did not warn the ATC, the experience of AOM is of interest: there were to skilled pilots in AOM, and the first (and single) distress message was received 13 to 15mn after the initial loss of control.

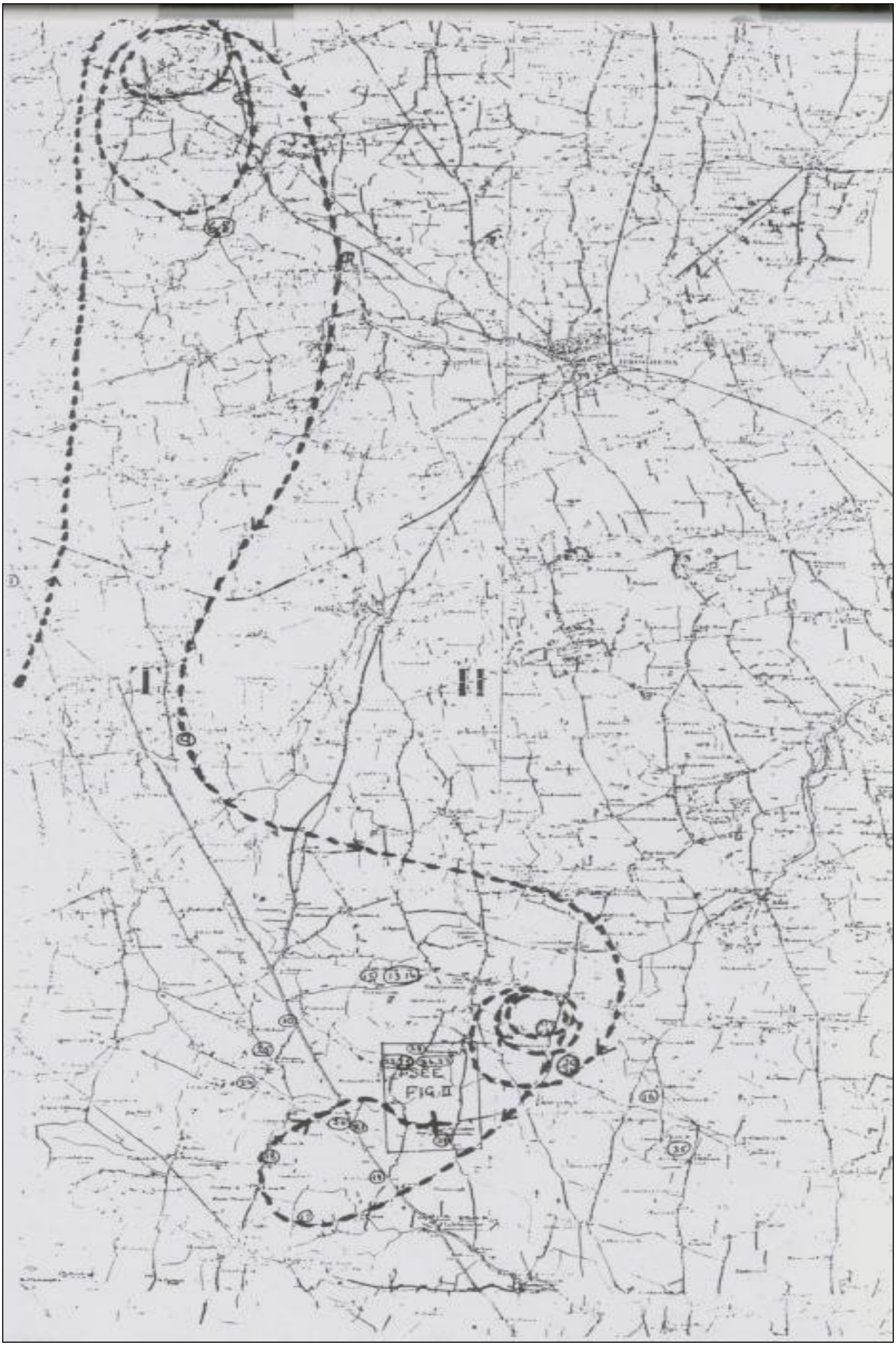
In the case of AOF, the Captain was the only one skilled pilot on board, having to counter the high level forces as in the AOM on the stick. In addition, the evidence that the R/T transceivers were operative after the dive is not today available.

3. CONCLUSIONS

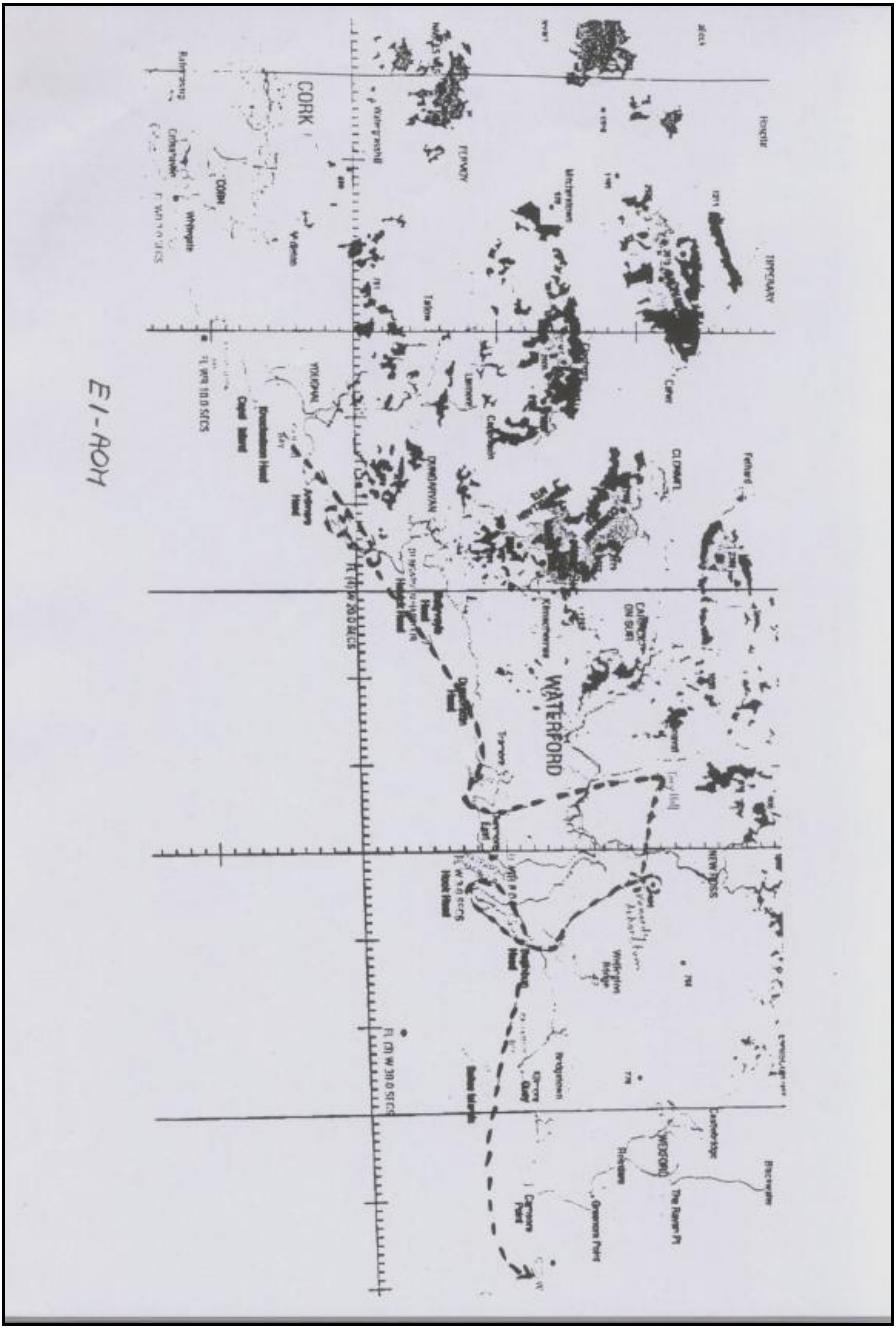
In 1968, the similarities between the periods of the disabled flight of EI-AOF and EI-AOM could not be identified, since the track reconstruction of EI-AOM was based on inadequate information.

The technical investigations performed by the manufacturers did not include, generally, in "evidences" but in "no evidences", since, in particular, they could not focus on those "weak points" which were identified later on.

As a consequence, the conclusions of the 1968 AOF accident report should have to be re-assessed, taking advantage of the lessons learned at the occasion of the other accidents occurred later on, in particular the one occurred to EI-AOM, its "sister-ship" in terms of design status and maintenance methods.



EI-AOF



EI-AOM

APPENDICES 4

4a: The Viscount Aircraft

4b: Flight Controls

4c: Metal Fatigue

4d: Flutter

Appendix 4a THE VISCOUNT AIRCRAFT

4a.1 General View

4a.2 View “General Arrangement

4a.3 Leadings Particulars

4a.4 Tail Related Views

4a.5 DART Engine Views

Appendix 4a

The Viscount Aircraft

The Viscount designed and manufactured by VICKERS ARMSTRONGS Ltd., is a pressurised passenger carrying aircraft powered by four propeller turbine engines.

The Viscount 630 prototype first flew in July 1948 whilst the prototype of the first 700 series, a slightly larger and more powerful aircraft, flew in August 1952. This was followed by a stretched higher weight model, the 800 series. All together, 445 Viscounts were built. The Viscount Type Certificate was finally withdrawn in July 2000.

The Viscount was certified to the British Civil Airworthiness Requirements (BCAR) Section D issues 2 and 3 effective 1 January 1951. It was subsequently certificated by the United States Department of Transportation Federal Administration Aviation under CAR 10 on the basis of a United Kingdom Certificate of Airworthiness issued for each aircraft. This recognised the UK certification basis as being equivalent to CAR 4b effective May 18, 1954. There were three basic variants:

(i) 700 Series

(ii) 800 Series

(iii) 810 Series

The 700 Series Viscount was powered by four Rolls-Royce R.Da.3 Mk 506 and later by R.Da.6 MK 510 engines; all 700's fitted with this latter engine being known as 700 D's.

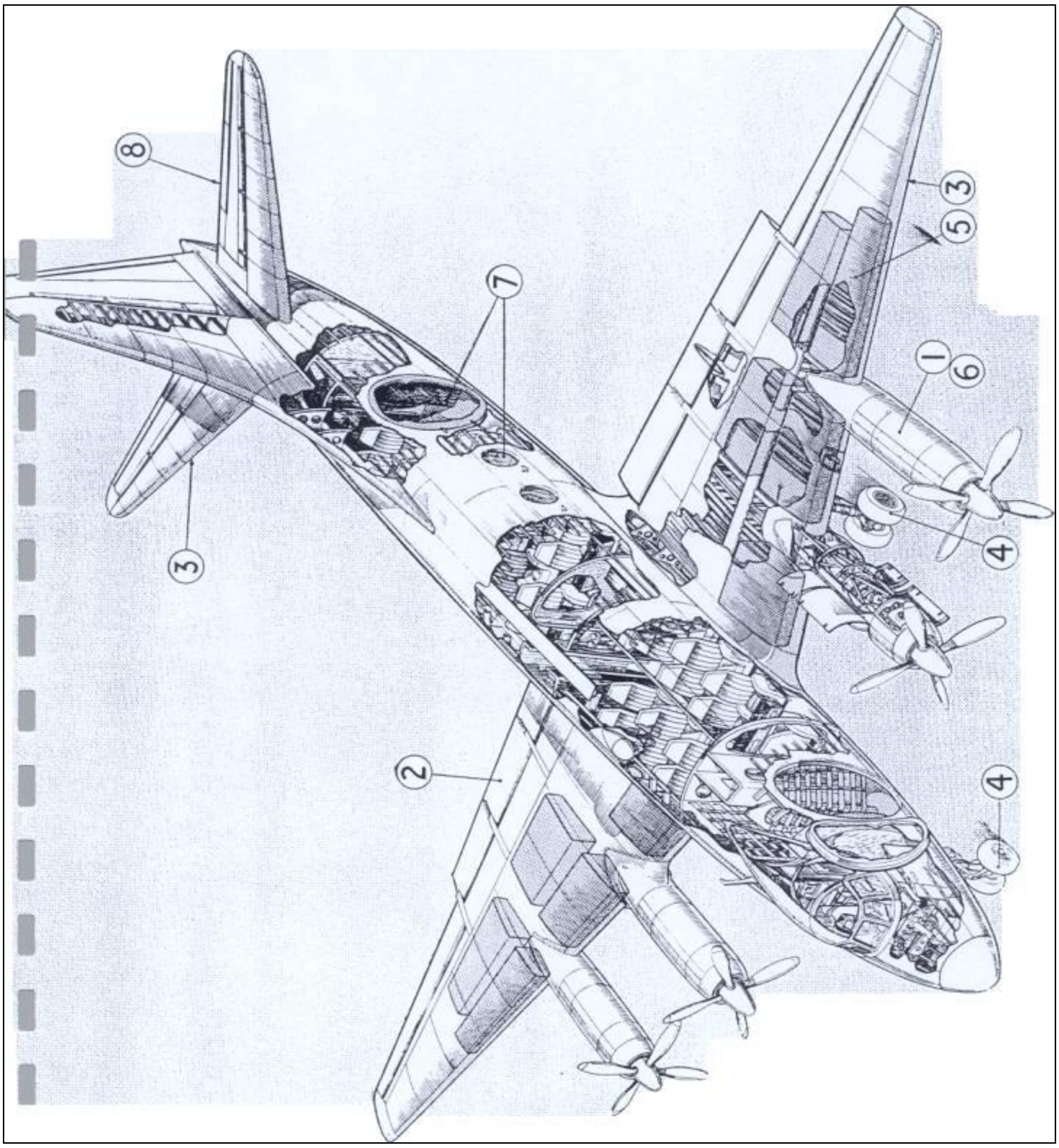
The Type 745 was the first to have the Mk 50 engines and offered improvements in operating weights, range and speed. Extensive modifications were carried out to the wing spars to increase their life, particularly necessary for operation over short range route networks. These included a significant increase in bottom spar boom area and a change in its material from DTD 363A to L65. The 745 had a maximum take-off weight of 64,500lb and a landing weight of 57,500lb.

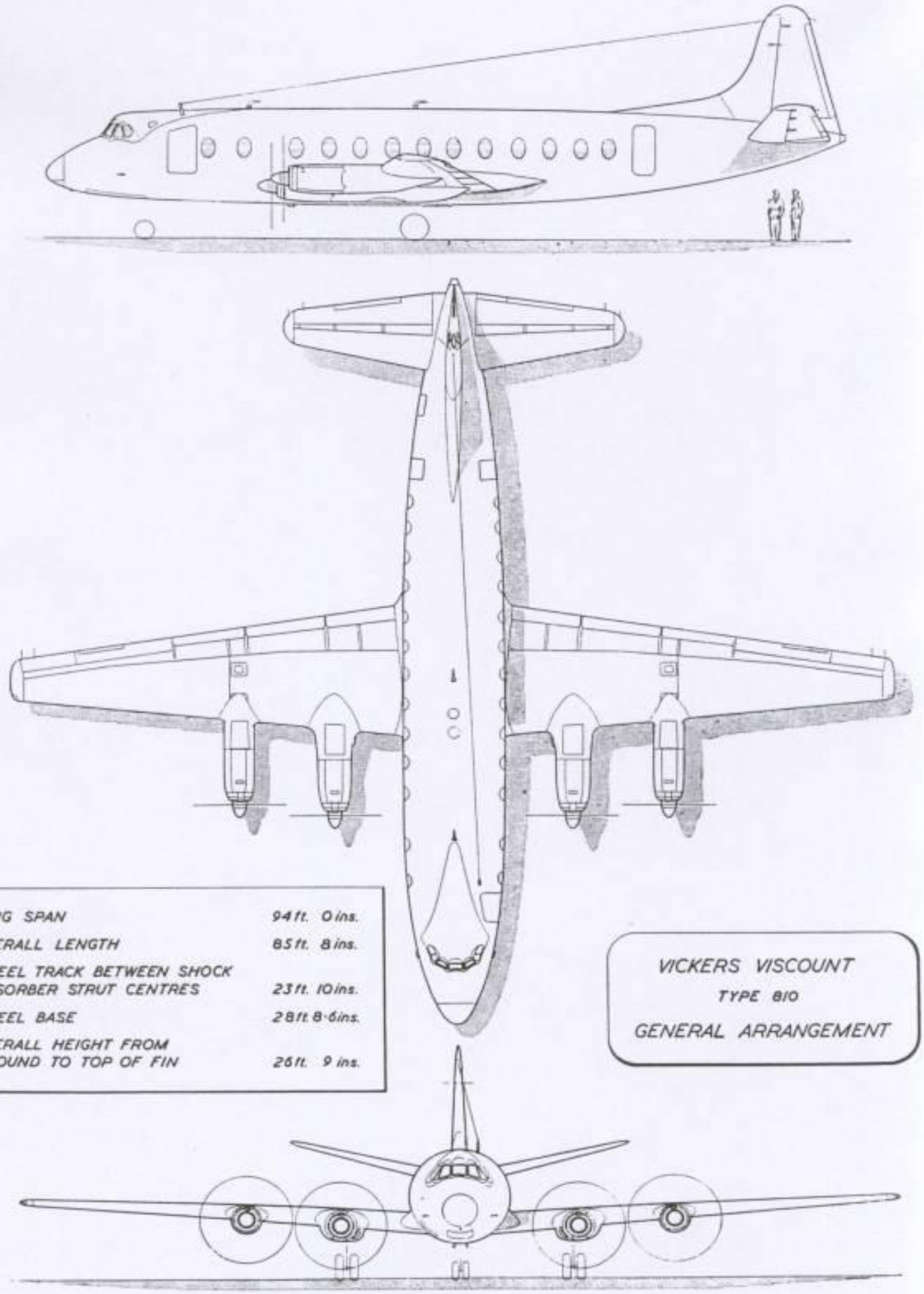
The higher all-round power of the R.Da.6 justified a stretched Viscount resulting in the 800 Series. The overall length of the fuselage was increased by 46.0in giving a 15% increase in capacity. The wing structure was similar to that of the 745. The maximum landing weight increased to 59,500lb. The tail planes and elevators were to significantly changed through the various models.

The two-turbined Dart engine had reached its limit in R.Da.6. An additional turbine stage was introduced which resulted in improved performance and this engine was termed the R.Da.7. A derated (Mk 520) version was first used on the Viscount 806 but these were later replaced by the Mk510 engines. The Viscount 810 Series used the R.Da.7 Mk 525 and Mk 530. The 810 Series wing structure was improved in relation to the 800 Series with a further increase in the take-off and landing weights to 72,500 lb and 64,000 lb respectively.

Aer Lingus EI-AOM was an 800 Series aircraft carrying the designation of Model 803 and Serial Number 178.

Aircraft details are to be found in the 1970 report.





WING SPAN	94 ft. 0 ins.
OVERALL LENGTH	85 ft. 8 ins.
WHEEL TRACK BETWEEN SHOCK ABSORBER STRUT CENTRES	23 ft. 10 ins.
WHEEL BASE	28 ft. 8·6 ins.
OVERALL HEIGHT FROM GROUND TO TOP OF FIN	26 ft. 9 ins.

VICKERS VISCOUNT
TYPE 810
GENERAL ARRANGEMENT

FIG. 1. 3-VIEW GENERAL ARRANGEMENT

432

403

Leading Particulars

Dimensions

Span	94 ft. 0 in. (28.65 *m.*)
Length	81 ft. 2 in. (24.73 *m.*)
Height	26 ft. 9 in. (8.16 *m.*)

Weights

Maximum take-off weight	48,000 lb. (21,772 *kg.*)
Maximum landing weight	45,500 lb. (20,639 *kg.*)

Fuselage

Overall length (*external*)	81 ft. 2 in. (24.73 *m.*)
Maximum width (*saloon*)	10 ft. 0 in. (3.05 *m.*)
Maximum height (*saloon*)	6 ft. 4 in. (1.93 *m.*)
Entrance doors—width	4 ft. 7 in. (1.4 *m.*)
height, front	5 ft. 2 in. (1.57 *m.*)
rear	5 ft. 6 in. (1.67 *m.*)

Main Plane

Aerofoil section	Modified N.A.C.A. 63
Root chord	178 in. (4.54 *m.*)
Tip cord	53.1 in. (1.35 *m.*)
Incidence (*average*)	2° 30'
Dihedral	4° 30'
Gross area, including ailerons	963 sq. ft. (89.4 *m²*)
Nett area, " "	844 sq. ft. (78.2 *m²*)
Aileron chord	26.5 in. (0.67 *m.*)
Aileron area, including trim tabs (*total*)	71.8 sq. ft. (6.67 *m²*)
Flap chord	27% of local wing chord
Flap area (*total*)	156 sq. ft. (14.43 *m²*)
Wing loading at max. take-off weight	49.8 lb./sq. ft. (238 kg./*m²*)
Wing loading at max. landing weight	47.2 lb./sq. ft. (230 kg./*m²*)

Landing Gear

Type	Twin wheel tricycle, forward - retracting with steerable nose-wheels.
Disposition	Main unit at each inner nacelle and nose wheel unit forward.
Shock absorbers	Vickers oleo pneumatic.
Travel	10 in. (254 *mm.*)
Retraction	Electrical, single jack per unit.
Brakes	Pneumatic, duplicate operation.

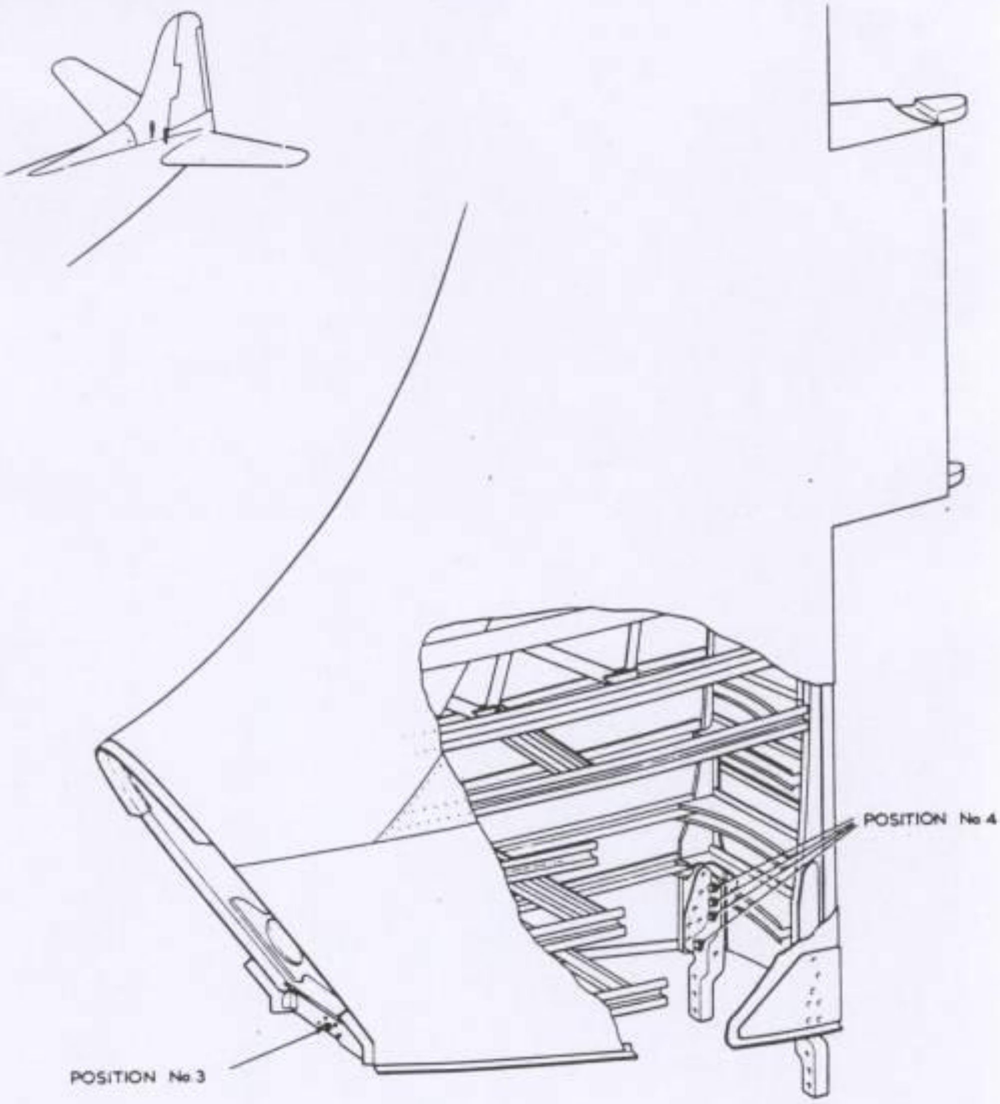
Tail Unit

Tail plane and elevator	
Root chord	103.4 in. (2.63 *m.*)
Tip chord	41.4 in. (1.05 *m.*)
Incidence (*average*)	1° 30'
Dihedral	15°
Elevator maximum chord	56.2 in. (1.43 *m.*)
Tail plane and elevators total gross area	238 sq. ft. (22.1 *m²*)
Tail plane and elevators total nett area	203 sq. ft. (18.9 *m²*)
Elevator area, total, including trim tabs	104 sq. ft. (9.67 *m²*)
Fin area	66 sq. ft. (6.13 *m²*)
Rudder area	62 sq. ft. (5.75 *m²*)

Power Plants

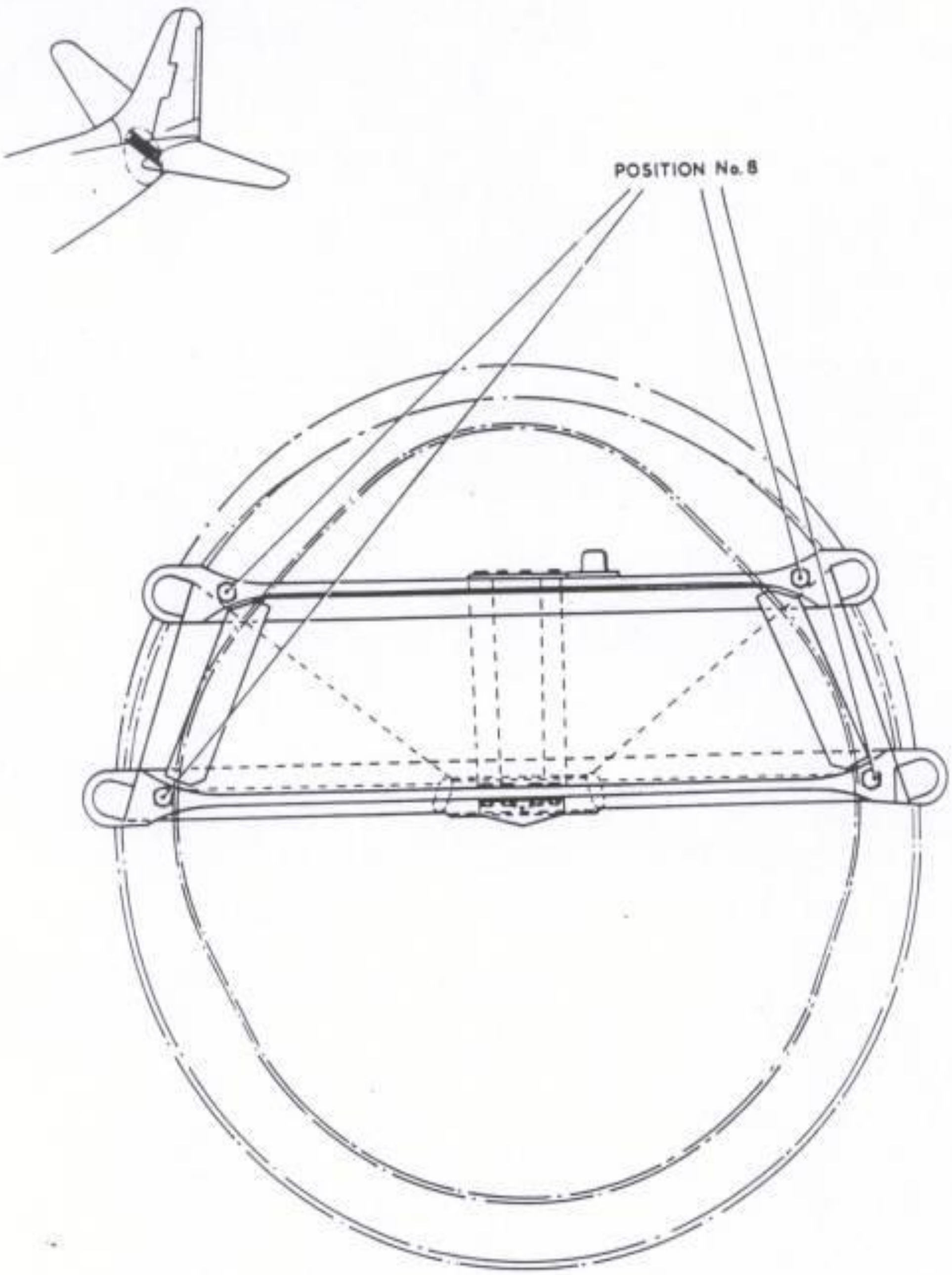
Engines	Four Rolls-Royce Darts, RDa3.
Propellers	Rotol, 4-bladed, fully feathering constant speed.
Diameter	10 ft. (3.05 *m.*)
Power	1,400 s.h.p. each, plus 255 lb. (115.8 *kg.*) thrust.
Fuel tank capacity	1,400 Imp. gals (1,680 *U.S. gals.*) (6,360 *litres*)
Oil capacity (*including feathering reserve*)—	
Each engine	4.69 Imp. gals. (5.6 *U.S. gals.*) (21.3 *litres*).
Total	18.75 Imp. gals (22.5 *U.S. gals.*) (85.3 *litres*).

