Overseas National Airways, Douglas DC-10-30, N1031F, accident at Istanbul Yesilkoy Airport on 2 January 1976, report dated 7 September 1976, released by the General Directorate of Civil Aviation, Ministry of Communications, Ankara, Turkey

1. INVESTIGATION

1.1 History of Flight

Saudia 5130, an unscheduled international passenger flight, from Jeddah to Istanbul with alternate Izmir. As Istanbul was reporting marginal weather in the forecasts. The passengers were booked to Ankara.

Saudia 5130 departed Jeddah at 01.10 hours GMT. Maintaining flight plan route, established contact with Ankara control and obtained the weather forecasts at destination as follows:

Ankara: ceiling 00, visibility 50 metres

Istanbul: clear, surface wind 270/14 knots, temperature 7°C
dew point 4, QNH 1022mb

Istanbul ACC cleared Saudia 5130 to descent from FL 350 to FL 170 reporting at flight levels 280 and 200. At 0421 before reaching YAA VOR, Saudia 5130 called Istanbul approach control and reported leaving FL 190 for FL 170. At 0421 approach control cleared Saudia 5130 to TOP NDB via YAA then Bravo point. Then cleared the aircraft to descent and maintain FL 110 expect runway 24 expect NDB approach.

Events following this instruction are shown as tape recorded in Appendix A1.

At 0437 tower called the airport fire and rescue service and reported the aircraft on fire on the Runway 24.

According to first officer statement:

a. In the both barometric altimeters minimum altitude was set to 360 ft. and was called when reached, but, this call has not been recorded on the cockpit voice recorder.

b. He also stated that after passing 360 ft. one of the VASIS lights started to turn red and he warned the Captain as "We are below the Approach Slope". This was recorded on the cockpit voice recorder. (According to the CVR transcription this warning took place only five seconds before the impact.)

c. Upon this warning from the first officer, the Captain increased the power of all three engines but they stated that they still experienced an increasing sink rate despite of extra power application which is in correlation with the DFDR recordings.

d. Description of the accident. Prior to the impact flight engineer called 50 and 40 ft. When he was calling 30 ft. the aircraft hit the ground. (0436.22 GMT) These heights called from the Captain's radio altimeter.

The point of impact was approximately on the extension of the runway centerline, at a distance of approximately 27 ft. from the beginning of the stopway and its elevation was approximately 9 ft. below the runway stopway elevation.

The aircraft struck the ground in a nose up attitude with both main gear and center gear. The gear dug into the ground deeply and the digging continued for a distance of approximately 15 ft. with left main gear digging deeper.

During the first impact number one engine separated from the aircraft and flew with a velocity higher than that of the aircraft in a direction of approximately 15° to the left of the aircraft direction.

However, there were at least two witnesses who reported fire in number one engine before the impact. But, the flightcrew stated that there were no parameter indications in the cockpit instruments to confirm this. Fire broke out on both the engine and the left wing simultaneously when the engine separated from the aircraft.

The aircraft made the second hard impact with the runway. This time the left main gear and center gear separated from the aircraft and the left wing tip made contact with the runway. The aircraft skid along the runway and turned to the left side of the runway. The nose gear dug into the ground and the aircraft moved with nose gear digging into the soft ground. The aircraft slued to the right and came to rest at a heading of approximately 160° with the landing direction at a distance of approximately 500 metres from the approach end of the runway.

When the aircraft came to stop the left wing was on fire. The flight crew reported that there were no lights in the cockpit and the cockpit was black except for the cabin door which was open allowing some light from the cabin emergency lights to enter the cockpit. When the aircraft stopped, the flight engineer closed the fuel pumps, the first officer discharged the fire extinguisher of number one engine. The captain called through the cockpit door to evacuate the aircraft. When the flight engineer located his flash light in the darkness the other fire handles were pulled down and the bottles discharged by first officer.

The stewardesses opened the doors 1R, 2R, 3R and 4L and the slides were deployed. The door 4R was jammed partially open.

