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Civil Aircraft Airworthiness Data-Recording Programme. Special Events Relating to Handling and Control (January 1963 to February 1966)

by the

CAADRP Special Events Working Party

(Co-ordinated by A. W. Cardrick

R.A.E. and K. D. Mephan R.A.E.)

LONDON. HER MAJESTY'S STATIONERY OFFICE

1970

PRICE *15s 0d* [*75p*] NET

U.D.C. 656.7.08 : 629.13.074

C.P. No. 1080*
February 1969

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SUMMARY

Since October 1962 continuous trace records of airworthiness data have been taken from a small number of aircraft in normal airline service. Throughout the recording period the records have been searched for unusual occurrences, and each of these has been studied to determine its nature and, where possible, its cause.

This Report describes a selection of Events relating to handling and control which were detected in records taken between January 1963 and February 1966.

CAADRP is project administered by the Royal Aircraft Establishment in collaboration with the Air Registration Board, and involving a number of Airlines and C.I. Data Centre Limited.

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* Replaces R.A.E. Technical Report 69023 - A.R.C. 31460.

CONTENTS

1 INTRODUCTION

The Civil Aircraft Airworthiness Data-Recording Programme enables a systematic study to be made of the normal operation of civil transport aircraft. A small number of aircraft in regular airline service are fitted with analogue paper trace recorders to collect data on airspeed, barometric height, normal acceleration, outside air temperature and control surface movement. The whole programme is fully described elsewhere[1].

From time to time unusual or extreme events (Special Events) are noted; a selection of Special Events related to handling and control is the subject of this Report. All these Events occurred to four-engined pure jet transport aircraft in normal scheduled airline operations, between January 1963 and February 1966.

Selections of Special Events which have already been published in this Series relate to:-

Events of an Operational Nature[2].
Events of Meteorological Origin[3,4].
Autopilot Induced Control Disturbances[5].
Missed Approaches[6].
Airspeed Control[7].

It should be noted that the frequency of Special Events cannot be derived from these reports, neither can conclusions be drawn on their relative frequency.

A summary of all available information is given with a reproduction and description of the record of each Special Event. Definition is necessarily lost in photographic reproduction and comments are frequently based on observations from the original records.

Comments are also given as to the possible explanation of each Event; these represent the opinions of a Working Party comprising members of R.A.E., A.R.B., C.I. Data Centre Limited and the airlines concerned.

2 NOTE ON THE SELECTION OF SPECIAL EVENTS

After the photographic record has been developed, it is examined and annotated by the airline concerned. It is then scrutinised by a member of the Special Events Working Party, and finally examined in detail at the

Data Centre during routine analysis. There are thus at least three stages in which a Special Event occurring during a recorded flight may be detected.

It is not possible to lay down a hard and fast guide as to what is regarded as an unusual or extreme event, but the following examples are typical:-

(a) Normal acceleration increments of ±1.0 g or larger.

(b) Rapid and large changes of height or airspeed.

(c) Excessive application of a control.

(d) Infrequent operational events, such as abandoned take-off, missed approaches, engine failures, engine-out landings, etc.

(e) Unusual oscillations on any of the traces.

(f) Exceedances of operational limitations such as maximum operating speeds.

Although each record is examined at least three times it is unlikely that every unusual event will be detected. Also, each event selected for inclusion in a report is either particularly interesting or typical of a particular sort of event; choice of more than one representative event indicates differences within the sort; it does not mean that such events occur often. Frequencies cannot be derived from the data presented here.

This selection of Special Events relates to the manner in which aircraft are handled under various conditions and includes examples of records from take-off, climb, cruise, descent and landing.

3 SPECIAL EVENTS INCLUDED IN THIS REPORT

3.1 General

Fig.A.1 shows a sample of a normal flight to familiarise the reader with typical recorded parameters.

The twenty-two Special Events relating to handling and control which were selected for this Report are grouped according to flight phase. Descriptions and comments are interleaved with the reproductions of the analogue trace records of the events, and are presented, immediately following the Concluding Remarks, in Appendix A.

3.2 Events during take-off and initial climb

		Fig. No.
A.2.1	Normal acceleration oscillation during take-off roll. (Three examples.)	A.2a, b, c
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A.2.3	Manoeuvre after unstick.	A.4a, b, c
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A.2.5	Airspeed loss after take-off. (Two examples.)	A.6a, b, c

3.3 Events during climb

A.3.1	Control in turbulence during climb.	A.7

3.4 Events during cruise

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A.4.2	Variation of stability with Mach number.	A.9
A.4.3	Emergency descent.	A.10

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A.5.1	Height losses in a holding pattern.	A.11
A.5.2	Steep glide path.	A.12

3.6 Events during final approach and landing

A.6.1	Unusual control usage. (Two examples.)	A.13a, b
A.6.2	Engine pod scrapes. (Three examples.)	A.14a, b, c
A.6.3	Unusual elevator usage during flare.	A.15
A.6.4	Use of full starboard aileron.	A.16

4 CONCLUDING REMARKS

Scrutiny of CAADRP analogue records of airworthiness data has revealed a number of operational features which give cause for concern. Some of these, for example the tendency for normal acceleration oscillations to develop during the take-off roll, (Figs.A.2a, b, c) are related to particular types of aircraft, but other features, such as the substantial height loss

reported during the turns of holding pattern (Fig.A.11) and the example of the use of a very steep glide path (Fig.A.12), reflect operational procedures.

In addition, the records have proved invaluable in the investigation of operational incidence such as the incipient 'jet upsets' (Figs.A.8a, b) and 'pod scrapes' (Figs.A.14a, b, c) reported here. It is only by careful study of the circumstances and salient features of such events that effective prevention action can be taken.

Appendix A

DETAILS OF SPECIAL EVENTS

A.1 Presentation of diagrams

This Appendix gives an example of an analogue trace of normal flight at Fig.A.1. All other figures (A.2 to A.16) are reproductions of traces from Special Events and plots or graphs where required.

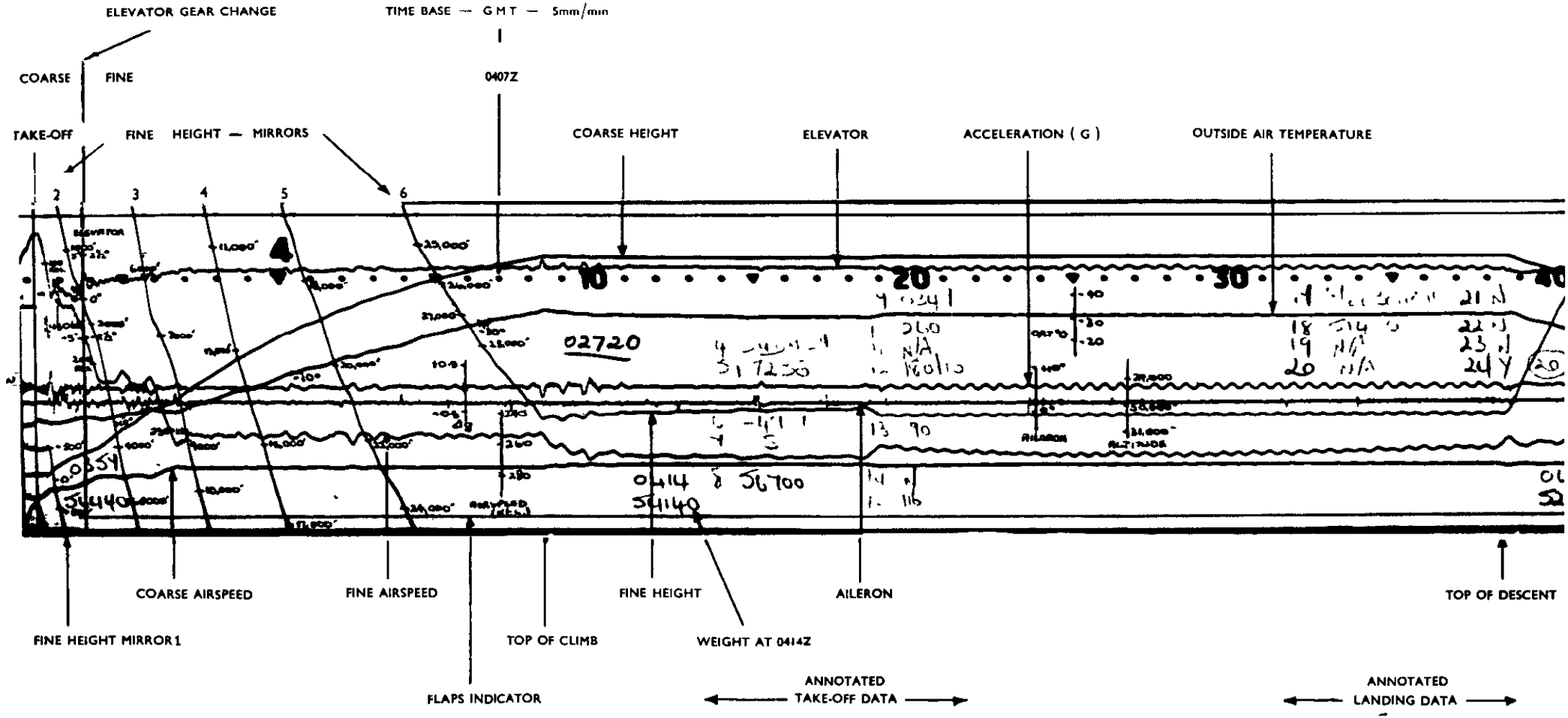

Fig.A.1 Portion of typical record

A.2 Events during take-off and initial climb

A.2.1 Normal acceleration oscillations during take-off roll

Sector: (a) New York - London, May, 1965, Flight 14140.
(b) New York - London, September, 1965, Flight 15787.
(c) New York - London, February, 1966, Flight 16624.

Description

The examples presented in Figs.A.2a, b, c, illustrate the build-up and decay of large amplitude oscillations in normal acceleration at the aircraft cg during take-offs at high all-up-weights from runways 22 and 31L at New York. The amplitude and frequency for the above flights are 0.4 g at 1 cps, 0.5 g at 1.4 cps, and 0.3 g at 1.6 cps. Similar oscillations of up to 0.25 g amplitude are not uncommon.

Supplementary Information and Discussion

Runways 22 and 31L at J.F.K., New York are of concrete with numerous small discontinuities and several intersections.

The measured frequencies of the acceleration oscillations are typical of large transport aircraft as discussed by Morris and Hall in a paper on runway roughness[8] in which studies relating to acceptable levels of flight deck vibration are reported. The results presented in this paper indicate that due to excitation of the fuselage bending mode the amplitude of flight deck vibration could have reached 1 g as the aircraft accelerated between about 40 and 90 knots. This is much greater than the tentative 'maximum acceptable' level of ±0.4 g postulated by Morris and Hall, but the oscillation decays completely into the normal, apparently random, vibration well before the critical phases of take-off are reached. This probably accounts for the lack of concern among aircraft crews, who regard such take-offs merely as 'very rough'.

However from these records it is apparent that in normal operations on particular runways some aircraft can experience normal acceleration oscillations which could be associated with unacceptable levels of flight deck vibration. Although this has not as yet produced control difficulties it is considered that the situation merits close attention. Recent work by Handel-Hall[9] has identified this problem with excitation of the undercarriage heaving mode.