Two Pictures of the Viscount Tail



424 - FIG 1

Fig. 1: Fin Leading Edge to Fuselage (Station 871)

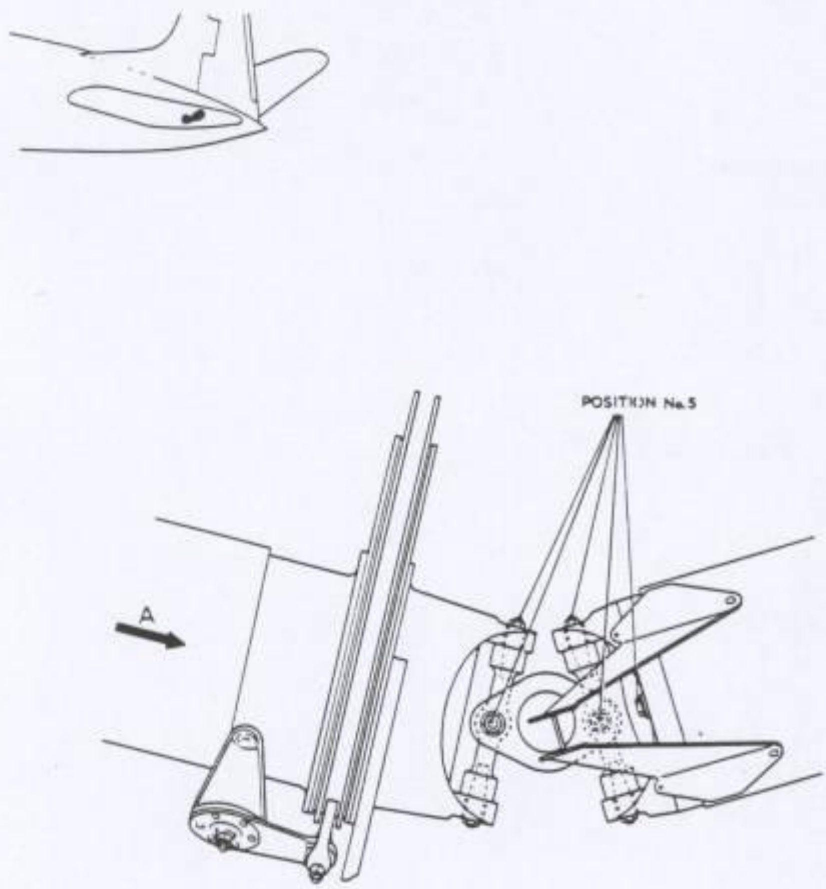


424 - FIG 2

FEB. 11/72

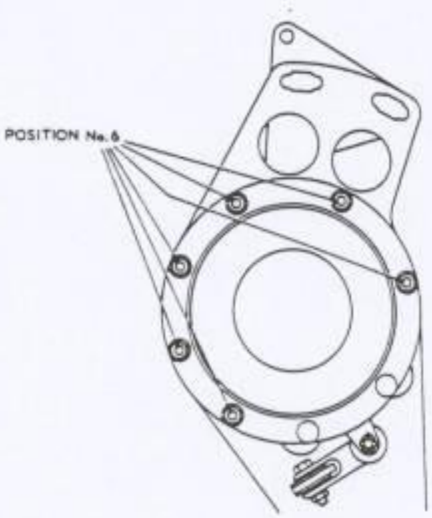
Fig. 2: Tail Centre Section Spar to Fuselage (Station 934)

Viscount 800/810 Series Aircraft Manual



424 - FIG 3

Fig. 3: Elevator Torque Tube to Gimbles (Tailcone)

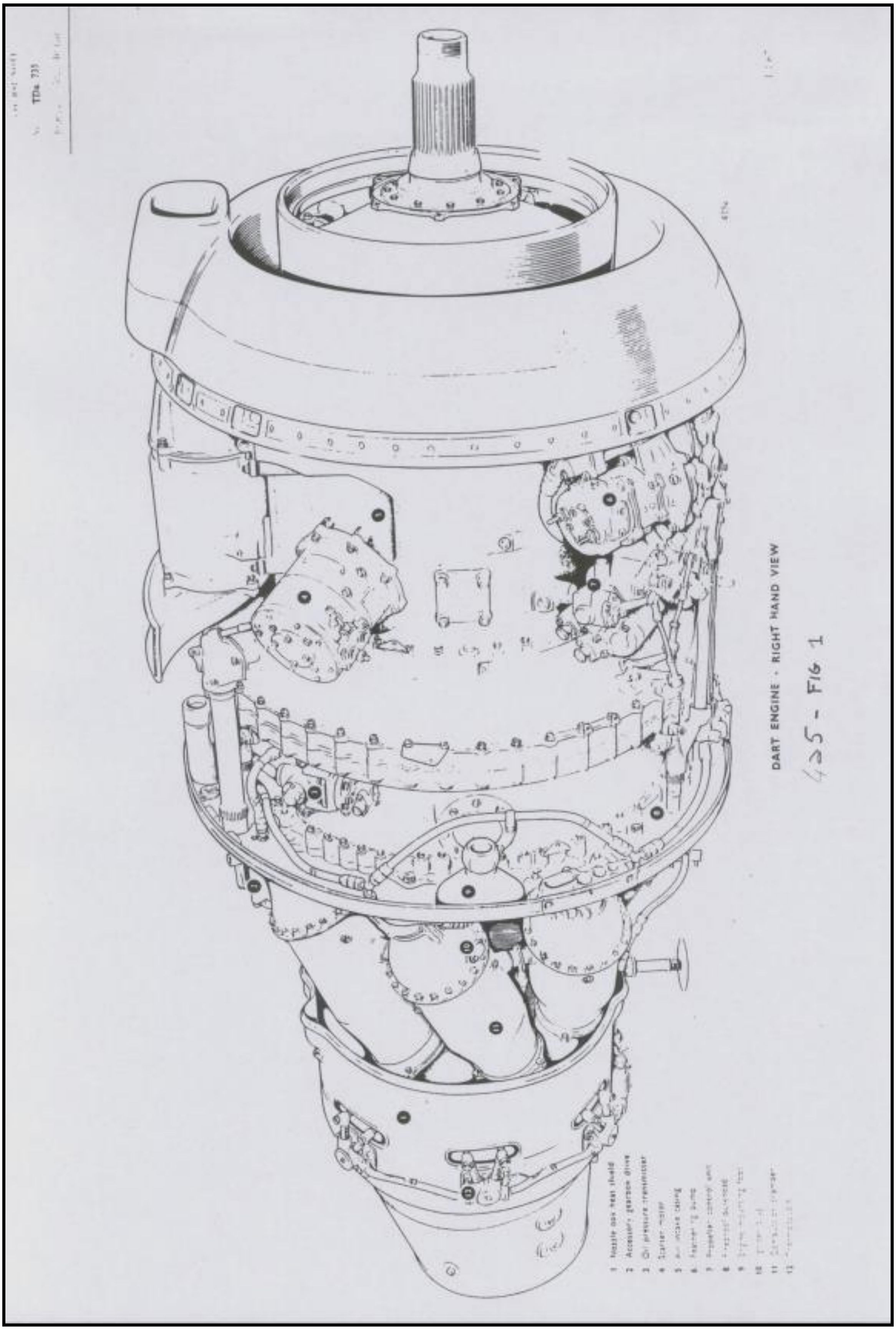


4.a.4 – FIG 4

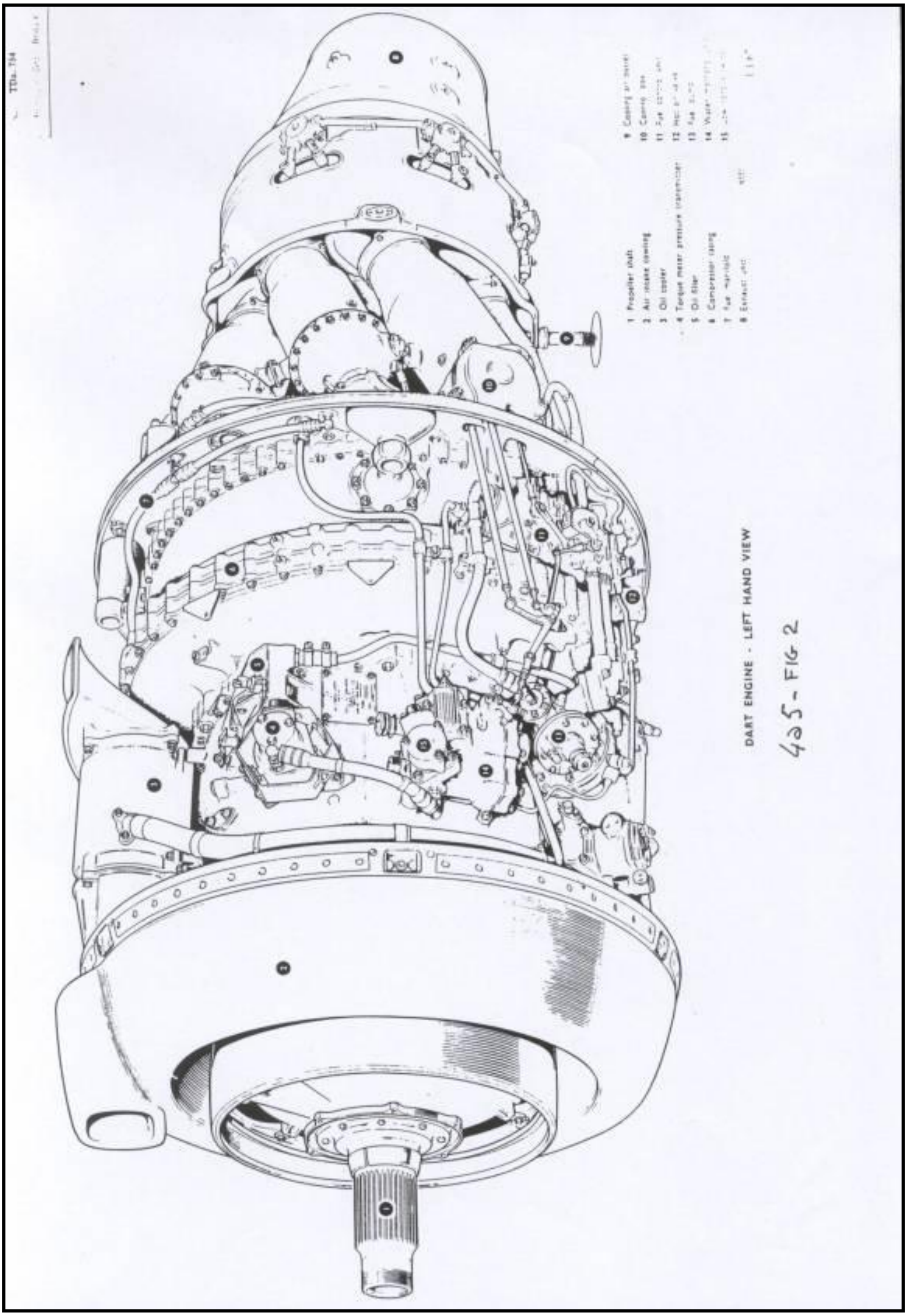
FEB.11/72

Fig. 4: Spring Servo Mechanism Levers to Elevator (Port Elevator Torque Tube)

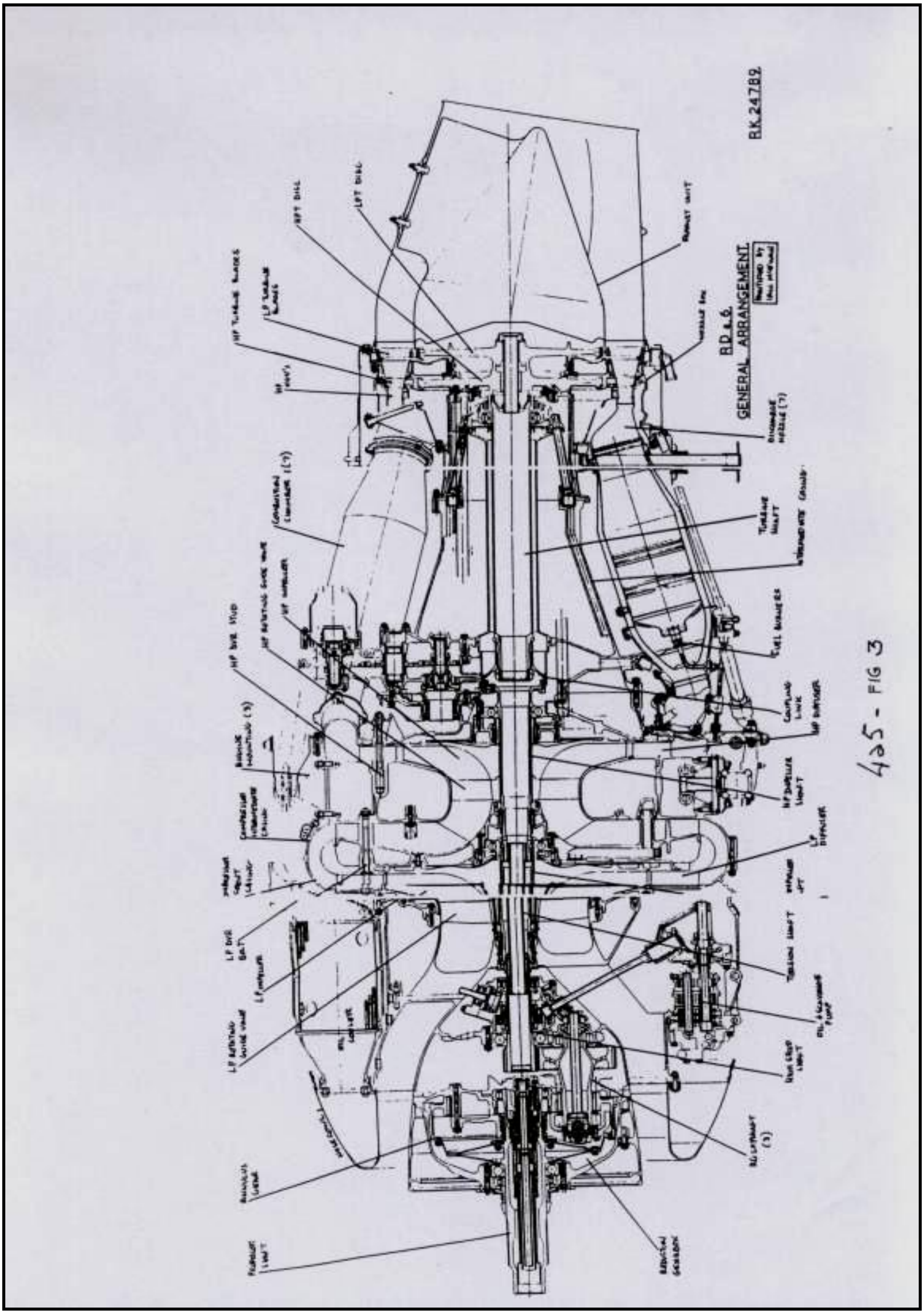
Appendix 4a.5 DART Engine Views



1. Right Hand View



2. Left Hand View



3. “General Arrangement” View

Appendix 4bFlight Controls

Flight Controls

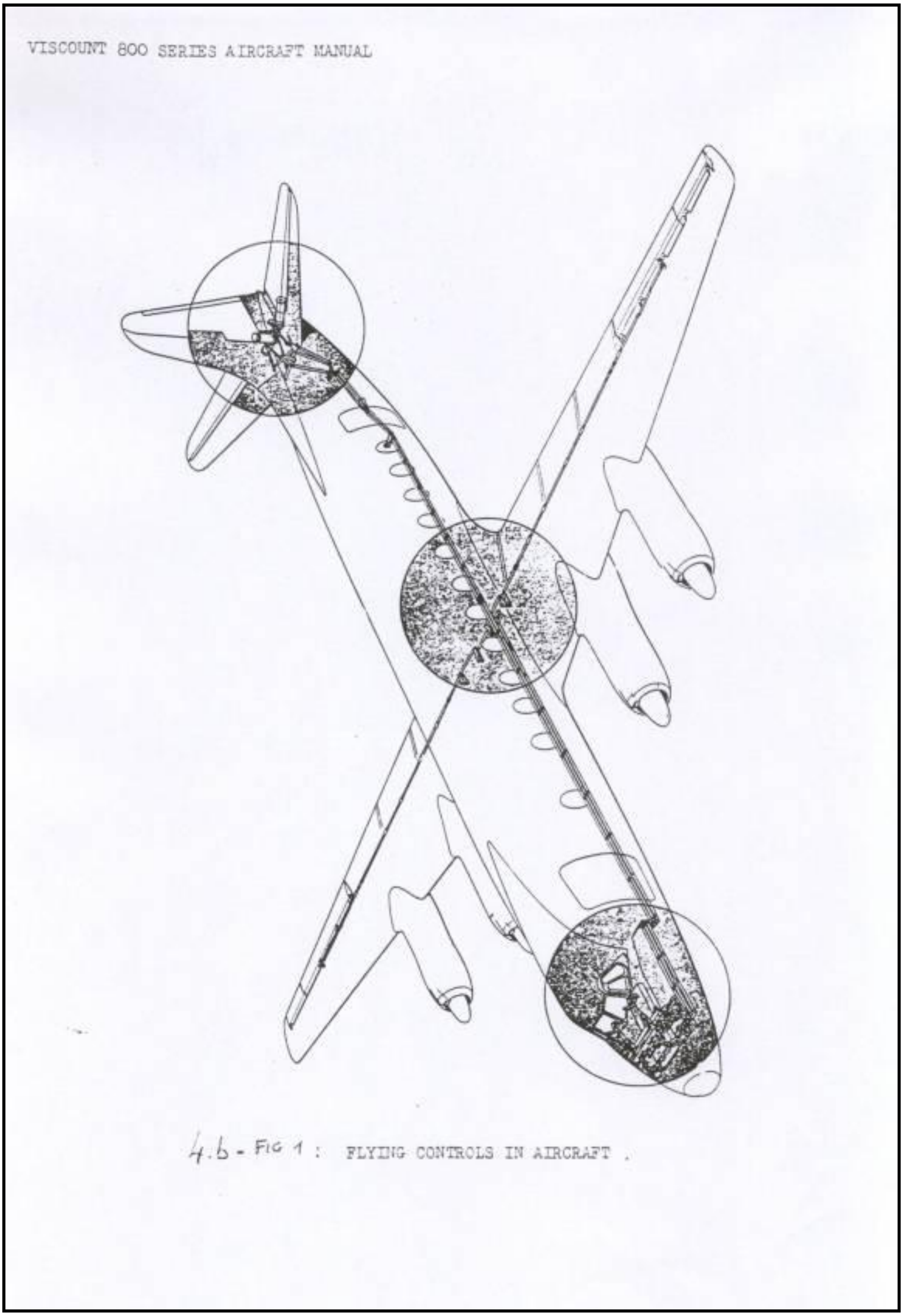
The functions of the elevator tabs:

A manually controlled **trim tab**, working as a secondary control surface, is hinged at the rear of the starboard elevator. The tab is controlled by two handwheels in the cockpit through a chain, cable, rod and gear mechanism. The tab moves in the opposite direction to the elevator and is adjusted in order to “trim out” or remove excessive pilot control forces. The primary pitch control of the aircraft is by direct deflection of the elevators by the pilot through the control column. However, when the autopilot is engaged, pitch control adjustments are made by means of a servo motor connected to the tab.

A **spring servo tab** is fitted to the inner position of the port elevator. This tab moves in the opposite sense to the main control and operates through a mechanism mounted on the port elevator torque tube. For normal operation when the control forces are light, the tab acts as part of the elevator. However, when pilot control forces exceeds 25 pounds, a spring in the tab control mechanism compresses and the tab is deflected so as to produce an aerodynamic force that aids the pilot in moving the elevator. A skew bar mechanism in the tab control system utilises a spindle called a spigot (part number 70120-367) which is a lifed item and features elsewhere in this report.

Outboard of the spring tab on the port elevator is the **anti-balance tab**. This moves in the same sense as the main control and is automatic in operation. This anti-balance or anti-servo tab is used to aid the pilot in returning the elevator to the neutral position and prevents it from moving to full deflection due to aerodynamic forces.

Fig. 1: Flight Controls in Aircraft



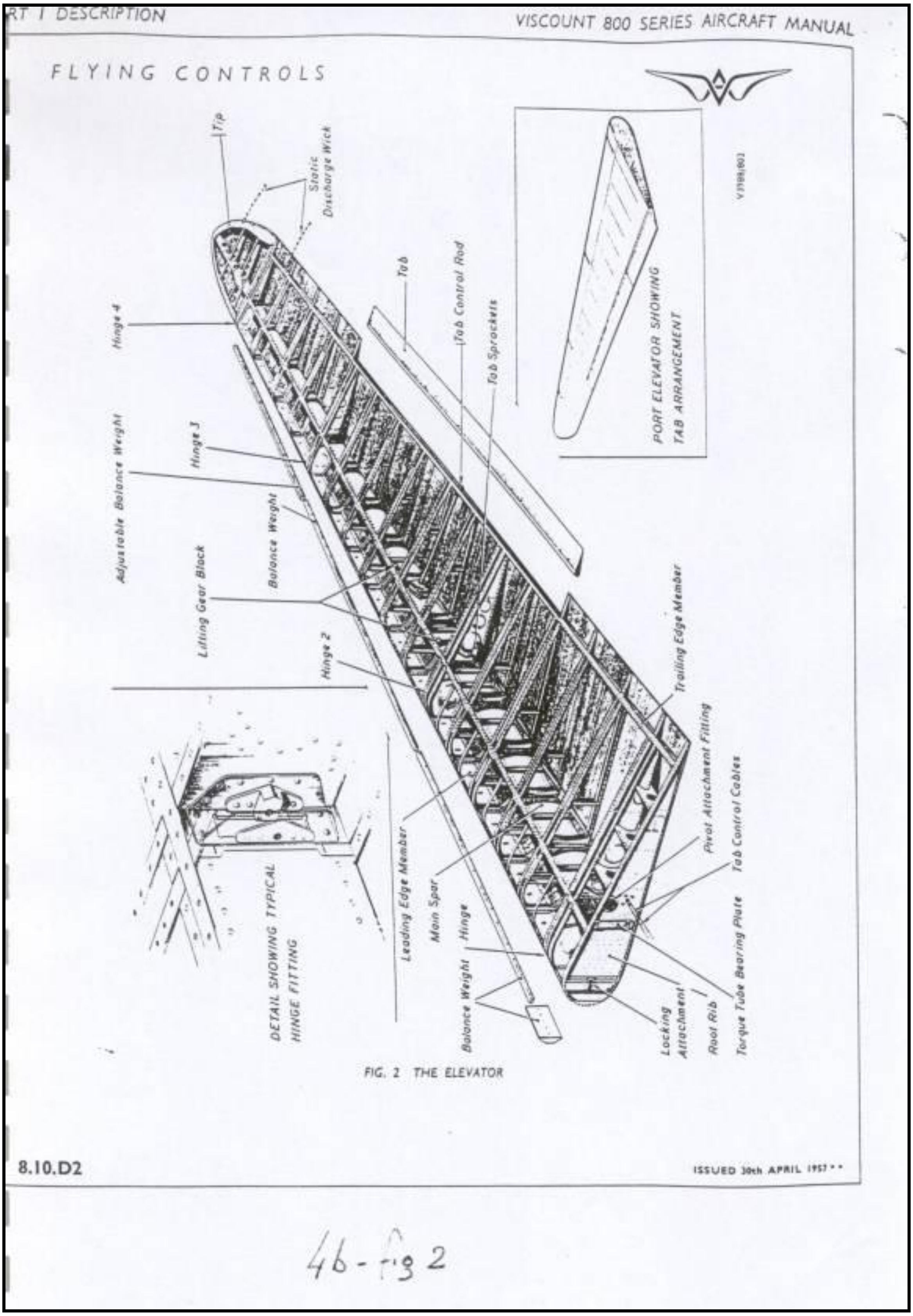
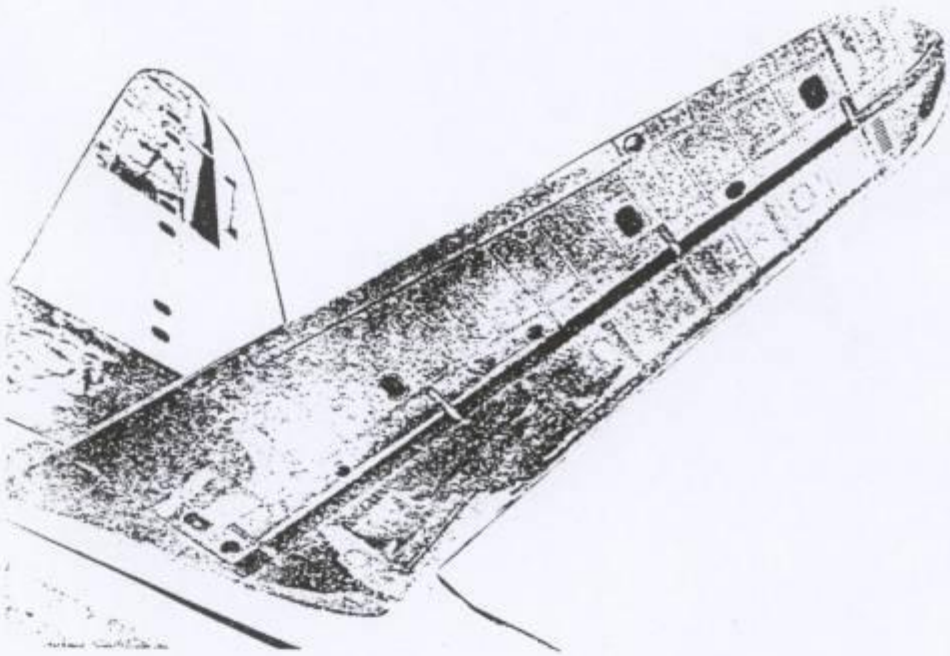


