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FOREWORD

Accident investigation is recognized today as one of the fundamental elements of improved safety and accident prevention. Nearly every accident contains evidence which, if correctly identified and assessed, will allow the cause to be ascertained so that corrective action can be undertaken to prevent further accidents from similar causes. Thus, the ultimate object of accident investigation and reporting, which is to permit the comparison of many accident reports and to observe what cause factors tend to recur, can be accomplished. These factors can then be clearly identified and brought to the attention of the responsible authorities.

The Accident Investigation Division of the Air Navigation Committee of PICAO* at its first session in 1946 recommended that States forward copies of reports of aircraft accident investigations and inquiries, and aeronautical publications and documents relating to research and development work in the field of aircraft accident investigation, to PICAO in order that the Secretariat might appraise the information gained and disseminate the knowledge to Contracting States.

The world-wide collection by ICAO of accident reports and aeronautical publications and documents relating to research and development work in the field of aircraft accident investigation, and publication of the material in condensed form, assists States and aeronautical organizations in research work in this field. By stimulating and maintaining continuity of interest in this problem the dissemination to individuals actively engaged in aviation of information on the actual circumstances leading up to the accidents and of recommendations for accident prevention also contributes to the reduction of accidents.

The first summary of accident reports and safety material received from States was issued in October 1946 (List No. 1 Doc 2177, AIG/56) under the title of "Consolidated List of publications and documents relating to Aircraft Accident Investigation Reports and Procedures, Practices, Research and Development Work in the field of Aircraft Accident Investigation received by the PICAO Secretariat from Contracting States". This was followed by further summaries at regular intervals, the last report being issued on 31 July 1950 (List No. 12, Doc 7026, AIG/513). These summary reports were found to be of considerable technical interest to States, and in view of the large number of requests for copies, it was decided, early in 1951, to revise the method of publication and to produce the material in the future in the form of an information circular entitled "Aircraft Accident Digest".

The first Digest was issued in 1951 under the present title and with the new method of presentation. Since then, the usefulness of the series has continued to elicit favourable comment from the aeronautical world.

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* Provisional International Civil Aviation Organization

However, late in 1964, the Secretariat carried out a study of the problems associated with the publication of the Digest and considered various methods which, it was thought, would lead to a more rapid dissemination of accident reports forwarded to ICAO for release in summarized form in the Digest. These studies also consider amending the presentation of the summaries with a view to producing them in a more standardized manner. Accordingly, the Secretariat prepared a uniform plan using fixed subject headings, in an agreed order and with standard paragraph numbering, to enable readers to extract pertinent information more readily, as desired according to their particular interests. This plan was submitted to the Third Session of the Accident Investigation Division - Montreal, 19 January - 11 February 1965 - for its consideration and development.

The summaries appearing in this Digest were prepared using the Secretariat's uniform plan. However, the plan was subsequently modified by the AIG III meeting and future Digests will be prepared in accordance with the final version of the uniform plan as proposed by the meeting and approved by the Council in the light of States' comments. Details of this revised format can be found in the Report of the Meeting (Doc 8486-AIG/III) where they appear as Recommendation 1. 3/1.

Another important aspect of Recommendation 1. 3/1 of the AIG/III meeting was to the effect that the State instituting the inquiry into an aircraft accident involving aircraft engaged in commercial air transport operations, or into an accident from which information likely to contribute to the promotion of aviation safety can be obtained, shall send to ICAO three copies of the Summary of the Report, prepared in one of the three working languages of ICAO in the agreed format and using, as far as possible, the terminology contained in the ICAO Lexicon (Doc 8291). This is a significant development since at present the full final report itself is requested.

Digest 14 is the first that is being published as two volumes. This is the result of Recommendation 3/1 made by the AIG/III Division to the effect that the Digest should be published twice yearly at approximately six monthly intervals in order to achieve a more prompt transmission of accident information to States. The meeting also recommended (Recommendation 3/2) that a higher degree of priority should be given by ICAO to the production of the Digest.

As for the content of the two volumes of the Digest, the first will contain only summaries. The second volume, in addition to further summaries, will provide other accident data such as classification tables, statistics, lists of laws pertaining to accident investigation and articles concerning accident prevention. The two-column format of the Digest, used previously, involved a considerable degree of drafting which was time-consuming. It has therefore been discontinued and a more conventional presentation is being used.

It is hoped that States will co-operate to the fullest extent permitted by their national laws in the submission of material for inclusion in future issues of this Digest. It is recognized that investigations take a diversity of forms under the variety of constitutional and juridical systems that exist throughout the membership of ICAO and that, for this reason, accident investigation presents one of the most difficult problems of standardization in international civil aviation. At the same time it is a most fruitful source of material for the attainment of the objectives of the Chicago Convention.

The usefulness of such a publication as this is directly proportional to the thoroughness with which accidents are investigated, the frankness and impartiality of the findings, and the readiness with which they are disclosed and authorized to be published. It is in this way only that this most fertile field for international co-operation can be effectively exploited. The measure of interest that this publication has aroused, and the vital information it imparts amply demonstrate the possibilities of ultimate achievement when every accident is investigated with the greatest thoroughness and the findings disclosed with complete frankness.

Restriction upon reproduction in the Digest seriously impairs, of course, the usefulness of any reports, as it is only by comparison between the circumstances that occasioned the accident and the circumstances of other operations that potentially hazardous circumstances can be foreseen and avoided. Names of persons involved may, however, be omitted without detracting from the value of the report.

Follow-up action and other supplementary information or comments on an accident report by the State of Registry or State of Occurence provide useful material for inclusion in the Digest.

Whenever possible, photos and diagrams have been obtained for illustration purposes in order to give a clearer overall picture of the crash area, an idea of the probable flight paths of aircraft, the location of witnesses to the crash, and in general to make the reports more interesting to the reader.

Part II of this Digest dealing with Aircraft Accident Statistics is based on material derived from the Air Transport Reporting Forms G submitted by States and other sources. (For further review of material included refer to the Introduction, page 154).

Part III which contains accident prevention articles and bulletins includes material pertaining to the following subjects: the descent and approach phases of flight in jet operations, pitot static icing, jamming of control surfaces and horizontal stabilizer icing.

Part IV presents a list of laws and regulations of States containing provisions relating to aircraft accident investigation. It replaces the list which appeared in Accident Digest No. 13 and includes all amendments to that list received by ICAO up to 15 December 1965.

The material for this Digest has been obtained from various sources, is printed for information only and does not necessarily reflect the views of the International Civil Aviation Organization.

COMMENTS ON ACCIDENT SUMMARIES AND CLASSIFICATION TABLES - 1962

Reports of 50* aircraft accidents which occurred during 1962 in commercial air transport operations are summarized in Volumes I and II of Digest 14. Also included are summaries of an accident to a DC-6B of President Airlines in Ireland on 10 September 1961 (See Vol. I, Summary No. 1) and of an accident to an Air France, Boeing 707 at Lisbon on 15 June 1961 (See Vol. II, Summary No. 1). Classifications of these two accidents are added at the conclusion of the summaries. Volume II also contains summaries of a near miss (26 July 1962) and accidents occurring during a training flight (26 April 1962), a test flight (9 October 1962), and a non-commercial ferry flight (26 November 1962). The aforementioned are included in the Digest as they satisfy one or more of the following criteria:

1) World-wide interest in the accident, due to either

   a) major disaster aspect which resulted in wide publicity, or
   b) special nature of the accident and possibility of remedial action;

2) Suitability of the original report for preparation of a summary;

3) Interest as an example of good accident investigation practice.

Although they do not appear in classification tables A and B, they have been classified according to pages 16-20 of the ICAO Manual of Aircraft Accident Investigation - Doc 6920 - AN/855/3 (Third Edition), and the classifications appear at the end of each summary concerned.

The accidents occurring in commercial air transport operations may be classified as follows:

Scheduled operations	37
International	15
Domestic	22
Non-scheduled operations	13
International	5
Domestic	8

The classifications in tables A and B follow closely the suggestions contained in the ICAO Manual of Aircraft Accident Investigation. They have, however, been based on accident reports founded on a variety of reporting and analysing techniques. Only a portion

* Collisions between aircraft are normally counted as two accidents. However, two collisions appearing in this Digest have each been counted as a single accident. In one instance one of the aircraft involved was a private aircraft (Vol. II, Summary No. 24), and in the other instance it was a military aircraft (Vol. II, Summary No. 21).

of the total number of accidents investigated by States is either released for general publication or sent to ICAO. Due to the smallness of the total samples (50) no attempt has been made in this publication to prepare classification tables according to the type of operation being conducted, for instance, whether scheduled or non-scheduled; and no differentiation is made between accidents occurring on domestic and on international flights. However, a notation on the type of operation being conducted, where known, is included in Table A. While the tables may serve a useful purpose in indicating causal trends, the numbers are too small to be significant for statistical purposes and readers are warned not to place too much reliance on the trends so indicated without comparison with other sources, such as those published by other international organizations and national administrations.

Although considerable care has been taken in drawing up Table A to ensure that the classification conforms with the findings of the reports from States, the very brevity of the table might give a wrong impression in some instances. The reader is, therefore, always invited to refer to the summary in the Digest and, if necessary, the report from which it is derived.

A survey of the 50 commercial air transport accident summaries for 1962 suggests that the following features are worthy of attention:

(i) 42% of the accidents occurred during the approach and landing stages. (This figure is 8% less than that which was shown for landing accidents in 1961). Of these, 24% were undershoots and 33% were collisions with terrain or objects. Stalled aircraft accounted for 10% of the total landing accidents. The remaining accidents (33%) were of various types. Of four aircraft which hit rising terrain, three accidents resulted from navigational errors. A collision was reported of a military aircraft which was improperly cleared for take-off and struck a commercial aircraft which had just landed. One instance of explosive decompression is included. Erroneous altimeter indications may have played a part in one of the landing accidents.

(ii) 38% of the accidents occurred during the en route phase. Amongst those, 47% were collisions with rising terrain or trees and 16% were airframe failures. Explosions in flight and ditchings accounted for 11% each. The remaining 15% were made up of a mid-air collision, a collision with a whistling swan and a forced landing - each representing 5% of the en route accidents classified. Approximately one-half of the aircraft which struck rising terrain while en route were flying in adverse weather conditions at the time of the accidents. One of the aircraft which ditched had two engine failures and then improper action by a crew member disabled a third engine. The other ditching was necessary because of an overspeeding propeller.

(iii) 20% of the accidents occurred during take-off. Amongst these, 20% were overshoots following aborted take-offs and 30% were collisions with water or trees. The following types of accidents made up the remaining 50%; ground loop, wing-tip landing, wheels-up landing, loss of control, and airframe failure. Each type accounted for 10% of the total. Crew fatigue combined with a loss of power on the port engines to result in the collision with water.

Manual of Aircraft Accident Investigation

The ICAO Manual of Aircraft Accident Investigation (Doc 6920-AN/855), which was first published in 1949, was completely revised in 1959, and the Third Edition is now available in English, French and Spanish. The Manual is designed to facilitate the proper training of investigators, without which many of the lessons that can be learned from the misfortune of accidents may be lost. In addition to the promotion of a higher technical standard of accident investigation, the Manual provides for a standard form of classification and reporting which will facilitate comparison of accident data and the international application of remedial measures arising from accident investigation.

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TABLE A. - ACCIDENT CLASSIFICATION - 1962 (based on phase of operation)

Phase of Operation	No.	Type of Accident	No.	Description	Type ** of Operation	Digest 14 Vol. I Summary No.	Digest 14 Vol. II Summary No.
Take-off (20%)*	10	Ground loop	1	Pilot overcontrolled the aircraft during the take-off run.	S	14	
		Wing tip landing	1	Pilot did not discontinue take-off when No. 1 propeller was overspeeding, and the aircraft could still have been stopped on the runway.	S		3
		Wheels-up landing	1	Pilot's attention was diverted during take-off. Aircraft settled to the runway striking its propellers.	S	11	
		Overshoot	2	Pilot inadvertently caused stabilizer to move to 1-3/4° nose down. As a consequence he aborted the take-off and overshot the runway.	S		19
				Jamming of the trim mechanism prevented the pilot from correcting an out-of-trim condition.	NS		12
		Collision - water	1	Probable loss of power on both port engines and crew fatigue caused the accident.	NS		15
		Collision - objects - trees	2	Possible jammed elevator spring-tab.	NS		5
				Pilot failed to discontinue take-off even after right wing tip hit a wall and broke off.	NS	2	
		Loss of control	1	A rudder servo unit malfunction produced yaw, sideslip, and roll which led to a loss of control.	S		4
		Airframe - ground	1	Both nose wheels of the aircraft became detached during the take-off run.	S		13
En route (38%)	19	Collision - aircraft - both airborne	1	Both pilots failed to maintain adequate lookouts for other aircraft.	S & P***		24
		Collision - rising terrain	7	Pilot made the en route climb at a low altitude and the aircraft became trapped in a canyon and stalled during a turn.	NS	4	
				Attempted low visual flight near mountains and in deteriorating weather conditions.	S	5	
				Aircraft drifted to the north of its track.	S	12	
				Navigational error in adverse weather conditions.	S	20	
				Undetermined	NS	8	
				A series of errors by the crew led to the accident.	NS	28	
				The aircraft was flown below a safe altitude in bad weather and struck cloud-covered high ground.	S		9

* Percentages are based on the total number of 1962 accidents classified - 50
** S = Scheduled NS = Non-scheduled P = Private
*** Collision involving two aircraft, however, it is counted as one accident because one of the aircraft was not engaged in commercial air transport operations.

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TABLE A. - ACCIDENT CLASSIFICATION - 1962 (based on phase of operation)

Phase of Operation	No.	Type of Accident	No.	Description	Type of Operation **	Digest 14 Vol. I Summary No.	Digest 14 Vol. II Summary No.
En route (cont'd)		Collision - objects - trees	2	Tried to fly VFR in IFR conditions.	S	24	
				Undetermined.	S		26
		Collision - objects - birds	1	Collided with whistling swan. Left horizontal stabilizer was weakened and separated. Loss of control followed.	S	21	
		Explosion in flight	2	A dynamite explosion in the right rear lavatory	S	10	
				Possible explosion in flight. Lack of substantiating evidence - cause undetermined	NS	7	
		Airframe - Air	3	Malfunction of electric elevator trim tab unit resulted in aircraft uncontrollability and structural failure of right wing.	NS	16	
				Lost door in flight due to improper locking.	S	15	
				For undetermined reasons, the port elevator separated from the aircraft in flight.	S	3	
		Emergency condition - forced landing	1	Crew failed to diagnose complete loss of power caused by inadvertent movement of the master ignition switch to "off" position	S	9	
		Emergency conditions - forced alighting on water	2	Two of the four engines failed and improper action by the flight engineer disabled the third engine. Aircraft was ditched at sea.	NS	18	
				Uncontrollable overspeeding propeller due to failure in the blower section of No. 2 engine.	NS	19	
Landing (42%)*	21	Ground loop	1	Loss of directional control as a result of improper technique employed in a crosswind landing in adverse weather.	S	13	
		Water loop	1	Closing and locking mechanism of nose wheel doors failed.	S		11
		Undershoot	5	Pilots' misjudged distance and altitude during the final approach.	S	6	
				Incapacitation of the pilot-in-command at a critical point in the approach.	S	25	
				Final stage of approach was carried out below the normal glide path with insufficient engine power.	S	27	
				Pilot did not carry out the approach in accordance with the prescribed procedures.	S		10
				Descended below the prescribed altitude for undetermined reasons. Possibility of erroneous altimeter indications.	NS		28

* Percentages are based on the total number of 1962 accidents classified - 50

** S = Scheduled NS = Non-scheduled

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TABLE A. - ACCIDENT CLASSIFICATION - 1962 (based on phase of operation)

Phase of Operation	No.	Type of Accident	No.	Description	Type ** of Operation	Digest 14 Vol. I Summary No.	Digest 14 Vol. II Summary No.
Landing (cont'd)		Collision - aircraft - one airborne	1	Controller cleared the Voodoo aircraft for take-off before the Viscount was clear of the active runway.	S & M ***		21
		Collision - ground	2	Failure of the crew to monitor altitude properly during a landing approach.	S	26	
				Failure to use correct technique during abandonment of approach in fog.	S	23	
		Collision - rising terrain	4	Navigational error. Struck high ground or a mountain.	S S S		6 14 16
				The aircraft deviated, for reasons unknown, from the track prescribed for the instrument approach along the ILS back course of Lima-Callao Airport, and struck a mountain.	S		25
		Collision - objects - snowbanks	1	Following a landing in crosswinds, the pilot could not correct the aircraft's direction on a slippery runway which was restricted by snowbanks.	S		2
		Stall	2	Undetermined.	S S	22	27
		Airframe - air	1	Undetected insecure latching of the rear service door resulted in an in-flight explosive decompression.	S		22
		Emergency conditions - precautionary landing	1	Attempted 3-engine go-around when aircraft was in a full landing configuration at insufficient airspeed and altitude to maintain control.	S		17
		Emergency conditions - forced landing	1	Failure of the left engine and execution of a sharp 180° turn to the left of the original flight path.	NS	17	
		Emergency conditions - nose gear jammed	1	The nose wheel jammed because one of the maintenance crew had interfered with the door mechanism.	S		7

* Percentages are based on the total number of 1962 accidents classified - 50
** S = Scheduled NS = Non-scheduled M = Military
*** Collision involving two aircraft, however, it is counted as one accident because one of the aircraft was not engaged in commercial air transport operations.

TABLE B. - ACCIDENT CLASSIFICATION - 1962 (based on accident causes)

Causal Factor	No.	Description	No.	Digest 14 Vol. I Summary No.	Digest 14 Vol. II Summary No.
Pilot (46%)	23	- misuse, engine controls	1	9	
		- misuse, flight controls	2	14	19
		- misjudged distance	3	6, 27	10
		- failed to compensate for wind	1	13	
		- failed to observe aircraft	1		24
		- failed to maintain flying speed	1		17
		- failed to discontinue take-off	2	2	3
		- improper IFR operation	7	12, 20, 23, 26, 28	14, 16
		- improper VFR operation	1	4	
		- improper in-flight planning	1		9
		- continued VFR into unfavourable weather	2	5, 24	
		- other (inattention)	1	11	
Other personnel (4%)	2	- inadequate maintenance inspection	1		7
		- improperly cleared	1		21
Power plant (8%)	4	- engine structure	2	18	15
		- supercharger	1	19	
		- undetermined	1	17	
Airframe (6%)	3	- flight control system: electric elevator trim tab unit	1	16	
		rudder servo unit	1		4
		trim mechanism	1		12
Landing gear (4%)	2	- nose gear	1		13
		- nose wheel doors' mechanism	1		11
Equipment and accessories (4%)	2	- door	2	15	22
Airport terrain (2%)	1	- snow	1		2
Miscellaneous (6%)	3	- dynamite device	1	10	
		- bird collision	1	21	
		- incapacitated (crew)	1	25	
Undetermined (20%)	10		10	3, 7, 8, 22	5, 6, 25, 26, 27, 28

* the percentages are based on the total number of 1962 accidents classified (50)

PART I

SUMMARIES OF AIRCRAFT ACCIDENT REPORTS

No. 1

Air France, Boeing 707/328, F-BHSH, which was involved in an accident on the runway at Lisbon Aerodrome, Portugal, 15 June 1961. Accident report published by the Directorate General of Civil Aviation, Portugal.

1. Historical

1.1 Circumstances

The aircraft was on a scheduled flight (No. 109) from Paris to Lima with Lisbon as the first intermediate stop. It took off from Orly with 93 passengers and 10 crew members at 2059 hours GMT. The flight proceeded normally at flight level 350. At 2229 it contacted the Lisbon Area Control Centre (ACC), reported its position, gave its estimated time of arrival at Lisbon (2255 hours), and requested permission to initiate descent at 2236 hours. After receiving permission from the ACC, the aircraft started its descent at 2240 hours. At 2251 it contacted Lisbon approach control and requested instructions for landing. Lisbon reported the wind at 360°/10 kt and asked whether the pilot preferred to land on runway 05 or 36. He chose 05 and asked for the QFE. Lisbon confirmed the permission to land on runway 05 and gave the QFE as 1006.1 mb. At 2259 the aircraft was on final approach at a normal speed of 145 kt. During the landing, which took place at 2300, the front landing gear collapsed. The aircraft completed the landing on its nose and came to rest in the centre of the runway about 1 650 m from the approach end.

1.2 Damage to aircraft

The lower part of the fuselage at the level of the front landing gear was seriously damaged by friction with the runway, and the ensuing outbreak of fire caused other damage inside the aircraft.

1.3 Injuries to persons

No passengers or crew members were seriously injured.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The aircraft had a valid Certificate of Airworthiness and had a Block C inspection on 12 June 1961. Its estimated weight (87 000 kg) and centre of gravity (28.7%) at the time of landing at Lisbon were within the prescribed limits.

2.2 Crew information

The pilot-in-command, aged 50 years, held a valid airline pilot's licence and possessed the necessary ratings to fly a Boeing 707. He had logged a total of 20 082 flying hours, with more than 400 hours on Boeings.

The co-pilot, aged 36, held a commercial pilot's licence with a Boeing 707 rating. He had flown 6 685 hours, including 81 on the Boeing 707.

The other crew members also held valid licences and were fully qualified for this type of aircraft.

2.3 Meteorological conditions

The meteorological conditions observed at Lisbon at 2250 hours were as follows:

> sky clear, visibility 25 km; north wind at 10 kt; temperature 16°C; QFF 1019.1 mb.

2.4 Navigational Aids

Nothing to report.

2.5 Communications

Air-ground communications were exchanged without incident up to the time of the accident.

2.6 Aerodrome Installations

Runway 05/23 is 2 080 m in length and 50 m wide, and the various gradients of this runway are less than the maxima authorized by ICAO.

2.7 Fire

As a result of the friction of the lower part of the fuselage and the collapsed nose gear against the runway, fire broke out in the nose gear compartment and spread to hold No. 1 and from there to the interior of the fuselage, where it seriously damaged the aircraft equipment.

The passengers and crew evacuated the aircraft without difficulty. All the emergency exits functioned normally with the exception of the door to the right of the galley, which was jammed.

The Board of Inquiry considered that the airport fire fighting services did not act as rapidly as might have been desired.

2.8 Wreckage

Nothing to report.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

Although the SFIM flight recorder, located in the electronic hold near the nose gear compartment, was damaged in the fire, the tape was in very good condition and could be used by the Brétigny flight test centre.

An analysis of the various elements of the Inquiry led the Board to the following conclusions:

- The first touchdown on the runway took place about 250 m from the threshold of runway 05;

- this first contact by the main landing gear was sufficiently rough to make the aircraft bounce up again;

- the second touchdown took place 200 m further along the runway, on the nose gear;

- the vertical stress on the nose gear, to which was added a significant lateral stress, brought about the collapse of the nose gear.

3.2 Probable causes

The accident was probably due to insufficient action on the part of the pilot-in-command to control the first rough contact with the runway, causing an extremely violent touchdown on the nose gear.

The Board considers that the following facts led to the events that produced the accident:

1. The aircraft was aligned with the runway centre line only on a relatively short final segment, for 1 minute and 6 seconds.

2. The aircraft's heading (according to the flight recorder) at the time of the first touchdown was considerably different from that of the runway and required a rather large change of direction at critical speed.

The Board also considered that although the gradients on runway 05 are within the limits defined by ICAO, they were an aggravating factor in the development of the accident.

3.3 Recommendations

The Board was of the opinion that the attention of crews of modern aircraft should be drawn to the importance of correct alignment with the runway, and to the techniques to be used to control bouncing due to rough landing or any other cause.

Scheduled International Landing Gear collapsed Pilot - not aligned with the runway

ICAO Ref: AR/815

No. 2

Swissair, Caravelle SE-210, HB-ICY accident at Kloten Airport, Zurich, Switzerland on 1 January 1962. Accident report No. 1962/1/65, dated 13 June 1962, released by the Federal Board of Inquiry, Switzerland.

1. Historical

1.1 Circumstances

Flight 215, a scheduled international flight to Zurich, departed Dusseldorf at 2122 hours GMT carrying 8 crew and 17 passengers. Heavy snow had been falling since midday and Zurich Airport and instrument runway 16 were closed from 2000 to 2200 hours for snow clearing operations. Snowbanks reduced the width of runway 16 to 50 m. HB-ICY was No. 4 in the approach sequence. The pilot-in-command began the approach at 2221 hours with the automatic pilot connected to the ILS. The wind was reported as 030°/4 kt. Visual contact was made, with the runway slightly to starboard, and the automatic pilot was switched off about 130 m above the ground. An excessive starboard correction was made requiring a counter-correction to re-align the aircraft with the centre line of the runway. The threshold of the runway was crossed at a speed of 114 to 129 kt, this being adequate for the landing weight of 34 350 kg. In spite of the use of increased lighting, visibility was poor. The pilot saw the runway only as a white landscape with two rows of lights in front of him. The snowbanks were indistinguishable as such. For the final phase of the flight the pilot switched on the wing headlights, but not the noselight, since he was afraid of dazzle in the prevailing snowstorm. At 2225 hours the aircraft touched down 550 m from the threshold at a high angle of attack and with a slight bank and yaw to port. The runway surface was slippery at the time because it was covered with wet snow. As the aircraft was slightly left of the runway centre line following touchdown the pilot tried by gentle correcting action to align the aircraft with the runway by steering and braking but was not successful. About 1 000 m after the threshold the aircraft ploughed into a snowbank on the port side after running a short distance with the port wheels over the snowbank and with the other wheels on the swept runway surface. By releasing the brake parachute and by actuating the steering column and brakes, the pilot succeeded in getting the aircraft back to the centre line. However, the pilot was unable to prevent the aircraft from crossing the centre line as by now the nose wheel had jammed. It, therefore, crossed to the other side and collided with the snowbank on the starboard side about 1 450 m from the threshold. It came to rest, still on its undercarriage, 10 m past the right-hand edge of the runway, 1 600 m from the threshold. The runway lighting installations on both sides of the runway were slightly damaged.

1.2 Damage to the aircraft

The aircraft was substantially damaged. The flaps, fuselage, undercarriage and engines all suffered damage from impact with the snow. The cost of repairs was over 300 000 Swiss Francs.

1.3 Injuries to persons

None of the occupants of the aircraft was injured.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The aircraft's operating permit was valid until 31 December 1962.

Its landing weight and centre of gravity were within the permissible limits.

The aircraft was equipped with ILS, an approach coupler to the autopilot and a tail-released braking parachute.

2.2 Crew information

The crew was made up of a pilot-in-command, two co-pilots, two stewards and three stewardesses.

The pilot-in-command, age 31 years, held a valid airline pilot's licence and a type rating for the Caravelle SE-210. He trained on the Caravelle in 1960 and since that time had flown 700 hours on it. One hundred and ten of these hours were flown in the three months preceding the accident. He had a total of 4 700 hours flight time.

The two co-pilots were 30 and 37 years of age respectively. Both were transport pilots and held valid commercial pilot licences with type ratings for the subject aircraft.

2.3 Weather information

Exceptionally heavy snowfalls occurred in the central and eastern parts of central Switzerland from midday on 1 January to midday of the following day.

The crew of HB-ICY were given weather reports for Zurich at 2120 hours just before take-off from Dusseldorf and at 2150 hours while en route.

At 2220 hours the weather at Zurich Airport was as follows:

> wind 030°/3 kt, visibility 1 800 m, moderate snowfall, cloud base 500 ft, temperature 0°C, atmospheric pressure 957 mb.

There was a slight north wind up to an altitude of 2 000 ft above which a strong southwest wind (15 - 20 kt at 3 000 ft) was flowing in the area at the time of the accident.

2.4 Navigational Aids

The Rhine radio beacon was available to the flight.

2.5 Communications

No mention is made in the report of any communications difficulties.

2.6 Aerodrome Installations

The landing took place on instrument runway 16 which is 3 700 m long and

60 m wide. In addition, the runway has concrete shoulders, each of which is 7.5 m wide.

Runway 16 is equipped with approach, threshold, runway and touchdown area lighting, but there is no centre strip lighting. The runway lights are spaced at intervals of 30 m with a lateral separation of 62 m and a lamp height of 0.6 m from the ground. At the time of the accident the lights of the touchdown area were not switched on.

Because of the snow conditions at Kloten Airport (Zurich), several NOTAMs were issued which were available to the crew of HB-ICY prior to take-off from Dusseldorf. The airport was closed from 2000 to 2200 hours for snow clearing operations.

At 2210 hours, i.e. about 15 minutes prior to the touchdown, the crew of the flight was advised that there was 1/2 inch of wet snow on runway 16 and that the braking effect was moderate to poor. There were snowbanks 1/2 m high on either side of the runway, and the actual runway width available was 50 m.*

At 2223 hours the crew of a DC-7C, HB-IBK, which had just landed at Zurich, reported braking effect was poor. HB-ICY landed two minutes later.

2.7 Fire

There was no fire.

2.8 Wreckage

No details are contained in the report as to the damage to the aircraft.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

The accident was not attributed to serious technical failure or obvious error of any person concerned.

* The Inquiry report stated that ICAO's Annex 14 - Standards and Recommended Practices for Aerodromes - prescribes a runway width of not less than 45 m for major international airports. At the time of this accident there were no special ICAO regulations regarding procedure in snow conditions. There are no Swiss regulations relevant to the present case.

Note of ICAO Secretariat:

Whilst no ICAO regulations regarding procedures to be followed in snow conditions exist, it should be noted that Attachment B, Section 5 of Annex 14, Fourth Edition, dated August 1964, contains guidance material on assessing and expressing braking action when conditions of snow, slush, ice or mud cannot be avoided. The Aerodrome Manual, Part 5, contains further information on this subject, on improving braking action and on clearing of runways.

The accident would probably not have occurred if the runway had not been re-opened to traffic before the snow had been completely cleared away. However, to keep the airport closed for several hours more would have been a grave decision.

If there had been no snowbank on the left edge of the runway the aircraft might have left the runway at that point and the resulting damage might have been greater.

Various factors played a part in the aircraft's running off the runway. The manner of approach resulted in a touchdown with the aircraft having a slight bank and yaw to port and with its nose wheel well clear of the runway. This was followed by an ineffective heading correction. An earlier and more determined correction following touchdown might have prevented the collision with the snowbank on the port side. As for lighting facilities, the lighting was not "on" in the touchdown zone. The pilot's decision not to use the nose headlight was, under the circumstances, a wise one during the approach and touchdown, but it had an adverse rather than favourable subsequent reaction. The low touchdown speed resulted in the lateral steering effect being weaker initially. Because of the high angle of attack, the nose wheel, which is important for steering, did not come in contact with the ground until fairly late in the landing. Also the arrangement of the power units on the Caravelle excludes a rapid heading correction through the application of asymmetric power. Finally, the slipperiness of the runway due to the wet snow reduced the braking effect. The weather conditions had so reduced the runway's safety margins that they could no longer make up for the lack of precision in the aircraft's approach and landing, which in normal circumstances would probably have fallen within acceptable tolerances.

3.2 Probable cause

The aircraft ran off the runway because the pilot set it down at a slight angle to the centre line owing to crosswinds and was unable to correct direction in time on a runway which was slippery and restricted by snowbanks on either side.

3.3 Recommendations

No recommendations are contained in the report.

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ICAO Ref: AR/825

No. 3

Iranian Airways Company, DC-3, EP-ABB accident during take-off run at Kabul Airport, Afghanistan, 2 January 1962. Report released by The Director General of Civil Aviation, Afghanistan.

1. Historical

1.1 Circumstances

Flight IR-123 was a scheduled international cargo flight from Kabul, Afghanistan to Tehran, Iran. Aboard were two pilots. The co-pilot was in the left-hand seat and operating the flight controls at the commencement of the take-off run. The aircraft was cleared for take-off on runway 29 at 0843 hours GMT. When accelerating for take-off the pilot-in-command noticed that the propeller of No. 1 engine was overspeeding and surging as high as 3 300 rpm. As the aircraft approached an indicated airspeed of about 80 kt the captain took command. He noticed that the aircraft was headed to the left away from the runway centreline towards three runway lights in a concrete footing at the left edge of the runway. To avoid a possible collision with these lights the captain applied elevator control and lifted the aircraft off the runway. The overspeeding propeller condition did not subside although he followed the procedure prescribed in the company operations manual for corrective action. The flight path was about 30 to 45° to the left of the runway and in the general direction of the Kabul Airport terminal building so the captain attempted to turn the aircraft further to the left to avoid collision with the building. About 325 ft from the south edge of runway 29 the left wing contacted the ground and the aircraft crashed at 0846 hours GMT (1316 hours local time).

1.2 Damage to the aircraft

There was major damage to the aircraft.

1.3 Injuries to persons

The two crew members sustained minor injuries.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The aircraft had a certificate of airworthiness valid until 21 March 1962. Its maintenance release was valid for the flight to Tehran. The gross take-off weight of EP-ABB was 12 128 kg, i.e. close to the maximum permissible of 12 200 kg for cargo operations as shown in the Company's Operations Manual. No provision is made for reduction of take-off weight for airport elevation or temperature. The centre of gravity of the aircraft, computed as 25.3%, was within the approved limits.

2.2 Crew information

The pilot-in-command, age 36 years, held an Iranian airline transport pilot licence with ratings for DC-3 and DC-4 aircraft. He had flown a total of 8 800 hours of which approximately 3 500 hours were on the DC-3. He had flown 105 of these hours during the 30 days preceding the accident. During his training for the airline transport pilot flight test of the Federal Aviation Agency (U.S.A.), which was successfully completed, engine failures before and after V_1 were emphasized.

The co-pilot, age 29 years, had an Iranian commercial pilot's licence with ratings for DC-3, DC-4 and Viscount aircraft. His total flying experience amounted to 3 500 hours of which about 2 000 hours were on the DC-3 and 45 hours had been flown during the 30 days preceding the accident.

2.3 Weather information

At the time of the accident the wind was from 180° True at a velocity of 2 kt. The temperature was between 5.6° and 7.6° centigrade, the latter being that recorded for the 0900 hours GMT observation.

2.4 Navigational Aids

Not involved in the accident.

2.5 Communications

They were not a factor in the accident.

2.6 Aerodrome Installations

Runway 29 is constructed of concrete. It is 9 100 ft long and is at an elevation of 5 795 ft. The runway gradient has not been determined. At the time of the accident it was dry, and there were no obstructions on it.

2.7 Fire

Fire broke out following impact. The fire was originally confined to the broken fuel, oil, and hydraulic fluid lines at the engine nacelle and at the exposed ends of this broken plumbing on each engine. The fire in the area of the No. 2 engine nacelle was also fed by fuel flowing from the right main fuel tank.

Fire fighting equipment of the Afghan Air Authority Department of Civil Aviation and the Royal Afghan Air Force was used to fight the fire. The principal fire extinguishing agent used was foam. Approximately 1 500 gallons per minute of expanded foam were discharged in the crash area; prompt action by the fire fighting crew effectively extinguished the fire in approximately three minutes.

2.8 Wreckage

The wreckage was examined extensively for malfunctions of operating components and systems and for structural failures. The investigation did not result in the finding of evidence to show that there were technical defects in the airframe, engines or accessories.

At the time of impact the aircraft was intact and in the take-off configuration with the landing gear extended and the wing flaps up.

The impact forces on the propellers were such as to result in the separation of the entire propeller assemblies and reduction gearing from the power section of their respective engines. The propeller blades had been bent rearward showing that at impact the engines were not developing a substantial amount of power. The engines were subsequently found to be structurally capable of normal operation. Each of the three blades of the left-hand propeller was 040° from the low pitch stop. Each of the three blades of the right-hand propeller was approximately 009° from the low pitch stop. Although the captain stated that the No. 1 propeller was overspeeding to a serious degree, there was no evidence to show the cause of the overspeeding. The distributor valves in each propeller dome were in normal operating condition, and both governors appeared to be capable of normal functioning prior to impact.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

The emergency occurred at a very critical moment, at a time when the flight controls were changing hands and at the approximate time when a decision was necessary for discontinuing or continuing the take-off.

The runway was more than adequate for bringing the aircraft to a stop if the captain had selected this alternative. However, the aircraft was already headed in a direction that would take it off the runway at the approximate time when a decision was necessary. Although the captain stated that the better course of action would have been to discontinue the take-off, a procedure prescribed in the operating manual, he did not choose to do so because he believed that the aircraft would remain airborne.

The loss of aircraft performance, which resulted because of the necessity for the reduction of power on the No. 1 engine, was further compounded by the drag created by the overspeeding propeller of the No. 1 engine. The co-pilot testified that attempts to feather the propeller of the engine proved unsuccessful due to the failure of the feathering button to engage. The captain stated that although he had experienced demonstrations in training flights of the rudder force required to control the aircraft at V_{mc}, (minimum control speed), the force required in this instance was greater than he had ever experienced before. He was unable to state conclusively whether or not he had the right rudder at the limit of its travel, but he did believe that his seat was properly positioned to permit him to reach full rudder travel if he had the strength to do so.

For the conditions existing at the time of this take-off a distance of 2 200 ft was required with full rated take-off power. The maximum power available from each engine at the elevation of this airport as stated by the captain is approximately 200 bhp less that the rated take-off power of 1 200 bhp. In this instance the aircraft was lifted off the runway after accelerating a distance of approximately 1 837 ft or 363 ft less than the minimum prescribed by the manufacturer with full rated take-off power.

When observed by the control tower operators at Kabul the aircraft was believed to be about 20 ft in the air during the time it was airborne. It was, therefore, apparent that one of the sustaining elements for this short period of flight was the phenomenon of ground effect.

3.2 Probable cause

The captain failed to discontinue the take-off when he saw that No. 1 propeller was overspeeding and at a time when the aircraft was still on the runway.

3.3 Recommendations

No recommendations are contained in the report.

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ICAO Ref: AR/697

No. 4

American Airlines, Inc., Boeing 707-123B, N 7506A accident at Jamaica Bay, Long Island, New York on 1 March 1962. Civil Aeronautics Board (U.S.A.) Aircraft Accident Report, File No. 1-0001 released 15 January 1963.

1. Historical

1.1 Circumstances

The aircraft was flown from Tulsa, Oklahoma to New York International Airport (Idlewild) on 28 February. It was a normal flight, and the aircraft reached New York at 0007 hours* on 1 March. A layover check and an origination check were carried out on the aircraft, and pilot-reported discrepancies were corrected. At 1005 hours Flight One was cleared for take-off from runway 31L on a scheduled domestic non-stop IFR flight to Los Angeles. Eighty-seven passengers and 8 crew were aboard. Dispatching of the aircraft was normal and in accordance with standard company procedures. The aircraft carried out what appeared to be a normal take-off, and lift-off was at 1007 hours about 5 000 ft down runway 31L. At 1007:37 the aircraft started a gentle turn to the left approximately 8 000 ft down the runway, at an altitude of 100 ft, and was established on a heading of 290° at 1007:42. Radar contact was made with the aircraft. Straightening out from the turn, the aircraft continued to climb for several seconds on a heading of 290° and started a second turn to the left as instructed by Departure Control. These manoeuvres were in accordance with the noise abatement procedures then in effect for taking-off from runway 31L. (See Figure 1) Having started the second turn, the angle of bank increased until the aircraft rolled through 90° of bank at a peak altitude of about 1 600 ft msl. It then entered an inverted, nose-low attitude and plunged earthward in a nearly vertical dive. It struck the earth in the shallow waters of Pumpkin Patch Channel of Jamaica Bay during low tide about 3 NM southwest of the Idlewild Control Tower. Impact was at an angle of approximately 78° nose down on a magnetic heading of 300°. Impact occurred at 1008:49 hours. Fire broke out a few minutes later.

1.2 Damage to the aircraft

The aircraft was totally destroyed.

1.3 Injuries to persons

All 8 crew members and the 87 passengers aboard the aircraft were fatally injured in the accident.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The last periodic inspection was performed on the aircraft on 18 January 1962. At that time the total time on the aircraft was 7 922 hours. As of 1 March the total time was 8 147 hours.

*All times herein are eastern standard time.

The maintenance and servicing performed on the aircraft during its layover at Idlewild on 1 March had been properly completed before N 7506A was released for dispatch.

The gross take-off weight of the aircraft and its centre of gravity were 247 038 lb and 24.4% MAC respectively. Both were within the prescribed limits.

All records examined showed that the aircraft was continuously maintained in an airworthy condition in accordance with FAA-approved company policies and procedures. Only one instance of improper maintenance was found where an outboard bellcrank was erroneously installed at the inboard bellcrank position of the spoiler controls in the right wing. This was rectified on 25 February 1962.

2.2 Crew information

The crew consisted of a pilot-in-command, a co-pilot, a second officer, a flight engineer and four stewardesses.

The pilot-in-command, age 56, had flown a total of 18 300 hours including 1 600 hours on the Boeing 707. He held a valid airline transport pilot's certificate with numerous ratings. He was issued an FAA rating in the Boeing 707 on 1 April 1960 and was line qualified on 25 April 1960. He received his last proficiency and line checks for the Boeing 707 on 13 October 1961 and 20 September 1961 respectively. He passed an FAA first-class flight physical on 1 October 1961 without waivers.

The co-pilot, age 35, had flown 4 800 hours including 900 hours on the Boeing 707. He held a valid airline transport pilot's certificate with ratings for the Douglas DC-6 and DC-7. He qualified as co-pilot on Boeing 707s in September 1959 and received his last proficiency check in the Boeing 720B on 19 December 1961. He satisfactorily passed an FAA first-class flight physical on 5 December 1961 without waivers.

The other flight crew members were also properly certificated and physically fit.

2.3 Weather information

At take-off the weather conditions were as follows: 15 000 ft scattered; visibility 15 miles; wind northwest at 19 kt; temperature 30°F; dewpoint 11°F; altimeter 30.30 in. Hg. According to the flight recorder aboard the aircraft, the flight encountered light friction turbulence.

2.4 Navigational Aids

They are not significant in this accident.

2.5 Communications

Company personnel familiar with the voices of the flight crew, after listening to the control tower recording of transmissions from Flight One, believed that they were made by the second officer. No indications of alarm or any abnormality on the part of the crew were discernible during any of Flight One's transmissions.

At 1008:23 an unmodulated signal of one-half second duration was received on the Departure Control frequency. The sound of this signal was very similar to the unmodulated carrier associated with previous transmissions from Flight One.

2.6 Aerodrome Installations

Runway 31L is 14 600 ft long and 150 ft wide, with a gradient of minus .01%. It was dry at the time of take-off. The field elevation is 12 ft msl. The northwest shore line of Jamaica Bay is about 200 yd to the left of and parallel with the runway. Heavily populated areas lie directly beyond the end of runway 31L.

2.7 Fire

Shortly after impact, floating debris and fuel ignited and burned fiercely.

2.8 Wreckage

The aircraft had made a crater in the bottom of the bay which was approximately 130 ft long and 8 to 10 ft deep. On impact the wings were fragmented, and the fuselage was crushed like an accordion, breaking into many sections. Impact and fire damage was extensive and precluded examination of numerous components of the aircraft which might have yielded important information. The cockpit area suffered the most extreme fragmentation of the entire fuselage, the degree of fragmentation gradually decreasing toward the tail of the aircraft.

Adverse weather conditions and exceptionally high tides made recovery of the wreckage difficult, and slow. Some of the wreckage recovered was in the form of metal masses resolidified after having melted. These were given X-ray examination and in some cases were chipped apart for study.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

Examination of the wreckage pointed out the following:

a) the landing gear was fully retracted;

b) all wing flaps were fully retracted;

c) the hydraulic system was operating up until the time of impact;

d) there was no evidence of any in-flight damage or failure of the engines;

e) there was no evidence of an in-flight fire, an explosion, structural fatigue or overload failure;

f) there was no evidence that an electrical arc, short or overload had existed in the electrical system prior to impact;

g) nothing was found to indicate a malfunction of the aileron, of the horizontal stabilizer or of the elevator servos prior to the accident.

During the investigation many possibilities as to the cause of the accident were considered. All possibilities were examined taking into account the evidence that was available, and the possibilities were narrowed down to the following:

1) physical incapacitation of the crew;

2) loss of engine power;

3) malfunction of lateral control system;

4) malfunction of the rudder boost system;

5) malfunction of the rudder servo unit.

1) Physical incapacitation of the crew

Toxological studies carried out on the flight crew ruled out incapacitation due to toxic gases, alcohol and drugs. Unrecoverable body tissue vital to complete medical evaluation made it impossible to obtain results which would give irrefutable positive or negative proof of incapacitation insofar as the pathological and histological examinations were concerned. The medical histories of the flight crew provided no evidence to indicate that any crew member had physical characteristics likely to result in any kind of incapacitation.

The possibility of both pilots becoming physically incapacitated simultaneously was considered to be remote and was therefore eliminated. During the departure either pilot was able to immediately assume control of the aircraft if the other was disabled. Also the second officer and flight engineer could have assisted in the restraint of an unwanted control input.

The last radio transmission from the flight at 1008:09 revealed no sign of crew incapacitation. According to the flight recorder the first deviation from normal climb-out started at 1008:12 and by 1008:30 the flight conditions were beyond successful recovery action. Therefore, there were 18 seconds during which other flight crew members could have restored control of the aircraft had one of the pilots become incapacitated. It appeared to be highly improbable that any control input during this period would be of such magnitude and duration as to prevent corrective action by other flight crew members.

In view of the foregoing, the Board considered it unlikely that crew incapacitation caused or contributed to this accident.

2) Loss of engine power

Examination of the engines disclosed no evidence of any abnormality which would have affected their operation.

One analysis of flight recorder data indicated a power decrease near the apex of the climb. There very probably was a power reduction in the late stages of the subject flight.

American Airlines' energy analysis and flight tests by Boeing indicated that maximum power must have continued until about 1008:14. The energy analysis also indicated that from 1008:14 to 1008:28 the thrust history could have varied anywhere from continuation of maximum power to a 50% reduction. The energy analysis does not provide any indication as to whether any possible power decrease considered was intentional or unintentional.

Total loss of power from the left outboard engine, the most critical, would not have presented a critical problem in maintaining control of the aircraft. Loss of two engines on one side was believed improbable.

The Board concluded that loss of engine power was not an initiating or contributory factor in this accident. Such a conclusion does not, however, eliminate from consideration the probability of an intentional power reduction by the crew in an effort to maintain control of the aircraft.

3) Malfunction of lateral control system

No positive indication of any malfunction in the lateral control system was found during examination of the wreckage. However, many critical parts were either unrecovered or melted down, with the result that there could have been a malfunction in one of these parts.

One area of possible discrepancy was found - marks made on the aileron cable bus quadrants at impact corresponded to the right inboard aileron being about 10° up at the time, with other impact damage indicating that the control wheels were beyond the full right wing down position, the right inboard spoilers about 28 and 31° up and the outboard section of the right outboard spoiler about 40° up. Since the airspeed at impact was about 200 kt, as indicated by the flight recorder, normal operation of the lateral control system with wheels at full throw would have produced 20° up right inboard aileron, and 40° up right inboard spoiler, without use of speed brakes to augment lateral control. This discrepancy tends to lend credence to the possibility of some malfunction in the lateral control system.

A study made by Boeing indicates that if an outboard aileron is jammed, the action of the lockout mechanism on the connecting quadrant during flap retraction from 20° to 0°, can actuate the other aileron surfaces through the bus cables. If the left outboard aileron is more than 2° up when jammed, the resultant left roll from the flap-driven aileron surfaces cannot be overcome by control wheel effort alone.

Additional possibilities in connection with a jammed aileron could be pertinent to this accident. Deflections or failure at another point unanticipated in the Boeing analysis and not disclosed by ground tests could result in full flap retraction without failure of the link rod. This could result in at least three of the four ailerons being held in deflected positions. The spoilers would still remain operable through the cable system from the control wheels.

Another possibility is that although failure of the link rod is accepted, the pilot-in-command and first officer could reasonably be expected to apply lateral control effort to the limit of their physical capabilities prior to the link failure. The resulting force would load the aileron control system from the control wheels through mechanical linkage to the tabs on the inboard ailerons and to the spoiler control valves. As a result, abnormal pilot input failures at certain points in the system appear possible, such as deformation of the sleeve between the control wheel and the control column or the terminal at the bottom of the control column. Such deformations could result in less than normal lateral control being available after the flaps are fully retracted.

If the flaps were retracted from 20 to 0° between 1007:57 and 1008:09, the possible dog leg in the flight recorder heading trace as the result of gimbal error at high bank angles between 1008:07 and 1008:17 is in general agreement with a left roll produced by binding of the left outboard aileron. If flap retraction did not cause failure of the outboard aileron link rod, or if abnormal pilot effort caused control system deformations, the left roll could continue despite maximum opposing control wheel effort. Rapid application of right rudder could then be expected. This should yaw the aircraft nose right and roll it out of the bank. However, the flight recorder traces do not indicate any right yaw until about 1008:19, this yaw being only a small fraction of that which could be produced by rudder effort.

Using the actual speeds from the energy analysis and median values from the flight recorder normal acceleration trace, lift coefficient histories were determined. Comparison of these at 1008:30 with the lift coefficients for heavy stall buffet as determined by Boeing tests discloses agreement only for the 50% thrust condition. This implies the start of a nose left sideslip at 1008:12. The only apparent logical way in which a nose left sideslip could have started at this time in a manner necessary to satisfy the energy analysis, would be the loss of power from the Nos. 1 and 2 engines as a result of the unwanted roll. However, no reason for such power loss can be seen without assuming other failures. Therefore, these types of lateral control failure do not appear to be a causal factor.

Following impact the flaps were found in the retracted position. Had the crew felt that their difficulty was one of lateral control it would be reasonable to expect them to extend the flaps in order to regain use of the outboard ailerons. Other recovery methods available were asymmetric power and rudder control. Considering the methods available, as applied solely to a lateral control malfunction, it does not appear likely that such a malfunction occurred.

The Board considered that the hypothesis of a possible malfunction in the lateral control system was unlikely.

4) Malfunction of the rudder boost system

Damage to various components of the rudder system gave conflicting evidence of rudder position at impact. The most reliable evidence of rudder position was that indicative of 9 to 10° right rudder deflection. The impact deformation to the right rudder pedal assemblies was indicative of both the pilot-in-command and the first officer applying right rudder pressure at time of impact. The right inboard and outboard spoilers were found extended. This indicates that both auxiliary and utility hydraulic pressure were available up to the time of impact and that the hydraulic quantity was sufficient to supply hydraulic pressures for normal operation of all systems, including the rudder power system.

Any failure in the control valve link rod, the ratio bellcrank, or structure supporting the bellcrank; or disconnect of either the bolt attaching the rod to the bellcrank or the pivot bolt for the ratio bellcrank, would prevent normal application of both control input and follow-up action to the control valve.

The possibility of a disconnect of the bolt attaching the ratio bellcrank to the forward end of the valve actuating rod was given considerable attention during the investigation. This bolt has a countersunk head and is installed head down to avoid interference with a stiff, flexible hydraulic hose connecting to the power unit case. If the securing nut, normally safetied by a cotter pin, were missing, the bolt could drop down and contact the hose where it would ride back and forth with subsequent movement of the controls. If the sharp-edged bolt head should come to rest on the hose, the resultant rubbing action could cause wear and fouling of the hydraulic hose and either restrict control movement or rupture the hydraulic hose or both. A world-wide inspection of 707 aircraft following the accident disclosed that this bolt was properly installed and safetied in all aircraft.