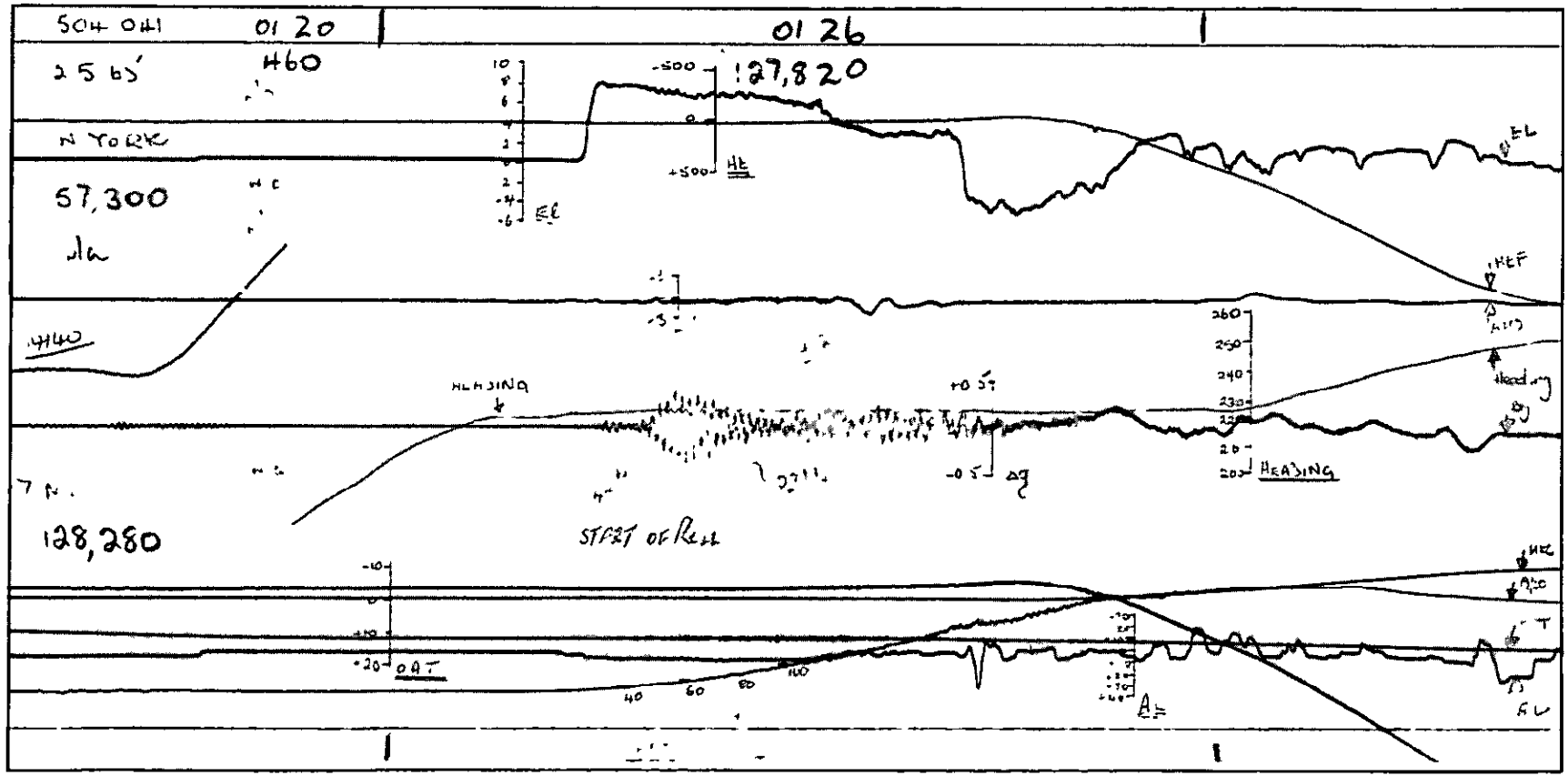

Fig.A2(a) Event in flight 14140

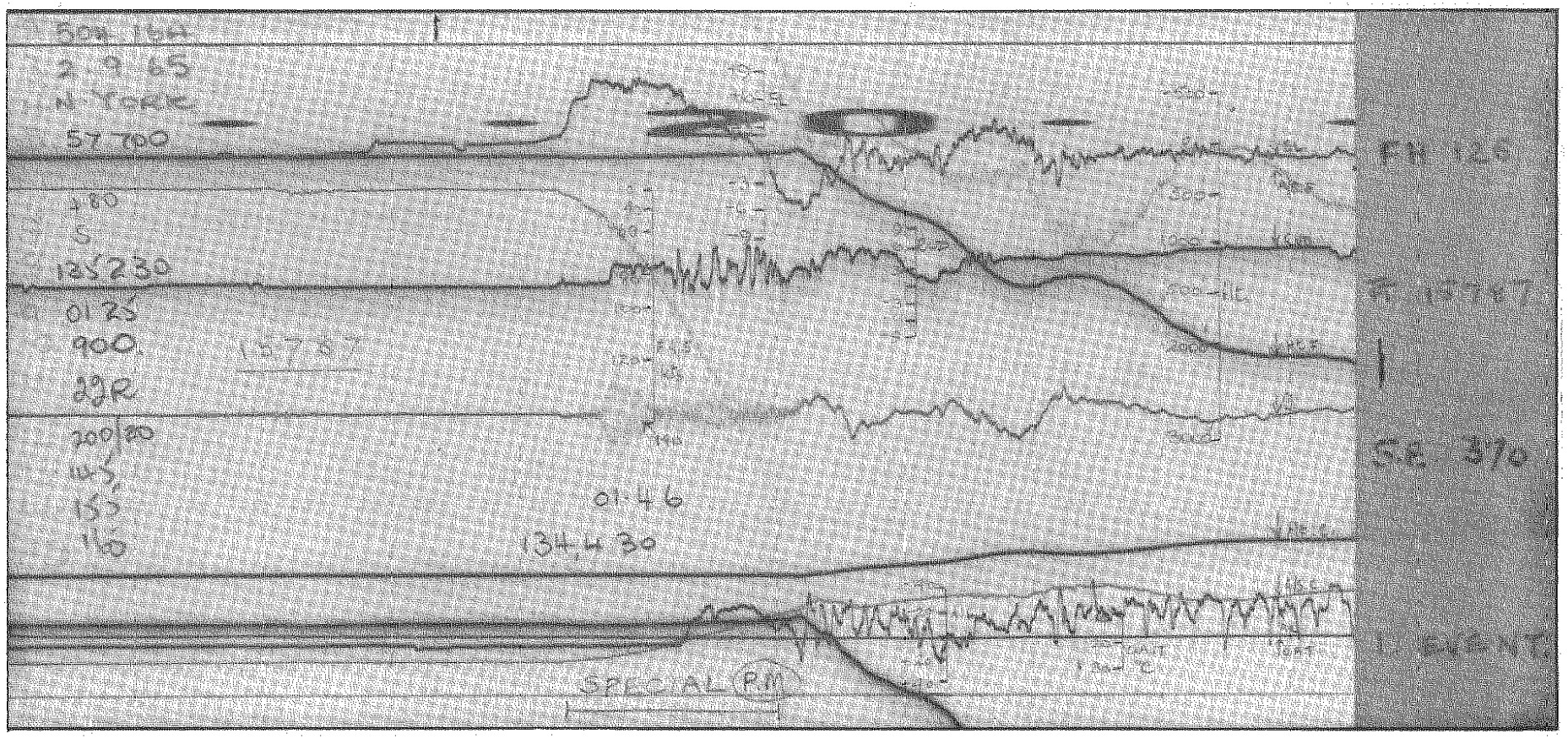

Fig.A2(b) Event in flight 15787

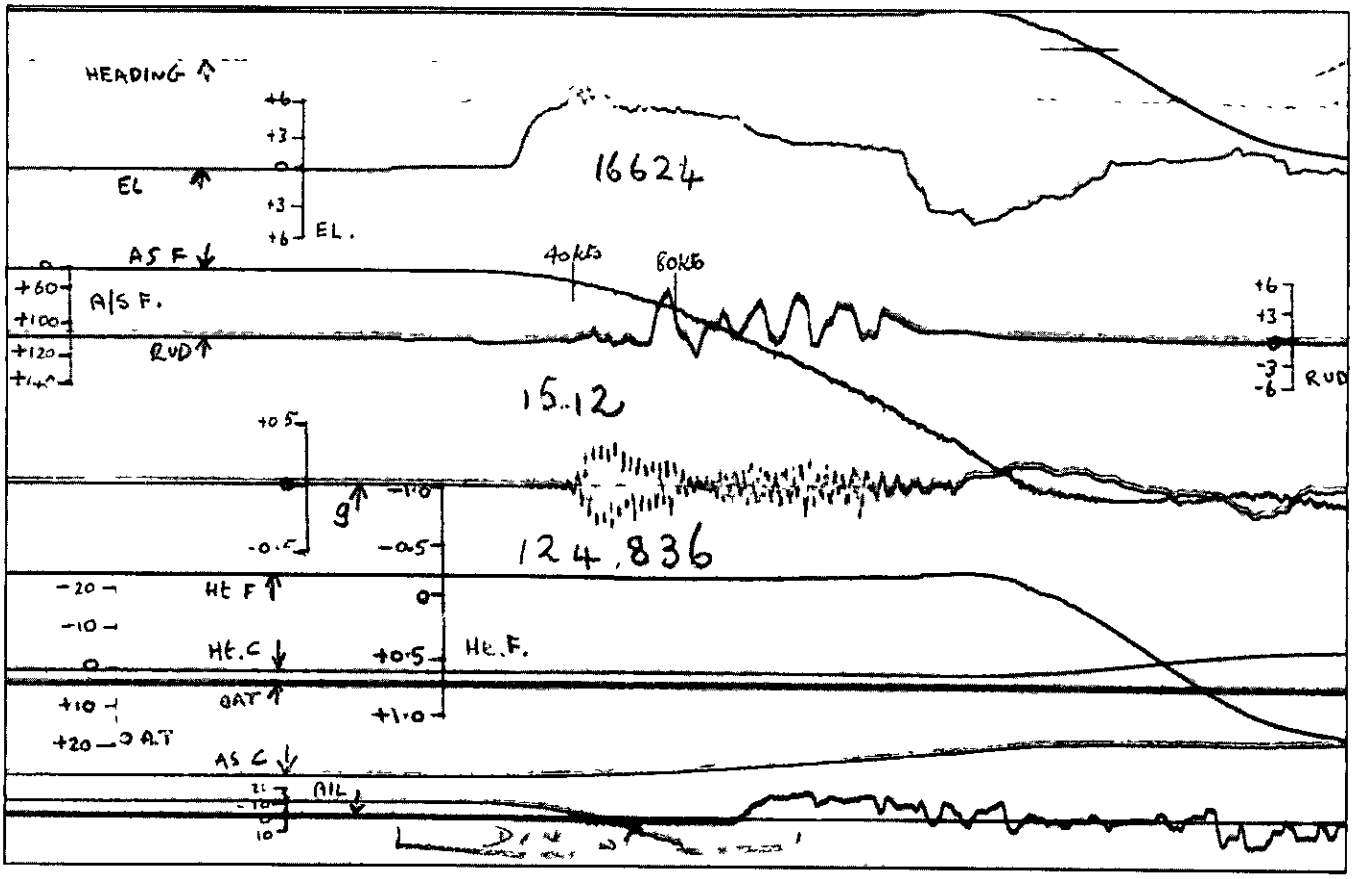

Fig.A2(c) Event in flight 16624

A.2.2 Unusual rudder usage on take-off

Sector: London - Bermuda, November 1963, Flight 04827.

Description

Large, but not maximum, left rudder movements were applied throughout the take-off run. Climb-out appears to have been delayed. (See Fig.A.3.)

Supplementary Information

Surface meteorological information (see Appendix B, Meteorological Report 1) shows that the take-off took place in gusty and severe cross-winds, accompanied by moderate to heavy rain. The pilot also noted in the log:

"Stick Shaker ... Have had a warning, on normal position, at about 20-30 ft off runway."

It was subsequently determined that one of the stick shaker signal transducers was unserviceable and that the take-off took place in winds gusting from 23 kt to 31 kt at 80° to the runway.

Sunset was at 1613Z, approximately 3 minutes after take-off.

Discussion

The control usage in the take-off is consistent with the procedure to be adopted in a high cross-wind. The maximum allowable cross-wind on take-off is 30 kt. The delay in climb-out may have been caused by the shaker warning.

The aircraft was nearly at maximum take-off weight.

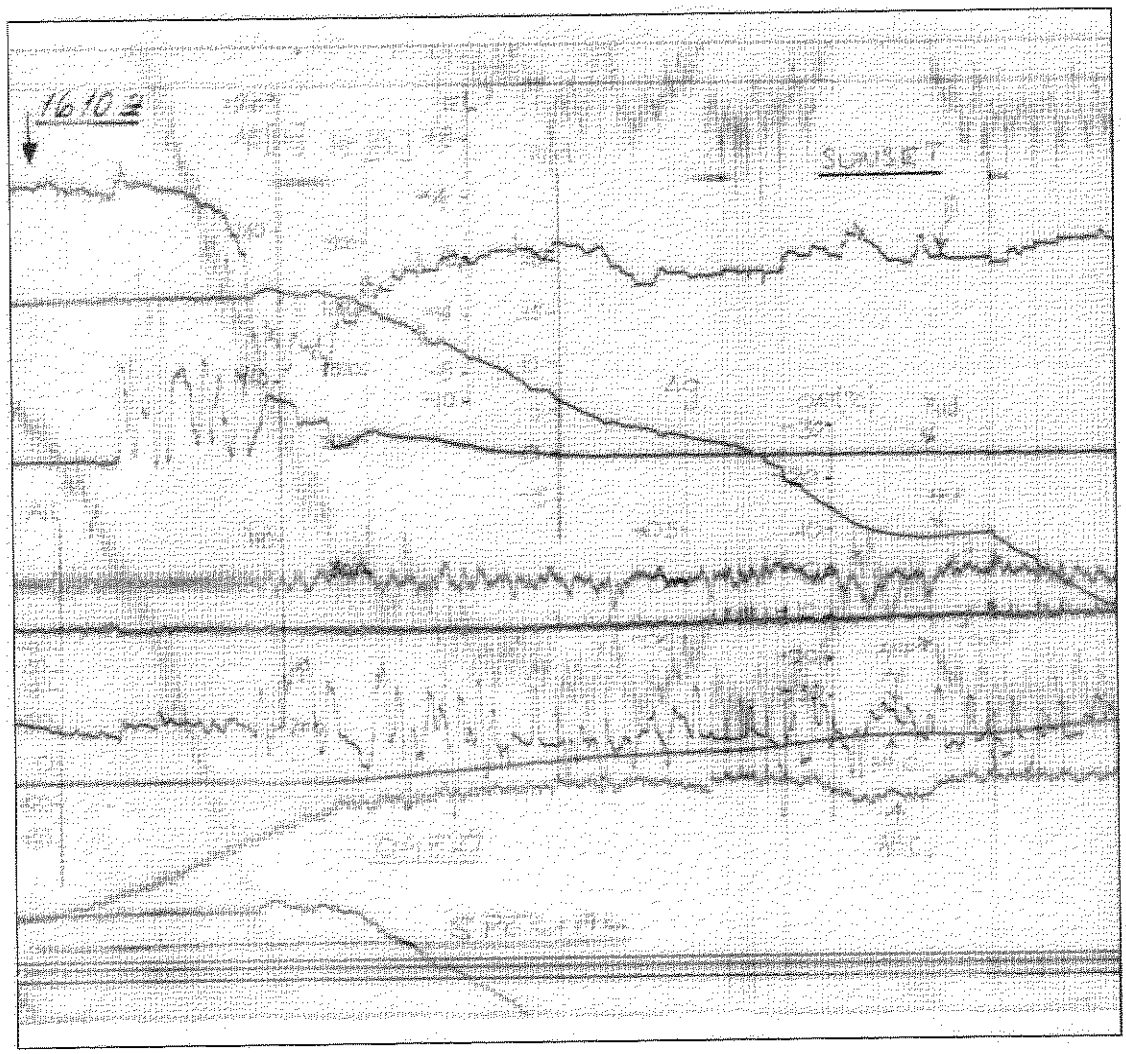

Fig.A3 Event in flight 04827

A.2.3 Manoeuvre after unstick

Sector: Montego Bay - Kingston, November 1963, Flight 04787.

Description

A normal acceleration increment of +0.5 g was pulled immediately after lift-off, during a light weight take-off (see Fig.A.4a).

Supplementary Information

The results of further studies on normal accelerations, due to manoeuvre immediately after unstick, are given in Figs.A.4b and A.4c. These show the results of 350 take-offs by this type of aircraft.

Discussion

It can be seen from Fig.A.4b that normal acceleration increments greater than +0.3 g are exceptional for this type but from Fig.A.4c, there is a tendency to pull rather more g at light weights. The elevator control used is by no means large in this case, and because the airspeed has reached 158 kt, the margin of normal acceleration between that applied and that necessary to produce stall buffet is in excess of 0.8 g.