Fig. 2: The Elevator Structure



46 - FIG 3

Fig. 3: Elevator Access Panels

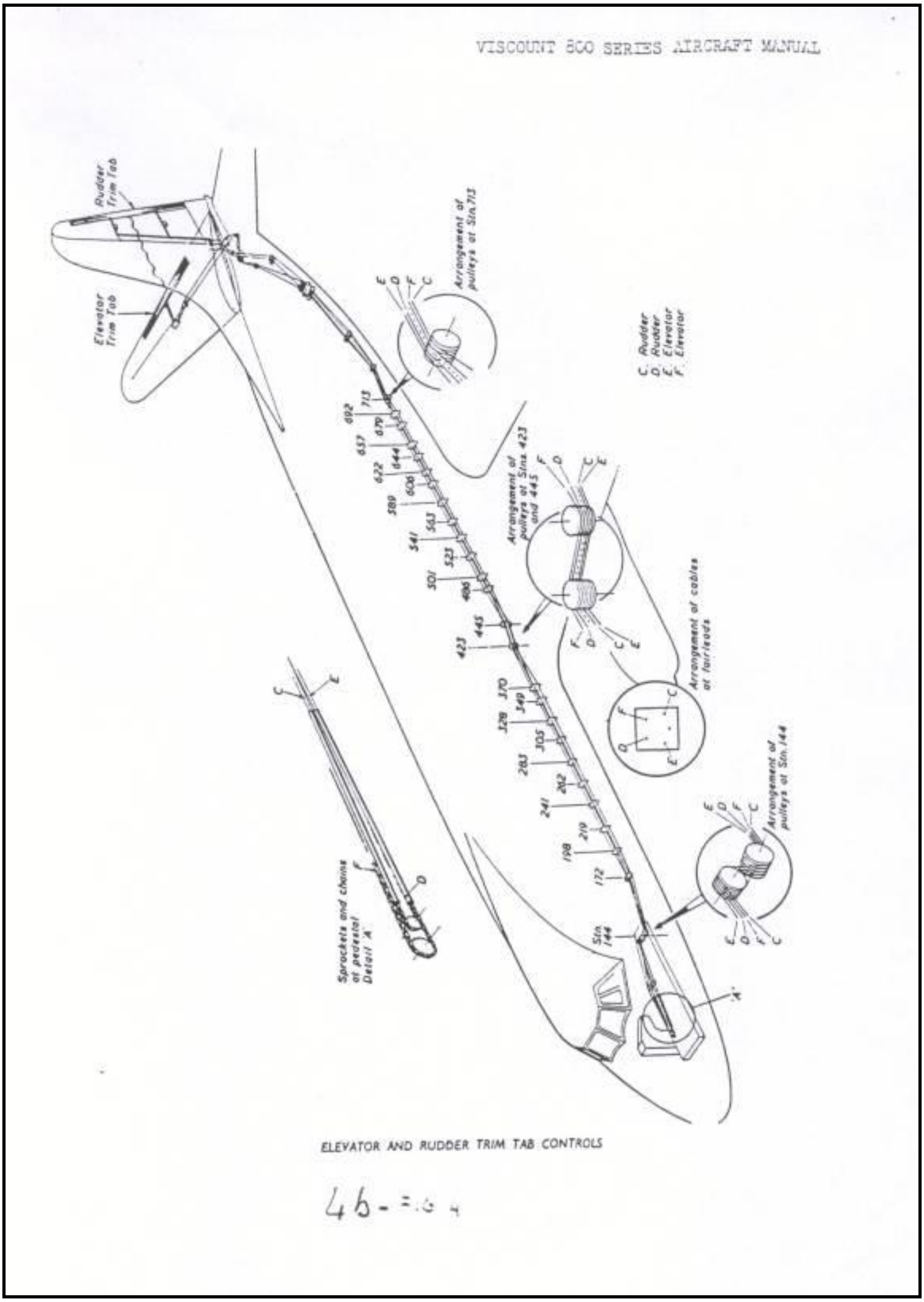
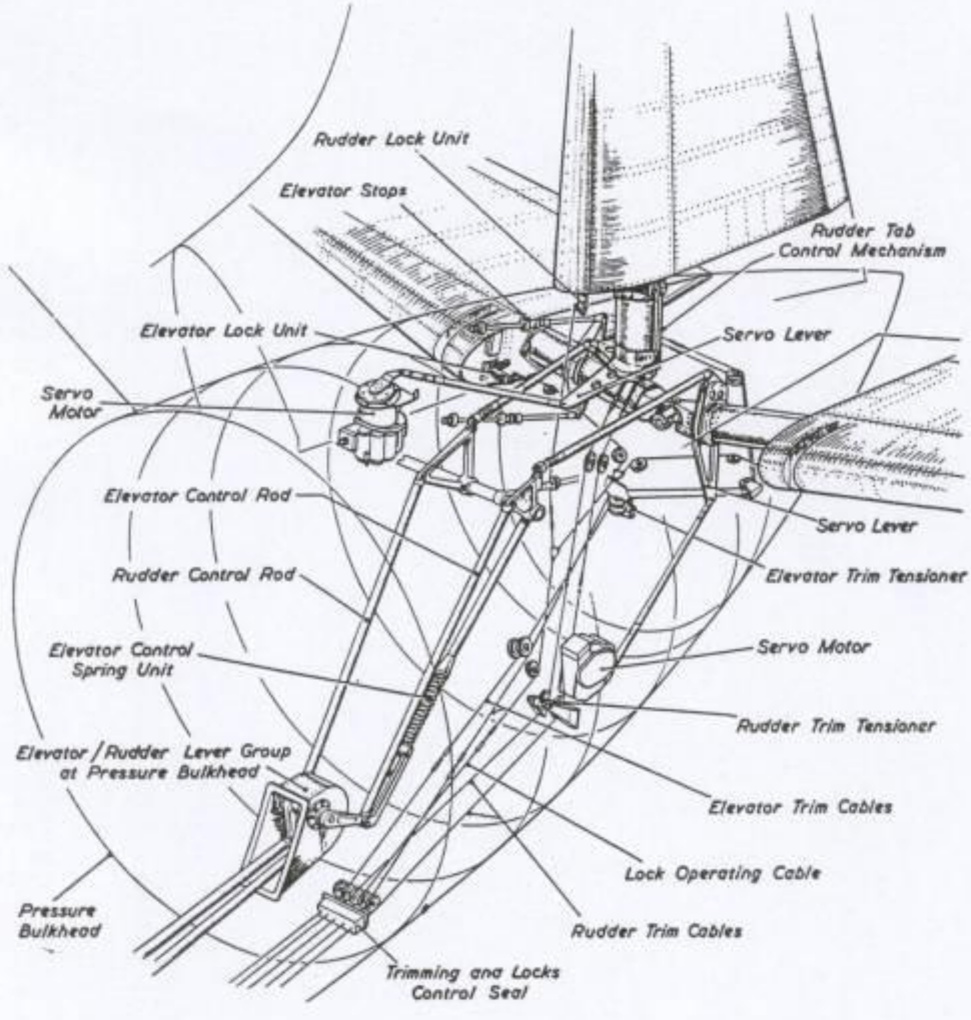


Fig. 4: Elevator and Rudder Trim Tab Controls

VISCOUNT 800 SERIES AIRCRAFT MANUAL



CONTROLS AFT OF PRESSURE BULKHEAD

4b - FIG 5

Fig. 5: Controls Aft of Pressure Bulkhead

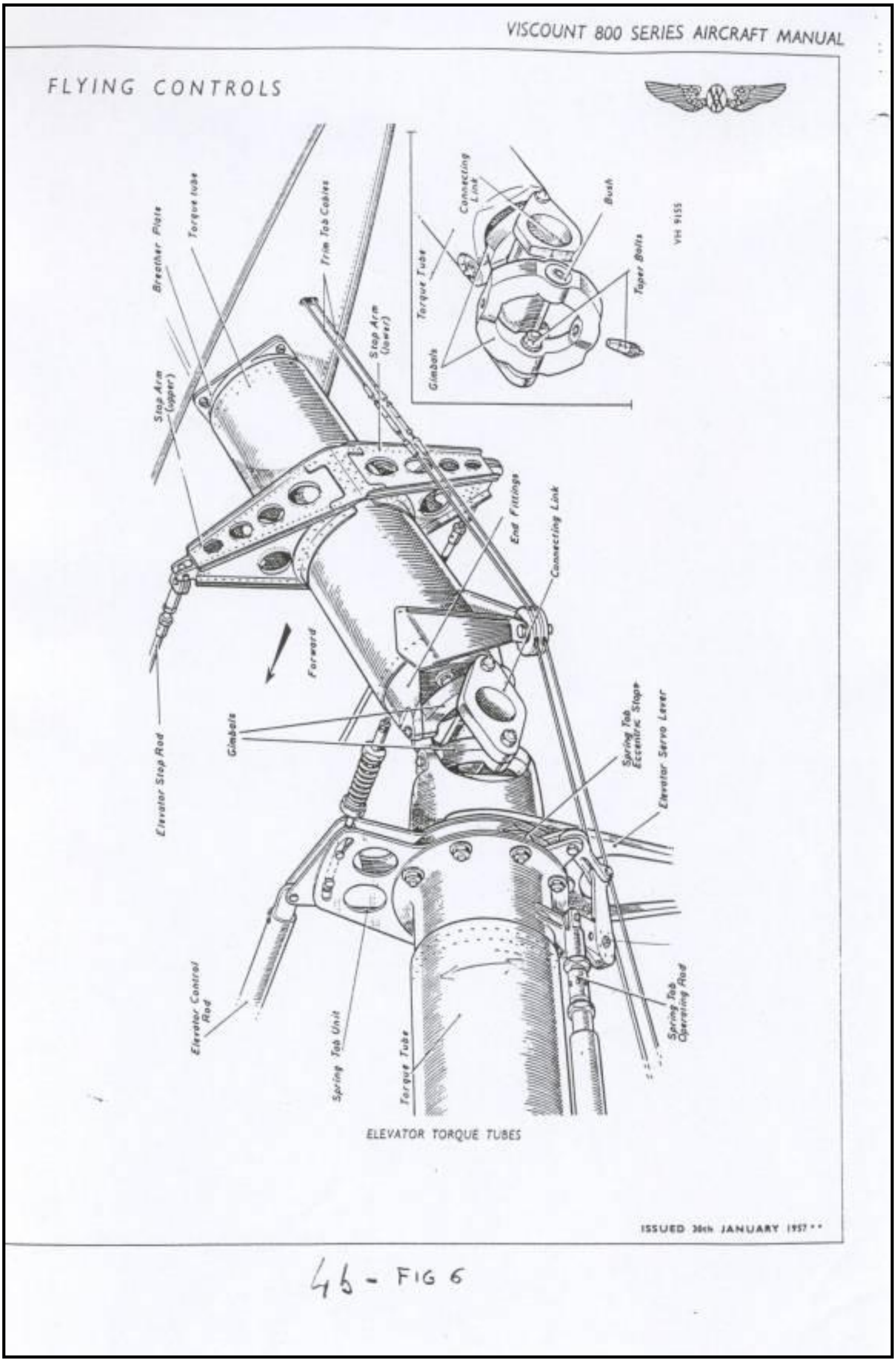
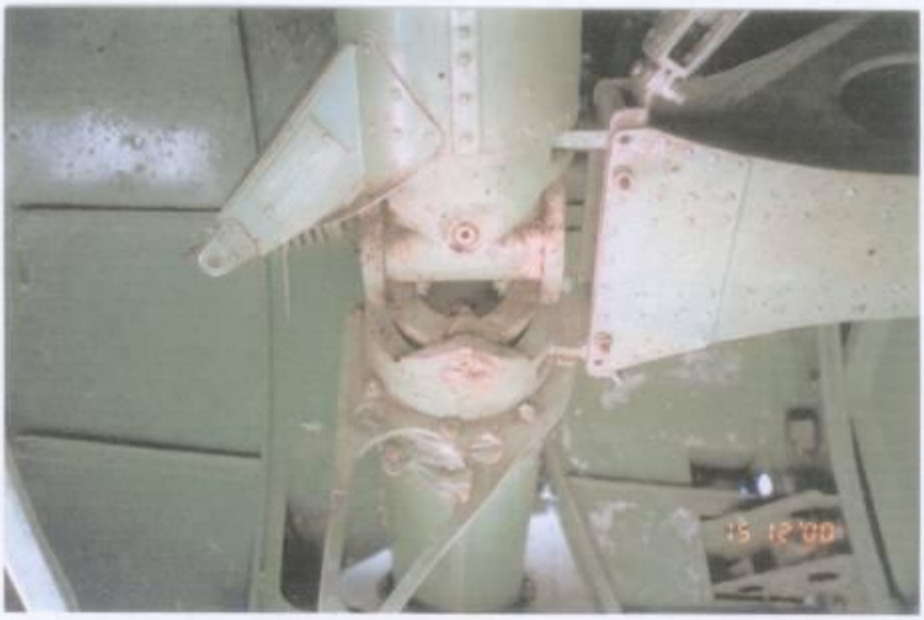


Fig. 6: Elevator Torque Tube

C/S SPAR



ELEVATOR TORQUE TUBE

4b - Pictures

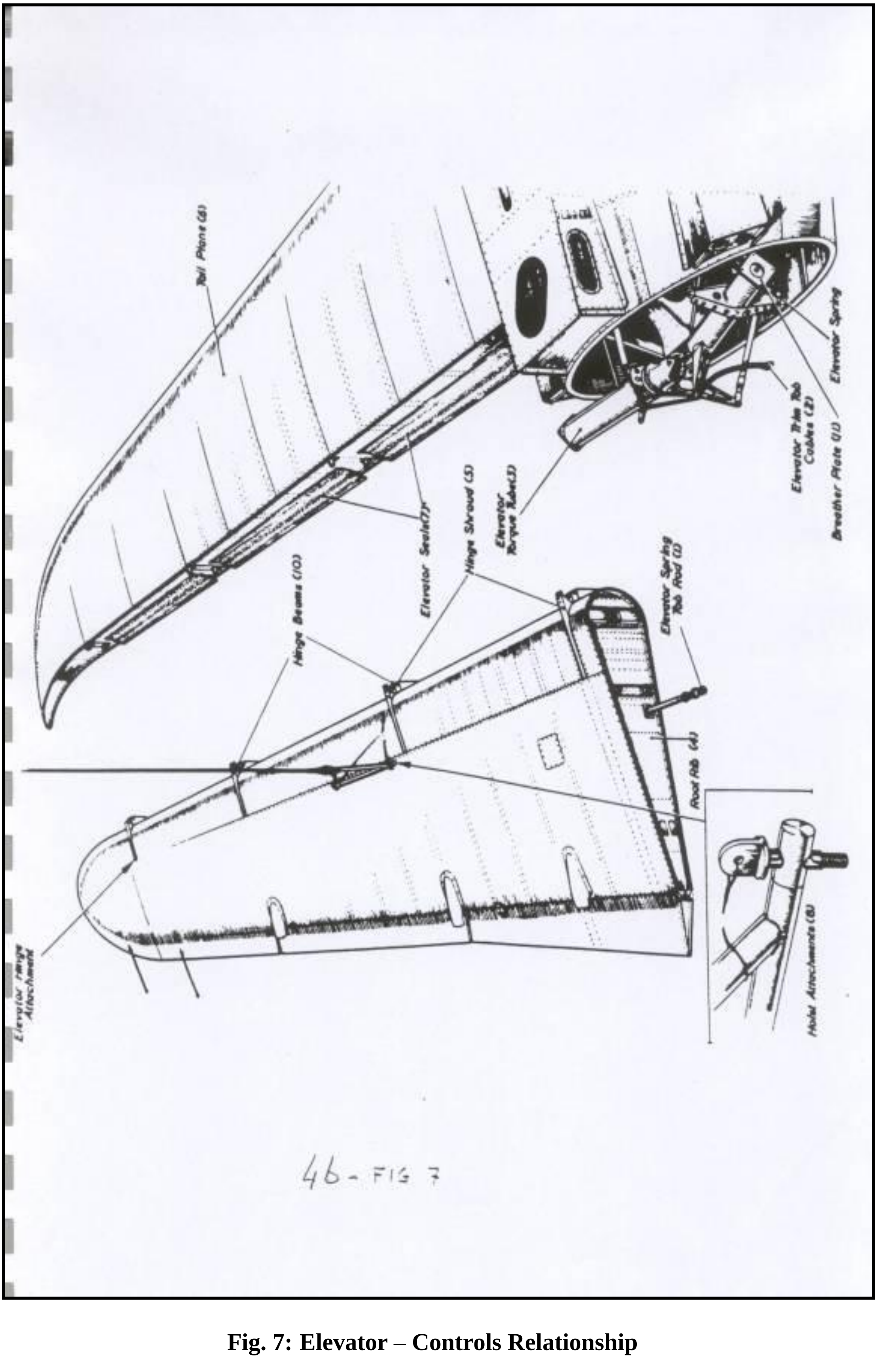


Fig. 7: Elevator – Controls Relationship

Appendix 4c Metal Fatigue

Appendix 4c

Metal Fatigue

Metal Fatigue is the phenomenon whereby if a part is subjected to repeated loads at a level well below that required to cause failure in a single application, a crack will eventually initiate and propagate to failure.

The repetitive loads may cover a wide range, such as that affecting an aircraft wing or tail, ranging from very small frequent loads from turbulence and manoeuvres, up to those from heavy gusts which occasionally occur in flight. It is the cumulative effect of this "spectrum of loads" which eventually, usual after thousands of hours, results in the appearance of fatigue cracking.

An example of fatigue caused by low repetitive loads but over a high number of cycles may be observed in propeller blades. Each time a rotating blade passes the side of the fuselage, a small load input is produced. Should some defect be present, such as a corrosion pit or a stone nick, then over some millions of propeller revolutions a fatigue crack and blade separation could take place.

In the case of tailplane flutter such as occurred to an Indonesian Viscount in 1980 and probably affected EI-AOM, very high loads are involved. Flutter resulted in the bending of both tailplanes upwards and downwards symmetrically with a large tip deflections at a rate of six times per second.

In some cases, flutter can cause almost immediate failure of the structure and much depends upon the severity and the detail design of the structure. In the case of EI-AOM, the tailplane could only have been expected to last minutes rather than hours.

Following is a brief explanation of the setting of fatigue lives, the substantiation of the Viscount Tailplane and some service background.

(a) The Criteria

Both the British and the United States requirements applicable at the time of the certification of the Viscount specified that the structure be substantiated against either Safe Life or Fail Safe Standards.

The **Safe Life** Concept requires that those parts of the structure whose failure could result in loss of the aircraft must be able to remain safely in use up to a pre-determined retirement life. Safe Life components are not normally subject to any inspection program related to fatigue although they may be examined periodically for such problems as wear or corrosion.

Safe life structures are basically simpler and easier to stress and substantiate than fail-safe designs but they do have the greater disadvantage of being subject to catastrophic fatigue failure at a level which may be extremely remote but is unacceptable by today's standards.

There is, unfortunately, an inherent scatter in the initiation and propagation of metal fatigue which in a practical flight structure cannot be absolutely catered for. Factors are applied to fatigue test results and to calculations in order to determine an acceptable retirement life for the component concerned. In all cases, fatigue scatter factors are predicated by the acceptance of a small, but nevertheless real, risk of failure.

In some aspects the real life situation is even less attractive. The most thorough test and evaluation program cannot cater fully for an unforeseen severe operating environment, corrosion, accidental damage or a manufacturing defect – all of which can very readily initiate premature fatigue cracking. There are many recorded cases of aircraft being lost in this way from such diverse initiating causes as a surface scribe mark, a badly fitted bust in a hole, a heat treatment error, a corrosion pt, etc..

The **fail-safe** concept is based upon providing sufficient redundancy in a structure that a failure on one part will not result in the loss of the whole. This redundancy may be provided by alternative load paths or by known satisfactory crack propagation characteristics, both considered in conjunction with residual strength capability and the provision for inspection.

The Viscount was designed almost entirely to the Safe Life concept with the result that the fuselage pressure cabin, the five lower booms of the wing main spar, the tailplanes and various smaller components all had specified retirement times.

Unfortunately, the state of the art in the 1950's did not lead to very precise life calculations aside from the inherent problems of scatter mentioned earlier. It should be noted that 50 years later life estimation methods are not much better, which is one reason **Safe Life structures are not now allowed in the certification of new civil transport category aircraft.**

Another difficulty was the Vickers, in line with some other manufacturers at the time, for practical test rig reasons, did not carry out fatigue tests to a full spectrum of the loads expected in service or were required to. Instead, single load level repetitive tests were carried out and the results adjusted by calculations based on the known fatigue endurance of similar structures. The 800 Series Viscount wing test was an advance over the 700 series in that an additional ground-air-ground cycle was added.

(b) The Tailplane

The tailplane life was established by a combination of tests, calculations and service experience.

Although not specifically required by the applicable design and certification standards, Vickers carried out a series of static and fatigue tests of tailplanes in the 1950s.

The test rig consisted of the rear unpressurised fuselage section fitted with a pair of tailplanes. The fuselage was supported by a vertical rigged frame

Load was applied by a single hydraulic jack on each side, applying load to four pads and, through a link to a beam, simulating elevator loads.

The derivation of applied loads is quite complex with tailplanes and in this case Vickers installed strain-range-counters in airline aircraft in service. A single load level was applied in the range of that regularly found to occur in service and endurance test points were obtained representing cycles to failure. The method Vickers used to calculate the safe life of the structure was to adopt the shape of a standard fatigue endurance curve (in this case the average joint curve derived by Heywood and published by the Royal Aeronautical Society as Data Sheet E.05.01) and fixing its position along the endurance axis by means of a test failure point. Once the endurance curve and load spectrum were established, the damage rate was obtained by using a linear cumulative damage hypothesis.

It should be explained for those not familiar with aircraft design that generally speaking, horizontal tail surfaces or tailplanes are subjected to flight loads in a downwards direction. This is usually called 'negative lift'.

In flight, the mass of the aircraft is countered by the lift produced by the movement of the wings through the air. In order to give a practical range of passenger loadings and to provide controllability and balance, designs are arranged to produce a negative lift or load acting downwards on the tailplanes as they pass through the air. This enables pilot control to be maintained when manoeuvring or lowering flaps as the aircraft is kept in balance by movement of the elevator control surfaces attached to the tailplanes.

To allow for scatter in test results and other variables, a factor was applied to the mean estimated life in order to establish a safe retirement life. The standard practice at this time was to apply a scatter factor of five.

The above method of life estimation was state-of-the-art fifty years ago but would not be permitted today even for the setting of transport aeroplane damage tolerance inspections.

It is now accepted that a fully randomised spectrum of loads must be applied to cover load sequence effects and such matters as fretting. Prior static loading and high test loading rates should be avoided.

Vickers carried out fatigue tests on three pairs of tailplanes. One pair was new, one pair taken from a service aircraft with over 5,000 landings (very good practice) and one pair which had been subject to static strength tests (not good practice). In the first test the centre section failed, in the second the spar upper boom failed at the root and in the third the upper boom root end steel fitting failed.

Vickers clearly carried out extensive and dedicated work to ensure the safety of the tailplane in the light of best practice at the time. The approach used, the material and design philosophy employed were similar to that used on the wing.

In the light of serious fatigue problems which later developed in the wing spar booms, it would not be entirely surprising if some problems subsequently manifested themselves in the tailplane, albeit with perhaps some additional factor.

(c) <u>Service Experience</u>

As mentioned earlier, corrosion is one subject which can have a marked influence on fatigue. In this respect, it is interesting to note that the CAA occurrence reports list one British Viscount 800 series with a corroded tailplane spar top boom under the steel root fitting. This is a matter of considerable concern when one considers the boom had only been fitted 2,076 flying hours previously.

It was a fatal airline accident in Australia on December 31, 1968 which highlighted both the unconservative nature of the life estimations carried out and mandated by the Regulatory Authorities, and also how a manufacturing or maintenance error could destroy confidence in the retirement life approach.

In the Australian case, a Viscount 720C VH-RMQ, suffered an inner wing spar lower boom fatigue failure resulting in the loss of the wing in flight.

The safe life of the boom concerned was promulgated as 11,400 flights whilst the failure occurred at only 8,090 flights. The most obvious reason for the premature failure was the lack of interference fit of a steel bush in the DTD 363 aluminium ally spar. The interference fit was a life enhancement measure. Unfortunately, the story did not end there as other cracks were found both in the accident aircraft and more significantly in several aircraft spars inspected at Weybridge. A total of 19 spar booms were examined and fatigue cracks were discovered in 16 of them. One boom was found to have ten small cracks. Even more disturbing was the discovery of fatigue cracks in some 800 Series Viscount booms which were thicker, hence less highly stressed, and manufactured from a copper based alloy, L65, with significantly better fatigue characteristics.

Following the discovery, the Viscount retirement lives were reduced on a global basis. The Australian regulatory authority took a different view, believing the risks were too great, and required the withdrawal of Viscounts from service.

The fuselage pressure cabin also introduced concerns including severe corrosion in some lower skin panels. Corrosion, of course, can have a major effect on the initiation of premature fatigue cracking. Remedial action included special inspections, replacing of skin belly panels and flying at reduced cabin pressure in order to conserve life.

The point of the above comments in only intended to show the unconservative, or at least fatigue sensitive, nature of the Viscount form a long-term structural integrity viewpoint.

Although designed in accordance with internationally agreed standards of fifty years ago, the aircraft could not possibly meet today’s damage tolerance standards.

A very extensive LIFE EXTENSION REVIEW was carried out by BRITISH AEROSPACE in the 1980’s for 800 series Viscount. This confirmed the continuing structural integrity of the aircraft subject to specified modifications, inspections and retirement lives.

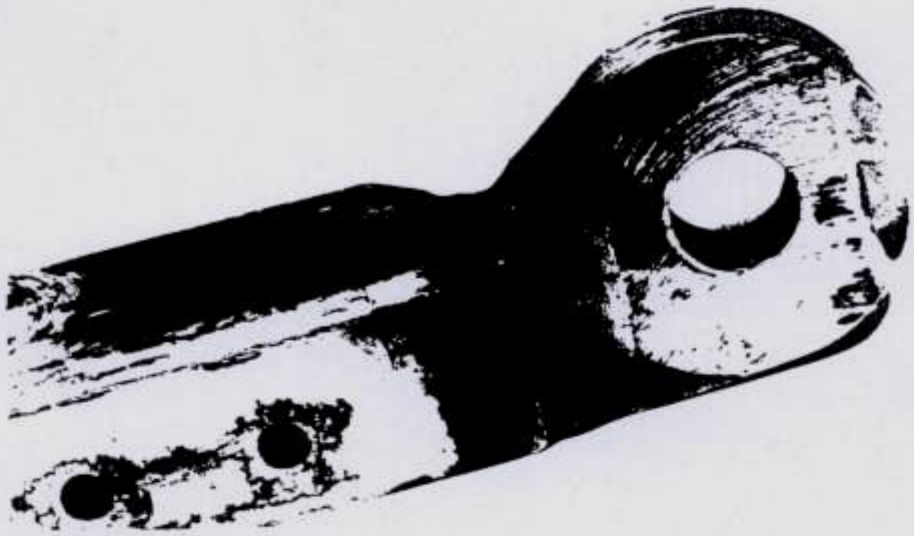
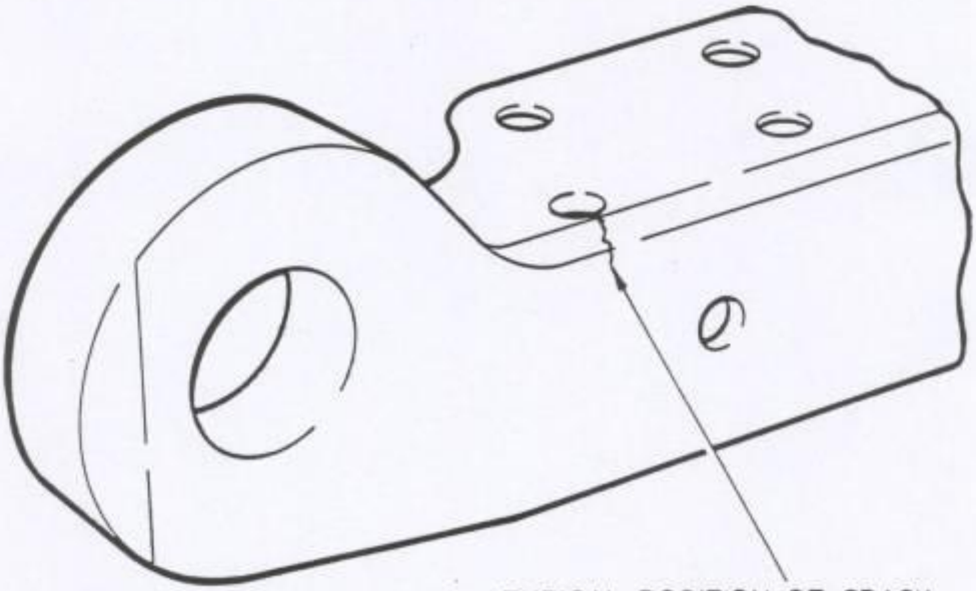