A study of the results from Boeing and Project RACE* tests, in conjunction with the flight recorder traces of the subject flight, indicate roll effects from sideslips which could possibly result from a malfunction in the rudder boost system caused by any of the control valve disconnects mentioned above. Control valve unporting which may result from such disconnects could be sufficient to cause full hydraulic flow rate to the power cylinder, or it could be at a lesser rate due to the throttling effect of a small uncentring of the rudder control valve.

a) Full hydraulic flow rate to the power cylinder

In the case of a full hydraulic flow rate to the power cylinder (maximum rate hard-over) starting at about 1008:12, the variations of indicated altitude and airspeed shown in Figure 2 do not correspond to the high sideslip angles which can be predicted as a result of full rudder displacement. The Boeing test data show that maximum rudder deflection would probably occur in less than two seconds with maximum rate hard-over producing extremely violent aircraft response. At the probable high rate of rudder deflection, any attempt to correct with normal lateral control alone would not stop the resultant roll and sideslip.

In less than four seconds the sideslip would build up to about 14° which is twice the maximum sideslip reasonably deducible from the flight recorder traces and at a rate of sideslip increase about eight times greater.

The use also of 20° of speed brakes, with only one second delay in starting the recovery attempt, would produce sufficient control to stop the roll, but not sufficient to decrease the bank angle. However, approximately the same sideslip angle and sideslip rate would remain, which again is not in agreement with the flight recorder traces.

The use of lateral control and maximum asymmetric thrust, with only one second delay in applying both, would counteract the roll and sideslip, but the maximum slip angle and rate would still be much greater than indicated by the flight recorder traces, and it appears highly unreasonable to assume that the pilot would accomplish this sequence of corrective actions in the one-second time interval.

* A programme of flight tests originated by the Federal Aviation Agency in an effort to shed light on the cause of the accident.

It was concluded that this accident could not have been initiated by a maximum rate rudder hard-over.

b) Uncentring of the control valve

In the case of a small uncentring of the control valve, the flow rate could conceivably be throttled sufficiently to reduce rudder deflection to produce sideslip effects largely consistent with the angles and rates indicated by the flight recorder traces from 1008:12 to 1008:26. This would imply application of asymmetric thrust after a delay of about six seconds, as indicated by the cessation in sideslip increase from 1008:19 to 1008:22 in the American Airlines' analysis for 50% thrust reduction.

Such a delay in applying thrust asymmetry appears more reasonable than any lesser time delay, since first attempts to take corrective action with the control wheel are more instinctive. The increasing sideslip after 1008:22 could then result from the increasing rudder displacement caused by the unported control valve, and after 1008:28 with decreased lateral control effectivity as the wing angle of attack increased. With maximum aileron effort being applied and nose high stabilizer trim corresponding to that at crash impact, it appears possible that the pitch-up indicated by the acceleration trace could have resulted from an entirely unintentional small change of the elevator control force as a direct result of the high aileron control forces being applied, as the pilot concentrated with great physical effort on lateral recovery. Carrying this possible sequence still further, boost disconnect at about 1008:32 would also tend to result in the nose right sideslip indicated by the flight recorder airspeed trace due to the cessation of the rudder input with power asymmetry and opposite aileron still applied. Cutoff of the remaining two engines shortly afterward still leaves time for the reduced rpm indicated by the torsional damage to all four engines at crash impact.

The Board, therefore, concluded that a throttled rudder control valve malfunction could have been the initiating abnormality which resulted in the accident.

5) Malfunction of the rudder servo unit

The servo motor drives a cable pulley through a clutch which limits the force authority of the servo. Since the cables from this pulley are attached into the rudder system at the aft quadrant, control forces from the servo produce exactly the same effects as equal cable loads from the rudder pedals. However, the clutch in the servo unit is so designed as to permit overpowering of the servo by application of pilot forces to the rudder pedals in the event of any probable malfunction, including false electrical signals. The American Airlines' 707 checklist specifies engagement of the yaw damper, of which the rudder servo is a component, shortly after take-off. The heading trace shown in Figure 2 changes from a wavering line to a straight line at 1007:38, suggesting yaw damper engagement at this instant.

The investigation disclosed that the rudder servo wiring had an "open" in the rate generator circuit. It was found that the brown wire, which connects the output of the rate generator to the input of the autopilot amplifier, and the orange wire, which is the ground or return side of the 18 volts input, were severed, and that the blue wire, which connects 18 volts AC to the rate generator input, was holding together with only one strand. The separations in the wires were adjacent to each other. The nature and protected location of the wire damage precludes the possibility of such damage having occurred at impact. Also, some spare servo units from American Airlines' stock and numerous servo units on the manufacturer's assembly line were found with similar damage and markings. It was determined that damage had occurred as a result of improper use of tweezers when tying the wire bundles to the motor housing. This was considered to be conclusive evidence that the damage to the rudder servo unit of N 7506A was initiated by assembly or maintenance operations. Following the original damage, it is believed that tensile strain in the securing of the wire bundle caused wires that were damaged but not completely severed to be necked down and weakened to the extent that vibration and other disturbances over a period of time caused their final separation. There was no evidence of melting or deposits characteristic of arcing, however, the low voltages and high impedances involved would not produce an arc of sufficient intensity to create such evidence.

Flight tests have demonstrated that separation of the wires without shorting results only in a loss of damping which is hardly perceptible to the crew in the speed range under consideration. Therefore, the final wire separations could have occurred during Flight One or prior thereto. A yaw damper hard-over occurs when there is shorting between the proper ends of the damaged rate generator leads. Referring to Figure 2, this appears likely to have occurred at 1008:12, where the recorded altitude and airspeed indicate the start of an abnormality. Shorting at this time could have been brought about by the inherent tendency of severed leads to untwist from a twisted bundle, as well as by the loosening of the loop around the rate generator case as a result of the wire separations which makes shifting due to vibratory loads much more likely.

It was established that shorted rate generator leads can produce a maximum rudder deflection of 8° in 8 seconds, which in turn results in a roll to 56° in 5-1/2 seconds, starting from a 30° bank at 210 kt IAS. Maximum aileron recovery action during flight tests was started 1-1/2 seconds prior to the aircraft reaching 56°. During this 1-1/2 second interval, the roll increased 13°. Test data establishing the foregoing was based on flight conditions at essentially 1 g acceleration loads. Furthermore, the tests are obviously planned manoeuvres under which conditions the pilot is not confronted with the necessity of analysing the malfunction, deciding what corrective action he will take, and experimenting to produce the desired results. In addition, when considering the operating conditions of Flight One, there were several distracting influences such as departure procedures, radio communications, flap retraction, turbulence, lack of visual horizon reference ahead due to the nose-high attitude of the aircraft, and the excellent weather conditions which would decrease frequency of reference to the attitude instruments. As a consequence, it is unreasonable to assume that under the operating conditions of Flight One at this time the pilot, confronted with an unexpected roll, would start corrective action as soon and to the extent characteristic of planned flight tests.

Recorded instances of yaw damper malfunction or mismanagement showed that in all instances the crew was late in recognizing the yaw damper as being the source of the problem and was slow in initiating corrective action. In some cases, even after initiation of corrective action, the dangerously steep banked attitudes increased and persisted well beyond flight test values before recovery was effected. In some instances the crew took advantage of additional lateral control capabilities, such as use of speed brakes, flaps extension, etc., recovered to level flight, analysed the difficulty and then disengaged the offending yaw damper. However, in some cases the crew never analysed the difficulty. The flight recorder traces indicate that at 1008:12, when the nose left yaw damper hard-over began, the aircraft was in about a 30° bank. It follows then that an unopposed yaw damper hard-over would rapidly increase the bank angle to critical conditions. The first crew reaction would be to decrease the bank by gradually applying opposing control wheel force, probably with a greater delay in reaching full aileron deflection than the five seconds experienced during other test flight conditions. The pilot may have applied opposite rudder also, but with insufficient force to overpower the servo resulting in little or no benefit.

The flight recorder traces indicate that five to six seconds after the malfunction started, the nose-left slip effect of the malfunction suddenly became greater than the effects of opposing control forces. It can be assumed that the pilot then applied asymmetric power to arrest the roll, producing the indicated drop in altitude and the levelling of the airspeed trace at 1008:21 as a result of decreased sideslip. This power reduction also agrees with the energy analysis. In conjunction with these altitude and airspeed trace characteristics, consideration of the heading trace indicates the possibility of a time mismatch between traces, placing the cessation of heading change about one second early. Through this portion of the manoeuvre the nose-high pitch attitude of the aircraft was maintained. Because of late and inadequate application of lateral control the momentarily arrested yaw then resumed and started an increasing nose left slip at 1008:22, as indicated by the rising altitude trace.

At 1008:25 the median acceleration trace indicates the start of a rapid increase in load factor to 1.8 g's at 1008:30. During this rise the individual deflections of the acceleration trace become higher in frequency than before, indicating the start of stall buffet. The turbulent airflow over the wing during stall buffet further decreases the lateral control capability remaining after lock-out of the outboard ailerons.

It is possible that the increasing load factor progressing to stall buffet could have been brought about by a combination of some or all of the following:

a) the basic malfunction of the rudder control system was initially disguised by turbulence and was not quickly identified;

b) the difficulty of recognizing, in the initial stages, the abnormal attitude of the aircraft due to excellent VFR conditions tending to decrease frequency of reference to the attitude instruments;

c) an attempt to maintain the specified flight departure path as evidenced by the 2.3 nose high elevator trim found in the wreckage;

d) inability to effect immediate corrective action due to possible initial reliance on lateral control without application of the additional effect of speed brakes or flap extension;

e) an unintentional nose-high attitude while attempting lateral recovery;

f) the absence of stick shaker stall warning prior to initial stall buffet;

g) the continued operation of a malfunctioning yaw damper.

The flight recorder traces suggest that at about 1008:33 the yaw damper was disengaged, accounting for the sharp decrease in indicated airspeed characteristic of a nose right slip. This leaves sufficient time for retarding the Nos. 1 and 2 throttles, with resultant reduction of the rpm to flight idle prior to impact. It appears likely that the rudder boost was deactivated shortly before impact, accounting for the 9° right rudder indication which was found during the examination of the wreckage.

After 1008:30 the aircraft was in heavy stall buffet, highly abnormal attitudes, and at altitudes too low for recovery to be effected before crash impact.

The Board concluded that a rudder servo malfunction due to shorted wires was the most likely abnormality to have produced the accident.

3.2 Probable cause

The probable cause of the accident was a rudder control system malfunction producing yaw, sideslip and roll, leading to a loss of control from which recovery action was not effective.

3.3 Recommendations

As a result of this accident the Board made the following three recommendations to the Administrator of the Federal Aviation Agency:

It was recommended that -

1. an Airworthiness Directive be issued to require a one-time inspection of the servo rate generator motors on all Eclipse-Pioneer Model PB-20D Automatic Flight Control Systems for damaged wire bundles, and that the Agency take measures as necessary to ensure satisfactory quality control during manufacture and overhaul;

2. an Airworthiness Directive be issued to require mandatory incorporation of applicable Boeing Service Bulletins pertaining to replacement of the Gladden solenoid-operated valves in the flight control and hydraulic interconnect systems due to flaking of the nickel plating tending to contaminate the hydraulic fluid;

3. the current airworthiness requirements for automatic flight control systems in Section 4b.612(d) of the Civil Air Regulations and the related CAM (Civil Aeronautics Manual) material, as specifically applied to the high speed swept-wing design turbo-jet aircraft, be re-evaluated for the purpose of establishing realistic time allowances for recognition of abnormal aircraft motions, decision to take corrective action, and initiation of the proper correction in all pertinent flight regimes; and that necessary changes to the requirements be applied retroactively to turbo-jet aircraft equipped with automatic flight control systems.

3.4 Action taken

As of January 1963 the Federal Aviation Agency had taken appropriate action on the first two recommendations and had the third under study.

Also following this accident the Federal Aviation Agency amended the noise abatement procedures. It restricted the commencement of the first turn until the aircraft reaches an altitude of 300 ft and also eliminated the advisory, "In the interest of noise abatement, do not delay turn to 290°", from the departure clearance for runway 31L. As of 25 December 1962 the procedure was changed to require a climb on a 290° heading to 1 000 ft before further turns are made.

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ICAO Ref: AR/741

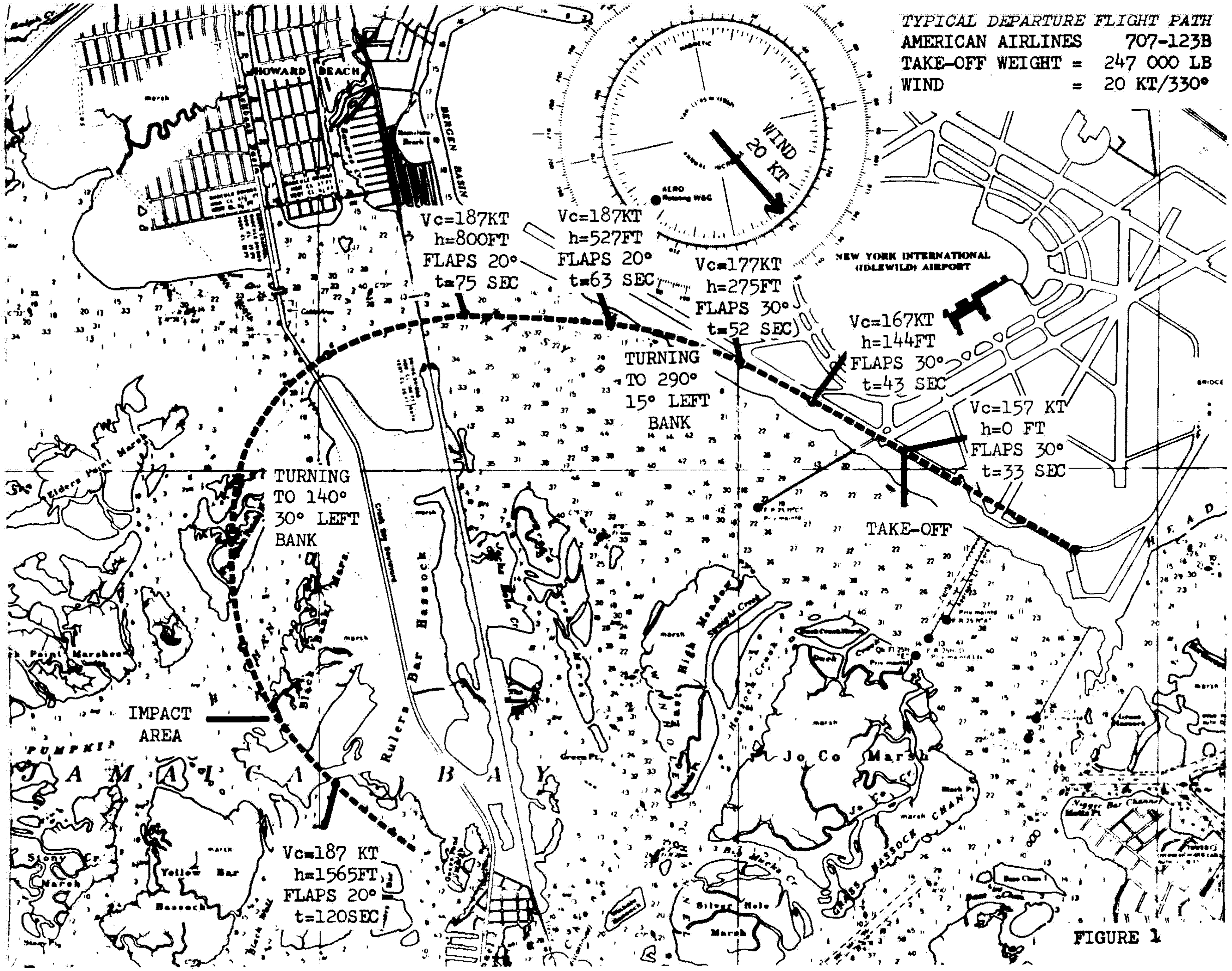
TYPICAL DEPARTURE FLIGHT PATH
AMERICAN AIRLINES 707-123B
TAKE-OFF WEIGHT = 247 000 LB
WIND = 20 KT/330°
WIND 20 KT
NEW YORK INTERNATIONAL (IDLEWILD) AIRPORT
HOWARD BEACH
BERGEN BASIN
Vc=187KT h=800FT FLAPS 20° t=75 SEC
Vc=187KT h=527FT FLAPS 20° t=63 SEC
Vc=177KT h=275FT FLAPS 30° t=52 SEC
Vc=167KT h=144FT FLAPS 30° t=43 SEC
Vc=157 KT h=0 FT FLAPS 30° t=33 SEC
TAKE-OFF
TURNING TO 290° 15° LEFT BANK
TURNING TO 140° 30° LEFT BANK
IMPACT AREA
Vc=187 KT h=1565FT FLAPS 20° t=120SEC
JAMAICA BAY
Rulers Bar Hassock
Jo Co Marsh
GRASS HASSOCK CHAN
Yellow Bar Hassock
Silver Hole Marsh

FIGURE 1

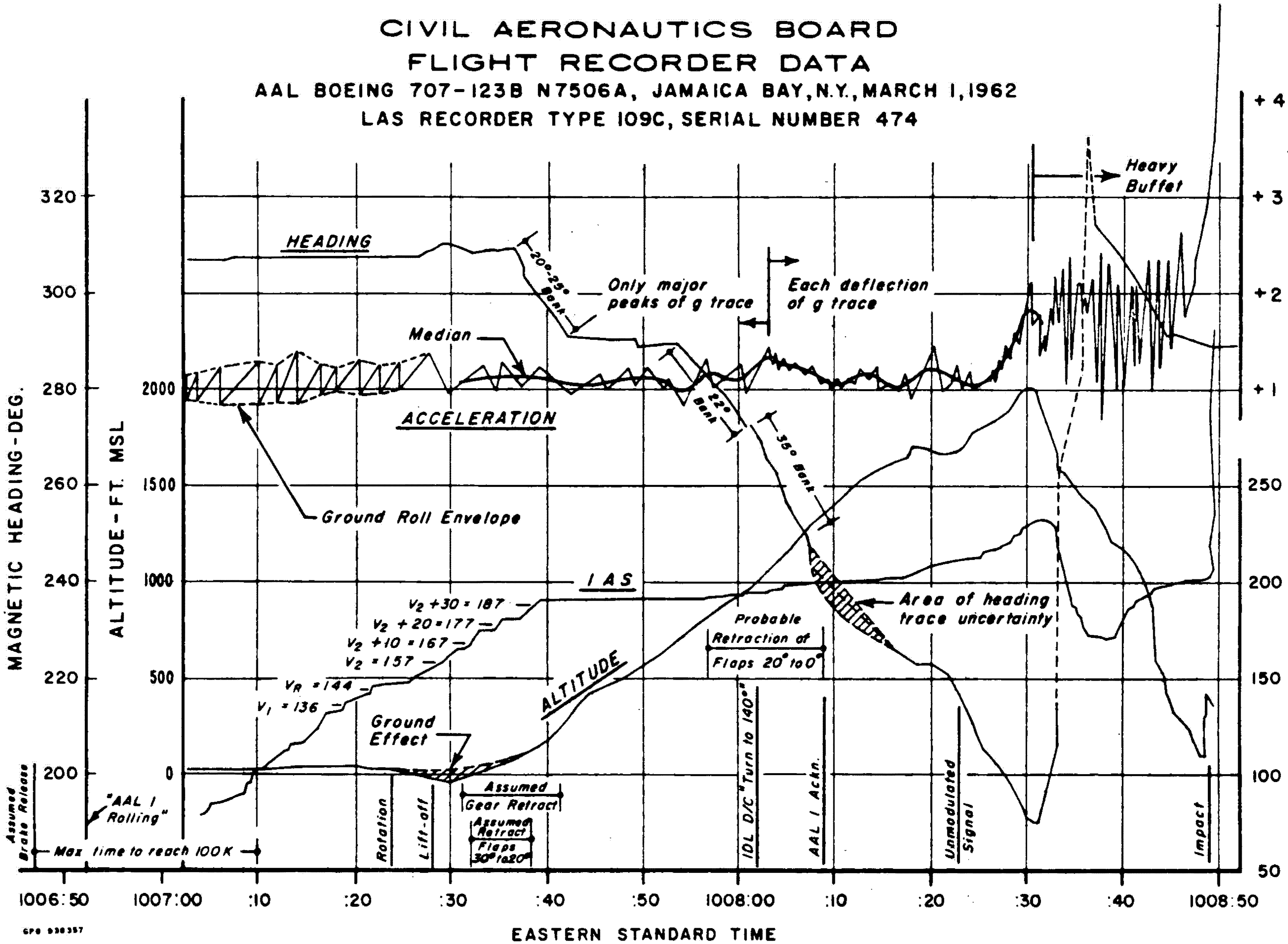
CIVIL AERONAUTICS BOARD
FLIGHT RECORDER DATA
AAL BOEING 707-123B N7506A, JAMAICA BAY, N.Y., MARCH 1, 1962
LAS RECORDER TYPE 109C, SERIAL NUMBER 474
MAGNETIC HEADING - DEG.
ALTITUDE - FT. MSL
VERT. ACCEL. - G's
IAS - KNOTS
EASTERN STANDARD TIME
HEADING
Median
ACCELERATION
Ground Roll Envelope
20°-25° Bank
22° Bank
35° Bank
Only major peaks of g trace
Each deflection of g trace
Heavy Buffet
IAS
ALTITUDE
Area of heading trace uncertainty
Probable Retraction of Flaps 20° to 0°
V_2 +30 = 187
V_2 +20 = 177
V_2 +10 = 167
V_2 = 157
V_R = 144
V_1 = 136
Ground Effect
Assumed Gear Retract
Assumed Retract Flaps 30° to 20°
Assumed Brake Release
"AAL 1 Rolling"
Max time to reach 100K
Rotation
Lift-off
IDL D/C "Turn to 140°"
AAL 1 Ackn.
Unmodulated Signal
Impact
1006:50
1007:00
:10
:20
:30
:40
:50
1008:00
1008:50

FIGURE 2

No. 5

Caledonian Airways Ltd., DC-7C, G-ARUD accident 2 km from Douala Aerodrome, Cameroon, 4 March 1962. Civil Aircraft Accident Report of the Commission of Inquiry, Federal Republic of Cameroon, released by the Ministry of Aviation (United Kingdom) as C.A.P. 202.

1. Historical

1.1 Circumstances

G-ARUD was on an international non-scheduled flight (CA 153/154) from Luxembourg to Luxembourg via Khartoum, Lourenço Marques, Douala and Lisbon. The flight departed Luxembourg on 1 March 1962 and arrived at Lourenço Marques on 2 March where there was a stop-over period of 36 hours 55 minutes. The aircraft left Lourenço Marques on 4 March and arrived at Douala at 1645 hours GMT after a flight of 8 hours 45 minutes. The flight up to the arrival at Douala was made without incident. There were 10 crew members and 101 passengers aboard when the aircraft left the ramp at Douala at 1805 hours. The taxiing instructions gave the take-off runway 12 (QFU 12), the altimeter setting 1010 mb (QNH) and the wind 220°/8 kt. G-ARUD held clear of the active runway for landing traffic and during this period witnesses heard the engines being run up. The aircraft lined up on runway 12 and took off at 1820 hours. (Night take-off. Evening twilight ended at 1756 hours). According to the controller on duty at the control tower the aircraft's landing lights were not on during the take-off. The aircraft lifted off runway 12 after what appeared to be an unusually long run of approximately 2 400 m (of 2 850 m available) after release of the brakes and gained height with difficulty. The anti-collision light was seen at a low altitude and then disappeared behind the trees. Five seconds later the sky was lit up by a fire. The left wing and left side of the fuselage struck the first trees of the forest at a height of about 22 m above the elevation and about 2 300 m beyond the threshold of runway 30. After the initial impact in a near level flight attitude and with the aircraft slightly banked to port, it then went progressively into a dive with the left wing low and sheared the tops of the trees over a traversed distance of about 130 m before final impact with the water of a creek. The attitude of the aircraft on final impact was approximately 25° nose down with the same angle of left bank. The aircraft exploded on impact. The fuel and oil spread over the surface of the water and ignited. The fire destroyed the unsubmerged parts of the wreckage. The accident occurred at 1821 hours GMT.

1.2 Damage to aircraft

The aircraft was destroyed by the impact, the fire or submersion.

1.3 Injuries to persons

All occupants (10 crew and 101 passengers) lost their lives.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The Certificate of Airworthiness was valid until 28 November 1962. Maintenance of the aircraft met the approved maintenance schedules. The take-off weight of the aircraft at Douala was within the prescribed limits for the circumstances. The computed centre of gravity was well within the prescribed limits.

2.2 Crew information

The pilot-in-command, age 41, held a valid airline transport pilot's licence properly rated for the flight. He had a total of 11 587 hours flying time of which 287 hours were on DC-7C aircraft. In the preceding 90 days his flight time was 199 hours 35 minutes.

The co-pilot, age 39, held a valid airline transport pilot's licence properly rated for the flight. He had a total of 10 249 hours flying time of which 227 hours were on DC-7C aircraft. In the preceding 90 days his flight time was 185 hours 05 minutes.

The second co-pilot, age 39, held a valid commercial pilot's licence properly rated for the flight. He had a total of 7 187 hours 30 minutes flying time of which 187 hours 30 minutes were on DC-7C aircraft.

The three engineers held valid flight engineers' licences. One held a first engineer rating for DC-7C aircraft, another held a second engineer rating for DC-7C aircraft, and the third held no rating for DC-7C aircraft. The first engineer had 2 772 hours experience on DC-7C aircraft and the other flight engineers had 242 and 28 hours of DC-7C time respectively.

The remaining crew members were the navigator and three female cabin attendants.

2.3 Weather information

Meteorological conditions prevailing at Douala Aerodrome at the time of the aircraft's take-off were:

Temperature	28.8°C
humidity	79%
wind	260°/5 kt
visibility	15 km
cloud	400 m 3/8 Fc
	600 m 2/8 Sc
	1 500 m 2/8 Cb (to the southwest)
QNH	1010 mb

The aerodrome and line of approach for runway 30 were reported as being clear.

2.4 Navigational Aids

ILS, VOR, MF beacons. In view of the flight phase and the meteorological conditions at the time of take-off, these items can be discounted.

2.5 Communications

HF, VHF. Take-off clearance was given to the aircraft. No recording of tower communications was made.

2.6 Aerodrome Installations

The aerodrome and ground facilities were fully adequate.

2.7 Fire

Fire occurred after impact and explosion. Fuel and oil on the surface of the water ignited and destroyed the unsubmerged part of the wreckage.

2.8 Wreckage

The wreckage trail commenced at the location of the first trees struck by the aircraft which showed that initial impact was on the bottom left-hand side of the fuselage at the left wing root. The trail of the wreckage indicated the aircraft's direction of travel was 110° - some 14° to port of the QDM of the runway (124°). The violence of the final impact with water caused the wreckage to disintegrate into a large number of parts some of which were heavily deformed by contact with the trees and mangrove roots. On certain parts a very clear line of demarcation between the area destroyed by fire and the intact area shows these parts were submerged and that destruction by fire was due to fuel burning on the surface of the water. No trace of fire was found on any of the submerged parts.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

The following hypotheses were examined in detail:

a) act of sabotage;
b) failure of one or more power plants;
c) control surface flutter;
d) incorrect operation of the undercarriage and flaps;
e) untimely or asymmetrical retraction of the flaps;
f) structural failure;
g) erroneous indications of the instruments;
h) electrical failure;
i) incident in the cockpit;
j) crew fatigue;
k) inadequate fuel characteristics;
l) errors in the load sheet.

Insufficient evidence was found to corroborate any of these hypotheses. In discussing the abnormally long take-off run before lift-off (about 2 400 m, instead of about 1 500 m), several causes were analysed including failure of a power plant, excessive flap setting for take-off or deliberate holding down of the aircraft above a speed higher than V2. In the Commission's opinion the most suitable explanation for the long ground run is provided in the theory of "difficulties arising at the time when V2 was reached causing the crew to delay either deliberately or involuntarily, the lifting-off of the wheels". There was no evidence of smoke in the cockpit or fire which might have distracted the crew and caused a delay in rotation of the aircraft. During the technical examination of the wreckage the mechanism of the right elevator spring-tab was found jammed in such a manner as to prevent the movement of the spring-tab in the nose-up direction of the control surface. In view of the similarity of friction markings found in the same mechanism of other DC-7C aircraft, and information received of an abandoned take-off at V2 of a DC-7C in April 1961*, flight tests were made which revealed that with one of the two spring-tabs jammed, a pull force of 40 - 45 kg (as opposed to a normal 14 - 16 kg) has to be applied to cause the desired rotation of the aircraft. This could provide an explanation for the increase in the ground run prior to lift-off.

3.2 Probable causes

The facts on which the Commission can base its conclusions are as follows:

1 a) The operator, Caledonian Airways, held an Air Operator's Certificate in order and valid.

1 b) The DC-7C aircraft, G-ARUD, had a valid Certificate of Airworthiness on the day of the accident.

1 c) The crew of G-ARUD held the necessary valid licences and qualifications.

The Commission of Inquiry has good reason to think that the co-pilot, a captain, who held -

- a valid airline transport pilot's licence,
- a qualification for aircraft commander in the DC-7C since 17 January 1962,

was carrying out a route qualification under the control of the pilot-in-command during the flight Luxembourg - Lourenço Marques - Douala - Lisbon - Luxembourg.

The Commission deduces from this that during the take-off from Douala the co-pilot was probably in the left-hand seat and the pilot-in-command in the right-hand seat.

The pilot-in-command acquired his flying experience with a major international carrier, a European international operator and two companies in the United Kingdom. He was well experienced on four-engined aircraft. As for DC-7C experience - he made 13 flights during training and 20 take-offs as pilot-in-command, including 14 at night. He was reported to be a very competent and capable pilot.

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* This incident caused Douglas to issue an SSTR, dated 1 May 1961, suggesting, but not requiring, the checking of the spring-tab mechanisms.

Although the co-pilot had a total of 5 844 hours as pilot-in-command, it was mainly time flown on DC-3 and Bristol 170 aircraft. His experience as pilot-in-command on four-engined aircraft and DC-7Cs was fairly limited. On DC-7Cs, as pilot-in-command, he had carried out about 15 take-offs, including 6 at night. He was considered to be a very capable pilot and had gained his experience while employed by an airline in the United Kingdom and while training with a European international operator.

The flight engineer had good experience on the DC-7C before joining Caledonian Airways. He had flown 2 594 hours with a major international carrier from October 1957 to October 1961 and was reported as being a capable and competent engineer officer.

The Commission is, therefore, led to conclude that the crew of G-ARUD held valid licences and qualifications and that it corresponded to the average crew of a four-engined aircraft, with nothing exceptional. The DC-7C experience of the pilot-in-command and the first officer was relatively limited, however.

1 d) The pitch of the propellers on impact was about 37° for the four engines, which eliminates the hypothesis of the failure of one of the engines. The first reduction had not been made.

From consideration of the curves V = f (pitch, power) provided by Hamilton, it can be deduced that the speed on impact was about 170 kt (V2 = 126 kt, V2 + 15 = 141 kt), which for practical purposes eliminates the hypothesis of a stall.

1 e) At the time of the impact, the undercarriage was retracted.

1 f) The first impact with the trees took place at 22 m above the aerodrome elevation of 11 m.

The point of first impact is about 5 100 m from the point of release of the brakes at the beginning of runway 12, i.e. about 2 300 m from the threshold of runway 30 and 475 m to the left of the runway centre line.

The angle of deviation to the left is therefore 11°, measured from the end of the runway, and 21° 30' measured from the position of the middle marker.

At the time of the first impact, the aircraft appears to have been slightly banked on the port side and the pitch attitude was far nearer to level flight than to even a shallow dive.

1 g) The accident occured at 1821 hours GMT; the sun set at 1735 hours and twilight ended at 1756 hours. The aircraft's landing lights do not appear to have been used on the take-off of G-ARUD at Douala. On the other hand, the anti-collision light functioned until the crash.

1 h) The corrected weight of G-ARUD on take-off from Douala was 139 266 lb, and the Commission has no reason to doubt the centre of gravity of 29.5% calculated by the crew. In any event, it has ascertained from the calculations of the Air Registration Board that the effective centre of gravity could not have been further to the rear.

The Commission has also to take into consideration the following points:

2 a) the starboard elevator spring-tab of G-ARUD was found jammed when the wreckage was examined in France where it had been taken for expert examination.

Several members of the Commission think that this jamming took place before the impact. The Commission recognizes unanimously that such jamming was possible, and in view of the facts established by the Commission, the Douglas Company subsequently issued a service bulletin recommending a modification similar to that which several well-known international companies using the DC-7 are applying.

2 b) Although the flap control lever was found in the position of 10°, examination of the surfaces of the flaps and the corresponding expert examination of the jacks, hinged connection cover plates and guides give the Commission reason to believe that at the time of the impact the flaps were retracted or in a position very close to the retracted position. If this is so, it can be concluded that everything must have been normal when the pilot-in-command ordered the retraction of the flaps, the speed then being V2 + 15 = 141 kt, and that a few seconds at most before the impact and about 10 seconds after the flaps had been previously retracted the control was replaced to the position of 10°, the crew having observed an abnormality of some kind or other.

2 c) Flight tests were carried out at the request of the Commission of Inquiry by the French Flight Test Centre at Istres in October 1962, and then at Brétigny in May 1963. The object of the tests was to compare the behaviour and control forces of the DC-7C on take-off and during the first climb phase, more particularly during the retraction of the flaps, with the same load and centre of gravity as that of G-ARUD at the time of the accident, in the following two cases:

- one elevator spring-tab jammed
- the two elevator spring-tabs free

The main facts revealed by the report of the Flight Test Centre and by the annexed interpretations are as follows:

A) With a centre of gravity position, further to the rear, of 28.5%, approximating that of G-ARUD at Douala, the stick forces on the lifting-off of the nose wheel and on take-off, with a spring-tab jammed, are surmountable but still sufficiently high to explain the abnormal length of the take-off run of G-ARUD which, according to the evidence of the Tower Controller, was still running along the ground when it blocked the observer's view of the light of the glide path transmitter.

B) In all cases and with all centre of gravity positions, the retraction of the flaps is accompanied by a fairly considerable variation in stick force, and in order to maintain a constant speed, attitude or altitude during the retraction of the flaps, the pilot must always exercise a pull force on the control column if he does not operate the trim tab.

With the centre of gravity and weight of G-ARUD at Douala, the stick forces on the retraction of the flaps to maintain constant flight attitude are:

- approximately 5 to 10 kg when the control surface is normal
- approximately 10 to 17 kg when one of the spring-tabs is jammed.

Even when the control surface is normal, the forces may be sufficient to produce a not inconsiderable risk of negative rate of climb with all the resultant dangers if the aircraft is not at a sufficient altitude. The risks of negative rate of climb are obviously aggravated if a spring-tab is jammed.

2 d) It is therefore regrettable, in the case of the Douala accident, that the take-off and climb procedure for the DC-7C applied by Caledonian Airways did not include a minimum altitude for flap retraction, apart from a reference to the necessity of being clear of obstacles, as opposed to the procedure adopted by other operators which stipulated that this operation should not be begun at night before 400 ft.

The Douala approach chart available to the crew of G-ARUD did not show any obstacle on take-off on runway 120 except the building of the middle marker, 10 ft high, 1 070 m from the end of the runway, and the aerial of the radio beacon, 138 ft high at a distance of 6 km.

It was, therefore, theoretically sufficient that the minimum gradient of climb of 1.2% should be guaranteed from 50 ft onwards which the aircraft should have reached at the end of the "take-off distance". The aircraft would thus have been at an altitude of 160 ft (approximately 50 m) on passing the point of impact.

The crew of G-ARUD, which had landed at Douala at about 1630 hours, could not have been unaware of the presence of the trees along the edge of the take-off flight path area on a bearing of 120°. Moreover, they are shown on the visual landing charts published by ASECNA which the crew could easily have seen at the aerodrome local control; but these charts give no indication of the height of the trees along the edge of the take-off flight path area.

2 e) The climb procedure adopted by Caledonian Airways included a minimum cooling speed of 160 kt IAS. It emerges from statements in agreement with one another of the crews of Caledonian Airways and of the pilots of another international carrier that the cooling speed adopted when clear of obstructions was 180 kt. It is highly probable that the crew of G-ARUD applied this rule, and this seems to be confirmed by the evidence of the Tower Controller who stated that the climb had been very slow.

2 f) The Commission is, therefore, led to think that G-ARUD deliberately remained at a low altitude after its take-off. It notes that the aircraft does not appear to have reached 180 kt.

2 g) It is improbable that the aircraft's deviation to the left of the extended runway centre line was the result of a deliberate action on the part of the crew. The crosswind and possible asymmetry of engine power are not sufficient to explain the deviation. It may have been the result of a defect either in the pilot-in-command's flight director (HZ. 1) or the emergency horizon (H6B6), which would have affected the indications of the instrument. If the pilot chose to follow the indications of the instrument at fault without checking those indications by the indications of the basic instruments - altitude, heading, pitch - he may have been sufficiently misled to make the deviation found at the wreckage.

The Commission notes that:

- nothing was found of the HZ. 1 and that the expert examination of the pilot-in-command's emergency horizon H6B6, which was recovered from the wreckage, has not made it possible, in view of the damage sustained, to establish whether or not there was a defect in the instrument;
- the failure of a horizon is no explanation of a decision by the crew to re-extend the flaps;
- during flight tests in the DC-7C at the Brétigny Flight Test Centre, when the crew was careful to maintain a given speed, attitude or altitude, involuntary changes of heading far greater than that of G-ARUD were observed.

3.3 Recommendations

The Commission considers that during the Inquiry certain abnormal facts were established or revealed by the evidence and statements of witnesses. Although some of these facts are not connected or are only indirectly connected with the accident, the Commission considers that it is its duty to formulate the following recommendations.

Recommendations regarding the aircraft

The Commission considered it regrettable that the constructor did not design a modification to the elevator spring-tab control mechanism, to eliminate the possibility of accidental jamming, immediately after the abandoned take-off incident to the DC-7C which led to the SSTR of 1 May 1961; this SSTR was so drafted that it minimized both the possible consequences and the nature of the incident and did not attract sufficient notice of the users.

The Commission has noted that, perhaps as a result of its action, Douglas subsequently designed such a modification and on 16 October 1962 issued Service Sketch No. 513, referring to the preceding SSTR and recommending the modification. The Commission thinks that this modification, or any other designed to achieve the same purpose, such as those applied by other major international carriers should be made mandatory as soon as possible.

Recommendations regarding personnel

Although there is no reason to think that training may be a direct factor in the accident in question, the Commission considers that it is essential to remind operators of complex modern aircraft of the necessity for a qualification of a very high standard for their crews: to obtain a qualification truly commensurate with such a standard, a minimum number of hours of training in flight and on the simulator must first be completed.

The Commission also considers it essential to remind the instructors responsible for the issue of type ratings of the responsibilities which devolve upon them. The Commission considers that when a rating is granted with training which is inadequate in respect of either its length or its results, a heavy responsibility lies with the instructor issuing the rating.

Recommendations regarding infrastructure

The Commission has noted the measures taken by the Cameroon services to ensure the co-ordination and efficiency of all personnel responsible for safety at the aerodrome. Tracks which can be used by cross-country vehicles have been made at 50 m intervals at right angles to the runway centre line along the take-off flight path area, in order to give access to the undergrowth and creek. A landing stage has been built on the creek, which still has some depth of water even at low tide, and a boat is kept there permanently.

An anemometer system has been installed near the middle marker for comparison with the Tower.

At the outer marker, 6.7 km from the threshold, three white lights have been installed at a height of 40 m, the light of which will give a visual fix along the runway centre line.

The Commission has asked the Cameroon services to check the height of the trees along the edge of the take-off flight path area on a bearing of 120° and if necessary to correct the Douala approach and landing charts. This work is in progress.

Recommendations of a general nature

The Commission recommends the systematic study, by operators, constructors and official services, of all incidents reported during operations, in particular those which might have led to an accident or have provided an explanation of an accident.

In view of the similarities between the Douala accident and other previous accidents to DC-6 and DC-7 aircraft during the same flight phase, in particular those occuring at Orly, Shannon and Bordeaux, the Commission suggests that the Cameroon Government examine the possibility of communicating the present report and its detailed annexes to the appropriate State authorities concerned.

The Commission recommends urgently that all multi-engined transport aircraft be equipped with flight recorders which will give basic data in the case of an accident.

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ICAO Ref: AR/800

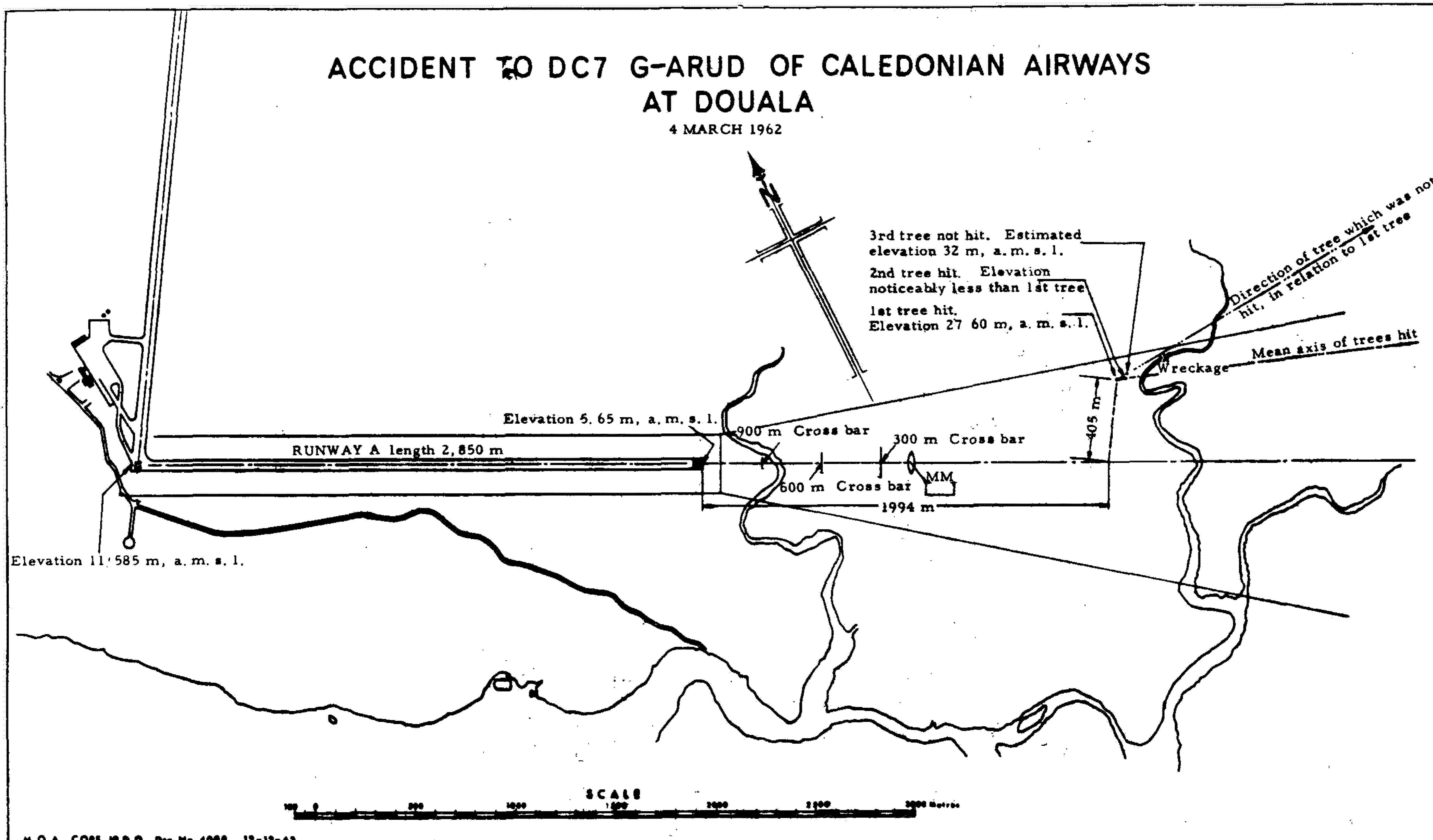
ACCIDENT TO DC7 G-ARUD OF CALEDONIAN AIRWAYS
AT DOUALA
4 MARCH 1962
N
3rd tree not hit. Estimated elevation 32 m, a.m.s.l.
2nd tree hit. Elevation noticeably less than 1st tree
1st tree hit. Elevation 27 60 m, a.m.s.l.
Direction of tree which was not hit, in relation to 1st tree
Mean axis of trees hit
Wreckage
405 m
Elevation 5.65 m, a.m.s.l.
900 m Cross bar
300 m Cross bar
RUNWAY A length 2,850 m
600 m Cross bar
MM
1994 m
Elevation 11.585 m, a.m.s.l.
SCALE
M.O.A., COPS 10 D.O., Drg. No. 4088 12-12-63

FIGURE 3

No. 6

Turk Hava Yollari Anonim Ortakligi (Turkish Airlines), Fairchild F-27, TC-KOP accident during approach to Incirlik Airport, Adana, Turkey on 8 March 1962. Findings released by The Minister of Communications, Turkey.

1. Historical

1.1 Circumstances

The aircraft was on a scheduled domestic flight from Ankara to Adana - Incirlik. It took off from Ankara at 1420 hours GMT and while en route reported to Adana that it had passed Aksaray and that its estimated time of arrival at its destination would be 1540 hours. At 1528 hours the pilot reported the aircraft was at flight level 175 and requested clearance to approach. At 1540 the Adana - Incirlik tower asked the pilot whether the aircraft was on the Adana beacon or radio range. The pilot advised that the aircraft was on the radio range between flight levels 170 and 175. The flight was cleared to 5 000 ft and was asked to report crossing 8 000 and 7 000 ft. Nothing further was heard from the aircraft. At 1543 hours it crashed at a point 6 800 ft amsl, approximately 47 NM from the Adana radio range.

1.2 Damage to aircraft

The aircraft was completely destroyed.

1.3 Injuries to persons

The three crew members and eight passengers aboard the aircraft were fatally injured.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The aircraft had a valid Certificate of Airworthiness. Maintenance on the aircraft and inspections had been carried out satisfactorily and at the required intervals. No malfunctions were reported prior to the accident. The centre of gravity of the aircraft was within the allowable limits.

2.2 Crew information

The crew were properly licensed.

2.3 Weatner information

According to the reports passed by the pilots to the Incirlik tower, the aircraft, prior to the accident, was flying around cumulus clouds, avoiding turbulence and changing altitude accordingly.

2.4 Navigational Aids

All ground radio navigational aids in the area were serviceable. No abnormality had been reported by pilots.

2.5 Communications

Air-ground communications were carried on according to normal procedures, and communications were recorded in the tower on tape recorders.

2.6 Aerodrome Installations

All facilities were serviceable.

2.7 Fire

No mention of fire is made in the report.

2.8 Wreckage

No details regarding the wreckage are given in the report.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

The report on this accident consists of only the findings of the Inquiry. It contains no discussion of evidence, analysis of wreckage, reports on the examination of witnesses, etc.

3.2 Probable cause

According to reports received by the Incirlik tower, the aircraft should have been on the Adana radio range at 1540 hours and at flight level 175. In avoiding cumulus cloud, and associated turbulent conditions, the pilot was not able to keep track of his exact position or to maintain exact altitude.

3.3 Recommendations

No recommendations are contained in the report.

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ICAO Ref· AR/826

No. 7

Swissair, Caravelle III, SE-210, HB-ICT accident at Kloten Airport, Zurich, Switzerland on 25 April 1962. Accident report No. 1962/7/91, dated 27 February 1963, released by the Federal Board of Inquiry, Switzerland.

1. Historical

1.1 Circumstances

The aircraft arrived in Geneva from Paris on 24 April and was towed to the Swissair hangar for a K* check and to be made ready for a flight to Paris next morning. That evening a student, who was designing a nose wheel chassis, went to the hangar where the foreman of the 1900 to 0400-hour shift gave him data on the Caravelle landing gear. They then went to HB-ICT. The foreman opened the control doors and main door of the nose wheel chassis so that the student could take pictures and then returned to his office. The student completed his inspection, without interfering with anything, and left. The foreman did not close the doors, gave no orders for them to be closed nor did he mention what had to be done to anyone else. The mechanic, who was checking the aircraft, reported between 2200 and 2300 hours that he had completed the K check. For this check he used the French version of work chart 6 as his guide. He did not check the undercarriage doors as he did not think he was obliged to. The foreman of the next shift (0400 hours) assumed, as he had no information to the contrary, that HB-ICT had only to undergo a V** check and be refuelled prior to take-off. No one noticed that the main door and two control doors had been left open.

The V check was begun on the ramp at 0715 hours, and the co-pilot made the external checks. Again the abnormal position of the nose wheelwell doors was unnoticed. After the engines had been started, the ramp mechanic tried to close the main door of the nose wheel compartment by hand. He could not. Not understanding the mechanism, and presuming its position to be normal, he believed the door would automatically close in the air, with the retraction of the landing gear. The deputy chief of the runway service asked him whether the main door was in order and was satisfied with the reply that the doors would close in the air.

Flight SR 142, a scheduled international flight from Geneva to Paris, took off shortly after 0735 hours central European time on 25 April, carrying 6 crew and 66 passengers. Following take-off the nose landing gear jammed when almost fully retracted. The pilot decided to return to Geneva but was instructed, by Swissair operations control, to proceed to Zurich for technical reasons. The aircraft arrived over Zurich at 0827 hours. Further unsuccessful attempts were made to extend the nose gear. At 0905, Swissair asked for a foam carpet on instrument runway 16 between taxiways 3 and 7. Foam spraying began at 0917. When about half of the required runway length had been prepared, the operation was discontinued as the aircraft's fuel supply was running low. At 0956 the aircraft touched down 400 - 600 m from the runway threshold at a speed of 100 kt. The drag chute was released immediately. The pilot carefully rotated the nose of the aircraft and the nose grazed the runway surface 1 175 m from the threshold, at a speed of 80 kt. The aircraft rolled 740 m further and came to rest on the foam carpet 1 915 m from the runway threshold. During the landing roll a fire broke out in the compartment under the flight deck.

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* K check - following every flight to Basle, Geneva and Zurich and to foreign airports if the period on the ground exceeds eight hours.

** V check - before every take-off

1.2 Damage to aircraft

The nose of the aircraft was substantially damaged and 16 000 working hours were necessary to repair it. The aircraft was out of circulation for sixty-one days.

1.3 Injuries to persons

None of the 6 crew and 66 passengers aboard the aircraft was injured.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

A traffic permit had been issued for the aircraft on 22 March 1962 which was valid until 31 December 1964.