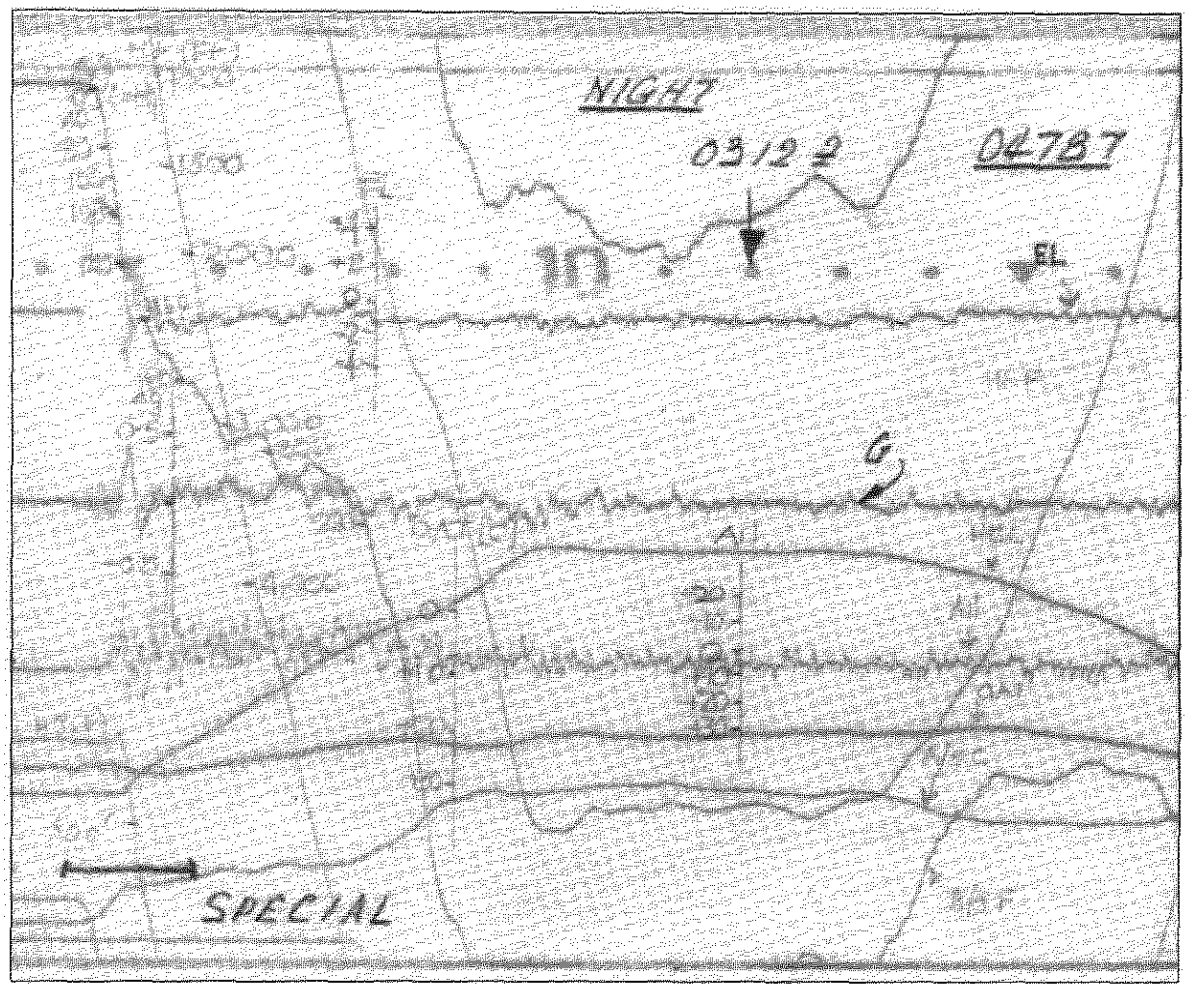

Fig.A4(a) Event in flight 04787

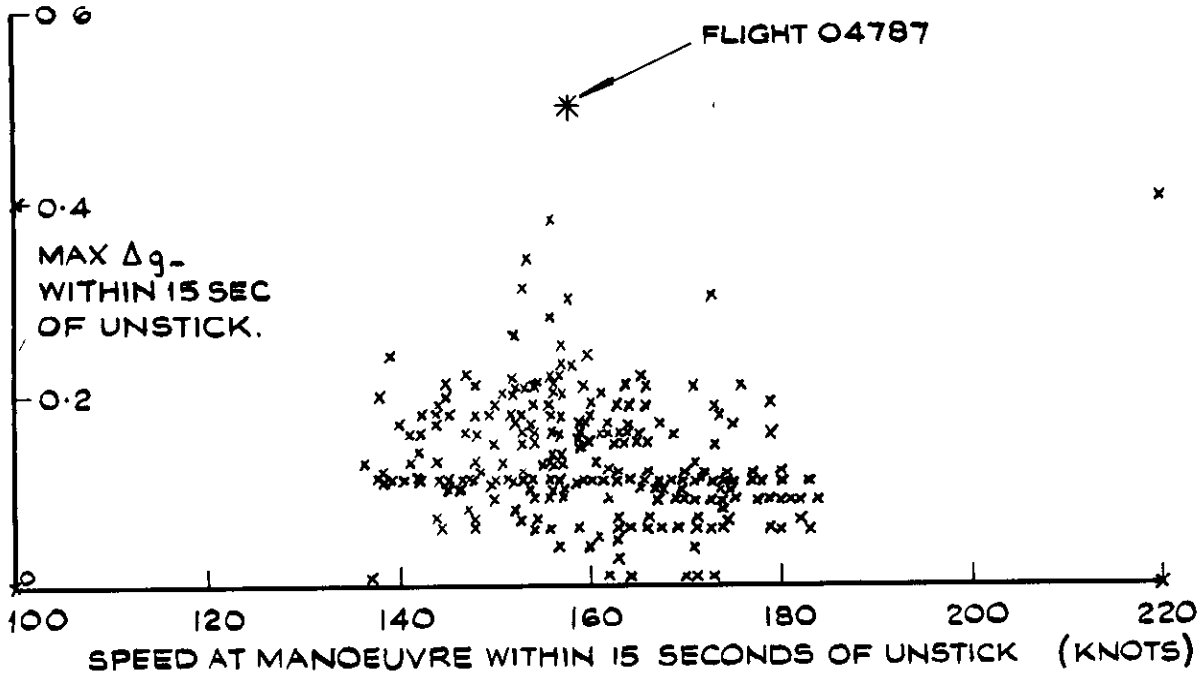

FIG.A4 b RELATIONSHIP BETWEEN MANOEUVRE SPEED AND ACCELERATIONS FOLLOWING UNSTICK.

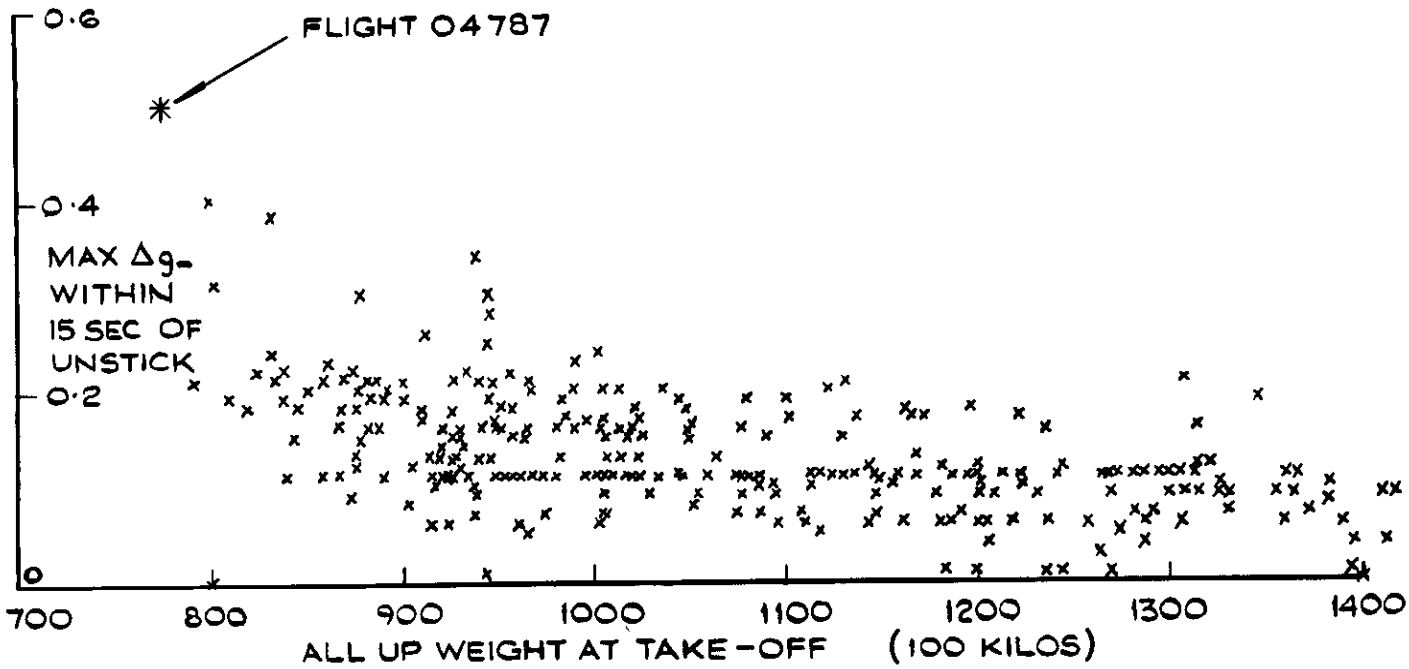

FIG A4 c RELATIONSHIP BETWEEN TAKE-OFF WEIGHT AND MANOEUVRE ACCELERATION FOLLOWING UNSTICK.

A.2.4 Late climb out

Sector: Amsterdam - Kano, June 1963, Flight 01830.

Description

The fine height trace indicates that the aircraft did not start to climb until 15 seconds after unstick. (See Fig.A.5.)

Supplementary Information

The meteorological information (Appendix B, Meteorological Report 2) suggests good visibility, light winds, and thunderstorms.

Discussion

From examination of the change in position error on the altimeter trace the aircraft appears to have rotated without deliberate action on the part of the pilot at 146 knots ias. Unstick appears to have occurred 9 seconds later at a speed of 166 knots ias. Normal rotation and unstick speeds for the weight would be 152 knots and 162 knots ias respectively. Therefore the fine height trace indicates that the aircraft stayed very close to the ground for a period of 8 seconds before the climb was commenced.

The question of faulty instrumentation has been considered, but the smooth variation of the height trace after the start of climb is thought to render this explanation unlikely. The noise on this trace some 8 seconds after the start of climb is due to retraction of the undercarriage.

Delayed climb-out procedures are rare, particularly from inland airports. However, as the take-off was made in good visibility over flat terrain the delayed climb does not in this instance, give rise to concern.

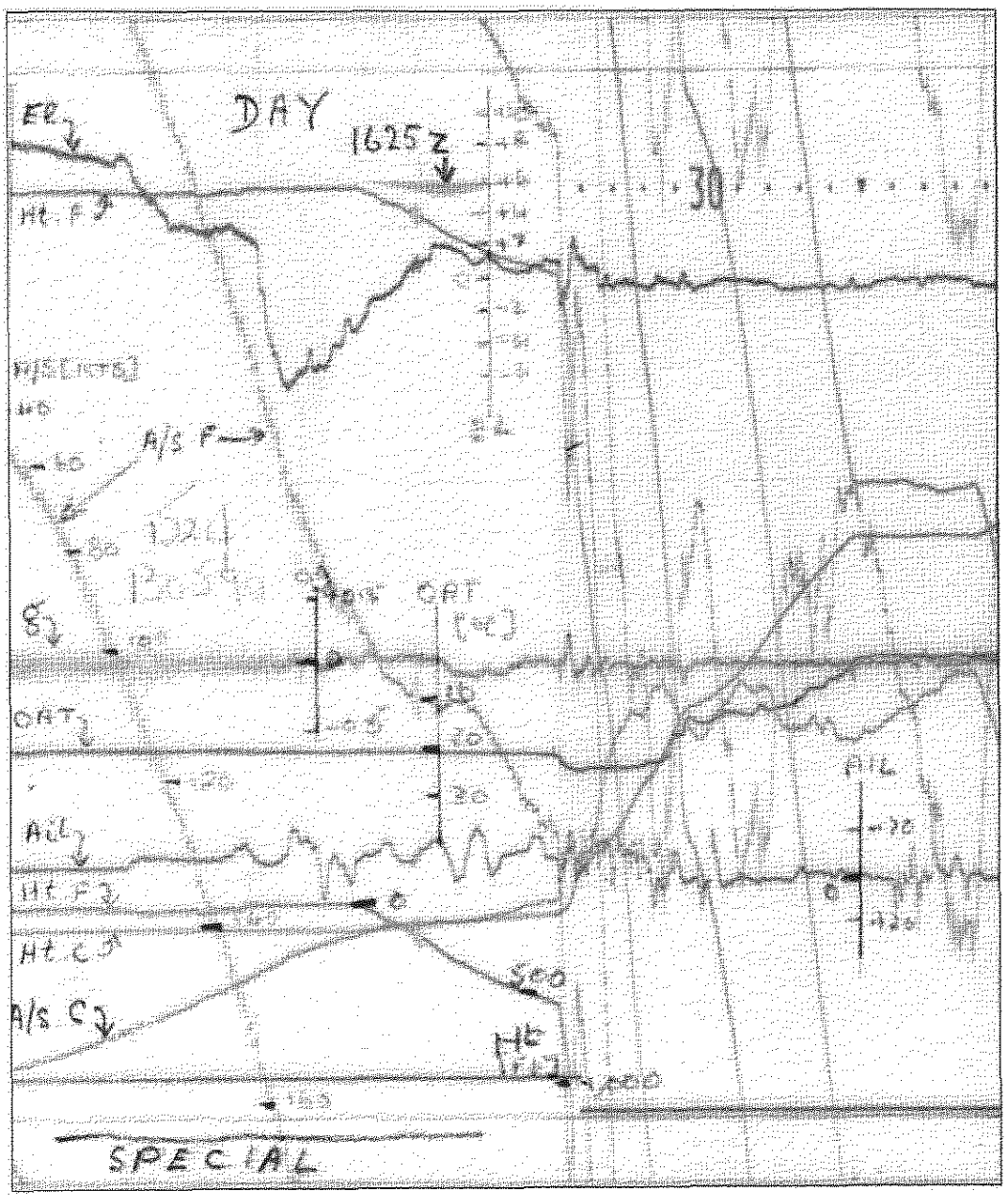

Fig.A5 Event in flight 01830

A.2.5 Airspeed loss after take-off

Sector: (a) Baghdad - Beirut, May 1964, Flight 08052.
(b) London - Rome, May 1964, Flight 08071.

Description

During each take-off, the indicated airspeed was allowed to fall back after attaining climb-out speed and thereafter fluctuated with about 10 knots amplitude and period of about $\frac{1}{2}$ minute until 2000 ft altitude was reached. A similar fluctuation occurred near the top of the climb with a period of 2 minutes. The first event is at night and it is probable that both events occurred during instrument flight conditions. (See Figs.A.6a, b, c.)

Discussion

Maximum and minimum speed limitations were not contravened during these oscillations. This type of oscillation in airspeed and height is known to occur when insufficient attention is given to the artificial horizon and reliance is placed on the altitude, airspeed and vertical speed indications.