PLATE I TAILPLANE SPAR JOINT FITTING
WITH 0.65 INCH FATIGUE CRACK

4C - FIG 1

VISCOUNT

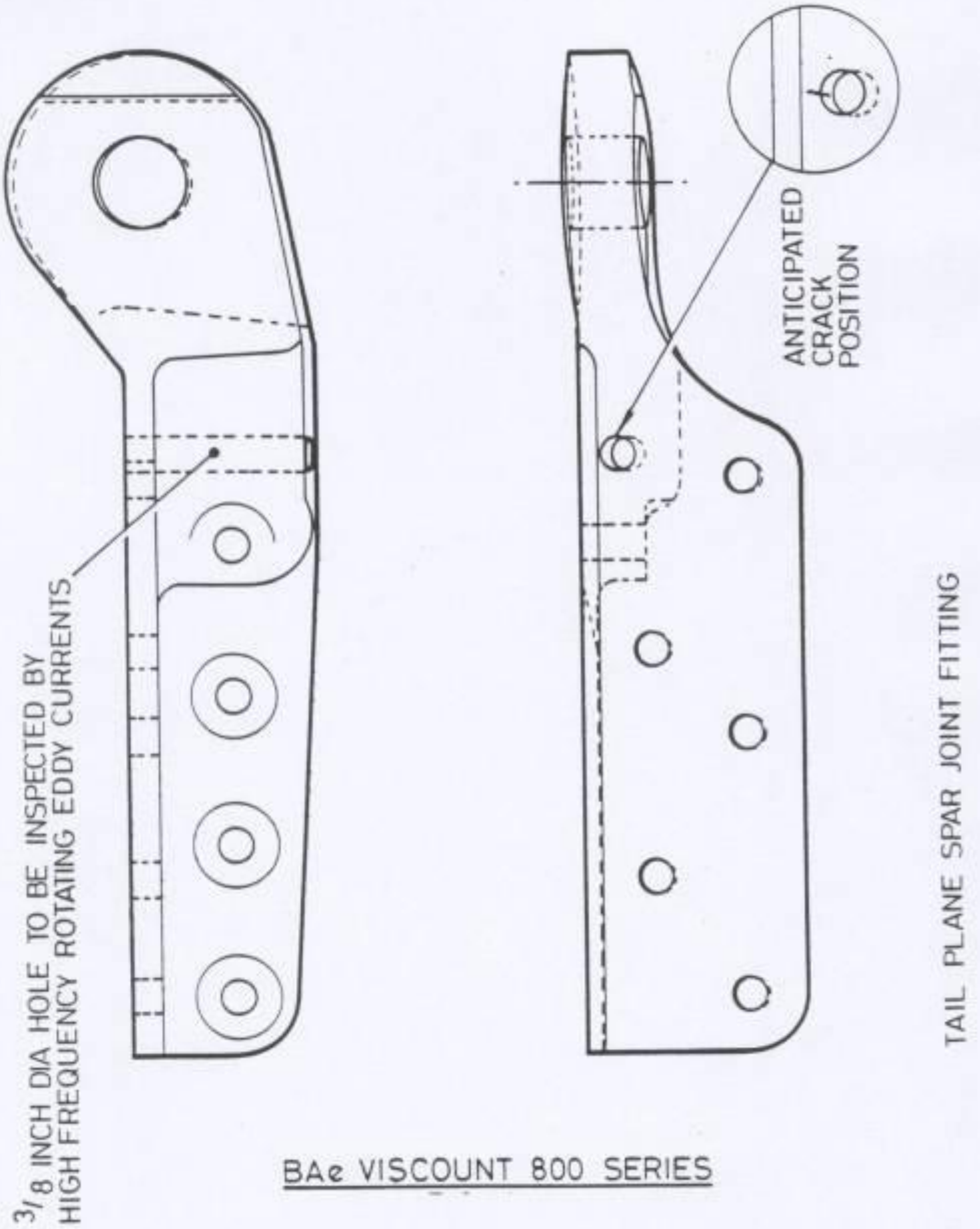


TAIL PLANE SPAR JOINT TOP FITTING

BRITISH AEROSPACE REGIONAL AIRCRAFT LIMITED
WOODFORD AERODROME, CHESTER ROAD, WOODFORD
CHESHIRE SK7 1QR, ENGLAND

4C - FIG 2

VISCOUNT

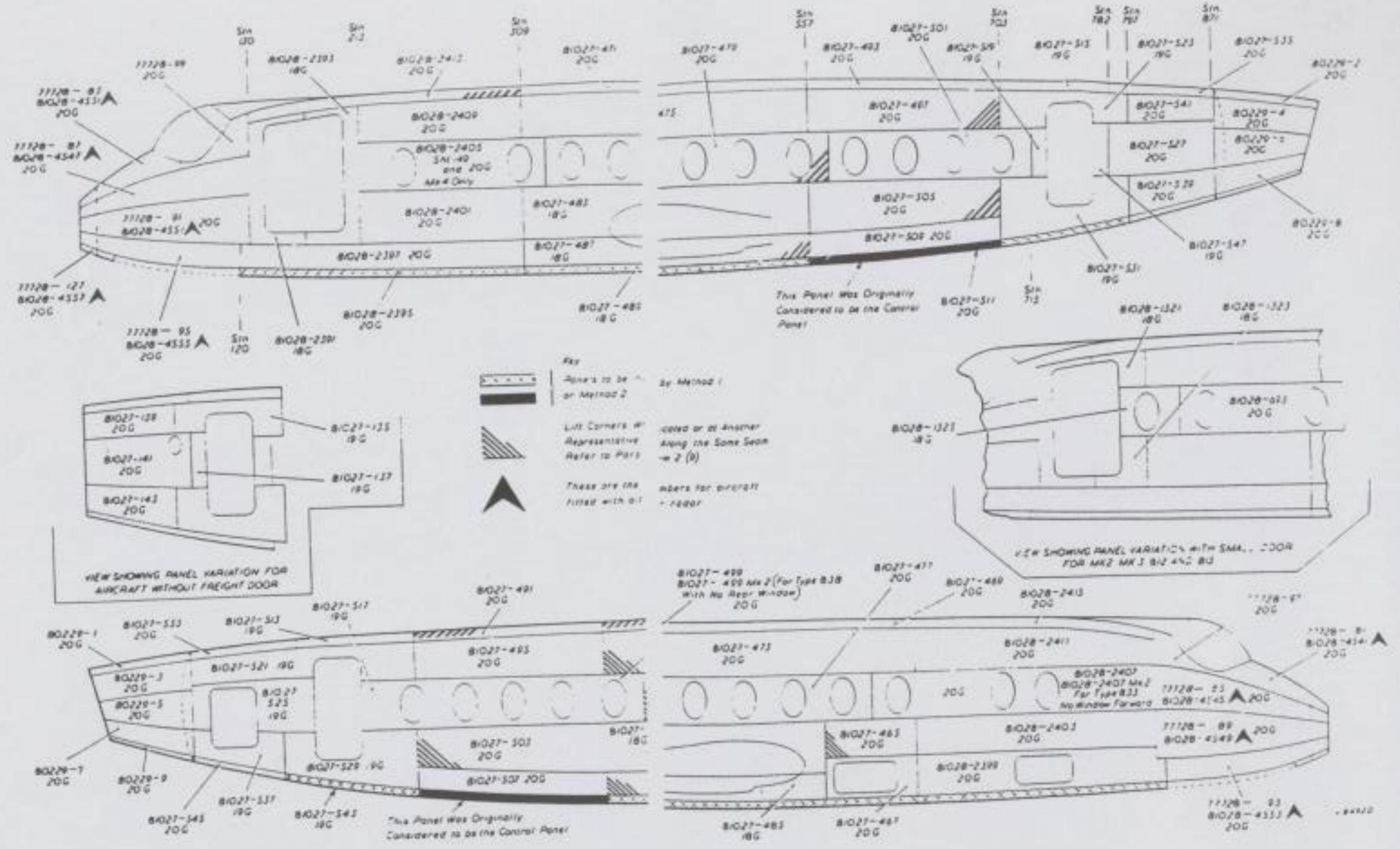


BAe VISCOUNT 800 SERIES

BRITISH AEROSPACE REGIONAL AIRCRAFT LIMITED
WOODFORD AERODROME, CHESTER ROAD, WOODFORD
CHESHIRE SK7 1QR, ENGLAND

4C - FIG 3

4C - FIG 4



AREAS I EXAMINED FOR CORROSION

Appendix 4d Flutter

4d.1 **Characteristics of separation sequence vs air speed (Extract from Aeroloading Note No. 627 – Dec 6, 1965)**

4d.2 **Example of separation process (Extract from Bouraq Accident Report – Viscount PK IVS – Aug 26, 1980)**

Appendix 4d

Flutter

Flutter is a violent vibration caused by the interaction of structural flexibility, mass and aerodynamic forces.

As a simplified example, visualise what happens to a control surface when the aerofoil ahead of it flexes slightly, perhaps due to a small gust. We are talking here of wing flexure interacting with aileron rotation, tailplane with elevator or fin with rudder. Assume also that the mass of the control surface is behind its hinge line, as is usual.

If the aerofoil moves slightly upward, the mass of the control surface causes the control to lay behind and rotate with its trailing edge down. Because of structural flexibility this tends to happen even if the control system is held firmly. The deflected configuration momentarily increases lift on the aerofoil and acts to increase its initial displacement. Eventually, structural stiffness overcomes the aerodynamic forces and the aerofoil starts to return to its normal position. As the aerofoil moves down, the control surface again lags behind, but now rotates training edge up and so again accentuates the displacement, this time downward.

Above a certain speed, there is sufficient aerodynamic energy for successive vibrations like this to build up progressively. This is flutter.

This simple type of flutter can be suppressed by adding balance weights to the control surface ahead of its hinge line. Doing this eliminates the tendency for the control surface to lag behind the vertical flexure of wing or tail and consequently the two motions no longer interact.

However, full mass is too heavy, is often impractical and cannot counteract all flutter tendencies.

Apart from speed, the extent of a flutter interaction is determined by resonance and phase relationships between the two interacting deflections. Pushing a swing illustrates this. A swing goes high with very gently pushes provided the pushes are applied exactly in time with the frequency at which the swing oscillates backwards and forwards.

A swing has just one normal frequency whereas an airframe has very many structural frequencies at which it bends, twists and rotates. Many of those frequencies vary with speed, as do aerodynamic loads. The extent to which two vibrations such as tailplane bending and elevator rotation can interact and may cause flutter depends on their predominant frequencies, and how close together those frequencies come within the flight envelope.

During aircraft design, specialist flutter engineers evaluate all possible interactions over a wide range of frequencies. In order to ensure that critical frequencies do not merge thereby eliminating the possibility of dangerous interactions.

Once the aircraft is in service, maintenance engineers must keep structural frequencies where they belong – well separated. Crucial to this are mass balance of controls, security of balance weights, control circuit stiffness and control surface free play. Even an excessively thick coat of paint or small repair can upset proper balance of a control surface and cause flutter. This is particularly important for control surface tabs.

The term “flutter” sounds innocuous, but it is not. It is violently destructive. Avoidance depends on meticulous design, maintenance of balance and allowable free play, and compliance with speed limits.

Appendix 4d.1

Characteristics of Separation Sequence vs Air Speed

(Extract from Aeroloading Note No. 627-Dec 6, 1965)

- Between 200 and 232,5kts. = No Separation
  - Wing protected by stall
  - Tail protected by elevator stop
- Between 232,5 and 302kts.
  - Wing protected by stall
  - Tail can be broken by large elevator application

    (From -22° at 232,5kts. to -8° at 302kts.)

- Between 302 and 353kts.
  - Wing can be broken, not further protected by stallo

    (from -5° to -3° applied on the elevator)
  - Tail can be broken

    (from -8° to -3° applied on the elevator)

- Between 353 and 392kts.
  - Wing breaks first

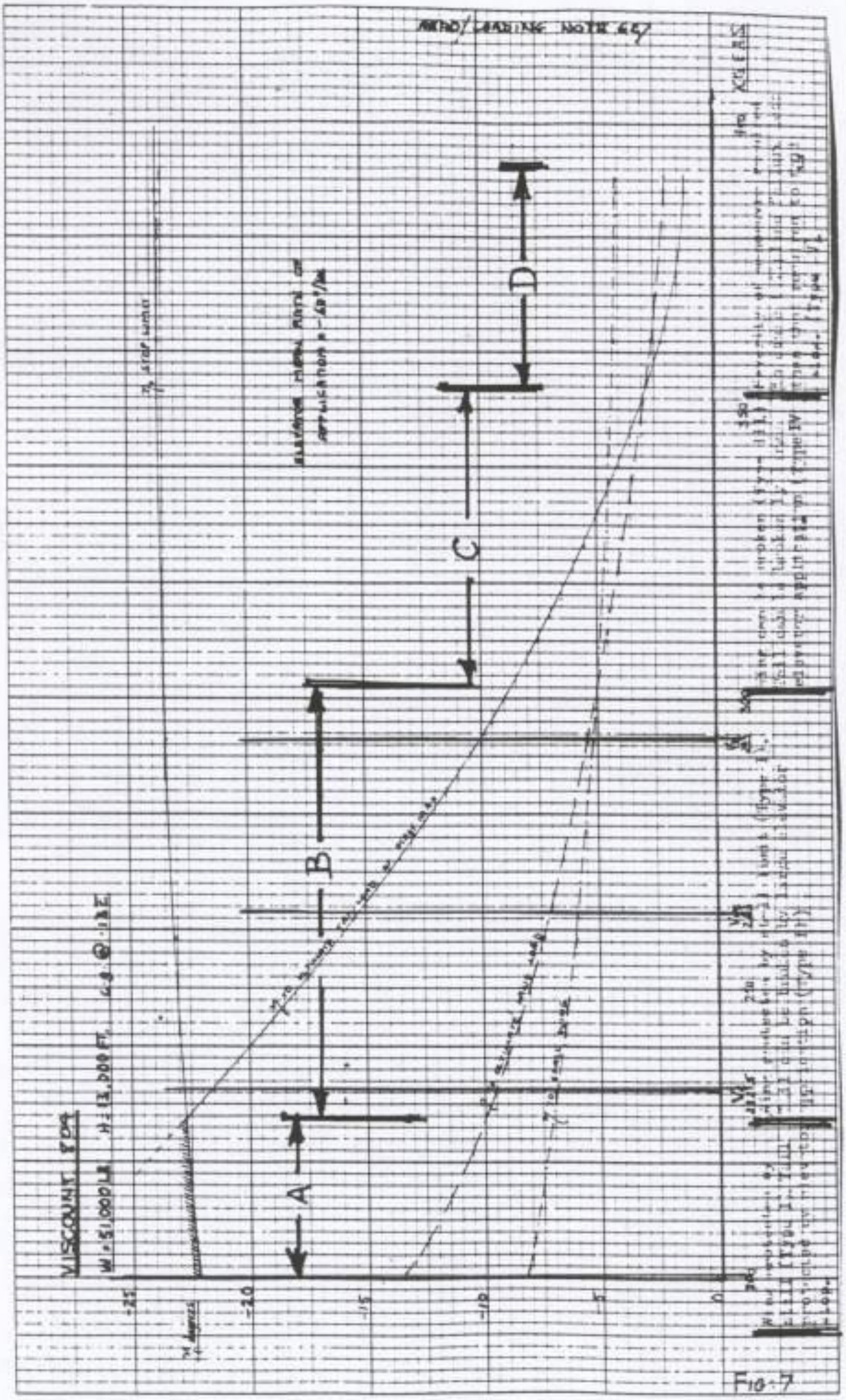
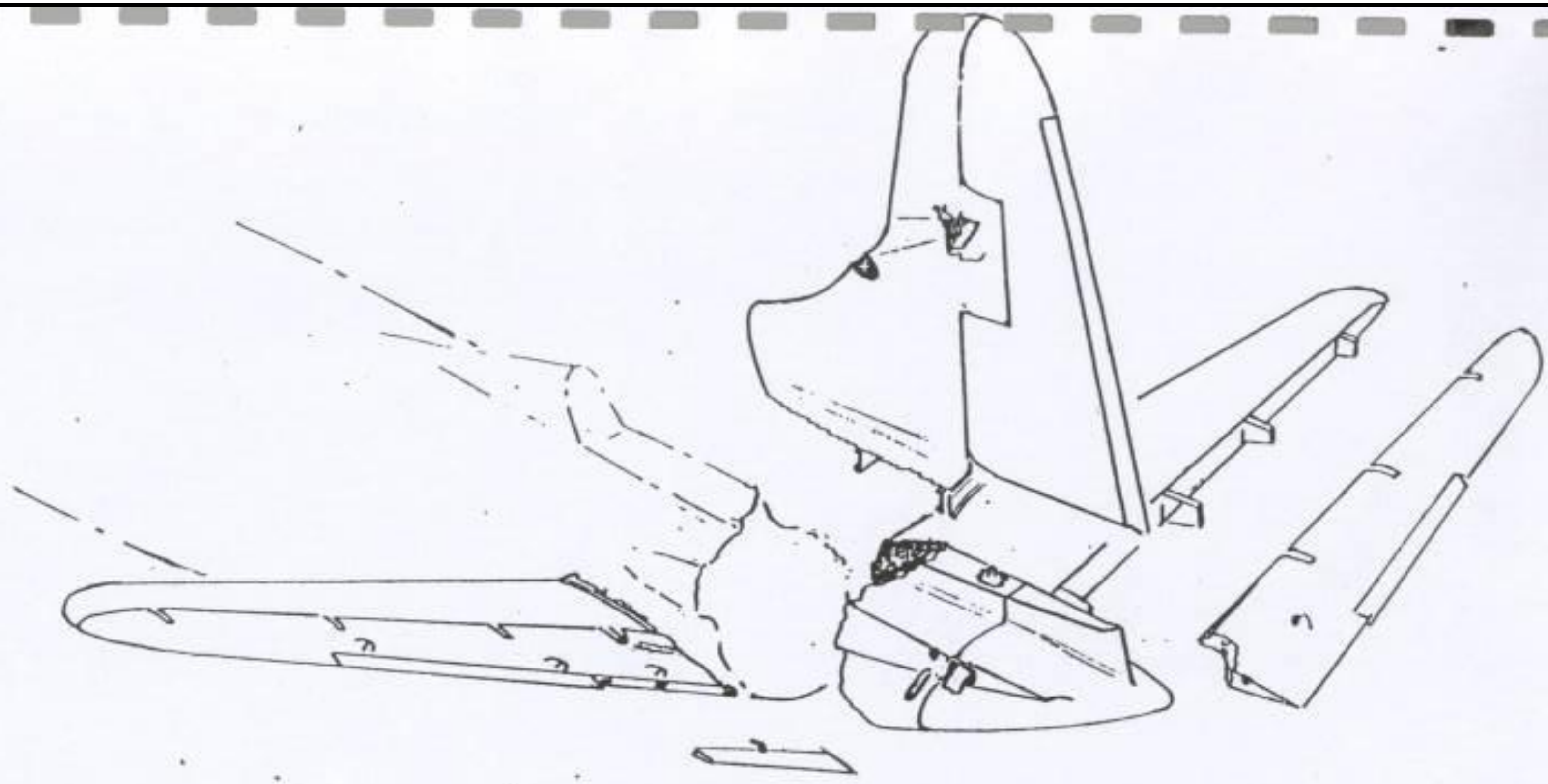

VISCOUNT 804
W = 51,000 LB
H = 13,000 FT.
-25
-20
-15
-10
-5
0
200
250
300
350
A
B
C
D
KTS EAS

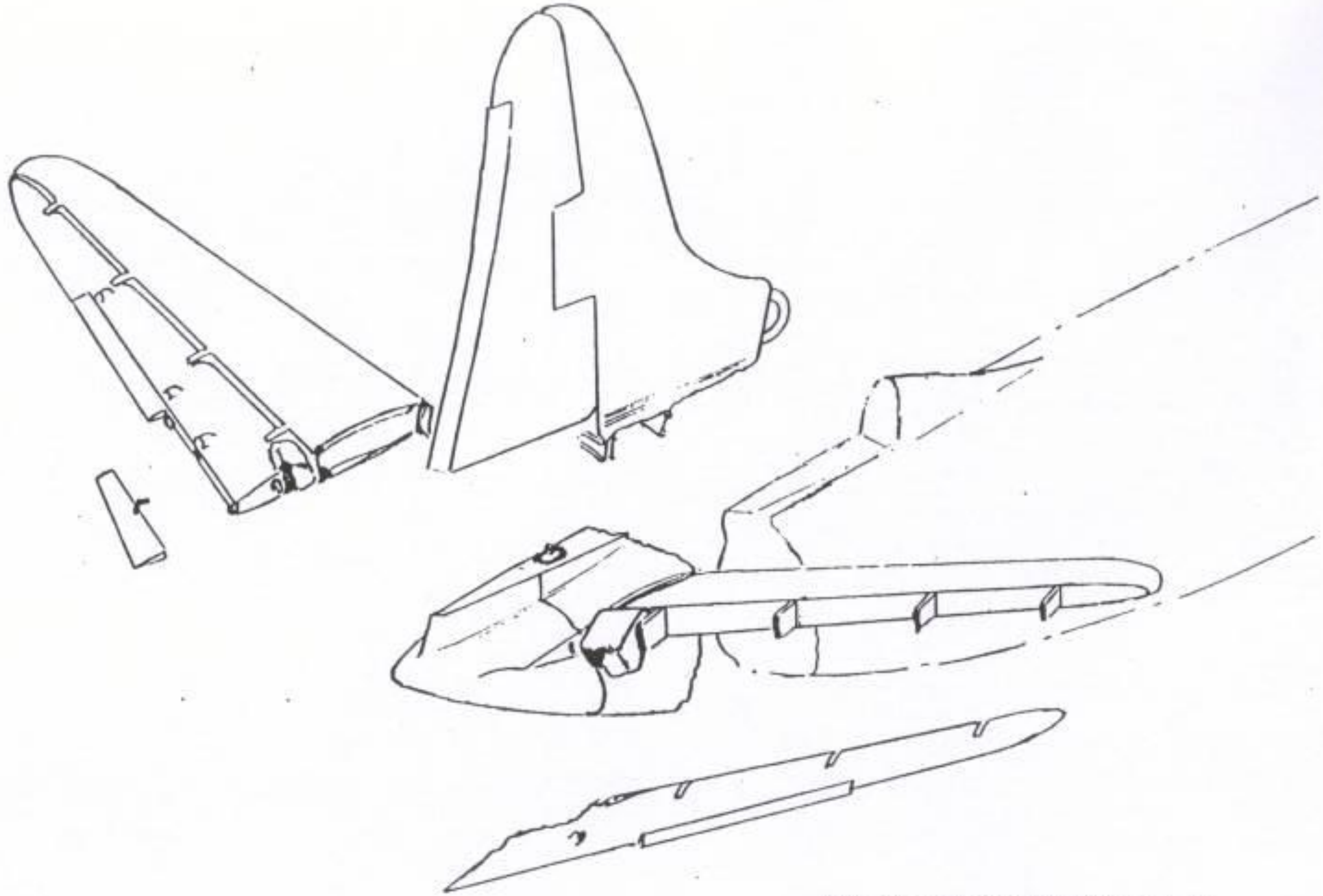
Fig. 7

4d 1.



FRAGMENTATION OF EMPENNAGE OF PK-IVS
(PORT REAR VIEW)

4d2-FIG 1

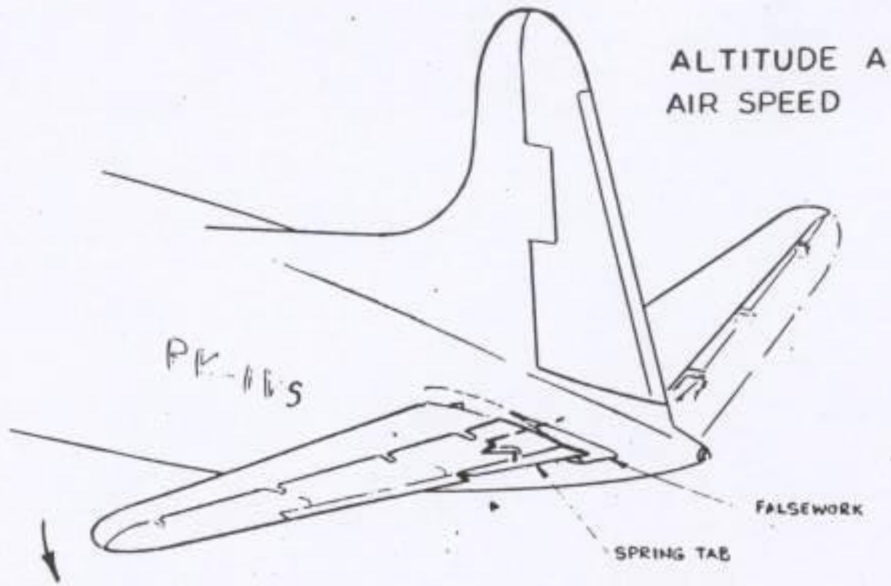


FRAGMENTATION OF EMPENNAGE OF PK-IVS
(STARBOARD REAR VIEW)

4d2 - FIG 2

1

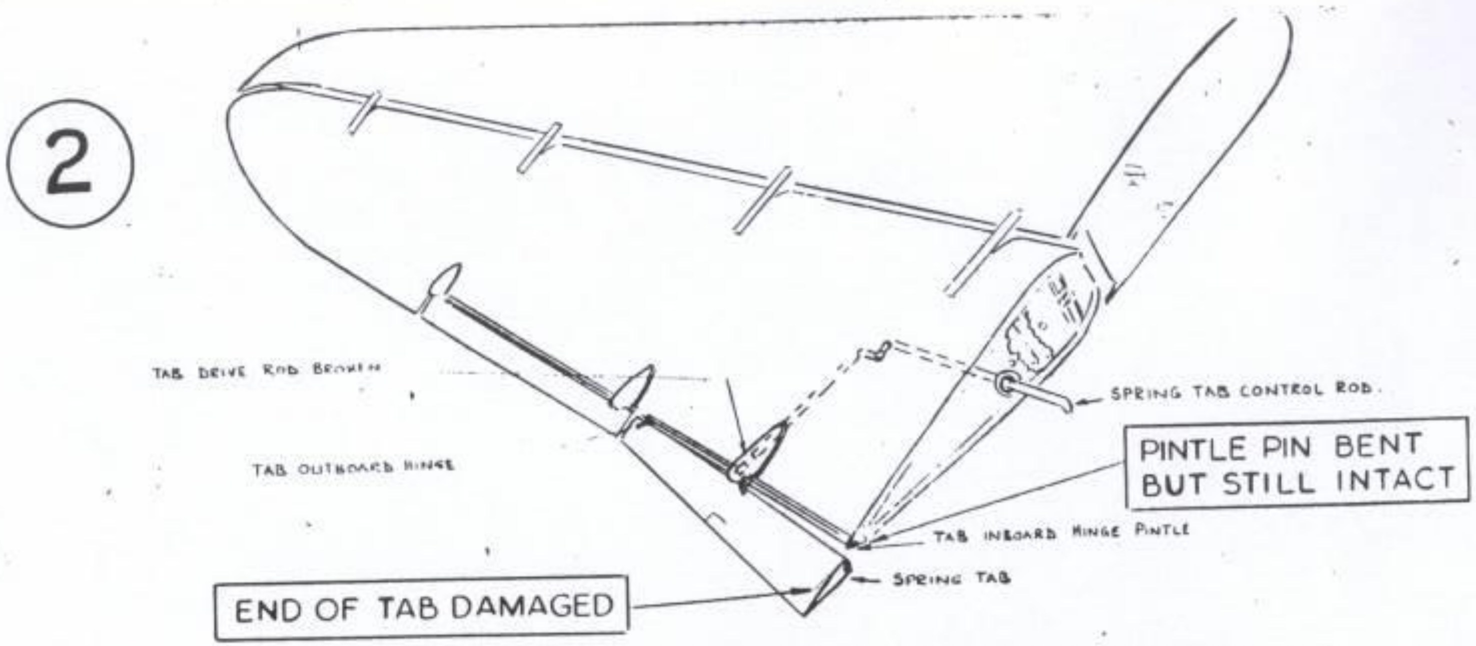
ALTITUDE APPROX 7000 FT.
AIR SPEED " 180 KN.



AS THE TAILPLANE BREAKS AWAY FROM FUSELAGE THE SPRING TAB CONTROL RODS ARE PULLED TO THE TAB UP LIMIT AND BEYOND UNTIL THE TAB CENTRE HINGE REACHES ITS LIMIT OF TRAVEL AND BOTH THE HINGE AND THE TAB DRIVE ROD FAIL.

THE INBOARD END OF THE SPRING TAB CONTACTS THE FALSEWORK AND THE TABS INBOARD HINGE IS PUSHED OFF ITS PINTLE. TAB DISTORTION AT THE MOMENT OF ROD FAILURE & THE CONSEQUENT SUDDEN RELEASE OF STORED ENERGY MAY HAVE BEEN A CONTRIBUTORY FACTOR.

4d2 - FIG 3

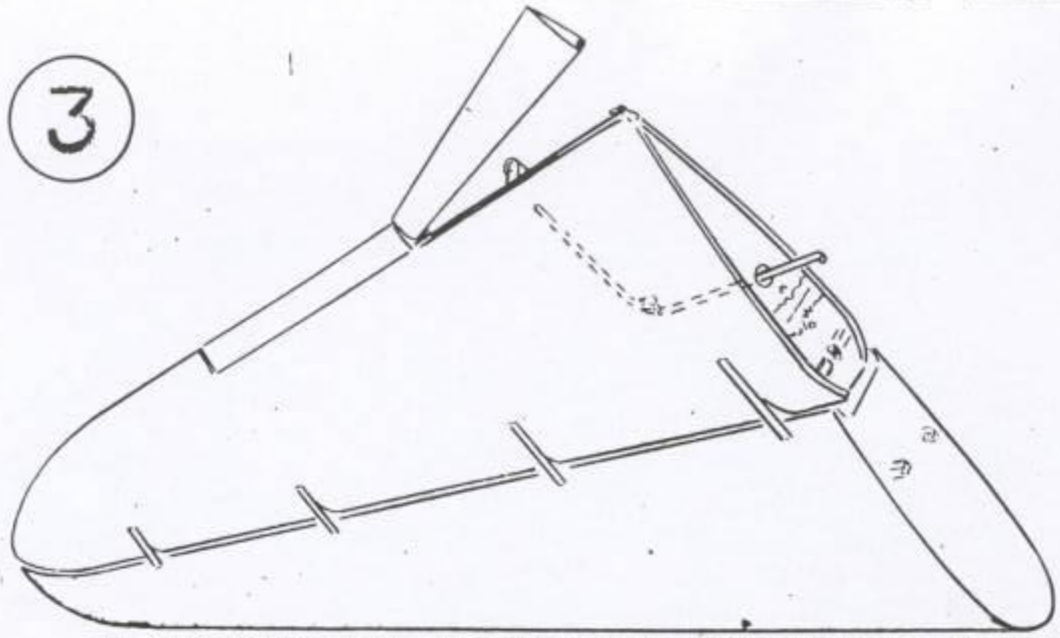


THE TAILPLANE DETACHES FROM THE FUSELAGE AND THE TAB CONTROL ROD BREAKS AWAY INBOARD OF THE ELEVATOR ROOT RIB

THE TAB REMAINS ATTACHED TO THE ELEVATOR BY ITS OUTBOARD HINGE ONLY AND THE TAB SKEWS OUT OF ALIGNMENT WITH THE ELEVATOR T.E.M.