The aircraft's actual landing weight, 34 100 kg, was below the maximum allowable of 43 800 kg. Its centre of gravity was also within the permissible limits.

It was not equipped with apparatus for the rapid dumping of fuel usually carried by aircraft of this type.

2.2 Crew information

The pilot-in-command, age 36 years, held an airline transport pilot's licence, endorsed for Caravelle III aircraft, which was valid until 21 June 1962.

The co-pilot, age 30, held a commercial pilot's licence endorsed for Caravelle III aircraft which was valid until 9 August 1962.

The other crew members on the subject flight were one steward and three stewardesses.

2.3 Weather information

Fine weather conditions existed throughout Switzerland on the day of the accident.

2.4 Navigational Aids

Not significant in this accident.

2.5 Communications

No difficulties were reported concerning the communications between the aircraft and the Swissair services assisting the flight.

2.6 Aerodrome Installations

Instrument runway 16 at Kloten Airport was used for the emergency landing. It is 3 700 m long and 60 m wide.

Everything possible was done by those on the ground to assist in the landing.

2.7 Fire

The fire which broke out during the landing roll was caused by the friction between the aircraft's nose and the ground. It was extinguished by the fire tenders.

2.8 Wreckage

Not applicable.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

Inspection of the nose gear showed that whereas the actuating mechanism of the left panel of the main door had functioned normally, the unscrewed connecting rod had become wedged on both sides, causing serious distortion and dislocation of the mechanism during the attempted retraction. This in turn jammed the nose gear when an effort was made to extend it.

In practice, checks are not done exactly as prescribed in the maintenance manual but follow an abbreviated coded operations chart.

At the time of the accident the maintenance manual contained no up-to-date instructions on the K check. The existing instructions were withdrawn on 7 February 1962 and had not been replaced.

The French version of work chart 6 of the K check, corresponding to the instructions previously in force, only referred to the undercarriage, shock absorbers, brakes and tires. It did not include the inspection of the undercarriage doors and well installations, although these were included in the German version of that chart.

Although the V check in the manual gave no instructions for checking the nose wheel chassis, the section corresponding to V check chart 1 stated that all control covers and service panels should be checked to make sure they were closed.

According to the manual, the crew which tows the aircraft from the hangar is responsible for ensuring that all doors are closed.

Several qualified persons might have discovered the open doors while carrying out their duties. However, the open doors were not conspicuous. Although it appears that the mechanic of the 0400-hour shift noticed that something was not quite right about the position of the door panel, he was not sufficiently experienced to understand the mechanism. He could not be expected on his own responsibility to delay the aircraft and call back his superior, who had probably left the field, in order to have him check the door when he was not sure that there actually was something wrong.

Following the Inquiry the crew submitted the official Swissair Manual of Flight Training and Flying Procedures for the SE-210 Caravelle, dated November 1961. It lists the procedure for the external check, which does not specify a general inspection of the airframe and windows, nor do any of the items relate to the landing gear doors.

3.2 Probable cause

The night before the accident one of the maintenance staff interfered with the door mechanism of the nose landing gear for reasons unrelated to the servicing of the aircraft. This interference resulted in the jamming of the nose gear in the nearly retracted position shortly after take-off, which in turn resulted in an emergency landing.

3.3 Recommendations

No recommendations are contained in the report.

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ICAO Ref: AR/827

No. 8

Federal Aviation Agency, Lockheed Constellation L-749A, N 116A, accident at Canton Island, Phoenix Group, Pacific Ocean, on 26 April 1962. Civil Aeronautics Board (U.S.A.) Aircraft Accident Report, File No. 2-0564, released 8 March 1963.

1. Historical

1.1 Circumstances

The aircraft took off from runway 9 at Canton Island at 0914 hours local time on a training flight carrying 4 FAA (Federal Aviation Agency) crew members and 2 passengers. It stayed in the airport traffic pattern, and several approaches and landings were made with various flap configurations, some employing propeller reversing after touchdown. The aircraft then left the traffic pattern and was climbed in order to conduct training in emergency procedures. These procedures included the feathering and simulated feathering of propellers and the simulation of hydraulic and electrical system failures. At 1142 hours the crew advised that they were four miles out, requested traffic information and stated that they intended to pass over the airport. Shortly thereafter the aircraft flew over the airport from north to south at an altitude of about 500 ft and then continued out over water where it circled several times. It then climbed to traffic pattern altitude and entered a left downwind leg. At 1210 the current altimeter setting of 29.86 was given to the flight and was acknowledged. This was the last contact with the aircraft. It was then observed carrying out an approach to land. Following touchdown it rolled 239 ft on the right main landing gear with the right wing continuing to drop. The aircraft then lifted off in a nose-high and right-wing-down attitude, and the right wing tip struck the ground at the right edge of the runway. The aircraft at the time was banked sharply to the right, and the nose was high. With the angle of bank increasing, the turn continued with the right wing scraping and being abraded by coral. An 18-inch high coral ridge was struck, causing further break-up of the wing. The angle of bank continued to steepen, and the aircraft cartwheeled, coming to rest 220 ft offshore in water about 3 ft deep. All engines broke free. The accident occurred at 1213 hours. Tire marks on the runway indicated that the average heading of the aircraft was 097°, 7° from the runway heading (090).

1.2 Damage to the aircraft

The aircraft was destroyed.

1.3 Injuries to persons

All four FAA crew members were fatally injured. One of the two passengers, not an FAA employee, was also fatally injured. The other, an FAA physician, was seriously injured.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The aircraft was owned by the United States Government and operated by the Federal Aviation Agency. Its total flight time amounted to 41 481 hours, 3 968 of which had been flown since the last Block III overhaul. It had been flown a total of 1 189 hours by the FAA.

The maintenance records of the aircraft indicated proper and current maintenance.

During the investigation, no weight and balance figures could be found for the aircraft. However, a flight engineer, who had flown aboard the aircraft the day before the accident, estimated the aircraft's gross weight at 88 156 lb. The maximum allowable for take-off was 107 000 lb.

2.2 Crew information

The pilot-in-command, age 38, had been designated as check pilot for this flight. He held an FAA airline transport pilot's certificate with ratings for L-749 and DC-4 type aircraft. His flight experience amounted to 5 867 hours which included 3 911 hours on Constellation aircraft.

The co-pilot, age 45, possessed an FAA commercial certificate with multi-engine and instrument ratings. He had a total of 8 353 hours flying of which 524 were on the Lockheed L-749A. On the subject flight he was being trained prior to his test for an airline transport pilot's certificate.

The flight engineer held a flight engineer's certificate and an airframe and power plant mechanic's certificate. He had a total of over 6 000 hours on Constellation aircraft.

The flight maintenance technician held an airframe and power plant certificate. He was receiving training on this flight as a flight engineer.

2.3 Weather information

At the time of the accident the weather conditions were as follows: scattered clouds at 2 000 ft; visibility more than 15 miles, temperature 86°F; dewpoint 73°F; wind east-northeast 6 kt; altimeter 29.86.

2.4 Navigational Aids

These are not relevant to the accident.

2.5 Communications

Communications were normal up until 1210 hours, the time of the last radio contact with the aircraft.

2.6 Aerodrome Installations

These are not relevant to the particular accident.

2.7 Fire

There was no fire either before or after impact.

2.8 Wreckage

The main wreckage consisted of a large portion of the fuselage and sizable portions of both wings. These parts were on a heading of 50° and were resting on a coral shelf. The empennage was broken from the fuselage and was found 40 ft aft of the fuselage break on a heading of 35°.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

The autopsies performed on the crew revealed one significant fact. The flight engineer's tissues contained therapeutic quantities of an unidentified barbiturate, with physical properties similar to butabarbital, which would be compatible with his having taken a 100 milligram dose of a medium or long-acting barbiturate three times a day for a prolonged period. This same tissue level could have been achieved in other ways, such as taking four or five 100 milligram tablets a few hours before death; or five or ten tablets 10 hours before death.

Section 43.45 of Part 43 of the Civil Air Regulations (U.S.A.) prohibits any person from serving as a crew member in civil aircraft while using any drug which affects his faculties in a manner contrary to safety. However, a deviation from this provision is found in the Administrator's Manual of Procedures which governs the operation of this flight in that it proscribes the use of barbiturates by crew members within twelve hours prior to flight.

Investigation of the airframe, systems and power plants revealed the following three items which could not be accepted as normal:

1) No. 4 propeller in reverse pitch (-20°)

2) No. 4 propeller governor low pitch relief valve excessively pitted and scored

3) aileron and rudder boost off

Apparently the approach was essentially normal until just prior to touchdown. No. 4 propeller operating during approach with an ineffective low pitch stop constitutes a logical cause for the landing events which occurred. As power and airspeed are progressively reduced, propeller pitch decreases to maintain the selected rpm until the low pitch stop is reached. Normally, any further reduction in airspeed and/or power is reflected by a reduction in rpm. In the event the low pitch stop is ineffective, blade angle is further reduced and at least initially, the selected rpm is maintained. This situation would be most readily evident to the crew by an rpm decrease on three tachometers and one, No. 4, would remain at the selected reading. Change in thrust as sensed by the pilot at the controls would be relatively minor and probably would go unnoticed during the phase under discussion. As the airspeed and/or power was further reduced and probably at the time power was reduced to start the flare, energy input to the propeller would decrease such that the selected rpm would not be maintained and the propeller blade angle would abruptly decrease with an appreciable rpm decrease, and would move into the reverse pitch regime and continue to full reverse. As the propeller moved toward full reverse, the reverse pitch indicating light located on the pilot's panel would come on. This light comes on about 5° before full reverse pitch is reached. (This condition could have been detected by the difference in the rpm between the engines by any of the three flight crew members. It could not be stated that the flight engineer's failure to detect the rpm change was the result of his use of barbiturates.) Accompanying the blade angle change would be an abrupt and very substantial increase in drag and some reduction of right wing lift. It was concluded that this is what occurred as it is compatible with the touchdown attitude as well as the physical evidence.

The possibility was considered that early use and/or misuse of the throttles may have precipitated the accident. Such an occurrence has been discounted because the short time involved precluded normal reversing and unreversing of the four propellers. Furthermore, the throttle arrangement on this aircraft makes inadvertent application of reverse thrust most unlikely.

An ineffective low pitch stop is considered the most likely cause of the premature reversal of the No. 4 propeller. There are several possibilities for an explanation. Either a governor low pressure relief valve seizing in the closed position or a low pitch stop lever assembly servo valve sticking in the open position would render the low pitch stop levers ineffective. A propeller feathering and unfeathering in flight would provide the positioning for either of these valves which, in the event of sticking, would precipitate the events which are believed to have culminated in the accident. Although No. 4 was not specifically mentioned, the survivor did state that simulated emergencies including feathering and unfeathering of propellers were accomplished during the training flight. The physical condition of the low pressure relief valve, as found, makes it the most likely cause of the unselected reversal.

The survivor, a doctor, was seriously injured and, at first, he was unable to recall many details prior to and immediately after the accident. However, he agreed to be questioned while under the influence of sodium amytal, a drug used to prompt memory recall. (The method or technique is known as narcosynthesis.) On 11 May 1962 he voluntarily submitted to a medically supervised interview under narcosynthesis with a Board investigator present. At this time he recalled many details of the flight including the words which the pilot-in-command shouted as the aircraft veered to the right on landing: "Controls frozen!" and "Ailerons frozen!" He also remembered that at approximately the same tine, the pilot-in-command reached for the aileron and rudder boost control levers and pulled them to the "off" position. The co-pilot, at this time, was in the left-hand seat and had both hands on the control wheel.

This was the first time that the narcosynthesis interview technique was used by the Board in connexion with the investigation of an aircraft accident.

It was obvious that the pilot-in-command's actions and his reaction to the directional and attitude control difficulty following touchdown were, in fact, to correct a control malfunction - not a propeller reversal problem. This action further compounded the control difficulties. A jammed aileron because of damage from contact of the right wing with the ground logically accounts for such a diagnosis, although erroneous, by the pilot-in-command.

3.2 Probable cause

The probable cause of the accident was loss of control during an attempted go-around following initial touchdown, as the result of an undetected reversal of No. 4 propeller.

3.3 Recommendations

No recommendations are contained in the report.

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Training Landing Loss of control Power plant - propeller and propeller accessories

ICAO Ref: AR/747

No. 9

East Anglian Flying Services Ltd. (Channel Airways), Dakota C-47, G-AGZB, accident at St. Boniface Down near Ventnor, Isle of Wight on 6 May 1962. C.A.P. 197, Civil Aircraft Accident Report No. EW/C/05, released by the Ministry of Aviation (U.K.)

1. Historical

1.1 Circumstances

The aircraft was operating a scheduled domestic service from Jersey to Portsmouth. Prior to the flight the pilot-in-command visited the meteorological office for weather briefing, and the co-pilot filed an IFR flight plan from Jersey to Portsmouth via Alderney and the FIR (50°N) boundary at flight level 30. G-AGZB took off from Jersey at 1354 hours GMT with 3 crew and 14 passengers aboard. At 1407 it reported to Jersey zone control that Alderney was in sight, and it was flying at 3 000 ft. At 1414 hours it notified Jersey control that it had reached the FIR boundary and was changing to the London FIR frequency. It appears that up to this point the flight had been made in clear weather. At 1415 hours G-AGZB called London FIR advising it had crossed the FIR boundary, estimated Portsmouth at 1435 and requested descent to 1 000 ft. Permission to descend was given. The aircraft then advised that it was "leaving three thousand feet for one thousand" and requested a check on the Wessex altimeter setting (QNH). London gave the setting which was repeated by the aircraft. No further communication was received from the aircraft. There was low cloud, drizzle and poor visibility 2 NM west of Ventnor, Isle of Wight when the coast guard on watch heard a low flying aircraft. He recorded the time as 1428 hours. A little later the aircraft was seen flying low towards St. Boniface Down which was enveloped in cloud. Shortly afterwards it was heard to crash on the upper slopes of the Down by a farm worker who immediately ran to the aircraft which had burst into flames. In his attempts to rescue the occupants he was successful in pulling the stewardess and a passenger clear of the burning wreckage. The accident occurred at 1429 hours GMT.

1.2 Damage to aircraft

The aircraft was destroyed by the force of the impact and the ensuing fire.

1.3 Injuries to persons

Both pilots and eight passengers were killed instantly. The stewardess and another passenger subsequently died of their injuries. Five passengers were seriously injured.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The Certificate of Airworthiness had been renewed on 18 April 1962. Maintenance of the aircraft and engines had been carried out in accordance with an approved maintenance schedule. The Certificate of Maintenance was current at the time of the accident. The aircraft's radio had been maintained in accordance with the approved schedule, and there was no record of any recent defect.

The load sheet for the flight indicated that the weight of the aircraft and its centre of gravity were within the prescribed limits.

2.2 Crew information

The pilot-in-command, age 36 years, held a valid airline transport pilot's licence, endorsed for Dakota aircraft, and a current instrument rating. He had flown over 7 000 hours of which 600 hours were as pilot-in-command of Dakota aircraft. He was familiar with the route. On the day before the accident his duty period exceeded 12 hours. His rest period of 11 hours 55 minutes was less than the minimum rest period of 13 hours determined in the Air Navigation Order, 1960. This is not considered to have had any bearing on the cause of the accident.

The co-pilot, age 37 years, held a valid commercial licence, endorsed for Dakotas, and a current instrument rating. He had completed a competency check on a Dakota aircraft on 19 March 1962.

2.3 Weather information

The weather forecast was as follows:

upper wind:	3 000 ft, 240°, 30-35 kt
temperature:	+10°C
cloud lowest layer	3/8 - 6/8 stratus, base 600 - 1 000 ft, top 1 500 ft, occasionally 8/8 on exposed coasts, base 300 - 600 ft
second layer	6/8 - 8/8 stratocumulus, base 1 500 - 2 500 ft top 4 000 - 5 000 ft
surface visibility:	6 - 10 NM but 1 - 2 NM in precipitation, 500 - 1 000 yd in hill fog

The weather at RAF Thorney Island - an airfield close to Portsmouth - was observed at 1358 and 1448 hours. On both occasions the visibility was observed as 2 000 yd and cloud 5/8 stratus at 200 ft and 8/8 stratus at 400 ft. These observations were similar to the weather forecast given to the pilot-in-command prior to the flight.

2.4 Navigational Aids

The aircraft was equipped with ILS and a single ADF receiver. At the time of the accident no radio approach aid was located at Portsmouth. The only aids available were an NDB and a GCA located at the RAF Station, Thorney Island.

2.5 Communications

Communications were normal up until the time of the accident.

It should be noted that no radio communication facilities existed at Portsmouth at the time of the accident.

2.6 Aerodrome Installations

Not contained in the report.

2.7 Fire

Fire occurred on initial impact and subsequently much of the wreckage was destroyed.

2.8 Wreckage

Examination of the wreckage revealed the undercarriage and flaps had been retracted, and both engines were developing power on impact. There was no evidence of pre-crash mechanical failure or malfunction of the aircraft or its equipment. The aircraft struck the ground at a height of 717 ft and then travelled 840 ft along the ground before coming to rest at a point 74 ft higher than the first point of impact.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

Until March 1961 the Company's weather minima for landing at Portsmouth were· cloud base 1 500 ft and visibility 2 000 yd. At that time Channel Airways obtained permission to use the radar facility (GCA) of the RAF Station at Thorney Island. The weather minima established for this aid were· critical height 500 ft and runway visual range 1 200 yd. The aircraft of Channel Airways were to break through cloud by GCA over Thorney Island and then proceed VMC to Portsmouth. However, no details were contained in the Company's Operations Manual as to how to use the facility, and the entry for Portsmouth in the weather minima section of the Manual did not indicate that the radar was at Thorney Island, that it could not be used in the Portsmouth area and that it was not available on Sundays, the day of the accident.

In January 1962 the Ministry wrote to the Operator stating that the weather minima for landing at Portsmouth were considered inadequate as the aircraft had to proceed visually from Thorney Island to Portsmouth and visibility of 1 NM and a minimum obstacle clearance of 300 ft within 5 NM were considered to be necessary.

On 12 February 1962 RAF Thorney Island gave Channel Airways a diagram showing the ATC let-down procedures to be followed at Thorney Island. The diagram showed a safety lane extending southeastwards from overhead Thorney Island in which aircraft could let down to 500 ft, and the tracks to be followed by aircraft under GCA, on ILS and in the holding pattern. There were no instructions as to how the aids were to be used by aircraft intending to land at Portsmouth.

On 20 February an NDB at Thorney Island became operational. It was to be used with the already established safety lane. On 3 March the pilots of Channel Airways were advised of the NDB. However, the notice issued in this respect did not indicate a let-down procedure for its use, made no reference to it in the Operations Manual or mark its position on the diagram in the flight guide. The Ministry was not informed that the aid was to be used.

Following the comments of the Ministry in January 1962, the Operator, on 22 February, submitted the following revised weather minima for Portsmouth: critical height 600 ft, runway visual range 1 500 yd. The officer concerned at the Ministry maintained that he attempted several times unsuccessfully to discuss the proposals by telephone with the chief pilot. However, the chief pilot stated that he had heard nothing further regarding the draft proposals and therefore gave the order on 3 May 1962 that they should be incorporated into the Operations Manual. It was not possible to ascertain whether the manual aboard the subject aircraft had been amended.

From the meteorological information available it would appear that the flight from Jersey was commenced in clear weather and then encountered a rapid build-up of cloud which developed to 8/8 coverage with the cloud base varying between approximately 400 ft and sea level. It was noted that an IFR flight plan had been filed and that the only radio let-down aid in the Portsmouth area was the NDB at Thorney Island. As a matter of prudent airmanship the pilot-in-command should have established his position over the beacon before descending below the safety altitude of 2 300 ft. His request at 1415 hours for permission to let down to 1 000 ft, which was later followed by a further descent, suggests he decided to attempt to continue the flight by visual contact.

After the accident, the weather minima approved by the Ministry for letting-down over Thorney Island with the radar were critical height 750 ft and runway visual range 2 000 yd.

3.2 Probable cause

As the result of an error of airmanship, the aircraft was flown below a safe altitude in bad weather conditions and struck cloud-covered high ground.

3.3 Recommendations

It was recommended that scheduled passenger transport services should be restricted to aerodromes which have radio communication facilities.

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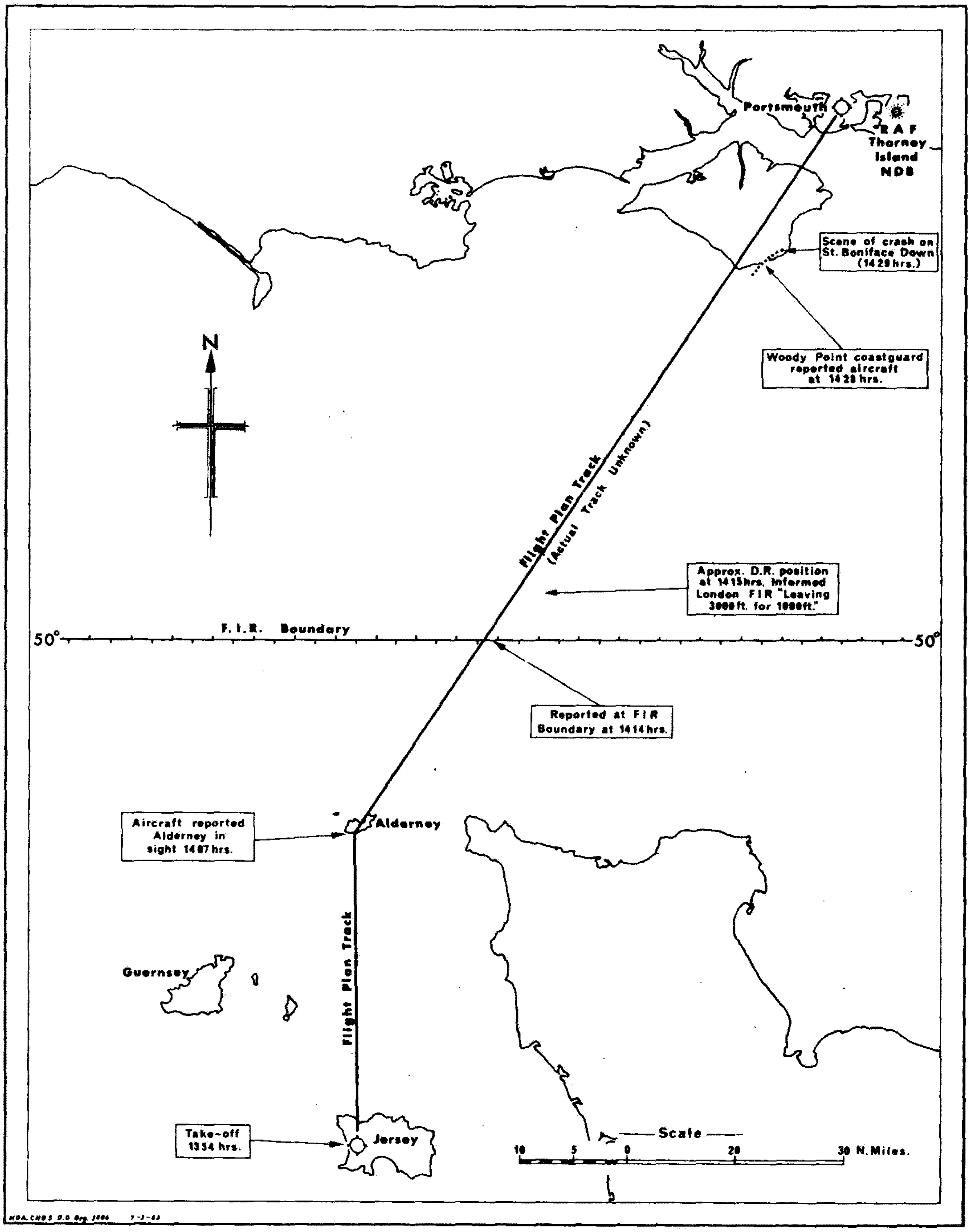
ICAO Ref: AR/785



ACCIDENT TO C-47 OF CHANNEL AIRWAYS AT ST. BONIFACE DOWN,
Near VENTNOR, ISLE OF WIGHT, 6 MAY 1962

FIGURE 4

No. 10

Serviços Aéreos Cruzeiro do Sul S.A., Convair 240, PP-CEZ accident at Vitória Airport, Espirito Santo State, Brazil on 9 May 1962. Report, dated 10 October 1962, released by the Brazilian Air Ministry, (SIPAer).

1. Historical

1.1 Circumstances

The aircraft was flying the Rio de Janeiro-Vitória segment of a scheduled international flight. At 2220 hours GMT it reported it was over Guarapari at 2 700 m and in instrument meteorological conditions. The aircraft was authorized to descend to 2 100 m and told to maintain that altitude until reaching the non-directional radio beacon at Vitória. At 2228 hours it reported it was three minutes out at 2 100 m and in visual meteorological conditions. The flight continued its descent and was given landing instructions for runway 23. The controller in the tower watched the aircraft descending, and at the end of the downwind leg he saw the landing lights being adjusted. When the aircraft reported on final, the landing instructions were repeated. Shortly thereafter power was applied in an effort to climb the aircraft, but it collided with a eucalyptus tree at a height of 40 m, 1 860 m from the threshold of runway 23. At that stage of the approach the aircraft should have been at a minimum altitude of 190 m (150 m above the ground). Fire broke out following impact.

1.2 Damage to aircraft

The aircraft was destroyed by impact and subsequent fire.

1.3 Injuries to persons

Three crew and twenty passengers were killed in the accident. Two passengers survived but were seriously injured.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

An overhaul (300-hour) of the aircraft was completed on 13 April 1962. Since that time it had flown 126 hours. The maintenance reports on the aircraft for the three weeks prior to the accident showed no abnormality.

The aircraft's take-off weight was 18 261 kg. It was estimated that during the Rio de Janeiro-Vitória portion of the trip it would have used approximately 625 kg of fuel. Therefore, at the time of the accident it weighed about 17 636 kg. The maximum permissible landing weight is not given in the report nor is any accurate information provided regarding the aircraft's centre of gravity.

2.2 Crew information

The pilot-in-command had flown a total of 18 386 hours. His time on Convair aircraft was 2 526 hours including 2 426 hours as pilot-in-command. He had a valid instrument rating and had flown a total of 6 128 hours on instruments. His night flying experience amounted to 2 144 hours.

The co-pilot had 3 637 hours' flying experience which included 395 hours on Convairs. His instrument experience while flying at night amounted to 1 212 hours.

Both were medically fit, and their flight time did not indicate that they were fatigued. Also, they were both familiar with the topography of the land in the accident area.

2.3 Weather information

Weather bulletins issued around the time of the accident, which occurred just after 2228 hours, showed no conditions which would have caused the accident. It was a dark, moonless night. The pilot of another aircraft, which flew over the area just after the accident, said that although there was light rain and turbulence, he was able to keep the runway in sight at all times.

2.4 Navigational Aids

The non-directional beacon at Vitória was operating satisfactorily and was available to the aircraft during its descent.

2.5 Communications

No communications difficulties were experienced.

2.6 Aerodrome Installations

All runway and obstruction lights were operating normally. The rotating beacon was also in good working condition. Approach lighting is not mentioned.

2.7 Fire

The post-crash fire destroyed the aircraft.

2.8 Wreckage

Very little wreckage remained to be examined following the fire. Based on the wreckage pattern, it was concluded that at the time of impact the aircraft was intact.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

According to the testimony of the two surviving passengers and qualified ground witnesses, nothing unsual occurred prior to the accident. However, the passengers felt that the aircraft descended too fast and that the turn onto final was too steep. From this it was inferred that the aircraft may have been too close to the runway on its downwind leg. While on final they heard power being increased just prior to impact.

For this aircraft type the standard procedure when on base leg is to make a descending turn that must terminate at an altitude of 150 m. As the turn was steep, the pilot must have neglected his altimeter and instead used the runway lights as reference points. The quick descent also made it difficult for him to estimate the aircraft's altitude As a result he misjudged his distance and descended too low behind the eucalyptus trees, losing sight of the runway lights. When he realized this, it was too late to avoid the collision with the trees.

When carrying out an approach at night in visual meteorological conditions the aircraft's altitude must be checked continuously on the altimeter until the aircraft nears the runway.

3.2 Probable cause

The pilot did not carry out the approach in accordance with the procedures prescribed by the airline and misjudged his distance from the runway.

3.3 Recommendations

No recommendations were made following the investigation of this accident.

ICAO Ref: AR/828

No. 11

Eastern Provincial Airways, Catalina, CF-IHA, accident when landing on water at Godthåb, Greenland, on 12 May 1962. Report, dated January 1963, released by The Directorate of Civil Aviation, Denmark

1. Historical

1.1 Circumstances

The aircraft departed Søndre Strømfjord at 0905 hours local time on a scheduled domestic public transport flight to Godthåb carrying 3 crew and 18 passengers. The trip was carried out under instrument flight rules at 10 000 ft, and was uneventful until the landing at Godthåb. The flight engineer made a pre-landing check and reported that everything was in order.

At a height of 400 ft the wing floats were lowered, the rpm was increased to 2 300 and speed was reduced to 100 mph. Visibility at this height was good, 8 - 10 miles, the sea was calm, and there were practically no swells.

Near the island of Hundeøen the captain prepared for a glassy calm water landing. (This was his first glassy calm water landing with a Canso equipped with full clipper bow). He reduced the speed to 95 mph and set himself the task of maintaining a rate of descent of 100 - 150 ft/min, flying largely by instruments.

The landing was made on a water area that had not been patrolled. This was contrary to the current safety rules.

In the water area at Godthåb, the harbour area proper and in the fiord area right up to the harbour, there is always a large amount of debris and rubbish floating that presents a danger to landing aircraft. This debris and rubbish comes, to a large extent, from a refuse plant, which is situated very near the intersection of the two landing strips shown in Eastern Provincial's latest instrument approach landing charts for the area.

Both pilots considered the touchdown was normal. However, after a run of a few seconds the aircraft swerved abruptly to starboard assuming an increasingly nose-down attitude. A steadily progressing but very quick deceleration took place.

The captain tried to check the swerve by applying left rudder and by increasing the power on the starboard engine. However, he was not successful. The co-pilot, therefore, pulled both fuel control levers fully back when the aircraft had deviated about 90° from the landing direction. Before the emergency exits in the roof could be opened the cockpit was more than 1 m below the surface.

Both pilots escaped through these emergency exits onto the wing from where they continued to the hatches in the luggage compartment in the rear cabin. The co-pilot tried to open the starboard hatch, but it could not be opened even though he got the handles turned. By united efforts and assistance from within the two pilots got the port hatch open and two passengers got onto the wing. A baby and the unconscious flight engineer were floating on the water in the luggage compartment so the co-pilot seized them and got them out. No other passengers were visible. The passengers who were rescued stated that it was impossible after the accident to open the two rear doors from within, because the luggage nets and the luggage had been placed in such a way as to make it impossible to operate the handles of the doors. The patrol boat did not arrive until 8-1/2 - 9 minutes after the accident as it had gone to another area thinking the aircraft might land there.

The accident occurred at 1055 hours local time.

1.2 Damage to aircraft

The aircraft was badly damaged.

1.3 Injuries to persons

Three crew and 18 passengers were aboard the flight. Of these, 15 of the passengers drowned in the accident. The two pilots were not injured in the accident, but the flight engineer received minor facial injuries and was also put under observation for concussion of the brain.

2. Facts ascertained by the inquiry

2.1 Aircraft information

CF-IHA was a Catalina PBY-5A which had been converted to a model TC-785. Shortly before the accident the aircraft was converted from semi clipper bow to full clipper bow. The latter is a good deal higher than the former.

The aircraft's certificate of airworthiness was valid and had been issued on 27 April 1962. A check of the maintenance schedule did not give any cause for remark.

The actual landing weight of the aircraft (26 403 lb) was below the maximum permissible (28 000 lb).

No weight and balance sheet was prepared prior to take-off. Consequently, the exact position of the centre of gravity was not known to the crew. When compared later on the basis of data available before conversion of the aircraft it was found to be slightly behind the rear limit.

Only the payload was stated in the load sheet. It did not contain the actual take-off weight, the maximum landing weight, the basic weight and the operating weight.

There were discrepancies in the figures given for fuel and oil, the weights of emergency equipment and the passengers. Other calculations pertaining to the flight were found to be inaccurate.

2.2 Crew information

The pilot-in-command held a Canadian airline transport pilot's licence valid until 8 November 1962. On 14 June 1961 it had been extended to include the PBY-5A aircraft. He also held a valid instrument rating. The pilot had flown a total of 4 000 hours, 3 400 of which were flown with the Royal Canadian Air Force.

Of 600 hours flown with this company, about 151 hours were as co-pilot on Catalinas including 30 hours in the left-hand seat. As captain on Catalina aircraft he had flown about 20 hours. Although the Canadian regulations had been complied with, it was still a matter for discussion whether the captain with his comparatively limited flying experience had acquired the experience necessary for a pilot-in-command on Greenland operations.

The co-pilot held a valid Canadian commercial pilot's licence. Although he did not hold an instrument rating, he was authorized, under the Canadian regulations, to act as co-pilot on IFR flights. He had a total of 1 300 hours to his credit including 650 on Catalinas of which 600 hours had been flown in Greenland.

2.3 Weather information

The weather conditions at Godthåb were above the landing minima for the company. Apart from the fact that glassy calm water conditions existed, the weather had no bearing on the accident.

2.4 Navigational Aids

There was a radio beacon at the Cook Islands and this had been used during the aircraft's descent through the overcast.

2.5 Communications

No information was contained in the report. However, VHF communication with the patrol boat could not be effected due to the use of battery-operated equipment in the latter.

2.6 Aerodrome Installations

No regular take-off/landing seaways had been established at Godthåb harbour.

2.7 Fire

There was no fire.

2.8 Wreckage

As it was feared that the damaged aircraft was going to sink following the accident it was towed to the island of Hundeøen where it was run aground. The aircraft was subsequently towed to the harbour at Godthåb. Attempts were made to locate and recover sunken metal parts of the aircraft; however, they were unsuccessful.

The nose wheel of the aircraft was retracted and locked. Both nose wheel doors were missing.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

Even in the early stages of the investigation it appeared that the actual cause of the accident could be traced to the fact that the nose wheel doors had been torn off during the landing.

Three possibilities were considered as to how this happened:

1) incorrect landing technique

2) the aircraft struck an object or sea ice during touchdown

3) mechanical malfunctioning of the nose wheel doors resulted in their not being closed and locked when the aircraft landed.

Some persons believed that landing at speeds greater than 80 mph with the resulting nose down position could cause water pressure on the nose wheel doors to build up to such an extent that they would be torn off.

Others took another view. Experts of the Danish Air Force considered a touchdown at 95 mph and a rate of descent of up to 250 ft/min to be safe under glassy calm water conditions. They also stated that touchdowns at lower speeds would require power to be reduced and the control column to be moved forward to prevent the aircraft from becoming airborne again.

The Company's Operations Manual advises pilots that when landing on glassy calm water they should land as close as possible to shore or reeds in the water and should let down at a slow rate of descent using power. After contact is made with the water, power should be cut and the control column moved slightly forward to hold the aircraft on the water.

Four test landings were carried out using different speeds from 80 - 95 mph. These tests were made with a Catalina of the Danish Air Force. They were photographed and showed that a landing made at speeds up to 96 mph and a rate of descent of 150 ft/min must be considered as normal, also as regards the nose down attitude of the aircraft during touchdown. This possibility was therefore regarded as having a comparatively low priority.

The possibility of collision with an object during touchdown could not be entirely precluded. Various objects were floating in the water where the landing took place. Also, sea ice may have been present. However, such objects would be hit by the rear section of the aircraft's keel or by the rear section of the nose wheel doors. A collision would have caused a certain amount of noise which would have been heard by the crew members and the passengers and there would have been a chance to get the aircraft airborne again. No such noise was reported. Also the damage in the nose-wheel well appeared to indicate that the fron edges of the door were exposed to downward forces. This possibility was also regarded as having a low priority.

The third possibility considered was the malfunctioning of the nose wheel doors. Various hydraulic components, locking mechanisms etc. for the operation of the nose wheel and nose wheel doors were removed from the wreckage and subjected to thorough examination at the Vaerløse Air Base. The Accident Investigation Board was shown the normal and abnormal operation of the nose gears and doors in a jacked-up Catalina.

The examination of the various units for operation of the nose wheel gear, the nose wheel doors and locking mechanisms disclosed that several of these units were in a poor condition.

The valve for operation of the nose wheel doors' locks was found to be periodically leaky which may have the effect that the closing mechanism of the nose wheel doors and the locking device receive hydraulic pressure simultaneously. This would result in the locking pins moving to locked position before the doors are closed in their proper position. The full closing of the doors is therefore stopped by the locking pins and there will be an aperture of about 70 mm between them. In spite of this the warning light in the cockpit will indicate that the doors are closed and locked. The warning light is operated by a microswitch which is actuated by the locking pins.

The flight engineer declared that he had checked the doors prior to the landing, that they were closed and locked, and that no light was visible in the nose wheel well. However, the check was not considered foolproof as a means of checking whether the doors were completely closed and locked. It is based on visual inspection as to whether light is visible in the nose wheel well. It is difficult to carry out and is dependent on light conditions. This possibility was given a very high priority.

A number of observations were made following the investigation of the accident, which although they do not have a direct bearing on the accident are worthy of note. They were as follows:

a) There should be free and unobstructed access to emergency exits.

b) The possibility of introducing a more effective system for opening doors and emergency exits should be looked into. A system might be considered where the hinges of doors could be released by a single jerk.

c) Signal and rescue material of patrol boats as well as instructions to patrol services should be considered for revision.

d) The VHF installations on patrol boats must be kept serviceable, and effective supervision should be maintained to ensure that this equipment is always in working order.

e) Emergency exits should be checked at suitable intervals.

f) A folder should be prepared containing information on emergency exits, instructions on the use of life jackets etc. There should always be a sufficient number of this folder on board aircraft of Eastern Provincial Airways operating in Greenland.

g) The preparation of a weight and balance sheet should be made obligatory.

h) Standard weights for passengers should be stated in the operations manual of Eastern Provincial Airways.

i) The company flight plan should be kept up to date while en route.

j) There should be an effective control to ensure that the required fuel reserves are carried on board aircraft.

3.2 Probable cause

As a result of the technical investigation, it was considered most probable that, because of a mechanical malfunctioning the nose wheel doors were not closed and locked and that there was an aperture of 70 mm when the landing took place. The gaping doors were torn off when the aircraft having landed at rather high speed sank deeply into the water. The extremely great water pressure in the nose wheel well forced the aft bulkheed of the well inwards resulting in severe damage to the front cabin.

3.3 Recommendations

Following the accident it was recommended that:

a) an effective check system be introduced for all Catalina aircraft of Eastern Provincial Airways in order to ensure that the nose wheel doors are closed and locked before landings on water are made;

b) rules be laid down specifying the minimum flying experience required of pilots-in-command of Eastern Provincial Airways' aircraft operating in Greenland;

c) efforts should be made to introduce a ban on the throwing of objects and refuse that can float into the water near towns in Greenland which are included in operations plans. This ban should apply not only to objects which might cause damage to aircraft when landing but to all objects, as the patrol service would thereby be facilitated, expedited and rendered more effective. The ban would most likely necessitate the construction of incinerators.

3.4 Action taken

New instrument approach landing charts have been issued with clearly delineated take-off/landing strips.

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ICAO Ref: AR/742

No. 12

Air France, Boeing 707-328, F-BHSM, accident at Orly Airport, France on 3 June 1962. Report released in Le Journal Officiel de la République Française, dated 17 January 1965.

1. Historical

1.1 Circumstances

The aircraft was on a non-scheduled (charter) international public transport flight from Paris to Atlanta and Houston via New York. Ten crew and 122 passengers were on the flight when, after a considerable delay to await the arrival of passengers, it was cleared to take off from runway 08 at Orly Airport at 1132 hours GMT. It aligned itself for take-off and waited 6 seconds, which permitted the setting and checking of take-off parameters on the four engines. Full thrust was applied, and the aircraft accelerated normally. From testimony and flight recorder data, the take-off was reconstructed as follows. Between 20 to 40 seconds after the start of the roll, the rate of acceleration was steady at 1.80 m/s^2. The aircraft rolled along the runway centre line without showing any tendency to veer to either side. V_1, determined as 147 kt IAS, was attained after a ground roll of 1 500 m. This was followed by VR, 158 kt IAS. Forty-eight seconds after the beginning of the take-off run and approximately when passing the 1 800 m mark, the aircraft reached the rotation speed (VR), and the pilot-in-command initiated the take-off manoeuvre by pulling backwards on the control column. According to witnesses, the aircraft made an incomplete rotational movement about 2 100 m from the threshold. It remained for 4 to 6 seconds with its nose slightly raised. Then the nose dropped when the brakes were applied. Thick smoke streamed from the wheels. The aircraft was 2 600 m from its starting point and had reached a maximum speed of 179 kt IAS. It braked for the last 680 m of the runway with an average deceleration of 1.2 to 1.3 m/s^2. After 250 m of braking the aircraft veered slightly to the left, and 50° of flap were selected. Then after another 250 m the aircraft listed heavily to starboard. Its path then curved right, which suggests a possible attempt to ground loop. However, the aircraft's speed precluded the success of this manoeuvre, and it left the runway while still on the centre line. It rolled for a while on the grass extension of the runway but, because of the unevenness of the terrain and the high speed of the aircraft (160 kt), the port gear broke off 110 m from the end of the runway and was wrenched away. The aircraft pivotted left, and engines No. 1 and 2 scraped the ground. Fire broke out in the port wing at the level of the landing gear. About 300 m beyond the end of the runway the aircraft crossed the encircling road. The starboard gear collapsed, and No. 2 engine broke loose. It then struck the approach lights, which represented a considerable obstacle. It started to disintegrate when reaching the hollow at the end of the runway extension, which descends at a steep angle towards the Seine. The front part of the fuselage struck a house and garage. The nose of the aircraft broke away, and the rest of the fuselage came to a stop 100 m further on. The site of the accident was 550 m beyond the end of runway 08 on its extended centre line, at an elevation of 89 m. The accident occurred at approximately 1134 hours.

1.2 Damage to the aircraft

The aircraft was destroyed.

1.3 Injuries to persons

Of the 10 crew and 122 passengers aboard the aircraft, only one steward and two hostesses survived the accident. However, the steward, who was badly burned, died the same evening in hospital.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

Its Certificate of Airworthiness was endorsed on 17 February 1962 after a major overhaul.

The Bureau Veritas had issued a certificate for the aircraft, dated 31 May 1963, showing that maintenance and repair work on the aircraft had been properly effected. No work had been done on the equipment during the night of 2/3 June 1962. Pre-flight inspection was carried out properly. All components were in working order at the time of the aircraft's departure.

At take-off the aircraft's weight (137 300 kg) and centre of gravity (23%) were within the permissible limits.

2.2 Crew information

The crew consisted of a pilot-in-command, a co-pilot, a navigator, a flight engineer, a purser, 3 hostesses and 2 stewards.

The pilot-in-command, age 39 years, held an airline transport pilot's licence valid until 19 September 1962. His pilot-in-command rating for Boeing 707 was dated 22 April 1961. His total flying time amounted to 14 225 hours and included 4 701 hours at night and 744 hours on Boeing 707s.

The co-pilot, age 40 years, held a valid airline transport pilot's licence, a co-pilot rating for Boeing 707s, and valid flight radio operator and navigator licences. He had a total of 15 194 hours' experience, which included 7 028 hours at night and 1 408 hours on the Boeing 707.

The pilot-in-command and co-pilot held valid medical certificates, and the Board did not believe that their flying time during the 30 days prior to the accident had caused them to be fatigued.

The flight navigator, age 42 years, held a valid navigator's licence and a valid flight radio operator's licence. He had flown 15 274 hours.

The flight engineer, also 42 years of age, held a flight engineer's licence valid until 12 June 1962. His flying time amounted to 13 057 hours.

2.3 Weather information

At the time of the accident the weather conditions at Orly were excellent. It was felt that they could only have had a favourable effect on the thrust of the engines and the length of the take-off roll. The conditions existing at the time were:

wind: 040°, 9 - 18 kt; horizontal visibility: 20 km;
cloud: 2/8 at 1 200 m; QNH: 1,031 mb; QFE: 1,020 mb;
temperature: 14°; dewpoint: between + 0°90 at 1100 h
and + 2°8 at 1200 h

2.4 Navigational Aids

They were not significant in this accident. All aids were functioning correctly.

2.5 Communications

The aircraft was in contact with Orly tower and Orly Approach. It acknowledged instructions given by Orly Approach at 1132 hours. No further VHF contact was made.

2.6 Aerodrome Installations

Runway 08 is 3 320 m in length.

2.7 Fire

A fire broke out before the aircraft reached the boundary road. It increased fiercely thereafter as the wings broke, allowing 62 800 kg of kerosene to escape. The fire spread rapidly engulfing the main part of the wreckage. The emergency and fire fighting services showed a high degree of alertness.

The fire, which spread over an area of about 2 400 square metres, was fought with 80 cubic metres of foam and 2 cubic metres of water spray. Although help arrived almost immediately, the fire was only brought under control 11 minutes after the accident and was totally extinguished 26 minutes later.

2.8 Wreckage

The cockpit was destroyed. The fuselage, particularly the passenger cabin and the two half-wings, was gutted and partly melted.

No anomaly was discovered in the examination of the controls or what was left of them. The stabilizer setting was 1.5 units nose-up. Tests showed that the reversers on all four engines were serviceable at the time of the accident. Nothing was found to suggest defective functioning of the engines.

The landing gear was extended at the time of the accident, and the flaps were extended 42°.

The flight recorder was found inside the tail cone. It had been subjected to some initial heating, but this had not affected the photographic paper inside.

The fuel used was analysed, but nothing abnormal was found.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

Various hypotheses were considered concerning possible causes of the accident.

a) Sabotage

No evidence emerged from the numerous technical analyses of the equipment or the police inquiry to support this hypothesis.

b) Failure of one or more power units

Examination of the four engines showed no evidence of failure.

c) Improper use or inadvertent retraction of flaps

An amateur film taken from the airport showed that the aircraft's flaps were extended normally at 30° during the first 1 300 m of the roll on the runway. Only 3 or 4 seconds separated the end of the film from the attainment of VR, and the flaps would not have had time to be lowered or retracted more than 6° at most. Furthermore, flight tests subsequently conducted at Istres showed that take-off is possible with 0° to 40° flaps. This hypothesis was therefore rejected.

d) Erroneous instrument readings

Failure of the two airspeed indicators is hardly possible as the dynamic and static ports have different locations in order to prevent simultaneous failure. Also, on the day of the accident there was no risk of icing-up of the dynamic or static ports.

Amateur pictures confirmed that the covers were not forgotten on the dynamic ports, and one of the static ports was recovered in the wreckage, free of obstruction.

Even if it was assumed that failure on one instrument had occurred after V_1, such a failure could easily have been overcome by the crew, who had a second instrument available.

Furthermore, tests carried out showed that a premature rotation would not prevent the aircraft from taking off but would delay the lift-off slightly, and there was evidence that the subject aircraft had effected a rotation although incomplete.

e) Electrical failure

No such failure appears to have occurred. The four alternator controls were normal, and the four alternators must, therefore, have been generating before the crash. This was confirmed by the state of the four coupling relays and of the four line relays. The examination of the signal and warning lights further discounted the possibility of electrical failure.

f) Flapping of control surfaces

One witness stated that he had noticed the elevator flapping rapidly several times over a wide arc following the drop of the nose and before the appearance of the first smoke coming from the wheels. This witness could only see the rear of the aircraft, and it is possible that his view of the tail unit may have been distorted by the stream of very hot gas escaping from the engines.

The impression of flapping may have resulted from variable refraction in the masses of very hot air swirling towards the tail of the aircraft and mingling there with the fresh air of the atmosphere.

Careful inspection of the hinges, pins and dampers of the elevator and pitch trim mechanism of F-BHSM failed to reveal any trace of a phenomenon of this type. Also, no flapping or vibration phenomenon had been observed during thousands of flying hours by KC 135s and Boeing 707s. The two surviving hostesses, who had been sitting at the rear of the aircraft, reported no abnormal vibration prior to the application of reverse thrust.

Study of the flight recorder tape revealed a significant increase in the level of vibration of the normal acceleration spot during the final seconds of the recording. The violent drop of the nose wheel, which must have preceded the application of the brakes, might explain the rise in the level of vibration recorded.

g) Incident in the cockpit

After examination of the cockpit, which was destroyed but not burned, the possibility of fire in the cockpit was ruled out.

Sudden physical collapse of the pilot-in-command at the moment of rotation was also considered. Examination of the medical records and autopsies on the crew showed nothing abnormal. If the pilot-in-command had collapsed, the co-pilot was quite capable of taking over.

h) Failure of the automatic tab to function

The degree of trim imparted by the automatic tab is relatively minor. It had melted in the fire, but the control linkage was recovered.

i) Jamming of the balance panels

This might prevent the elevator flaps from being deflected upwards when rotation speed was attained. This hypothesis seems very unlikely. The film taken of the early part of the take-off shows that the whole of the elevator was definitely lowered (tabs raised) during the acceleration period. Movement took place in the right direction. Accordingly, it is difficult to postulate that upward jamming could be possible. The Board decided to rule out this hypothesis.

j) Defective functioning of the spoilers

This hypothesis was also rejected by the Board because -

- the spoilers were found retracted;
- incorrect symmetrical functioning would show on the recording in a reduction of acceleration - this was not the case;
- incorrect asymmetrical functioning would not have prevented take-off. Flight tests were carried out and proved that the inadvertent raising of an outboard spoiler leaves sufficient lateral control to ensure take-off without demanding exceptional skill on the part of the pilot, provided that the slave control linkage with the aileron controls remains intact;
- no tendency of F-BHSM to yaw was observed during the acceleration phase;
- the speed brake control lever was found locked in the "off" position

k) Abnormal elevator load due to an "out-of-trim" condition

When F-BHSM left the apron its flaps were correctly extended at 30°, and the stabilizer was set at 1.5 units nose-up. This is more than 2 units nose-down in excess of the setting for take-off trim recommended in the Air France Flight Manual.

The Air France Operating Manual instructions valid at the time of the accident called for adjusting trim while taxiing, without verification before or during take-off.

It was not possible to say whether the known position of the stabilizer on departure from the apron was altered during the roll and take-off. It can only be stated that it never reached the extreme travel positions.

Following impact, the stabilizer's setting was almost identical to the setting at departure, i.e. 1.5 units.

The Board then considered whether this position coincided with the setting immediately prior to the dispersal of the wreckage. It concluded that if variations did occur in the position of the stabilizer during take-off, their sum was practically nil.

Rather than consider an incorrect trim setting prior to departure from the apron, which it regarded as highly unlikely, the Board gave thought to the possibility of an electrical failure in the trim controls. In this case it would have to be assumed that the crew neither used the trim switch nor checked the position of the trim until V_1. If the pilot had been aware of trim failure then, he would certainly have abandoned take-off. The instructions current at the time did not require him to make these checks.