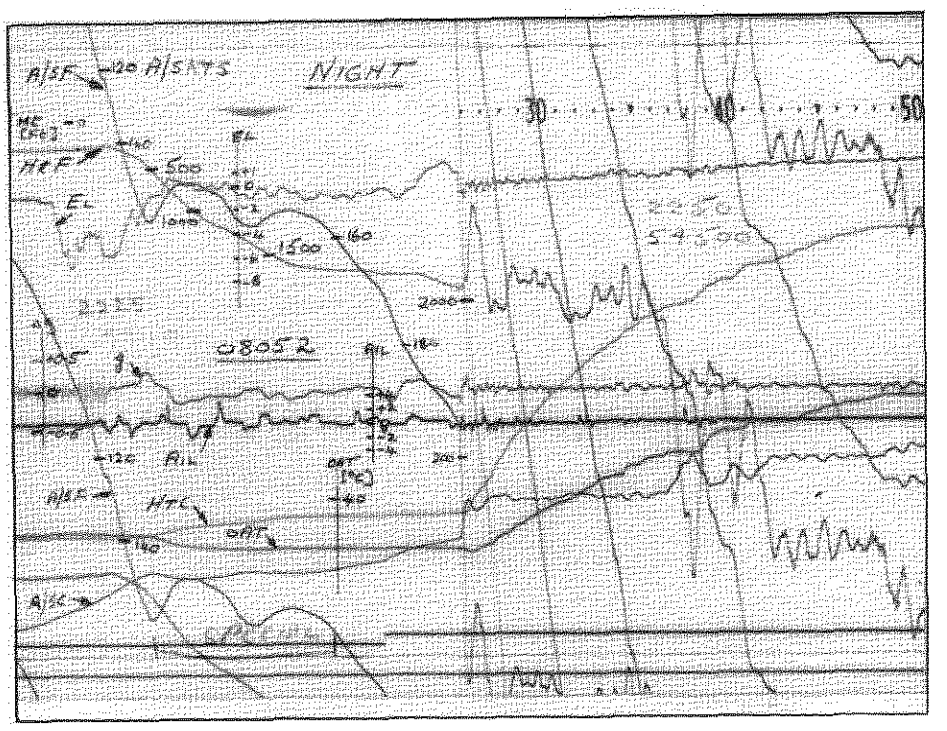

Fig.A6(a) Event in flight 08052

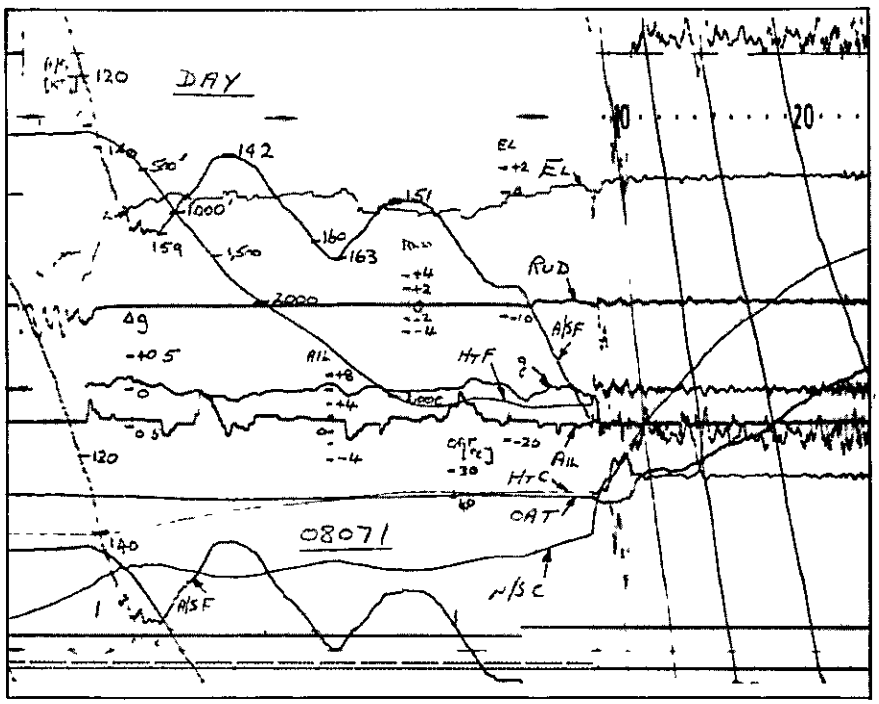

Fig.A6(b) Event in flight 08071

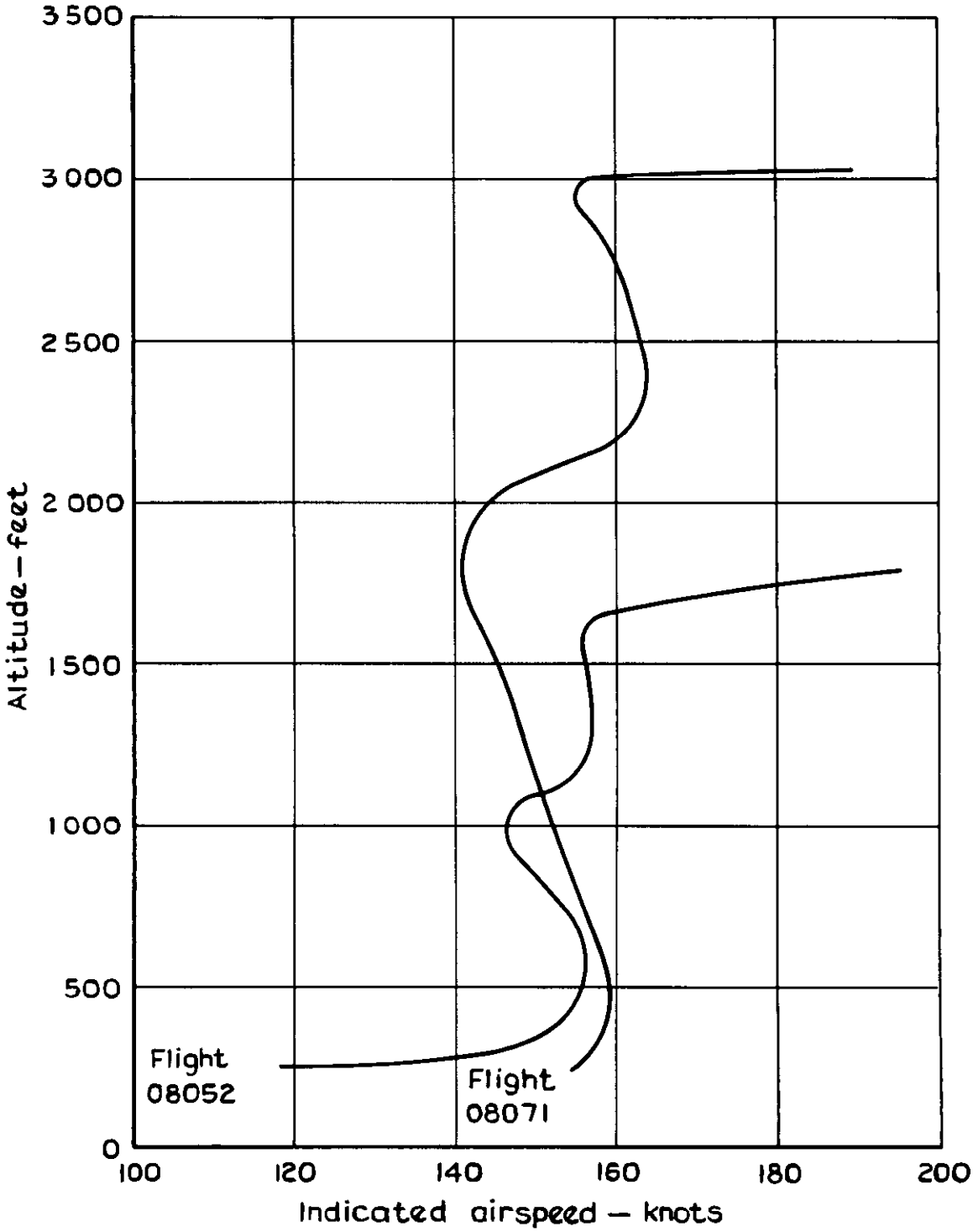

Fig. A6 c Change of airspeed with altitude

A.3 Events during climb

A.3.1 Control in turbulence during climb

Sector: Calcutta - Singapore, March 1965, Flight 13706.

Description

Severe turbulence was encountered between 9000 ft and 12000 ft during the climb out of Calcutta.

Considerable control surface movement was evident and airspeed excursions of up to 25 knots were recorded. (See Fig.A.7.)

Supplementary Information

The available meteorological information (see Appendix B Meteorological Report 3) indicates that the aircraft passed through an area of active thunderstorms.

Discussion

This example has been included to illustrate a storm penetration during climb. Control applications in the few minutes preceding the Event are compatible with slight changes in course possibly associated with the use of storm-warning radar.

The considerable control movements during the period in which the turbulence was encountered indicate that the pilot was having some difficulty and that he may have contributed significantly to the changes recorded in airspeed and height.

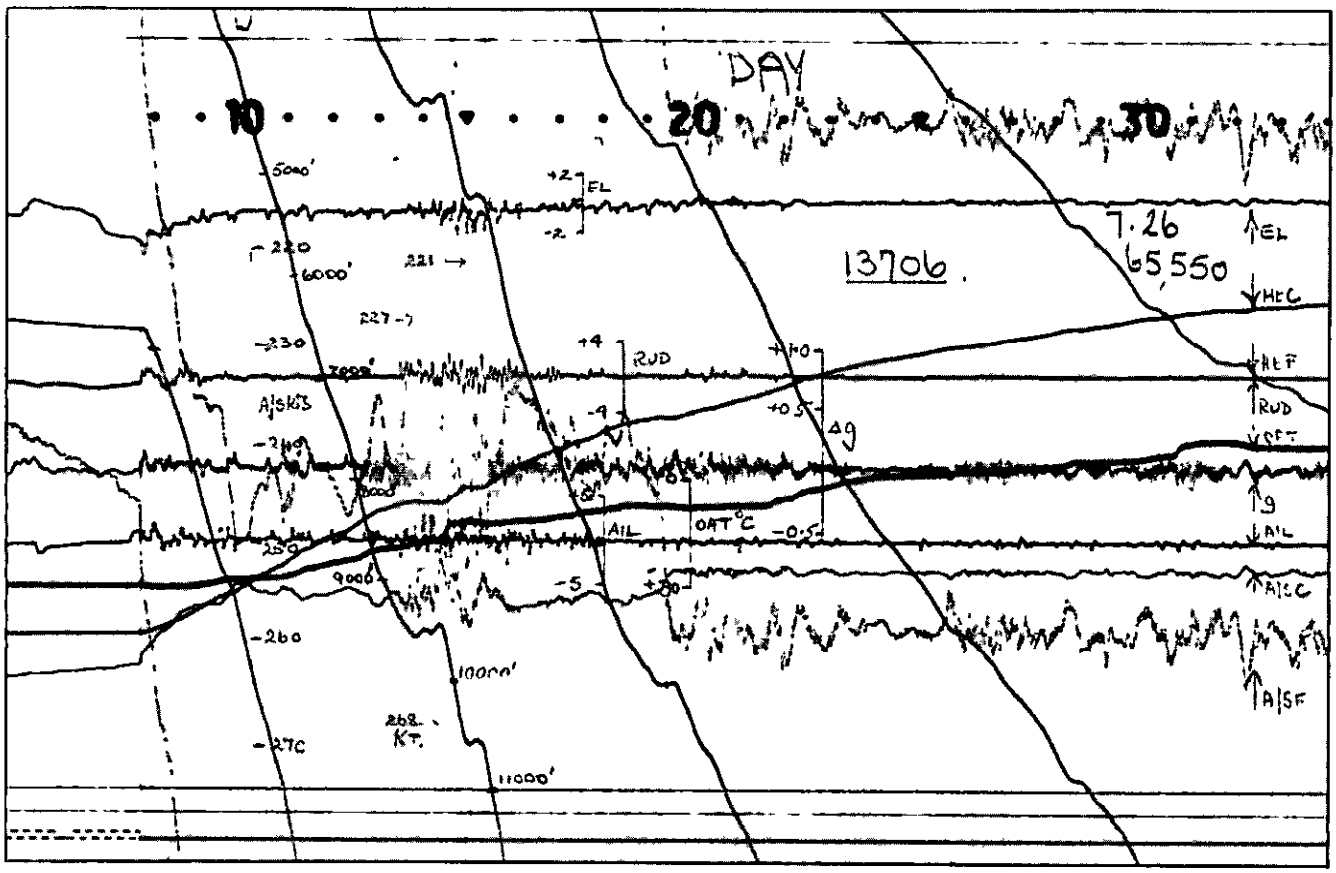

Fig.A7 Event in flight 13706

A.4 Events during cruise

A.4.1 Incipient 'jet upsets'

Sector: (a) Bombay - Colombo, January 1963, Flight 00349.
(b) London - Athens, July 1964, Flight 10791.

(a) Flight 00349

Description

An unusual deflection of the accelerometer trace at 1458Z occurred during a period of normal cruise at 24000 ft. At 1511Z the aircraft commenced to lose height and gain airspeed rapidly, and recovery was made by an application of aileron followed by an application of elevator (see Figs.A.8a, b).

Supplementary Information

The pilot recalled that after the Mach Warning Horn had sounded in cruise the aircraft was found to have entered a dive as the result of the autopilot disengaging without the knowledge of the crew. The autopilot disengagement was found to be due to a malfunction of No.2 inverter. No.1 inverter, which had been unreliable on previous sectors, had malfunctioned earlier in the flight, and some of its load (including the autopilot) had been transferred to No.2 inverter. The flight recorder was left on No.1 inverter.

Discussion

The unusual behaviour of the accelerometer trace at 1458Z was probably due to the malfunction of No.1 inverter. The accelerometer is an ac instrument (the only ac instrument in the recorder): in the event of failure of its power supply the indicator mirror is slowly deflected to a standby position by means of a weak spring in the indicator. The accelerometer was functioning normally after 1459Z.

Examination of the elevator and aileron traces suggests that the autopilot disengaged at approximately 1511Z, leaving the aircraft slightly out of trim laterally and nose down. The aircraft slowly went into a dive and the crew were finally alerted by the Mach Warning Horn. Recovery was made by application of aileron followed by elevator suggesting that the aircraft had entered a spiral dive. Approximately one minute elapsed between autopilot disengagement and the initiation of recovery action. During the incident the airspeed increased by some 20 knots, the aircraft lost about 1500 ft in height and a maximum normal acceleration increment of 0.3 g was experienced. The operational limit for this aircraft is 1.5 g increment.

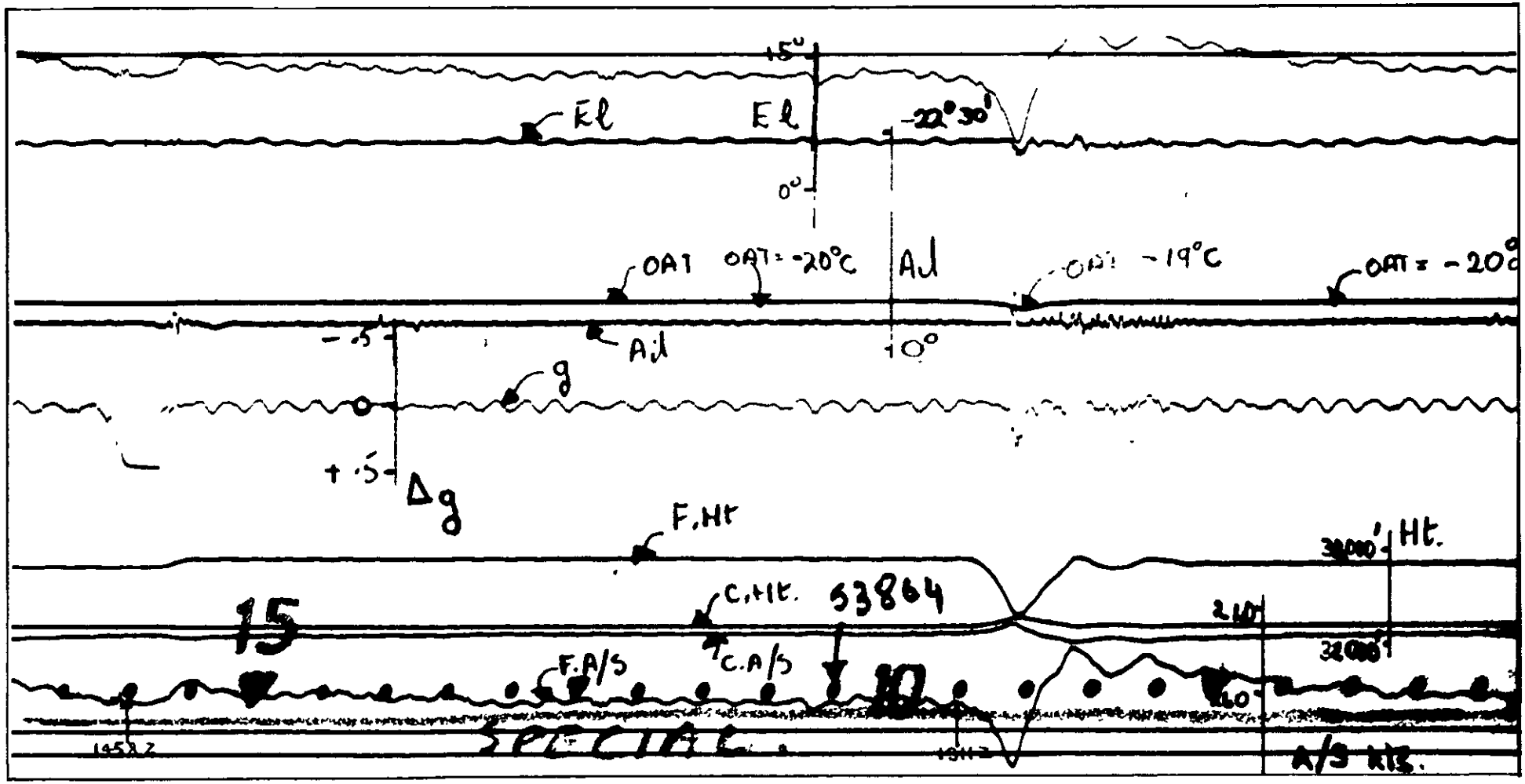

Fig.A8(a) Event in flight 00349

(b) Flight 10791

Description

Some four minutes after commencing cruise at 33000 ft the aircraft began to lose height and gain airspeed rapidly. (See Fig.A.8b.) As before the autopilot disengaged following an inverter malfunction. Recovery was aided by the use of airbrakes and apparently the operation of the automatic Mach trim device.

Discussion

In this instance the aircraft was left markedly out of trim laterally and slightly nose-up as evidence by the initial small loss in airspeed at time 2253Z. The aircraft then smoothly entered a spiral dive with height and airspeed changing more rapidly than in the first Event. Again the crew were alerted by the Mach Warning Horn and recovery was initiated by the use of ailerons and airbrakes. The automatic Mach trim device also appears to have operated since no elevator movement is apparent. Approximately one minute elapsed between the apparent time of disengagement and the initiation of recovery action. During this incident the airspeed increased by some 30 knots, the aircraft lost about 1500 ft in height and a maximum normal acceleration increment of 1.2 g was experienced. The operational limit for this aircraft is 1.5 g increment.