4d2 - FIG 4

3

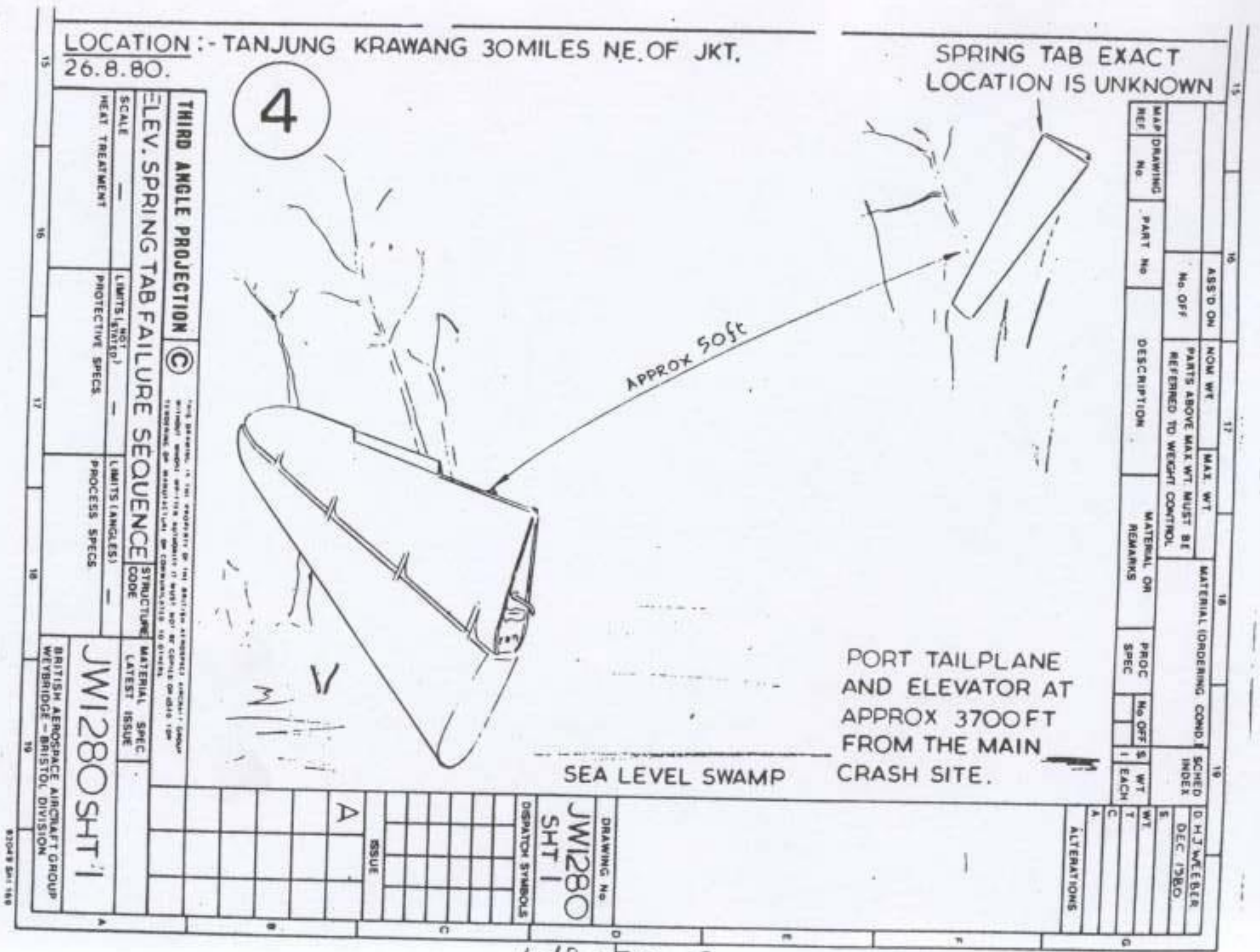


THE TAB FALLS WITH THE ELEVATOR AND THE PORT TAILPLANE UNTIL THE TAB IS TORN FREE FROM ITS REMAINING ATTACHMENT POINT AT THE OUTBOARD END TAB HINGE POSITION, EITHER DURING THE FALL OR POSSIBLY WHEN CRASHING THROUGH THE UNDERGROWTH.

TAB SEPARATION FROM THE ELEVATOR

THE SPRING TAB OUTBOARD HINGE LEADING EDGE · CHANNEL SECTION DUCTILE FAILURE LOADING, BEING REACTED BY THE ELEVATOR T.E.M. UNTIL THE HINGE FITTING RIVETS PULLED THROUGH AND THE TAB FALLS FREE. THE RHOMBIC DISTORTION OF THE TAB OUTBOARD HINGE CUTOUT WOULD SUGGEST THAT THE TAB WAS TWISTED OUT OF ALIGNMENT WITH THE ELEVATOR T.E.M. AT THE MOMENT OF SEPARATION.

4d2-FIG 5


LOCATION :- TANJUNG KRAWANG 30MILES N.E. OF JKT.
26.8.80.
4
SPRING TAB EXACT
LOCATION IS UNKNOWN
APPROX 50ft
PORT TAILPLANE
AND ELEVATOR AT
APPROX 3700FT
FROM THE MAIN
CRASH SITE.
SEA LEVEL SWAMP
THIRD ANGLE PROJECTION ©
ELEV. SPRING TAB FAILURE SEQUENCE
STRUCTURE CODE
MATERIAL SPEC LATEST ISSUE
SCALE —
LIMITS (NOT STATED) —
LIMITS (ANGLES) —
HEAT TREATMENT
PROTECTIVE SPECS.
PROCESS SPECS.
JW1280 SHT 1
BRITISH AEROSPACE AIRCRAFT GROUP
WEYBRIDGE – BRISTOL DIVISION
ASS'D ON
No. OFF
NOM WT
MAX. WT
PARTS ABOVE MAX WT. MUST BE REFERRED TO WEIGHT CONTROL
MATERIAL (ORDERING COND.)
SCHED INDEX
MAP REF
DRAWING No.
PART No
DESCRIPTION
MATERIAL OR REMARKS
PROC SPEC
No OFF
S I
WT EACH
D. H.J. WEEBER
DEC. 1980
ALTERATIONS
DRAWING No.
JW1280
SHT 1
DISPATCH SYMBOLS
ISSUE
A

4d2 - FIG 6

Appendices 5

5.1 1968 Track Reconstruction

5.2 Mid-Air Collisions Scenario

5.4 As per Witnesses Scenarios

Appendix 5.1a 1968 Track Reconstruction

- The reconstruction was based on the information given by the Shannon R/T transcripts. The positions of the AOM when emitting to Shannon are identified as follows:

- A source of inaccuracy exists in the fact that it is not clear when AOM exactly left the way "as the flight plan" through Tuskar to fly direct to Strumble.

- A source of doubt is linked to the fact that the wreckage was discovered near to Tuskar, at a position quite near from the one AOM should be if it followed its flight plan via Tuskar.

- Another source of inaccuracy results from the ETA Strumble give at 11.03

- Another source of inaccuracy results from the fact that "by Bannow" is not a precise position.

Consequently, a large "uncertainty zone" around the AOM position at 10.58 is defined:

(1) is a circular arc based on the position of AOM, as calculated from the time of the message "by Bannow".

(2) is a circular arc based on the estimate Strumble at 11.03.

(3) is a circular arc based on the estimate at 10.58 if AOM flew as per the flight plan, via Tuskar, estimating Strumble at 07.

The following map shows tracks:

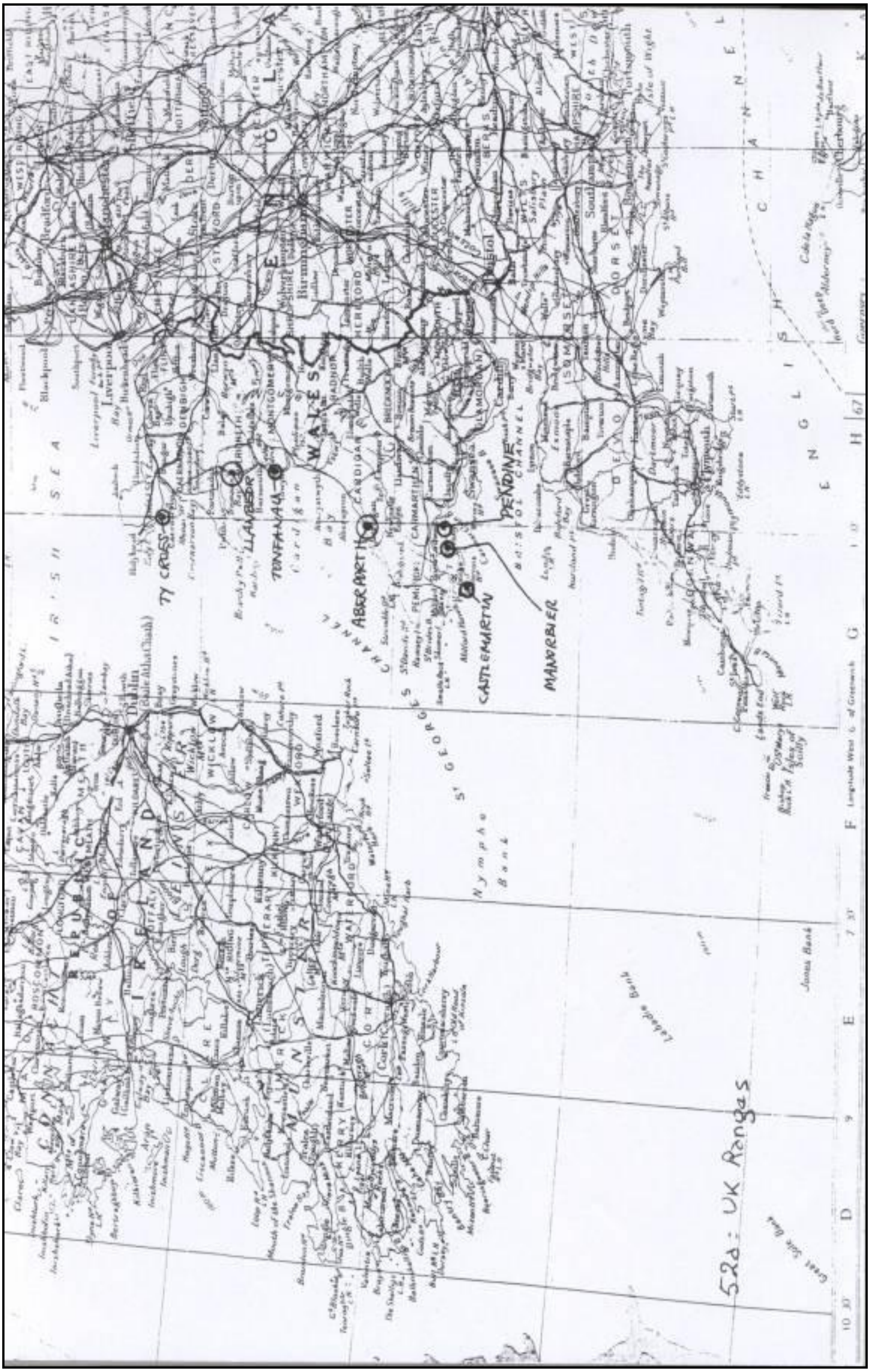
- via Tuskar, as per the flight plan (blue)

- direct Strumble, as acknowledged at 10.41 (red)

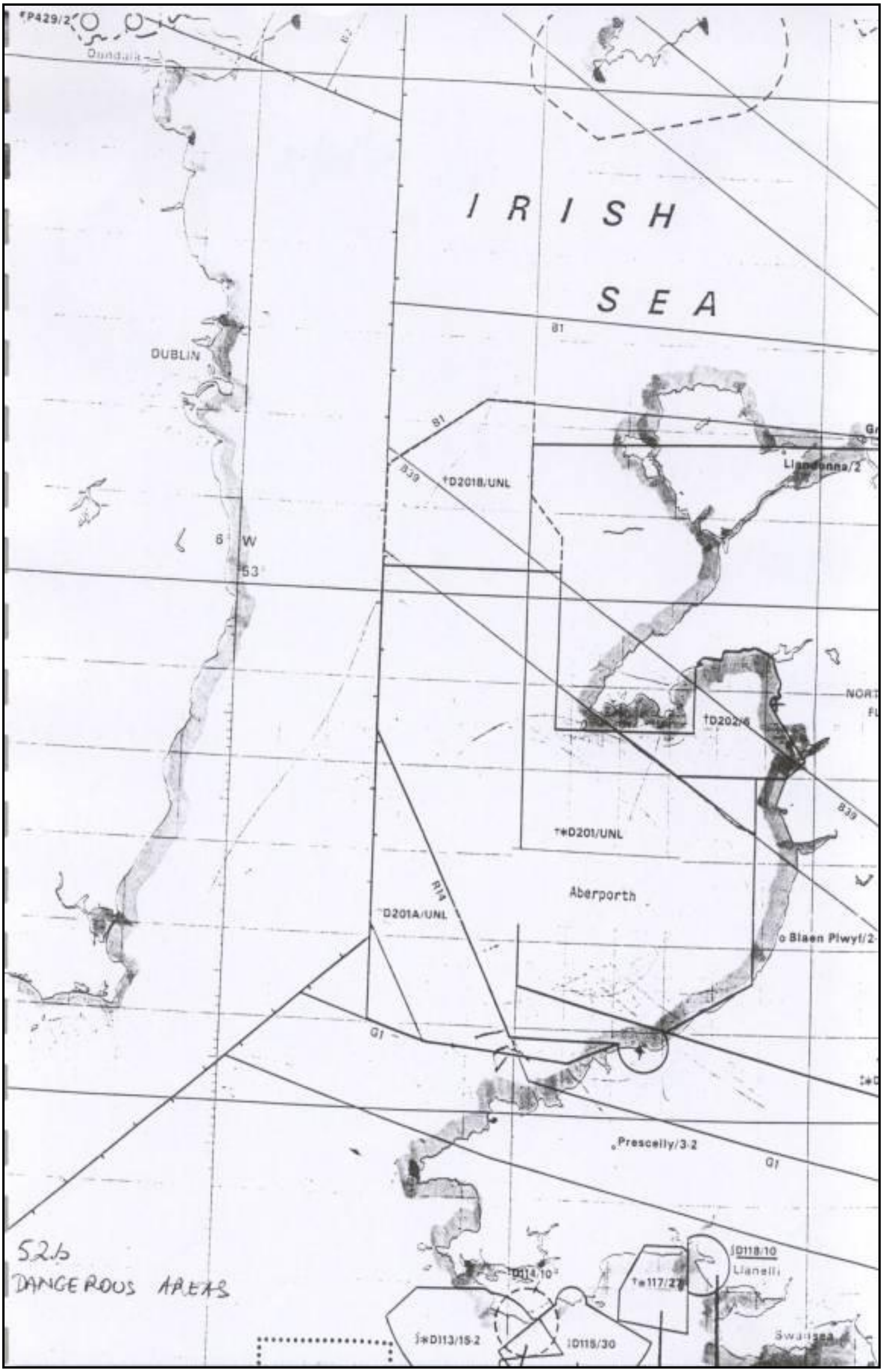
F I R
DUBLIN CTA
SHANNON CTA
WATERFORD
SHANNON CTA
AWY G 1
AWY R 14
D201 A
DANGER AREAS
(1)
(2)
(3)
SHANNON FIR—CTA
LONDON FIR
O C E A N
N T I C
D 119

5.1.a

Appendices 5.2

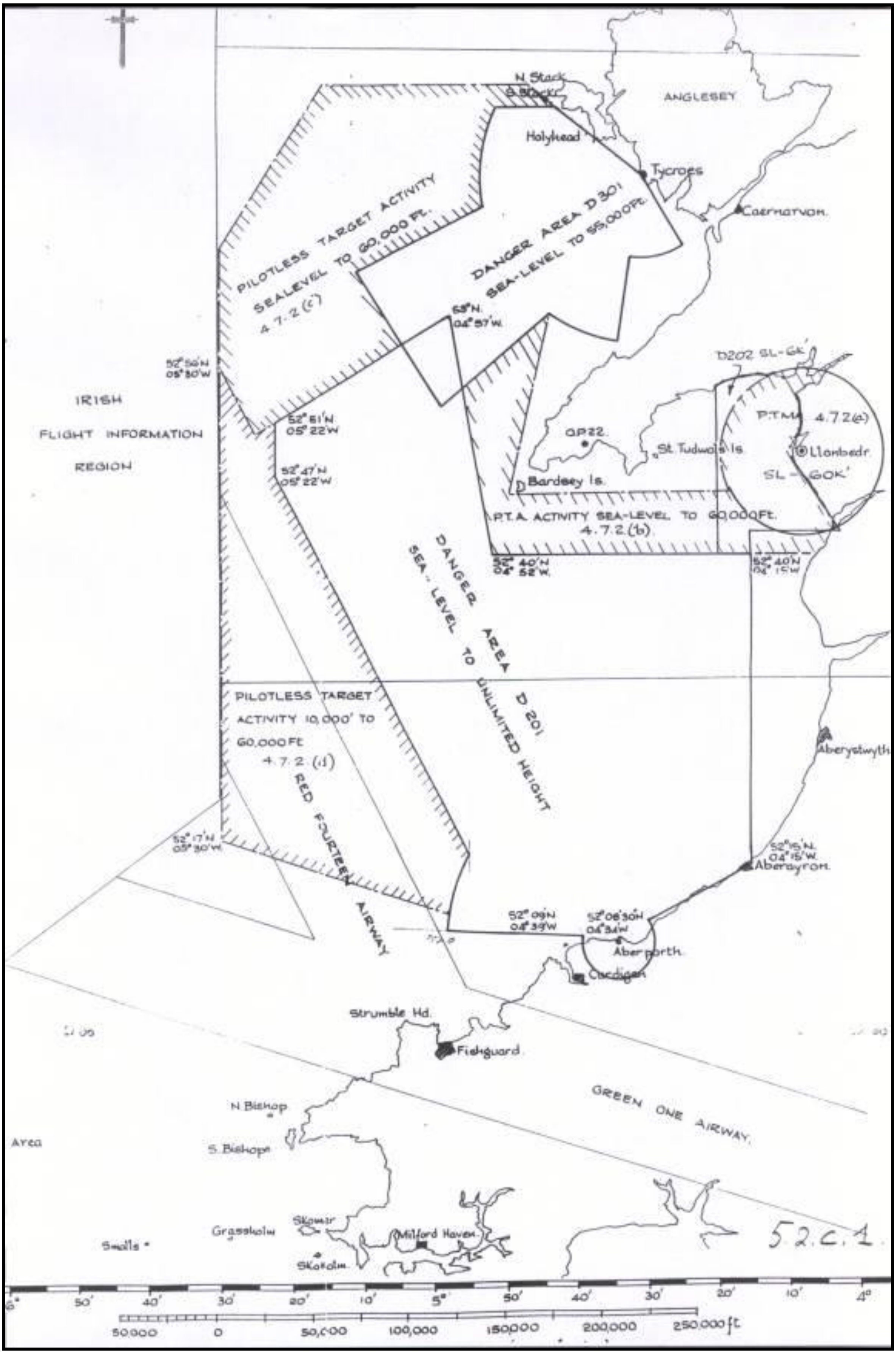


5.2a Location of UK Ranges in 1968

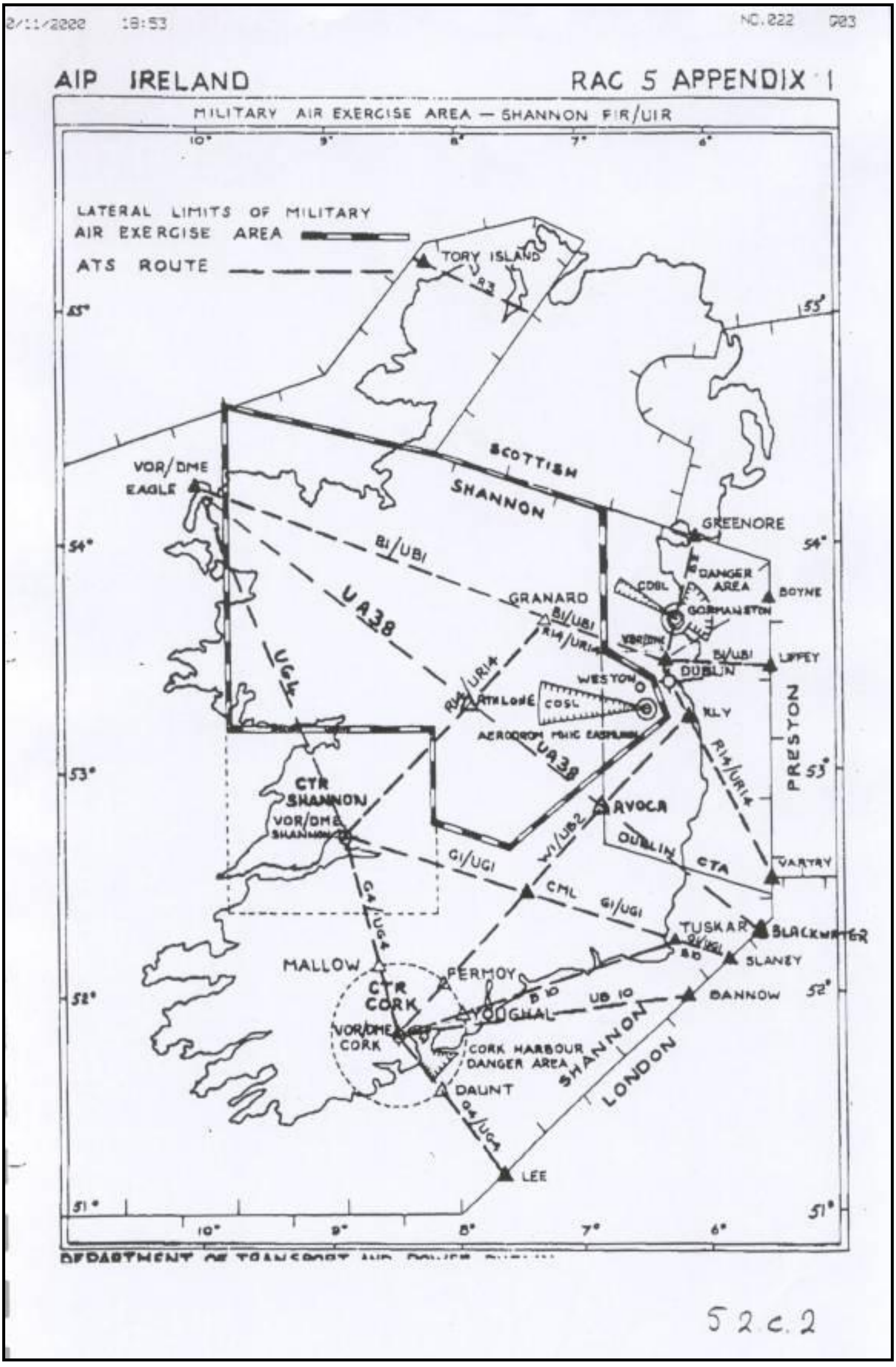


5.2b **Dangerous Areas over the St. Georges Channel (1968)**

5.2c Military Activities (1968)



5.2c.1 In UK



5.2c.2 In Ireland

5.2d Drones Characteristics (1968)

POSSIBLE AIRBORNE OBJECT - DRONE - MISSILE, MANNED OR UNMANNED

1. **DRONES**

	Nation /Year	Type	Characteristics/Dimensions	Performances	Role/Activities	Technical-Operational Description
1.1	Australia 1950 Melbourne + UK + USA	JINDIVIK pilotless Standard Weapon Target MK 1,2,3 A	MK 3 A : improved control and trial equipments Span (5,9 – 7,8) m Length (8,8) m M.T.O. (1500 – 1630) kg FOB: 500 kg	Ceiling : 66.000 ft (20100 m) Speed : . std MPH 391 KmH 630 . short span 645 - 1038 . extended span 276 – 445 . max speed : cruising 564 – 908 . ECO = 155 – 250 . ROC = 15000 ft/ 4570 mn . Practical ceiling 55 – 62000 ft . range (max fuel – max payload) . with pods 820 miles 1320 km . without pods 510 miles 820 km	Target tug for towed targets carrying radar enhancing devices	. Drone remotely controlled from either a ground or airborne station. . Radio Control Equipment comprises: - GEC receiver - Air Tech selector - BEME destroy receiver - GAF relay set receiving - NIC transducers (telemetry) - Notch acrials in fin leading edge - Trial equipments, Transponders and micro-wave reflectors are used for active and semi-active or beam-riding missiles. - Heat sources can be fitted for LOW I.R. output - Transponders in the X, S, C bands can be fitted for tracking at greater range. - Two types of towed targets may be fitted , consisting of : > Recoverable type short length tow > Expendable type long length tow (10000 ft) - Cameras in pod

Appendix 5.2.d.1

b

5.2e Missiles Characteristics (1968)

2. MISSILES

2.1 Surface to Air

BRITISH NAVAL GUIDED MISSILES

Nation /Year	Type	Characteristics/Dimensions	Performances	Role/Activities	Equipped Frigates Types
UK – 1967 – 1968 (in development in 1968)	. Sea-dart (Hawker Siddeley) GWS 30	. Range 25 Nmm . Span : 0,9 m . Length : 4,4 m . Weight : 550 kgs . Solid propellent booster . propulsion :	. Ceiling /M. Nbr . $M \geq 2$. Guidance : - autoguidance system - semi-active homing - radar beam lining (radar type 909)	- AA Warfare	F. 5650 T type 22 - SHEFFIELD - BRISTOL Firing tests begun in mi-1965
UK 1962 – 1967 Operational 1963	Sea-Slug (Hawker Siddeley) MK 1 (1962) MK 2 (1967)	- Range 15 Nm - Span 1,42 m - Length 5,9 m - Weight 900 kgs - 4 solid propellent boosters - high explosive war-head with proximity fuse	- Ceiling/M. Nbr . max 12000 m . M = 2 - lining : . beam-riding (radar 901)	AA Warfare	F. 5200 T County class - KENT - DEVONSHIRE - LONOON - HAMPSHIRE - GLARMORGAN FIFE
UK 1958 – 1965	Sea-Cat type 20 & 22 GWS MK 1 + 2 By SHORTS (Belfast (N. Irl) 2 high explosive type war-heads with both contact and proximity fuses	- MK 1 : . Short range : 4000 m . Tactical : 3000 m . 2 solid powder prop - MK 2 : . extended range : 7 – 8000 m . tactical : 6800 m . launched by JATO + 2 solid powder prop	- Ceiling /M. Nbr . visual and radar director . M. Nbr = 0,8 - Lining . beam riding radar (GWS 22) . sight riding (GWS 20)	Close range anti-aircraft missile	F. COUNTY class 2300 T . Leander class AJAX . 2100 T CAVALIER

Appendix 5.2.e.1

5.2e.1 Surface to Air = Naval

RAF GUIDED MISSILE

Nation /Year	Type	Characteristics/Dimensions	Performances	Role/Activities	Equipped Frigates Types
UK MK1 : 1958 MK2 : 1966	. Bloodhound	. Range > 45 Nmm . Span : 2,83 m . Length : 8,46 m . Diameter : 0,55 m . Weight : ????? . S Propulsion : 4 jettisonnable solid propellent booster + 2 B.S. Thor range + . Warhead : High explosive + proximity fuse	. Supersonic . . Guidance : - semi-active homing	- Surface to Air land based	

Appendix 5.2.e.2

e

5.2e.2 Surface to Air = Air Force

5.2e.3 Air to Air

2.2 Air to Air Missiles

Nation /Year	Type	Characteristics/Dimensions	Performances Guidance	Role/Activities	Fighters ac types equipped
UK 1966 –1967	Fire-Streak Hawker Siddeley	. Length 4 m . Span 0,75 m . Solid propellent . 50 lb war-head, can be detonated at a predetermined range	. Speed/M max M > 2,0 Opl M 0,75 Range 5 Miles . IR homing . Pursuit course weapon	. Close AA missile	Sea-Vix in MK 1 BAC lightning ac
UK	Red-Top	- Length 4 m - solid propellent - 68 lbs war-head	- M : 3,0 max Range 7 N - IR homing - Interception from any direction	. Close AA missile	Sea-Vix in MK 2 BAC lightning (F MK 3 and T6) (T MK 5)
USA adapted UK	Side-Winder N.O.T. 5	. Length 1 m	- M : 2,5 max Range 2 N - IR homing	. Close AA missile	Phantom II

Appendix 5.2.e.3

ROYAL AIRCRAFT ESTABLISHMENT

RANGES DIVISION

AIR TARGETS

(Issue ~~2~~ 3) (AL/2.)

NOVEMBER
~~September~~ 1968 AL/2.

E59

5.2 f.

in the towed target. The flares burn simultaneously.

3.3. Infra-red Aids

Towed targets can be fitted with either three, four or six type SR 549 flares. These have a burning time which varies between 25 seconds at sea level and 45 seconds at 50,000 ft. ~~For tow lengths greater than 100 ft., four type SR 549 flares are the standard fit.~~ The infra-red flares on a towed target burn simultaneously.

AL3

4. Miss-distance Photography

4.1. Standard Wing Pod Camera Packs - Two packs, each consisting of 2 AMPOR Mk. 3 cameras with W.R.E.T.A.R. 180° lenses are the standard fit for Jindivik 103A; these give complete spherical coverage from each wing tip. Camera running speed is approximately 100 frames/sec. and the camera running time with the standard (thin-base) film is 24 secs.; this can be divided into two runs of 12 secs. each, to cover two missile firings on one target sortie.

JINDIVIK

4.2. Non-standard Rearward-facing Cameras - Special lenses on the lower cameras, with special mirrors, give undistorted rearward view at an angle of depression of 17½° and an angular coverage of ± 17½°. This system is associated normally with towed targets on tow lengths of 100 ft. or 200 ft.

5. Safety

5.1. Destruction of Target Aircraft - In the event of a target aircraft malfunction due to any cause, it may be necessary to destroy it in the interests of safety. This action can only be carried out by the operating crew at Llanbedr who send a "Command Destroy" signal. The result of transmitting this signal is to energise the "Destroy" elevator actuator; to apply full 'down' elevator; to select 'Fuel Off'; and, after approximately 12 seconds' delay, to demand a full left aileron to the target. The aircraft should then descend within a 45° cone from the point of 'Destroy', e.g. from 50,000 ft. altitude, the target aircraft should not go outside a circle of 50,000 ft. radius, centred at the point at which 'Destroy' was received by the aircraft.