First actuation of the switch to nose-up probably took place shortly after VR. In this connexion it is significant to note that tests were subsequently carried out by the Boeing Company, the British and the French to study the effects of out-of-trim conditions. These tests showed that the influence of an out-of-trim condition grows rapidly with weight. At a weight of 137 700 kg and with the aircraft more than 2 units out of trim, the necessary effort required on the control column was about 60 kg.

Such an effort could appear prohibitive to a pilot and, coming as a surprise, it might cause him to abandon take-off, especially if at that time he found the trim inoperative.

When the pilot-in-command realized the extent of the out-of-trim condition, he switched the trim contactor to nose-up without, however, achieving any alteration in the position of the stabilizer. He probably tried to find the cause of the breakdown and hesitated before deciding to abandon take-off. The flight recorder showed that more than 9 seconds elapsed between the attainment of rotation speed and the maximum achieved speed of 183 kt.

At first the Board believed it could draw a valid conclusion from the fact that the expert analyses revealed that the Mach trim light was on at impact. Exhaustive study showed that no positive conclusion could be drawn from this fact because between the time No. 2 engine was torn off the aircraft, and the breaking away of the cockpit, 2.5 to 4.5 seconds might have elapsed, which corresponds to the time delay necessary for the Mach trim light to illuminate after No. 2 alternator stops supplying current.

Causes for the possible malfunction of the stabilizer control were looked into. In spite of numerous tests, no complete answer to this question could be found.

The two induction motors actuating the screw mechanism and the electromagnetic and mechanical clutches were tested. All mechanisms were operating correctly.

The pilot's and co-pilot's switches were checked. Nothing abnormal was detected.

A circlip of the rear manual control cable drum had come loose prior to the accident. It had been carried by the cable to a point between the drum and its casing where it became wedged. This circlip produced extra friction on the drum and caused a slight increase in the jackscrew manoeuvre torque. However, this would not account for the stalling and complete arrest of the main asynchronous trim motor.

No investigation could be carried out on the electrical relay boxes controlling the power supply to the asynchronous trim motor as they were destroyed by the fire. Failure of this equipment leads to interference with, or complete interruption of, the three-phase supply to the trim motor, which automatically ceases to function.

Failure of the trim control may be due to causes which cannot be elucidated by the most thorough technical investigation. Functional anomalies have been noticed by airlines using Boeing 707s. The causes could not be determined. For example, on 14 June 1962 the trim of Boeing 707 F-BHSP started moving without the switch being actuated and could only be stopped by the severing of the power supply cable.

Such anomalies may be due to poor sequence in the motor-clutch feed. The motor has to be energized ahead of the electromagnetic clutch. The present switch does not provide such a guarantee. Also unsolicited movements of the trim have been blamed on the reversibility of the ball-screw.

Had the crew been aware of the possibility of a load of about 60 kg on the control column, it could have overcome the "out of trim". The resistance on the control column may have led the pilot-in-command to believe that the stabilizer was jammed, which might explain his decision to abandon take-off.

The Board found·

- that having passed V_1, VR and V_2, the aircraft had to take off;
- that it did not take off;
- from the inspection of photos and film, that after the aircraft left the apron, the stabilizer was set at 1.5 units nose-up, i.e. slightly over 2 units out of trim towards nose-down;
- from inspection of the wreckage, that the position of the stabilizer control screw coincided with 1.5 units nose-up trim, and the stabilizer was believed to be at that position at break-up.

Accordingly, the Board concluded that an out-of-trim configuration existed and jamming of the trim mechanism prevented the pilot from correcting it during take-off.

The Board noted that the green marking made by the manufacturer which indicates on the trim indicator the range of positions within which the stabilizer is safe for take-off, embraces, in fact, at near-maximum weights and with the centre of gravity located forward, pointer readings implying traction efforts on the column which, without being strictly prohibitive, are considerable.

The Board also noted that

- cases have been reported recently of accidental functioning of the stabilizer trim mechanism;
- pilots placed in out-of-trim conditions similar to that of F-BHSM have all reported considerable efforts;
- in one case, at least, reported by Boeing, take-off was discontinued at VR and in other cases take-off took place after corrective action on the trim.

3.2 Probable cause

The accident was due to the concurrence of·

- a considerable out-of-trim condition producing major loads on the control column at VR and VLOF which may have seemed prohibitive to the pilot-in-command; and
- a failure of the trim servo motor control system, which prevented the pilot-in-command from rectifying the faulty setting of the stabilizer and, consequently, from reducing the reaction at the control column.

These factors led the pilot-in-command to discontinue take-off, but it was too late to stop the aircraft on the runway or slow it down sufficiently before the end of the runway.

Tests conducted by the Test Flying Centre at Istres showed that the pilot-in-command could have overcome the load on the control column and completed the take-off without endangering the continuation of the flight, even in the absence of any possibility of altering the trim. The results of these tests significantly modify the information published and certified to Air France at the time of the accident in regard to the amount of control column loads and that, on these grounds, the pilot-in-command did not have available all the data for making a decision within a few seconds.

The data available to the Board did not allow it to arrive at any positive conclusion regarding the conditions in which the abandoning of the take-off was attempted. It was convinced that no manoeuvre could have changed the consequences.

3.3 Recommendations

No recommendations are contained in the report.

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ICAO Réf. AR/860

No. 13

Scandinavian Airlines System, Caravelle III, SE-210, LN-KLR, abandoned take-off at Kloten Airport, Zurich, Switzerland on 5 July 1962. Report No. 1962/19/71, dated 17 August 1962, by the Federal Air Accident Investigation Commission, Switzerland.

1. Historical

1.1 Circumstances

The aircraft was to fly as part of the SAS/Swissair pool service on scheduled international passenger flight SR 234 from Zurich to Dusseldorf carrying 7 crew and 46 passengers. At 0751 hours central European time it was on its take-off run from runway 34 at Zurich when at a speed of 100 kt the crew noted heavy vibration of the nose wheel assembly. They decided to interrupt the take-off. They activated the braking parachute, but the wheel brakes were not applied. The aircraft was stopped 2 390 m (7 841 ft) beyond the starting point and was evacuated without difficulty. It was found that both nose wheels had become detached from the aircraft during the take-off run.

1.2 Damage to the aircraft

The axle support of the nose wheel assembly was sheared off to above the centre of the axle.

1.3 Injuries to persons

No one was injured.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The aircraft underwent routine maintenance in the SAS workshop at Stockholm - Arlanda on 29 June 1962 at which time both nose wheels of the aircraft were replaced.

It flew as Swissair flight SR 235 from Dusseldorf to Zurich on 4 July. During the night of 4 July the Swissair flight maintenance service replaced one wheel of the left main landing gear and a radio receiver. K and V checks followed.

At the time of the accident the aircraft's gross weight and centre of gravity were within the prescribed limits.

2.2 Crew information

The pilot-in-command, age 38 years, held an airline transport pilot's licence, which was valid up to 31 August 1962, and a rating for Caravelle aircraft. He had flown over 7 100 hours including 1 055 hours on Caravelles.

The co-pilot, age 33 years, had a commercial pilot's licence valid until 30 September 1962 and also a rating for Caravelles. He had over 2 900 hours of flying experience including 1 270 hours on Caravelle aircraft. He was performing the take-off at the time of the accident.

The other crew members aboard the aircraft were a radio operator, a purser, a steward and two hostesses.

2.3 Weather information

At the time of the accident, approximately 0751 hours central European time, the weather conditions were as follows:

horizontal visibility: 4 km (2.5 miles); light rain;

wind speed and direction: 5 kt from 300°; ceiling: 2 200 ft

2.4 Navigational Aids

They are not significant in this accident.

2.5 Communications

No mention is made in the report of communications.

2.6 Aerodrome Installations

The site of the accident was runway 34, which is 3 700 m (13 380 ft) long and 60 m (195 ft) wide.

2.7 Fire

There was no fire.

2.8 Wreckage

The first scrapes on the runway were 705 m (2 312 ft) from the starting point.

The lock screw on the left wheel nut was off, and the cone was stuck fast to the wheel hub. The left nose wheel nut, with the cone and lock screw, was found 650 m (2 133 ft) from the starting point and 59 m (194 ft) to the right of the runway centre line. The left nose wheel was found 1 560 m (5 118 ft) from the starting point and 375 m (1 238 ft) to the right of the runway centre line. The right nose wheel was found, with axle and wheel attachment, 1 059 m (3 574 ft) from the starting point and 68 m (223 ft) to the left of the runway centre line.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

It was ascertained that the wheel axle together with part of the bearing had been mounted inversely. It was not possible to establish when the mounting had been carried out and by whom. However, the faulty mounting could have been detected when the wheels were changed on 29 June 1962.

Following tests, it was concluded that the cone, which had jammed in the left wheel nut, must have become loose prior to the accident and following impact with the runway it was jammed back into the nut.

The primary cause of the accident was believed to be the loosening of the lock screw of the left wheel nut which allowed it to unscrew and resulted in the whole assembly becoming loose. The screw may not have been properly tightened with a wrench when the wheels were last changed. On the other hand, the screw, if properly tightened, may have shaken loose because of vibration. It is to be noted that K and V checks do not prescribe testing the resistance of the wheel lock screw. The lock screw is not secured, but its position on SAS aircraft is normally marked in red. However, there is no provision for marking the lock screw again after changing the wheel.

Two weaknesses in the construction of the nose wheel attachment were pointed out during this investigation. Considering the vibration and its effects that can be expected during the operation of the lock screw, which is not secured, a locking device would be useful. Secondly, the lock screws on either side have right-hand threading, and the construction of the nose wheel attachment does not preclude the possibility of inverse mounting of the wheel axle.

The Commission considered that the crew showed good judgement in not applying the wheel brakes, which could easily have imposed too great a strain on the defective nose wheel assembly and greatly increased the damage and dangers involved.

3.2 Probable cause

The wheel nut lock screw, which had no locking device, was no longer in place. This resulted in the loosening of the left wheel nut followed by the loosening of the nose wheels during the take-off run.

3.3 Recommendations

No recommendations were made in the report.

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ICAO Ref: AR/836

No. 14

Alitalia, DC-8, I-DIWD, accident 7 miles northwest of Junnar, Poona District, India on 6 July 1962. Report of the Court of Inquiry, dated 20 February 1963, released by the Department of Communications and Civil Aviation, Ministry of Transport and Communications, India.

(Comments by the State of Registry of the aircraft appear at the conclusion of the summary.)

1. Historical

1.1 Circumstances

Flight AZ-771 was a scheduled international passenger flight between Sydney and Rome via Darwin, Singapore, Bangkok, Bombay, Karachi and Teheran.

It departed Bangkok for Bombay on 6 July at 1516 hours GMT, carrying 9 crew and 85 passengers. Routine messages were exchanged with the appropriate air traffic control units during the flight. The following excerpts are based on messages on HF/RT up until 1820 - thereafter they are from the transcript of a tape recorder:

1720 First contact with Bombay FIC ... off Bangkok 1516 ... ETA Bombay 1845. Flight level 360, request weather forecast for the ETA.

1747 landing forecast 1730 GMT passed

1801 at flight level 350

1814 Akola 1813, flight level 350, estimating Aurangabad 1826. Request descent clearance at 1826.

The aircraft changed to Bombay Approach frequency at 1820.

1820 Aircraft requested to start descent when over Aurangabad, (AU) down to flight level 200. Approved.

1822 1800 weather provided and acknowledged.

1824:36 ... leaving flight level 350 down to 200, Bombay at 45.

1825 cleared down to 4 000 transition level, flight level 55 ..., altimeter 29.59 inches ...

1828:04 weather passed, QNH 29.58 inches

1829 wish to land on runway 27

1838:34 771 was asked whether it would be makinga three sixty over the marker or coming straight in from the outer marker for the landing

1838:49 "O. K. ", it replied.

1838:54 "771 is leaving now five thousand three six zero on the outer marker"
"771 say again your last message"

1839:09 "Say again please. "
"771 unable to make out your last message, will you please repeat. "
"771 please say again. "
"771 request your intentions - Are you coming straight in from the outer marker for landing runway two seven or making a three sixty over the outer marker then reporting leaving outer marker inbound over? "

1839:38 771 replied: "O. K. clear to the outer marker runway two seven make a three sixty on the outer marker then report the outer marker inbound for runway two seven. "
"Roger understand you will be making a three sixty over the outer marker. Report leaving outer marker while proceeding making a three sixty. "

1839:58 "Roger will do Alitalia seven seven one. "

This was the last contact with the aircraft. Failing to establish further communication with the aircraft, search and rescue action was initiated. The wreckage was eventually located on Davandyachi hill* at an elevation of approximately 3 600 ft amsl.

1. 2 Damage to aircraft

The aircraft was completely destroyed.

1. 3 Injuries to persons

All 9 crew members and the 85 passengers were killed in the accident.

2. Facts ascertained by the Inquiry

2. 1 Aircraft information

The aircraft was constructed in 1962 and had flown a total of 964 hours 34 minutes.

The aircraft had valid Certificates of Registration and Airworthiness, and its Certificate of Maintenance was signed by the pilot-in-command on 6 July 1962. No defects in the working of the aircraft had been reported.

It carried sufficient fuel for the subject flight, and its weight and centre of gravity were within the prescribed limits at the time of departure from Bangkok.

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* Approximately 52 NM 077° from Bombay Airport (Santa Cruz), on the Bombay - Aurangabad route.

2.2 Crew information

The crew of 9 consisted of 3 flight crew (the pilot-in-command, a co-pilot and a flight engineer) and 6 cabin crew.

The pilot-in-command was 50 years of age and had been a pilot since 1939. He had flown a total of 13 700 hours, 1 396 of which had been on DC-8's. During the 90 days preceding the accident he had flown 206 hours on this type of aircraft. He had passed his last medical examination in June 1962 and was in good health.

The pilot-in-command had met the Alitalia requirement for route qualification by undergoing a familiarization flight on this route prior to operating in command on the subject flight from Bangkok to Bombay. Previously he had made a few flights on DC-6/DC-7 piston-engined aircraft from Rome to Bombay in 1959 and in 1960, but he had not operated east of Bombay. His familiarization flight was in May 1962 with an Alitalia checkpilot. On that occasion he flew from Rome to Bangkok via Teheran-Karachi-Bombay. The familiarization flight over the Bombay-Bangkok-Bombay sector was of 7 hr 41 min duration of which 3 hr 57 min were at night. The flight was made in fair weather conditions. Following this familiarization flight, he appears to have flown on other routes, and on 1 July 1962 he flew in command from Rome to Karachi, and thereafter on 5 July 1962 on the route Karachi-Bombay-Bangkok, commencing the return flight from Bangkok on the night of 6 July 1962.

The checkpilot had made only one familiarization flight on the Bombay-Bangkok-Bombay route prior to his flight in May with the pilot-in-command of I-DIWD.

The checkpilot stated in his evidence, recorded on 7 August 1962, that the pilot-in-command of the subject flight was the only pilot who undertook the familiarization flight with him in May and that he had briefed him on all aspects of the sector. He also said that it was raining in the vicinity of Bombay during the flight. Later evidence showed that there had been other pilots on board during the checkflight, (although in what capacity could not be established), that no inclement meteorological conditions had prevailed, and that the weather at that time was fair to fine.

Because of the above-mentioned circumstances it was difficult to establish whether the minimum requirements in Chapter 9 of Annex 6 to the Convention on International Civil Aviation had been fully complied with.

The co-pilot, age 33 years, had been flying since 1956. His total flying hours amounted to 3 480 of which 1 672 had been on the DC-8 as co-pilot. Within the last 90 days before the accident he had flown 219 hours on the DC-8. He had had no familiarization flight nor previous experience on the route Bombay-Bangkok-Bombay. His last medical examination was in January 1962.

The flight engineer, age 31 years, had 4 070 hours to his credit including 386 on the DC-8 and 192 hours within the 90 days preceding the accident.

The pilot-in-command and co-pilot were both trained as navigators and had passed tests as such. No specialist navigator was carried.

2.3 Weather information

The weather information in the aerodrome forecasts and the flight forecast did not tally with the weather information supplied by the Bombay Meteorological Office.

A detailed analysis was made of the conditions existing around the time of the accident.

A chart providing thunderstorm and rain data for 6/7 July, between 1200 and 0300 hours GMT showed no thunderstorm activity in the accident area.

Messages were continuously exchanged between the Alitalia aircraft and ATC Bombay from the time when first contact was established near Jharsuguda. None of the messages indicated the aircraft was encountering bad or critical weather.

A report from an Indian Airlines DC-4 aircraft operating on the same route one hour later did not indicate any abnormal weather.

Three witnesses from villages in the vicinity of the accident site stated that the night of the accident was dark and that there was light rain but no thunder or lightning.

From all the information available it was concluded that the weather conditions were not hazardous and could not have been a factor contributing to the accident.

2.4 Navigational Aids

The aircraft carried the following radio navigation equipment:

VHF navigation receiver VOR-LOC (2)
receiver glide slope (2)
marker beacon receiver (2)
ADF receiver (2)
Loran receiver
radar
doppler
transponder

No malfunctioning of any equipment was reported by the aircraft.

The following aids were available at Bombay, Aurangabad and Poona:

Bombay	RSP (responder beacon), VOR, VDF (Visual), a locator beacon and a non-directional beacon
Aurangabad	VDF and a non-directional beacon
Poona	VDF, a non-directional beacon and a responder beacon

The navigation aids at Bombay, Aurangabad and Poona were working satisfactorily. Neither I-DIWD nor any other aircraft reported any malfunctioning of the aids available.

2.5 Communications

There was no failure of communications between the aircraft and Air Traffic Control, and the messages exchanged were all understood with the exception of a message at 1838:54, that the aircraft was leaving 5 000 ft and would make a 360^{o} turn over the outer marker, which was not heard by the Approach Controller.

2.6 Aerodrome Installations

Surveillance radar was available at Bombay as well as an ILS (instrument landing system).

2.7 Fire

No fire occurred prior to impact.

There was no evidence of a concentrated fire on any of the major components of the aircraft although there were indications of localized fires.

2.8 Wreckage

The first impact of the aircraft was with the slope of a ridge of Davandyachi hill, approximately 5 ft short of the top. Its heading at time of impact was 240^{o}M, about 5 NM to the left of the normal route.

Various figures were considered for the height of the spot where the aircraft had crashed. The altitude of 3 600 ft, the reading indicated by the co-pilot's jammed altimeter, was accepted as the correct height. That would be the altitude available to the pilot of the aircraft immediately prior to the crash.

From the marks on the ground it was clear that at the time of the initial impact the aircraft was almost in a level attitude, laterally as well as longitudinally. Soon after the initial impact, the aircraft must have bounced into the air and simultaneously disintegrated. This was also deduced from the trajectory followed by the wreckage after the disintegration.

Damage to all main components of the structure was very extensive, and the wreckage was scattered ahead over a wide area. All major components of the aircraft were accounted for.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

At Bangkok, the Alitalia station manager, who is also the flight dispatcher, personally obtained information from the meteorological authorities at Bangkok before he prepared the operational flight plan (hereafter referred to as the company flight plan) for the subject flight. He also stated that a copy of the company flight plan was handed over to the pilot-in-command. It was admitted that the pilot-in-command had not signed the plan to show his acceptance. In the absence of such a signature, a compulsory requirement according to the Alitalia Operations Manual, it was not possible to determine whether a copy of the flight plan was, in fact, handed over to the pilot-in-command or was available to him on board the aircraft. No such document was recovered from the wreckage. Apart from the evidence of the station manager, the company had no records to establish that the flight plan was received by the pilot-in-command.

The chief pilot for Alitalia and other Alitalia officials stated that they did not consider the company flight plan to be an indispensable document, although it was admitted that it must be on board.

According to the station manager, he accompanied the pilot-in-command to the meteorological office at Bangkok for briefing. In answer to a letter dated 30 August 1962, the Deputy Director General, Meteorological Department, Bangkok, replied that the pilot-in-command, co-pilot and dispatcher "did not come to the weather forecast station for briefing" and that "no briefing was made because neither the pilot nor the dispatcher came up for briefing."

It appears that the official flight plan, transmitted by Bangkok ATC, was prepared by the station manager after he had prepared the company flight plan. Both flight plans mentioned flight level 360 for the route after Nagpur - this should have been 350 to conform with quadrantal separation rules.

There was a major difference between the two flight plans on the point of commencement of descent:

official flight plan - the aircraft was to continue a level flight until 7 minutes after Aurangabad and the descent phase was to commence from the control area (100 NM) and take 13 minutes.

company flight plan - the aircraft would continue to fly level for 3 minutes after Aurangabad and a descent phase of 17 minutes was contemplated.

Actually, the pilot-in-command requested a descent from Aurangabad (152 NM), thus departing from both flight plans.

Furthermore, the official flight plan filed at Bangkok Air Traffic Control, mentioned the total number of persons on board as 98. The load sheet submitted along with the company flight plan showed the number of passengers as 86 and crew as 9.

It was contended that due to the shortcomings in the flight planning and briefing at Bangkok, the pilot-in-command could not have had any flight plan with him on the aircraft. The absence of a flight plan on board undoubtedly would have resulted in an additional workload for the pilot as no separate navigator was carried on board. However, though the circumstances created a doubt, it was not possible to prove that there was no flight plan on board the aircraft.

The messages exchanged during flight, the attitude of the aircraft when it struck the ground, and the subsequent inspection of the wreckage threw no suspicion on the structural integrity of the aircraft. Malfunctioning of the aircraft can, therefore, be ruled out as a possible cause of the accident.

No flight recorder was installed on the aircraft.

The suggestion that in the control area (Bombay) the minimum navigational aids were not available was without warrant. The complaint that the compulsory reporting points for the entry to and the exit from the control area on the route Bombay - Aurangabad were placed many miles from the radio aids and, consequently, it was not possible to evaluate accurately the position of the aircraft, was also without substance as shown by evidence of one of the captains testifying. He pointed out that a pilot can ascertain his position by using the facilities available on the route and taking cross-bearings from Aurangabad, Poona and Bombay. His evidence showed that the argument that the navigation aids on this route were inadequate could not be accepted. However, additional navigational facilities would assist pilots and air traffic controllers.

It was stated that the organization and operation of the ATC services in Bombay were defective and specifically that the Area Control Service was operating:

1) without its own frequencies;

2) without pre-established procedures and consequent instructions;

3) without the minimum adequate facilities for the control (operational benches - strips and designators - control charts);

4) with personnel inadequately trained for the service.

The Court considered that even assuming these defects existed, they would not constitute the cause of the accident.

As far as deficiencies in the training of ATC officers were concerned, however, no evidence supported this contention. The approach controller concerned had received ATC training both in India and the U.S.A. and was rated as above average.

It had been suggested that the approach controller was absent from the tower when the crucial clearance of descent to 4 000 ft was given and that his absence at this time prevented him from taking proper action when he took charge of approach control and sent subsequent messages to the aircraft. Evidence on record did not support this theory.

The aircraft, approaching Bombay from Aurangabad, had to fly over the Western Ghats. The highest point on this sector is indicated by a spot height of 5 400 ft, approximately 13 miles to the north of Aurangabad/Bombay track, 55 miles away from Bombay. The main contention in this inquiry was as to whether the clearance given by ATC to the aircraft to descend to 4 000 ft at 1825 GMT was in any manner incomplete, ambiguous or misleading and contrary to the ICAO regulations.

It was contended that the clearance so given was premature and without jurisdiction as it was passed at a time when the aircraft was outside the control area. It was established, however, that it is the normal practice for jet aircraft to commence descent outside the control area, and it is an accepted ATC procedure to permit them to do so. Such clearances are valid.

It was also contended that within the controlled area ATC was bound to take into consideration the terrain in giving its clearances and, therefore, the clearance to descend to 4 000 ft given by ATC in the present instance was wrong and contrary to the ICAO regulations as there was higher intervening terrain. It was not denied that prevention of collision with terrain was the primary responsibility of the pilot, but it was contended that ATC also had a parallel responsibility regarding prevention of collision with terrain within the controlled area and that responsibility was not fulfilled by ATC in this case. On the other hand, it was urged that terrain clearance was not the responsibility of the ATC but of the pilots exclusively and that, in giving clearances, the ATC fulfilled its primary objective of ensuring prevention of collision with other aircraft in flight and maintenance of a continuous and expeditious flow of air traffic.

In support of these respective stands reliance was place on the following documents:

i) ICAO documents

- Annexes 2, 4, 6 and 11 to the Convention on International Civil Aviation;

- PANS-RAC (Doc 4444-RAC/501/7) and PANS-OPS (Doc 8168-OPS/611);

- Regional Supplementary Procedures (Doc 7030);

- Jet Operations Requirements Panel (Doc 7828, JOR/3-2 and Doc 8035, JOR/4);

- Report of the Joint Middle East/South East Asia Regional Air Navigation Meeting (Doc 7967, MID/SEA);

- Circulars 26-AN/23 and 33-AN/28.

ii) Indian and Italian documents

- Indian Aircraft Rules, AIP India, Notams No. 6 (1954), No. 22 (1960) and No. 34 (1960), Instrument Approach charts;

- AIP Italy, Alitalia Route Manual and radio facility charts.

Having carefully considered the arguments given in support of the two conflicting views and having studied in detail the various references, it was concluded by the Court that the theory of parallel responsibility of pilots and of ATS personnel regarding terrain clearance during the initial approach descent could not be sustained. The Court also concluded that the clearance given by ATC to the aircraft to descend to 4 000 ft was neither premature nor incorrect and did not relieve the pilot from his responsibilities for ensuring that clearances received from air traffic control were safe in relation to the prevention of collision with terrain and the minimum height prescribed by the Operator.

The pilot failed to ascertain his correct position after he commenced the descent. Messages showed that he understood the clearance. As for the aircraft being at 5 000 ft six minutes before its ETA, it was suggested that perhaps the pilot thought he was nearer Bombay than he actually was.

He commenced the descent at 1824:36 hours from Aurangabad, leaving flight level 350 approximately 20 minutes before the ETA at Bombay. He reached an altitude of 5 000 ft at 1838:54, i.e. in about 14 minutes, approximately 6 minutes before the ETA of 1845 GMT at Bombay as against the company flight plan, which listed a descent of 13 minutes at 100 miles in the entry appearing against Bombay control area. In coming down to 5 000 ft and descending further to 3 600 ft the pilot-in-command not only contravened the minimum safety altitude of 9 000 ft prescribed by Alitalia but also went below the initial approach altitude of 4 000 ft given in the clearance. His message that he was leaving 5 000 ft for 360° over the outer marker would indicate that he thought the aircraft was in close proximity to the outer marker over which he intended to carry out a 360° turn presumably to lose speed gradually. The heading of the aircraft, the altitude of 3 600 ft, and the fact that he had left the direct track in the direction of the outer marker all indicated his intention to position the aircraft for a straight-in approach to runway 27. This resulted in the aircraft's flying into high terrain.

The radio facility charts were available for ready reference. Chart No. 21 only provided one spot height of 5 400 ft within the control area, 13 miles to the north of the track, and gave no indication of the height of other terrain nearer the route. An orographic map, which indicated the high terrain along the route, was found in the wreckage, however, it did not appear that the captain had used it.

It was contended that the pilot-in-command committed several serious errors on the flight which must have been due to his not being "in his senses" because of having consumed liquor on board the aircraft. According to the Indian Aircraft Rules "no person ... carried in an aircraft for the purpose of acting as pilot ... shall have taken or used any alcoholic drink ... within 12 hours of the commencement of the flight or take or use any such preparation in the course of the flight." This rule applies even to foreign aircraft which are airborne for the time being in or over India. The evidence showed that it was permissible for Alitalia pilots on flights over and in India to take drinks within 12 hours before the flight, or during the course of the flight, provided it was not done in the presence of passengers. It was, however, concluded that intoxication on the part of the pilot could be ruled out as a contributory cause of the accident.

The most important issue to be decided by the Court in this inquiry was the responsibility of the pilots and the air traffic controllers regarding terrain clearance. There is no doubt that, at present, the responsibility for ensuring terrain clearance rests with the pilot. However, it does appear that there is an impression amongst some pilots, possibly familiar with radar and other specialized procedures, that the clearances issued by air traffic control all over the world would take terrain into consideration. It was considered that such an impression is a dangerous one.

According to ICAO's Annex 6, Chapter 4, paragraph 4.2.4 "An operator shall establish the minimum safe flight altitudes for each route flown. These minima shall not be less than any that may be established by the State flown over except when specifically approved by that State". The note to this paragraph reads - "This standard does not require a State to establish minimum safe flight altitudes for routes over its territory". Some States have specified figures for the minimum safe altitudes of various sectors. India has also laid down such requirements in Notam No. 6 of 1954 which would be observed by the ATC for the en route stage. However, this does not safeguard aircraft against collision with terrain in the descent-to-land or climb-after-take-off stages. These stages will of necessity be covered by the rule of the air requiring a 1 000 ft clearance over terrain.

The exchange of R/T messages and the manoeuvres of the aircraft immediately preceding the crash were found indicative of the pilot's belief that he was in the vicinity of the outer marker. The Court considered that it was incumbent on the pilot not to have descended below the minimum safe altitude unless he had positively established the position of the aircraft for a straight-in approach. Furthermore it stated that it would not be desirable for a State to prohibit such approaches at all aerodromes, but wherever they are permitted they should be made under the restrictions mentioned in Recommendation No. 1 which follows:

3.2 Probable cause

The accident was attributed to a navigation error which led the pilot to believe that he was nearer his destination than he actually was and, therefore, caused him to make a premature descent in instrument conditions for a straight-in approach to land at night. The aircraft, consequently, crashed into high terrain.

Contributing causes were:

1. Failure on the part of the pilot to make use of the navigational facilities available in order to ascertain the correct position of the aircraft.

2. Infringement of the prescribed minimum safe altitude.

3. Unfamiliarity of the pilot with the terrain on the route.

3.3 Recommendations

The Court recommended the following:

1. (a) It should be stressed on pilots and air traffic controllers that in instrument meteorological conditions an aircraft cannot be descended below the minimum safe en route altitude until over a known aid at the airport, the only exception being when the position of the aircraft is positively established within the initial approach area where the initial approach altitude or sector altitudes would apply.

   (b) Straight-in approaches in instrument meteorological conditions should be permitted only if the position of the aircraft has been positively established by reference to radar/radio aids at a point from where it can safely descend below the minimum en route altitude.

The air traffic control clearances should be based on such procedures.

2. The instrument approach charts should highlight the fact that the minimum en route altitude applies right up to the initial approach - a practice which is already current in some published charts.

3. Radio facility charts (radio navigation charts), which are used for navigation purposes, should contain significant spot heights along the route to be followed. If this is impracticable, a reference to the spot heights in these charts should be completely eliminated to avoid any possible misconception on the part of the pilots.

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ICAO Ref: AR/779

COMMENTS OF THE STATE OF REGISTRY

The following comments have been made by the Italian authorities on the causes of this accident as set out in the Indian report:

In accordance with 5.3 of Annex 13 to the Convention (Chicago 1944) an accredited representative of Italy and qualified technical advisers to assist him participated in the inquiry.

The accredited representative of Italy and his technical advisers participated actively in the inquiry with a view to contributing to ascertain the real causes of the accident; this was done in accordance with the ICAO recommendation that the State of Registry should be permitted to make its participation effective (Annex 13, paragraph 7)

The accredited representative of Italy presented some relevant factual and circumstantial evidence of primary consideration, pertaining to the circumstances of the accident. However, no record of this appears in the official report containing the findings of the inquiry.

This causes the meaning of the aforementioned ICAO recommendation that the State of Registry should be permitted to make its participation effective, to be void of any significance.

In connexion with the foregoing, it is, therefore, deemed desirable to enumerate here the fundamental elements that the accredited representative of Italy submitted to the Court of Inquiry, as it is thought that they are of primary significance to the ascertainment of the causes of the accident under review.

The elements referred to above relate to certain deficiencies in the training of the ATC officers, the defective organization of the ATC Services in Bombay, and their ground aids to air navigation.

Such deficiencies can be summarized as follows:

- the defective organization of the ATC Services;
- inadequate facilities for Control;
- inadequate ground aids to air navigation;
- inadequate training of ATS personnel;
- absence of the Approach Controller on duty on 6/7 July 1962.

Furthermore, a fundamental element has been established, namely that a wrong descent clearance was given. This clearance was contrary to the specific rules issued by the responsible Indian Authorities under Notam No. 6 dated 1954.

The above Notam specifies that the minimum safe altitude along the route Aurangabad - Bombay is 6 400 ft. Aurangabad is 152 NM away from Bombay Airport. Along the route Aurangabad - Bombay there is an obstruction 5 400 ft high about 50 miles from Bombay Airport.

When the aircraft was over Aurangabad, a clearance to descend to 4 000 ft was given to the pilot. In this respect consideration should be given to the fact that no radio aids are available between Aurangabad and Bombay Airport, in spite of the existence of the above-mentioned significant obstruction.

This is why Notam No. 6 of 1954, issued by the Government of India, specifies that the minimum safe altitude is 6 400 ft. It is also relevant that the flight was taking place at night under cloud conditions.

It is true that the pilot had the option of not accepting the clearance, however we cannot but recognize that the pilot's action was determined by the reliance he placed upon the Air Traffic Control Service in Bombay.

In conclusion, the Italian Administration feels it necessary to point out that the accident was brought about mainly by an error (wrong clearance) by the Indian ATC Service, to which we must add, as a concurrent cause, the reliance of the pilot upon said clearance.

In fact, had the proper clearance been given to the pilot, i.e. consistent with Notam No. 6 of 1954, the aircraft would have descended, as provided in the same Notam for that section of the route, to 6 400 ft at the most.

An additional point, to which considerable importance should be attached, is that the Control authorized an aircraft flying in IMC to a straight-in approach without first previously and positively establishing the position of the aircraft in spite of both the presence of a significant obstruction along the route and the rules contained in the above-mentioned Notam.

It may be stated that the clearance for a straight-in approach, under the above flying conditions, as given to the pilot of the aircraft must be considered as one of the main causes of the accident.

The Court of Inquiry, in its final conclusions, recommended the following:

a) it should be stressed on pilots and air traffic controllers that in instrument meteorological conditions an aircraft cannot be descended below the minimum safe en route altitude until over a known aid at the airport, the only exception being when the position of the aircraft is positively established within the initial approach area where the initial approach altitude or sector altitudes would apply;

b) straight-in approaches in instrument meteorological conditions should be permitted only if the position of the aircraft has been positively established by reference to radar/radio aids at a point from where it can safely descend below the minimum en route altitude.

The air traffic control clearance should be based on such procedures.

In reality the foregoing words assume and apply to factors and causes which should justify the recommendations themselves. Therefore these causes should obviously have been included and pointed out in the first part of the final conclusions, where the factors contributing to the accident are listed.

In conclusion, according to the Italian Administration, because of the facts which were ascertained during the inquiry with regard to the deficiencies in both the aids and the personnel of the Indian ATC Service and above all because of the evident improper clearance, the main causes of the accident should be attributed to these negative elements and also to the reliance that the pilot placed upon the clearance given him by ATC.

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No. 15

Trans Mediterranean Airways, DC-4 Skymaster, OD-AEC accident at Brindisi, Italy on 9 July 1962. Report released by the Directorate of Civil Aviation, Italy

1. Historical

1.1 Circumstances

The aircraft departed Beirut at 1425 hours GMT on 8 July as non-scheduled international cargo flight MV 103 to Brindisi, Frankfurt and London. It reached London at 0815 on 9 July. The return flight, MV 104, left London at 1202 hours, the same day, for Beirut via the same stops. It was carrying two crews, each made up of a pilot-in-command, a co-pilot and a radio officer. The crew, which had flown the aircraft from Beirut to London, was resting in the cargo compartment during the return trip. There were no passengers. The aircraft reached Brindisi at 2030 hours and, after refuelling, it took off from runway 05 at 2141 hours. The take-off was normal up to the time of lift-off, however the aircraft did not gain height as expected. After reaching a height of 60 m it began to descend gradually, in a slightly banked to port attitude, and struck the sea about 2 250 m from the end of the runway, 4° left of the extended runway centre line. Fire broke out. The accident occurred at approximately 2142 hours.

1.2 Damage to the aircraft

The aircraft was destroyed.

1.3 Injuries to persons

All 3 operating crew and the 3 crew resting in the cargo compartment were killed in the accident.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The aircraft's Certificate of Airworthiness was valid until 8 March 1963. The last maintenance was carried out on the aircraft in Beirut on 30 June 1962, and a certificate was issued to show it was in satisfactory condition. No technical defects concerning the aircraft were reported at Brindisi.

At take-off the aircraft's weight and centre of gravity were 32 319 kg (slightly below the permitted maximum) and 22.5% respectively i.e. within the prescribed limits.

2.2 Crew information

The pilot-in-command, age 45, was a highly experienced pilot and had flown over 15 000 hours. He had flown 5 000 hours on DC-4's. He held South African and Lebanese airline transport pilot licences with ratings for various aircraft types including the DC-4. He passed his last proficiency check for instrument flight on 29 May 1962.

The co-pilot, age 27, had a co-pilot rating for DC-4's and an instrument rating. He had flown 2 700 hours. When joining Trans Mediterranean Airways he underwent a medical examination in May 1962 and was pronounced fit for flight duties. However, he did not report back for a checkup 30 days later as instructed. At the time of the accident he was not properly qualified medically, but no errors in the handling of the aircraft came to light during the investigation which could be specifically attributed to insufficient physical control.

The radio operator, age 29, was properly qualified and had about 3 000 hours of flight time to his credit.

2.3 Weather information

At the time and site of the accident there was no wind, the temperature was 21° C and the dew point was 19°. Visibility in flight was reported by the pilot of another aircraft, which was landing at the time of the accident, as being somewhat reduced owing to the onset of darkness and the moon, which was in the sundown phase. He could not see the line of the horizon out to sea and had to fly by the use of instruments.

2.4 Navigational Aids

Aids available on the flight were ILS, VOR and radio compass.

The aircraft was fitted with the following:

2 HF sets
1 Loran
1 radio altimeter
3 VHF Collins transmitter/receivers
2 VOR - ILS
2 ADF receivers
1 Collins glide path receiver
1 marker beacon

2.5 Communications

Prior to take-off from Brindisi and up until the time of the accident at 2142 hours, radio messages were exchanged between the aircraft and the Brindisi Tower. They were in the correct phraseology and were tape recorded.

2.6 Aerodrome Installations

The aircraft took off from runway 05/23 which is equipped with white runway lights and green threshold lights. The length of runway 05, which is normally 1 940 m, is reduced to 1 890 at night, the threshold lights having been moved in 50 m from the end of the runway.

2.7 Fire

It could not be determined whether or not fire broke out aboard the aircraft prior to impact. Most eye witnesses said there was no sign of fire. An intense fire developed upon impact with the water and was fed by fuel spilt when the tanks burst. The fire completely engulfed the aircraft while it remained afloat.

The aircraft's fire fighting equipment was not used.

The fire fighting equipment on the ground reached the aircraft as quickly as possible but did not arrive until about three quarters of an hour after the accident occurred. The equipment had little effect as the fire was in an advanced stage.

2.8 Wreckage

The wreckage was located on the sea bed, at a depth of approximately 55 m, about 2 250 m from the end of runway 05, slightly left of the extended runway centre line at an angle of about 90° to it.

No marks were found on the ground beyond the end of the runway.

Engines Nos. 1 and 2, the four propellers and the outer part of the left wing were found away from the main wreckage, however, the relative distances of these parts were such that separation in flight was excluded.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

At the time of impact the undercarriage was retracted and locked, and the flaps were at a normal setting for take-off.

Following wreckage examination it was believed that, most likely, the aircraft struck the water with its engines functioning. The throttle controls were all found in the full throttle position and therefore it did not appear that the crew had taken steps to stop or throttle back the engines. However, both port engines may have been damaged prior to impact which might have resulted in a loss of power. The technical examination of the engines showed that the front bearing of No. 1 engine had begun to seize up, and the inlet valve on cylinder No. 8 of No. 2 engine was broken. This latter type of failure produces combustion in the exhaust pipe which may cause a fire through flame-back.

The position of the rudder trim tab, which was fully extended to port, suggested a pronounced extension of the rudder to starboard and that the aircraft had been subjected to a strong tendency to yaw to port, which could only have been caused by lack of power in one or both of the port engines.

Tests on the engines eliminated the possibility of overspeeding and loss of the propellers in flight.

The Lebanese regulations regarding flight time limitations (Decree No. 17183, dated 12/3/57) state that a crew may carry out a maximum of 13 hours' flight in a 24-hour period and has the right to a number of hours of rest equal to the hours flown in the preceding 24 hours, provided that the period of actual rest is not less than 8 hours after completion of the maximum permitted flight time.

However, where a crew is unable to have a complete period of rest, it may perform one or more additional trips for an aggregate time not exceeding the 13 hours, provided that the outstanding hours of rest are added to the hours of rest accruing after these flights. Rest may not, however, be accumulated in excess of two periods. The maximum flight time (13 hours) may be extended to 18 when an extra pilot-in-command is carried. The regulations do not establish how many hours of duty the crew should have in a 24-hour period, nor does the decree envisage rest on board the aircraft. Rest times at stops are considered hours of duty.

The crew that was flying the aircraft on the return trip from London to Beirut had been aboard since 1425 hours on 8 July 1962. However, that crew had not been on duty during the first part of the flight from Beirut to London, and the aircraft was equipped with bunks for the use of the crew. The pilot-in-command had spent 20:38 hours in flight plus a total of 10:39 hours on the ground during refuelling and transit stops which came to a total of 31:17 hours on duty. He may, therefore, have been tired at the time of the accident. If the Brindisi-Beirut portion of the trip (approximately 6:30 hours) had been completed the crew would have been on duty nearly 40 hours in all and would have been aboard the aircraft for about 27 of these.

3.2 Probable cause

The accident was probably caused by a loss of power on No. 1 and 2 engines following take-off, which resulted in a gradual loss of height. The probable slow psycho-physical reaction of the crew, due to fatigue, may have prevented perception of the danger and the timely execution of manoeuvres to prevent the accident, or minimize its consequences.

3.3 Recommendations

As a result of this accident it was recommended that:

1) ICAO should formulate a common Standard for all Contracting States governing the relationship to be observed between periods of flight duty and rest for crews;

2) rest should be taken on the ground.

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ICAO Ref: AR/757

No. 16

United Arab Airlines, Comet 4C, SU-AMW, accident 52 NM northeast of Bangkok Airport, Thailand, on 19 July 1962. Report released by the Director, Civil Aviation Administration, Department of Transport, Thailand, 15 November 1963.

1. Historical

1.1 Circumstances

Flight No. UA869 departed from Hong Kong for Bangkok, an intermediate stop, on a regularly scheduled international passenger service to Cairo, United Arab Republic, with 8 crew members and 18 passengers aboard. Take-off time was 1330 hours GMT. The flight plan, filed by the captain, indicated a climb speed of 400 mph (TAS) to 31 000 ft, the selected cruising altitude, where a cruising speed of 467 mph would be maintained. The check points along the route and the estimated times of arrival (ETAs) were listed as:- Delta 1403, North Reef 1420, Tourane 1445, Ubol 1513 and Bangkok 1555. During the flight the position reports and ETAs given by the aircraft coincided with the flight plan estimates. At 1514 UA869 advised Bangkok ATC that the flight had crossed the Bangkok FIR boundary at 1508 and passed over Ubol non-directional beacon (NDB) at 1513 and requested to fly direct from Ubol NDB to Bangkok VOR. This request was granted by Bangkok ATC. At this time UA869 advised Bangkok ATC that the ETA for Bangkok VOR would be 1547. At 1527 the flight advised Bangkok ATC that it would be over the 100 mile perimeter at 1530. This was acknowledged by ATC, and the flight was instructed to contact Bangkok control on 118.9 Mc/s at the 100 mile perimeter. At 1529 UA869 reported it was at the 100 mile perimeter. At 1530 UA869 reported to Bangkok control that it was 90 miles out and requested descent clearance to a lower altitude. On receiving the flight's Bangkok VOR ETA at 1544, Bangkok control cleared the flight to descend to 4 000 ft on the Bangkok VOR radial of 073 degrees and to report when commencing descent from 31 000 ft. The flight was instructed to contact Bangkok approach control at 1539 hours on frequency 119.7 Mc/s. These instructions were acknowledged by UA869. At 1535 the flight was cleared to 3 000 ft and informed that the altimeter setting was 1007.8 mb. At 1540 UA869 transferred to the Bangkok approach control frequency 119.7 Mc/s. Immediately after this UA869 reported to approach control that it was descending from 13 000 ft and estimating Bangkok VOR at 1544. Approach control advised the flight to adjust the altimeter setting to 1007.8 mb and then cleared the flight to cross Bangkok VOR for final approach on runway 21R and report immediately on descending from 3 000 ft. The flight acknowledged the message, and stated the instructions would be followed commencing at 1541-1/2. At 1550 Bangkok approach control attempted to contact UA869 without success. A radar station working with USAF and the Royal Thai Tactical Air Command recorded UA869 on its screen at a point 94 miles distant at 1536 and at about 1544/45 the trace of UA869 vanished from the screen at a point about 55 miles distant on a bearing of 060°. On 20 July the Government search and rescue party located the wreckage of the aircraft in jungle on the side of a mountain 52 NM from Bangkok Airport on a bearing of 060°. The time of the accident was determined to be 1544/45.

1.2 Damage to aircraft

The aircraft was totally destroyed on impact.

1.3 Injuries to persons

All occupants of the aircraft, i.e. 8 crew and 18 passengers, lost their lives in the accident.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The validity of the Certificate of Airworthiness is not mentioned in the report, nor is it stated if the gross weight and centre of gravity were within the prescribed limits at the last take-off point.

2.2 Crew information

Not available.

2.3 Weather information

The weather conditions in the vicinity of Khao Yai mountain between 1500 and 1800 hours were: wind southwest 10 kt, visibility 4 miles, mostly cloudy with light to medium continuous rain.

2.4 Navigational Aids

The aircraft was fitted with Doppler, which was not in use, and twin VOR receivers. The ADFs on board were not being used at the time of the accident.

The non-directional beacons were in operation at Ubol and at Nakhon Ratchasima, which is located close to the route 100 miles from Bangkok. There are three non-directional beacons and a VOR station at Bangkok.

2.5 Communications

Communications were normal until 1542:30. At this time a noise was heard identical to that made when pressing the microphone switch. However, no communication was made. Further attempts to communicate with the aircraft were unsuccessful.

2.6 Aerodrome Installations

Information not available.

2.7 Fire

Some parts of the fuselage were burnt resulting from fire caused on impact and the rupturing of a fuel tank. The aircraft was using high octane fuel.

There was no indication of fire occurring prior to the accident or of use having been made of the fire protection system.

2.8 Wreckage

The aircraft was totally destroyed when it collided with the ground with all engines delivering nominally moderate power. Only the navigator's ADF tuning boxes were found, and these were not in use at the time. Adequate fuel remained in the three remaining fuel tanks.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

According to the position reports transmitted during the flight, UA869 had a ground speed of 455 mph between Tourane and Ubol non-directional beacon, a distance of 205 miles. With this ground speed as a basis, it was determined that at 1530 the flight should have been 137 miles from Bangkok VOR and not 90 miles as noted in the flight's position report at 1530. It was also determined that the normal ground speed for this aircraft is in the order of 365 mph during descent, and that as the aircraft commenced descent from 31 000 ft at 1530, the distance traversed up to the time of the accident at 1544 should have been 85 miles, which would place the aircraft at a point 52 miles from Bangkok VOR which coincides with the site of the accident. The possibility was also discussed that the pilot either did not use the navigational ground aid facility at Nakhon Ratchasima, located 100 miles from Bangkok and close to the route flown, or that if he did, he had been incorrect in his calculations of the distance travelled. It was noted that the flight had been instructed to approach the VOR station on the 073 radial and to maintain an altitude of 3 000 ft and that the bearing of the accident site from the VOR station, determined to be 055°, differed from this by 18°.

3.2 Probable causes

The principal cause of the accident was the pilot's action in commencing descent at 1530 hours when the aircraft was 137 miles and not 90 miles from the Bangkok VOR as reported to Bangkok Control, and the aircraft, therefore, collided with a mountain at a point 52 miles distant.

It is probable that the pilot-in-command did not actually pass over the points he reported to the Flight Control Units, but only estimated he had passed these points which resulted in grave errors of time and distance in his computations.

It is also probable that the pilot-in-command had been too self-confident so that his actions were not according to the fundamental principles of air navigation.

3.3 Recommendations

A pilot-in-command should take full advantage of all navigation aids available to him, both on the aircraft and on the ground, when navigating.

When calculating time and distance, a pilot-in-command should check and re-check the points over which the aircraft passes, particularly when approaching an airport of intended landing.

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ICAO Ref: AR/787

No. 17

Canadian Pacific Air Lines, Inc., Bristol Britannia 314, CF-CZB accident at Honolulu International Airport, Honolulu, Hawaii on 22 July 1962. Civil Aeronautics Board (U.S.A.) Aircraft Accident Report File No. 1-0011, released 13 August 1963.

1. Historical

1.1 Circumstances

The aircraft had arrived in Honolulu at 0507 hours Hawaiian standard time on 21 July as CPA Flight 323 from Vancouver, British Columbia, Canada. It was departing, the evening of 22 July, as Empress Flight 301 on a scheduled international flight for Nandi (Fiji Islands), Auckland (New Zealand) and Sydney (Australia). The night take-off was commenced at 2238 hours local time* and approximately two minutes after becoming airborne and during the climbout a fire warning indication for No. 1 engine was received in the cockpit. The No. 1 propeller was feathered and the tower controller was advised that the aircraft was returning to Honolulu. As an over-gross landing weight condition existed, fuel jettisoning in the amount of 35 000 lb was carried out. The jettisoning operation was completed at 2306 hours following which the flight was vectored west of the outer marker to intercept the ILS final approach course for Runway 8. The three-engine landing approach appeared normal until the aircraft had proceeded beyond the runway threshold and had commenced its landing flare at an altitude of approximately 20 ft above the runway centreline. A go-around was attempted from this position, and the aircraft banked and veered sharply to the left. Initial ground contact was made by the left wing tip approximately 550 ft to the left of the runway centreline and approximately 1 700 ft beyond the threshold of the runway. The aircraft progressively disintegrated as it moved across the ground, then struck heavy earth-moving equipment parked approximately 970 ft from the runway centreline. The accident occurred at 2319 hours.

1.2 Damage to aircraft

Except for the rear portion of the fuselage and attached tail section, the aircraft was destroyed by impact and fire.

1.3 Injuries to persons

The aircraft was carrying a crew of 11 and 29 passengers at the time of the accident. The 7 flight crew and 20 of the passengers sustained fatal injuries. The 13 survivors received varying degrees of crash injuries and burns.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The only aircraft maintenance required while in Honolulu was the replacement of the No. 4 inverter. There were no carryover items, and no discrepancies were entered on the pre-flight inspection form.