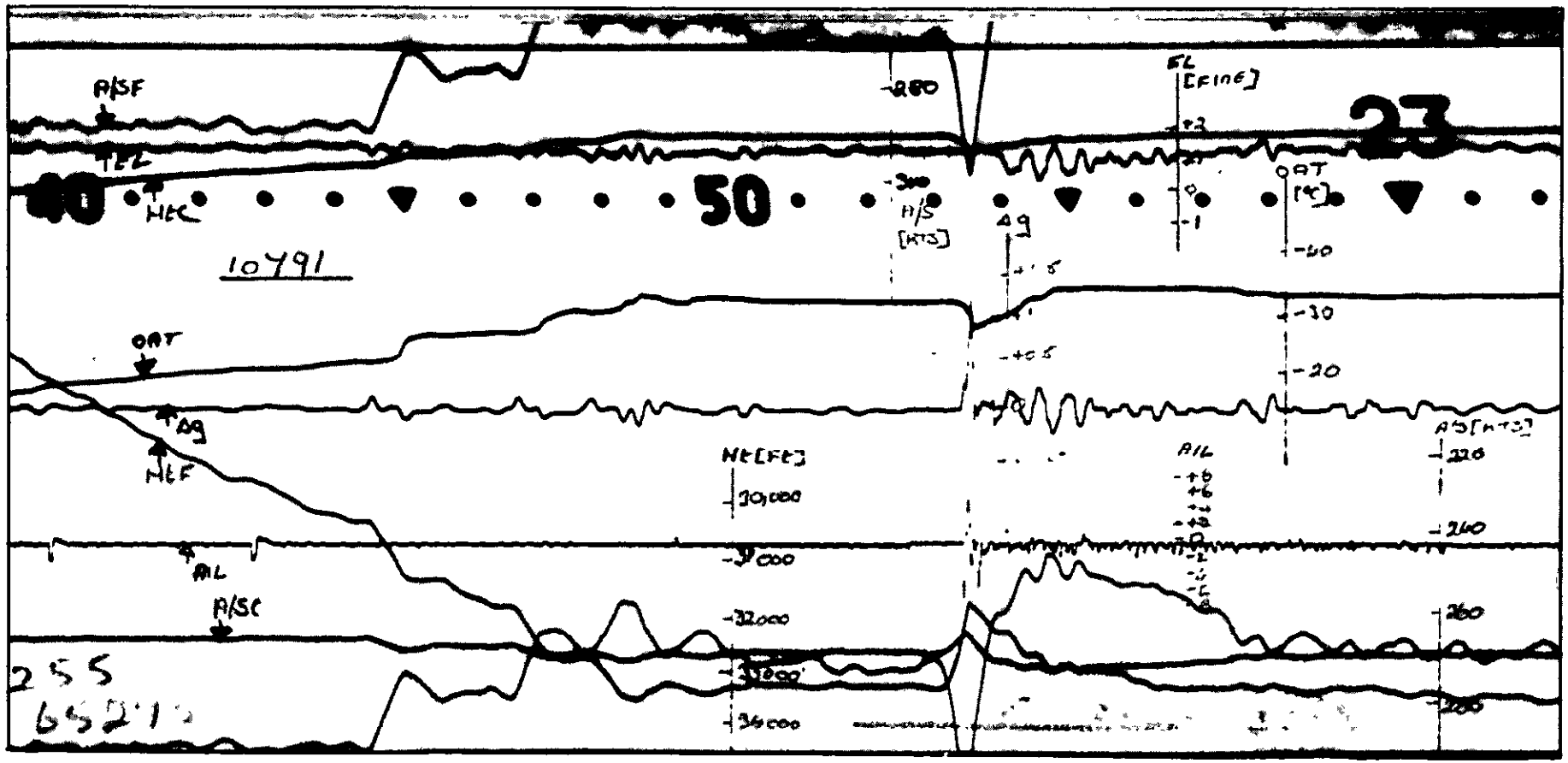

Fig.A8(b) Event in flight 10791

A.4.2 Variation of stability with Mach number

Sector: Honolulu - Tokyo, July 1963, Flight 02857.

Description

A gradual onset of unusually large and frequent aileron movements (7-10 cycles/minute) in the cruise was accompanied by fluctuations in airspeed. (See Fig.A.9.)

Supplementary Information

The pilot reported:-

"This aircraft whilst flying at 39000 ft, Mach 0.80 started to dutch roll persistently. The only way it would be made to fly steadily was by increasing speed to 0.82 Mach. Conditions covering the period mentioned were as follows:-

Alt. 39000 ft. Ram Air Temp. -30 to -34.
Static Air Temp. -52 to -57. Mach 0.80/0.81.
ias 250/252 knots. Weight 110 000 kg/100 000 kg.
Fuel in centre tank 8000 kg decreasing, wing tanks full including reserves.
Sky clear on top stratus cloud.
Below 95000 kg with centre tank and reserves empty 0.80 again established aircraft steady; static air temp. -52°C, ram air temp. -27°C, ias 250; in the initial onset of the dutch roll condition taking out the autopilot in no way assisted in establishing steady flight."

The airline reported:-

"1. C of G position was well forward (Load Sheet has been checked out as correct).

2. Amp. Computer (A/P system) was subsequently changed but the unit concerned was not u/s. Since the aircraft dutch rolled without yaw damper or A/P it could not be attributed to this system."

Discussion

The record indicates airspeeds of 260 kt, 247 kt and 260 kt, before, during and after the event, corresponding to Mach numbers of 0.83, 0.80, 0.83 respectively which suggests that the pilot was unaware that he had previously been cruising at the speed at which he finally stabilized. Normal long range cruise is at Mach numbers of 0.79-0.81 and the maximum permissible Mach number in turbulence is 0.80.

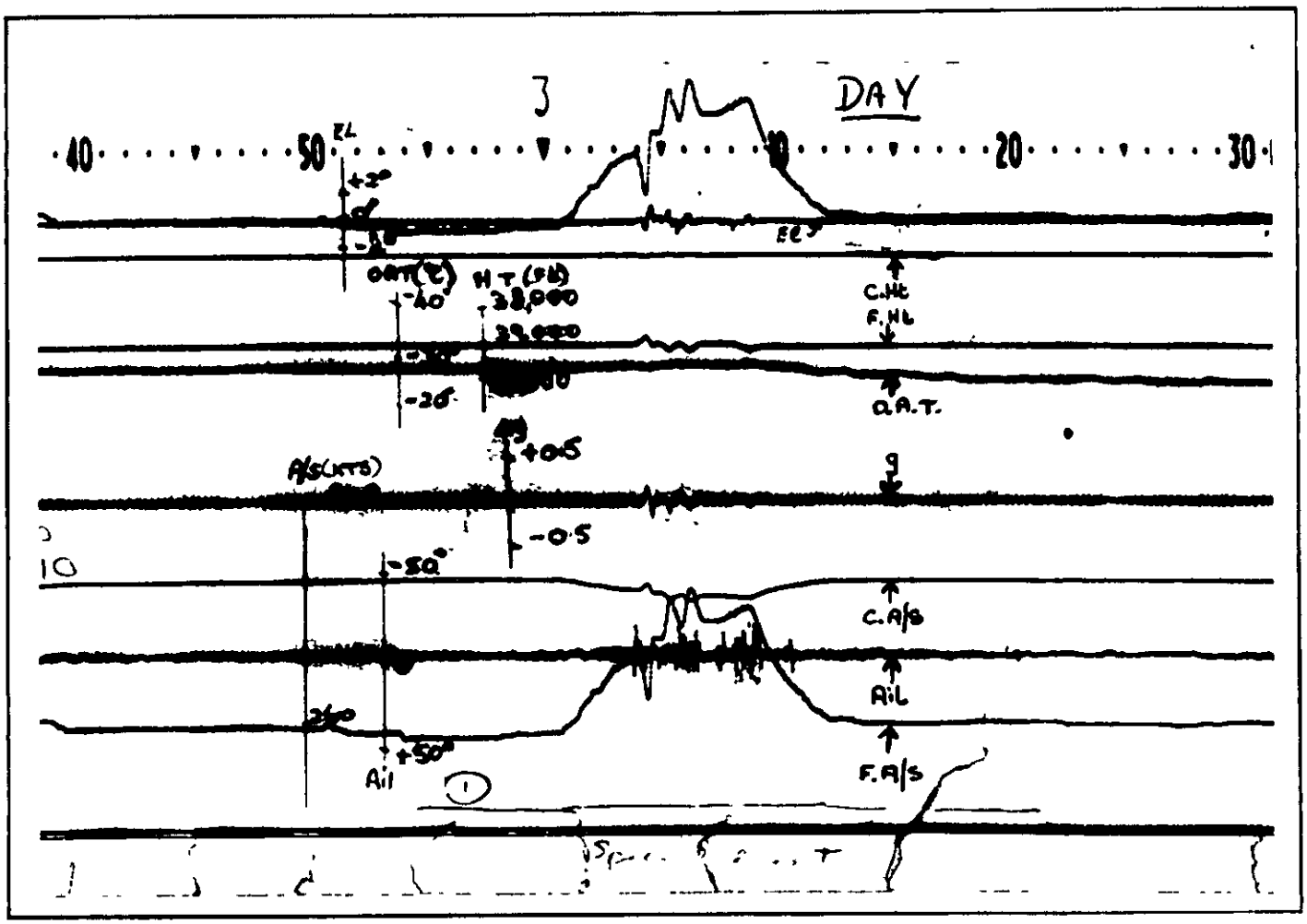

Fig.A9 Event in flight 02857

A.4.3 Emergency descent

Sector: Bombay - Karachi, June 1965, Flight 15000.

Description

During cruise at 32000 ft a pressurisation system failure was experienced and an emergency descent was made to 14000 ft. (See Fig.A.10.)

Supplementary Information

The following extracts were provided by the Airline.

(a) From the Incident Report.

"Pressurisation failure: control impossible: cabin climbing at rate 17000 ft/min: emergency descent: diverted to Karachi: 4000 kg fuel dumped for landing weight."

(b) From the Technical Log:

"The L.P. (Low Pressure) duct pressure dropped to zero or very near zero. All bleed opened but still no L.P. pressure.

Emergency descent to 14000 ft when L.P. duct rose and cabin started to pressurise, but any attempt to turn-off a bleed resulted in an uncontrolled climb of the cabin which indicated a high leak rate from the L.P. duct. Both before and after the incident both controllers (auto and manual) functioned normally."

Discussion

The recommended descent procedure was followed very closely. Airspeed was reduced and a turn initiated before commencing the descent from 32000 to 14000 ft. This was accomplished in $3\frac{1}{2}$ minutes without significant exceedance of either the Mach number of airspeed limitations of M = 0.83 and 320 knots respectively.

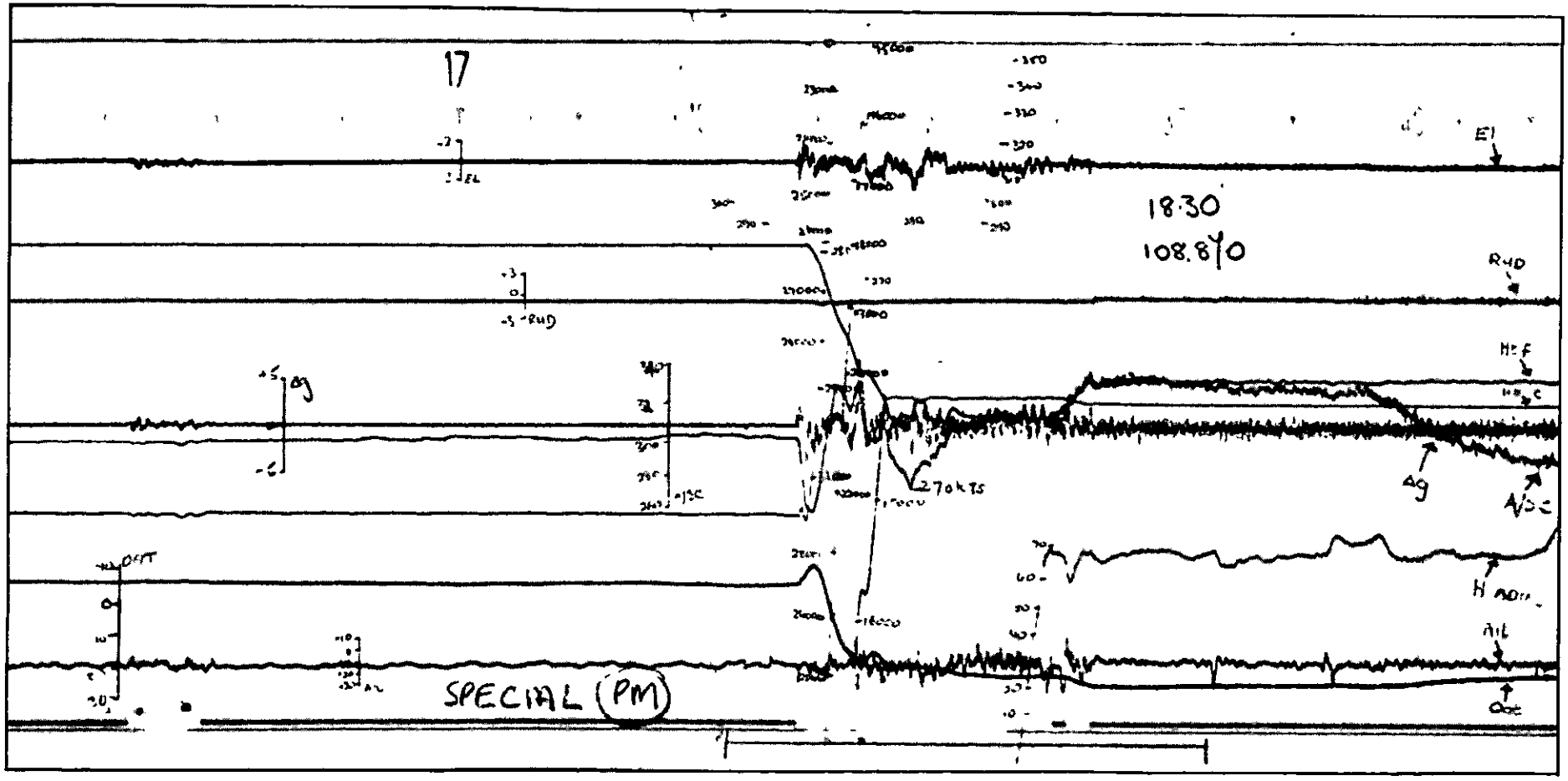

Fig.A10 Event in flight 15000

A.5 Events during descent

A.5.1 Height losses in a holding pattern

Sector: Jesselton - Hong Kong, July 1965, Flight 15273.

Description

The aircraft was apparently requested to fly a holding pattern at 6000 ft, but considerable height was lost in both initial and final turns. (See Fig.A.11.)

Supplementary Information

The aircraft was being flown by the crew of an airline to which the aircraft was temporarily on charter. The Event occurred during the day, apparently in the absence of cloud.

Discussion

The aircraft entered both turns at an altitude of 6000 ft, but failed to maintain height and lost 350 ft in the first and 700 ft in the second turn; during this period the airspeed varied between 210 and 250 kt. Although such imprecise airspeed control is not exceptional, altitude holds are normally maintained to within 100 ft or so.