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Doors 1L, 2L and 3L were open but slides were not deployed. The stewardesses evacuated the aircraft of 364 passengers in a matter of 3 to 5 minutes and before the last passenger was thrown from the forward door the fireman had foamed the fire on the left side of the aircraft.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Non-fatal	1	-	-
None	12	364	-

1.3 Damage to Aircraft

The left wing of the aircraft was burned out. The lower surface of the right wing was damaged. The lower fuselage from the wing center section to a section across the aft passenger doors was destroyed including all gear. The number one engine was destroyed and the number two engine was destroyed or damaged.

1.4 Other Damage

The aircraft destroyed the localizer antenna, the runway end lights, obstruction lights and some runway edge lights.

1.5 Crew Information

The crew was medically fit, properly licenced and adequately experienced for the flight. (See Appendix B)

1.6 Aircraft Information

See Appendix C.

1.7 Meteorological Information

Pertinent surface weather observation follows: 0430 : D GMT

Surface wind: 190/10
Visibility : 10 kms.
Temperature : 7.7°C
Humidity : 76%
QNH : 30:18 Inch. Hg.
Clouds : 3/8 Sc 900 metres

And Radiozonde information at 00:00 GMT hours as follows:

msl Altitude (m)	Pressure (mb)	Temperature (°C)	Direction/vel. in Knots
193	1000	7	225/11
510	972	6.4	240/23
1300	872	3.2	240/23
1521	850	2.4	280/20
2330	769	0.9	270/24
3069	700	-5.7	265/24
4160	608	-13.6	280/30
5607	500	-25.1	280/22
7195	400	-35.6	280/24
9135	300	-50	295/24

1.8 Aids to Navigation

Navigational facilities within the IST TMA and associated with the NDB number 3 approach for runway 24 were:

YAA VOR and the IST VORTAC are used for the area navigation. The TOP NDB was located 3.9 nm from the threshold of runway 24. Runway 24 was equipped with standard lighting and with 2-bar VASIS. But there were no approach lights at 24 approach end. There were two red (obstruction) lights located before the beginning of the stopway.

All navigational aids were functioning normally during the approach.

1.9 Communications

There were no communication difficulties reported during the flight.

1.10 Aerodrome and ground facilities

Runway 24 was a hard-surface concrete runway 7546 ft. long and 197 ft. wide. The terrain before the approach end rises to the elevation of the stopway which is 89 ft. from the mean sea level. The approach end of the runway was provided with a stopway of 60 metres.

1.11 Flight Recorders

The aircraft was equipped with a United Data control cockpit voice recorder, serial number 1028. The CVR was opened and the tape listened in the Audio Laboratory of the NTSB. The flight appeared to be routine and all checklist items and operational items were accomplished on the untranscribed as well as the transcribed portions of the tape. The transcript was arbitrarily started at the NDB inbound.

The aircraft was also equipped with a Sunstrand DFDR, model 573A, serial number 2006. The print out of the DFDR in NTSB laboratory started at 3973 ft. pressure altitude (4213.5 feet m.s.l.) on the descent to runway 24 and ended approximately 2½ minutes after impact. The engines' thrusts and 3 accelerations read incorrectly.

The DFDR was connected to the NTSB's readout equipment and a transcription (computer) tape was made. This transcription tape showed out-of-sync data in two places near the end of the flight; these occurred immediately after airspeed readings of 151 and 95 knots. The out-of-sync areas most likely mark first and second impacts of the aircraft.

Data from CVR and DFDR are discussed in the Section 2 of this report and an approach profile from the data is attached to the report.

1.12 Wreckage

Small pieces of the left flap and left main gear were scattered along the approach area of the runway. The left main gear was located on the centerline of the runway at a distance of 270 metres from the threshold. The center gear was located on the right edge of the runway at a distance of 180 metres from the threshold. The number 1 engine was located on the right side of the runway at a distance of 450 metres from threshold and 18 metres from the runway edge. The number 3 engine was trapped on the fuselage.

1.12.1 Engine Number One

The engine was inspected by General Electric power plant engineer and no unusual items were noted.

1. Borescope

See Appendix D.