* Hawaiian standard time

Following the completion of the fuel jettisoning operation the aircraft was in flight for approximately 13 minutes before the accident occurred. It was assumed that during this time the crew had sufficient opportunity to ensure that the remaining fuel load was symmetrically distributed and that the aircraft trim was set accordingly.

The gross landing weight of the aircraft at the time of the attempted landing was estimated at 134 005 lb. This was computed by subtracting both the 35 000 lb of jettisoned fuel and the 5 000 lb of fuel estimated to have been consumed in flight from the recomputed ramp gross weight of 174 005 lb. The maximum allowable three-engine gross landing weight is 135 000 lb. At the estimated landing weight the centre of gravity during approach would have been 18.2 percent MAC (Mean Aerodynamic Chord) which is within the approved aircraft landing limits.

2.2 Crew information

The pilot-in-command, age 45, held a valid Canadian airline transport certificate with a Britannia aircraft endorsement. He had a total of 13 250 flying hours of which 920 hours were in Britannia aircraft. In addition to his training flights he had, as captain, performed two previous three-engine landings in the Britannia under actual conditions. This was his first check over this route on Britannia aircraft.

The check pilot on this flight, age 44, also held a valid Canadian airline transport certificate with a Britannia aircraft endorsement. He had flown a total of 16 073 hours including 1 628 hours on Britannias. He had signed the flight clearance for this flight.

The two first officers, aged 33 and 30 years, held valid certificates with Britannia aircraft endorsement. Each had flown close to 5 700 hours including approximately 1 500 on Britannia aircraft.

The second officer, age 28, also held a valid airline transport rating with a Britannia endorsement and had flown 4 234 hours of which 956 were on Britannias.

The two navigators, aged 34 and 35 years, held valid Canadian flight navigator certificates.

The other crew members aboard were a purser and three stewardesses.

All crew members had 34:30 hours rest prior to this flight.

2.3 Weather information

Not considered significant. Visibility was good and the aircraft was below all cloud.

2.4 Navigational Aids

The flight was vectored to intercept the ILS for final approach to runway 08. The captain checked his position on passing the outer marker on final descent.

2.5 Communications

No difficulties were experienced in the air-ground communications. The final transmission from the flight was about 50 seconds prior to impact.

2.6 Aerodrome Installations

Runway 8 is 12 380 ft and 200 ft wide and has a U.S. standard configuration "A" approach lighting system with sequenced flashing (strobe) lights. This system includes a row of green threshold lights and white, high-intensity runway lights. All lights, with the exception of the strobes, were on and operating throughout the approach of CF-CZB.

2.7 Fire

There was no evidence of fire prior to initial impact. The fire and rescue crew proceeded to the crash scene immediately and succeeded in keeping the fire from the rear portion of the fuselage but were unable to extinguish the fire which had completely engulfed the main section of the aircraft.

The investigation revealed no evidence of an actual fire in the No. 1 engine. Furthermore, there was no evidence to indicate that any fire extinguishing agent had been discharged.

2.8 Wreckage

Four earth-moving vehicles in the 10 to 22 ton weight class were parked approximately 850 ft to the north of, and parallel to runway 8. This equipment was being utilized in the construction of a jet taxiway which is parallel to and 750 ft from the runway. Three of these vehicles formed a partial barricade to the progress of the disintegrating aircraft and confined the main portion of the wreckage in this area.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

No flight recorder was installed nor was one required on the aircraft.

All three landing gear assemblies were recovered and although the impact and fire damage was severe, it was determined that they were in the up or nearly up position at impact.

All eight flap screwjacks were found in the fully extended position corresponding to a 45-degree flap setting.

Control surface positions at impact could not be determined because of the extensive damage to the flight control system from impact and fire. However, there was no evidence to indicate a flight control or structural failure prior to impact.

All four engines and propeller assemblies separated from the aircraft during its disintegration and were recovered in the wreckage area. It was determined that the No. 1 propeller was in the fully feathered position and that the engine was not operating at the time of impact. Inspection of powerplants Nos. 2, 3 and 4 indicated that they were operating at impact and their propellers were at approximate blade angles of 25 degrees. The flight low pitch (flight fine) stop is 22 degrees.

No evidence was found in any of the powerplants, including No. 1, that would indicate a failure or malfunction prior to impact.

From the probable approach flight path, based on observations of survivors and witnesses, in conjunction with the wreckage distribution pattern, it was determined that the go-around was initiated at a point approximately 600 ft beyond the runway threshold and at an altitude of between 20 and 40 ft above the runway centreline. This was further substantiated by the fact that the landing gear was observed in the extended position as the aircraft crossed over the runway threshold but was found in the retracted position in the wreckage area. The average landing gear retraction time for the Britannia is 8-1/2 seconds. Thus, using a target threshold speed of 115 kt it would require 8 seconds to cover the distance of 1 600 ft from the go-around initiation point to the general wreckage area. The minimum threshold speed of 115 kt used in this computation is undoubtedly high considering that the pilot had most likely reduced power below that necessary for approach and was in the process of flaring the aircraft prior to initiating the go-around. However, it does sustain the conclusion that the landing gear retract position had been selected at the initiation of the go-around and that sufficient time was available to attain retraction prior to impact.

The Board was unable to determine the reason why a go-around was attempted at so late a stage in the approach and with the aircraft in the full landing configuration. There was no evidence that a go-around was required to avoid any obstacles, vehicles or pedestrians that may have been on the runway.

The possibility of a fuel imbalance condition resulting from a fuel jettison system malfunction was presented for consideration by the Board. It was theorized that a fuel jettison valve on the right wing did not close following the fuel jettisoning operation resulting in an asymmetrical fuel loading condition. It was stated that this condition presented a control problem at flareout which necessitated a go-around. The Board thoroughly reviewed this report and concluded that the effects of fuel imbalance resulting from the described system failure would not have resulted in the sequence of events that were evidenced in the investigation of this accident. Another possible reason considered for the go-around was the receipt of an unsafe landing gear warning horn and/or light in the cockpit when the throttles were retarded. However, no physical evidence was found to substantiate this possibility.

From all the evidence available, the Board concluded that a go-around was attempted shortly after the aircraft had crossed the runway threshold and while it was still in a full landing configuration. The abruptness of the aircraft's veering from the runway, in conjunction with the evidence of a shallow angle of bank at impact, confines the responsible factors necessary for this manoeuvre to those which would produce a condition of asymmetry about its vertical axis. It can be assumed that an airspeed of 115 kt (target threshold speed) or above was maintained until the aircraft crossed over the threshold. From this point and until the go-around was initiated, engine power was reduced and the aircraft was flared in preparation for landing thus decreasing the airspeed to or below V^*_{mcl} (minimum control speed at landing). Because the aircraft was

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* V_{mcl} in the landing configuration with 45° flap setting is 100 kt. Subsequent tests carried out under similar conditions confirmed the improbability of being able to maintain directional control below this speed.

operating at a speed below V_{mcl}, it could not have responded to the application of primary flight control so as to accomplish the described manoeuvre. The existence of a split-flap condition was ruled out by the position of the flap jackscrews which evidenced a symmetrical full down flap configuration. However, an asymmetric thrust condition could have produced the necessary yawing moment the manoeuvre required. The Board believed that this condition was developed by the sudden application of take-off power on the three operating engines.

3.2 Probable cause

The probable cause of this accident was the attempted three-engine go-around, when the aircraft was in a full landing configuration, at insufficient airspeed and altitude to maintain control.

3.3 Recommendations

No recommendations are contained in the report.

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ICAO Ref: AR/767

No. 18

Pan American Airways Boeing 707/321, N 726PA and Royal Netherlands Air Force, de Havilland DHC-2 (Beaver), near-miss near Teuge, Netherlands on 26 July 1962. Report, dated 18 December 1963, was released by the Netherlands Aviation Board.

1. Historical

1.1 Circumstances

N 726PA left Dusseldorf at 1121 hours GMT on scheduled international passenger flight CL 75/26 to Schiphol Airport, Amsterdam. Aboard were 79 passengers and 9 crew members. The IFR flight was to be via Airway Blue 1. At 1132 the flight informed Area Control Centre Amsterdam that it had passed Winterswijk NDB at the cruising altitude of 10 000 ft, and two minutes later it was instructed to descend to 3 500 ft so that the Harderwijk NDB would be crossed at 4 000 ft. The aircraft acknowledged. The third pilot was flying the aircraft from the right-hand seat under the supervision of the pilot-in-command. The second pilot was occupying the jump seat behind the pilot-in-command. The pilot-in-command reduced power to idle thrust and began the let-down using the automatic pilot. According to the flight recorder, the rate of descent was about 3 500 ft/min, and the airspeed was about 355 kt IAS (382 kt TAS). The anti-collision lights were on. Using the automatic pilot the pilot-in-command reduced the rate of descent by adjusting the pitch control. The aircraft had passed 5 000 ft, and the rate of descent had decreased. When descending over Teuge Airfield at 1135 the pilot in the left-hand seat saw a single-engined military aircraft loom in front of him and, without disconnecting the automatic pilot, he pulled back with all his strength upon the control column in order to bring the nose of the aircraft up sharply. According to the flight recorder the maximum positive acceleration was 2.25 g (load factor 3.25). After the Beaver had passed, the pilot-in-command slackened his pull on the control column, whereupon the aircraft pitched forward violently. This movement was accompanied by large vertical deceleration of a maximum of -2.72 g (load factor -1.72). This manoeuvre caused those passengers and crew who did not have their seat belts fastened to be thrown up against the ceiling and overhead racks with the result that some were seriously injured. Also, cabin furnishings were damaged. The aircraft completed the flight without further incident and landed at Schiphol at 1151.

The pilot of the Beaver aircraft received authorization at 1045 hours for a VFR flight from Ypenburg Military Airfield to Twente Air Base. He took off at 1105 hours carrying 3 passengers. The first part of the flight was made at 3 000 ft until just before the aircraft came under Soesterberg Air Traffic Control when the aircraft was climbed to 5 000 ft because of low cloud which extended up to 3 000 ft. At 1117, permission was granted for the aircraft to enter Soesterberg local control area and Soesterberg beacon was crossed. At 1128 the aircraft was cleared by Deelen military air traffic control to fly at 5 000 ft over the next NDB which lies practically on the centreline of Airway Blue 1. He was warned to be on the alert for civil aircraft on the airway. At 1131:30 the pilot advised that he had passed the Apeldoorn NDB. He tuned his radio compass to Twente Air Base beacon and altered his track angle to 085°. He was still flying at 5 000 ft, the altimeter setting was 29.92, and the speed of the aircraft was 110 kt IAS (118 kt TAS). The aircraft was clear of cloud.

Shortly after crossing the beacon the pilot saw a four-engined aircraft approaching ahead and slightly to starboard about 50 - 100 ft above him. He depressed the control column immediately, throttled back and banked slightly to port. He estimated his rate of descent at 2.5 to 4 mps (500 to 800 ft/min) and his bank angle at about 20°. In all, the aircraft descended about 500 ft. He stated that about 15 seconds elapsed between his first glimpse of the Boeing and the moment that the two aircraft passed each other. He said that he banked to port in order to keep the oncoming aircraft in sight. When it had passed, he returned to his previous track angle of 85°, climbed to 5 000 ft and proceeded to Twente where he landed at 1201 hours and reported the incident to the military flight information centre at Hilversum.

1.2 Damage to aircraft

As a result of the near-miss, some of the cabin furnishings of the Boeing were damaged.

The Beaver aircraft was undamaged.

1.3 Injuries to persons

Of the 79 passengers and 9 crew aboard the Boeing, 29 passengers and 2 crew members were injured, some seriously.

No injuries were sustained by the 4 occupants of the Beaver aircraft.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

Both aircraft had valid Certificates of Airworthiness and maintenance declarations were filed for them prior to departure. The aircraft were loaded and trimmed within the prescribed limits.

2.2 Crew information

The 9 crew aboard the Boeing included 3 pilots and a flight engineer with the following experience:

	total flight time	time on Boeing 707's
pilot-in-command (age 54)	22 000 hours	2 477 hours
second pilot (age 42)	14 000 "	621 "
third pilot (age 43)	12 000 "	1 453 "
flight engineer	17 500 "	1 869 "

All held the required licences.

The pilot of the Beaver aircraft was 37 years of age. He had a valid licence for this type of aircraft and had flown a total of 2 416 hours, including 1 051 hours on the Beaver.

2.3 Weather information

There is no meteorological station in the immediate vicinity of the accident site. Weather data was, therefore, taken from reports of nearby stations. One of the experts, having studied the available information, concluded that visibility at the near-miss point was probably at least 8 km. At 5 000 ft the visibility would not have been impeded by clouds. The winds at this altitude were 210°/15 kt.

2.4 Navigational Aids

Aids available to the Boeing aircraft were non-directional beacons at Winterswijk and Harderwijk and a VOR at Winterswijk.

The Beaver aircraft made use of the military beacons at Soesterberg, Apeldoorn and Twente Air Base.

2.5 Communications

No communications difficulties of either aircraft are mentioned in the report. The second pilot, occupying the jump seat behind the pilot-in-command, was carrying out the communication duties for the Boeing.

2.6 Aerodrome Installations

Not applicable.

2.7 Fire

Not applicable.

2.8 Wreckage

Not applicable.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

The Boeing and the Beaver were flying IFR and VFR respectively. No co-ordination is prescribed in regard to the combination of IFR and VFR flights. At the time that the pilots saw or should have seen each other, the aircraft were approaching nearly head-on at a closing speed of approximately 500 kt (900 km/h).

Although the Beaver pilot stated that he sighted the Boeing 15 seconds before the near-miss, the Board did not consider this possible. Judging from the relative positions of the aircraft and the tilt of the Beaver, the most likely moment at which the avoidance manoeuvre was initiated was 6 seconds before the near-miss. Allowing 3 seconds for appraisal of the situation and his decision to act, the moment at which the Beaver pilot first sighted the Boeing was fixed at 9 seconds before the near-miss. This corresponds to a distance of 2 km. It can be assumed that the Beaver pilot had kept the necessary lookout in order to enable him to execute the prescribed manoeuvre in time.

The Boeing pilot-in-command stated that he first saw the Beaver one second before the near-miss. This would indicate a separation distance of about 250 m. He said that the lookout maintained on the Boeing was in keeping with normal practice. However, it was considered by the Board to be inadequate. As the flight was being made entirely in visual meteorological conditions, non-controlled traffic was to be expected on the airway. With three highly experienced pilots in the cockpit, the duties should have been arranged in such a way that one of the pilots could maintain an effective lookout.

The airline regulations do not specify clearly that it is essential to maintain an effective lookout in all visual weather conditions, and it would seem that in practice this rule is not always observed. Therefore, it was considered that it would not be right for the Board to take disciplinary action against the pilot-in-command for his error.

The flight recorder data showed that the pilot-in-command applied great force to the control column in his attempt to lift the aircraft from a descent attitude into a climbing one. Calculations made by the Boeing Company showed that the pressure on the control column required to produce the necessary tail load must have been in the order of 150 lb. Adding to this the 33 lb needed to overcome the automatic pilot would bring the initial pull to about 180 lb.

The flight recorder registered a very high negative load factor (-1.72) immediately following the maximum positive acceleration. This indicates that the control column returned quickly to the level flight position.

The automatic pilot, which was still engaged, counteracted the change from descent to climb produced by the pilot's pull limiting the effectiveness of this and subsequently hastening the return of the control column. It was considered highly probable that the pilot-in-command did not allow for the reaction of the autopilot and that he did not know how to manoeuvre the aircraft so as to compensate for the effect of the automatic pilot. However, he was not considered to be at fault in this respect since the circumstances were so different from anything he had previously experienced. It was concluded, however, that continued connexion of the automatic pilot contributed to the incidence of high negative acceleration. But here again the pilot was not regarded as open to blame for failing to disconnect the autopilot in view of the limited time in which he had to act.

3.2 Probable causes

The accident was attributed to the following causes:

a) the pilot of the Beaver aircraft failed to bank to starboard as required by Article 14 of the Air Traffic Regulations; and

b) the pilot of the Boeing failed to maintain an adequate lookout.

3.3 Recommendation

The Board recommended that air transport companies should issue clear instructions concerning the maintaining of effective lookouts in weather conditions in which non-controlled free flights are authorized.

Scheduled International & Military En route Near-miss Pilot - failed to observe aircraft

ICAO Ref: AR/829

No. 19

Panair do Brasil S. A., DC-8, PP-PDT, accident at Galeão Airport, Guanabara State, Brazil on 20 August 1962. Report released by the Brazilian Air Ministry (SIPAer).

1. Historical

1.1 Circumstances

The aircraft was on a scheduled international flight from Buenos Aires to Rio de Janeiro (Galeão Airport) and Lisbon. It arrived at Galeão Airport following an uneventful flight. Another crew took over for the last segment of the flight. From testimony and the readout of the flight recorder tape, which was recovered from the wreckage, the take-off was reconstructed as follows. The take-off run began at 2303 hours GMT from runway 14. The aircraft's acceleration appeared to be normal. The pilot-in-command declared that, at a speed between 100 and 135 kt (V_1), he noted that the control column was too far back and pushed it forward. At this point the co-pilot released the controls, which is normally done when the aircraft reaches V_1. It is believed that in fact an attempt to rotate the aircraft was made around 132 kt. The aircraft continued to accelerate normally. The co-pilot announced 148 kt, the rotation speed (VR), and the pilot pulled back on the control column. However, the aircraft did not respond, so he pushed it forward again. No indication of this rotation attempt was revealed by the flight recorder reading. He and the co-pilot then pulled back on the control column, however, the nose of the aircraft did not rotate since the pilot had already reduced power 14 seconds after reaching VR. Also, the tape reading indicated that the brakes were used for 5 seconds prior to any power reduction. The first marks of braking were found approximately 2 300 m from the threshold. (See Figure 5) The pilot realized that the aircraft could not be stopped on the remaining portion of the runway so he turned the aircraft off the runway to the right and fully reduced power. The brakes were applied but not reverse thrust. Heavy and steady braking marks started 2 600 m from the threshold. Of his own accord, the co-pilot applied full power for reversion and tried to operate the spoilers but could not do so because of the bumps. The right wing lowered, dragging engines No. 3 and 4. The left wheels of the landing gear sank into the sand, and engines No. 1 and 2 also began to drag. All four engines lost their ejectors and reversion cones, causing the aircraft to accelerate. It continued moving at a high speed, hit the airport wall, crossed the adjoining highway, lost engines No. 1 and 2 and the left landing gear and finally came to rest in the sea, 50 m from shore. It drifted 100 m while floating and then sank to a depth of 8 m.

There were no lights on board the aircraft when it came to a stop as the automatic emergency lighting system did not function. One cabin attendant used one of the two flashlights available. The darkness increased the panic and confusion. The passengers could not use the main door as an exit because it would open into the sea. They did not know where the emergency exits were. However, the exits were then opened and most of the passengers left the aircraft on the starboard side. The fact that the four exits were all in the central part of the fuselage hampered the evacuation as the number of passengers (94) was considerable. The crew left the aircraft via the cockpit windows. No instructions had been given on emergency procedures and therefore the passengers and most of the crew did not take their life jackets with them when leaving the aircraft. Although the aircraft was equipped with six life rafts, no crew member tried to use them.

Three small Search and Rescue motorboats, with insufficient capacity, assisted in the rescue operations. Few life jackets were available. The smallest of the boats reached the site five minutes after the accident and twelve life jackets were distributed. The two other boats, based at Santos Dumont Airport, arrived much later. Twenty-five minutes after the accident, the aircraft had submerged completely.

1.2 Damage to aircraft

The aircraft was damaged beyond repair.

1.3 Injuries to persons

Of the 11 crew and 94 passengers aboard the aircraft, 1 crew member (a stewardess) and 14 passengers drowned. Seven crew and 27 passengers were injured.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The aircraft had a certificate of airworthiness valid up to 30 September 1962. Maintenance on the aircraft was up-to-date on the day of the accident. No abnormalities concerning the aircraft were reported by the crew who flew the aircraft just prior to the subject flight. The aircraft was involved in a minor accident on 9 July 1962 but had been repaired and returned to service. The accident of 20 August was in no way related to the previous one.

The aircraft's centre of gravity position was at 23%, i.e. between the permissible limits of 17.5% and 32%. At take-off the gross weight of the aircraft was approximately 305 000 lb. This is less than the maximum allowable of 315 000 lb for a DC-8 taking-off from Galeão Airport in the prevailing weather conditions.

2.2 Crew information

The pilot-in-command had adapted well to jet aircraft and was considered to be a studious pilot. He had a total of 13 504 hours flying experience, and all his ratings were valid. His time on DC-8 aircraft was 812 hours. He had not flown during the 43 days prior to the accident. He was examined on ditching procedures in 1957, and he had not been checked on them since that time.

The co-pilot was also considered to be a competent and well-experienced pilot having flown 14 643 hours including 223 hours on DC-8 aircraft. During the 30 days before the accident he flew 45 hours. His training on ditching procedures ended in May 1956, and he had not been checked on them since.

The flight engineer had 7 508 hours of flight experience including 906 hours on DC-8's. His most recent flight was five days before the accident.

2.3 Weather information

The weather conditions were good at the time of the accident.

2.4 Navigational Aids

Not relevant to this accident.

2.5 Communications

Radiocommunications with the aircraft were normal prior to the accident.

2.6 Aerodrome Installations

Runway 14 is 3 300 m long. The aerodrome lighting was operating normally at the time of the accident.

2.7 Fire

Although fuel spilt by the aircraft on the ground and the water caught fire, the aircraft itself did not catch fire. The ground fire was first fought by airline and airport employees with portable fire extinguishers. Subsequently, firemen took over. The flaming fuel on the sea was, fortunately, carried away from the wreckage by the sea's current.

2.8 Wreckage

The left landing gear and engines No. 1 and 2 had been torn off. The nose wheel, the right landing gear and engines No. 3 and 4, which were all badly damaged, had remained with the aircraft.

Underwater dives were carried out to check the position of certain components of the aircraft and subsequently the aircraft was floated and removed to the beach in order that the damage could be studied further. The aircraft had been damaged first by the accident and then by salt water corrosion.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

From examination of the wreckage and subsequent tests, the following conclusions were reached:

- the controls were free and operating normally up to the time of the accident;
- the autopilot was not in operation;
- the stabilizer, which had been set at 3° nose-up prior to take-off was at a setting of 1-3/4° nose-down at the time of impact;
- no evidence of mechanical failure, short circuit or malfunction was found in the stabilizer's mechanism.

Although the cause of the change in the stabilizer's setting could not be definitely determined, the most likely hypothesis for this change was inadvertent action by the pilot on the servo motors electric control switches located on the control column wheel. This caused the stabilizer to assume a full nose-down position. As the stabilizer's position indicator is not easily seen at night, and as there is no warning device indicating an abnormal setting, the pilot was unaware of the situation. When the aircraft failed to take off after three attempts, the pilot believed that the stabilizer was not operating, and he decided to abort the take-off.

This decision was taken approximately 9 seconds after reaching the rotation speed (VR) and by that time the aircraft had reached a speed of 170 kt and was about 1 100 m from the end of the runway.

The following acceleration-stop distances were calculated for a normal emergency stop procedure and taking into account the prevailing weather conditions at the time of the accident:

	IAS at which decision to abort take-off is taken		
	148 kt (VR)	160 kt (V_2)	170 kt (V_2 + 10)
Acceleration distance	1 700 m	1 970 m	2 150 m
Stop distance	732 m	782 m	840 m
Total distance	2 432 m	2 752 m	2 990 m

However, the pilot-in-command did not use correct emergency stop procedure. He first started to apply brakes and reduced power 5 seconds later when the aircraft was only 700 m from the end of the runway. He did not reverse thrust, which was done later on by the co-pilot, and the spoilers were not used. Furthermore, he did not inform the crew of his decision to abort the take-off, which resulted in considerable confusion in the activities of the crew.

Regarding the non-operation of the emergency lighting systems of the aircraft at the time of the accident, the Panair maintenance division assumed that -

1) when checked 60 hours before the accident, the batteries on the aircraft had already reached their lifetime, or

2) they failed during the last 60 hours before the accident.

It was observed that inadequately manufactured batteries require frequent replacement. Also, as a result of failure to comply with instructions, unnecessary use is made of the emergency lights at flight terminals.

It was also considered that the pilot's lack of flying experience during the 43 days before the accident had a bearing on the accident.

3.2 Probable cause

The take-off was discontinued when the aircraft would not rotate at a speed of 175 kt because the stabilizer setting had switched from 3° nose-up to 1-3/4° nose-down.

Contributing factors to the accident were the delayed decision of the pilot to abort the take-off and the incorrect compliance with the standard procedure used for emergency stopping.

3.3 Recommendations

The following were recommended following the investigation of the accident:

To the manufacturer

- a change in the stabilizer control system to reduce the possibility of unintentional handling;
- a warning device to indicate the wrong position of the stabilizer;
- improvement of the conspicuity of the stabilizer's indicator, especially for night flying;
- a study to improve the distribution of emergency exits to allow for speedy evacuation;
- better lighting to show the location of emergency exits;
- further study of the emergency lighting system;

To operators

- review of procedures for instructing passengers before take-off on emergency procedures and use of aircraft survival equipment;
- mandatory compliance with crew briefing requirements before take-off;
- strict surveillance of pilots who have not flown within the last 30 days;
- systematic re-study of emergency lighting systems;
- use of flashlights by stewards during night take-offs and landings.

To the Air Ministry

The Accident Investigation Board should follow up the studies recommended by the General Inspectorate to:

The Directorate of Civil Aviation

The Directorate of Air Routes

The Directorate of Health

The Directorate of Engineering

concerning data obtained during all investigations which may be of interest as far as flight safety is concerned.

The Accident Investigation Board should ask foreign organizations for reports on accidents to jet aircraft in order to disseminate their findings to Brazilian airlines.

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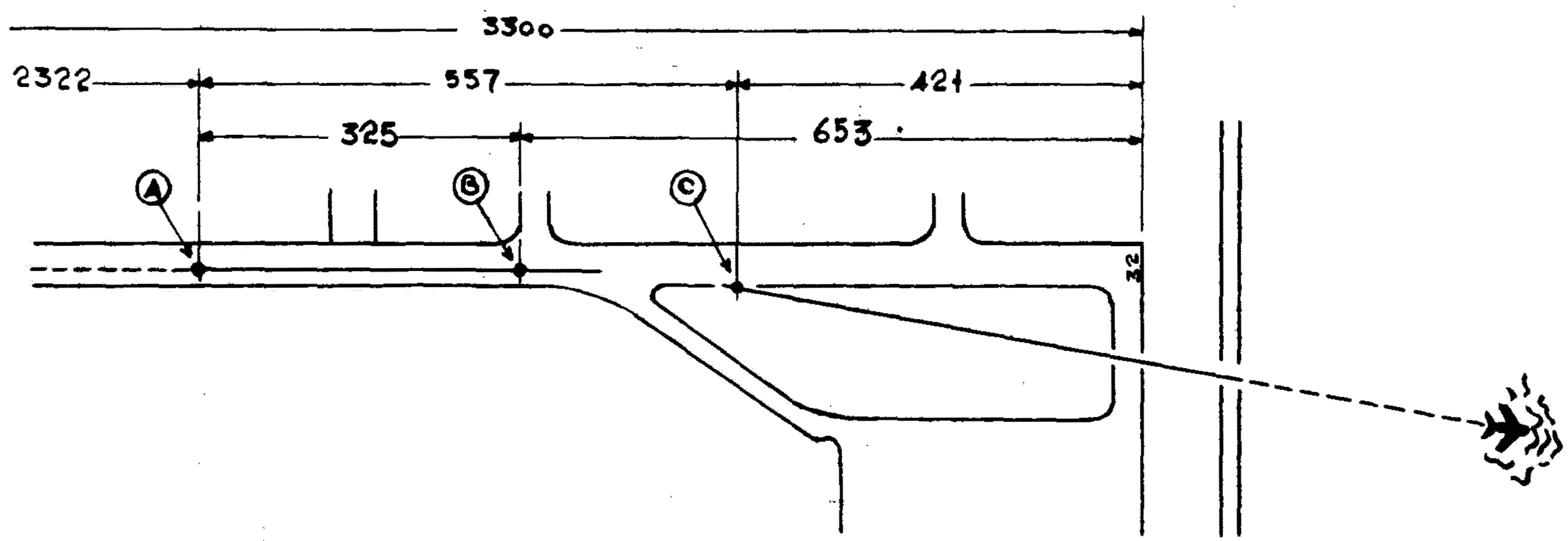
ICAO Ref: AR/830

ACCIDENT TO DC-8, PP-PDT OF PANAIR DO BRASIL S.A. AT GALEAO AIRPORT, BRASIL



CORRELATION WITH THE MARKS FOUND ON THE RUNWAY

A - FIRST BRAKE MARKS

B - BEGINNING OF VIOLENT BRAKING

C - POINT WHERE THE AIRCRAFT LEFT THE RUNWAY

FIGURE 5

No. 20

Pluna Airlines, DC-3, CX-AGE accident at Carrasco Airport, Uruguay on 9 October 1962. Report released by the Directorate General of Civil Aviation, Uruguay.

1. Historical

1.1 Circumstances

The aircraft was undergoing the final flight test required for issuance of its Certificate of Airworthiness. It was to be a visual, local flight lasting about 1 hr 30 min. No passengers were aboard the aircraft. The take-off run began at 1514 hours, 200 m from the threshold of runway 23. This meant that 1 900 m of the runway remained for the take-off. The aircraft rose to a height which could not be determined but could not have been less than 5 m or more than 15 m. About 30 seconds after the commencement of the manoeuvre its right wing grazed the surface of the runway several times. During the later contacts the landing gear bounced off the ground with such force that the right tire burst and the landing gear leg broke causing the axle and propeller to hit the ground while the right engine was turning at almost full power. The aircraft again bounced into the air, rolled over completely and finally came to rest upside down. Between the time the aircraft bounced into the air and the moment it finally came to rest, the pilot turned the power off completely. This was proved by an inspection of the condition and final positions of both propellers and the engine control switches, which were in the "off" position. Fire broke out for reasons that could not be precisely ascertained.

1.2 Damage to aircraft

As a result of impact and fire it was estimated that damage to the airframe was 99%. The propellers were destroyed. Except for some isolated components of engine No. 2, the engines were completely destroyed.

1.3 Injuries to persons

All occupants of the aircraft, i.e. 10 crew, or maintenance crew, were fatally injured.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The aircraft did not have a valid Certificate of Airworthiness. It was undergoing the final flight test required for its issuance. At the time of the accident the aircraft was operating well within its licensed weight limits, and its load was correctly distributed.

It had undergone the general overhaul, reconditioning and inspection by Pluna Airlines required after 5 000 hours of airframe operation.

Based on a statement by the flight dispatcher, and related documentation, the flight was commenced under satisfactory technical conditions.

2.2 Crew information

The pilot-in-command held a category "C" airline pilot's licence which was valid until 14 March 1963. He had a total of 6 380 hours 45 minutes flying experience recorded with the Directorate of Civil Aviation of which 5 781 hours were on DC-3s.

The co-pilot held a category "B" commercial pilot's licence which was valid until 10 February 1963. He had flown 1 714 hours on DC-3s.

Others aboard were an inspector of the Directorate General of Civil Aviation, who was present for the airworthiness certification, and seven engineers of Pluna Airlines, who were observers. All possessed the licences required for the duties they were performing on the subject flight.

2.3 Weather information

The meteorological conditions were not a factor contributing to the accident.

2.4 Navigational Aids

Information not available.

2.5 Communications

Messages were exchanged with the control tower up to the time the aircraft took off. These were recorded. They indicate that the pilot-in-command accepted an immediate take-off ahead of other traffic.

2.6 Aerodrome Installations

The aircraft was using runway 23, the most suitable for the subject operation. This runway is 2 100 m long and 45 m wide.

2.7 Fire

The fire, which broke out following final impact, was probably caused by an electrical short circuit, friction heating or parts of the power plant igniting the scattered fuel.

Fire fighting was initiated with rapidity. One fire truck reached the aircraft in less than a minute. However, the capacity of the fire fighting equipment was inadequate to extinguish the great amount of fuel - 1 514 litres - which the aircraft had spread about.

Members of the Investigating Board, who arrived at the site about one hour after the accident occurred, saw several fire fighting teams still struggling to extinguish areas of fire that persisted in spite of the large quantity of extinguishing material that had been sprayed.

2.8 Wreckage

The aircraft was destroyed by impact and fire.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

Marks on the runway showed the starboard wing scraped it no less than four times, each time with increased violence. The following possible reasons for the wing's striking the runway were initially considered:

1) the position of the trimming tab of the aileron of the starboard wing

It is doubtful, however, whether the trimming tab, even at its extreme position, would affect the controllability of the aircraft to such an extent that one or both pilots could not counter its action.

2) failure of the starboard landing gear leg

This possibility was eliminated as, apart from other evidence, the aircraft was airborne at the time when contact with the ground was made.

3) failure of the port engine attachment clamps through faulty installation

This was considered, since several of the clamps were found to have been incorrectly installed. However, it would have been necessary for several of the supports to fail at the same time, which is highly improbable. For this and other reasons, rupture of the engine supports was concluded to have been the consequence of and not the cause of the accident.

The end of the starboard wing's aileron was found separate from all the other components. It was evident from marks on it that the aileron was at an angle of -10° throughout and thus exerted a considerable disaligning force, which operated all the time or at least as long as the wing was in contact with the ground.

The configuration of the aircraft was normal and in conformity with the settings of the control surfaces. Given these factors, the Inquiry looked for the reason for the incorrect operation or non-operation of the controls. It considered three possible causes in detail:

1) pilot error
2) obstruction of the aileron control
3) inverted operation of this control

No evidence was found to support 1) or 2). The pilots were experienced, and the two control columns were recovered in normal working condition.

It was possible to establish that the installation, from the control columns as far as the triangle joints was correct, however, the latter had been attached to the <u>opposite</u> cables leading to the bellcranks, causing the inverted functioning of the whole system. (See Figure 6)

The Pluna mechanics believed that an inverted connection was not possible without giving rise to friction and easily detectable noises. Tests were, therefore, made on another DC-3 aircraft which was undergoing maintenance. The results showed that the system appears to function quite normally whether the triangle joints are correctly attached or inverted. Thus, the only way of determining correct installation is by visual inspection after the connections have been made.

The Board then looked into the maintenance operations and checks which had been carried out on the aircraft. It felt that no single individual could be held responsible for executing the work in a negligent or careless manner since several persons had taken part in the repairing, fitting and checking of the aileron controls.

Only one error could be specifically established. That was the pilot's failure to complete a test or pre-flight procedure. The Pluna Test Flight Plan mentions specifically "Functioning and Direction of Ailerons and Trimming Tabs" among the items under "Tests on the Ground".

The following points were brought out when the Board of Inquiry was investigating this accident:

- there was a lack of qualified mechanics - the airline has no mechanics' training school;

- the work schedules, although adequate, were not accurately kept;

- there were no specific schedules for final inspection;

- the maintenance staff did not possess proper manuals in Spanish.

The Board heard opinions alleging that the flight crew showed defective judgement on two occasions:

- it was asserted that the take-off was rushed and insufficient time was given to the pre-flight control check procedures required prior to a test flight, owing to the pressure of traffic and perhaps the demands of the control tower. Based on the recorded communications between the tower and the aircraft, the Board considered the procedure to be normal.

- it was asserted that after the first contact of the wing with the runway, seven seconds after lift-off, the pilot did not reduce power and discontinue the flight. The Board considered that if this course of action had been taken the damage might have been less; but it did not have sufficient material to substantiate this. In order to pass judgement on the pilot's behaviour during the actual emergency, certain additional factors would have to be known.

After the first contact with the runway the pilot had five seconds to make a decision, and he may have failed to take the best one. It also must be remembered that the aircraft was still in flight at this time, and that the brake system was, therefore, inoperative.

Based on established facts, the Board of Inquiry believed that the only known failure by the crew was that they carelessly checked or failed to check the direction of movement of the ailerons prior to take-off.

3.2 Probable cause

The accident was attributed to a maintenance error, which was not noticed by the airline inspectors and the inspector from the Directorate General of Civil Aviation. This was followed by an omission on the part of the pilot.

3.3 Recommendations

Following this accident the Board of Inquiry and the Directorate General of Civil Aviation made the following recommendations:

1. Pluna should take steps to improve its existing system of checks so as to eliminate verbal "Seen. O.K." reports.

2. Pluna should arrange for workshop job schedules to be signed in all cases and only by persons holding a proper licence.

3. Pluna should take steps to provide maintenance staff with Spanish language manuals and make these easily accessible to them.

4. Pluna should entrust trial flights to specific crews specializing in this activity.

5. Pluna should introduce some system to eliminate the possibility of inverted connection of DC-3 aileron controls. It is suggested that bolts of different diameter be used for each aileron or that the length of the right-left cable sections be modified.

6. The airport authority should improve the access facilities of vehicles to the operational area so as to provide more effective control in emergencies.

Test flight Take-off Ground loop Other personnel - inadequate maintenance inspection and Pilot - inadequate pre-flight inspection and/or preparation

ICAO Ref: AR/745

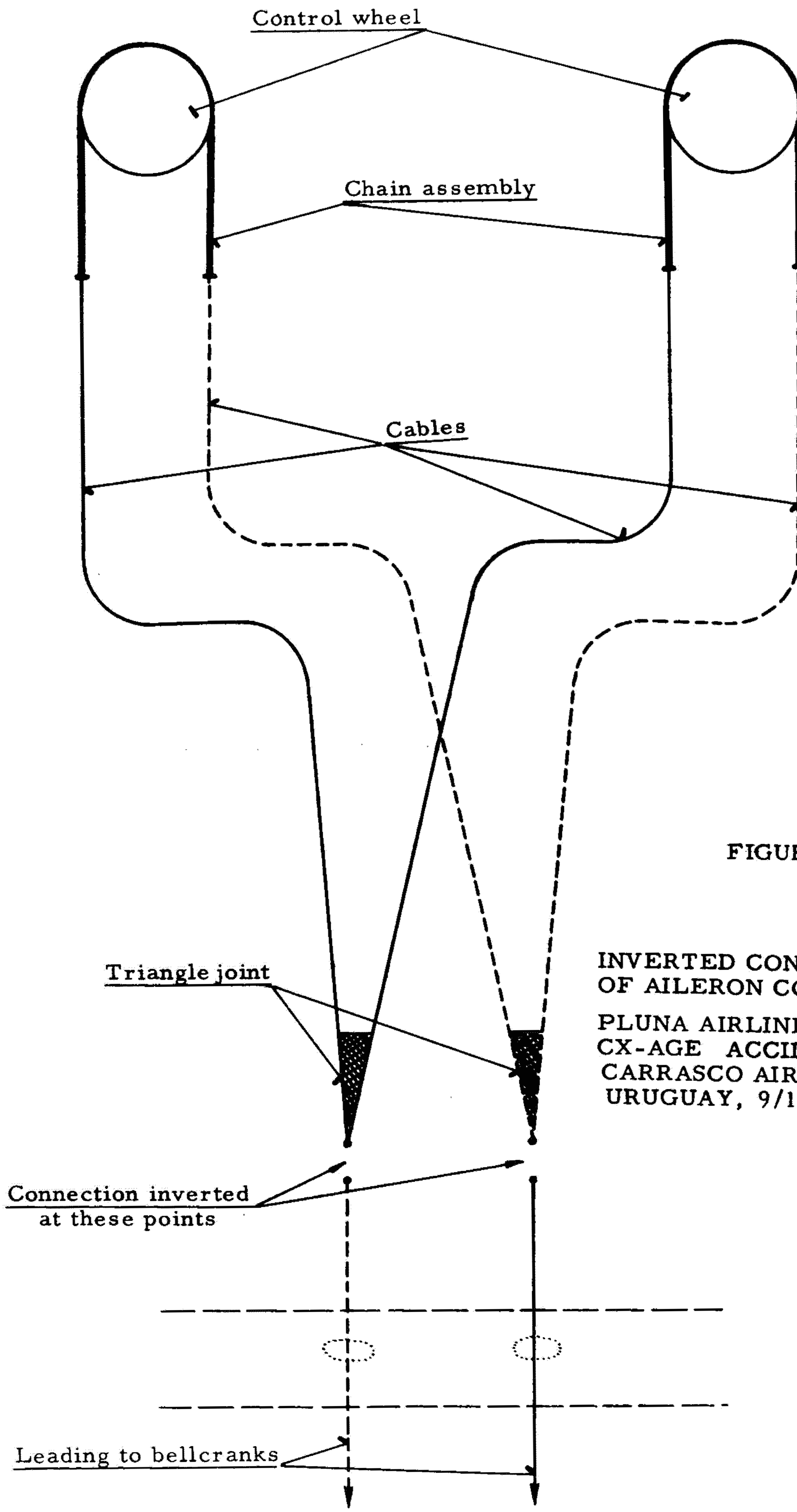


FIGURE 6

INVERTED CONNECTION OF AILERON CONTROLS

PLUNA AIRLINES, DC-3, CX-AGE ACCIDENT AT CARRASCO AIRPORT, URUGUAY, 9/10/62

No. 21

Trans Canada Air Lines, Vickers Viscount 700, CF-THA and No. 416 All Weather Fighter Squadron, Voodoo CF-101B, 17452, collided at Bagotville Aerodrome, R.C.A.F. Station, Bagotville, Quebec, Canada on 10 October 1962. Accident report No. 1821 released by the Department of Transport, Canada.

1. Historical

1.1 Circumstances

TCA flight 455 was a scheduled domestic flight from Seven Islands to Bagotville, Quebec. Four crew and 15 passengers were aboard. The flight was uneventful, and a ground controlled approach was made at Bagotville. The aircraft landed on runway 11, touching down at 1849 hours, 1 000 ft after the runway threshold and 1 000 ft before a Voodoo aircraft, which was holding short of the runway awaiting take-off clearance for an Air Intercept mission. About 3 900 to 4 000 ft from touchdown the Viscount was reported by the controller to have turned north towards a high speed taxi strip.

The Voodoo was cleared to position and held at a point 2 000 ft east of the threshold of runway 11. It was cleared for take-off at 1850 hours, and the controller then directed his attention to another aircraft which was taxiing.

The collision occurred 20 seconds later, 200 ft west of the intersection of runways 11 and 18-36, just after the controller had returned his attention to the active runway. The Voodoo was airborne at the time and struck the Viscount's fin and rudder about 14 ft above the runway. The Voodoo's right undercarriage entered the Viscount's fuselage on the port side, aft of the rear door and continued through the fuselage on an angle of approximately 6° to the centre line of the aircraft for about 55 ft. The Voodoo caught fire but continued to climb to 1 200 ft asl where the crew, using ejection seats and parachutes, successfully evacuated the aircraft. The aircraft then crashed in a field. The Viscount came to a stop on a heading of 048° at the intersection of runways 11 and 18-36, 200 ft beyond the impact point and clear of the active runway.

1.2 Damage to aircraft

The Viscount was substantially damaged. The Voodoo was destroyed by impact and fire.

1.3 Injuries to persons

One stewardess on the Viscount was killed and another seriously injured as a result of the accident. One passenger died of injuries a few hours later. A number of other passengers suffered injuries and shock.

The pilot and navigator of the Voodoo suffered minor and serious injuries respectively.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The Viscount had a valid Certificate of Airworthiness, and there was no evidence to indicate any fault in the airframe, engines, propellers or controls prior to the accident.

The Voodoo was airworthy, and there was no evidence of any malfunction having occurred.

2.2 Crew information

Viscount

The pilot-in-command had a valid airline transport pilot's licence. He had a total of 15 578 hours flying experience including 4 500 hours on the Viscount. During the 90 days prior to the accident he flew 233 hours on Viscounts. He was fully qualified in respect of route checks and terminal qualifications.

The co-pilot also held a valid airline transport pilot's licence. His experience amounted to 7 183 hours of which 5 800 hours had been flown on Viscount aircraft. His experience on this aircraft type, during the 90 days before the accident amounted to 215 hours. He had flown 740 hours as pilot-in-command on Viscount aircraft.

The crew had been on duty for eight hours and ten minutes prior to the time of the accident.

Voodoo

The pilot had an instrument rating. He had flown 1 280 hours in all of which 132 hours were on Voodoo aircraft. His night flying time totalled 30 hours. His experience on jet aircraft amounted to nearly 1 100 hours.

The navigator was also qualified.

2.3 Weather information

The weather conditions were not considered to have contributed to the accident.

2.4 Navigational Aids

Not applicable.

2.5 Communications

Following touchdown, the Viscount changed from the radar frequency (134.1 Mc/s) to the tower frequency (126.2 Mc/s).

No communications difficulties were reported.

2.6 Aerodrome Installations

Bagotville Aerodrome has an elevation of 521 ft asl. The three runways are 11-29, 18-36 and 06-24, which are 10 000, 6 000 and 4 240 ft in length respectively. The western end of runway 11-29 was extended 2 000 ft in August 1962. At the time of the accident the runway and approach lights were set at low intensity. The runway and its lighting system were fully serviceable.

2.7 Fire

The Voodoo caught fire following the collision.

2.8 Wreckage

No description of the wreckage is provided in the report.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

Based on an intensive investigation, known facts and the evidence of eye witnesses, it was assumed that the Viscount turned to the north in the vicinity of the high speed taxiway prior to the take-off clearance being given to the Voodoo. Evidence concerning the duration of this manoeuvre or the extent of the deviation from the runway heading is not conclusive.

3.2 Probable cause

The controller assumed in error that the Viscount was turning off at the high speed taxi strip and cleared the Voodoo aircraft for take-off before the Viscount was clear of the active runway.

3.3 Recommendations

No recommendations were made following this accident.

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ICAO Ref: AR/868

No. 22

Allegheny Airlines, Inc., Convair 340/440, N 8415H accident near Bradley Field, Windsor Locks, Connecticut on 19 October 1962. Civil Aeronautics Board (U.S.A.) Aircraft Accident Report, File No. 1-0029, released 18 July 1963.

1. Historical

1.1 Circumstances

Flight 928 was a scheduled domestic passenger flight from Washington, D.C. to Providence, Rhode Island with en route stops at Philadelphia International Airport, Pennsylvania and Bradley Field, Windsor Locks, Connecticut. The flight to Philadelphia was routine. Four crew members and forty-eight passengers were aboard the aircraft at the time of departure for Bradley Field. During start-up it was noticed that the rear service door warning indicator was on. The ramp agent climbed on a power unit and closed this door. Both pilots and the ramp agent were able to check that after closure the appropriate door warning light was out. At take-off all door warning lights indicated that the aircraft's doors were closed and locked. Take-off from Philadelphia was at 1955 hours eastern daylight time, during the hours of darkness. The cabin pressurization system was activated. About five minutes after take-off, during the climb to cruising altitude, a high-frequency whistling noise was heard coming from the rear service door. The co-pilot visually checked the door handle's position and that the overhead door latches were in place and locked. He further tested the door handle manually. The bottom door latches were not visible but appeared to be correctly locked. Tests showed that there was no air leak around the door. Thus, he could not find anything wrong with the door but was of the opinion that the noise was coming from around the rubber seal. The captain instructed him to attempt to stop the noise. Several dampened pillow covers were placed on the rear side of the door where the rubber seal was visible. This stopped the noise. The flight continued at the cruising altitude of 5 500 ft with sea level cabin pressure maintained for passenger comfort. About 57 NM from Bradley Field, light turbulence was encountered. The seat belt sign was switched on and left on. Shortly thereafter a gradual descent was commenced. The flight reported to Bradley Approach Control when it was about 10 miles southwest of the WTIC radio tower, which is located near Bradley Field. It was instructed to make a straight-in approach to runway 6. At approximately 2052 hours, just after passing through the 4 000-foot level, there was an explosive decompression. This was felt in the cockpit and at the same time the service door warning light illuminated. The decompression tore off the cockpit-cabin door which was blown about 8 ft down the cabin aisle. The decompression also ripped the lavatory door from its hinges and forced its occupant, the second stewardess, to the floor. The first stewardess, who was in the buffet area, was ejected through the rear service door, which had blown open, and fell to her death. Bradley Tower was advised of the accident, and the aircraft landed at Bradley Field at 2058 hours.

1.2 Damage to the aircraft

Most of the damage was limited to the cockpit-cabin door, the lavatory door and the rear service door.

1.3 Injuries to persons

The first stewardess was killed when she was ejected through the rear service door of the aircraft and fell to the ground.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

At the time of the accident the total time on the airframe was 20 960 hours. The aircraft was currently certificated.

When the aircraft was released at Philadelphia its gross weight and centre of gravity were within the prescribed limits.

Allegheny Airlines had recorded seven inadvertent inflight rear service door openings since their Convair aircraft were put into operation in April 1960. Three of these occurrences involved N 8415H.

Convair recognized the deficiencies in the rear service door and since 1954 it had issued several Convair 340/440 Service Bulletins recommending modifications. The majority of the modifications had not been incorporated in N 8415H.

2.2 Crew information

The crew members on the subject flight were a pilot-in-command, a co-pilot and two stewardesses. All held valid certificates.

2.3 Weather information

At Bradley Field there were clear skies and visibility was more than 15 miles.

2.4 Navigational Aids

Not significant in this instance.

2.5 Communications

The flight experienced no communications difficulties.

2.6 Aerodrome Installations

Not significant in this instance.

2.7 Fire

There was no fire.

2.8 Wreckage

There was no wreckage.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

Investigation at Bradley Field and at Washington National Airport established that electro-mechanical continuity existed in the rear service door warning light system. However, this system does not indicate the position of the two aft latching hooks.

The door was recovered, repaired and reinstalled. The circumstances were duplicated, and tests showed that when slammed shut the two upper hooks and the lower forward hook went into place, and the door warning light went out even though the lower aft hook was not engaged. With the door in this semi-latched configuration, the cabin was pressurized to the appropriate differential, and it was observed that engine vibration progressively moved the door handle towards the open position. During depressurization the door handle moved further towards the open position and at 0.5 psi differential pressure the rear service door popped outwards at the bottom. From this it was concluded that the closing procedure of the rear service door at Philadelphia had resulted in an insecure engagement of the aft lower latching hook over its lock pin. The improper latching of the service door had not been indicated by the warning light and would have been difficult to detect by reference to the position of the door handle. The slight displacement from the locked position could easily have been overlooked in a visual inspection.

It was also concluded that the partially engaged lower aft latching hook remained in this configuration during the climbout from Philadelphia and subsequent cruising flight. The descent to Bradley Field, with the resulting decrease in pressure differential, lessened the tension on the partially engaged latching hook against the lock pin. The insecurely positioned lower aft latching hook allowed the lower portion of the door to be distorted by pressure which, when assisted by aircraft vibrations, caused the door handle to move toward the open position. When this hook became disengaged, further distortion of the door occurred and the door handle travelled to the fully open position thereby disengaging the forward lower hook, resulting in explosive decompression. Immediately prior to the decompression, assuming a pressure differential of 1.7 psi, the total force exerted on this door would have been in excess of 3 000 lb. Therefore, anyone adjacent to this door during explosive decompression would be ejected from the aircraft.