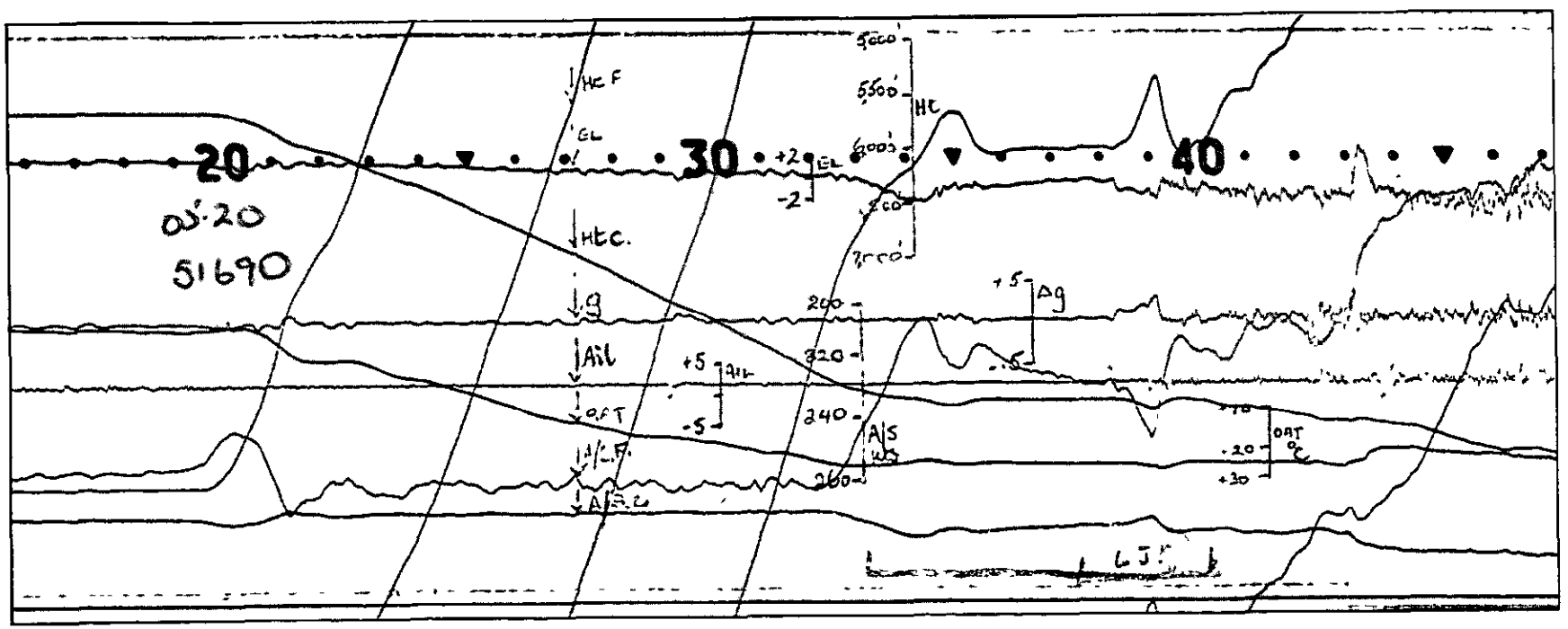

Fig.A11 Event in flight 15273

A.5.2 Steep glide path

Sector: Nassau - Miami, October 1964, Flight 11724.

Description

The indicated rate of descent during final descent and approach exceeded 2700 ft per minute, reducing to 2000 ft per minute until just before the threshold. The indicated airspeed at threshold was 146 kt and a positive normal acceleration increment of 0.8 g was recorded at touchdown. (See Fig.A.12.)

Supplementary Information

It is known that the flight plan scheduled 10 minutes from top of descent to touchdown, and that the achieved time was 10.5 minutes. The aircraft was being flown by the First Officer and the landing was at night.

Discussion

This is included as an example of high rate of descent during approach. More normal final approach descent velocities for this aircraft type are near 750 ft per minute. The threshold speed was hight but within the recommended band of 139 to 147 kt.

On the glide path from 6000 ft to 1000 ft the estimated average ground speed was 170 kt and rate of descent 2700 ft/min; this gives a glide path angle of 9^{o} compared with the normal 3^{o}. From 1000 ft to the ground (150 kt, 2000 ft/min) the angle reduced to $7\frac{1}{2}^{o}$. Information was not available to enable wind speed to be taken into account but this would almost certainly have increased the estimated approach angle by a small amount.

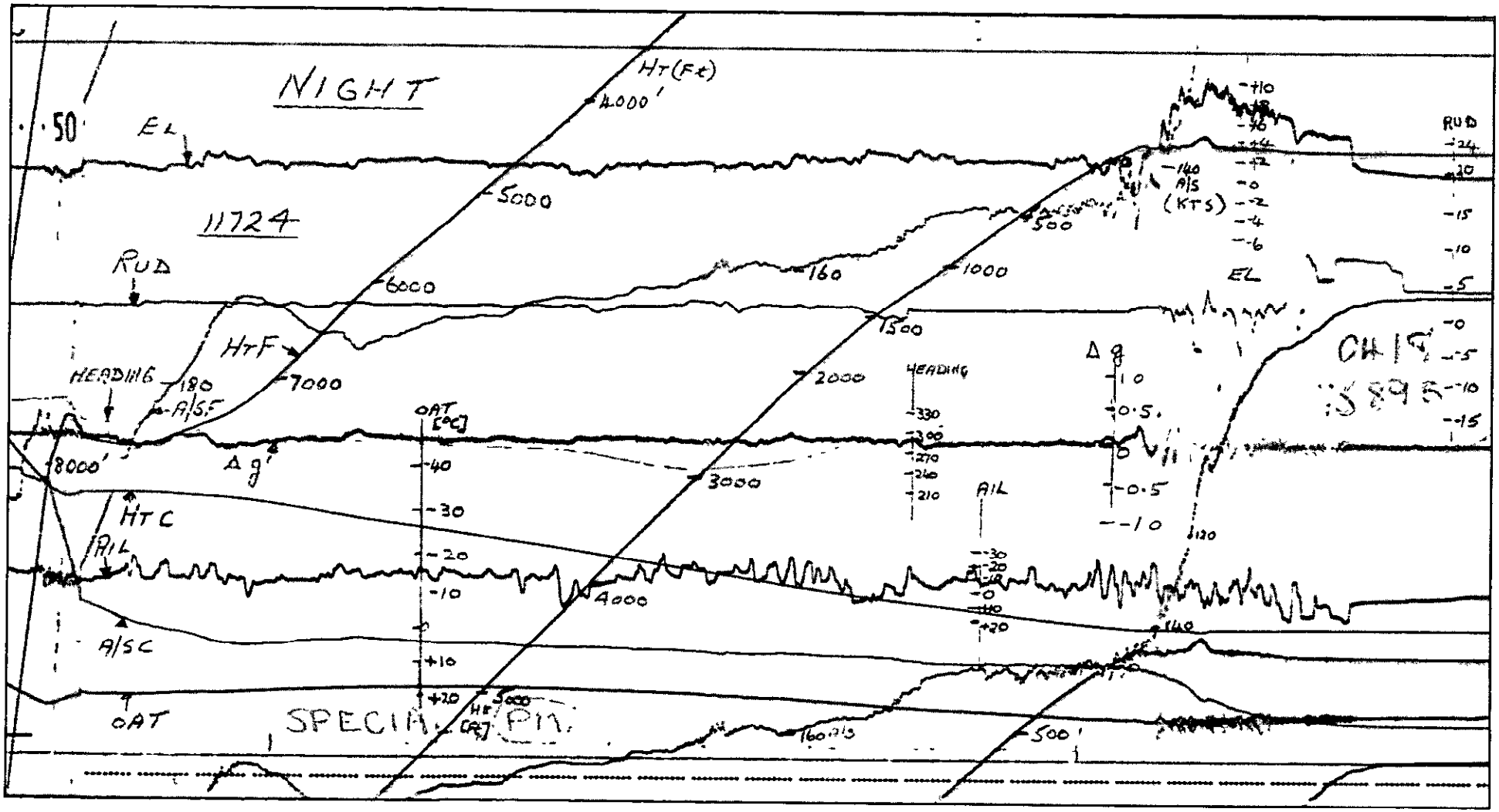

Fig.A12 Event in flight 11724

A.6 Events during final approach and landing

A.6.1 Unusual control usage

Sector: (a) Honolulu - Tokyo, February 1964, Flight 05871.
(b) Prestwick - New York, February 1964, Flight 06212.

Description

Both records show unusually large and rapid use of aileron and elevator controls during approach and landing. (See Figs.A.13a, b.)

Supplementary Information

Met data for both landings are given in Appendix B, Met Reports 4 and 5.

Discussion

The approaches were made in turbulent conditions, but the recorded normal acceleration increments appear to be almost entirely due to manoeuvres; the pilot inputs to the aileron and, to a lesser extent, to the elevator, indicate over-control. A common feature of both landings appears to be the irregular descent rate, which suggests that unaided visual approach procedures were employed.

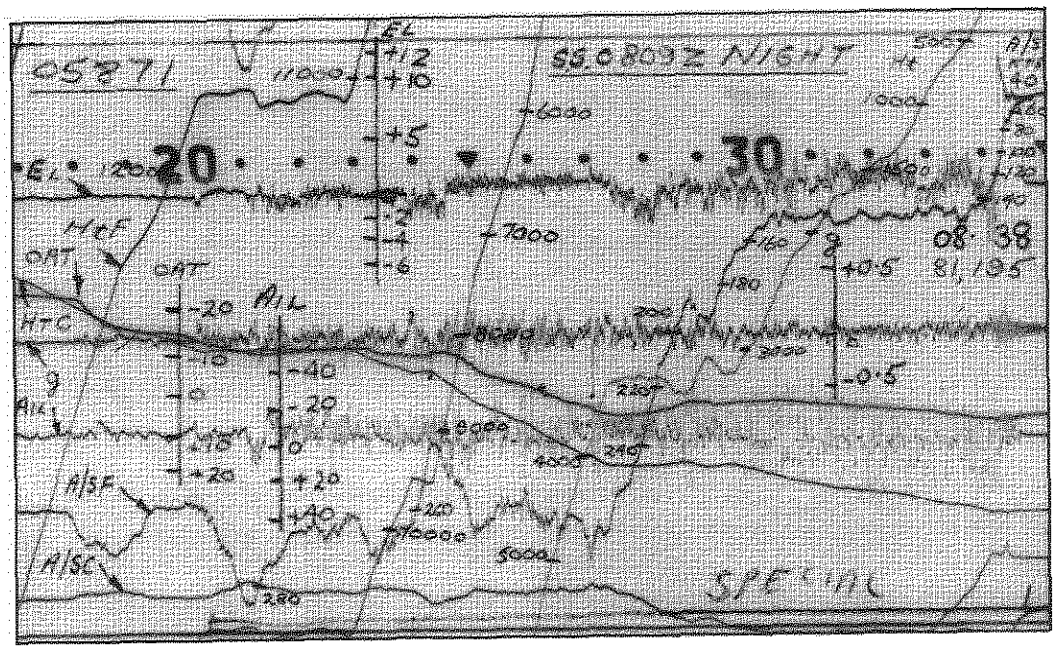

Fig.A13(a) Event in flight 05871

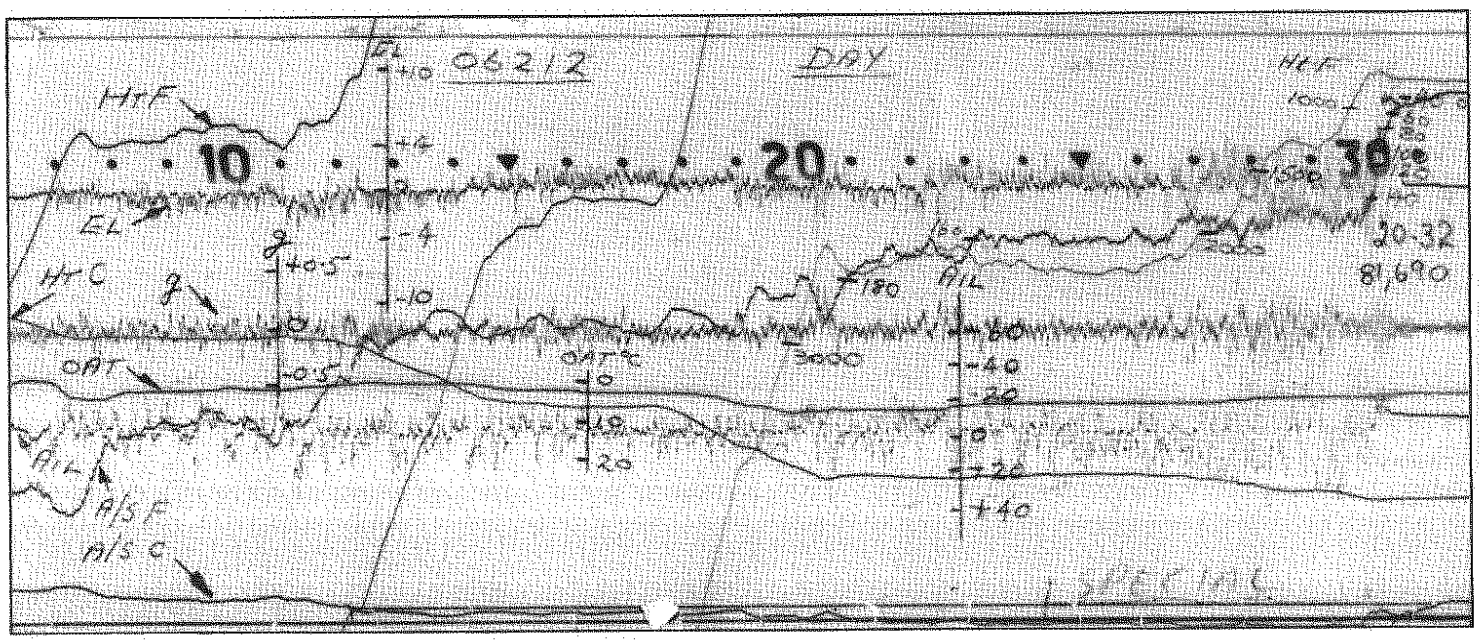

Fig.A13(b) Event in flight 06212

A.6.2 Engine pod scrapes

Sectors: (a) Trinidad - Barbados, May 1964, Flight 08236.
(b) Darwin - Hong Kong, October 1964, Flight 11533.
(c) Stansted - Stansted, August 1964, Flight 09959.

Description

On aircraft of the same type, two operational landings were made in which an engine pod or engine pods touched the ground. Approach and threshold techniques were recorded as normal in each case. In the landing at Hong Kong some turbulence was present but there was none in the Barbados landing. The third record is from a training flight where two pods touched the ground during a touch-and-go with a simulated engine failure. (See Figs.A.14a, b, c.)

Supplementary Information

The local meteorological conditions prevailing during each operational landing are given in Appendix B, Met. Reports 6 and 7. Reports by the crews are given in Appendix C.

Landing at Barbados: Runway in use - 09 Landing by First Officer.
Landing at Hong Kong: Runway in use - 13 Landing by Captain.
Landing at Stansted: Runway in use - 05 Landing by First Officer under training.

Discussion

During the Barbados and Stansted incidents, steady crosswinds of 14 kt and 18 kt respectively were reported at 55° and 60° from starboard. The Hong Kong incident also occurred in crosswind conditions and on this occasion the wind was at 50° from port at 12 kt with some evidence of gusting to 32 kt. Visibility was not critical and cloud base was 1200-1400 ft at Barbados and Hong Kong. Full lateral control movements were not employed during these landings, but were used during the Stansted take-off. Inputs to the aileron control were the same for both the Barbados and Hong Kong incidents with increasing amplitude towards touchdown.

NOTE: On the records of the Hong Kong landing, the CAADRP accelerometer was slightly underdamped, which resulted in excessive noise on the normal acceleration trace after touchdown.