5.2. 'Signal Fail' orbit and recovery - 'Signal Fail' orbit is an automatic fail-safe condition of the aircraft in the event of a fault in the ground transmitter or both aircraft receivers such that two successive transmissions of Radio Hold pulses are missed. In this case, the aircraft will descend or climb to a holding condition of 30° port or starboard orbit in 'Level Cruise' between 4,000 ft. and 6,000 ft. altitude. (Direction of orbit can be selected prior to take-off or during controlled flight by the skipper). When the fault has been corrected and Radio Hold pulses are again transmitted, the aircraft may be restored to normal control, by transmitting a 'Straight' command.

5.3. Restriction on Jindivik Tracks - With the exception of the take-off and landing phases, a pilotless target aircraft may not be flown over land. To assist those concerned with planning trials involving a Jindivik 103A, the following rules apply:-

(a) Trials in which the Jindivik has not been engaged by a missile

The Jindivik may not be flown closer to land than a distance

52f1

5.2f.1 Safety (of Jindivik)

METEOR

complete spherical coverage from each wing tip. Camera running speed is approximately 100 frames/sec., the camera running time with standard (thin-base) film is 24 seconds; this can be divided into two runs of 12 seconds each, to cover two missile firings on one target sortie.

6. Safety

6.1. Destruction of Target Aircraft

In the event of a target malfunction due to any cause, it may be necessary to destroy it in the interests of Safety. This action can only be carried out by the operating crew at Llanbedr, who send a "Command Destroy" signal. The result of transmitting this signal is to fire the Destroy elevator ram; to apply full 'down' elevator; to select "Fuel off"; and to demand a full left aileron to the target. The aircraft should then descend within a 45° cone from the point of 'Destroy'; e.g. from 30,000 ft. altitude, the target aircraft should not go outside a circle of 30,000ft. radius, centred at the point at which 'Destroy' was received by the aircraft.

6.2. 'Signal Fail' Orbit and recovery

'Signal Fail' orbit is an automatic fail safe condition of the aircraft in the event of a fault in the ground transmitter or both aircraft receivers, such that two successive transmissions of Radio Hold pulses are missed. In this case, the aircraft will descend or climb to a holding condition of 30° port or starboard orbit in 'Level Cruise' between 4,000 ft. and 6,000 ft. altitude. (Direction of orbit can be selected prior to take-off). When the fault has been corrected and Radio Hold pulses are again transmitted, the aircraft may be restored to normal control by transmitting a 'Straight' Command.

6.3. Restriction on Meteor Tracks

With the exception of the take-off and landing phases, a pilotless target may not be flown over land. To assist those concerned with planning trials involving a Meteor 16, the following rules apply :-

(a) Trials in which the Meteor has not been engaged by a missile

The Meteor may not be flown closer to land than a distance equal to one nautical mile plus the altitude of the Meteor.

(b) Trials in which the Meteor is to be engaged by a missile

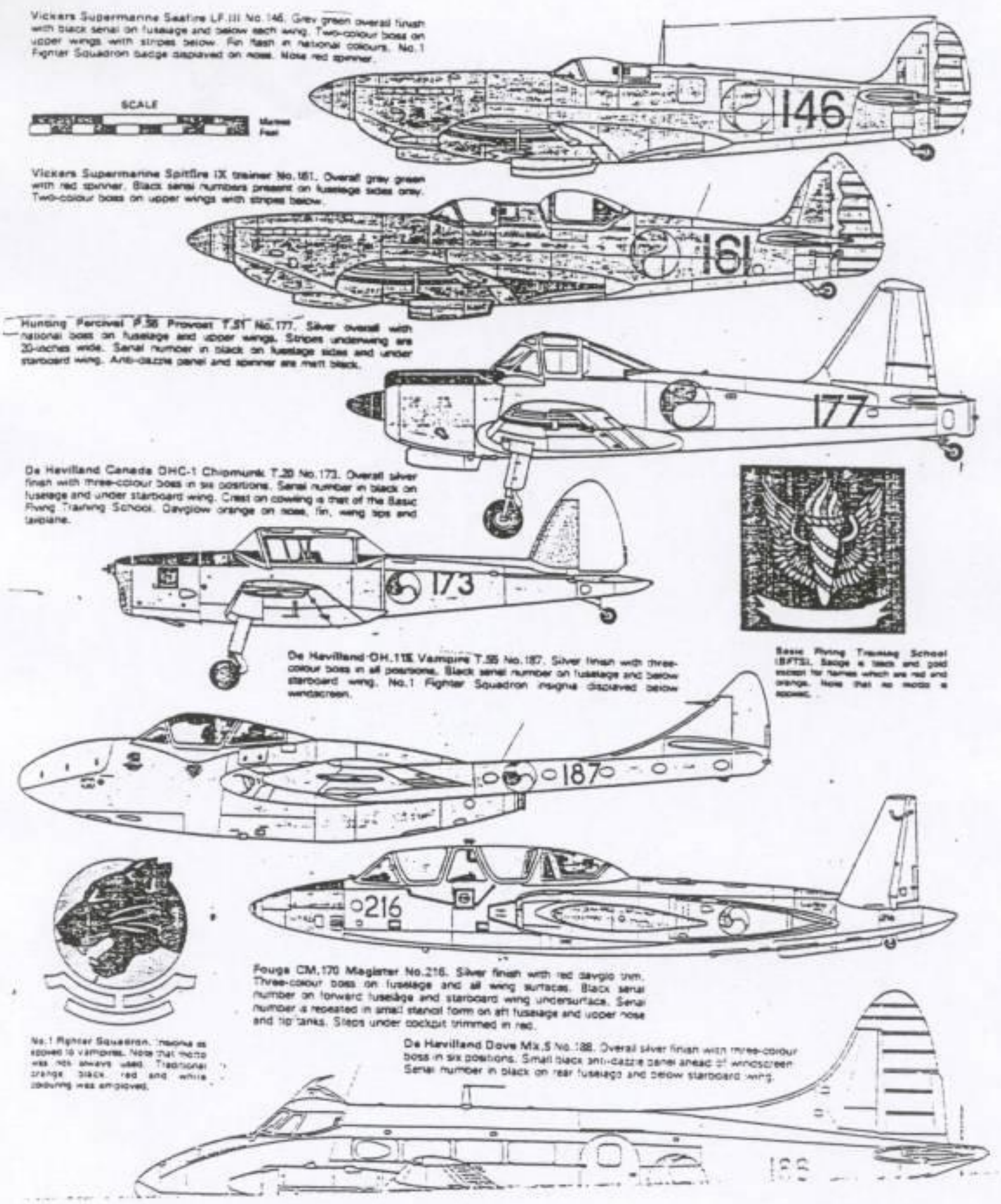
Each trial must be individually vetted, but the following may be used as a guide for planning purposes.

The point of interception by the missile must be clear of land by 2½ nautical miles plus the Meteor's altitude at interception, in the direction of the track of the Meteor; and by 1½ nautical miles plus such altitude in the direction at right angles to the track.

23. 16

52.f2.

5.2f.2 **Safety (of Meteor)**



5.2.g

5.2g Irish Air Corps Aircraft (1968)

HUNTING

HUNTING AIRCRAFT, LTD.

HEAD OFFICE AND WORKS: LUTON AIRPORT, LUTON, BEDFORDSHIRE.

Directors: P. Ll. Hunting (Chairman); G. L. Hunting; C. P. M. Hunting, B.A., A.C.A.; W. A. Summers, C.B.E. (Managing); R. R. S. Cook; L. C. Hunting, M.A.; K. D. Morgan (Secretary); F. W. Buglass, M.I.P.E. (Works); and F. H. Pollicutt, F.R.Ae.S. (Technical).

The Percival Aircraft Company was formed in 1932. It was re-organized as Percival Aircraft Ltd. in 1937, and the works were moved from Gravesend to Luton. In 1944 the company became part of the Hunting Group and a branch office was opened at Toronto, Canada, in 1946. The name was changed to Hunting Percival Aircraft, Ltd. in 1954 and to Hunting Aircraft, Ltd. in 1957.

In 1958 Hunting participated in the formation of a consortium with Fairey Aviation Ltd. and de Havilland Holdings, Ltd. to produce the D.H. 121 jet airliner which has been chosen by B.E.A. The new company is known as the Aircraft Manufacturing Co., Ltd. (Airco) (which see).

The current Hunting products are the Provost, the Jet Provost, the Pembroke and the President.

The Provost, a side-by-side two-seat basic trainer, is at the time of writing in service at all the basic flying schools in the R.A.F. but was due to be replaced during [illegible] by the Jet Provost Mk. 3, initial evaluation versions of which have been in service with the R.A.F. for the past three years.

In addition to the R.A.F., the Jet Provost is in service with the Ceylon Air Force, and its piston-engined predecessor—the Provost—is serving with the Air Forces of Rhodesia, Burma, Eire, Iraq and Sudan.

The Pembroke is in service in the Royal Air Force, the Royal Rhodesian Air Force, the Belgian Air Force, the Finnish Air Force, the Swedish Air Force, the Royal Danish Air Force, the West German Air Force and the Sudan Air Force.

The civil version of the Pembroke is known as the President.

52.h.

Hunting Provost T.Mk. 53 armament trainers as supplied to the Sudan Air Force.

THE HUNTING P.56 PROVOST

The P.56 trainer was designed to Specification T.16/48 to meet R.A.F. requirements. Three prototypes were built, two fitted initially with the Armstrong Siddeley Cheetah 18 engine and the other with the Alvis Leonides engine. The first (Cheetah-engined) prototype flew for the first time on February 23, 1950.

As the result of comprehensive trials the Leonides-engined P.56 was selected as the standard R.A.F. basic trainer under the designation Provost T. Mk. 1.

The armed version of the Provost for weapon training can be equipped with the following armament: 2 × .303-in. machine-guns; 1 camera-gun and 2 × 250-lb. bombs; or 8 × 25-lb. bombs; or 8 × 25-lb. bombs and 4 × 60-lb. R.P.; or 6 × 60-lb. R.P.

The following are the designations of the Provosts which have been exported:—

Provost T. Mk. 51. T. Mk. 1 (unarmed) supplied to Eire Air Corps.

Provost T. Mk. 52. Armed version supplied to the Royal Rhodesian Air Force.

Provost T. Mk. 53. Armed version supplied to the Eire Air Corps, the Burma Air Force, the Iraqi Air Force and the Sudan Air Force.

The following description applies specifically to the Provost T. Mk. 1.

TYPE.—Two-seat Basic Trainer.

WINGS.—Cantilever low-wing monoplane. Wing section NACA 23015 (mod.) at root. NACA 4412 (mod.) at tip. Aspect ratio 5.78. Dihedral 6°. Incidence 3°. All-metal stressed skin construction. Metal covered ailerons and trim-tabs. Pneumatically-operated slotted flaps. Total flap area 18.94 sq. ft. (1.74 m.²). Gross wing area 214 sq. ft. (20 m.²)

FUSELAGE.—All-metal monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal one-piece tailplane, interchangeable elevators, fin and rudder, the fixed surfaces covered with smooth and movable surfaces with fluted alloy skin. Trim and balance tabs in elevators, combined trim and balance tab in rudder. Span of tailplane 13 ft. 6 in. (4.1 m.). Total horizontal area 48.6 sq. ft. (4.51 m.²). Total vertical area 35.09 sq. ft. (3.26 m.²)

LANDING GEAR.—Fixed tail-wheel type. British Messier oleo-pneumatic shock-absorbers. Differential pneumatic brakes. Dowty liquid-spring tail-wheel strut. Track 11 ft. 1½ in. (3.38 m.)

POWER PLANT.—One 550 h.p. Alvis Leonides 25 nine-cylinder air-cooled geared and supercharged radial engine. Three-blade metal constant-speed airscrew, 9 ft. (2.74 m.) diameter. Fuel capacity 66 Imp. gallons (300 litres).

ACCOMMODATION.—Crew of two in enclosed cockpit. Instructor (on starboard) and pupil sit side-by-side, with full dual controls and dual instrument panels. Sliding canopy is mechanically-operated and jettisonable.

DIMENSIONS.—
- Span 35 ft. 2 in. (10.9 m.)
- Length 29 ft. (8.85 m)
- Overall height (tail up) 12 ft. (3.66 m.)

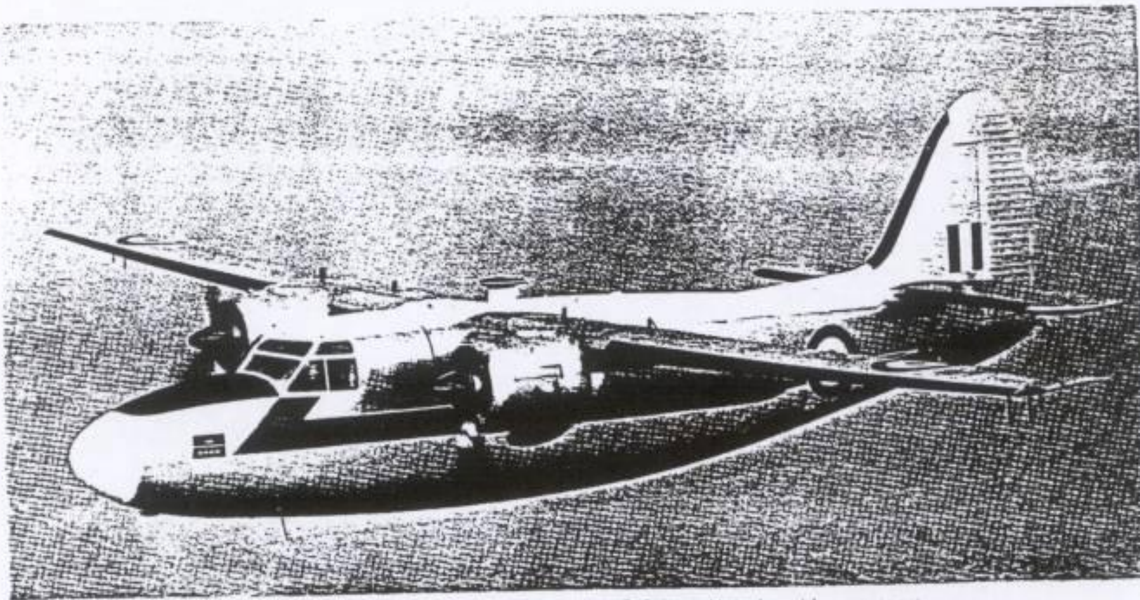
WEIGHTS AND LOADINGS.—
- Weight empty (equipped) 3,350 lb. (1,521 kg.)
- Crew (2) 400 lb. (182 kg.)
- Fuel and oil 529 lb. (240 kg.)
- Weight loaded 4,400 lb. (2,000 kg.)
- Wing loading 20.6 lb./sq. ft. (100.5 kg./m.²)
- Power loading 8.0 lb./h.p. (3.63 kg./h.p.)

PERFORMANCE.—
- Max speed 195 m.p.h. (313 km.h.) at sea level and 200 m.p.h. (322 km.h.) at 2,300 ft. (700 m.)
- Max. continuous cruising speed 194 m.p.h. (310 km.h.) at 7,900 ft. (2,410 m.)
- Max. economical cruising speed 177 m.p.h. (283 km.h.) at 11,500 ft. (3,510 m.)
- Stalling speed, flaps down 67 m.p.h. (108 km.h.)
- Initial rate of climb 2,200 ft./min. (11.2 m./sec.)
- Rate of climb at 5,000 ft. (1,525 m.) 1,870 ft./min. (9.5 m./sec.)
- Climb to 5,000 ft. (1,525 m.) 3.3 minutes.
- Climb to 10,000 ft. (3,050 m.) 7.0 minutes.
- Rate of roll (per second) 90 degrees.
- Service ceiling 22,500 ft. (6,860 m.)
- Take-off to 50 ft. (15.2 m.), grass surface 283 yds. (260 m.)
- Landing run 265 yds. (242 m.)
- Duration (at economical weak cruise) 4 hrs.

THE HUNTING P.66 PEMBROKE

The Pembroke is an eight-seat communications and light transport aircraft which is in service with the Royal Air Force. It is adaptable for freighting, long-range ferrying, casualty evacuation and photographic survey duties.

Fixed fittings in the cabin are provided for eight 15G rearward-facing seats, for stretchers or for lashing down cargo. The main cabin door is removable for parachuting freight and equipment.



The Hunting Pembroke C. Mk. I (two 560 h.p. Alvis Leonides engines).

52 h.

Hunting P56 Provost MK 51 Characteristics

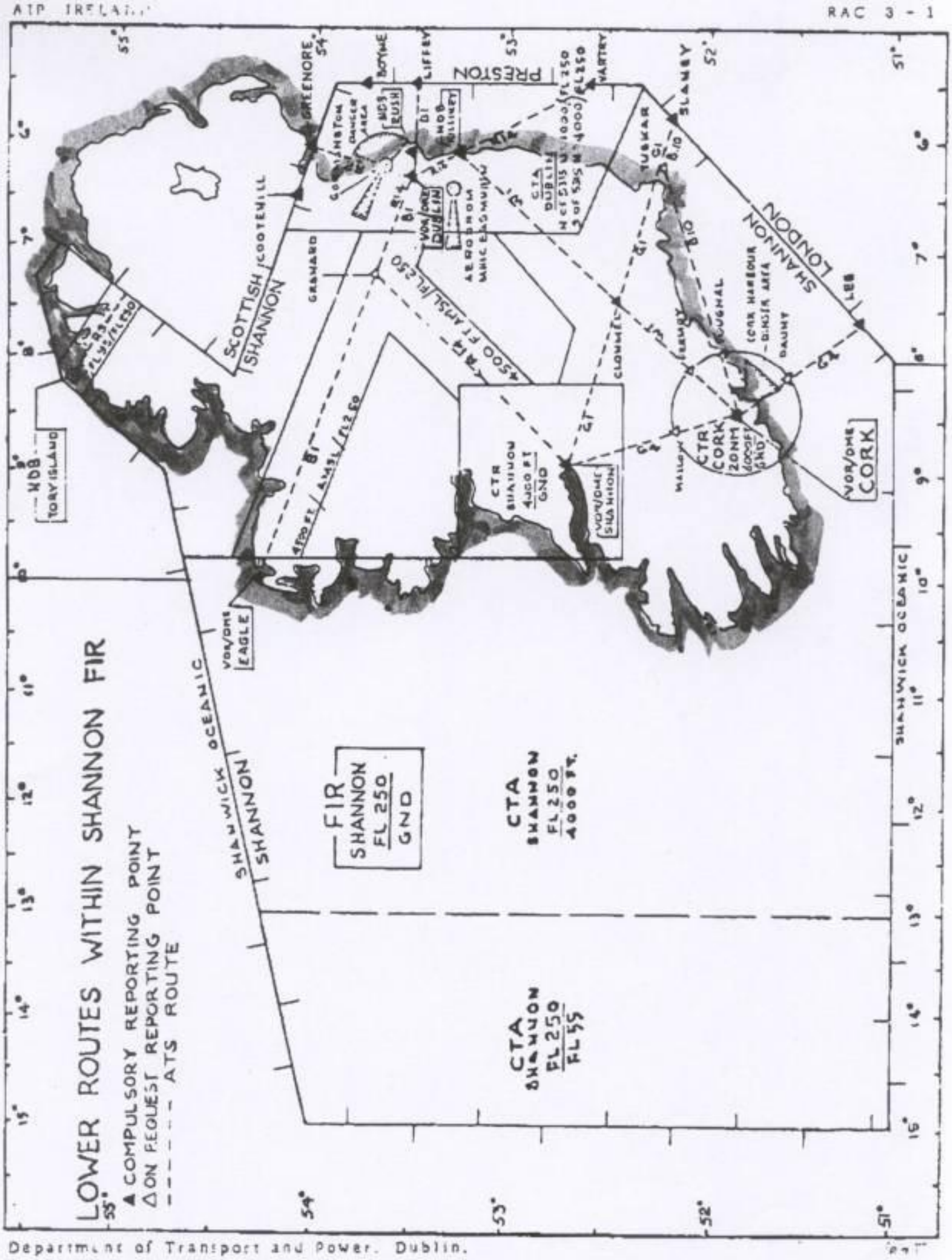
Date	A/C	PILOT	CREW	OFF	ON	Movements	Details
19-3-68	197	FL	+2	0935	0951	2.	D A C.
Tuesday	187	IS	FN	1100	1130	2.	GCA EIDW.
~~MON~~	196	FX	+1	1327	1427	2	Drawn W. Dún Laoire
	196	IF	+2	1453	1500	2.	Demo. Local.
	176	IJ	FV	1508	1515	2.	Demo Local.
20-3-68	197	FK	FX	0900	0930	2.	AUTO ROT.
Wednesday	196	FK	+1	1051	1238	2	D/wnch D/Laoire.
~~THUR~~	180	FE	FP	1103	1255	22	⊙ + Forced Landings
	189	FQ	FJ	1052	1254	22	⊙ + Forced Landings
21-3-1968	176	IJ	FW	0835	1138	2	ILS/VOR EINN.
Thursday.	196	IF	+1	0854	0909	2	D.A.C.
	180	IN	FE	1037	11.27	2	Steep turns FL70
	180	IN	FP	12.38	13.09	2	Steep Turns
	176	IJ	FV	13.35	14.28	2	BASIC I.F
	197	FK	FL	13.36	14.18	2	I.F Sim
	197	FL	FK	14.25	14.44	2	I.F Sim
	180	FJ	FQ	14.26	1526	2	Steep turns FL70
	176	IJ	FB	14.38	1524	2	Basic I.F Sim
22.3.68	176	FC	FB	09.10	1030	2	ILS, VOR, EIDW
Friday	186	IC	Solo	1017	1114	4.	Air Test
	183	FE	FP	1033	1157	6	Steep Turns FL100
	180	FQ	FJ	1044	1145	2	" " FL100
	183	IN	FJ	13.10	13.57	2	Low Flying West of B
	180	IH	+1	13.17	13.54	2	Low Flying
	176	IJ	FW	13.45	15.07	4	BASIC I.F TEST
	180	IH	+1	14.02	14.39	2	Low Flying
	183	IN	FQ	14.05	14.52	4	Low Flying West of BN
	180	FJ	FE	14.50	1530	12	Circuits
	196	FK	+3	14.53	~~14.55~~ 15.06	2	Local
	197	IF	+1	14.56	15.20	2	Blackrock - Pigeon House = BN
	183	FP	+1	15.01	15.30	10	Circuits
	184	IA	Solo	15.08	1534	6	Circuits = Aerobatics
	184	FP	FQ	1620	1711	2	EX 16
	180	FE	FJ	1621	1709	2.	EX 16
23/3/68	196	FL	Solo	0931	0946	2	DAT
	196	FX	FV	1046	1140	2	MTH FLYING

Date	A/C	Pilot	Crew	OFF	ON	Movement	Details
Sun	196	IJ	+2	1225	1416	2	SAR Strumble
24-3-68	Heli 197	FL	+2	1231	1413	2.	SAR area
MONDAY	196	FO	+3	1034	1853	2	Search Ballyteigue Bay
25-3-68	197	FK	+1	1108	1134	2	DAC
"	176	IJ	FB+4	1116	1857	2	Search SE Coast VFR
"	194	FK	+2	12??	1925	2	TUSKAR ROCK SEARCH SGT FITZ - CPL O'BRIEN.
Tuesday 26-3-68	196	FO	+2	0703	1917	2	TUSKAR AREA - SEARCH.
	197.	FX	+5	0922	1918	2	" " "
	186	IC	Solo	0939	1010	4	O GH. FL240
	176	FB	FV+4	1023	1444	2	TUSKAR AREA - SEARCH.
	196	IJ	+4	1520	1824	2	TUSKAR FOXTROT CHARLIE, LT MCGRATH. LT ??. LT ??
Wednesday 27.3.68	196	FK F3	FX+3	08.53	13.46	2	BNA : Wexford
	176	FC	FV+4	0854	1229	2.	Tuskar Area Search
	186	IS	PL	10 Detail Cancelled			~~GCA~~ DW ; [illegible]
	176	IJ	F?+3	1308	1624	2	Tuskar Area Search.
THURS 28-3-68	197	IF	+2	0912	1313	2.	DUNCANNON - SALTEE.
	176	IJ	+5	0933	1355	2.	" "
	186	IS	PM	0935.	1038	6	GEN HANDLING.
	196.	FL	+1	1101	1123	2	DAC
	176	FB	+4	1425	17.26	2	DUNCANNON - SALTEE
FRIDAY 29-3-68	197	IF	+4	0925	1704	2	RESSLARE.
	176	IJ	FC	1304	1816	2	Search area - Valley - Commit.
Saturday 30-3-1968	197	IF	FK+3	0847	1357	2	Carnsore to Tuskar Search Area
	176	FN	FC+3	0919	1435	2	TUSKAR SEARCH AREA
	186	IA	SOLO	0951	1043½	6	
	196	FX	+1	1059	1118½	2	DAC.
SUN	176	FB	+4	0913	1311	2	TUSKAR SEARCH
	197	IX	+4	0927	1327	2	"
31-3-68	196	FO	+1	1114	1125.	2	DAC

Date	A/C	Pilot	Crew	Off	On	Mens	Details
1.4.68 Monday.	196	FL	+1	1330	1337	2	D.A.C.
2-4-68 Tuesday	176	1.J	+1	08,35	0853	4	DAC
	193	1S	Solo	0929	1018	2	Flight Test.
	176	1J	+4	1000	1223		ASR Tuscar
	180	FE	FP	1020	1121	8	Aerobatics GH. FL100
	184	FQ	FJ	1021	1119	12	" "
	193	1S	+1	1059	1143	2	Formation Flying.
	186	1C	PM	1059	1143	2	
	196	FX	+1	1108	1130	2	DAT.
3.4.68 Wednesday	176	FC	F?	0915.	1209	2	SEARCH TUSKAR.
	186	RED 1S	RED SEC	0918	1013	2	FORMATION
	193	1G				2	Practise.
	184	FJ	FQ	1031	1128	4	Aerobatics Forced Ldgs
	180	FP	FE	1033	1127	2	" "
	186	1H	RED SEC	1053	1141	2	FORMATION
	193	1G			1139	2	"
	19[illegible]	F[illegible]	+1	1109	1118	2.	D.A.C
	180	IN	FQ	13.14	13.37	6	Local F. landings
	184	FE	FP	13.16	1358	8	F. landings
	180	1N	FJ	1340	1408	8	Forced Landings
	197	FU	+1	1409	1715	82	Ambulance Brains, Castlebar, Brains
	180	1N	FE	1418	14.40	8	Circuits
	184	FQ	FJ	14.35	1517	8	Aerobatics FL 100
	180	IN	FP	14.46	1514	6	Circuits
4.4.68. Thursday	176	1D	+4	0859	13.16	2	Rosslare. - Search.
	186	1H	PO	0948	1042	2	Red Sec. Formation
	193	1C	PM	0948	1042	2	
	184	FP	FE	1017	1126	2.	IF Sim + QGH
	180	FJ	FQ	10.23	1121	2.	IF Sim + QGH
	187	1A	Solo	13.43	14.35	6	G. Handling FL 320.
	184	FP	FE	13.47	15.19	8	IF Sim QGH
	180	FJ	FQ	13.49	15.18	4	IF Sim QGH
	196	1.F	+1	13.56	14.10	2	General Handling Low
	193	PM	Solo	14.21	14.54	14	Circuits
	176	FU	FB	1424	15.10	2	ILS = VOR = EIDW

Appendix 5.4

5.4a	**Lower Routes within Shannon F.I.R. in 1968**
5.4b	**EI-AOM Flight Reconstruction**
5.4c	**Astronomic Data (Sun Related) at the Time of the first EI-AOM Spin**
5.4d	**Sensitivity of the DART Engine to the Negative Accelerations**
5.4e	**Rigging, Symmetry and Control Surface Check at Aer Lingus on Viscount in 1968**
5.4f	**Fuel and Water Methanol Systems**
5.4g	**R/T Propagation Aspects**
5.4h	**Timing of the Shannon Recorder**


LOWER ROUTES WITHIN SHANNON FIR
▲ COMPULSORY REPORTING POINT
△ ON REQUEST REPORTING POINT
- - - - ATS ROUTE
FIR SHANNON FL 250 GND
CTA SHANNON FL 250 4000 FT.
CTA SHANNON FL 250 FL 55
SHANWICK OCEANIC
SHANNON
SCOTTISH
SHANNON
LONDON
PRESTON
NDB TORY ISLAND
VOR/DME EAGLE
VOR/DME SHANNON
VOR/DME CORK
CTR CORK
CTR SHANNON
GREENORE
BOYNE
LIFFEY
VARTRY
SLANEY
TUSKAR
COOTEHILL
GRAWARD
CLONMEL
YOUGHAL
LEE

5.4.2

Appendix 5.4b Track Reconstruction

Map 1: General View of the Track Reconstruction

Map 2: Track Reconstructed and Witnesses Position between Youghal and Tramore

Map 3: Track Reconstructed and Witnesses Position between Tramore and Tuskar Rock