The flight crew took reasonable precautions to determine that the service door was secure. However, their analysis that the leak was the result of a door seal was in error. Since Allegheny Airlines had experienced several inadvertent openings of the service door when operating Convair 340/440 aircraft, the Board felt that the crew should have depressurized the aircraft, as a precaution, and warned the stewardesses and passengers to avoid the rear service door area.

Only brief emergency instructions regarding rear service door and window pressurization leaks were contained in the Allegheny Airlines Operations Manual. No specific instructions were given regarding impending pressurization failure. Currently effective operations instructions now provide comprehensive pressurization instructions and emergency procedures.

3.2 Probable cause

An undetected insecure latching of the rear service door resulted in an inflight explosive decompression which ejected a stewardess from the aircraft.

Contributing factors were Allegheny Airlines' inadequate emergency pressurization instructions, and the continuation of pressurized flight after discovery of the pressurization leak.

3.3 Recommendations

On 5 November 1962 the Board recommended to the Federal Aviation Agency that methods for improving the Convair 340/440 rear service door system be considered, and that the adoption of these improvements be of a mandatory nature. Consequently, the Federal Aviation Agency issued an Airworthiness Directive, effective 18 December 1962, making mandatory the modification of Convair 340/440 rear service doors incorporating improvements contained in Convair Service Bulletins. This Airworthiness Directive requires, among other pertinent items, that:

1. The Airplane Flight Manual be revised to require inspection of the latching before take-off and each time the rear service door is operated;

2. The aircraft be depressurized if there is evidence of a latch disengagement or leakage around the door;

3. Inspection holes and lights be installed for inspection of the lower door latches; and

4. Door latching electrical warning switches be installed in the upper and lower forward latches.

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ICAO Ref: AR/758

No. 23

Líneas Aéreas La Urraca Ltda., Curtiss C-46A, HK-354X, accident at Port Henderson Hills, Jamaica, West Indies on 26 November 1962. Report released by The Director of Civil Aviation, Jamaica, West Indies.

1. Historical

1.1 Circumstances

The aircraft was on a non-commercial ferry flight from Fairbanks, Alaska via Miami and Jamaica to Bogota, Colombia. At the time of departure from Miami the aircraft was carrying a pilot, two passengers, four spare engines and a quantity of spare parts. The flight landed at Palisadoes Airport, Kingston (Jamaica) at 1701 hours GMT on 25 November. Following refuelling of the aircraft, fuel was observed venting from the right front tank. This was rectified, and departure was delayed until the next day.

A night take-off run was made at 0847 GMT, early in the morning of 26 November. This was longer than usual, and the initial climb was more gradual. However, the departure was not so abnormal as to cause alarm. The aircraft was cleared to climb ahead to 1 500 ft following take-off from runway 29 before setting course. Several witnesses saw the aircraft starting to turn to port on crossing the coast line, 3-3/4 miles from the end of the runway. Three minutes after becoming airborne, while still in a shallow climbing left-hand turn, the aircraft flew onto the southern face of the Port Henderson Hills at a height of 700 ft, just below the brow. The accident occurred at 0850 hours, 5 miles from the airport and 1-1/2 miles south of the extended runway centre line. After scraping along rough ground over the brow of the hill, the aircraft fell down a steep precipice, and fire broke out.

1.2 Damage to the aircraft

The aircraft was destroyed.

1.3 Injuries to persons

The pilot and one passenger were killed. The other passenger was seriously injured.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

At Fairbanks, on 10 November, a U.S. licensed aircraft maintenance engineer certified that the aircraft was airworthy for one flight only, from Fairbanks to Miami. A ferry permit was issued to that effect. The flight was to be limited to visual flight rules (day) only and only essential crew and their baggage were to be carried. The aircraft had no certificate of airworthiness allowing for the carriage of passengers and non-essential freight. The engineer listed ten limited airworthy items in his certification to be replaced or overhauled and to be re-inspected prior to further flight from Miami. While considerable maintenance work was carried out at Miami, it was not possible to establish whether all the limited airworthy items listed by the engineer at Fairbanks were attended to before the aircraft left Miami.

The ferry permit did not stipulate a maximum permissible all-up weight. The weight of the aircraft at time of departure from Palisadoes was estimated to be 47 960 lb which was well in excess of the normal civil limitation of 45 000 lb for unmodified C-46 aircraft.

2.2 Crew information

The pilot-in-command, age 35, was the owner and chief pilot of the Company. He held a valid Colombian airline transport pilot's licence, endorsed for C-46 aircraft. He had operated several times through Palisadoes Airport, often at night. There was evidence that he had had adequate rest before the final flight. He was the only crew member aboard the aircraft. On aircraft the size of the C-46 two pilots, at least, are normally required.

On the subject flight the right-hand seat was occupied by one of the two passengers. This man held an aircraft maintenance engineer's licence corresponding to engine inspector, but he was not a licensed flight crew member. He had worked upon the aircraft both at Fairbanks and at Miami and had been on board the aircraft since its departure from Fairbanks.

2.3 Weather information

Information not available.

2.4 Navigational Aids

Information not available.

2.5 Communications

The pilot was in touch with Palisadoes Tower by radio prior to take-off. On the previous day he had established contact on HF and VHF with Palisadoes (Kingston) tower after having been out of all contact for over three hours after reporting at Nassau. If he encountered difficulties following his final departure, being the only crew member, he may have been too busy controlling the aircraft to use the radio.

2.6 Aerodrome Installations

Information not available.

2.7 Fire

Fire consumed all but the rear section of the fuselage but did not break out until after the aircraft had struck the ground.

2.8 Wreckage

Examination of the wreckage showed that when the aircraft first made contact with the bush and rocky ground it was in a shallow climbing turn to port with both engines under power. The undercarriage was retracted, and the propellers were in the low pitch position.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

The controls, instruments and engine components were either destroyed by fire or were too badly damaged by it to permit any signs of malfunctioning prior to impact to be detected.

The average rate of climb of the aircraft before impact was calculated to have been 233 ft/min, which was well below the rate of climb expected of this type of aircraft, properly loaded, with engines developing normal climb power. The heavily laden condition of the aircraft would have been only a partial explanation of the slow rate of climb.

Improper loading could have affected the aircraft's performance. However, there was no evidence that the distribution of the main load was changed at Palisadoes following the flight from Miami.

The shifting of the aircraft's load during flight might also have affected its performance. However, it was not considered likely that any of the spare engines had become free in flight as all four broke free together at a considerable distance from the first point of impact with the ground.

The survivor was questioned several times following the accident. On one occasion she stated that the pilot had said that one of the engines was dead and that the pilot was busy with the roof and the controls. However, the evidence showed that both engines were operating at the time of impact although the poor rate of climb makes it seem possible that one or both of them were not using full power.

There were considered to be three possible explanations for the pilot's deviation from his clearance to climb ahead to 1 500 ft:

1) a 100% altimeter error was experienced - this was considered unlikely;

2) pilot error - he may have turned on to the course for Bogota before reaching the minimum terrain clearance altitude;

3) mechanical difficulty was encountered which affected the controllability of the aircraft or distracted the pilot from observing the high ground.

3.2 Probable causes

The aircraft was turned during the climb after take-off at a height insufficient to clear rising ground. The ability of the pilot to avoid the hill may have been affected by some mechanical or other failure, although the occurrence of such a failure was not established.

A contributing factor was that the carriage of one pilot was inadequate for the safe operation of an aircraft of this type.

3.3 Recommendations

No recommendations are contained in the report.

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Non-commercial ferry flight Take-off Collision - rising terrain Pilot - misjudged distance after failing to adhere to ATC climb-out clearance

ICAO Ref: AR/781

No. 24

Viação Aérea São Paulo S/A (VASP), Scandia, PP-SRA and privately-owned Cessna 310, PT-BRO were involved in a mid-air collision and crashed in the Paraibuna District, São Paulo State, Brazil on 26 November 1962. Report released by the Brazilian Air Ministry (SIPAer).

1. Historical

1.1 Circumstances

The Scandia aircraft was flying a scheduled domestic service from Congonhas Airport (São Paulo) to Santos Dumont Airport (Rio de Janeiro). It left Congonhas at 1144 hours GMT on an instrument flight plan and was flying Airway AB-6 at the approved cruising altitude of 2 400 m. Five crew and 18 passengers were aboard. The flight advised of its progress en route and at 1203 hours was abeam São José dos Campos, estimating Ubatuba at 1214 hours. When it did not report Ubatuba as expected, an alert message was sent at 1242 hours.

The Cessna had taken off from Santos Dumont at 1111 hours GMT en route to Marte. It was flying the same airway in the opposite direction on a VFR flight plan and carried 4 persons. Following its last contact with Santos Dumont it did not report its position. The alert phase was declared at 1251 hours, thirty minutes after its estimated time of arrival at Marte. It was learned later by the Inquiry that the sound of the two aircraft colliding was heard, and eye witnesses saw them fall, at approximately 1209 hours.

1.2 Damage to aircraft

Both aircraft were destroyed.

1.3 Injuries to persons

All 5 crew and 18 passengers aboard the Scandia and the 4 occupants of the Cessna were killed.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

Data available concerning the aircraft showed that they were both airworthy, and their gross take-off weights and centres of gravity were within the permissible limits.

2.2 Crew information

The crew members of both aircraft were satisfactorily certificated, experienced and familiar with the equipment of their respective aircraft. They also knew the routes which they were flying.

2.3 Weather information

At the time of the accident the weather was excellent. The sun's position could not have hampered either pilot. The visibility was adequate for VFR flights at the time of the accident.

2.4 Navigational Aids

The radio navigational aids on the route were functioning properly.

2.5 Communications

The Scandia aircraft maintained contact up until six minutes before the accident. It did not report any communications difficulties.

The Cessna was not heard from after its last contact with Santos Dumont. The time of this communication is not given in the report.

2.6 Aerodrome Installations

Not applicable.

2.7 Fire

There was no fire.

2.8 Wreckage

Examination of the wreckage did not indicate any fire or malfunction of the power plants, equipment or accessories.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

Neither pilot deviated from his prescribed course.

The pilot of the Scandia was performing his IFR periodic flight check. It was assumed, therefore, that he may have been operating by instruments "under the hood".

The indications were that the pilots were not able to minimize the conditions of the accident after their mid-air collision. Both aircraft went straight into the ground.

An approved instrument flight plan does not exempt a pilot from maintaining an adequate lookout when in visual flight conditions.

Subsequent to the collision, Notam No. 1105, dated 14 May 1963, prohibited VFR flights on Airway AB-6 between the Rio and São Paulo control zones. It also mentioned other segments of the Airway on which the same rule applies and prescribed safety measures to be taken.

3.2 Probable cause

Both pilots failed to maintain adequate lookouts for other aircraft.

3.3 Recommendation

It was recommended that airlines and military organizations should bring to the attention of their pilots the safety measures contained in Notam No. 1105 of 14 May 1963. This notice is also supplied by the Directorate ot Civil Aeronautics to flying clubs and private pilots.

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ICAO Ref: AR/831

No. 25

Empresa de Viação Aérea Rio Grandense, S.A., (VARIG), Boeing 707, PP-VJB, accident on La Cruz Peak, Surco District, Lima Province, Peru on 27 November 1962. Report, dated 16 October 1963, released by the Ministry of Aviation, Peru.

1. Historical

1.1 Circumstances

Flight 810 departed Galeão Airport (Rio de Janeiro) at 0353 hours GMT on 26 November on a scheduled international flight to Lima-Callao Airport. Aboard were 17 crew members and 80 passengers. In accordance with its flight plan, the aircraft reported over the following points: Pisasununga (0430), Campogrande (0524), Curumbá (0548), Santa Cruz (0630), Cochabamba (0652), Charaña (0715) and Pisco (0813). Based on radiocommunications between the aircraft and the tower and data prepared by Boeing, based on the aircraft's flight recorder, the final portion of the flight Pisco-Lima was as follows. At 0809 the flight reported to Air Traffic Control, Lima, at 36 000 ft, estimating Pisco at 0813 and Lima-Callao Airport at 0836 and requested permission to descend. Lima ATC advised of a DC-6, which had departed Lima at 0735 and was also estimating Pisco at 0813 when it would be cruising at 13 500 ft. After passing Pisco at 0813, and leaving 36 000 ft at 0814, Flight 810 reported at 0819 hours that it had reached 26 000 ft. Authorization to continue descending for a straight-in approach to runway 33 was granted. At 0824 it reported to Approach Control ten minutes from the station, at 15 000 ft, still in descent. By 0830 hours it had reached 12 000 ft over Las Palmas. As it was too high for a straight-in approach to runway 33, Approach Control suggested that it make a 360° turn over Las Palmas and report again overhead Las Palmas. The aircraft continued descending. It turned slightly right of its 330° heading, passing east of Limatambo Airport, then made a left turn and passed over Lima-Callao Airport. It continued turning until it was headed south, passing west of Las Palmas in order to initiate the outbound procedure from the ILS back course, and then made a 180° turn to intercept the ILS back course (327°). However, it kept to the normal intercept course for almost three minutes before starting its turn to the north. Its heading was 333° when it hit La Cruz Peak, about 8 miles east of the approach track of the Morro Solar ILS back course. The time of the accident was believed to be 0837 hours when the flight broke off communications with Lima Approach Control. The emergency phase was declared at 0855. The wreckage of the aircraft was located by Peruvian Air Force personnel at 1800 hours.

1.2 Damage to aircraft

The violence of the impact caused the aircraft to explode and burn. It was completely destroyed.

1.3 Injuries to persons

All 17 crew members and 80 passengers aboard the flight were killed.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The aircraft's Certificate of Airworthiness was renewed on 12 September 1962 and was valid until 22 May 1963. The aircraft had flown 6 326.41 hours since manufacture and 1.27 hours since its last check. VARIG uses the progressive overhaul system.

The weight of the aircraft and its centre of gravity are not given in the report.

2.2 Crew information

Although the report stated that there were 17 crew members on the flight, it only contained detailed information concerning two pilots-in-command and two second officers.

Both pilots-in-command held airline transport pilot licences, valid IFR ratings and were medically fit. They had been with this Airline for approximately sixteen years. Their experience was as follows:

time flown up to November 1962	13 640 hours	16 304 hours
total night flying	2 125 "	1 997 "
flying time on Boeing 707s	1 200 "	433 "
night flying on Boeing 707s	441 "	209 "
IFR flying time	8 184 "	9 782 "

The two second officers held the required licences and had been with the Airline 15 years and 9 years 8 months. Their flying experience was:

time flown up to November 1962	16 520 hours	11 081 hours
total night flying	1 856 "	2 266 "
flying time on Boeing 707s	1 614 "	388 "
night flying on Boeing 707s	606 "	114 "
IFR flying time	9 800 "	6 000 "

Flying times during the last 30 days and last 24 hours for the abov - did not indicate the possibility of crew fatigue.

2.3 Weather information

The meteorological office at Lima provided weather information for 0700 hours, 0800 hours, 0837 hours and 0900 hours. The conditions at 0837 hours, the assumed time of the accident, were:

wind 200°/5 kt, visibility 14 km, cloud 8/8 stratus at 570m

The conditions between Pisco and Lima were good.

2.4 Navigational Aids

The aircraft was equipped with radar, ADF, VOR and ILS (glide slope indicator and localizer).

There was a scarcity of navigation aids along the route flown. This is believed to be one of the reasons why the aircraft arrived overhead at Lima 8 or 9 minutes before the estimated time of arrival.

Aids available at Pisco and Lima were:

Pisco	NDB	
Lima	NDB	Las Palmas
	"	Limatambo (2)
	"	Callao
	"	Ventanilla
		ILS localizer
		glide slope

All navigation aids were operating normally before, during and after the accident.

Two of the NDB stations - Limatambo LIM 335 and Limatambo R 400 - have the same name but operate on different frequencies with different call signs and at different locations. They appear on Jeppesen Approach Chart 21-2, dated 16 January 1962, for Lima International, which was used by the crew on the subject flight.

2.5 Communications

A tape recording was made of the communications between Lima and Flight 810. Unfortunately the quality of the recording was poor because the tape was old and worn. A call being made by Flight 810 at 0837 hours was not completed. Until that time no difficulty was reported.

Radiotelephony communications pertaining to the subject flight were also made through Lima Radio. A high frequency transmitter at Lima failed at 0633 hours but resumed operation shortly thereafter at 0648 hours.

2.6 Aerodrome Installations

The ground installations at Lima-Callao Airport were operating normally before, during and after the accident. The runway at Callao which is used for landing aircraft is runway 15/33. It is 11 487 ft long and 175 ft wide.

2.7 Fire

The aircraft burned following the explosion at impact.

2.8 Wreckage

Examination of the wreckage showed that at impact the main landing gear was extended. However, it was not possible to determine the position of the nose wheel landing gear.

The ailerons were almost intact and working freely. The aileron trim tabs were at neutral.

There were no breaks in the flap control system, and the flaps appeared to be at 30°. Examination of the outboard flap drive screws on both wings indicated an asymmetric flap condition.

The indicator screw of the rudder trim tab showed the trim tab at neutral.

Markings showed that the elevators were still attached to the aircraft at impact, and there was no evidence of any malfunction.

Threads of the stabilizer jackscrew assembly projecting above the nut corresponded to an approximate 1° nose up position.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

The distribution of the wreckage at the site of the accident proved that the aircraft was nearly straight and level at impact and that its speed was approximately 165 - 170 kt, which is normal for final approach. There was no indication that the aircraft was in a state of emergency. Impact marks on the four engine nacelles confirmed the level position of the wings and showed that the nacelles and engines were intact at the time of the accident. Examination of the engine that was not completely destroyed showed that it was operating at approach power at impact.

The flight reported all reporting points on the route in accordance with the estimated time on its flight plan. However, its flight plan allowed 23 minutes for the 113 - mile Pisco-Lima segment, although, based on the experience of other airlines operating jet aircraft, the average flying time is 16 minutes. This resulted in an overestimated time of 7 minutes and explained the aircraft's altitude on arriving at Lima.

The flight between Pisco and Lima was reconstructed on the basis of flight recorder data and recorded communications. It had been cleared to descend from 36 000 ft before passing Pisco. Twenty-three minutes before the accident the aircraft passed over Pisco where the heading was changed from 286° to 338°, then to 330°. At this point it was at approximately 34 000 ft and descending at an average rate of over 1 500 ft/min, with an average speed of 445 kt, until 8 minutes before the accident. Six minutes after passing Pisco, the flight had been cleared to make a straight-in approach to runway 33, which implies reaching Las Palmas at 2 000 ft. The aircraft reached the Las Palmas area around 15 000 ft, and was therefore much too high to carry out a straight-in approach. The flight recorder showed no sudden descent or levelling off to avoid collision with known traffic in the Lima area. Possibly, on sighting the lights of Lima through the cloud cover over the city, the aircraft was flying with the Pisco NDB behind it, and the pilot asked for the Lima NDB to be switched on. It was assumed that he then tuned to the Limatambo airport NDB (R400) instead of the proper NDB used for the ILS back course procedure (LIM 335). This may be why the aircraft changed heading from 325° to 342° and passed within a mile of Limatambo Airport. This assumption was confirmed by the following. The aircraft completed its turn, passing over Callao Airport, and came out facing the NDB station. It then turned to fly southward. About 30 seconds after passing Las Palmas, where it received the beacon signal, the outbound track from the ILS course was initiated. The maximum outbound track is one minute.

The entire procedure was carried out in the vicinity of the ILS course. Therefore, when the 180° left turn was made to put the aircraft on a heading of approximately 012° for interception of the ILS course, (327°), the aircraft passed through this course and, when it assumed a 012° heading, the aircraft was east of the ILS course. As for the reading on the Collins integral instrument, it may be assumed that the heading shown was not 147°, the correct figure for entering the ILS front course, but 327°, the figure for the back course. As a result the equipment would give reversed indications. These would explain why the flight was continued for almost three minutes on a 012° heading, with the instrument showing the ILS course forward and to the right, whereas with the correct setting for course interception, it would have made a turn immediately to intercept the ILS back course on the west side.

Based on the foregoing, the last turn could be explained as follows: the pilot tuned in erroneously to the Limatambo NDB R400 believing it to be LIM 335. Thus, he inferred from the ADF indications that the ILS course was in front of him. Added to this error was the fact that the Collins integral instrument was incorrectly adjusted. After the prescribed number of minutes of flight, the Limatambo radio beacon (R400) showed 90° to the left. The pilot may have believed that the ILS system was out of order and started his turn to a heading of 330°. He had only reached 333° when the accident occurred. However, this assumption could not be ascertained as the Collins integral equipment was not found in the wreckage.

3.2 Probable cause

The Accident Board has determined that the accident involving the Boeing 707 aircraft, registration PP-VJB, was probably caused by a deviation, for reasons unknown, from the track prescribed for the instrument approach along the ILS back course of Lima-Callao Airport.

3.3 Recommendations

No recommendations are contained in the report.

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ICAO Ref: AR/832

No. 26

Panair do Brasil S.A., Lockheed Constellation 049, PP-PDE, accident near Manaus, Amazonas State, Brazil on 14 December 1962. Report released by the Brazilian Air Ministry (SIPAer)

1. Historical

1.1 Circumstances

The aircraft departed Belem at 0231 hours GMT on a scheduled domestic flight to Manaus carrying a crew of 7 and 43 passengers. It was flying on Amber 1 Airway in accordance with an approved flight plan. The trip was expected to take three hours and the flight carried enough fuel for 11-1/2 hours. At 0504 hours the flight contacted radio Manaus, reporting it was six minutes out. It received landing instructions and was asked to report again when in the traffic pattern. At 0519 the aircraft again contacted Manaus and asked whether its engines could be heard by the station. Radio Manaus replied in the negative and asked the reason for the question. No further messages were exchanged. Shortly thereafter the "uncertainty" and "alert" phases were declared. The wreckage was found approximately 45 km from Manaus.

1.2 Damage to aircraft

It was destroyed.

1.3 Injuries to persons

All 7 crew and 43 passengers were killed.

2. Facts ascertained by the inquiry

2.1 Aircraft information

None available.

2.2 Crew information

None available.

2.3 Weather information

None available.

2.4 Navigational Aids

The non-directional beacon at Manaus was operating normally.

2.5 Communications

The aircraft was communicating with radio Manaus on VHF, frequency 126.7. The VHF transmitter was checked and found to be in satisfactory condition.

2.6 Aerodrome Installations

The night marking was adequate, and operating faultlessly.

2.7 Fire

There is no mention of fire in the report.

2.8 Wreckage

The wreckage of the aircraft was located at 1425 hours GMT, the day after the accident.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

Based on a reconstruction of the accident, it was concluded that the aircraft had struck trees when in level flight. At the time of impact the landing gear and flaps were up, and the carburettor mixtures for the engines were set at auto lean.

3.2 Probable cause

The cause of the accident was not determined.

3.3 Recommendations

No recommendations are made in the report.

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ICAO Ref: AR/833

No. 27

Polskie Linie Lotnicze ("LOT" Airlines), Viscount 804, SP-LVB, accident at Okęcie Aerodrome, Warsaw, Poland, on 19 December 1962. Extract from the Report of the State Accident Investigation Commission released by the Department of Civil Aviation, Ministry of Communications, Poland.

1. Historical

1.1 Circumstances

SP-LVB was flying a scheduled international trip from Warsaw to Berlin and Brussels and was to return to Okecie Aerodrome, Warsaw on the same day. It had left Warsaw at 0845 hours GMT and had reached its final destination, Brussels, at 1251 hours. After refuelling, it took off from Brussels on the return trip at 1455 hours and was to make the same en route stops. At Berlin it took on additional passengers and luggage. Aboard the aircraft were a crew of 5 and 28 passengers. The aircraft took off from Berlin for Warsaw at 1755 hours. During the approach to Okecie Aerodrome the flight made use of one beacon as prescribed in the procedures. It was cleared to land when at a height of 60 - 70 m, however it crashed to the ground 1 335 m from the threshold of the landing runway (329°). The accident occurred at 1930 hours, approximately 46 seconds after it had been cleared to land.

1.2 Damage to aircraft

The aircraft was destroyed by impact and fire.

1.3 Injuries to persons

All occupants of the aircraft, 5 crew and 28 passengers, were killed.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

On departure from Berlin the aircraft's gross weight was 24 067 kg.

2.2 Crew information

The pilots completed their basic training on the Viscount 804 while in England. They were properly certificated for this type of aircraft and were medically fit. No information on their ages and flying experience is contained in the report.

2.3 Weather information

The weather conditions at 1900 hours (i.e. 30 minutes before the accident) were as follows:

wind: 030°, 18 km/h; visibility: 7 km; snow on the ground;
cloud: 6/8 fractostratus, cloud base: 250 m;
QNH: 1012.0 mb; temperature: -5°C; dew point: -7°C

2.4 Navigational Aids

A non-directional beacon was available to aircraft landing at Okecie Aerodrome.

2.5 Communications

There does not appear to have been any difficulty as the aircraft received permission to land less than one minute before the accident.

2.6 Aerodrome Installations

No information in this respect was submitted.

2.7 Fire

Fire broke out following impact. The wreckage examination showed no signs of an explosion having occurred in the air.

2.8 Wreckage

No description of the wreckage is available.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

Examination of the wreckage indicated that at impact the aircraft was in the landing configuration with its undercarriage and flaps down.

Prior to the accident, the engines, controls and electrical equipment of the aircraft were functioning satisfactorily.

A detailed examination of the aircraft's wreckage at the site of the accident was not possible because of bad weather.

3.2 Probable cause

The accident was attributed to a loss of speed and stalling of the aircraft. The reason for the loss of speed was not determined.

3.3 Recommendations

No recommendations were made following the investigation of the accident.

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ICAO Ref: AR/834

No. 28

Empresa de Viaçao Aérea Rio Grandense, S.A. (VARIG), Convair 240, PP-VCQ, accident at Brasilia Airport, Brazil on 22 December 1962. Report, dated 27 March 1963, released by the Brazilian Air Ministry (SIPAer).

1. Historical

1.1 Circumstances

The aircraft was flying a non-scheduled domestic flight from Rio de Janeiro to Belo Horizonte and Brasilia. It carried 5 crew members and 35 passengers. It departed Belo Horizonte for Brasilia at 2002 hours GMT on 21 December on an IFR flight plan. At 0040 hours on 22 December the flight reported to Brasilia Area Control Centre that, according to its approved flight plan, it was flying on Airway Green 3 at 3 300 m and passing over Cacique, the last reporting point. It then changed to the Brasilia tower frequency and was authorized to descend to 1 800 m. At 0048 hours it received the altimeter setting (QFE) 893.3 mb from the airline. Two minutes later the Brasilia tower advised that the wind was 330°/10 kt, the altimeter setting (QNH) was 1,016 mb, and asked the flight to report when reaching Brasilia. At 0054 the flight reported at 1 800 m. It was instructed to report when outbound for runway 28 and was given the latest weather conditions. Initial approach was begun at 0056 hours. At 0059 the flight reported it was on final approach. The tower gave it the latest wind conditions, 330°, velocity 8 - 10 kt, and the aircraft was cleared to land. The message was acknowledged. Nothing further was heard from the flight. The tower controller saw a flash of light in the direction from which the aircraft was expected, however, he did not think anything abnormal had occurred. After a few unsuccessful calls, search and rescue services were alerted. The aircraft had struck trees and the ground 8 400 m from the runway and continued over uneven ground for 300 m.

As the aircraft fell on its side, only the side exit facing upward could be used for evacuation. Because of the failure of normal lights and the fact that no flashlights were available, it was difficult to find the emergency exit.

1.2 Damage to the aircraft

The aircraft was substantially damaged.

1.3 Injuries to persons

Of the 5 crew and 35 passengers aboard the flight, only the pilot-in-command was killed. The co-pilot was seriously injured, and one of the hostesses was slightly injured.

2. Facts ascertained by the Inquiry

2.1 Aircraft information

The aircraft had flown a total of 21 728 hours including 11 994 hours since its last overhaul. Maintenance on the aircraft had been carried out properly, and the maintenance reports contained no mention of any difficulty which could have caused the accident.

The weight of the aircraft and its centre of gravity at the time of the accident were within the prescribed limits.

2.2 Crew information

The pilot-in-command was qualified to fly the aircraft. He held a valid instrument rating and was physically fit. He had a total flying time of 7 165 hours of which 2 392 hours were on the Convair 240.

The co-pilot was also physically fit. He had a total flying time of 3 395 hours of which 178 hours were on the Convair 240.

Both pilots were known to comply regularly with operational and traffic procedures, and their flying time during the last 30 days does not indicate any possibility of fatigue.

2.3 Weather information

In the last communication with the flight, when it was cleared to land, the tower provided the latest wind conditions: 330°, velocity 8 - 10 kt. Visibility at the time was 20 km, and there were no dangerous cloud formations. It was raining slightly at the time of the accident. The general weather situation was not considered to be poor enough to cause the accident.

2.4 Navigational Aids

The non-directional beacon at Brasilia was operating properly.

2.5 Communications

Communications between the flight and Air Traffic Control were made without difficulty. The last contact with the flight was at approximately 0059 hours GMT.

2.6 Aerodrome Installations

The rotating beacon and the runway lights at Brasilia were operating satisfactorily.

The aircraft was landing on runway 28. The elevation of the airport is 1 059 m.

2.7 Fire

There is no mention of fire in the report.

2.8 Wreckage

No description of the wreckage appears in the report.

3. Comments, findings and recommendations

3.1 Discussion of the evidence and conclusions

The instrument approach chart for runway 28 published by the Directorate of Air Routes establishes the following:

initial approach	2 minutes	
altitude to be reached by the end of the intermediate approach	1 350 m	(QNH)
final approach	1 minute	29 seconds
critical altitude	1 209 m	
minimum horizontal visibility	1 500 m	

For scheduled flights the established minima for runway 28 are ceiling 100 m and visibility 1 000 m.

Normally the aircraft complete the intermediate approach 3 600 m from the non-directional beacon (approximately over the site of the accident) at an altitude of 1 350 m, i.e. 200 m above the ground.

The approach chart used by the pilots on the subject flight was issued by the Operator. It was similar to the one published by the Directorate of Air Routes with the following amendments:

a) critical altitude = 1 159 m

or a height of 100 m

b) duration of final approach -

1 minute 32 seconds at a speed of 260 km/h

c) the minima for night landings and take-offs appear as footnotes -

ceiling = 150 m

visibility = 1 000 m

d) the minima at the bottom of the page were deleted and new minima, established by Notam 51, issued by the Operator, were handwritten on the lower edge of the sheet -

ceiling 200 m (for runway 28)

visibility 1 500 m

The co-pilot, who survived the accident, said he followed the approach procedure with the instrument approach chart in hand. No holding was performed, and no delay was observed as far as the non-directional beacon silence cone determinations were concerned. When he reported the aircraft was on final approach, the altimeter was indicating 1 350 m, which is in accordance with the approach chart. All altimeter settings were QNH. The aircraft continued descending at the prescribed rate on bearing 230° of the Brasilia non-directional beacon. Fifteen to twenty seconds later the main landing gear struck trees. Shortly before the accident he could see the land beneath the aircraft but not the runway. He noticed no change in engine power or in the aircraft's attitude.

A Convair captain, who was a passenger on the subject flight, stated that he sighted the runway lighting during the intermediate approach and that the aircraft's altitude at that time appeared to be normal. He estimated that the main impact occurred 10 to 15 seconds after the beginning of the final approach. It was concluded from the reconstruction of the approach, based on testimony, that the intermediate approach ended about 10 000 m from the non-directional beacon. The pilots should have seen the airport lighting at the end of the intermediate approach at an altitude of 1 350 m. The fact that they did not see the runway lights indicates that they were at an altitude below that indicated by the altimeters - where the ground was an obstruction to the line of sight of the aerodrome.

The normal rate of descent being 150 m/min, it takes 1 min 20 sec to lose 200 m. To lose 200 m in 20 sec the pilot would have to increase the rate of descent to 600 m/min immediately following the base turn. Such an abrupt descent would have been noticed by the passengers and crew.

Past accidents similar to this one were studied. The only one in which the pilot survived was as follows: after a night flight, an instrument descent was being carried out with ceiling and visibility unlimited. The aircraft levelled off at the critical altitude and was on final approach when it struck the ground in an area full of trees. The pilot-in-command and the co-pilot, both well-experienced in instrument flight, stated that the difference between the altitude indicated on the altimeters and the actual altitude was approximately 200 m.

The Investigating Board concluded that, in view of the preceding, there is a possibility in the subject accident of erroneous altimeter indications for undetermined reasons.

3.2 Probable cause

The aircraft descended below the prescribed altitude for undetermined reasons.

3.3 Recommendations

The following recommendations were made during the investigation:

1. A review of the instrument approach chart(s) should be made for runways 10 and 28 at Brasilia.

2. Any changes to instrument approach charts should be kept up-to-date until new ones are issued.

3. When night minima are different from day minima, the differences must be pointed out.

4. Every instrument approach chart must show the profile of the ground overflown with distance references for the outbound portion of the approach, if there is no non-directional beacon marker. Also, all elevations should be marked.

5. Until Recommendation 3 is adopted, pilots must study carefully the minima contained in the regulations, which have been written in as footnotes to instrument approach charts. They should also study the Notams for the routes to be overflown.

6. Flashlights must be carried aboard aircraft and stored in locations easily accessible to the crew.

7. Emergency exits must be marked with phosphorescent paint.

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ICAO Ref: AR/835

PART II

AIRCRAFT ACCIDENT STATISTICS 1962

INTRODUCTION

GENERAL COMMENTS

1. This section of the Aircraft Accident Digest No. 14 contains a detailed analysis of the statistics for the year 1962, as well as selected data for the years 1925 to 1963 inclusive. Figures for the years subsequent to 1951 were obtained largely from the ICAO Air Transport Reporting Forms G (Aircraft Accidents; see pages 162 and 163) filed by Contracting States. In order to arrive at as complete a picture as possible of accidents in which public aircraft were involved, other sources had to be used for those countries which have not yet filed the required reporting Form.

2. The statistics shown are the best available to date but are subject to adjustment when additional Forms G are filed.

DESCRIPTION OF TABLES AND CHART

3. CHART Passenger fatality rate and traffic on scheduled air services 1945 - 1963.

TABLE A-1 Accidents with passenger fatalities on scheduled air services 1925 - 1963

TABLE A-2 Number of fatal accidents, passenger fatalities and survivors of turbo-jet, propeller-driven (turbine and piston) aircraft - scheduled air services 1960 - 1963.

4. Three tables are given for the year 1962. The accident data has been recorded under the country in which the airline which suffered an accident is registered, thus not under the country where the accident took place. These three tables give the following information:

TABLE B Passenger fatalities occurring on scheduled international and domestic operations.

TABLE C Aircraft accident summary of all operators engaged in public air transport.

TABLE D Aircraft accident summary of all operators engaged in public air transport by type of operation.

SAFETY RECORD

5. The preliminary reports so far received on accidents in world air transport in the year 1963 indicate further improvements in the safety record on both scheduled and non-scheduled services (international and domestic). The passenger fatality rate per 100 million passenger-kilometres, at 0.49 (0.79 per 100 million passenger-miles), is the lowest ever recorded for world scheduled air services as a whole. This is the third successive year in which the rate has shown a substantial reduction, and indications are

that the long-term steady downward trend in this rate, which seemed to have been interrupted between 1955 and 1960, has once more been resumed (see Table A-1). This satisfactory trend in the accident rate should not, of course, give rise to any complacency, since there were still about two serious crashes per month on the average throughout the year, killing a total of about 700 passengers and injuring many more. Nevertheless, the further reduction of the 1962 accident rate, which was already low in comparison with previous years, is undoubtedly an achievement that can be regarded with satisfaction.

6. Table A-2 shows how the accident figures on world scheduled air services from 1960 to 1963 were divided between turbo-jet, turbo-propeller and piston-engined aircraft. It will be observed that the number of fatal accidents for the three classes of aircraft have remained fairly constant over the past three years, which means that the accident rates for the jets and the turbo-props have substantially improved, since their volume of flying has rapidly expanded. Exact statistics are not available, but it would seem clear that the gradual introduction of the large turbo-jet airliners has been an important factor in the reduction of world accident rates. Although the number of fatal accidents of turbo-props has remained constant over the past four years, their volume of flying has not expanded as fast as that of the turbo-jets. It must be remembered that the propeller driven aircraft (turbine and piston) tend to be utilized on the routes with predominantly shorter stages, where the exposure-to-accident risk is proportionately greater. (The exceptionally low figure of 9 passenger fatalities per accident for the turbo-props in 1963 appears to be a reflection of generally low load factors on the services where they operate.)

7. Analysis of the 1963 statistics by aircraft type shows the DC-3 to have had 9 out of the total of 30 scheduled service fatal accidents. This is considerably more than the proportion of flying hours now carried out by these aircraft since, although about a quarter of all transport-type aircraft on national registers are probably still DC-3's, they are steadily being replaced by more modern types on the scheduled services, and their rate of utilization also tends to fall. Examination of the types of accident suffered by DC-3's, however, provides no indication that their age or state of serviceability had anything to do with their relatively high accident rate. On the contrary, the DC-3 accidents reported in 1963 contained a rather higher proportion than usual of typical bad-weather accidents (crashed into mountain in storm, hit mountain in monsoon, landing in bad weather, etc.) than for the general run of scheduled service accidents. The explanation is, no doubt, that DC-3's are replaced first on the air services in the more developed parts of the world so that, as the years go by, they are left with a higher and higher proportion of operations in the less developed areas, where ground facilities (and particularly meteorological facilities) are poorer. This, perhaps contains an important warning for those concerned with safety of air transport in the developing regions, since eventually the DC-3's will be replaced in those regions also and the more modern aircraft replacing them will, in general, be more sensitive to deficiencies in ground facilities, owing to their higher landing speeds and greater cruising heights. They will thus tend to have even more accidents than the DC-3's unless the ground facilities are substantially improved.

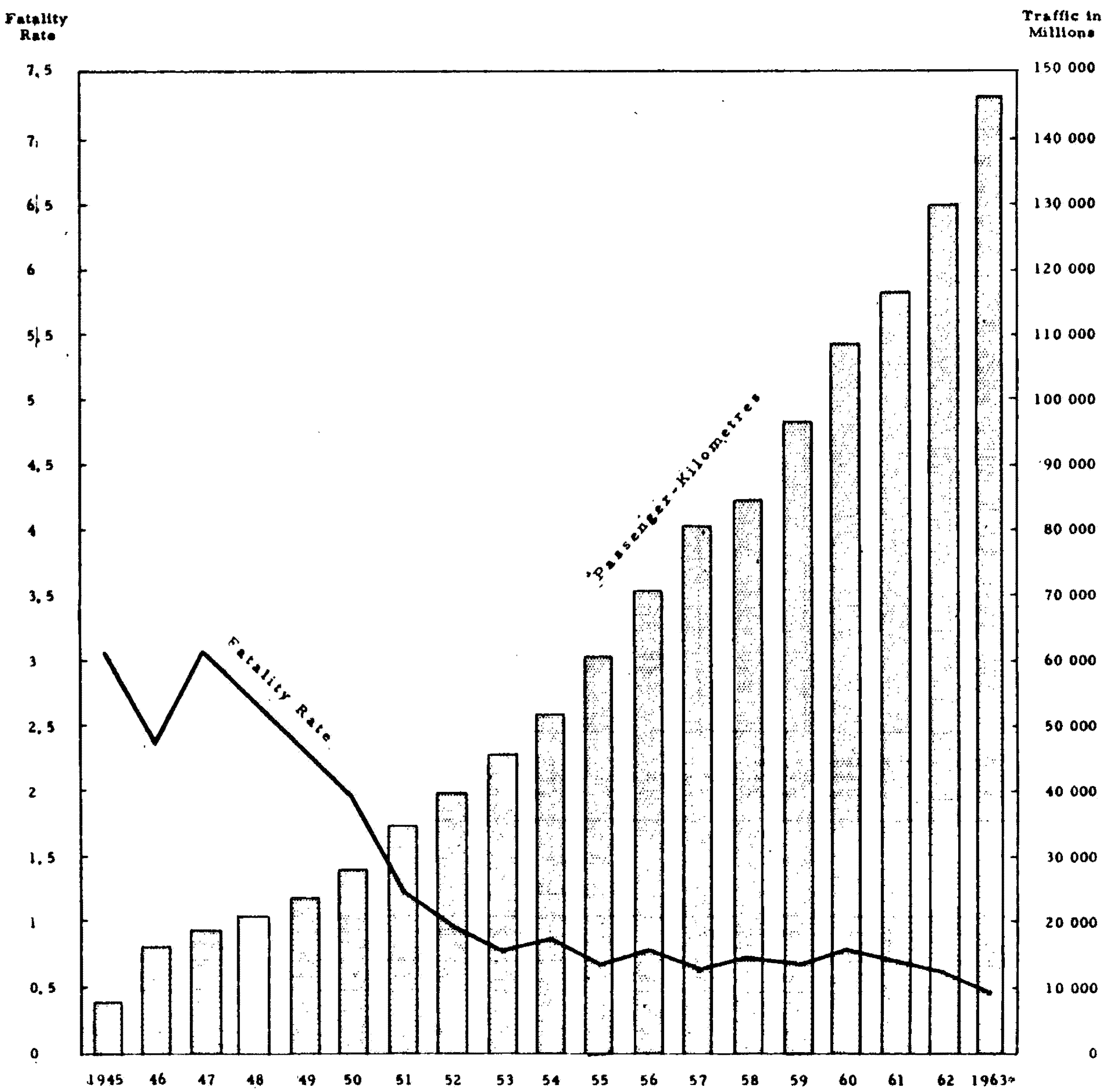
8. Once again, analysis of the types of accident indicates a high proportion of cases where the aircraft hit the ground or a mountain in poor visibility. Perhaps as many as 13 of the 30 fatal accidents on scheduled air services might have been prevented if the pilot had had more accurate information concerning his position and height above the ground immediately prior to the crash.

9. Non-scheduled passenger aircraft of the transport type had a very much better accident record in 1963 than in 1962, the number of fatal accidents reported falling from 18 to 7. It still remains true, however, that the number of passenger fatalities on charter flights is proportionately much greater than on scheduled flights: preliminary records indicate that such fatalities (reported as 158 in 1963, about one third the number reported for 1962) amount to about one quarter of the passenger fatalities on the scheduled air services, which probably flew more than ten times as many passenger-kilometres.

Paragraphs 5 - 9 reproduced (with minor changes) from Doc. 8402. Annual Report of the Council to the Assembly for 1963.

PASSENGER FATALITY RATE AND TRAFFIC

SCHEDULED AIR SERVICES 1945 - 1963*



NOTES: Fatality rate equals number of passengers killed per 100 million passenger-kilometres flown.

* Preliminary

TABLE A-1

ACCIDENTS WITH PASSENGER FATALITIES ON SCHEDULED AIR SERVICES

1925 - 1963

YEARS	Accidents in which Passengers were killed		Passenger-Kilometres Flown (millions)	Fatality Rate per 100 million Pass-Kms.	Millions of Pass-Kms. per Fatality	Aircraft Hours Flown (millions)	Fatal Accidents per 100 000 Aircraft Hours
	Number of Accidents on Pass. Carrying Aircraft	Number of Passengers Killed					
YEARLY AVERAGE							
1925 - 1929	...	36	130	28	4	...	...
1930 - 1934	...	80	445	18	6	...	...
1935 - 1939	...	133	1 475	9	11	...	...
1940 - 1944	...	114	3 795	3	33	...	...
YEAR							
1945	...	247	8 000	3.09	32	2.5	...
1946	...	376	16 000	2.35	43	3.8	...
1947	...	590	19 000	3.11	32	4.2	...
1948	...	543	21 000	2.59	39	4.6	...
1949	...	556	24 000	2.32	43	4.8	...
1950	27	551	28 000	1.97	51	5.0	0.54
1951	20	443	35 000	1.27	79	5.6	0.36
1952	21	386	40 000	0.97	104	6.0	0.35
1953	28	356	46 000	0.77	129	6.4	0.44
1954	28	447	52 000	0.86	116	6.7	0.42
1955	26	407	61 000	0.67	150	7.3	0.36
1956	27a/	552	71 000	0.78	129	8.0	0.34
1957	31	507	81 000	0.63	160	8.7	0.36
1958	30	615	85 000	0.72	138	8.8	0.34
1959	28	611	97 000	0.63	159	8.9	0.31
1960	32a/	847	109 000	0.78	129	8.6	0.37
1961	25	805	117 000	0.69	145	7.9	0.32
1962	28	765	130 000	0.59	170	7.7	0.36
1963*	30	717	147 000	0.49	205	7.8	0.38

NOTES: * Preliminary figures.
a/ Includes mid-air collision counted as one accident.
Exclusions: The People's Republic of China, the USSR and other States which were not members of ICAO at 31 December 1963.

TABLE A-2

1960 - 1963

Type of Aircraft	Fatal Passenger Accidents				Passengers Killed				Passengers Surviving			
	1960	1961	1962	1963*	1960	1961	1962	1963*	1960	1961	1962	1963*
Turbo-Jet	3	6	7	5	113	257	424	347	16	105	79	88
Propeller-driven (turbine)	7a/	6	7	5	264	192	100	47	15	13	23	1
Propeller-driven (piston)	23a/	13	14	20b/	470	356	241	323b/	173	52	81	169
Total	33	25	28	30	847	805	765	717	204	170	183	258

NOTES: * Preliminary figures.
a/ Includes one mid-air collision between a turbo-jet and a propeller-driven (piston) aircraft (counted as two accidents in the total).
b/ Includes 1 helicopter with 3 passenger fatalities.
Exclusions: The people's Republic of China, the USSR and other States which were not members of ICAO at 31 December 1963.

1962

TABLE B

CONTRACTING STATES OF ICAO
PASSENGER FATALITIES OCCURRING ON
SCHEDULED INTERNATIONAL AND DOMESTIC OPERATIONS
YEAR 1962

Description	Country Total of Hours Flown	Number of Fatal Accidents	Number of Passengers Killed	Country Total of Passenger-Kilometres	Fatality Rate per 100 Million Pass-Kms.	Millions of Passenger-Kilometres per Fatality
	(thousands)			(millions)		
Total Scheduled Operations						
Brazil	293+	5	175	3 148+		
Canada	266	2	21	5 509		
Colombia	138	2	42	1 001		
Cuba	14+	1	18	122+		
Czechoslovakia	36	1	8	506		
Ethiopia	18	1	3	124		
France	222	1	103	6 129		
Italy	108	1	85	2 634		
Nepal	2*	1	6	8*		
Peru	38*≬	1	15	183*≬		
Poland	21	1	28	140		
Spain	88	1	14	1 236		
Turkey	19	1	8	122		
United Arab Republic	29	2	28	366		
United Kingdom	544a/	1	9	8 742a/		
United States	3 491	4	158	70 424		
Venezuela	75	1	20	432		
Viet-Nam (Rep. of)	13	1	24	77		
All Other States	2 290	-	-	28 887		
Total	7 705	28	765	129 790	0.59	170
International Scheduled Operations						
Brazil	23	3	114	798		
Canada	75	1	20	2 204		
France	17	1	103	174		
Italy	71	1	85	2 262		
Nepal	2*	1	6	5*		
Poland	10	1	28	91		
United Arab Republic	22	2	28	334		
All Other States	2 122	-	-	50 334		
Total	2 342	10	384	56 202	0.68	146
Domestic Scheduled Operations						
Brazil	270*	2	61	2 350		
Canada	191	1	1	3 304		
Colombia	128/	2	42	766/		
Cuba	11+	1	18	48+		
Czechoslovakia	21	1	8	223		
Ethiopia	4	1	3	11		
Peru	29*≬	1	15	92*≬		
Spain	60/	1	14	589/		
Turkey	15	1	8	103		
United Kingdom	151a/	1	9	1 313		
United States	3 037	4	158	54 025		
Venezuela	50	1	20	196		
Viet-Nam (Rep. of)	11	1	24	61		
All Other States	1 385	-		10 507		
Total	5 363	18	381	73 588	0.52	193

NOTES:

Accident data have been recorded under the country in which the airline is registered and not under the country where the accident took place.

Under "Total Scheduled Operations" are listed all countries with scheduled airlines which had aircraft accidents resulting in passenger fatalities. These data have been segregated as to those fatalities occurring on a scheduled international flight and/or a scheduled domestic flight.

Source of data: ICAO Air Transport Reporting Forms and outside sources.

/ Includes Territorial Operations.
+ Provisional data.
* Estimated data.
≬ Includes non-scheduled flights (revenue).
a/ Federation of Malaya and the United Kingdom: includes the apportionment of international and domestic traffic for Malayan Airways Limited registered in the State of Singapore.