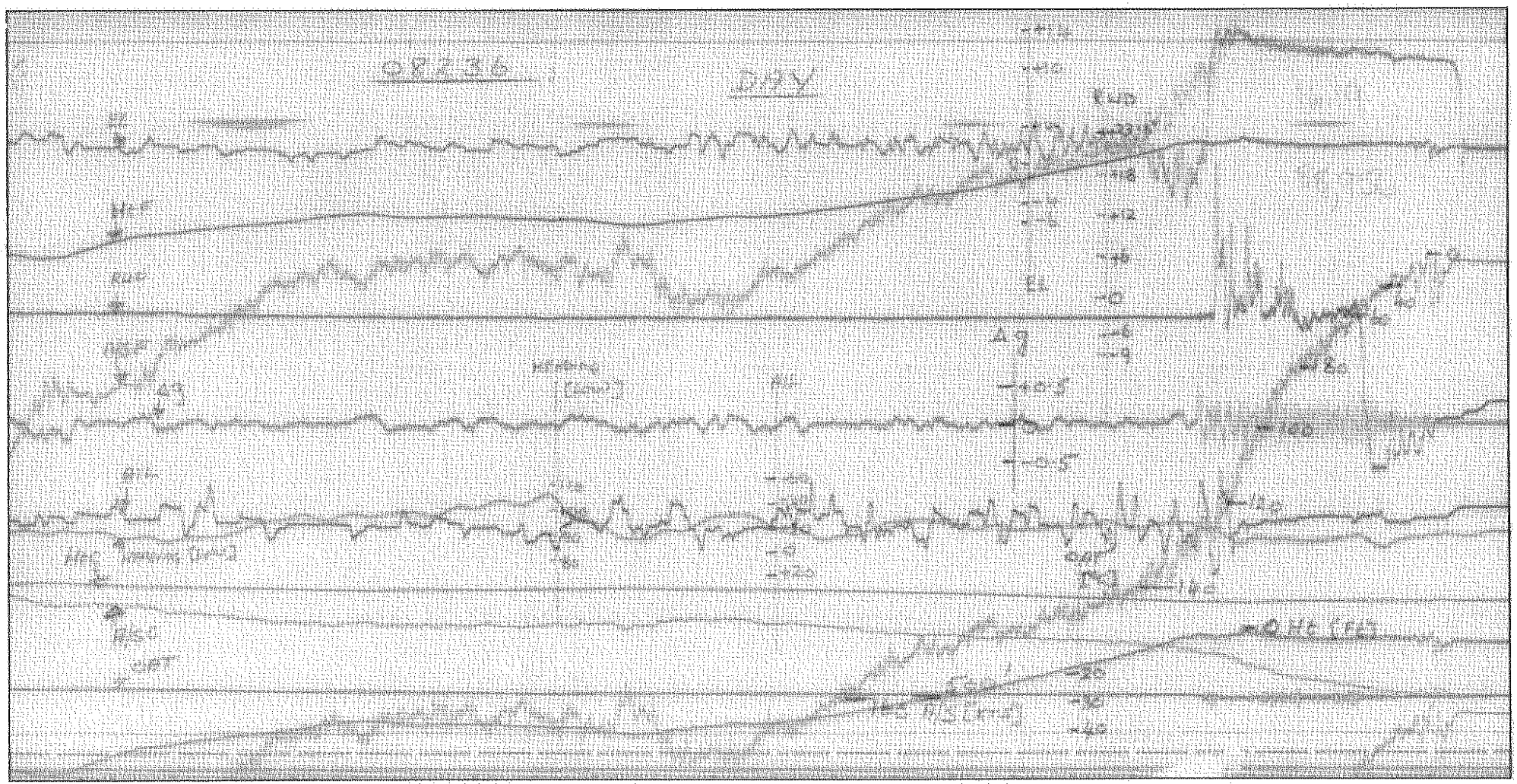

Fig.A14(a) Event in flight 08236

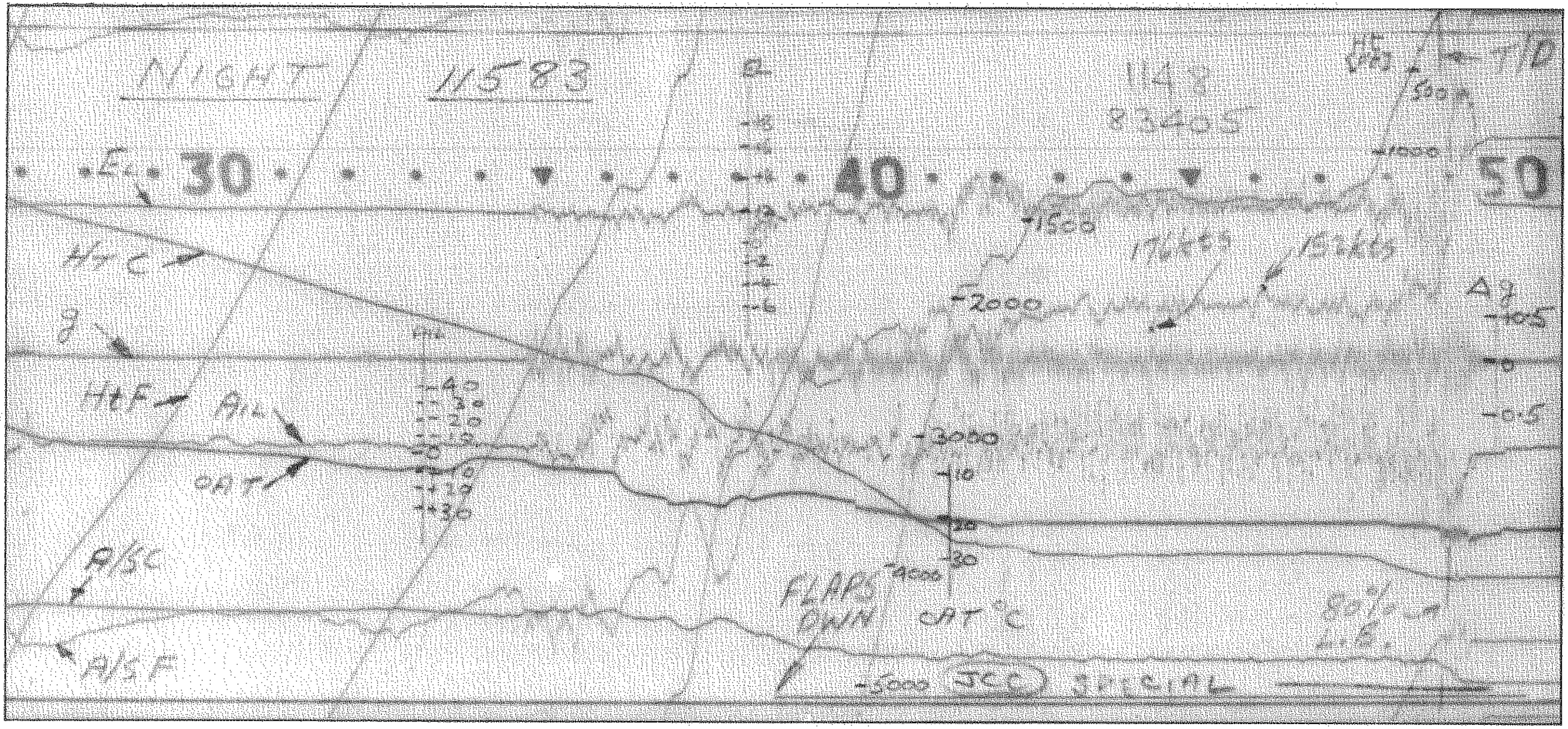

Fig.A14(b) Event in flight 11583

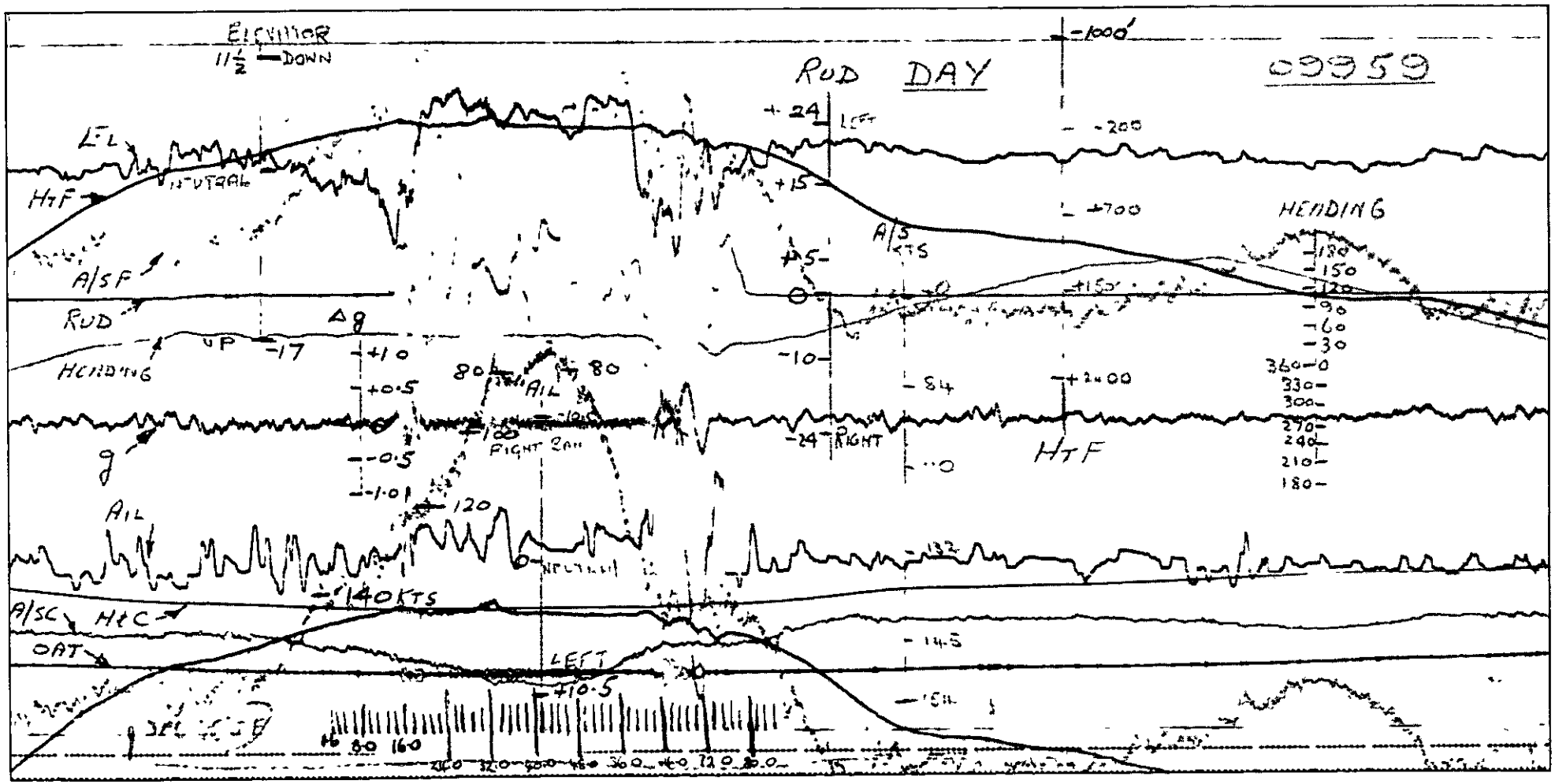

Fig.A14(c) Event in flight 09959

A.6.3 Unusual elevator usage during flare

Sector: Malta - Naples, May 1963, Flight 01065.

Description

An abnormally high elevator deflection was applied progressively during the later part of the flare and after touchdown. (See Fig.A.15.)

Supplementary Information

The aircraft was near maximum landing weight but a runway of adequate length was available; the runway at Naples is 7218 ft long.

Discussion

The steady and prolonged application of elevator suggests that the nosewheel was held off the runway to assist deceleration, possibly on a wet surface, at near maximum landing weight.

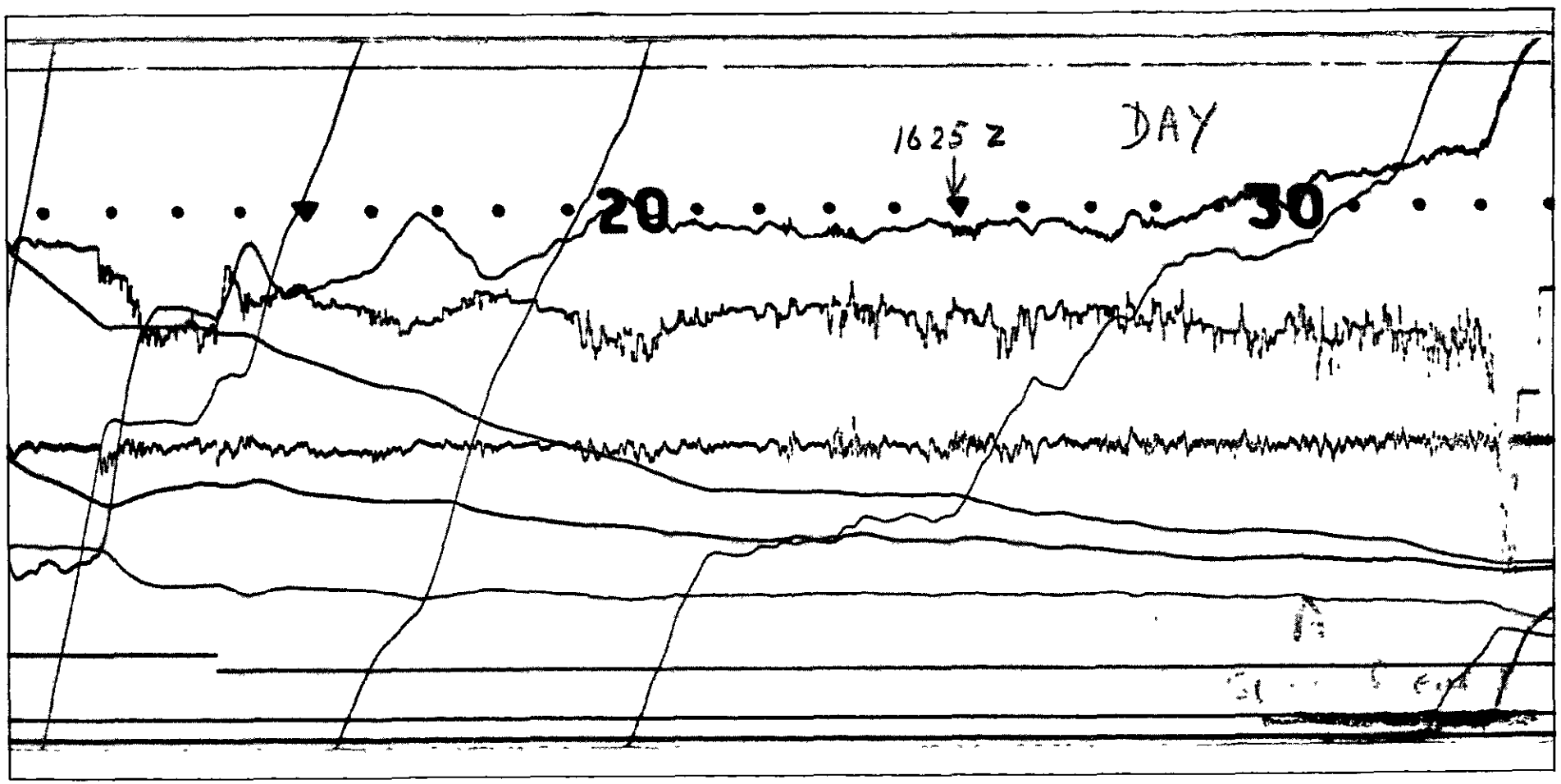

Fig.A15 Event in flight 1065

A.6.4 Use of full starboard aileron

Sector: Rome - Amman, February 1964, Flight 06132.

Description

Full starboard-bank aileron was applied on touchdown (see Fig.A.16).

Supplementary Information

Meteorological data are presented in Appendix B, Met. Report 8.