2. General

a. Fan rotor. All blades were in undamaged condition and had not come into contact with the case, the abradable shroud being undamaged.

b. Accessories. The accessory gear box split in two, the break point being to the left of the transfer gear box. The main fuel filter and fuel/oil heat exchanger had the lower extremities ground off and holed. The transfer gearbox was undamaged.

c. Fire damage. There was evidence of fire damage from 4 o'clock to 1 o'clock, aft looking forward and going clockwise. The fire was heaviest in the area 4 to 7 o'clock. Sum "p" clamp rubber coverings were charred through and the outer coverings of some wire bundles also showed the same distress, however, the inner coverings were intact and no melted wires. The fire had appearance of being not very intense or of long duration.

d. Cowlings. The inlet cowl was destroyed, however, all attachment points to the fan frame were secure, the sheet metal to these still being in place. The fan cowls were missing. The fan reversers were in place and all latches and attachment points secure. The core cowls were also in place and the forward two latches secure.

There was no external evidence of fire in the areas of either cowling, however, they were all badly damaged as a result of contact with the ground.

1.13 Medical and Pathological Information

None.

1.14 Fire

At 04:37 GMT hours the control tower personnel warned the airport fire and rescue about the crash and the team arrived at the site in a matter of 30 seconds. The fire team used 2 dry chemical vehicles and 4 foam tracs. Dry chemicals and foam trace were used on both sides of the aircraft. The fire fighting team extinguished the fire in the left wing before it reached the aircraft fuselage. A total of 207 kilos of dry chemical, 1100 kilos of foam and 20,000 litres of water were used to extinguish the fire.

1.15 Survival Aspects

The accident was a survivable one as a result of effective fire fighting.

1.16 Test and Research

The Barometric altimeters were tested and found normal. (For engine number 1, see Appendix D)

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The following analysis are based on:

a. Voice recorder at A.T.C. (Air Traffic Control) in Yesilkoy Airport.

b. The DFDR (Digital Flight Data Recorder) print-outs.

c. The CVR (Cockpit Voice Recorder) transcription.

d. Correlation of 3 recorders.

e. Additional evidences strengthening these recording data.

The first discontinuity in the DFDR print-out was considered to be the first point of impact. Print-outs after the first point of impact were considered to be unimportant as far as the reason of first impact was concerned.

At the time of accident the QNH in Yesilkoy airport was 30.18 inch Hg. Both Barometric altimeters were set to 30.18 Inch Hg. Approximate msl (mean sea level) altitude was found by raising pressure altitude 240 ft.

When flight reported procedure turn inbound 3000 ft. and descending to 1800 ft., the heading of aircraft was about 225°.

The Tower controller requested the flight to report leaving NDB. The crew replied to this that they were approaching the NDB and they had the runway in sight. This reporting from the crew took place 126 seconds before the impact at an altitude of 1621 ft. msl. (See Figure 1)

The crew did not report passing the NDB, and there was no evidence that they checked their altitude over the NDB. The minimum authorized msl altitude above the NDB was 1800 ft.

During the final approach it was dark (early in the morning). The visibility was reported by the captain as fair to good. According to the weather forecast there were no clouds in the area of final approach. The 2-bar VASIS was installed at the runway 24 to give 30 approach slope.

Regarding the pre-landing checklist items and operational items, they were accomplished in scheduled time.

The approach profile of the aircraft for the last 280 seconds of the flight before the impact is plotted in Figure 1 and for the last 66 seconds in Figure 2.