CONTRACTING STATES OF ICAO
AIRCRAFT ACCIDENT SUMMARY FOR 1962
OF ALL OPERATORS ENGAGED IN PUBLIC AIR TRANSPORT

1962

TABLE C

Contracting States of ICAO at 31 December	Number of Accidents		Passenger Injury			Crew Injury			Others Injured		By Operators With an Accident		During Year by all Operators Engaged in Public Air Transport	
	Total	Fatal	Fatal	Serious	Minor or None	Fatal	Serious	Minor or None	Fatal	Serious	Number of Landings	Hours Flown	Hours Flown	Aircraft Landings
Afghanistan	-													
ø Argentina +	2	1	-	1	28	1	-	6	-	-			96 763	42 192
ø Australia	2	-	-	-	14	-	-	7	-	-			311 742	
Austria	-													
Belgium	-													
Bolivia	-													
Brasil a/	6	6	175	29	52	34	9	3	-	-				
Burma	-													
ø Cambodia	-	-	-	-	-	-	-	-	-	-				
Cameroun	-													
ø Canada	43	7	38	2	82	11	4	43	-	-	361 993	357 463	434 883	410 081
Central African Republic	-													
Ceylon	-													
Chad	-													
ø Chile	8	2	3	-	77	2	2	15	-	-	16 658	24 154	37 077	22 682
ø China	-	-	-	-	-	-	-	-	-	-			8 369	6 823
ø Colombia	4	3	42	1	6	7	1	2	-	-	79 909	88 865	150 098	148 546
Congo (Brazzaville)	-													
Congo (Leopoldville)	-													
Costa Rica	-													
Cuba	1	1	18	-	-	4	-	-	-	-				
ø Cyprus	-	-	-	-	-	-	-	-	-	-			1 969	1 725
Czechoslovakia	1	1	8	31	-	3	-	-	-	-				
Dahomey	-													
Denmark	-													
Dominican Republic	-													
Ecuador	-													
El Salvador	-													
Ethiopia	1	1	3	12	-	2	1	-	-	-				
ø Finland	-	-	-	-	-	-	-	-	-	-			48 779	44 578
ø France	10	3	225	-	-	22	5	-	-	-			57 573	23 957+
Gabon	-													
ø Germany (Fed. Rep. of)	4	3	5	-	8	3	1	2	-	-	10 000	5 942	278 660	195 849
Ghana a/	-	-	-	-	-	-	-	-	-	-				
ø Greece	-	-	-	-	-	-	-	-	-	-			28 786	20 162
Guatemala	-													
Guinea	-													
Haiti	-													
Honduras	-													
Iceland	-													
ø India	9	4	1	-	58b/	21c/	-	27	-	-	N.A.	119 930	169 283	N.A.
Indonesia	3	1	-	-	-	-	-	-	1	-	13 092	23 070	34 514	22 087
Iran	-													
Iraq	-													
ø Ireland	-	-	-	-	-	-	-	-	-	-			44 225	37 286
Israel	-													
ø Italy	1	1	85	-	-	9	-	-	-	-	34 750	71 330	109 830	73 142
ø Ivory Coast	-	-	-	-	-	-	-	-	-	-			31 335	
ø Japan	1	1d/	-	-	-	4	-	-	-	-	6 769	4 513	145 428	96 676
ø Jordan	-	-	-	-	-	-	-	-	-	-				
Korea	-													
Kuwait	-													
Laos	-													
Lebanon	-													
Liberia	-													
Libya	-													
Luxembourg	-													
Malagasy	-													
Malaya (Fed. of)	-													
Mali	-													
Mauritania	-													
Mexico a/	4	4	7	-	-	3	3	-	-	-				
Morocco	-													
Nepal a/	1	1	6	-	-	4	-	-	-	-				
ø Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	163 909	67 901
New Zealand	-													
Nicaragua	-													
Niger	-													
Nigeria	-													
Norway	-													
Pakistan	-													
Panama	-													
Paraguay	-													
Peru a/	1	1	15	-	-	3	-	-	-	-				
Philippines	-													
ø Poland	1	1	28	-	-	5	-	-	-	-	4 754	9 982	23 216	14 428
Portugal	-													
Saudi Arabia	-													
Senegal	-													
Sierra Leone	-													
ø South Africa	7	1	-	-	30	2	-	13	-	-	81 505	78 082	107 743	94 735
Spain	1	1	14	-	-	4	-	-	-	-				
Sudan	-													
ø Sweden	17	-	-	-	38	-	1	25	-	-	47 328	49 853		158 759f/
ø Switzerland	2	-	-	-	37	-	-	17	-	-	49 439	68 651	72 428	54 050
Syrian Arab Republic	-													
Tanganyika	-													
Thailand	-													
Tunisia	-													
ø Turkey	2	1	8	-	-	3	1	2	-	-	17 500	15 285	22 728	22 561
ø United Arab Republic	8	5	28	1	142	17	-	15	-	-			31 223	
ø United Kingdom	17	6	112	6	303	15	3	61	-	-	170 935	296 807	580 360	371 696
ø United States	74	11	281	26	1 638	49	7	269	3	-	2 305 649	2 407 793	N.A.	3 779 937g/
Upper Volta	-													
Uruguay	-													
Venezuela	1	1	20	-	-	3	-	-	-	-				
ø Viet-Nam (Rep. of)	1	1	24h/	-	-	3	-	-	-	-	8 315	10 726	15 736	11 710
ø Yugoslavia	1	-	-	-	25	-	-	4	-	-	13 631	22 121	23 127	14 060
Total for 98 States	234	69	1 146	109	2 538	234	38	511	4	-				
TYPE OF OPERATIONS														
Scheduled International	24	12	384	41	475	73	9	90	-	-	see Table D			
Scheduled Domestic	90	25	383	64	1 563	80	14	225	4	-				
Non-Scheduled International	16	8	343	-	375	40	5	47	-	-				
Non-Scheduled Domestic	74	15	29	4	108	26	4	62	-	-				
Non-Revenue	26	5	-	-	17	12	3	67	-	-				
Unclassified	4	4	7	-	-	3	3	-	-	-				
Total Operations	234	69	1 146	109	2 538	234	38	511	4	-				

NOTES: Source of data: Air Transport Reporting Form "G" filed by countries indicated with a ø. All other country data from outside sources.

N.A. Not available.

+ Provisional.

a/ Confirmation letter received.
b/ Including 2 infants.
c/ Including 10 ejection crew.
d/ During training.
e/ Statement received.
f/ Only the Swedish quota of Scandinavian Airlines System's operations is included.
g/ Certificated route air carrier only.
h/ Including 3 babies.

1962

TABLE D

CONTRACTING STATES OF ICAO
AIRCRAFT ACCIDENT SUMMARY FOR 1962
OF ALL OPERATORS ENGAGED IN PUBLIC AIR TRANSPORT
BY TYPE OF OPERATION

Type of Operation Contracting States of ICAO at 31 December	Number of Accidents		Passenger Injury			Crew Injury			Others Injured		By Operators With an Accident	
	Total	Fatal	Fatal	Serious	Minor or None	Fatal	Serious	Minor or None	Fatal	Serious	Number of Landings	Hours Flown
SCHEDULED INTERNATIONAL OPERATIONS												
Brazil	3	3	114	29	52	21	7	3	-	-		
ø Canada	2	1	20	1	8	7	-	4	-	-	4 257	19 284
ø Colombia	1	-	-	-	-	-	-	2	-	-	330	1 943
ø France	1	1	103	-	-	10	-	-	-	-	-	123 880
ø Italy	1	1	85	-	-	9	-	-	-	-	34 750	71 330
Nepal	1	1	6	-	-	4						
ø Poland	1	1	28	-	-	5	-	-	-	-	4 754	9 982
ø Switzerland	1	-	-	-	37	-	-	10	-	-	44 449	65 932
ø United Arab Rep.	3	3	28	-	-	16	-	-	-	-		
ø United Kingdom	2	1	-	-	68	1	-	14	-	-	70 676	184 292
ø United States	8	-	-	11	310	-	2	57	-	-	98 104	218 172
Total for 11 States	24	12	384	41	475	73	9	90	-	-		
SCHEDULED DOMESTIC OPERATIONS												
ø Argentina +	2	1	-	1	28	1	-	6	-	-		
ø Australia	1	-	-	-	6	-	-	5	-	-	59 636	84 658
Brazil	3	3	61	-	-	13	2	-	-	-		
ø Canada	5	1	1	-	14	1	2	3	-	-	110 918	129 778
ø Chile	3	-	-	-	74	-	2	12	-	-	16 016	23 310
ø Colombia	3	3	42	1	6	7	1	-	-	-	79 579	86 922
Cuba	1	1	18	-	-	4	-	-	-	-		
Czechoslovakia	1	1	8	31	-	3	-	-	-	-		
Ethiopia	1	1	3	12	-	2	1	-	-	-		
ø France	4	-	-	-	-	-	-	-	-	-	-	73 428
ø India	3	-	-	-	48	-	-	14	-	-	-	101 199
Indonesia	3	1	-	-	-	-	-	-	1	-	13 092	23 070
Peru	1	1	15	-	-	3	-	-	-	-		
ø South Africa	2	1	-	-	30	2	-	8	-	-	17 371	25 767
Spain	1	1	14	-	-	4	-	-	-	-		
ø Turkey	2	1	8	-	-	3	1	2	-	-	17 500	15 285
ø United Arab Republic	2	-	-	1	48	-	-	6	-	-		
ø United Kingdom	4	1	9	6	122	3	-	12	-	-	76 844	67 480
ø United States	45	6	160a/	12	1 162	28	5	153	3	-	2 174 282	1 997 941
Venezuela	1	1	20	-	-	3	-	-	-	-		
ø Viet-Nam (Rep. of)	1	1	24b/	-	-	3	-	-	-	-	8 315	10 727
ø Yugoslavia	1	-	-	-	25	-	-	4	-	-	13 631	22 121
Total 22 States	90	25	383	64	1 563	80	14	225	4	-		
NON-SCHEDULED INTERNATIONAL OPERATIONS												
ø France	1	1	122	-	-	8	2	-	-	-	-	540
ø India	2	2	-	-	-	5	-	2	-	-	-	3 791
ø Sweden	4	-	-	-	30	-	-	10	-	-	5 918	33 641
ø United Arab Republic	1	-	-	-	94	-	-	8	-	-		
ø United Kingdom	3	2	102	-	110	10	3	7	-	-	12 783	29 517
ø United States	5	3	119	-	141	17	-	20	-	-	9 536	46 577
Total 6 States	16	8	343	-	375	40	5	47	-	-		
NON-SCHEDULED DOMESTIC OPERATIONS												
ø Canada	36	5	17	1	60	3	2	36	-	-	246 818g/	208 401c/
ø Chile	5	2	3	-	3	2	-	3	-	-		
ø Germany	4	3	5	-	8	3c/	1	2	-	-	10 000	5 942
ø India	4	2	1	-	10d/	16e/	-	11	-	-	-	14 940
ø South Africa	5	-	-	-	-	-	-	5	-	-	64 134	52 315
ø Sweden	10	-	-	-	8	-	1	10	-	-	23 262	11 697
ø United Kingdom	3	2	1	-	1	1	-	2	-	-	8 818	9 995
ø United States	7	1	2	3	18	1	-	13	-	-		112 779
Total 8 States	74	15	29	4	108	26	4	82	-	-		
NON-REVENUE OPERATIONS												
ø Australia	1	-	-	-	8	-	-	2	-	-		-
ø France	4	1	-	-	-	4	3	-	-	-	-	16 977
ø Japan	1	1f/	-	-	-	4	-	-	-	-	6 769	4 513
ø Sweden	3	-	-	-	-	-	-	5	-	-	18 148	4 515
ø Switzerland	1	-	-	-	-	-	-	7	-	-	4 990	2 729
ø United Arab Republic	2	2	-	-	-	1	-	1	-	-		
ø United Kingdom	5	-	-	-	2	-	-	26	-	-	1 814	5 522
ø United States	9	1	-	-	7	3	-	26	-	-		
Total 8 States	26	5	-	-	17	12	3	67	-	-		
UNCLASSIFIED												
Mexico g/	4	4	7	-	-	3	3	-	-	-		
Total 1 State	4	4	7	-	-	3	3	-	-	-		

NOTES: Source of Data: Air Transport Reporting Form G filed by countries indicated with a ø. All other country data collected from outside sources.

+ Provisional data.

a/ Including 2 passengers on an all cargo carrier.
b/ Including 3 babies.
c/ Includes non-scheduled international operations.
d/ Including 2 infants.
e/ Including 10 ejection crew.
f/ During training.
g/ Statement received.

INTERNATIONAL CIVIL AVIATION ORGANIZATION

FORM G

AIR TRANSPORT REPORTING FORM

AIRCRAFT ACCIDENTS

Year ended: .... Country: ....

Name of Operator	Type of Operation	Number of Landings	Aircraft Hours	Number of Accidents		Number of Persons Aboard		Number of Persons Injured					
								Passengers Injured		Crew Members Injured		Others Injured	
				Total	Fatal	Passengers	Crew	Fatal	Serious	Fatal	Serious	Fatal	Serious
a	b	c	d	e	f	g	h	i	j	k	l	m	n
	Scheduled international Scheduled domestic Non-scheduled international Non-scheduled domestic Non-revenue												
	Scheduled international Scheduled domestic Non-scheduled international Non-scheduled domestic Non-revenue												
	Scheduled international Scheduled domestic Non-scheduled international Non-scheduled domestic Non-revenue												

Total hours flown and number of landings during the year by all operators engaged in public air transport:	Aircraft hours .... Landings	**Remarks:**

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The attention of ICAO should be drawn to any unavoidable deviation from the instructions.

FORM G

INSTRUCTIONS

Form to be filed by **each State** in respect of operators registered in the country to perform public air transport, which have had aircraft accidents (regardless of where the accident takes place or the nationality of the aircraft involved). The Form should also include accidents to aircraft on the country's register when, at the time of the accident, the aircraft was under control of a foreign public air transport operator (which should be identified).

This form is to be filed **ANNUALLY**, not later than **2 months** after the end of the year to which it refers.

DATA TO BE REPORTED

Data in columns *a* to *n* for an **individual operator** is to be reported only if its aircraft (whether owned or not owned) is involved in an accident (regardless of where the accident takes place).

Data should be reported in columns *c* and *d* relating to the total activities of the operator during the year, subdivided into the types of operation indicated.

Data should be reported in columns *e* to *n* opposite the type of operation in which the aircraft was engaged at the time of the accident.

NOTES:

A collision between two or more aircraft should be reported separately for each operator involved, and additional details should be provided under "Remarks".

Accidents resulting in only minor injuries or damages should not be reported.

Each State is to report the "hours flown" and "landings made" in the lower left hand corner of the Form, whether or not an accident has been reported.

EXPLANATION OF TERMS

Aircraft accident means an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which:

a) any person suffers death or serious injury as a result of being in or upon the aircraft or by direct contact with the aircraft or anything attached thereto, or

b) the aircraft receives substantial damage (Annex 13).

Scheduled and **non-scheduled operations** relate to operations for which remuneration is received. The terms apply to the stages of an operation, but not necessarily to the operator; thus, an airline whose operations are predominantly scheduled may, from time to time, operate non-scheduled flights.

Non-revenue relates to operations such as positioning flights, test flights, training flights, etc.

International and **domestic** are classifications according to the rules given below for the classification of flight stages, a "flight stage" being the operation of an aircraft from take-off to landing:

International:

A "flight stage" with one or both terminals in the territory of a State other than the one in which the airline is registered.

Domestic:

A "flight stage" with both terminals in the territory of the State in which the airline is registered.

COLUMNS

Number of landings (Column *c* and lower left):

If the number of landings cannot be ascertained without difficulty, an estimate may be given and a note inserted under "Remarks" indicating that the figure is an estimate.

Aircraft hours (Column *d* and lower left):

Report to nearest number of whole hours. Indicate under "Remarks" basis used — such as "block-to-block", "wheels off-wheels on", etc.

Passengers injured (Columns *i*, *j*):

Include the total number of passengers involved, both revenue and non-revenue.

Crew members injured (Columns *k*, *l*):

Include hostesses, stewards and supernumerary crew in addition to flight crew.

Others injured (Columns *m*, *n*):

Include all persons injured other than those aboard the aircraft.

PART III

THE INITIAL DESCENT PROBLEM

by

H.E. Smith, Flight Service Mgr.
British Overseas Airways Corporation

(Reprinted with the kind permission of the author)

That there is a general problem in avoiding high ground has been demonstrated somewhat catastrophically in recent years, but this paper deals with the descent phase of flight in a jet operation, where most of the incidents and accidents to scheduled international services have occurred.

My own examination of these incidents and accidents (in some cases somewhat cursory) has led to the conclusion that in stating the problem in terms of "the avoidance of high ground" there is the danger that we will miss the primary problem and indeed mislead the experts who might have little difficulty in providing us all with airborne radar designed for this particular purpose.

The problem is surely much wider than this for the descent of the jet, at least the significant portions of it, takes place in a terminal area, where the air traffic system imposes a direct influence and where in the interest of all aircraft an efficient descent is required to be conducted in all conditions, not merely "visual met. conditions." Cockpit workload in this particular phase of flight is already high enough.

As the beginning and end of the descent is fixed, the problem presented to the flight deck is that of maintaining a planned path, with horizontal, vertical and "time" components; through a medium (the air) which has, in precise terms, unpredictable velocity and in a vehicle the airspeed of which varies with air conditions and significantly with altitude.

Expressed in this form, it is not difficult to appreciate that a simple air traffic descent clearance in terms of altitude to a non-directional beacon ahead - in isolation sound enough - nevertheless may set the scene for a possible catastrophe on the way down. Is airmanship and a non-directional beacon enough?

Relatively minor errors in top of descent position and variations in actual wind component (W/C) and true airspeed (TAS) affect the planned path, particularly in the vertical plane, with a consequential loss of safety height and procedural time separation. The only way to overcome any lack of knowledge of these varying factors with limited navigation ability is by staying very high until "overhead" the beacon, a procedure which in the circumstances is quite rightly defined as good airmanship. Yet a very high final descent procedure still imposes a height time exposure to some of these variables at a time when navigation is still very largely by dead reckoning. A number of accidents and incidents have occurred at low altitude after overheading the beacon (N. D. B.) as high as 13 500 ft.

It would be generally accepted that a 2 000 ft safety buffer is adequate up to 15 000 ft, with a good altimeter and the local QNH, if level flight is being maintained. It is not so generally realized that this margin is inadequate in descent over the same terrain, except perhaps when conditions do permit a visual descent.

The problem is illustrated in Fig. 1 (B.707 Descent Path I), where height is plotted against distance out in nautical miles. The high ground shown does not portray an actual position but we could all recognize some near approximation; accidents and incidents have occurred, in one case at 11 000 ft and two around 6-7 000 ft. The majority of the scheduled jet cases have occurred below 3 000 ft.

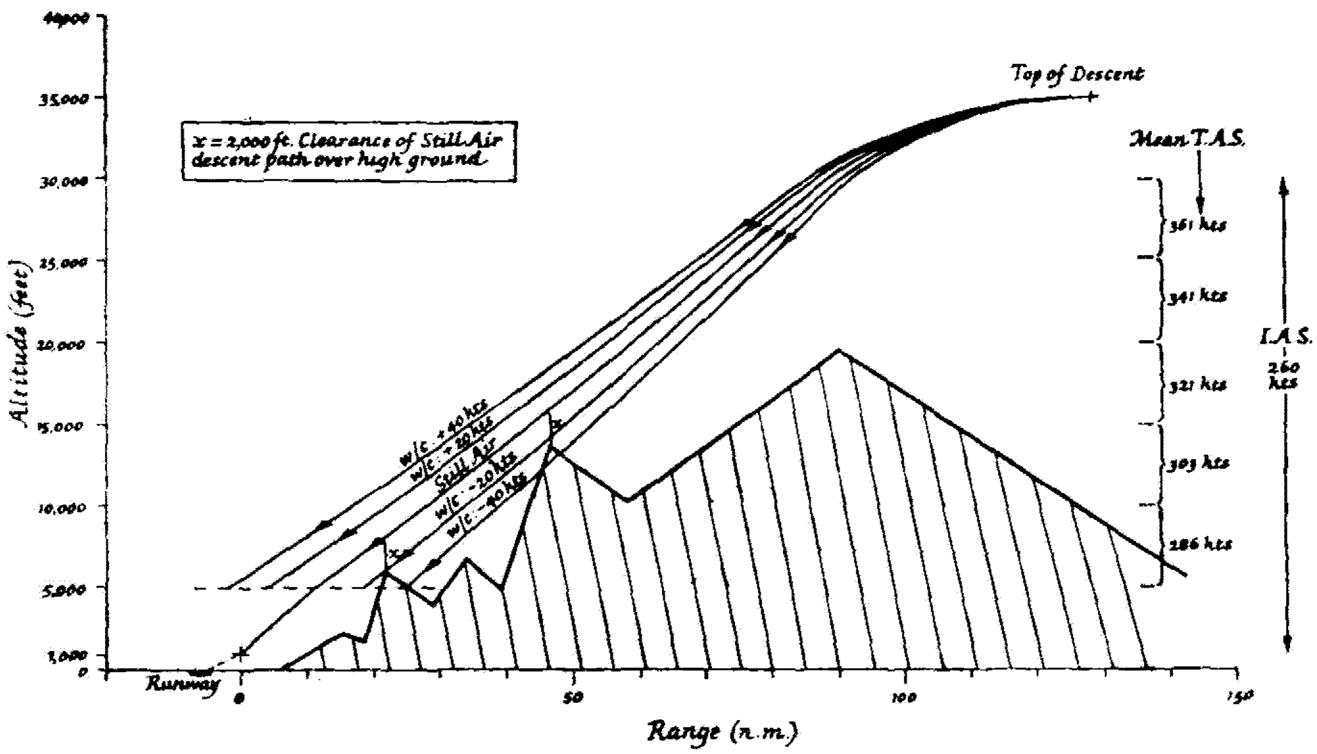

FIG. 1. B707 descent path. Height is plotted against distance out.

The "top of descent" position is correctly placed to provide 2 000 ft clearance of the primary peaks at approximately 6 000 ft and 14 000 ft using the "still air" path as the datum, the other paths being drawn for head and tail wind components of 20 and 40 kt respectively. An indicated airspeed of 260 kt is assumed - a normal procedure - and a mean true airspeed has been derived for each 5 000 ft interval. The rate of descent below 30 000 ft is approximately 1 800 ft per minute.

Any increase in headwind over the forecast on which the top of descent has been established steepens the descent path gradient and for this particular case a 20 kt headwind is sufficient to provide a "paper" catastrophe at the 6 000 ft peak. The scale of the chart is not ideal to indicate conclusively that the problem becomes more acute with loss of altitude but it will be readily appreciated that with a constant rate of descent and constant headwind component the reduction of T.A.S. with altitude again steepens the gradient on the way down.

For any surface profile such as this and flight path ending at the N. D. B., the primary controlling factor is the top of descent position. It can be seen that in this case it would only be necessary to delay the descent by one minute to overcome the 20 kt wind error against this particular profile.

Fig. 2 shows the danger of an early descent (or 5 mile error). The intended top of descent is shown and the broken line depicts the original flight path. The planned 2 000 ft clearance is almost lost as the displacement of the still air indicates; the safeguard is obvious. The avoidance of high ground will remain in the pilot's mind the essential problem until adequate navigation facilities are provided.

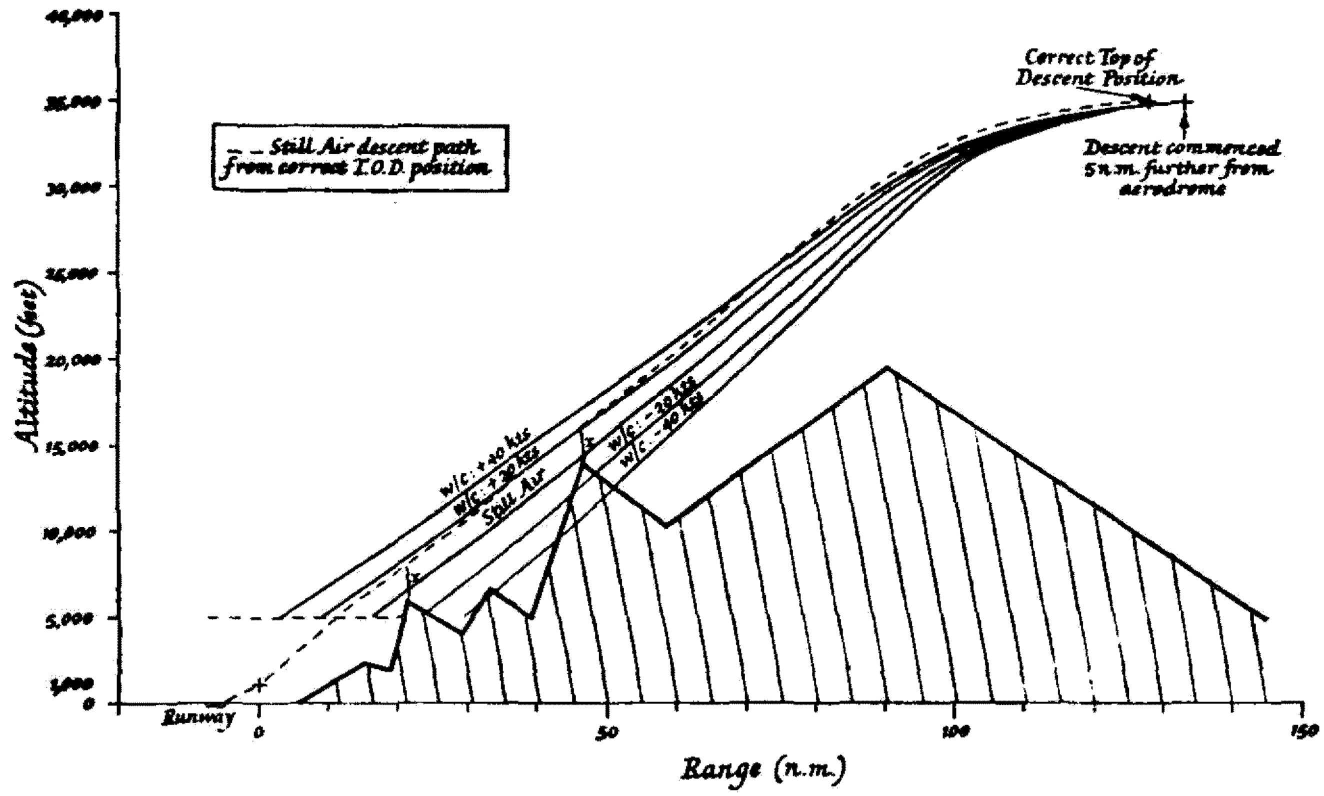

FIG. 2. The danger of an early descent (or 5-mile error).

It cannot be expected that the unsatisfactory position which exists in many areas overseas will be rectified overnight, but the urgent need to resolve the primary problem which includes the avoidance of high ground is a real one.

The navigational problem of meeting an air traffic clearance is difficult enough in the descent path when the only assistance is a non-directional beacon, but with high ground in the vicinity of the descent the total problem is critical. It must be a controlled descent from beginning to end in which horizontal position can always be established and forward speed and rate of descent integrated, not only to avoid high ground but to meet the traffic requirements to the advantage of all.

Pitot Static Icing

(These two reports dealing with pitot static icing on heavy turbo-jet transport aircraft were first published in Accident Prevention Bulletin 64-5 of Flight Safety Foundation Inc., New York. They subsequently appeared in Aviation Safety Digest No. 39 released by the Department of Civil Aviation, Australia. They emphasize the importance of cross-checking the flight instruments on jet aircraft and should be of particular interest to pilots who are now converting to jets.

Pilots' Safety Exchange Bulletin 64-104 (Flight Safety Foundation Inc., New York) contained another article, "Wrong Indication of Captain's and Co-pilot's Pressure Instruments", concerning pitot static icing, which was reprinted in ICAO Aircraft Accident Digest No. 13.)

Pitot Head Icing

After completing a night flight over a route on which considerable thunderstorm activity was encountered, the captain of a large jet gave the following report of his experience:

"During the climb I was completely engrossed in watching radar, heading, and airspeed. At about 28 500 ft we were between two large and very active storms that were some 25 miles apart, and we were in cloud or overhang associated with the storms. Engine heat was on and there was visible precipitation and static on the windshield. The cloud thinned, then the moon and stars became visible. I called for engine heat 'off'.

As expected, the ASI reading increased and I trimmed back on the autopilot. The speed continued to rise, and soon (perhaps 10 seconds) it indicated 365 kt, with VSI showing over 4 000 fpm climb, and a very high Mach reading. There was slight turbulence and my immediate thought was updraft associated with the storms. I pointed this out to the flight engineer and called for 89 per cent High Pressure Compressor R.P.M., and then asked for the co-pilot's airspeed reading. He reported 185 kt, falling.

On hearing this, I disengaged the autopilot, put the aircraft in level attitude and called for 95 per cent H.P. Compressor R.P.M. Then we began a cockpit check! At this point I did not know what was wrong and what instruments to believe, but I did have confidence in the horizon. There was a lot of negative 'g' during the nose drop to level flight, but I must point out I was not conscious of a particularly nose high attitude. In a few seconds the flight engineer found that the pitot head heat switches were in the 'off' position. They were put 'on' and in no time the panel returned to normal and my ASI was reading 220 kt or thereabouts. The height loss was 1 500 ft.

Later, when everything was back to normal, I began to wonder if this might have happened to those aircraft involved in loss of control incidents. The following would seem to me to be pertinent:

1. In my own particular incident, assuming the co-pilot's ASI to be correct (not necessarily true), it would only have taken a moderate amount of turbulence or a turn to bring on a low speed stall.

2. How do you recover from a stall at night and in cloud without ASI?

3. What are the likely manoeuvres to be expected in such a recovery?"

Static Port Icing

The airline jet had been cruising at 37 000 ft for several hours, with an outside air temperature of minus 50°C. Descent was started towards an airport where ground temperature was +30°C. Everything was normal at first, but at about 18 000 ft the aircraft entered moderate rain which continued down to 6 000 ft. At about 10 000 ft both the captain's and co-pilot's altimeters and rate of climb indicators began to fluctuate, and at first the crew thought it was caused by the rain. However, the fluctuations continued even after the aircraft had emerged into the clear again, and the crew contacted their company by radio to request that the fuselage be checked for ice, especially around the static ports, as soon as the aircraft arrived. It was found that even though the aircraft had been flown in temperatures of +20°C. for five or six minutes and the ground temperature was +30°C., the aircraft still had ice on the fuselage, though the static ports had cleared.

In relating this experience, the capain wrote:

"What we had was a very cold-soaked aircraft descending through rain which immediately froze on contact with the skin of the aircraft. We have had this to contend with in runback on the wing in the past, and it remains a problem when using wing heat."

"Since this experience," the captain added, "I've advocated heating the area around the static ports to prevent such a situation occurring. With the jet, the icing problem has been cut to a minimum in the areas of flight where in the past we had our greatest exposure. But the incident just mentioned is one that has come about with the jet. In fact, in over four years of jet experience, it was the only time I have seen icing become a problem and it was where you'd least expect it ... in the tropics!"

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JAMMING OF CONTROL SURFACES

While taxiing from the apron to the runway prior to take-off, the pilot of a turbo-prop aircraft noticed that, when the inboard propellers were used in reverse thrust to assist braking, numerous small stones were being "picked up" from the surface of the taxitrack. A final check for freedom of the control surfaces was made before take-off and it was then found that the aileron control jammed in the full left bank position.

On returning to the apron, it was seen that numerous small stones had lodged between the aileron trim tabs and the ailerons. It seems that these were in the grit that had been spread on the taxiway the previous night in order to improve braking action following a heavy frost.

In view of this incident, pilots are advised to be cautious in using propellers in reverse thrust when taxying at aerodromes where grit has been used on runways, taxiways or aprons, and always to recheck the freedom of controls immediately before take-off.

Horizontal Stabilizer Icing*

(from Flight Safety Focus issued by The Flight Safety Committee, United Kingdom)

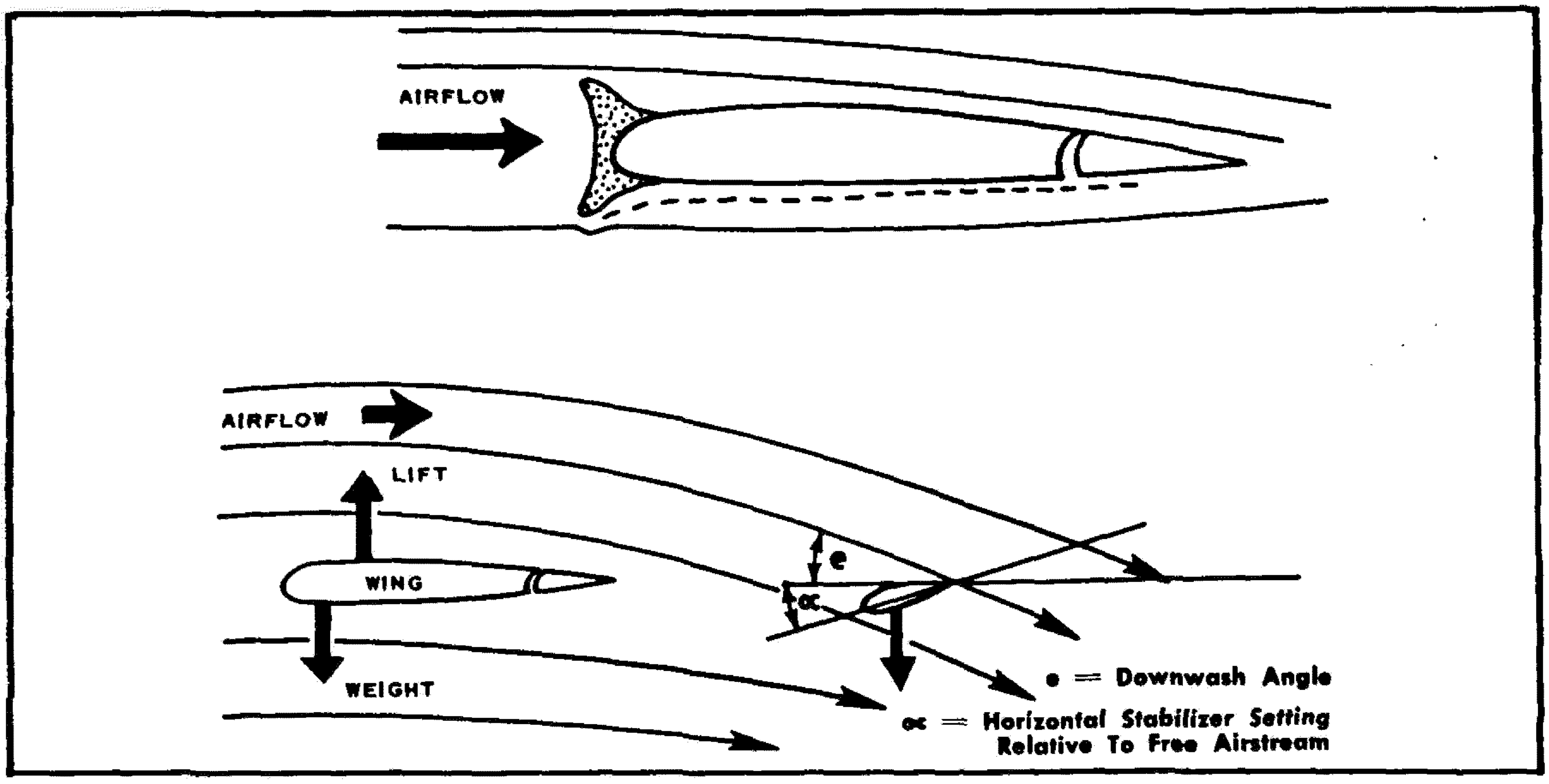
After some incidents which occurred in icing conditions, experimental investigations have been made in the United Kingdom, the U.S.A. and the U.S.S.R., into the effect of ice formations on the horizontal stabilizer leading edge. It is known that in extreme cases such formations can lead to difficulties in control.

The serious cases occur with a sharp "horn" shaped ice formation (see diagram) - the shape is more important than the amount - which causes separation of the flow on the underside of the horizontal stabilizer; this alters the pressure distribution and therefore the aerodynamic forces acting on the elevator.

Whether such separations will occur or not will be determined by many factors, such as speed, local angle of attack of the airflow at the horizontal stabilizer and the precise nature of the ice formation, which cannot of course be predicted.

The angle of attack at the horizontal stabilizer is the sum of

- the setting of the horizontal stabilizer relative to the free air stream, and
- the deflection of the free air stream due to the lift generated by the wing: this is termed the downwash.



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* Horizontal stabilizer icing caused the accident to Continental Air Lines, Viscount 812, N 242V at Kansas City Airport, Missouri, U.S.A. on 29 January 1963. A summary of this accident will appear in Accident Digest No. 15.

The diagram shows that the horizontal stabilizer setting relative to free air stream is normally negative (nose down) and this angle increases with increasing nose down aircraft incidence, i.e., with increasing forward speed or with lighter weight. The downwash angle depends on the lift distribution along the wing and, in particular, will increase as flaps are progressively lowered.

Flap lowering also causes a rearward movement of the point through which the lift may be said to act on the wing, so that a higher downward load is required on the horizontal stabilizer to prevent the nose from dropping and this is provided to a greater or lesser extent by the increase of downwash.

Flow separation on the lower surface as a result of leading edge ice will do two things:

- it may cause the elevator to be pulled down;

- it will cause more up elevator movement to be needed to compensate for the decay in horizontal stabilizer lift.

These two effects combine to produce a pull force which may reach a very high value in a badly iced up condition, and in an extreme case - say, after increasing the flap angle - it may be impossible to recover control without loss of height and considerable effort.

An investigation has been made concerning a reported airline incident where, on lowering the flaps to the final approach setting, an aircraft developed a nose down attitude which required considerable manual effort to overcome. After some subsequent difficulty in maintaining the desired approach attitude, the pilot was able to continue the approach and accomplish a safe landing. It is worth noting that the final approach flap selection had been made at the maximum permitted airspeed for that setting.

External inspection of the aircraft - immediately after landing - revealed the described horn-type ice formation along the tail surface leading edge, the fin and the outboard sections of the main-planes.

The amount of ice understandably surprised the pilots - for the following reasons:

- the sector concerned was of only 18 minutes duration;

- the cloud layer at departure and destination airfield was relatively thin (3 000 ft or so) and well defined, affording good contact conditions below its base and clear air conditions 'on top' during the cruise phase of the flight;

- the pilots had inspected the wing leading edges at the top-of-climb and established an ice-free condition.

Although power plant anti-icing had been in use throughout the flight and windshield heaters also in continuous use (and switched to 'High' during descent) the L/Edge anti-icing system was not used for the very simple reason that it was considered unnecessary.

Conclusion

Ice can form extremely quickly and, in the case of the horizontal stabilizer, it could reach hazardous proportions in the approach phase without any prior evidence of its presence in the clean configuration.

Where the use of aircraft anti-icing systems is concerned there is ample world-wide evidence of the fact that pilots tend to rely on personal judgement. It must now be emphasized that the pilot cannot always be aware of the presence of ice on his aircraft - especially the horizontal stabilizer - not to mention the fact that the shape of any accrued ice will be only one of an infinite variety.

The moral, therefore, is simply this:

In the interests of flight safety, pilots should make the fullest use of all available anti-icing systems whenever ice is present or likely to be encountered even for a short time. Modern anti-icing systems are extremely effective and, when properly used, will prevent the ice formation described in this note.

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JET APPROACH PROCEDURES

The following information and data were prepared by Captain Paul Soderlind, Director Flight Operations - Technical, Nortwest Airlines.

Flight Standards Bulletin No. 14-65 (NWA), 8 December 1965

General

This bulletin talks about:

- The reasons for changing to 30° landing flap on the 727.
- The runway aiming point.
- The NWA jet procedures speeds system and jet speed stability characteristics.
- Approach drag characteristics of the 727, 720B, and 320B/C.
- High sink rate approaches.

While much that follows relates directly to the 727, it is also pertinent to operation of the other jet types. It will also be educational for propeller pilot types and is being issued to all. We ask that you read it carefully, for the message it carries is important to a better understanding of the airplane.

Final Approach And Landing Flap - 727

All normal final approach and landing operations will henceforth be made with 30° flap on the 727. Certain of the reasons are related to approach and landing drag characteristics.

The main reasons for the change are these:

1. Engine failure, or loss of "A" or "B" system, requires use of 30° landing flap. Thus use of 30° flap for all normal landings simplifies procedures.
2. Noise under the approach path will be reduced about 1.5 PNdb. This is larger than it looks, reducing from 103 to 100 PNdb, for example, cuts the noise in half.
3. Exposure to flap damage from runway clutter, or because of unusual roll or pitch attitudes at touchdown will be reduced.
4. Smoke tests show that ingestion of foreign material during reversing is significantly reduced at flap settings less than 40°.
5. Present data indicate that the "C" version of the 727 will require the use of 30° flap for landing at forward C.G.'s, thus use of 30° for all normal 727 landing operations provides standardization.

6. Final approach with 30° flap will be flown at the marked bug, and thus will be standard with other NWA jet types.

7. Thrust required for descent on the average glide slope will be almost the same as required in the MANEUVER configuration in level flight. Little or no thrust adjustment will thus be necessary when transitioning to landing configuration and starting down the glide slope.

8. A 30° flap final approach requires about 5000# less thrust than with 40, and thus leaves a larger margin of excess thrust available. This will be especially important for operations at the higher airports and/or when temperatures are high.

The following are also pertinent:

9. 30° flap stall speeds are about 2K higher than with 40, and THRESHOLD speeds about 3K higher in consequence. The additional 3K increases the landing distance, but less than it might seem. With all brakes and the anti-skid system operating normally, the stopping distance increases only 160'.

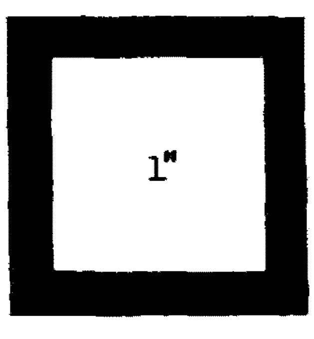
10. Approach body attitude will be approximately 2° more nose up than with 40° flap. At maximum landing weight, with speed at the marked bug, the normal body attitude on a 3° glide slope will be 1.9° nose up as compared to .4° nose down in the 40° flap case. With this change in approach attitude, the landing perspective will be different and it will be more important than ever to aim for the 1000' point.

11. The change in landing attitude will affect the area illuminated by the landing lights. 30° flap night landing tests conducted before the decision to change was made indicated this would pose no problem. However, if lights are not properly adjusted "in the shop" the difference may be noticeable. In any event, the fleet is being campaigned to insure proper light adjustment, and the basic adjustment will be revised if this proves desirable.

12. 30° flap is to be used as the standard setting for all normal landing operations. You do not have the prerogative of using 40° just because you might "like" it better.

Runway Aiming Point, All Airplanes

If you were in a 320 descending on a 2.6° glide slope, and aimed for the 500' touchdown point instead of the 1000' point, the main gear would clear the end of the runway by:



The numbers for other types will be different but the basic problem the same.

AIM FOR THE 1000' POINT !

Jet Procedure Speeds

Our initial studies in preparation for jet operations indicated that the "standard" jet procedures speeds systems had certain undesirable features. As a result, we developed a system that provides many advantages, with simplification being perhaps the most important one. The speeds were chosen in a manner that differed from existing methods, and then integrated with use of the IMI in a particular fashion. The resulting system gives clear and distinct advantages, and it is unique to Northwest. But regardless of how a particular procedure speeds system is chosen, the jet's characteristics demand that the airplane be flown "on speed".

If you always fly the jet reasonably close to established speeds, its responses can lead you more and more deeply into the impression that it is "just another airplane". But it very definitely is not, and the ways in which it differs are very important indeed. At the speeds used in the maneuvering and approach regimes, the speed stability of the jet airplane is very different from that of the propeller airplane. The specific ways in which it differs--and the practical meaning it has to the pilot--will be covered in a future Flight Standards Bulletin devoted solely to that subject. Meanwhile, it suffices to say that if you "get behind" the jet airplane insofar as flying the proper procedure speeds is concerned, it will react in a manner different from that of the propeller airplane, and substantially different from what 10 to 20 thousand hours in propeller airplanes, have led you to expect. You can avoid difficulties stemming from the jet's differing speed stability characteristics if you always fly the established procedure speeds, and stay mentally "on the edge of your seat" throughout these flight regimes. A coming Flight Standards Bulletin will discuss specifically why this is so.

Figure 1 is a "drag map" of the 727 during an approach and landing at maximum gross weight. It shows the relative thrust requirements for the configurations shown, and for two flight paths, one level, one descending. Each letter represents the thrust requirement for its stated configuration. The height of each letter represents the amount of thrust required, as read against the vertical scale on the left. The horizontal position of each letter represents the speed as read against the scale on the bottom of the plot.

1. At Point A, the airplane is in the ZERO FLAP MANEUVER configuration, and the drag is about 8000# . Since for level flight, thrust must equal drag, the thrust required at Point A is also 8000# . In other words, the drag determines the amount of thrust required to maintain steady, level flight.

   Although not directly related to the subject at hand, speed has a significant effect on drag, and the drag will increase with either an increase or decrease in speed from Point A. ZERO FLAP MANEUVER is the speed for minimum drag, thus the speed at which minimum thrust is required.

2. At B, the airplane is in the MANEUVER configuration, the only change from Point A being that the flaps have been extended to 15° and the speed reduced to MANEUVER . Extending flaps 15° increases the lift, and as a direct consequence, the drag is increased--by some 5000# in this case. 5000# more thrust must now be added to maintain level flight.

At Point B, the "drag map" branches off to show two different final approach configurations, one with 30, the other with 40° flap. The 30° flap case will be discussed first.

3. At C the gear is down, the flaps are at 30°, and the airplane is descending on a 3° glide slope. While extending the gear and the flaps to 30° increases the drag about 7500# , the airplane is now going downhill and is worth about 7200# of "thrust". The drag increase due to extension of the gear and 30° flap is almost balanced by the "thrust" provided by going downhill 3°. At lighter weights (e.g., 110,000#) the thrust required will be the same on the 3° glide slope as it was in the level, MANEUVER configuration and little or no thrust adjustment will be necessary. A happy fringe benefit of the 30° flap final approach.

4. Point D represents the drag, thus thrust required, <u>in level flight</u>. And here some further explanation is needed. To convert the 3° descending flight path to level flight would require the addition of about 6400# of thrust if it were done with thrust alone. This does not imply that a thrust application is necessary to flare the airplane because in normal circumstances (proper speed and sink rate), the thrust is actually reduced following the flare. With the airplane descending on a 3° glide slope at proper APPROACH speed, there is an increment of about 20K between final approach and touchdown speeds. This increment represents

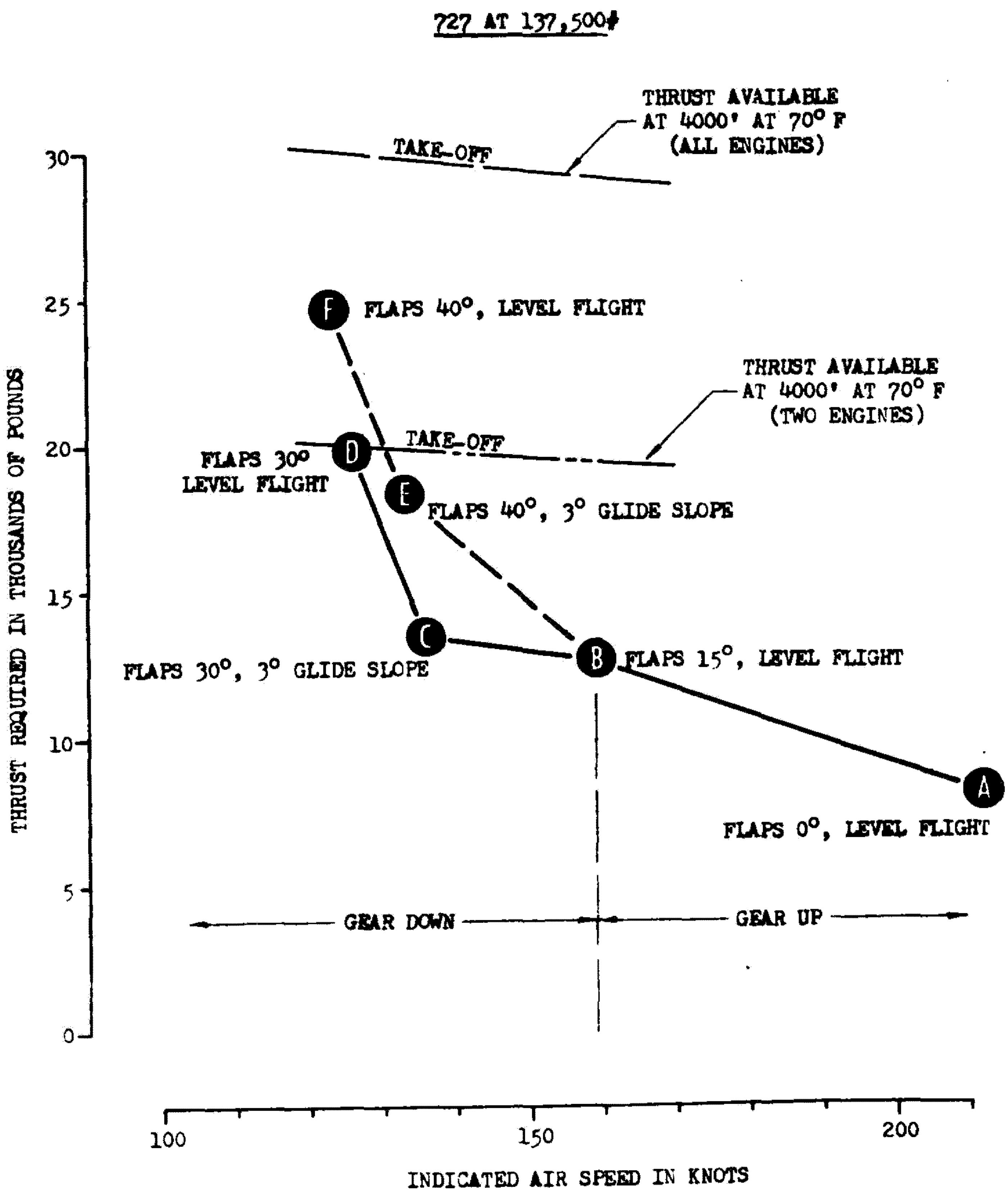


FIGURE 1

a store of kinetic energy, and this is used to convert the descending flight path to a near level flight path for a gentle touchdown. In other words, the "thrust" necessary to convert the descent to level flight comes from the energy stored in the speed increment between approach and touchdown speed. The descent could be stopped either by an application of thrust or by flaring, but the latter is of course the normal method.

With some combination of high sink rate and final approach speed, the energy contained in the normal approach-to-touchdown speed increment will not be enough to stop the descent. If the final approach were made at THRESHOLD speed for example, this "maximum-able-to-stop" sink rate would be less than if some higher speed were used. This is why the approach speed must be higher whenever the sink rate is excessive. But even though this is true, it is a case of one evil (excessive speed) being used to fight another (excessive sink rate). The excessive speed is an evil because it can result in a low engine RPM, and the excessive sink rate an evil for obvious reasons.

Although a thrust application is not necessary under normal sink rate/approach speed combinations, Point D is used to show the level flight thrust required simply to give you a feel for the amount of excess thrust remaining--to stop a high sink rate, for example. In other words, if a downdraft "used up" the energy stored in the speed increment between approach and touchdown speeds, all that would be left to stop the descent would be an application of thrust, and the amount you have left over the level flight requirement is the increment between Point D and the all-engines "TAKE-OFF" line shown above it. Some 10,000# in this case.

5. When you transition from MANEUVER (Point B) to the 40° final approach configuration (Point E), the thrust required goes up sharply despite the fact that the descent contributes some 7200# of "thrust". At Point E some 5000# more thrust is required than at Point C, and all because of the addition of 10° more flap. Another way of putting it is that the additional 10° of flap will require about half an engine's worth more thrust at the altitude/temperature combination of Figure 1. There are cases where you might not have half an engine to spare.

6. The level flight thrust required in the 40° flap landing configuration is shown by Point F--about 25,000# . It is interesting to note that this is three times the thrust required for level flight in the clean configuration. Note also that at TAKE-OFF thrust, only about half an engine's worth of excess thrust remains available, and this with all engines running.

7. The two-engine TAKE-OFF thrust available line is also of interest. Note that at 4000' and 70°F, there is just enough to maintain level flight in the 30° flap landing configuration, and substantially less than enough for the 40° flap case. This is, of course, why you would not use 40° flap for the engine-out case.

Perhaps the most important thing to be learned from Figure 1 is that the excess thrust available is only one-fifth of the total thrust required for level flight in the 40° flap landing configuration. Or only one-third of the thrust required on a 3° glide slope. In some cases these might not be very comfortable margins. The additional thrust excess available at 30° is particularly significant in stopping excessive sink rates.

Look now at engine acceleration characteristics for they are an important part of the whole picture.