Map 4: Idem

Map 5: Idem

<u>Map 1</u>: General View of the reconstructed Tracks

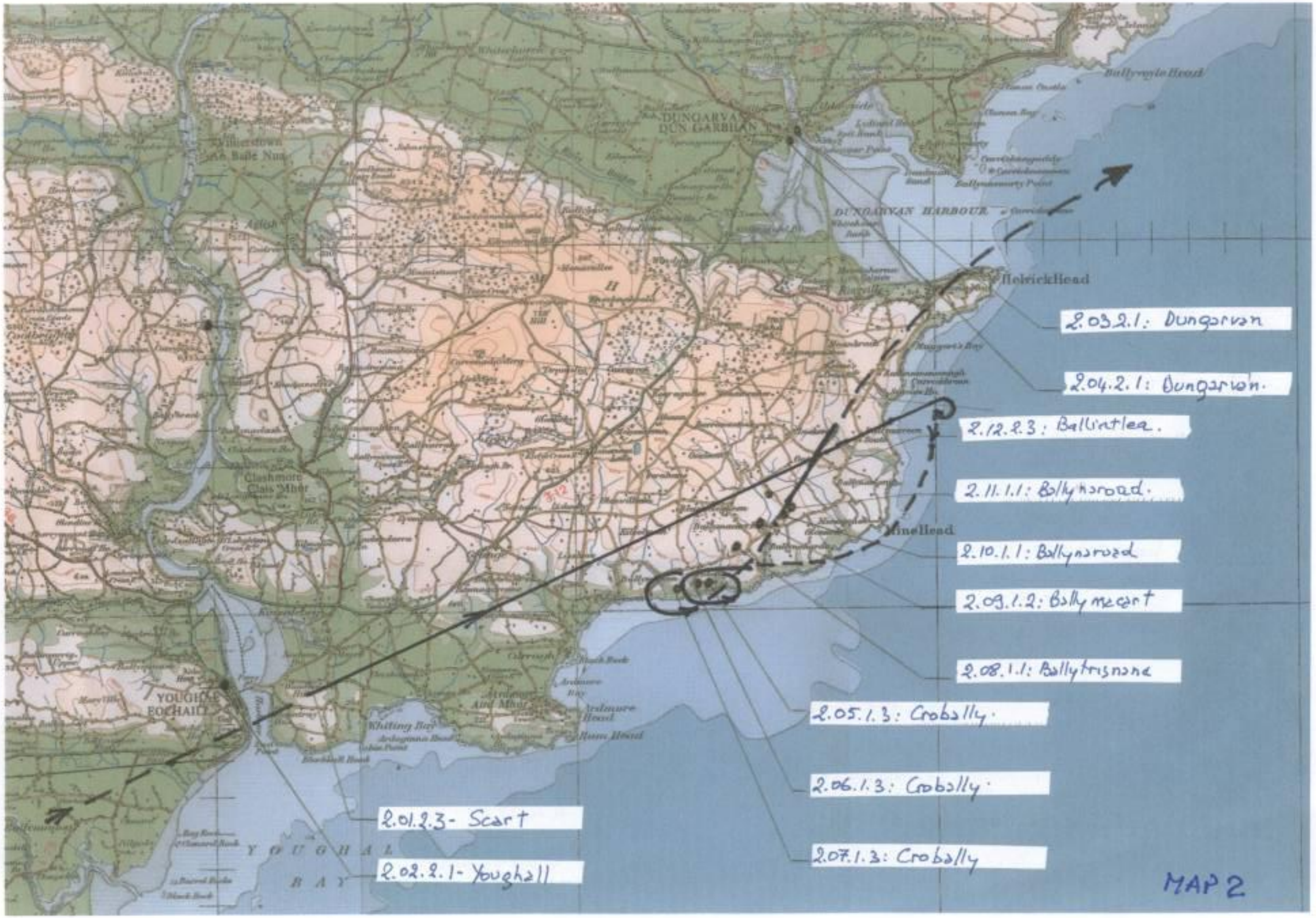
(1) According to Shannon R/T Transcript

(2) According to Ground Witnesses Statements

<u>Map 2:</u> Track Reconstructed and Witnesses Position from Youghal to Tramore

1. 2.01.2.3	**2.** 2.02.2.1	**3.** 2.03.2.1	**4.** 2.04.2.1	**5.** 2.05.1.3
6. 2.06.1.3	**7.** 2.07.1.3	**8.** 2.08.1.1	**9.** 2.09.1.2	**10.** 2.10.1.1

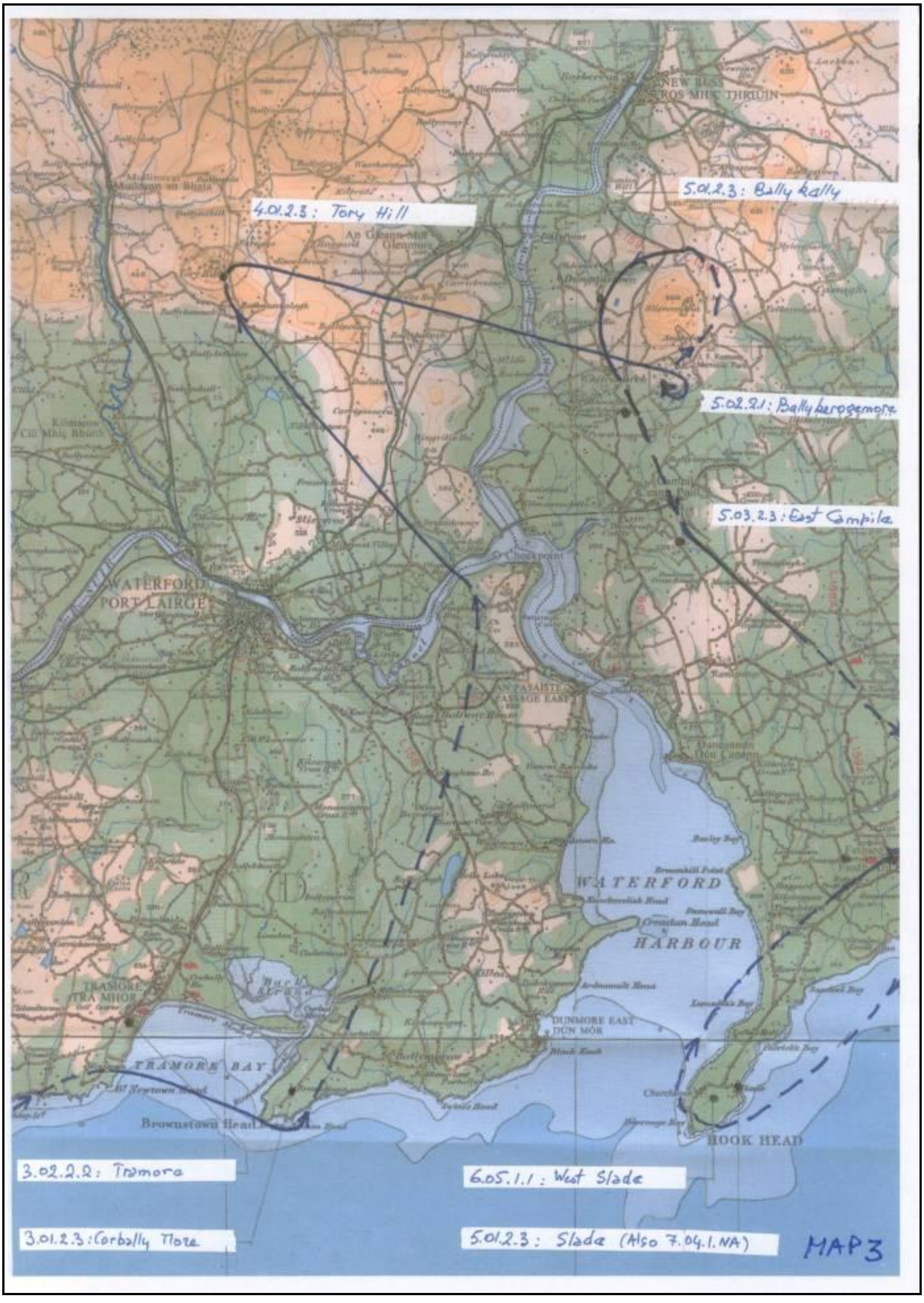
NB: Dotted Line when the Viscount was not observed.


DUNGARVAN
DUN GARBHAN
DUNGARVAN HARBOUR
Ballyvoyle Head
Helvick Head
Mine Head
Ardmore Head
Ram Head
Whiting Bay
YOUGHAL
EOCHAILL
YOUGHAL BAY
Clashmore
Clais Mhór
Villierstown
Aglish
2.03.2.1: Dungarvan
2.04.2.1: Dungarvan.
2.12.2.3: Ballintlea.
2.11.1.1: Ballynaroad.
2.10.1.1: Ballynaroad
2.09.1.2: Ballymacart
2.08.1.1: Ballytrisnane
2.05.1.3: Crobally.
2.06.1.3: Crobally.
2.07.1.3: Crobally
2.01.2.3- Scart
2.02.2.1- Youghall

MAP 2

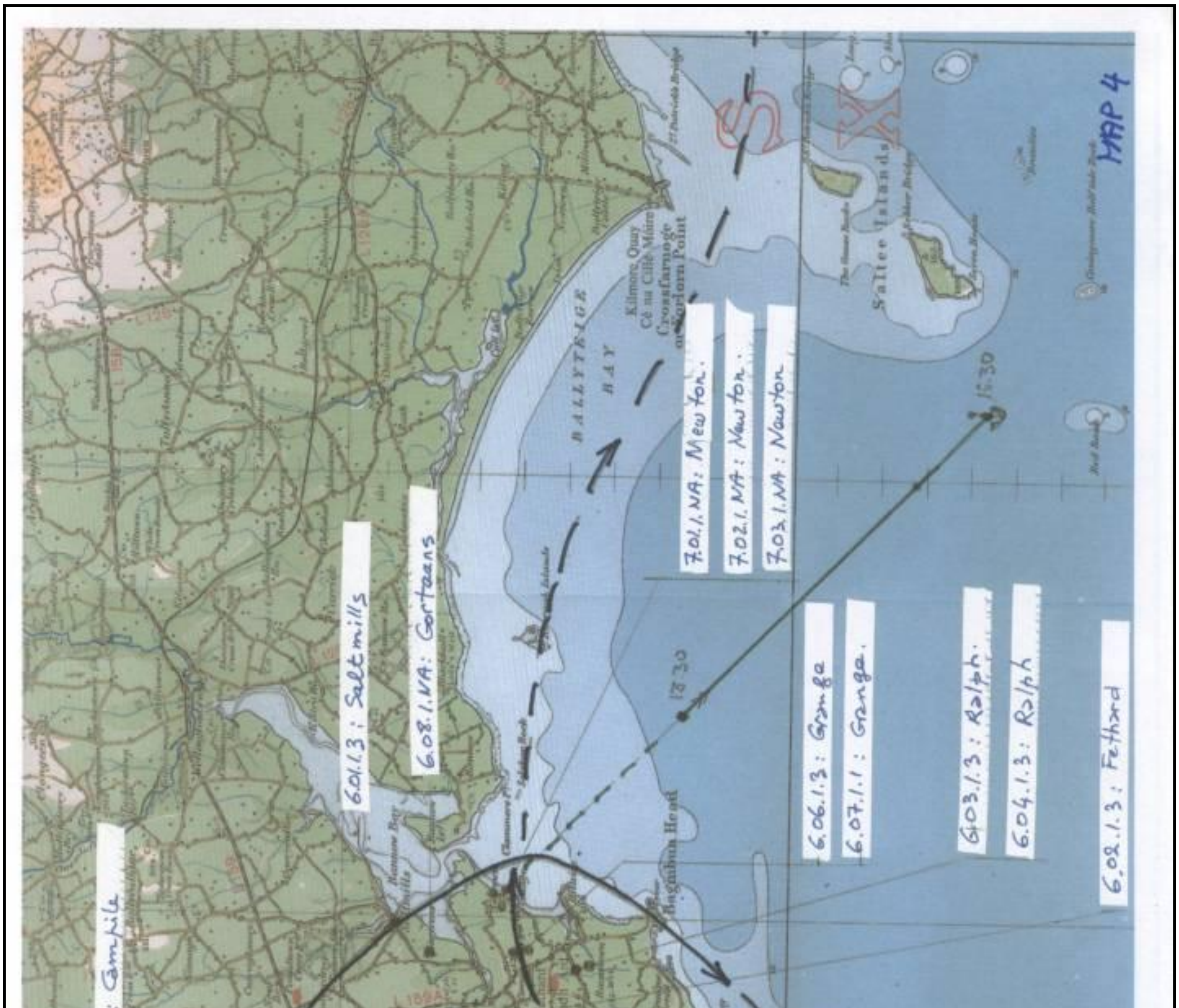
Map 3:

Track Reconstructed and Witnesses Position between Tramore and Tuskar Rock (continued)



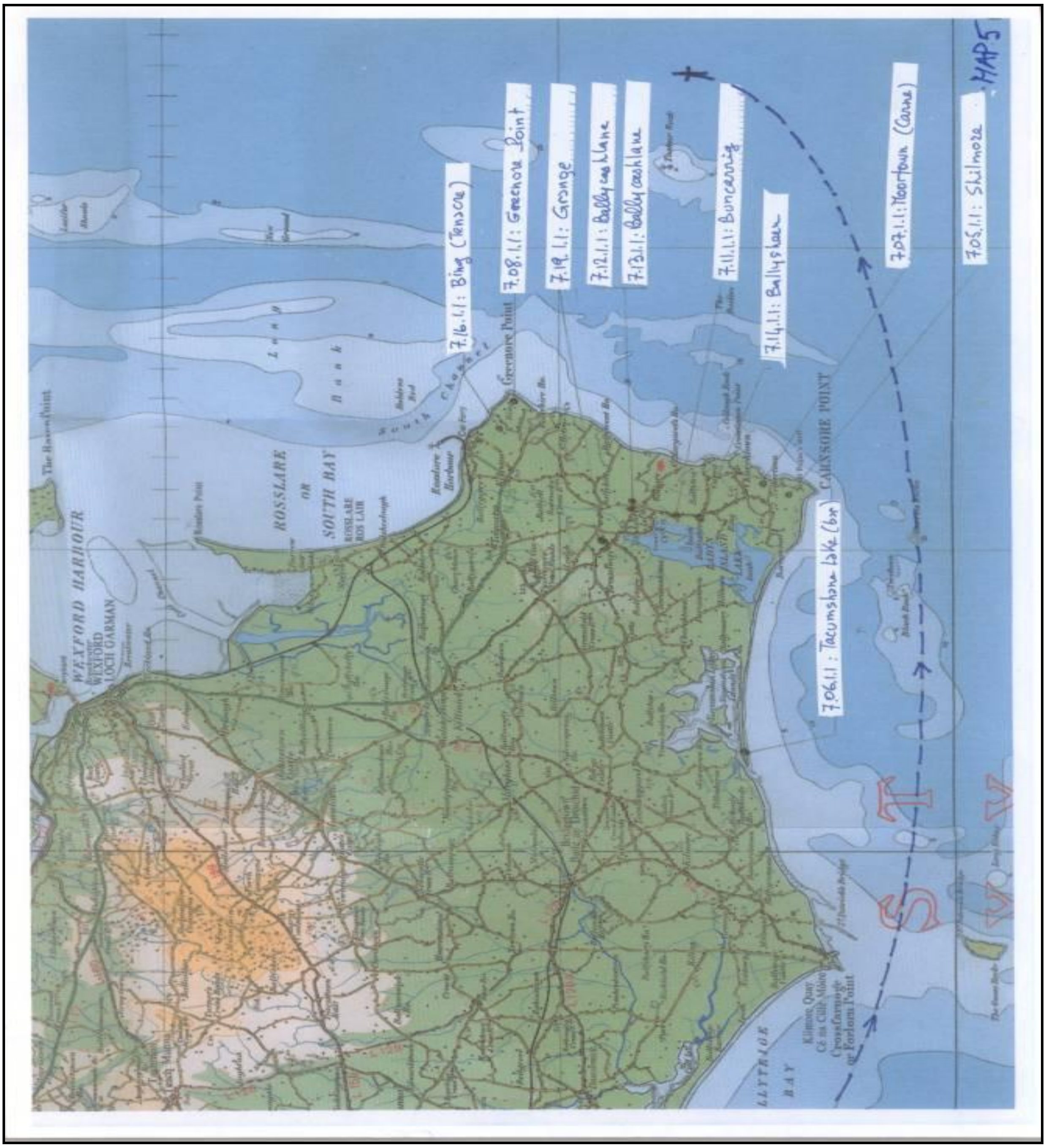
Map 4:

Track Reconstructed and Witnesses Position between Tramore and Tuskar Rock (continued)



<u>Map 5:</u>
Track Reconstructed and Witnesses Position from Tramore to Tuskar Rock (3 Views)

1. 3.02.2.2	**2.** 3.01.2.3	**3.** 4.01.2.3	**4.** 5.01.2.3 and 7.04.1 NA	**5.** 5.02.2.1 (2 persons)
6. 5.03.2.3	**7.** 6.01.1.3	**8.** 6.08.1 NA	**9.** 6.02.1.2	**10.** 6.03.1.3 and 6.04.1.3
11. 6.05.1.1	**12.** 6.06.1.3 and 6.07.1.1	**13.** 7.01.1 NA; 7.02.1 NA and 7.03.1 NA	**14.** 7.06.1.1	**15.** 7.05.1.1
16. 7.07.1.1	**17.** 7.08.1.1	**18.** 7.11.1.1	**19.** 7.12.1.1	**20.** 7.13.1.1
21. 7.14.1.1	**22.** 7.16.1.1	**23.** 7.19.1.1		
NB: Dotted Line when the Viscount was not observed.				



Appendix 5.4c Astronomic Data (Sun Related) at the Time of the first EI-AOM Spin

These data were used by the Team to cross-check the statement of witness 2.01.2.3

5.4c

émis par : 33 1 46 33 28 34   1UREAU LONGITUDES   A4->A4 09/11/00 15:28 Pg: 1/1

Ministère de l'Education Nationale de la Recherche et de la Technologie
Observatoire de Paris

Institut de Mécanique Céleste et de Calcul des Ephémérides

BDL

reau des longitudes   77, avenue Denfert-Rochereau - 75014 PARIS

Centre National de la Recherche Scientifique
UMR 8028

Téléphone : (0)1 40 51 22 70
Télécopie : (0)1 46 33 28 34
Minitel : 3615 BDL
Internet : http://www.bdl.fr

A Paris, le 9 novembre 2000

EXP'AIR SARL
36, rue Alphonse Pallu
78110 LE VESINET

Monsieur,

En réponse à votre fax du 7 novembre, je vous informe que, le dimanche 24 mars 1968 (pour un lieu de latitude 52° 1' nord et de longitude 7° 52' ouest), la hauteur et l'azimut du Soleil étaient :

	Hauteur	azimut
- 10h 40m (TU) :	33° 32' au-dessus de l'horizon	36° 16' est compté à partir du sud
- 10h 45m (TU) :	34° 19' au-dessus de l'horizon	34° 51' est compté à partir du sud

Souhaitant avoir répondu à votre attente, je vous prie d'agréer, Monsieur, l'expression de mes très sincères salutations.

M. Heurtier

Michel Heurtier

5.4.c.

Appendix 5.4d Sensitivity of the Dart Engine to the Negative Accelerations

5.4d.1 Extract of the Rolls-Royce operating instruction for DART 520, 525 and 530 in the Vickers Viscount

OPERATING INSTRUCTIONS

DART 520, 525 AND 530
in the
VICKERS VISCOUNT

Publication ref. F-Da7-V

Issue 2

5.4.d.1

2. Associated flight fine pitch lock failure.

In the event of a complete electrical failure, the engines should be stopped as soon as practicable after landing to prevent engine overheating because of the propeller flight fine pitch locks remaining engaged.

Variation of take-off r.p.m.

The r.p.m. at take-off when using water/methanol could, in some instances, vary slightly above or below that recommended.

Negative 'g' flight

Negative 'g' manoeuvres should be avoided where possible, as sustained negative 'g' conditions may cause automatic feathering of one engine when the auto system is armed i.e. above 11,500 r.p.m. (12,800 r.p.m. post Fokker S.B. 61-25).

The T.G.T. should be monitored to avoid excessive temperature which may result from an abortive auto-feather.

SIMULATED AUTO-FEATHERING IN FLIGHT

Demonstration of an engine failure has to cover two aspects.

1. Demonstration of the auto-feathering system

This may be done on the ground with the engine stationary (see the Maintenance Manual). However, the following drill is recommended (provided the engine incorporates Dart Mod.733 - F.C.U. with modified back pressure valve) for use in flight, but only under cruise conditions:

Power lever	- Set to obtain at least 12,000 r.p.m. (13,000 r.p.m. post Fokker S.B.61-25)
Fuel shut-off valve handle	- Pull (shut)
H.P. fuel valve lever	- LOCK OUT

When the propeller has auto-feathered the fuel shut-off valve should be returned to the OPEN position (pushed in) as soon as the feathering is complete and before completing the normal manual feathering drill. Relight the engine within 2 minutes except where the conditions stated in the following paragraph prevail.

If during flight, prior to a demonstration of the auto-feathering system, the indicated outside air temperature has not dropped below 0 deg.C. the limit of 2 minutes may be disregarded provided sub-zero temperature conditions are not encountered.

5.4d.2 + 5.4d.3 Extract of the Rolls-Royce operating instructions for DART in the Fokker Friendship

Printed in Great Britain

ROLLS-ROYCE

OPERATING INSTRUCTIONS

DART
in the
FOKKER FRIENDSHIP

Publication ref. F-Da7-FoF
Issue 2

5.4.d.2

5.4.d.2

Dart Engines Effects of Negative 'g'

A survey has been made of the known incidents in which Dart-engined aircraft have been subjected to Neg. 'g', either deliberately or inadvertently, to establish the frequency with which such incidents occur, and the effect on the engines with particular reference to the initiation of auto-feathering. Unfortunately, records do not include Negative 'g' as a reportable flight condition so we are mainly dependent upon individual memories giving a lead to these incidents; there may have been more than the four cases

However, the examples given do indicate that encountering Neg. 'g', of sufficient magnitude or duration to trigger off the auto-feather system during normal commercial flying, is a rare occurrence. We have found only one incident that comes into this category, and that occurred during approach when we would expect heavy, unavoidable turbulence to be most frequently met, and when loss of one engine could cause severe embarrassment.

Although it is well established that Neg. 'g' will initiate auto-feathering, the fact that there is only one recorded incident occurring due to turbulence encountered during normal flying indicates that the risk is very small. The proven capability of obtaining an immediate re-light reduces the hazard even further, except possibly at low altitudes during approach. Twin-engined aircraft have an additional safeguard in that only one engine can auto-feather, but for four-engined aircraft the possibility of losing all engines does exist although the inadvertent application of Neg. 'g' sufficiently prolonged to affect all engines must be remote.

Incidents Involving Negative 'G'

(1) **Armstrong Whitworth Argosy (Dart 526) 28.7.60**

The aircraft was being test-flown to simulate Auto-Pilot runaway. While climbing with the Auto-Pilot switched on, nose-down trim was applied and the Auto-Pilot then selected off. The aircraft entered a manoeuvre in which it became subject to Neg. 'g . All four engines are reported to have "malfunctioned" during this manoeuvre, and were subsequently manually feathered and relit. Unfortunately, due to failure of the automatic recording system, the information available from the flight was scanty and unreliable, so a repeat check.
took place on 31st August, 1969.

For the second test the auto-feathering circuit breakers were tripped on Engines 3 and 4. Negative 'g' was induced by a "push-over" from climb with engines running at nominal cruise conditions of 14,200 R.P.M. and 750 deg. C. T.G.T. Three separate checks were attempted, differing only in the length of time for which Neg. 'g' was held, and the following significant conclusions drawn from the two checks completed. (The third check was terminated prematurely because of high T.G.T's):

(a) Partial or complete auto-feathering will occur depending on the length of time for which Neg. 'g' is held.

(b) On test, engines would only partially feather ie Neg. 'g' was held for 2.5 secs. (the shortest period checked) and this resulted in excessive T.G.Ts. during subsequent recovery.

(c) On test, engines would auto-feather completely if Neg. 'g' was held for 4 secs, with T.G.Ts. reaching 1000 deg. C. plus for approx. 2 secs.

(d) If auto-feathering was dis-armed no engine malfunction occurred following negative accelerations, although oil pressure will fall (L.O.P. warning light on) and torque pressure will drop correspondingly to below 50 p.s.i.

54.d.3.

(2) Aer Lingus Viscount (Dart 510A) 12.6.67

During recovery from stall, initiated as part of a training flight, with the aircraft in the approach configuration, the elevator control was pushed rapidly forward as the throttles were advanced to full power, causing the application of considerable Neg. 'g', as a result of which the aircraft finished up pointing almost vertically downwards. The time spent in Neg. 'g' conditions is believed to be about 3 secs.

During the incident, Nos. 1 and 2 feathering current flow lights flickered, and No. 3 propeller auto-feathered, reaching a J.P.T. of over 700 deg. C. This engine was found to be seized after landing.

Investigation of the engine revealed severe damage to the turbine assembly, all H.P. and L.P. blades having failed through mid-aerofoil. This degree of overheating is far greater than normally expected from auto-feathering with the engine giving power, and was due to cancellation of the auto-feather signal before feathering was completed, and recovery of R.P.M. from an abnormally coarse blade angle with the throttle open selecting a high feul flow. The final auto-feathering would have occurred subsequent to the loss of power as the turbine blades were destroyed by the overheating.

The other three engines were not similarly damaged, presumably because of tolerances in the propeller and auto-feather systems.

A report by Aer Lingus following this incident includes the following statement: "It is well known amongst our pilots that auto-feather lights flicker during turbulence and some pilots trip the auto-feather circuit breakers as a matter of course." Information solicited by Aer Lingus from B.E.A. and K.L.M. included the facts that B.E.A. had never experienced an auto-feather in turbulence although they were aware of the possibility under Neg. 'g' conditions, and K.L.M. confirmed that they had never experienced auto-feathering as a result of Neg. 'g' during stalls or flight training.

(3) U.S. Navy Gulfstream (TC-4C) (Dart 529-8) 30.11.67.

The aircraft was deliberately subjected by Grumman pilots, to Neg. 'g' conditions as part of tests intended to satisfy U.S. Navy requirements. During the application of Neg. 'g' the R.H. engine initiated propeller coarsening, but did not completely auto-feather. The crew did not notice the engine overheat which was discovered later from photo-panel results. There is no report of any trouble with the L.H. engine.

The aircraft was subject to Neg. 'g' over a period of 1.8 secs., a maximum of -0.1 G being reached and sustained for a little over 1 sec. Torque pressure started to fall about 2 secs. after Neg. 'g' was first applied, i.e. just as positive 'g' flight was resumed, and reached 50 p.s.i. to activate the low torque switch about 2 secs later. As the propeller coarsened, R.P.M. fell from 12,000 to 6,500 feet in about 1½ secs, recovering in about 3½ secs. T.G.T. rose to a peak of 1070 deg. C. indicated, exceeding the maximum limit of 930 deg. C. for a total time of about 2½ secs. The engine continued satisfactorily in service after a visual inspection of the H.P. turbine blades.

Grumman had been warned that sustained Neg. 'g' would cause auto-feathering, and were advised to de-activate the circuit before the flight test, but had decided against this as they were only doing preliminary investigations, with only minor application of Neg. 'g'. It would appear that the U.S. Navy have accepted the aircraft without any further tests.

(4) Air West Inc. FH.27 (Dart 514-7) 6.11.68.

The R.H. engine auto-feathered in severe turbulence on approach to North Bend Oregon. A successful relight was achieved at the first attempt, after recovering control of the aircraft. The landing was abandoned, and the flight continued to Medford, Oregon. At the time of entering turbulence the aircraft altitude was approx. 2,500 feet, with an I.A.S. of about 150 Kts. engines set to 14,200 R.P.M. The aircraft suddenly pitched up and turned, causing loss of control, auto-feathering occurring during a second buffet just as control was being regained at about 2,000 feet and 140 Kts. Casualties were a baby, sent to hospital with a bump on the side of the head, and a woman in a state of shock. (Both presumably, caused by the turbulence, not as a result of auto-feathering). The Pilot's report contains no complaint of yaw, or abnormal handling problems directly associated with the auto-feathering.