The CAS (Calibrated Air Speed) print-outs and the approximate msl altitude of the aircraft were used to establish the last 67 seconds approach profile of the aircraft with respect to the horizontal distance of the aircraft from the point of impact. This profile was also compared with the 3° VASIS slope. (Figure 3) The last 67 seconds of the flight before the point of impact was established by taking the average CAS and vertical speed at intervals of 5 seconds up to 60 seconds and an interval of 7 seconds thereafter. Some of the results of these calculations were as follows:

Intervals of 5 seconds before impact	Average (CAS) of aircraft (knots)	Average vertical speed of aircraft (ft/sec)	Average glide angle of aircraft (degrees)
1st 5 seconds	150.95	14.2	3.20
2nd 5 seconds	152.85	17.4	3.85
3rd 5 seconds	154.25	16.6	3.65
4th 5 seconds	155.80	14.4	3.15
5th 5 seconds	156.50	13.6	2.95
6th 5 seconds	158.25	10.8	2.35
7th 5 seconds	158.75	10.2	2.20
8th 5 seconds	156.65	10.3	2.25
9th 5 seconds	154.40	10.2	2.25
10th 5 seconds	153.80	11.0	2.45
11th 5 seconds	154.85	10.2	2.25
12th 5 seconds	156.55	12.4	2.65
13th + 2 seconds	157.32	11.85	2.55

This approach profile was compared with the glide slope of the VASIS, which started at the touch down zone of the runway 24 at a distance of 255 meters from the threshold. (Figure 3) A further calculation showed that approximately 90 seconds before the impact the aircraft was over the NDB when its msl altitude and heading were 1210 ft. and 218° respectively. The msl altitude of the VASIS Approach slope over NDB was 1330 ft.

According to this calculations the aircraft was considerably below the glide slope before the NDB until 25 seconds before the impact. 25 seconds before the impact the aircraft crossed the approach slope and flew above the approach slope for a time of 10 seconds. During this flight the maximum height of aircraft above the approach slope was 12 ft. 15 seconds before the impact the aircraft started to deviate downward from the approach slope progressively until the point of impact. During the impact the value of the barometric altimeter was retrieved to be a msl altitude of about 115 ft. The msl altitude of the point of impact was about 80 ft. This showed that the barometric altimeter error was about 35 ft., which was not in favour of the pilot. Considering this error it is possible to say that the aircraft has never been on the approach slope during the last 90 seconds of the flight. (Figure 3)

According to the CVR, 5 seconds before the impact, the first-officer warned the Captain that they were below the glide slope. At this moment the aircraft was 25 ft. below the approach slope (35 ft. barometric altimeter error not included). There was evidence that the Captain responded to this warning, applying extra power to 3 engines. 3 seconds before impact the rate of sink was decreased to 7 ft/sec, which was 19ft/sec before. However, as the rate of pitch started to increase from 3.1° to 9.1° during the last 4 seconds before the impact, the rate of sink started to increase again before the impact. The aircraft was banked 2.1° to the left before the impact. This indicated why the left side of the aircraft experienced more drag during the impact.

SOME COMPARISONS

There were no consistencies between the altitude call-outs by the first-officer and the corrected barometric altimeter print-outs. When the 2 data compared the results are as follows:

Time before impact (sec)	ALTITUDES		AVERAGE RATE OF SINK BETWEEN ALTITUDE CALLS	
	Calls due to CVR Transcription (ft.)	Due to corrected DFDR print-outs (ft.)	Due to CVR transcription (ft/min)	Due to corrected DFDR print-outs (ft/min)
66	800	943	1000	700
60	700	873	1200	744
55	600	811	400	628
40	500	654	353	603
23	400	483	1575	952
15	100 (above runway)	356		

"Above runway" for 100 ft. call remained a questionable text on the CVR transcription. The first officer stated that he called the minimum altitude (360 ft.), which did not occur on the CVR transcription. He also stated that he read all the altitude calls from the barometric altimeter.

The average rate of sink during the last 15 seconds of flight before the initial impact due to DFDR print-outs is 964 ft/min. The 100 ft. (above runway) call indicates that the aircraft lost a height of approximately 109 ft. during the last 15 seconds of flight before the initial impact, which corresponded to an average rate of sink of 436 ft/min.

There were no clear evidences from the crew that they knew the msl height of the runway threshold. The crew definitely did not know the uprising terrain before the threshold, which was not acceptable as an excuse. Also there were no statements from the crew that they cross-checked their altimeters before altitude calls.