Discussion

The control movements are consistent with a controlled port sideslip onto the runway centre line followed by a vigorous 'kick-off-drift' manoeuvre during which port rudder and full starboard aileron were applied.

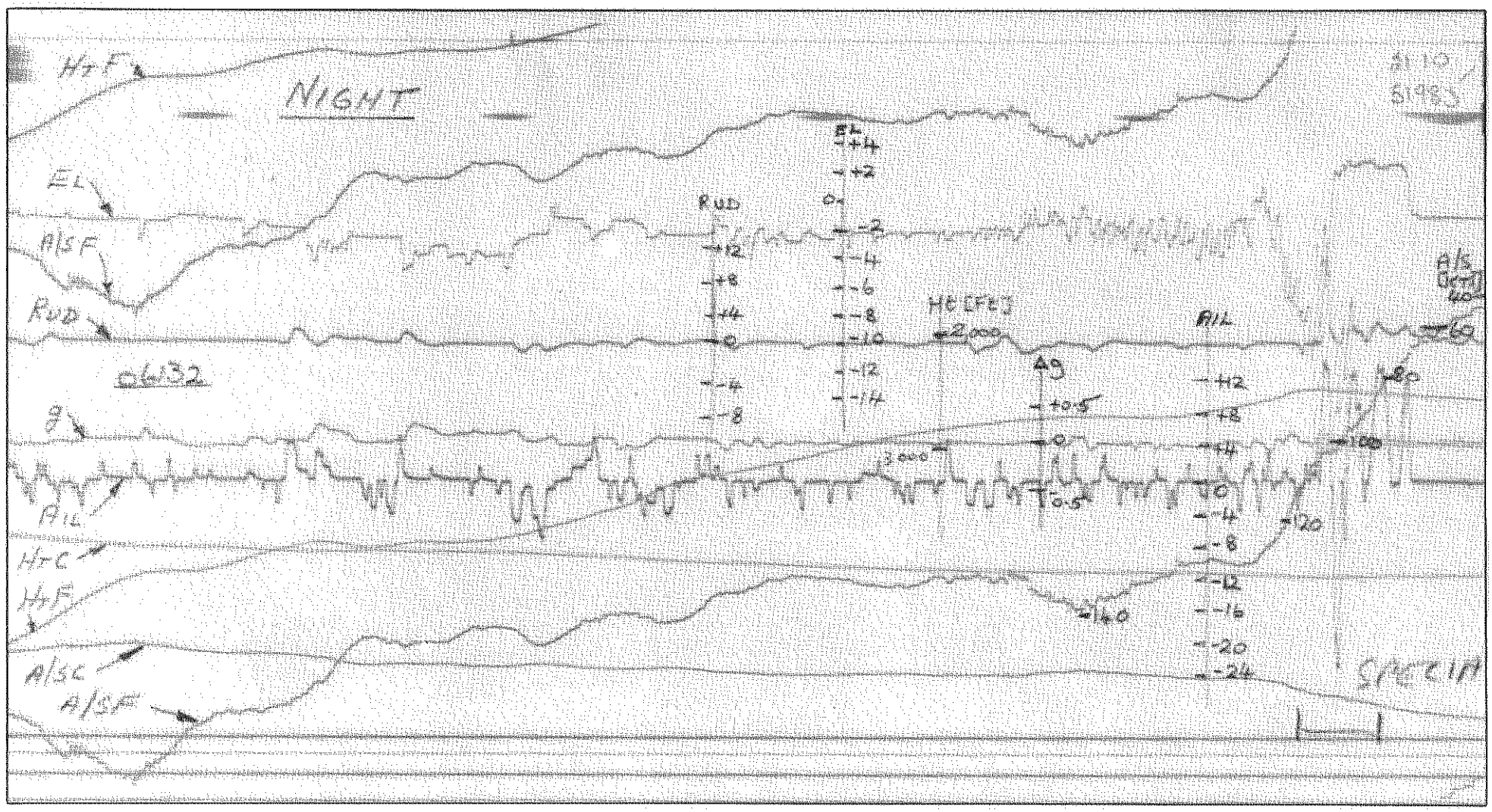

Fig.A16 Event in flight 06132

Appendix B

AVAILABLE METEOROLOGICAL REPORTS

Where they have been available, full and partial reports on local meterological conditions prevailing in the area of certain Special Events have been referred to. These are reproduced here.

B.1 Event in Flight 04827

GMT	Surface wind	Weather	Visibility	Cloud	QFE	Temp/dew pt.	Relative humidity
1545	170°/17 kt	Mod. rain	5 mm	2/8 St. 800 ft 8/8 St.1400 ft	990.9 mb	11.8°/11°C	94%
1615	180°/23 kt gusting 31 kt	Heavy rain	5 mm	8/8 St.1400 ft	-	11.8°/11°C	-
1645	180°/23 kt	Heavy rain	5 mm	8/8 St.1300 ft	988.2 mb	11.8°/11°C	94%

N.B. Runway in use 10 right.

B.2 Event in Flight 01830

Surface Met. Forecast and observations from Schipol Airport

Forecast

GMT	Wind	Visibility	Cloud	Weather
General:- 1300-2200	130°/5 kt	10 km	2/8 Cu 5000 ft 3/8 Ac 15000 ft	Haze
Varying to:	-	8 km	5/8 Cu 4000 ft	Light/Heavy Showers
Tending (with a 40% probability) between 1500-1800, to:	Var/15 kt	2 km	2/8 Cu 1000 ft 7/8 Cb 3000 ft	Thunderstorms

Observed

GMT	Wind	Visibility	Cloud	Weather	Temp/dew pt.	QNH
14:50	290-304°/17 kt	7 km	6/8 Cb 4000 ft 8/8 As 8000 ft	Thunderstorms	-	-
15:20	300°/9 kt	5 km	7/8 Cb 4000 ft	Thunderstorms	15°/14°	1013.3 mb
15:50	050°/7 kt	10 km	2/8 Cb 4000 ft 6/8 Sc 4000 ft	Thunderstorms	-	-

B.3 Event in Flight 13706

A scrutiny of the analytical as well as prognostic charts of 21.3.65 in relation to this aircraft, which left Calcutta at 0707 GMT for Singapore have shown no significant discontinuation or wind shears. It is however seen from the weather radar records at DUM DUM that during the period 06.45-07.00 GMT on 21.3.65 when the radar was in operation, there was a line type thunderstorm extending from 240 to 130 azimuth from west to south west of the radar station with an average height of the top of 12 km. The range corresponding to 240 azimuth was about 30 km and that corresponding to 130 azimuth about 65 km.

METEOROLOGICAL REPORTS

B.4 Event in Flight 05871

Tokyo Met Report

GMT	Ceiling cloud	Visibility	Direction wind	Pressure	Weather	Temperature dew point
0800Z	1000 ft scattered	12 nm	Calm	1002.6 mb	Rain	46°F/30°F
0830Z	1000 ft scattered	12 nm	East/6 kt	1003.0 mb	Occasional light rain shower	46°F/-
0900Z	1000 ft scattered	15 nm	Calm	1003.0 mb	Rain shower	46°F/28°F

B.5 Event in Flight 06212

New York Met Report

EST	GMT	Cloud and ceiling Measured	Cloud and ceiling a/c reports	Surface visibility	Surface wind	Weather	Runway in use
1454	1954	1000 ft SCTD	1600 OVCST	3 nm	050°/22 G28 kt	Rain/fog	040°
1514	2014	1000 ft SCTD	1500 OVCST	3 nm	060°/20 G25 kt	Rain/fog	RVR less than 6000 ft
1526	2026	800 ft SCTD	1000 OVCST	3 nm	050°/25 G33 kt	Rain/fog	
1539	2039	800 ft BRKN	1000 OVCST	2½ nm	050°/24 G30 kt	Rain/fog	
1540	2040	800 ft BRKN	1000 OVCST	2 nm	050°/24 G30 kt	Rain/fog	
1551	2051	700 ft BRKN	1000 OVCST	2 nm	050°/25 G31 kt	Rain/fog	
1630	2130	800 ft BKRN	1000 OVCST	1½ nm	060°/25 G32 kt	Rain/fog	

B.6 Event in Flight 08236

Met. data from Barbados: Day, Overcast 1400 ft, visibility 6 miles, wind 145°/14 kt.

B.7 Event in Flight 11583

Met. Report from Hong Kong:

GMT	Wind	Visibility	Cloud	QFE	QNH	Temp.	Dew point	Humidity
11.30	080/12 gusting 27 kt	5 nm Rain	3/8 1200 ft 5/8 1800 ft 8/8 8000 ft	Not available	1008 mb	25°C	Not available	Not available
12.00	070/12 gusting 23 kt	5 nm Rain	3/8 1200 ft 4/8 1800 ft 8/8 8000 ft	Not available	1009 mb	25°C	Not available	Not available
12.30	090/19 gusting 32 kt	5 nm Rain	3/8 1200 ft 3/8 1700 ft 8/8 8000 ft	Not available	1009 mb	25°C	Not available	Not available

B.8 Event in Flight 06132

GMT	Wind	Visibility	Weather	Cloud	QNH	Temp/dew point
2100	270/10 kt	20 nm	Fair	3/8 Cu at 2000 ft	1015.9	07°C/06°C

Appendix C

SPECIAL REPORTS

Additional reports on the events where the engine pods touched during landing, extracted from the Air Safety Review of the airline concerned

C.1 Landing at Barbados, Flight 08236

"During the landing on runway 09, which was being carried out by the First Officer, No.1 engine pod scraped the runway. The Captain reported that on touchdown the starboard wing lifted and neither he nor the First Officer were quick enough in taking corrective action to prevent the pod touching the runway."

"Examination showed that the engine was undamaged. The damage to the cowling was slight and considered satisfactory for further service."

C.2 Landing at Hong Kong, Flight 11583

C.2.1 Captain's report:

"The let down to the CC.NDB was carried out in heavy cloud, rain and moderate turbulence. We became visual over Cheung Chau Island at 1200 ft in rain. The Stonecutter Strobe light became visible approximately 40 seconds after leaving the beacon and, on going by Green Island, Kowloon could be clearly seen. The high intensity lights were requested, identified and the base leg and final approach started. Turbulence at this time was slight, in fact no more than would be expected in the weather conditions prevailing at the time. On short finals at 400 ft turbulence was encountered, this became severe at between 150 ft and 100 ft when I was committed to the landing. Immediately after touch-down the port wing lifted rapidly, a correction with rudder and aileron was initiated, then the port wing dropped sharply. A reverse correction was applied and the nose wheels lowered to the ground. I called for speed brake and the First Officer operated them. The landing was completed in a normal distance."

C.2.2 First Officer's report

"Just prior to overheading lead-in lights TWR confirmed W/V 090/15 kt. At 400 ft turbulence was encountered, becoming severe at 150/100 ft. At this time the aircraft was on centre line (RWY) and in the correct 'slot', speed V. Ref. +20, 151 knots. I called this speed and continued to monitor. The round out was made at the correct position and height - speed V. Ref. +15 knots approximately. The wings were level and there was no appreciable drift.

On touchdown the port wing came up at a rapid rate and the aircraft commenced to drift starboard. Application of aileron and rudder stopped this tendency and as the nose was lowered the port wing dropped very rapidly. The Captain immediately applied reverse aileron (to starboard) but this did not stop the roll until a relatively high angle of bank was attained. At this time the nose wheel was on the ground. The Captain continued to 'fly' the ailerons and he called for speed-brake - which I operated - then 'reverse'. I reversed all four engines, the Engineer and myself monitoring the application of power in reverse thrust which was entirely normal. At 100 knots the Captain took control of the throttles and the landing run was completely normally."

C.2.3 Third Pilot-Navigator's report

"On departure from Cheung Chau I was positioned in the jump seat on the aircraft monitoring the approach to runway 13. At this point I copied the actual weather passed by the TWR to be: visibility 3.5 miles, light rain at the airfield. We reported in acknowledgement that we have approximately 5 miles in light rain and had Green Island and Stonecutters Strobe in view. TWR then gave a wind of 090/18 knots and reported that gusts up to 30 knots had been experienced during the previous hour. At no time on the approach did we receive any information from the tower concerning turbulence on the approach."

C.2.4 Aircraft/ATC communications

"The play-back of the ATC recording confirmed the crew's report regarding visibility in that it was between 5 to 6 miles throughout the approach from Cheung Chau and it was also confirmed by a following aircraft which landed three minutes later. Regarding the surface wind, however, the First Officer (N/O) who acted as communicator from Cheung Chau to Kai Tak stated in his report that after leaving C.C. Tower gave a wind of 090/18 and reported that "there had been gusts up to 30 knots in the previous hour". The Captain appeared to be mildly critical of the Tower for not passing information on current gusts during his approach. However, the tape replay showed that the first message from the Tower to 802 after passing Cheung Chau stated "070/15 gusts to 30 knots in last 15 minutes". This was acknowledged by the aircraft. It was obvious from the quite genuine amazement of the Captain when he heard his replay that he had not heard this message in flight. The co-pilot was

also unaware of the message until hearing the playback. After this communication the Tower passed three further winds but made no mention of gusts: the last wind passed immediately before touchdown was 070/13. A subsequent check of the anemometer showed a gust of 31 knots about the time that the aircraft landed."

C.2.5 General review comment

"Prior to the incident the landing direction was 31 but the wind changed and aircraft was advised during descent that runway 13 was to be used. The aircraft weight was well within the limitations and the weather was above the minima for a night landing on runway 13.

The Captain advised that at the time of the incident power was OFF and he found it necessary to keep both hands on the flying controls due to the turbulence which was being experienced. He also stated that since 1.10.64. when posted to Hong Kong he had made one previous landing at night on runway 13 in similar wind conditions. The marks on the cowlings indicated that the aircraft was almost level fore and aft when the pods touched the runway."

C.3 Touch and go landing at Stansted, Flight 09959

C.3.1 General

Conditions: day, good visibility, wind 110/18 knots, weight - 86000 kg approximate VR 125 knots. Runway 05.

Just after take-off from a touch and go landing the aircraft banked sharply to port, the port wing tip struck the ground outside the runway and No.1 engine struck the runway. The aircraft was being flown by a First Officer in the right hand seat and No.1 engine had been throttled at VR to simulate a failure. The Captain took over and eventually regained control of the aircraft and returned to London without further incident.

Examination showed that the port wing tip was extensively damaged and the undersurface on No.1 engine cowling and exhaust unit were severely scraped. The wing tip and engine were changed.

C.3.2 The Captain's report

"The First Officer was under check and in control of the aircraft for take-off from runway 05 at Stansted, with wind reported 110/18. He had been briefed that the check would include a simulated engine failure at take-off but not warned that it would occur on this particular occasion.

At 125 knots ias I called 'rotate' and at the same time set No.1 thrust lever to the idle position. The take-off appeared to proceed normally until yaw and bank to the left developed rapidly. The First Officer reported to me later that this was due to application of left rudder after what he thought to be excessive correction with right rudder during engine failure, and this is consistent with the manoeuvres which ensued. The yaw and bank mentioned were checked in a rather extreme attitude by application of full rudder and aileron. No.1 thrust lever was set to 100% rev/min but it was not until thrust developed on the engine that recovery started and was completed after one oscillation to the right. Stansted Tower reported that the port wing tip had touched the ground so after visual inspection the aircraft was checked at V Ref with full flap before returning to London. In addition to reporting damage, a flap check was requested in case limiting speed had been exceeded, although I think it very unlikely that this had in fact occurred."

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February 1969

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Since October 1962 continuous trace records of airworthiness data have been taken from a small number of aircraft in normal airline service. Throughout the recording period the records have been searched for unusual occurrences, and each of these has been studied to determine its nature and, where possible, its cause.

This paper describes a selection of Events relating to handling and control which were detected in records taken between January 1963 and February 1966.

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