Appendix 5.4e Rigging, Symmetry and Control Surface Check at Aer Lingus on Viscount in 1968

This appendix is provided for illustrating the accuracy requested from the maintenance people when checking Viscount parameters like:-

- Rigging
- Symmetry
- Friction and Pre-load
- Control Surfaces Movements

These operations necessitated specialised very skilled personnel. **5.4e.1**

Engineering Manual	**Volume:2 Visc**	**Part:2**	**Date:23-12-63**	**7**	**Section:8**	**Page:1**

RIGGING, SYMMETRY & CONTROL SURFACE CHECK — **FORM No:TD.2316** — **SHEET 1 OF 3**

Item No.		**Requirements and Limits**	**Observed**	**Signature**	**Signature**
1.	**Rigging Check**				
	1.1 Main Plane Incidence	2°.30' ± 15'	2°.30"	S.A.L. 100	
	1.2 Main Plane Dihedral	P 3°.16' ± 15' S	3°.23" 3°.15"	S.A.L. 100	
	Inner Plane Stn.0-131 Outer Plane Stn. 131 outboard Both measured above spar	2°.50' ± 15' P S	3°.00" 2°.55"	S.A.L. 100	
	1.3 Tail Plane Incidence	-2°.46' ± 15'	2°.55"	S.A.L. 100	
	1.4 Tailplane dihedral measured above spar	13°.43' ± 15'	13°.50"	S.A.L. 100	
2.	**Symmetry Check**				
	2.1 Hose to outer wing	Limit ± 0.5"	.000	S.A.L. 100	
	2.2 Outboard engine to outer wing	Limit ± 0.5"	.000	S.A.L. 100	
	2.3 Tail to outer wing	Limit ± 0.5"	.000	S.A.L. 100	
	2.4 Tailplane to wing	Limit ± 1.0"	.000	S.A.L. 100	
	2.5 Fin tip to tailplane stn. 46.5	Limit ± 0.5"	.000	S.A.L. 100	

	2.6 Fin base to tailplane stn. 46.5	Limit ± 0.5"	.000	S.A.L. 100	
	2.7 Port Centre of inner spinner to centre of outer spinner	Limit ± 0.5"	10°.5⅝"	S.A.L. 100	
	2.8 Stbd. Centre of inner spinner to centre of outer spinner	Limit ± 0.5"	10°.5¾"	S.A.L. 100	
3.	**3.1 Spring Tab Friction & Pre-load** - Elevator Friction	½(A-B) must not exceed 10 lbs	2 lbs	S.A.L. 255	S.A.L. 89
	3.2 Elevator Pre-load	½(A-B) equal to (+10 lb (25 = Pull (- 0 lb	27 lbs	S.A.L. 255	S.A.L. 89
		(+2 lb (25 = Push (- 0 lb	25 lbs	S.A.L. 255	S.A.L. 89
	3.3 Rudder Friction	½(A-B) must not exceed 15 lbs	1 lb	S.A.L. 255	S.A.L. 89
	Rudder Pre-load	½(A+B) = 25+5 lb – 0 lb	25 lbs	S.A.L. 255	S.A.L. 89
	Note: Where, with the Control Lock engaged: **(a) Load on Pilots control as tab is just moving away from control** **(b) Load on Pilots control as tab returns to neutral**				

5.4e.2

Engineering Manual	Volume:2 Visc	Part:2	Date:31-3-59	7	Section:8	Page:2
RIGGING, SYMMETRY & CONTROL SURFACE CHECK					**FORM No:TD.2316** **SHEET 2 OF 3**	

Item No.		Requirements and Limits	Observed	Signature	Signature
4.	**Control Surface Movements**				
	4.1 **ELEVATOR** UP	20° Angular			
		13.94 + 0.1 - 0 in Linear	14.00"	S.A.L. 100	S.A.L. 255
	DOWN	13° Angular			
		2.1" Min Linear	9.10"	S.A.L. 100	S.A.L. 255
	4.2 **ANTI-BALANCE TAB** UP	15° Angular			
		1.57 + 0.05 - 0 ins Linear	1.57"	S.A.L. 100	S.A.L. 255
	DOWN	10°30" Angular			
		1.05 + 0.05 - 0 ins Linear	1.05"	S.A.L. 100	S.A.L. 255
	4.3 **SPRING TABS WITH LOCKS ON** UP	10° Angular			
		1.04" (Min) Linear	1.04"	S.A.L. 100	S.A.L. 255
	DOWN	20° Angular			
		2.08 (Min) Linear	2.10"	S.A.L. 100	S.A.L. 255
	4.4 **SPRING TABS WITH LOCKS ON** UP	3°.51" Angular			
		0.4" (Min) Linear	0.4"	S.A.L. 100	S.A.L. 255
	DOWN	20° Angular			
		2.03" + 0.05 - 0.0 ins Linear	2.10"	S.A.L. 100	S.A.L. 255
	4.5 **TRIM TAB** EACH WAY	12° Angular			
		1.25" (Min) Linear	1.40"	S.A.L. 100	S.A.L. 255
	4.6 **RUDDER** EACH WAY	15° Angular			
		15.6" (Min) Linear	15.85"	S.A.L. 100	S.A.L. 255
	4.7 **RUDDER TAB** EACH WAY	10° Angular			
		1.05" (Min) Linear	1.10"	S.A.L. 100	S.A.L. 255
	4.8 **AILERON** EACH WAY	20° Angular			
		6.08" (Min) Linear	6.15"	S.A.L. 100	S.A.L. 255
		20° Angular			

	4.9 **AILERON** EACH WAY **BALANCE TAB**	1.3" (Min) Linear	1.3"	S.A.L. 100	S.A.L. 255
		1.39" (Nominal) Linear			
		20° Angular			
	4.10 **AILERON** EACH WAY **TRIM TAB**	1.39" (Min Linear)	1.4"	S.A.L. 100	S.A.L. 255
	AER LINGUS				

5.4e.3

Engineering Manual	Volume:2 Visc	Part:2	Date:31-3-59		Section:2	Page:3

RIGGING, SYMMETRY & CONTROL SURFACE CHECK

FORM No:TD.2316

SHEET 3 OF 3

Item No.		Requirements and Limits	Observed	Signature	Signature
5.	**FLAPS** Angles to be measured on top surface of No. 1 Flap at inboard end.	**STOP** 19°	19°.10"	S.A.L. 255	S.A.L. 255
		33° + 1°.30" - 0.30"	33°	S.A.L. 255	S.A.L. 255
		40°	40°.10"	S.A.L. 255	S.A.L. 255
		47°	47°	S.A.L. 255	S.A.L. 255
		RETURN 19°	20°	S.A.L. 255	S.A.L. 255
		34°.30"	34°.30"	S.A.L. 255	S.A.L. 255
		41°.30"	41°	S.A.L. 255	S.A.L. 255
		47°	47°	S.A.L. 255	S.A.L. 255

At the NORMAL UP position the initial flap angle is 1°. This must be added to flap to give actual flap angle. Limits on Flap angle ± 1° (unless stated).

Full flap movement of 51° should not be obstructed as it may be used later.

The Elevator and Aileron movements are to be measured at the inboard ends and the Rudder movement at the lower and with the tab neutral.

Check that the inboard and outboard inclinomoter readings of each flap do not vary by more than 1° - 15".

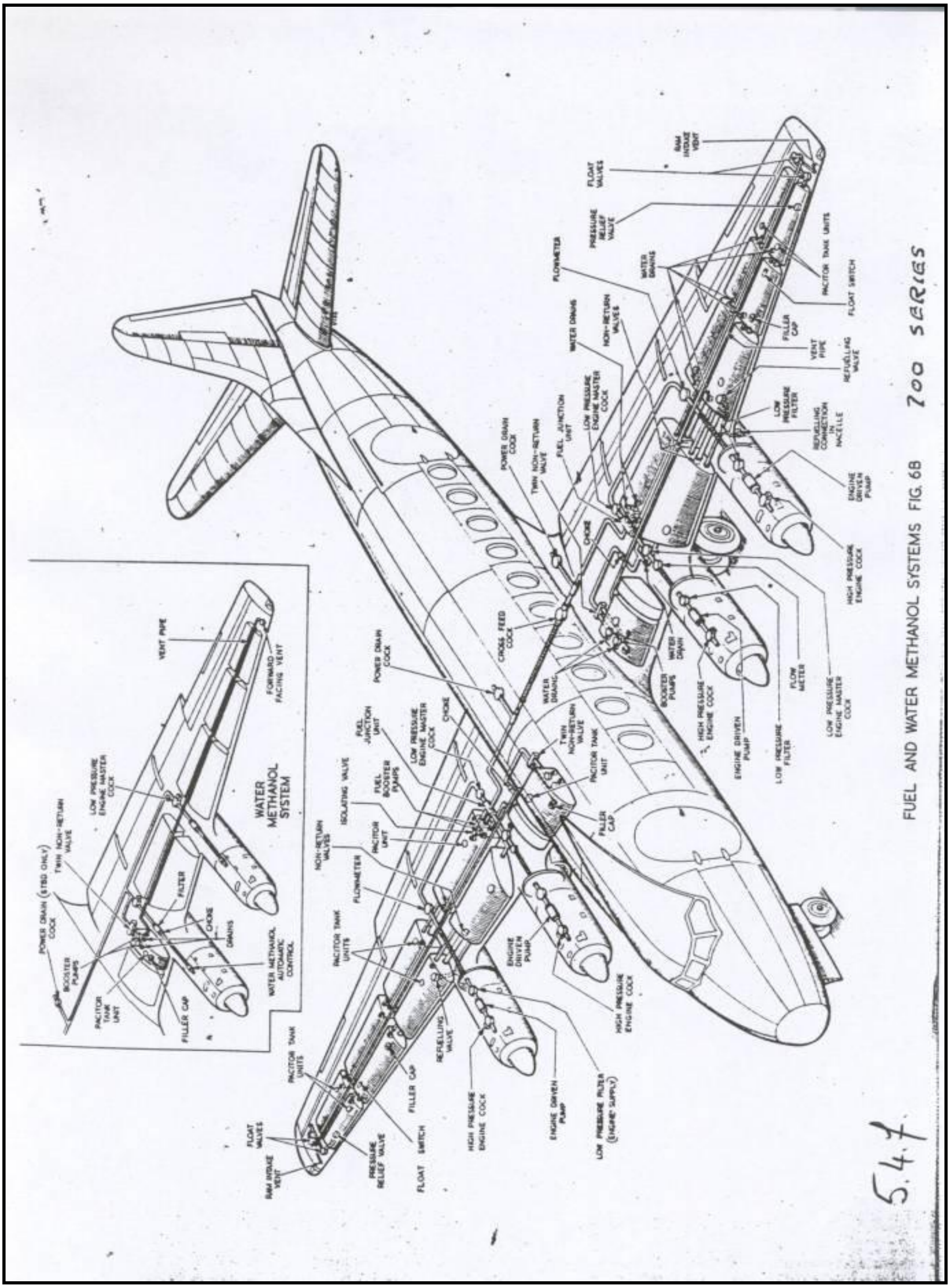
Aileron balance tab nominal movement (1.39") must be obtained if at all possible (measured at inboard end).

AER LINGUS

Appendix 5.4f Fuel and Water Methanol Systems

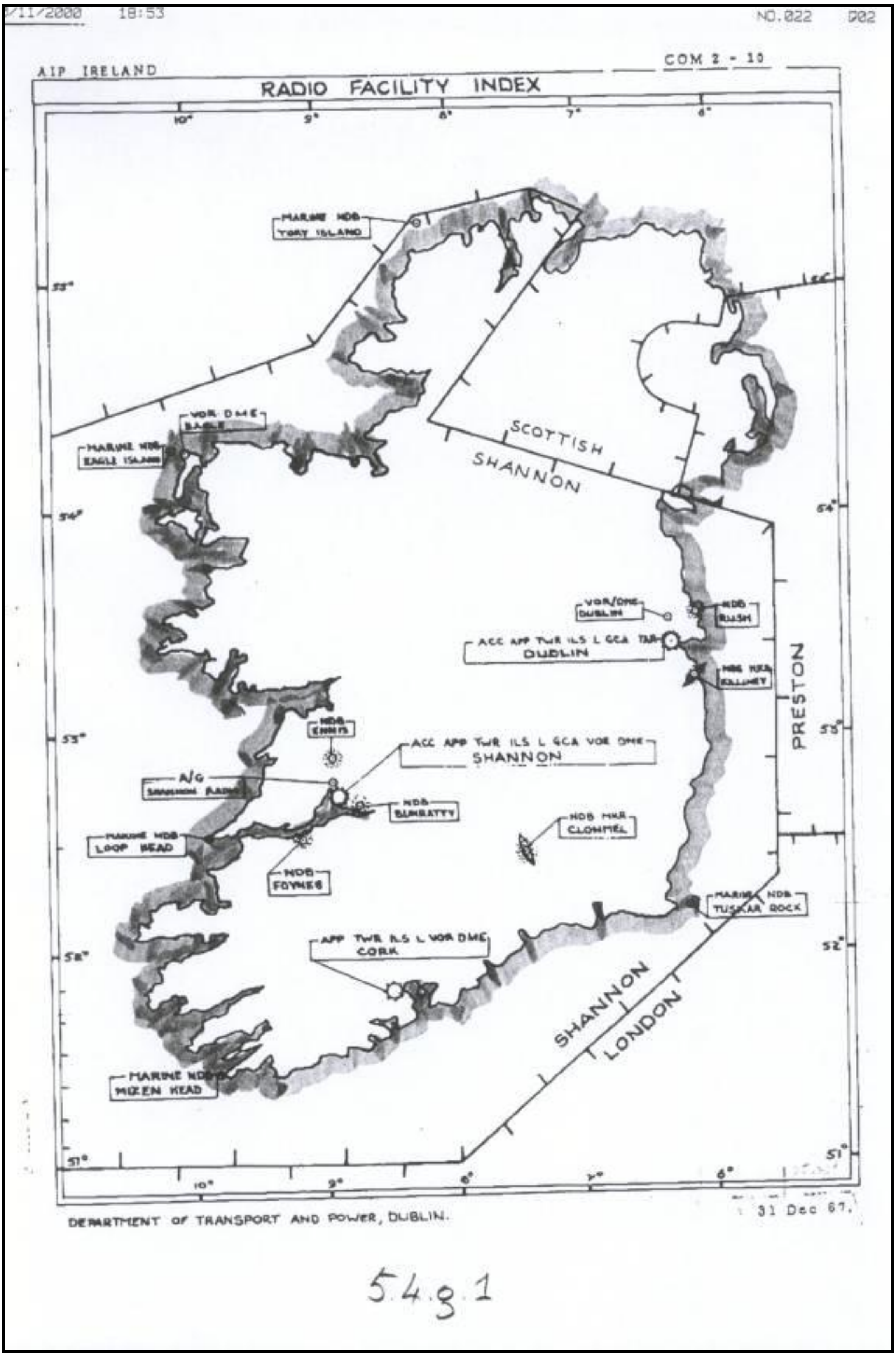
This Appendix is provided for a better understanding of the level of loads which can be suffered by fuel tanks and pipes during a spin or a spiral, which develops large lateral accelerations.

Such efforts may be at the origin of a fuel spray phenomenon.



Appendix 5. 4.gR/T Propagation Aspects

5.4.g.1 Radio facility index in Ireland in 1968



5.4.g.2 Radio propagation aspects of the accident to Aer Lingus Viscount EI-AOM.

Radio Propagation Aspects of the Accident to Aer Lingus Viscount EI-AOM

Near Tuskar Rock 24th March 1968

Captain Fintan Ryan ME
Chartered Engineer

The members of the independent international team who carried out the study of the circumstances of the above accident have requested me to provide this appendix dealing with radio propagation aspects of the study.

The physics underlying the propagation characteristics of the VHF radio waves used for communication with aircraft are very well understood. These waves propagate in a straight line and are blocked from travelling great distances over land by the curvature of the earth. The atmospheric conditions on the day of the accident were close to standard and no anomalous propagation effects would be expected under those conditions. The range obtainable depends on the height of the transmitting and receiving antennas above the earth and can be computed from the formula:

$$d = 1.23(\sqrt{h_1} + \sqrt{h_2})$$ [1]

Where: d = clear communication range between the two radios in nautical miles.
h_1 and h_2 are the heights of the antennas in feet.

The radio line-of-sight concept for the Kennedy Arboretum case is illustrated in Figure 1

Table1 shows the results of my calculations for communications from EI-AOM, assumed to be over Kennedy Arboretum, with London air traffic control and the other 4 aircraft on that channel at the time of the "spinning rapidly" call. For completeness, I have also included Tables 2, 3 and 4 showing the situation if EIAOM was at Bannow at various altitudes. If EIAOM was in the vicinity of the Kennedy Arboretum the following important statements can be made:

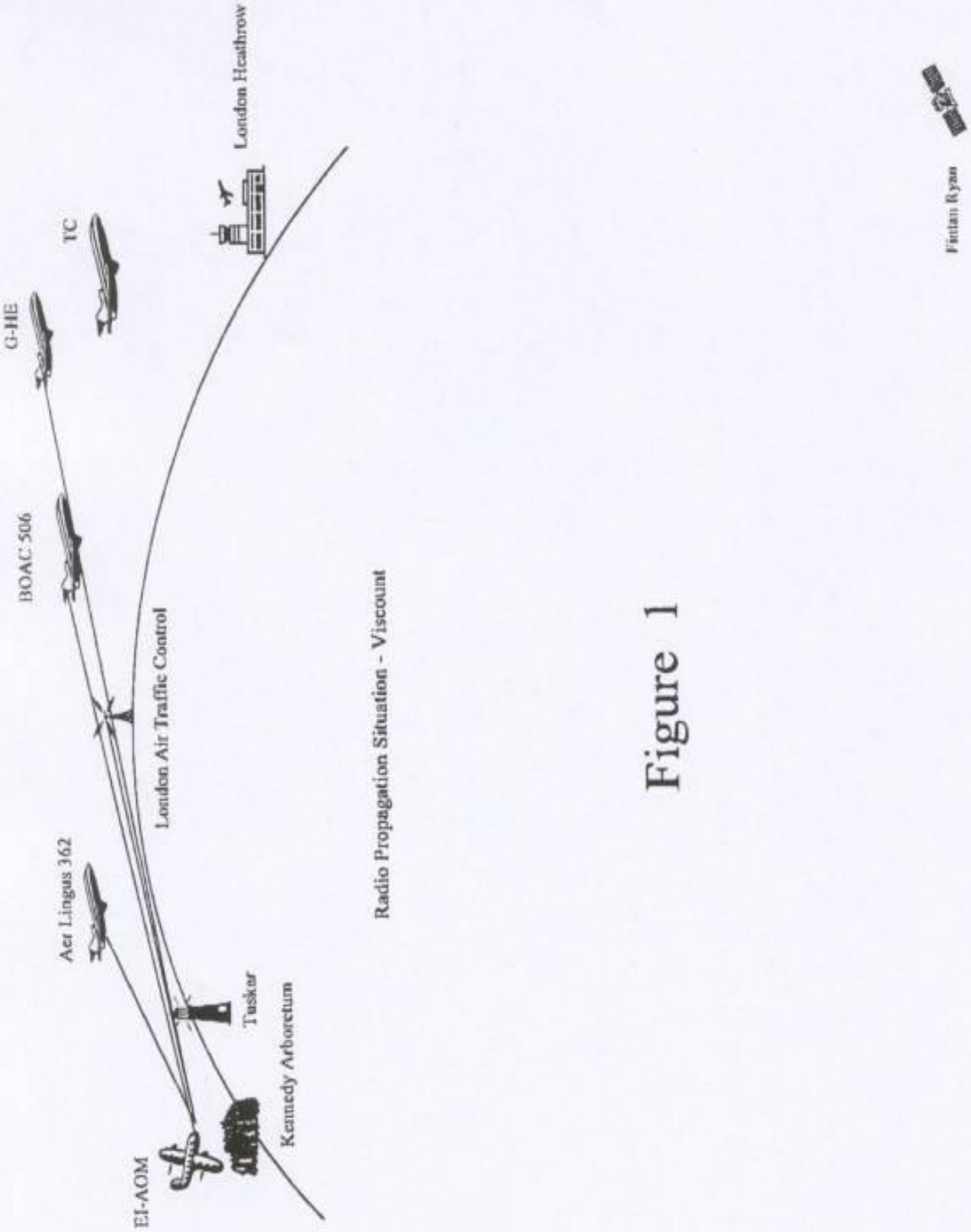
- The London VHF receiver at Davidstow **should** have received a weak signal - it did.[2]
- The Aer Lingus 362 **should** have received the transmission - it did
- The BOA 506 **should** have received the transmission - it did
- The G-HE **should** have received the transmission - it did not report
- The TC **should not** have received the transmission - it did not report.

At the three altitude scenarios presented in the tables for EIAOM assumed at Bannow, all four of the aircraft on the channel and London Airways should have received the transmission.

---

[1] This formula is promulgated by the International Civil Aviation Organisation and is contained in their Annex 10 - Aeronautical Telecommunications.

[2] Because Davidstow is a ground station with a very efficient antenna and very sensitive receiver, I have used the curves provided in ICAO Annex 10 in addition to the radio line-of-sight formula to compute this range. A very conservative transmitted power of 10 watts EIRP from EI-AOM and a receiver sensitivity of 5 microvolts for Davidstow were assumed



Radio Propagation Situation - Viscount

Figure 1

5.4.g.2.2.

Conclusion

The results of my analysis show that the reported performance of the radio systems on the day is consistent with the scenario in paragraph 6.5 of this report that the Viscount EI-AOM was flying at 5000 feet in the vicinity of the Kennedy Arboretum when it made the "spinning rapidly" radio transmission.

Line of Sight VHF Radio Range - Assumes Viscount EI-AOM Located over Kennedy Arboretum							
Call sign	Altitude	Call sign - Location	Altitude	VHF Range	Actual range	In/out	Result
	feet		feet	Nautical miles	Nautical miles	Range	
EIAOM	5,000	London Airways - Davidstow	1,073	140	131	in	Heard Transmission
EIAOM	5,000	Aer Lingus 362 - Vartry	13,000	227	54	in	Heard Transmission
EIAOM	5,000	BOAC 506 - 30 nms W London	14,000	233	199	in	Heard Transmission
EIAOM	5,000	TC - Wodley	9,000	204	229	out	No report
EIAOM	5,000	G-HE - 10 nms W Wodley	15,000	238	219	in	No report

Table 1

Line of Sight VHF Radio Range - Assumes Viscount EI-AOM Located over Bannow							
Call sign	Altitude	Call sign - Location	Altitude	VHF Range	Actual range	In/out	Result
	feet		feet	Nautical miles	Nautical miles	Range	
EIAOM	5,000	London Airways - Davidstow	1,073	140	98	in	Heard Transmission
EIAOM	5,000	Aer Lingus 362 - Vartry	13,000	227	44	in	Heard Transmission
EIAOM	5,000	BOAC 506 - 30 nms W London	14,000	233	165	in	Heard Transmission
EIAOM	5,000	TC - Wodley	9,000	204	195	in	No report
EIAOM	5,000	G-HE - 10 nms W Wodley	15,000	238	185	in	No report

Table 2

Line of Sight VHF Radio Range - Assumes Viscount EI-AOM Located over Bannow							
Call sign	Altitude	Call sign - Location	Altitude	VHF Range	Actual range	In/out	Result
	feet		feet	Nautical miles	Nautical miles	Range	
EIAOM	12,000	London Airways - Davidstow	1,073	175	98	in	Heard Transmission
EIAOM	12,000	Aer Lingus 362 - Vartry	13,000	275	44	in	Heard Transmission
EIAOM	12,000	BOAC 506 - 30 nms W London	14,000	280	165	in	Heard Transmission
EIAOM	12,000	TC - Wodley	9,000	251	195	in	No report
EIAOM	12,000	G-HE - 10 nms W Wodley	15,000	285	185	in	No report

Table 3

Line of Sight VHF Radio Range - Assumes Viscount EI-AOM Located over Bannow							
Call sign	Altitude	Call sign - Location	Altitude	VHF Range	Actual range	In/out	Result
	feet		feet	Nautical miles	Nautical miles	Range	
EIAOM	17,000	London Airways - Davidstow	1,073	201	98	in	Heard Transmission
EIAOM	17,000	Aer Lingus 362 - Vartry	13,000	301	44	in	Heard Transmission
EIAOM	17,000	BOAC 506 - 30 nms W London	14,000	306	165	in	Heard Transmission
EIAOM	17,000	TC - Wodley	9,000	277	195	in	No report
EIAOM	17,000	G-HE - 10 nms W Wodley	15,000	311	185	in	No report

Table 4

Captain Fintan Ryan ME, Chartered Engineer, 5 Glenmalure Square, Milltown Dublin 6

5.4.g.2.3.

Appendix 5.4.h Timing of the Shannon Recorder

EI 712 CORK - LONDON 24th MARCH, 1968.

This is a timed extract from the R/T transmissions on Shannon Area Control Frequency 127.5 Mc/s. during the period 1056 - 1058 G.M.T. on Sunday, 24th March, 1968.

TIME	FROM	TO	TEXT
1057.08	712	Shannon	Shannon Aer Lingus 712 is by Bannow level One Seven Zero, estimating Strumble at Zero Three.
1057.15	Shannon	712	712 Roger say again the time by Bannow. I got the Strumble Estimate OK.
1057.21	712	Shannon	Five Seven.
	Shannon	712	OK time Five Six a Half. Change now to London Airways 131.2. Good Day.
1057.28	712	Shannon	131.2 Good -

NOTE: Ref. the Transmission -

"OK time 56½ Change now to London Airways 131.2. Good day."

the exact time on the recorder when the A.T.C.O. said 56½ was 1057.24.

[signature]
G. McCudden

S.A.T.C.O.

2 copies to [illegible]
13/10

10th October, 1969.

DEPT. OF TRANSPORT & POWER
13 OCT 1969
AIR TRAFFIC SERVICES

5.4.h.

Appendix 7a «BAe Systems » Answer to RFQ, dated November 27th, 2000

BAE SYSTEMS

PWL/visc.AI1/11.00

27 November 2000

30 NOV. 2000

EXP'AIR S.A.R.L.
Cabinet d'Expertise Aeronautique et Spatiale
36 Rue Alphonse Pallu
78110 LE VESINET
France

For the attention of Manuel Pech – SUBJECT TO CONTRACT

Dear Sir,

Viscount Aircraft – Request for Quotation

We refer to your facsimile, reference DF257.00, dated 2nd November 2000, requesting a price quotation for the investigation and response to certain questions relating to the Viscount Aircraft.

In response we have pleasure in submitting our fixed price quotation of £150,000.00 (one hundred and fifty thousand pounds sterling) to investigate and respond to the questions listed in the attachment to your facsimile reproduced in the attached assumptions/exclusions for reference.

The above price is net, based on current economic conditions and exclusive of VAT.

Our quotation is subject to the attached Assumptions/Exclusions and is valid for a period of 30 days from the date of this letter, after which time it will be subject to confirmation.

We trust that this meets with your agreement and look forward to receiving your Order; whereon we will issue you with a draft Contract for approval.

However, should you have any queries regarding this quotation do not hesitate to contact the undersigned.

Yours faithfully,
for and on behalf of
BAE SYSTEMS (Operations) Ltd.

P W Leach
Senior Business Management Officer

Att.

BAE SYSTEMS (Operations) Limited Greengate Middleton Manchester M24 1SA United Kingdom
Telephone +44 (0) 161 681 2020 Fax +44 (0) 161 682 2612

Registered in England & Wales No. 1996687 Warwick House PO Box 87 Farnborough Aerospace Centre Farnborough Hampshire GU14 6YU

Attachment to BAE letter Ref. PWL/visc.AI1/11.00

ASSUMPTIONS/EXCLUSIONS

1. Work is limited to the review, evaluation and collation of existing archival data to answer the generic subject matter and where possible to extrapolate from such data specific replies to the questions.

2. Excluded is the generation of new data or testing that may be identified as a requirement to address specific questions.

3. Answers to the questions will be addressed in a written response, which BAE SYSTEMS will use all reasonable endeavours to issue within 10 (ten) months from acceptance of the Contract.

4. Payment to be made in UK pounds in accordance to the following schedule:

   i. One payment of £15,000.00 on the acceptance of the Contract.
   ii. Nine payments of £13,500.00 paid monthly commencing one month after the acceptance of the Contract.
   iii. Final payment of £13,500.00 on the issue of the response.

5. Questions to be responded to:

   1. Which damages can a bird strike (bird type: Bewick swan) provoke in the horizontal stabiliser, when degrading (bumps, cracks ....) the leading edge without breaking spars, booms or frames?
   Consequences of such damages on aerodynamic characteristics of a Viscount A/C flying in cruise at 240 kts, autopilot ON?

   2. Which perturbations in the aerodynamic flow around a Viscount A/C are produced by a door, swinging free around its hinges, without getting separated from the A/C, at a speed between 200 and 240 kts? May this result in a spin? (The door configurations, hinges, opening process, should be those of the different doors of EI-AOM A/Cs.)

   3. Which deformations of the rear part of the A/C (tail cone, horizontal and vertical empennages) may result from the application of an overpressure by 4,5 PSI or 6,5 PSI, generated by the detent of the cabin pressure going through a large crack in the rear bulkhead?
   This question results from a possible similarity with G-APEC Vanguard accident: so, we would appreciate having a clear description of the structure of the rear part of the Viscount and identification of the main construction differences between the Viscount and the Vanguard in that part.

   4. Which type of deformation of the horizontal empennage may generate flutter or extra loads such that the stick efforts are exceeding those which can be produced by the crew?

Cont.....

5. How long does it take for a peeled part of empennage skin, swinging in the air flow (speed varying from 240 to 270 kts), to become separated from the A/C. Results expected in minutes, approximations to be stated.

6. Cost estimate for digging in your archives, looking for the flight test report produced after the "spinning test"? Identification of g loads, strength, efforts ….etc.

7. Identifying the consequences of a spinning on the fuel system (everything which is not under R.R.), tanks venting devices, fuel/de-fuel units, ….

8. With regard to pitch control, as a function of the A/C speed, what is the efficiency of the engines regime compared to the one of the elevator?
Does this efficiency allow for a semi-control with a damaged horizontal empennage? Or with half a horizontal empennage missing?

9. If the crash occurred with a complete rear part of the A/C still attached, where should be located the separation line within the (fin + rudder) assembly?
Since it appears that the recovered wreckage is not in conformity with the expected result, is the observed difference significant that, when the crash occurred, the ~~St'd~~ Port empennage was already separated (ref. Bouraq accident)?