Figure 2 shows the percent of TAKE-OFF thrust vs. the time required to get it. These are the pertinent points:

1. The lower curved line shows the time necessary to accelerate the engine from IDLE thrust. If you were making an approach with thrust at IDLE, and suddenly found you needed a lot of thrust--to stop a high sink rate for example--it could take 8 - 9 seconds to get TAKE-OFF thrust. Now while you might not need TAKE-OFF thrust to save the day, note that it takes almost 4 - 5 seconds before any appreciable thrust increase develops.

NOTE: The acceleration lines of Figure 2 were taken from test cell data and slightly less time will be required for acceleration during flight. During recent flight tests, approximately 7 seconds were required for acceleration from IDLE to TAKE-OFF. Since the test cell data indicates that

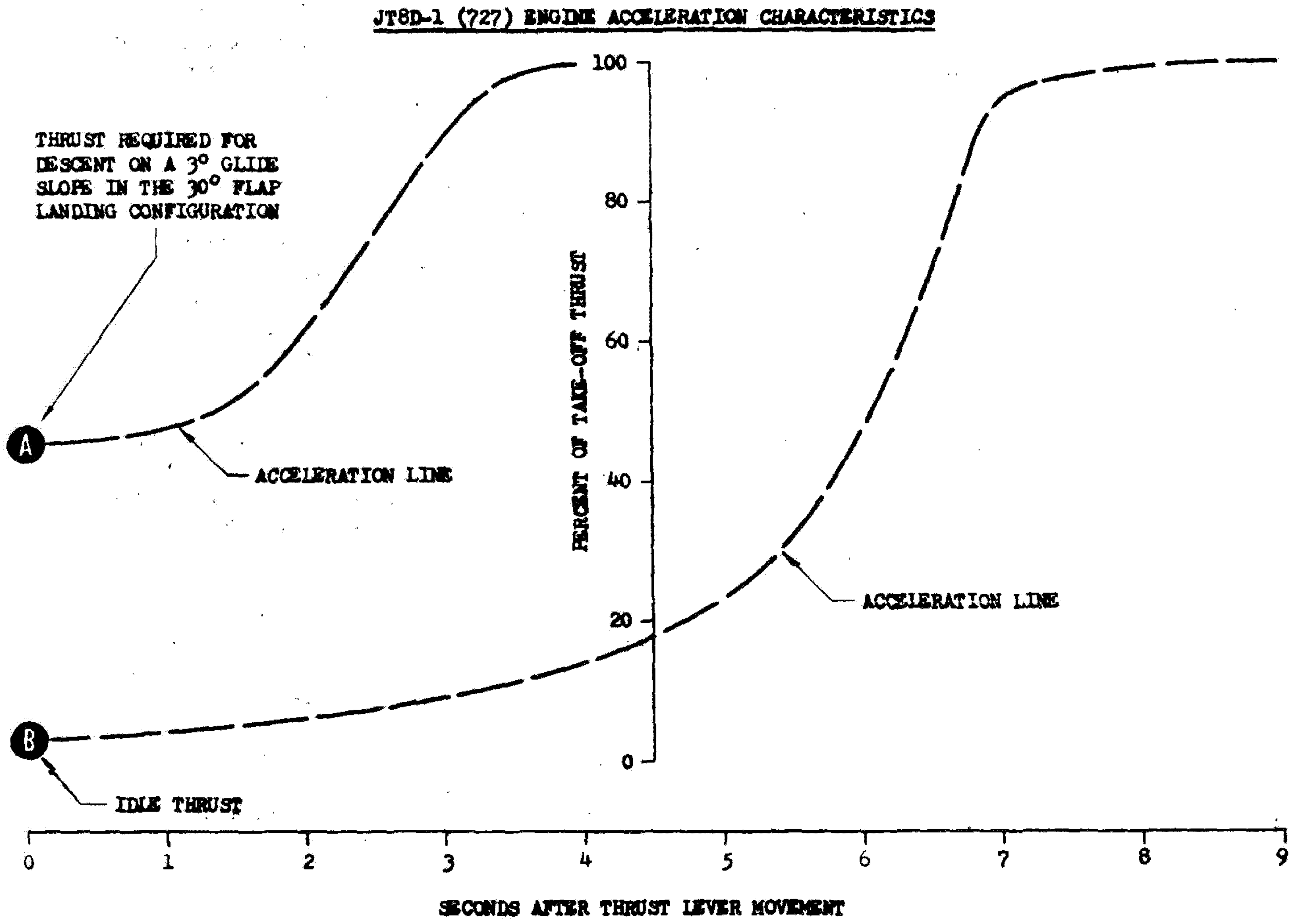


FIGURE 2

about 95% of TAKE-OFF thrust is available after 7 seconds, the agreement between this and the flight tests mentioned is good. In any event, the fact that acceleration times in flight may be slightly less than shown in Figure 2 should not be allowed to obscure the practical point - - if the approach is high enough and/or fast enough that the thrust levers are at or near IDLE, an appreciable amount of time will be required to get TAKE-OFF thrust.

2. If you were stabilized on the glide slope in the 30° flap configuration, the thrust required would be that shown at Point A, about 45%. Note that it takes less than half as much time to get TAKE-OFF thrust as compared to the former case, and that an appreciable thrust increase comes in the first 2 seconds. Indeed, the thrust you have at the beginning (Point A) you wouldn't get for nearly 6 seconds if you had started from the thrust-at-IDLE case.

3. If you are making one of these higher-than-glide-slope, continually-decelerating approaches, the thrust applied will be below Point A, the amount depending on how much too high and too fast you are. In such a case the acceleration time required will be greater than that shown by the upper curved line. Sooner or later, with this type of approach, trouble will follow.

4. While the acceleration lines of Figure 2 are for the JT8D (727) engine, those for the JT3D (720/320) have almost identical shapes but slightly longer acceleration periods. Further, the 720/320 on approach will often be operating at a lower percentage of TAKE-OFF thrust (an exception is the 320C at maximum landing weight), and this with the inherently longer acceleration times of the JT3D can combine to make for greater problems when you need more thrust, and need it in a hurry.

5. The engine acceleration picture is especially significant for the high-sink-rate approach. Besides the obvious reasons, the high angle approach makes difficult the judgment as to when recovery thrust must be applied. If the sink rate is very high, by the time you realize you need recovery thrust, it may well be too late to get it.

720B And 320B/C Approach Thrust Requirements

Figures 3 and 4 are "drag maps" for the 720B and 320B/C airplanes. All are based on maximum landing weight, and on a pressure altitude of 4000' at 70°F. Two patterns are shown on Figure 4 to cover both the "B" and "C" versions of the 320 since the maximum landing weight differ. The configuration at each of the lettered points (A, B, etc.) is the same for both airplanes, with only the speeds and drag level being different because of the differing weights.

720B AT 175,000#

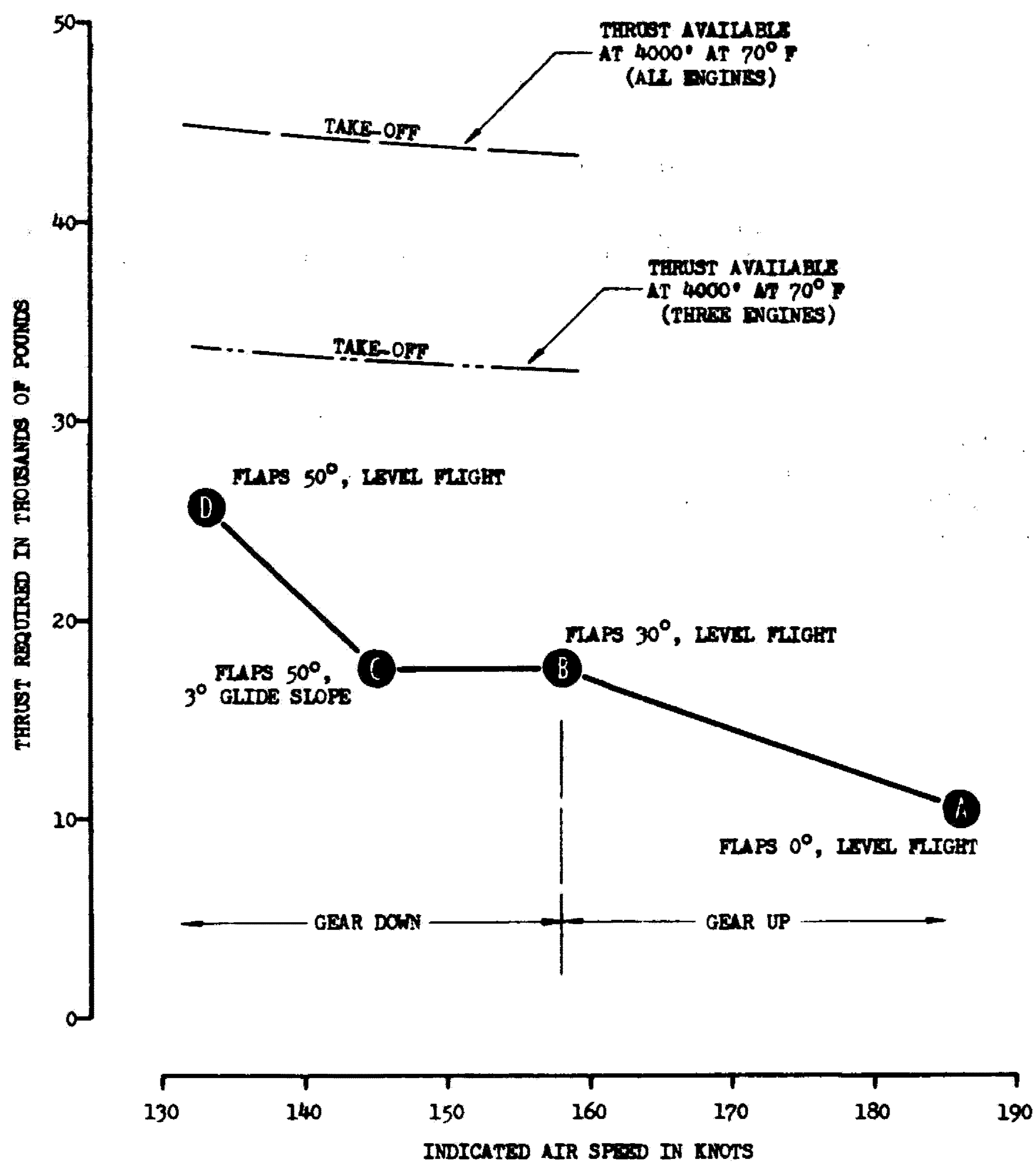


FIGURE 3

320B/C AT MAXIMUM LANDING WEIGHT

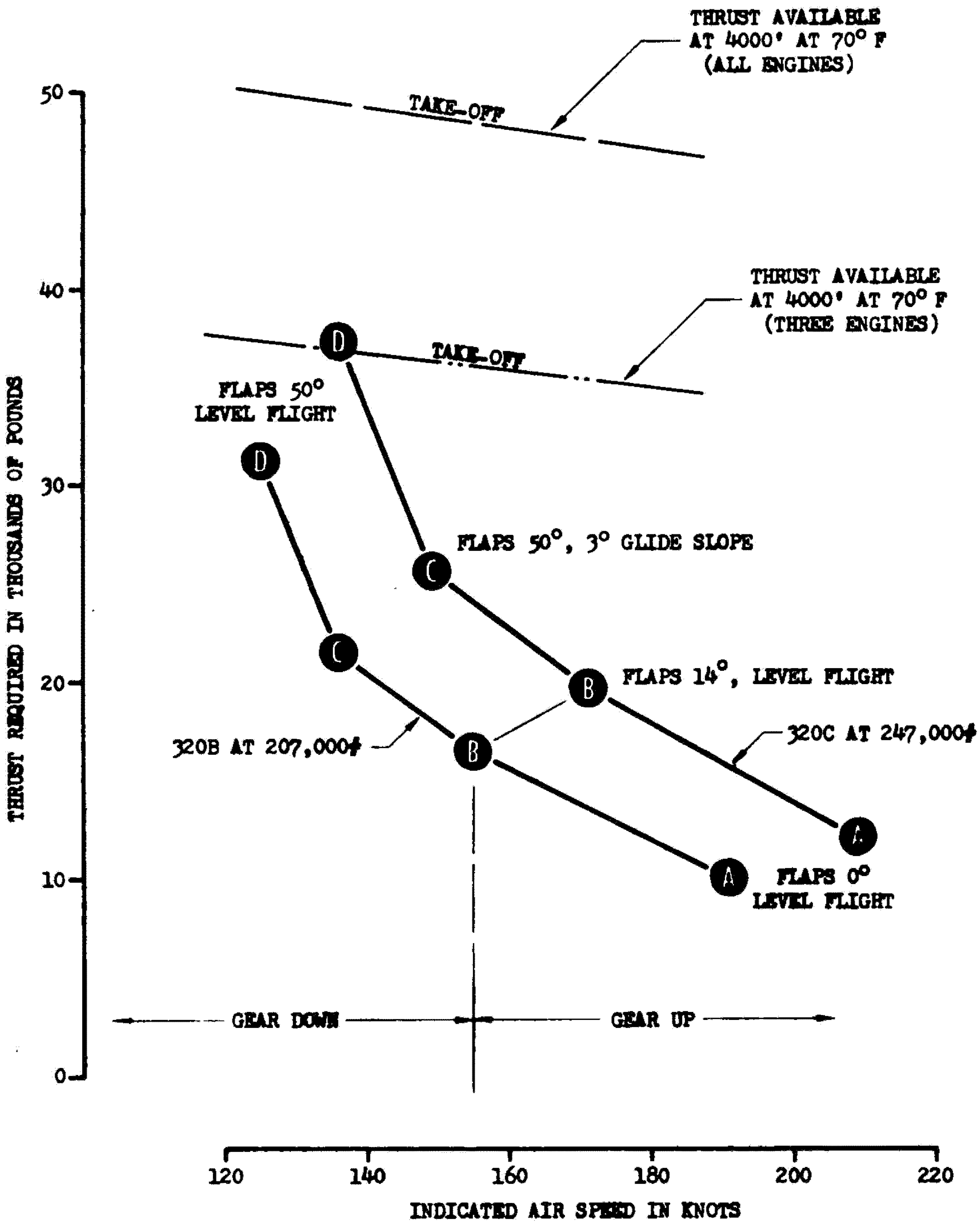


FIGURE 4

On all the "drag maps", each lettered position represents standard NWA configurations as follows:

Letter		Configuration
"A"	-	ZERO FLAP MANEUVER configuration and speed in level flight.
"B"	-	MANEUVER configuration and speed in level flight.

"C" - APPROACH configuration and speed (marked bug), descending on a 3° glide slope.

"D" - THRESHOLD configuration and speed, maintaining level flight.

In all cases, the gear is UP at positions "A" and "B", and DOWN for subsequent positions.

Excess Thrust Available

Figure 5 is a bar graph that shows the total thrust available vs. the amount required for a stabilized approach on a 3° glide slope in the landing configuration.

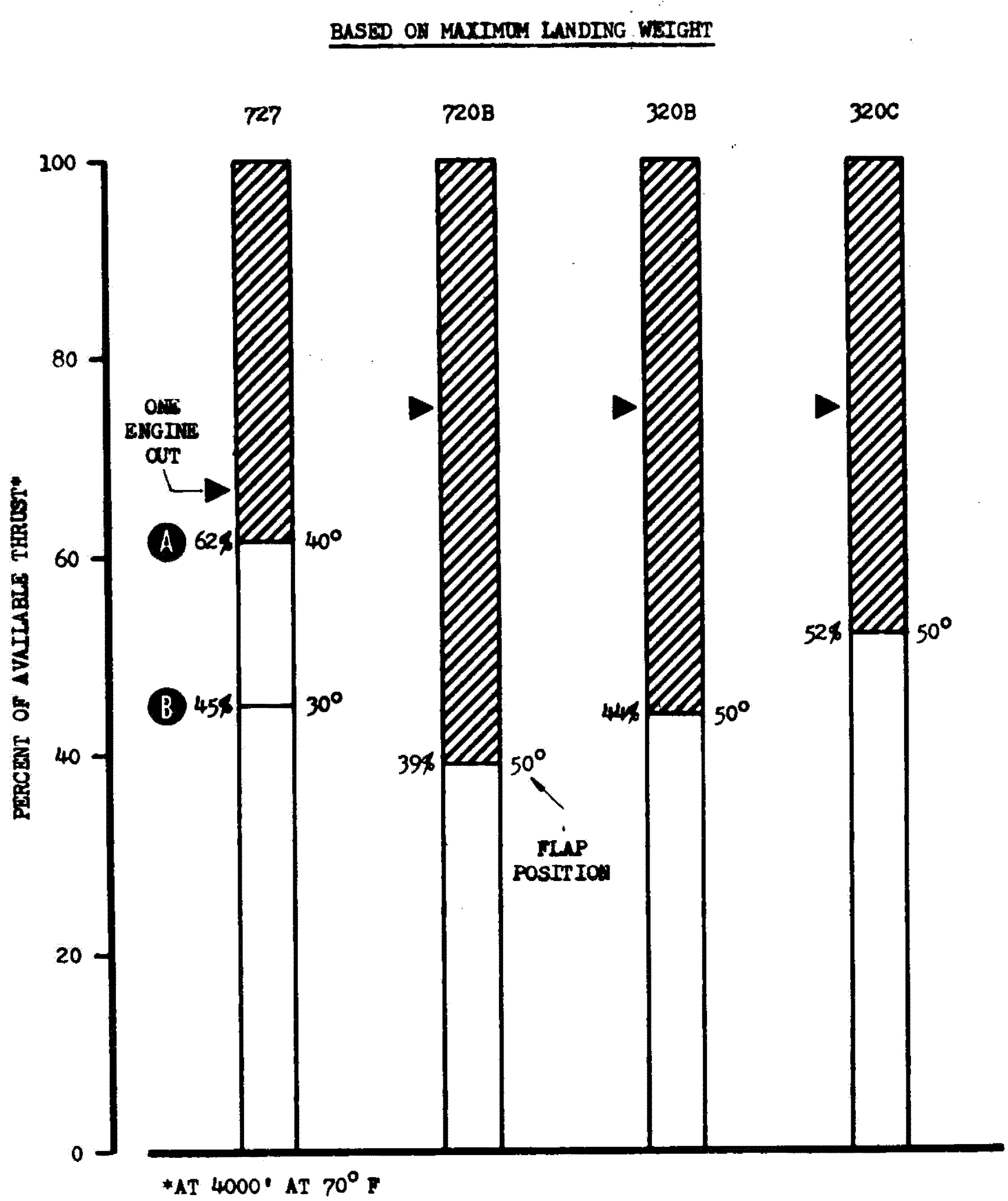


FIGURE 5

The top of each bar represents the total available thrust at TAKE-OFF EPR, all engines running. The figures on the left side of each bar show the approximate amount of thrust required to descend on a 3° glide slope at the proper speed, and in the landing configuration. The shaded upper portion of each bar shows the excess thrust available for whatever reason it may be needed.

In the 727 bar, note the difference between the amount of excess thrust available at the 40° flap position (Point A) as compared to the 30 (Point B). The black triangles show the total thrust available if one engine was inoperative.

The shorter the lower unshaded area of the bar is, the less thrust required on final approach, and the slower the engines will be to accelerate. Since the 720B is seldom at maximum landing weight during an approach, it will most often require less thrust than that shown, and engine acceleration time will be higher in consequence. While the same general condition would exist with other airplanes, they are not so often operated at the low weights. It may then be concluded that the low thrust acceleration problem is likely to be more severe on the 720B than on other types.

One of the most significant ways in which the jet transport has been improved is in the development and use of more sophisticated high lift devices. The contribution to operating safety has been great, for these devices permit lower operating speeds in the take-off and approach regimes. But you "never get something for nothing", and this is as true with sophisticated high lift devices as with anything else. High lift carries with it an inseparable partner, high drag, and the more effective the lift-increasing devices are, the higher the drag will be. But even the drag picture has two sides.

It is easy to jump to the conclusion that high approach drag is bad, but this is not necessarily so. While it decreases the excess thrust available to handle unforeseen events, it has distinct beneficial effects. The higher the approach drag, the better the speed stability will be, and improved speed stability is always welcome. High drag is also helpful when the runway is close to the wheels and the flare completed, since it contributes to shorter landing distances. It is necessary to balance the beneficial effects with those that are less desirable to get the right procedural mixture.

It is not a case of the drag being "too high" with full flaps. For all normal operations, there is more than enough thrust to counter any drag produced by full flaps. It is the abnormal situation--particularly the high sink rate approach--in which high drag levels can add to the problem.

1. High sink rates must be avoided in the final stages of the approach, preferably for at least the last 1000' of descent. Where high sink rates are necessary (as on 13R at JFK), they must be accompanied by an IAS higher than normal while the sink rate is high. The amount of speed excess will be roughly proportional to the sink rate, but neither the higher speed nor sink rate must be allowed to persist for the final stages of the approach.

2. Excess speed and sink rate both move to a higher level the point at which the flare must be commenced. This makes judgment of the proper start-of-flare height doubly difficult and sharply increases the exposure to a hard landing.

3. A continually decelerating approach at low thrust levels is thoroughly bad. A stabilized approach from the outer marker inbound is inherently -- and automatically--the answer to many approach problems.

   a. It eliminates the high sink rate problem.

   b. It helps you stay ahead of problems caused by the jet's weaker speed stability characteristics.

   c. It reduces the number of corrective changes (elevator inputs, trim, thrust changes) needed, and makes it easier to stay ahead of the airplane.

   d. It takes advantage of the better speed stability characteristics our final approach speed was selected to give.

   e. It keeps the engines at a high enough RPM so that delays in getting corrective thrust increases are minimized.

4. There is some rate of descent beyond which it will be impossible to complete the flare in the time and height available under some circumstances. Thrust limiting at the higher temperatures and/or altitudes will make this factor more severe.

5. Remember that standard operating procedures call for the pilot not flying to call out sink rates whenever they exceed 800 FPM. Strict adherence to this procedure can help keep you out of trouble.

In other words, get on the marked bug as soon after passing the outer marker as practicable, and stay there until approaching the threshold. If a higher speed is necessary because of gustiness, use it, but get stabilized on it. Don't be satisfied just because you are above the established speed and approaching it, for the latter has booby traps that are not always apparent.

PART IV

List of Laws and Regulations of States containing provisions relating to "Aircraft Accident Investigation"

(Replacing list in Digest No. 13)

ARGENTINA

1952	oct.	9	Resolución Núm. 100 (S. A. C.) - Normas para la investigación de accidentes de aviación civil y directivas generales para la investigación. Ampliada el 8 de enero de 1954.
1954	enero	12	Decreto Núm. 299 - Creación de la Junta de Investigaciones de Accidentes de Aviación y competencia de la Subsecretaría de Aviación Civil y Comando en Jefe de la Fuerza Aérea Argentina en la Investigación de Accidentes Civiles y Militares respectivamente.
	julio	15	Ley Núm. 14. 307 - Código Aeronáutico de la Nación: Título XVIII. - Disposiciones varias (Art. 208).
1957	feb.	19	Normas para investigación de accidentes de aeronaves de propiedad particular.

AUSTRALIA

1947	Aug.	6	The Air Navigation Regulations, S. R. No. 112/1947, as amended: Part XVI. - Accident Inquiry (Regs. 270-297).

AUSTRIA

1957	Dec.	2	The Federal Air Law: Part VIII. - D) Investigation of civil aircraft accidents.
1958	March	29	Ordinance No. 68 relating to aircraft accident investigation.

BOLIVIA

1964	agosto	28	Decreto Supremo Núm. 06877 - Reglamentación Técnica y Administrativa de la Ley de creación de la DGAC de 25 de octubre de 1947: (Art. 1 t).

BRAZIL

1948	April	15	Accident Inquiry Service Regulations (Decreto Núm. 24. 749).
1951	July	24	Portaria 280 - Recommendations relating to aircraft accident investigation.
1955	Feb.	28	Aviso Núm. 6 - Establishment of time for the accident inquiry service regulations.
1955	Sept.	9	Aviso Núm. 34-GM-4 - Interdiction of aircraft accident.

BULGARIA

1963			Law on Civil Aviation (Official Gazette No. 1 - 4 January 1963): VI. - Section 44.

BURMA

1934			The Union of Burma Aircraft Act, 1934 (XXII of 1934): Section 7. - Power of the President of the Union to make rules for investigation of accidents.
1937			The Union of Burma Aircraft Rules, as amended: Part X. - Investigation of Accidents.
1949	August		Notice to Airmen No. 5/1949 - Aircraft Accident and Incident Investigations.

CANADA

1960	Dec.	29	The Air Regulations, Order in Council P. C. 1960-1775 (SOR/61-10), as amended: Part I. Sec. 101. (6), (7) - Interpretation. Sec. 102. - Application. Part VIII. Div. III. - Accidents and Boards of Inquiry.
1964	Oct.	7	Air Navigation Order, Series VIII, No. 1 - Aircraft Accidents and Missing Aircraft (SOR/64-433).

CEYLON

1950	March	29	Air Navigation Act, No. 15/1950: Part I. Section 12. - Power to provide for investigation into accidents.
1955	May	4	Civil Air Navigation Regulations: Ch. XVI. - Accident Inquiry (Regs. 260-271).

CHAD

1963	avril	11	Décret N° 78/PR/TP portant Code de l'Aviation Civile: Livre Ier - Titre IV. - Des Accidents.

CHILE

*1951			Manual sobre Investigación de Accidentes de Aviación (Publicación de la Dirección de Aeronáutica MT 4-9).

CHINA (TAIWAN)

1953	Oct.	21	Civil Air Regulations No. 102 - Accident Reporting and Investigation.

* The text does not exist in the files of ICAO.

COLOMBIA

1960	julio	18	Decreto Supremo Núm. 1721 por medio del cual se crea y organiza el Departamento Administrativo de Aeronáutica Civil y se fijan sus funciones: II. Art. 5 c), IV. Art. 10 b), XII. Art. 38 d), XIII. Art. 40 b), XXII. Art. 61.
1964			Manual de Reglamentos Aeronáuticos: Parte VIII. - Seguridad Aérea - 82. Investigación de Accidentes.

COSTA RICA

1949	oct.	18	Ley General de Aviación Civil Núm. 762: Parte I. - Título I. - Cap. 2 Sección VIII. - Accidentes.
*1957	nov.	27	Decreto Ejecutivo Núm. 47 - Regulaciones aéreas: Parte VI. Accidentes. (La Gaceta, 12. 12. 57)

CUBA

1964	sept.	18	Ley Núm. 1160 por la que se crea el "Instituto de Aeronáutica Civil de Cuba": Art. 2. d). (Gaceta Oficial Núm. 30 - 22. 9. 64, p. 585)

CZECHOSLOVAKIA

1947			Decree of Ministry of Interior on accident investigation, No. 1600/47.
1956	Sept.	24	Civil Aviation Act: Para. 45. - Investigation of Aircraft Accidents.
*1961			Regulations on Administrative Investigation of Aircraft Accident Causes.

DAHOMEY

1963	déc.	27	Ordonnance Nº 26/GRPD/MTP portant Code de l'Aviation Civile et Commerciale: Livre Ier - Titre IV. - Des Accidents.

DENMARK

1960	June	10	The Civil Aviation Act. Came into force on 1 January 1962: Chapter XI. - Investigation of Accidents (Paras. 134-144).

EAST AFRICA

*1965			The Civil Aviation (Investigation of Accidents) Regulations, as amended.

EAST GERMANY

1963	July	31	Civil Aviation Law: IX. Flight Operation - Para. 44 - Investigation of Incidents.

* The text does not exist in the files of ICAO.

ECUADOR

1954	julio	8	Acuerdo Ministerial Núm. 7 - Reglamento de Aeronáutica Civil del Ecuador: Título II. Parte 8. - Investigaciones y encuestas de accidentes de aviación.

EL SALVADOR

1955	dic.	22	Decreto Núm. 2011 - Ley de Aeronáutica Civil: Cap. XV. - De la Investigación de Accidentes Aéreos (Art. 173-187).

ETHIOPIA

*1961	March	1	Investigation of Accident Regulations.
1962	Aug.	27	The Civil Aviation Decree No. 48/1962: 2. (b) (xiv) - Power of the Civil Aviation Administration to provide for investigation of accidents.

FRANCE

1937	avril	21	Décret relatif à la déclaration des accidents d'aviation.
1953	janv.	3	Instruction interministérielle relative à la coordination de l'information judiciaire et de l'enquête technique et administrative en cas d'accident survenu à un aéronef français ou étranger sur le territoire de la Métropole et les territoires d'Outre-mer.
1957	juin	3	Instruction du Secrétaire d'Etat aux Travaux Publics, aux Transports et au Tourisme n° 300 IGAC/SA, concernant les dispositions à prendre en cas d'irrégularité, d'incident ou d'accident d'aviation.
*1961	nov.	2	Arrêté relatif aux commissions d'enquête sur les accidents d'aviation.
1962	juin	20	Arrêté portant organisation et attributions du bureau "Enquêtes - Accidents" à l'inspection générale de l'aviation civile.

GERMANY (FEDERAL REPUBLIC OF)

1959	Jan.	10	The Aeronautics Act, as amended on January 8, 1961: Article 32 6).
1960	Aug.	16	General Administrative rules with respect to the technical inquiry in case of accidents occurring during the operation of aircraft.

GHANA

1958			Civil Aviation Act, 1958: Part II. - Paragraph 8 - Investigation of Accidents.

* The text does not exist in the files of ICAO.

GREECE

*1955	Dec.	30	Royal Decree on aircraft accident investigation
*1956	Nov.	20	(G. G. 27/A/56).
*1963			Amended by Royal Decree No. 377/1963 (G. G. No. 110/63/A).

GUATEMALA

1948	oct.	28	Decreto Núm. 563 - Ley de Aviación Civil: Capítulo X. - De los siniestros aeronáuticos (Art. 116-121).

HONDURAS

1957	sept.	3	Decreto Núm. 146 - Ley de Aeronáutica Civil: Título I. - Cap. II. - Dirección General de Aeronáutica Civil - (Art. 6 XIII). Cap. XIV. - Investigación de Accidentes Aéreos.

ICELAND

1964	May	9	Aviation Act - Chapter 11. - Flight Accidents Articles 141-147 - Investigation of Flight Accidents.

INDIA

1934	Aug.	19	The Indian Aircraft Act, 1934: Section 7. - Power of Central Government to make rules for investigation of accidents.
1937	March	23	The Indian Aircraft Rules, 1937, as amended: Part X. - Investigation of Accidents.

IRAQ

1939	Aug.	6	The Air Navigation Law No. 41: Article 5 (h).

IRELAND

1936			The Air Navigation and Transport Acts 1936 to 1959: No. 40/1936: Part VII. - Section 60 - Investigation of Accidents.
1957	Feb.	9	The Air Navigation (Investigation of Accidents) Regulations, S.I. No. 19/1957.

ITALY

1925	Jan.	11	Decree Law No. 356 - Rules for Air Navigation, as amended: Chapter VII.
1942	April	21	The Navigation Code, approved by Royal Decree No. 327 of 30 March 1942: Second Part - Air Navigation - Investigation of Accidents (Arts. 826-833).

* The text does not exist in the files of ICAO.

IVORY COAST

1963 déc. 26 Loi no 63-528 relative à l'aviation civile et commerciale: Livre Premier - Titre IV. - Des accidents.

JAMAICA

1953 The Air Navigation (Investigation of Accidents) Regulations No. 37/1953.

JAPAN

1952 July 15 Civil Aeronautics Law No. 231, as amended: Chapter 9 - Art. 132. - Investigation of Accidents.

JORDAN

1953 Law No. 55 on Civil Aviation: Investigation of Accidents (Article 106).

KOREA

1961 March 7 Aviation Law No. 591: Chapter IX. - Investigation of Accidents (Article 114).

LEBANON

1949 Jan. 11 Aviation Law: Chapter III. - Sub-Chapter 2 - Landing of Aircraft (Article 39).

LIBERIA

1962 Civil Aviation Regulations, effective July 1, 1963: Part VIII. - Aircraft Accident Investigation.

LIBYA

1956 The Civil Aviation Law No. 47: Part VI. - Accident Inquiry (Annex 13).

MALAYSIA (FEDERATION OF)

*1953 Nov. 1 Air Navigation (Investigation of Accidents) Regulations (L.N. 584/53).

MALI

1962 janv. 15 Loi no 62-12 AN-RM relative à l'aviation civile et commerciale: 1ère Partie - Titre VI. - Des enquêtes sur les accidents d'aviation.

MALTA

*1956 Civil Aviation (Investigation of Accidents) Regulations.

* The text does not exist in the files of ICAO.

MAURITANIA

1962	juil.	3	Loi n° 62-137 portant Code de l'Aviation civile: Article 9. - Enquêtes.
1962			Décret portant réglementation de la navigation aérienne: Première Partie - Titre VI. - Des enquêtes sur les accidents d'aviation.

MEXICO

1949	dic.	27	Ley de Aviación Civil (Libro IV de la Ley de Vías Generales de Comunicación): Cap. XIV. - De los Accidentes y de la Búsqueda y Salvamento (Art. 358-361).
1950	oct.	18	Reglamento para Búsqueda y Salvamento e Investigación de Accidentes Aéreos (en vigor a partir del 1° de enero de 1951).

MOROCCO

1962	juil.	10	Décret n° 2-61-161 (7 safar 1382) portant réglementation de l'aéronautique civile: Ière Partie - Titre VI. - Des enquêtes sur les accidents d'aviation (Art. 106-114).

NEPAL

1959	April	22	Act No. 22 to control and regulate civil aviation: Section 5. - Power of His Majesty's Government to issue rules pertaining to investigation of accidents.

NETHERLANDS

1936			Act regulating the Investigation of Accidents to Civil Aircraft (St. B. 1936, 522).

NEW ZEALAND

1948	Aug.	26	The Civil Aviation Act, 1948, as amended: Article 8. - Power to provide for investigation of accidents.
1953	Nov.	11	The Civil Aviation (Investigation of Accidents) Regulations, Serial No. 152/1953 (made in accordance with ICAO Annex 13).

NICARAGUA

1956	mayo	18	Decreto Núm. 176 - Código de Aviación Civil: Título II. - Cap. V. De la Investigación de Accidentes Aéreos.

NIGER

1962	juil.	17	Loi n° 62-13 portant Code de l'Aviation civile: Livre Ier - Titre IV. - Des accidents (Art. 63-65).

NORWAY

1956	Sept.	21	Royal Decree establishing a permanent aircraft accident investigation Commission. (1)
1960	Dec.	16	The Civil Aviation Act. Came into force on 1 January 1962 with respect to civil aviation pursuant to Order of the King in Council dated 8 December 1961: Chapter XI. C. Investigation of Accidents (Paras. 164-168).

PAKISTAN

1937	March	23	The Aircraft Rules (corrected up to 24 February 1956): Part X. - Investigation of Accidents.

PANAMA

1963	agosto	3	Decreto-Ley Núm. 19 por el cual se reglamenta la Aviación Nacional: Título II. - Cap. VII. De la Investigación de Accidentes Aéreos.

PARAGUAY

1954	enero	15	Resolución Núm. 54 por la que se establece la definición "Accidentes de Aviación" y las normas a ser cumplidas en tales casos.
1957	sept.	30	Ley Núm. 469 - Código Aeronáutico: Título XVI. - Accidentes Aeronáuticos.

PERSIAN GULF TERRITORIES

BAHRAIN

1958	March	2	The Bahrain Aircraft Accident Regulation, Notice 2/1958.

QATAR

1957	Aug.	17	The Qatar Aircraft Accident Regulations.

TRUCIAL STATES

1958	March	2	Aircraft Accident Regulation, Notice No. 1/1958.

PERU

1963	Dic.	26	Decreto Supremo Núm. 22 - Reglamento de Aeronáutica Civil del Perú. Modificado por Decretos Supremos Núm. 9 y Núm. 15 del 16 de abril y del 26 de mayo de 1964: Título VI. Cap. I. - Accidentes.

(1) The substance of ICAO Annex 13 is used in principle at aircraft accident inquiries in Norway. The annex is partially implemented as regulations through that Decree.

PHILIPPINES

1946	May	9	The Civil Aviation Regulations: Chapter XVI. - Aircraft Accident Investigation.
1952	June	20	The Civil Aeronautics Act, No. 776: Chapter V. - Section 32 - Power and Duties of the Administrator: (11) Investigation of Accidents.

POLAND

1962			Civil Aviation Act: Part V. - Chapter Two - Articles 50. 2 and 55.

PORTUGAL

1930	Oct.	25	Decree No. 20.062 - Air Navigation Regulations: Chapter VIII.

ROMANIA

1953	Dec.	5	Decree No. 516 - The Air Code of the Romanian People's Republic. Amended by Decrees No. 204 of 11 May 1956 (B. O. No. 15) and No. 212 of 20 June 1959 (B. O. No. 17): Chapter VI. - Search and Rescue of Civil Aircraft in Distress - Handling of flight accidents and incidents.

SENEGAL

1963	Feb.	5	Law No. 63-19 - Code of Civil Aviation: Book IV. - Flight Personnel Title I. - General Provisions - Chapter II. Discipline (Articles 143-146).

SIERRA LEONE

*1953	Dec.	30	Civil Aviation (Investigation of Accidents) Regulations (P.N. 114/53).

SOUTH AFRICA (REPUBLIC OF)

1950			The Air Navigation Regulations, G.N. 2762/1949, as amended up to 3 February 1961: Chapter 29 - Investigation of Accidents (Regs. 29.1 - 29.7).
1962	June	21	The Aviation Act No. 74: Section 12. - Investigation of Accidents.

SPAIN

1948	marzo	12	Decreto del Ministerio del Aire sobre investigación de accidentes y auxilio de aeronaves.
1960	julio	21	Ley Núm. 48 sobre Navegación Aérea: Cap. XVI. - De los accidentes, de la asistencia y salvamento y de los hallazgos.

* The text does not exist in the files of ICAO.

SUDAN

1960			The Air Act, No. 49/1960: Chapter V. - Accidents and Insurance.

SWEDEN

1957	June	6	The Swedish Air Act. No. 297. Came into force on 1 January 1962: Chapter 11 - Paras. 7-13 - Investigation of Accidents.
*1961	Nov.	24	Royal Decree relating to air navigation: Paras. 122-134 - Investigation of Accidents.

SWITZERLAND

1948	déc.	12	Loi fédérale sur la navigation aérienne (entrée en vigueur le 15 juin 1950): Articles 23-26.
1959	oct.	2	Loi fédérale concernant les enquêtes sur les accidents d'aéronefs, modifiant la loi fédérale sur la navigation aérienne de 1948.
1960	avril	1	Ordonnance sur les enquêtes en cas d'accidents d'aéronefs.

THAILAND

1954	Sept.	1	The Air Navigation Act, (B. E. 2497): Chapter 7. - Accidents (Sections 63 and 64).
1955	June	5	Civil Air Regulations No. 3 - Aircraft Accident Inquiry.

TRINIDAD AND TOBAGO

1954	Nov.	23	Air Navigation (Investigation of Accidents) Regulations, (G. N. 205/54).

UNITED ARAB REPUBLIC

1941	May	5	Decree - Air Navigation Regulations: Article 10.

UNITED KINGDOM

1949	Nov.	24	The Civil Aviation Act, 1949 (12 and 13 Geo. 6, Ch. 67): Part II. - Section 10 - Investigation of Accidents.
1951	Sept.	5	The Civil Aviation (Investigation of Accidents) Regulations, S. I. No. 1653. Came into operation on 1 October 1951.
1959	Aug.	6	The Air Navigation (Investigation of combined military and civil air accidents) Regulations S. I. 1959, No. 1388. Amended by S. I. 1960, No. 1526.

* The text does not exist in the files of ICAO

UNITED KINGDOM COLONIES

Article 76 of the Colonial Air Navigation Order, 1961, and Section 10 of the Civil Aviation Act, 1949, apply /the latter by virtue of the Colonial Civil Aviation (Application of Act) Order, 1952, as amended/ to the undermentioned Colonies:

Aden (Colony and Protectorate)
Bahamas
Barbados
Bechuanaland Protectorate
Bermuda
British Guiana
British Honduras
British Solomon Islands Protectorate
Central and Southern Line Islands - Malden
Starbuck
Vostock
Caroline
Flint

Falkland Islands and Dependencies
Fiji
Gibraltar
Gilbert and Ellice Islands Colony
Hong Kong
Leeward Islands - Antigua
Montserrat
St. Christopher and Nevis
Virgin Islands
Mauritius
St. Helena and Ascension
Seychelles
Southern Rhodesia
Swaziland
Tonga Islands
Windward Islands - Dominica
Grenada
St. Lucia
St. Vincent

ADEN

*1954 The Civil Aviation (Investigation of Accidents) Regulations (G.N. 125/54).

BAHAMAS

*1952 Aug. 1 Air Navigation (Investigation of Accidents) Regulations.

BARBADOS

*1952 April 29 Air Navigation (Investigation of Accidents) Regulations.

* The text does not exist in the files of ICAO.

UNITED KINGDOM COLONIES (Cont'd)

BERMUDA

*1948	Dec.	18	Air Navigation (Investigation of Accidents) Regulations.

BRITISH GUIANA

*1952	Aug.	18	Air Navigation (Investigation of Accidents) Regulations, No. 19/1952.

BRITISH HONDURAS

*1953	Dec.	19	Air Navigation (Investigation of Accidents) Regulations, (S.I. 1/54).

FIJI

*1952	May	1	Civil Aviation (Investigation of Accidents) Regulations, (L.N. 90/1952).

GIBRALTAR

1952	Jan.	3	Air Navigation (Investigation of Accidents) Regulations.

HONG KONG

*1957			Air Navigation (Investigation of Accidents) Regulations.

LEEWARD ISLANDS

*1952	July	31	Civil Aviation (Investigation of Accidents) Regulations, (S.R.O. 18/52).

MAURITIUS

*1952	Sept.	4	Civil Aviation (Investigation of Accidents) Regulations, (G.N. 200/52).

ST. LUCIA

1948	Nov.	27	Air Navigation (Investigation of Accidents) Regulations, (S.R.O. No. 40/48).

ST. VINCENT

*1953	Jan.	8	Air Navigation (Investigation of Accidents) Regulations, (S.R.O. No. 6/53).

SOUTHERN RHODESIA

1954	March	26	Aviation Act No. 10/1954: Section 4(s), (t), Section 13 - Enquiries.
1954	June	18	Air Navigation Regulations (F.G.N. No. 246/1954): Part 18. - Accidents.

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* The text does not exist in the files of ICAO.

UNITED STATES OF AMERICA

1958			The Federal Aviation Act of 1958, as amended (Public Law 85-726, 85th Congress, 2nd Session; 72 Stat. 731; 49 U.S. Code): Title II. - General Powers and Duties of the Civil Aeronautics Board - 204(a) General Powers; Title III. - Organization of Agency and Powers and Duties of Administrator - Sec. 313(c) Power to Conduct Hearings and Investigations; Title VII. - Aircraft Accident Investigation; Title IX. - Penalties - Sec. 902.(o) - Interference with aircraft accident investigation.
			The Federal Aviation Act of 1958, Annotated; Title VII

U.S. Code of Federal Regulations

Title 14 - Aeronautics and Space (Chapter II. - Civil Aeronautics Board Regulations)

1950	Sept.	15	Procedural Regulations - Part 303 - Rules of practice in aircraft accident investigation hearings, (as issued September 15, 1950, 15 F.R. 6440); revised effective February 15, 1957, 22 F.R. 1026; Part revised by Reg. PR-35, effective March 21, 1959, 24 F.R. 2224).
1950	Sept.	15	Procedural Regulations - Part 311 - Disclosure of aircraft accident investigation information. (As issued September 15, 1950, 15 F.R. 6441; reissued effective April 1, 1963, 28 F.R. 582)
1963			Safety Investigation Regulations - Part 320 - Rules pertaining to aircraft accidents, inflight hazards, overdue aircraft and safety investigations. (As reissued by Regulation No. SIR-4, effective April 1, 1963, 28 F.R. 583)
1964			Organization Regulations - Part 386 - Delegation and review of action under delegation; Determination of the probable cause of aircraft accidents. (As issued, effective April 7, 1964, 29 F.R. 5033)
1955			Policy Statements - Part 399 - Statements of General Policy (as issued, effective May 25, 1955, F.R. 4117; amended and codified, effective January 29, 1964, 29 F.R. 1454): Subpart F - Policies relating to aircraft accident investigations: 399.70 - Investigation of accidents involving foreign aircraft.
1958			Public Notice PN-13 - Request to Administrator of Federal Aviation Agency to investigate certain aircraft accidents for a temporary period. (As issued, effective December 31, 1958, 23 F.R. 10492)

UNITED STATES OF AMERICA (Cont'd)

1961			Public Notice PN-15 - Statement of Organization and Delegations of Final Authority. Effective July 3, 1961, 26 F.R. 7231: Section 1.2 - Functions of the Civil Aeronautics Board - (c) Safety Activities; Bureau of Safety - Sections 5.1 - 5.9; Section 7.2 - Functions of the General Counsel; Section 7.3 - Delegated Authority; Section 7.6 - Redelegation of Authority to Associate General Counsel, Rules and Legislation. (26 F.R. 7231)

U.S. Code of Federal Regulations

Title 22 - Foreign Relations

1952			Part 102 - Civil Aviation - Subchapter K - Economic, Commercial and Civil Aviation Functions: U.S. Aircraft Accidents Abroad; Foreign Aircraft Accidents involving U.S. Persons or Property. (As issued in Department Regulations 108.164, effective October 1, 1952, 17 F.R. 8207; Part 102 as republished, effective December 23, 1957, 22 F.R. 10871)

URUGUAY

1955	feb.	2	Decreto Núm. 23.826 - Reglamento para la investigación de Accidentes de Aviación de Carácter Civil.

VENEZUELA

1955	abril	1	Ley de Aviación Civil: Cap. X. - De los accidentes y de la búsqueda y rescate.

WESTERN SAMOA

1963	Aug.	1	Civil Aviation Act. No. 6/1963: Part VIII. - Accident Inquiry.

YUGOSLAVIA

1949	June	1	Decree on Air Navigation, as amended on 19 December 1951: IV. Flight (Article 28).

ZAMBIA

1954	March	26	Aviation Act No. 10/1954: Section 4(a), (t), Section 13 - Enquiries.
1954	June	18	Air Navigation Regulations (F.G.N. No. 246/1954): Part 18. - Accidents.

- END -

ICAO TECHNICAL PUBLICATIONS

The following summary gives the status, and also describes in general terms the contents of the various series of technical publications issued by the International Civil Aviation Organization. It does not include specialized publications that do not fall specifically within one of the series, such as the ICAO Aeronautical Chart Catalogue *or the* Meteorological Tables for International Air Navigation.

INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES are adopted by the Council in accordance with Articles 54, 37 and 90 of the Convention on International Civil Aviation and are designated, for convenience, as Annexes to the Convention. The uniform application by Contracting States of the specifications comprised in the International Standards is recognized as necessary for the safety or regularity of international air navigation while the uniform application of the specifications in the Recommended Practices is regarded as desirable in the interest of safety, regularity or efficiency of international air navigation. Knowledge of any differences between the national regulations or practices of a State and those established by an International Standard is essential to the safety or regularity of international air navigation. In the event of non-compliance with an International Standard, a State has, in fact, an obligation, under Article 38 of the Convention, to notify the Council of any differences. Knowledge of differences from Recommended Practices may also be important for the safety of air navigation and, although the Convention does not impose any obligation with regard thereto, the Council has invited Contracting States to notify such differences in addition to those relating to International Standards.

PROCEDURES FOR AIR NAVIGATION SERVICES (PANS) are approved by the Council for worldwide application. They comprise, for the most part, operating procedures regarded as not yet having attained a sufficient degree of maturity for adoption as International Standards and Recommended Practices, as well as material of a more permanent character which is considered too detailed for incorporation in an Annex, or is susceptible to frequent amendment, for which the processes of the Convention would be too cumbersome. As in the case of Recommended Practices, the Council has invited Contracting States to notify any differences between their national practices and the PANS when the knowledge of such differences is important for the safety of air navigation.

REGIONAL SUPPLEMENTARY PROCEDURES (SUPPS) have a status similar to that of PANS in that they are approved by the Council, but only for application in the respective regions. They are prepared in consolidated form, since certain of the procedures apply to overlapping regions or are common to two or more regions.

The following publications are prepared by authority of the Secretary General in accordance with the principles and policies approved by the Council.

ICAO FIELD MANUALS derive their status from the International Standards, Recommended Practices and PANS from which they are compiled. They are prepared primarily for the use of personnel engaged in operations in the field, as a service to those Contracting States who do not find it practicable, for various reasons, to prepare them for their own use.

TECHNICAL MANUALS provide guidance and information in amplification of the International Standards, Recommended Practices and PANS, the implementation of which they are designed to facilitate.

AIR NAVIGATION PLANS detail requirements for facilities and services for international air navigation in the respective ICAO Air Navigation Regions. They are prepared on the authority of the Secretary General on the basis of recommendations of regional air navigation meetings and of the Council action thereon. The plans are amended periodically to reflect changes in requirements and in the status of implementation of the recommended facilities and services.

ICAO CIRCULARS make available specialized information of interest to Contracting States. This includes studies on technical subjects as well as texts of Provisional Acceptable Means of Compliance.

EXTRACT FROM THE CATALOGUE
ICAO SALABLE PUBLICATIONS

ANNEX

Annex 13 — Aircraft accident inquiry.
2nd edition, March 1966. 16 pp. $0.50

MANUAL

Manual of aircraft accident investigation.
(Doc 6920-AN/855/3). 3rd edition, 1959. 257 pp. $4.00

ICAO CIRCULARS

18-AN/15 — Aircraft Accident Digest No. 1.
June 1951. 116 pp. $2.00

24-AN/21 — Aircraft Accident Digest No. 2.
1952. 170 pp. $0.85

31-AN/26 — Aircraft Accident Digest No. 3.
1952. 190 pp. $1.00

38-AN/33 — Aircraft Accident Digest No. 4.
1954. 186 pp. $3.00

39-AN/34 — Aircraft Accident Digest No. 5.
1955. 186 pp. $2.00

47-AN/42 — Aircraft Accident Digest No. 6.
1956. 237 pp. $2.50

50-AN/45 — Aircraft Accident Digest No. 7.
1957. 245 pp. $2.50

54-AN/49 — Aircraft Accident Digest No. 8.
1958. 212 pp. $2.25

56-AN/51 — Aircraft Accident Digest No. 9.
1959. 290 pp. $3.00

59-AN/54 — Aircraft Accident Digest No. 10.
1961. 286 pp. $3.00

62-AN/57 — Aircraft Accident Digest No. 11.
1961. 266 pp. $4.25

64-AN/58 — Aircraft Accident Digest No. 12.
1963. 376 pp. $5.75

69-AN/61 — Aircraft Accident Digest No. 13.
1964. 359 pp. $5.50

71-AN/63 — Aircraft Accident Digest No. 14. Vol. I.
1965. 115 pp. $2.00

N.B.—*Cash remittance should accompany each order. Catalogue sent free on request.*

PRICE: U.S. $3.25
(or equivalent in other currencies)