The comparison of the 2 data gives the following:

a. Altitude call-outs by the first officer are lower than altitudes due to corrected DFDR print-outs.

b. The average rate of sink during the time intervals between altitude calls vary considerably. These average sink rates and their variations do not agree with the crew statements.

c. Altitude calls by the first officer are considerably below the approach slope of the VASIS.

d. The evidences from the crew supported the average rate of sink during the time intervals between altitude calls, due to DFDR print-outs.

The evaluation of the above evidences suggested to suspect that the first-officer read the radio altimeter, which was quite unreliable for this non-precisional approach due to terrain characteristics along the approach path.

The flight engineer in his statement pointed out that at some time prior to 100 ft. call out, which according to the CVR transcription took place 15 seconds before the initial impact, he remembered glancing out to see top VASI bar red. This evidence indicated that at this moment the aircraft was close to the approach slope of the VASIS, but the closeness maintained only for about 10 seconds. This statement was in agreement with calculations which compared the glide path of the aircraft with the 3° approach slope of the VASIS. (Figure 3)

a. <u>Findings</u>

(1) During inbound of the NDB the crew reported descending to 1800 ft. This was acknowledged by the approach control.

(2) The approach control requested the flight to report leaving the NDB.

(3) Approximately 36 seconds before the NDB the crew reported, "We are approaching the NDB, we have runway in sight." At this time the msl altitude of the aircraft was calculated to be 1621 ft., heading 215°.

(4) Approximately 90 seconds before the impact it was calculated that the aircraft was over the NDB. This time the msl altitude and heading of the aircraft were calculated to be 1210 ft. and 218° respectively.

(5) The crew did not report leaving the NDB neither they checked their altitude over the NDB.

(6) The minimum authorized msl altitude over the NDB was 1800 ft. The NDB was located at a distance of 3.9 nm from the threshold of Runway 24.

(7) The VASIS were set to give 3° approach slope.

(8) The approach continued below the approach slope with moderate rate of descent until 25 seconds before the impact. There was no appreciable height adjustments along the approach path.

(9) The barometric altimeter showed 35 ft. error during the impact, which was not in favour of the pilot.

(10) 25 seconds before the impact the aircraft was close to the approach slope, but it was never above the approach when the barometric altimeter error of 35 ft. was concerned.

(11) The closeness to the approach slope was maintained about 10 seconds.

(12) 15 seconds before the impact the aircraft started to deviate from the approach slope downward progressively.

(13) At least 15 seconds before the impact the flight engineer saw the top VASI bar red. However, this was an indication that the aircraft was coming close to the approach slope but this was not maintained.

(14) 5 seconds before the impact the first officer warned the captain that they were below the glide slope.

(15) The CAPTAIN responded increasing the power of 3 engines. First, sink rate decreased but as the pitch increased considerably, the sink rate started to increase again just before the impact.

(16) During the final approach all altitude call outs by the first officer were considerably lower than the corrected barometric altimeter print-outs.

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(17) The aircraft was airworthy. There was no evidence of malfunction which might have been a contributing factor in this accident.

(18) The crew was properly licenced, adequately experienced and medically fit for the flight.

b. Probable Cause

The aircraft reported the runway insight before reaching NDB and crossed the NDB about 600 ft. below the established minimum. In the final approach continuously followed a path (glide slope) which was also below the 3° angle approach slope of the VASIS.

There were strong evidences that first officer's altitude call-outs were from the radio altimeter, which was considered a contributing factor for this low approach due to terrain characteristics.

RECOMMENDATIONS

1. It was recommended to the relavent authorities that improved approach lights should be installed before the Runway 24 at an elevation equal to the runway threshold elevation (reconstruction programme of this runway is on progress).

2. It was strongly recommended that the radio altimeter was unreliable for altitude reference during this type of approach, especially under similar terrain characteristics.

Investigation Committee

Asri AY	-	Head of the Investigation Committee
Ziya AKTURK	-	Member of the Investigation Committee
Nihat DOGANGUNES	-	" " " "
Sedat CILINGIR	-	" " " "
Cetin GUVENIR	-	" " " "
Aytekin BILGI	-	" " " "

Fig. 1

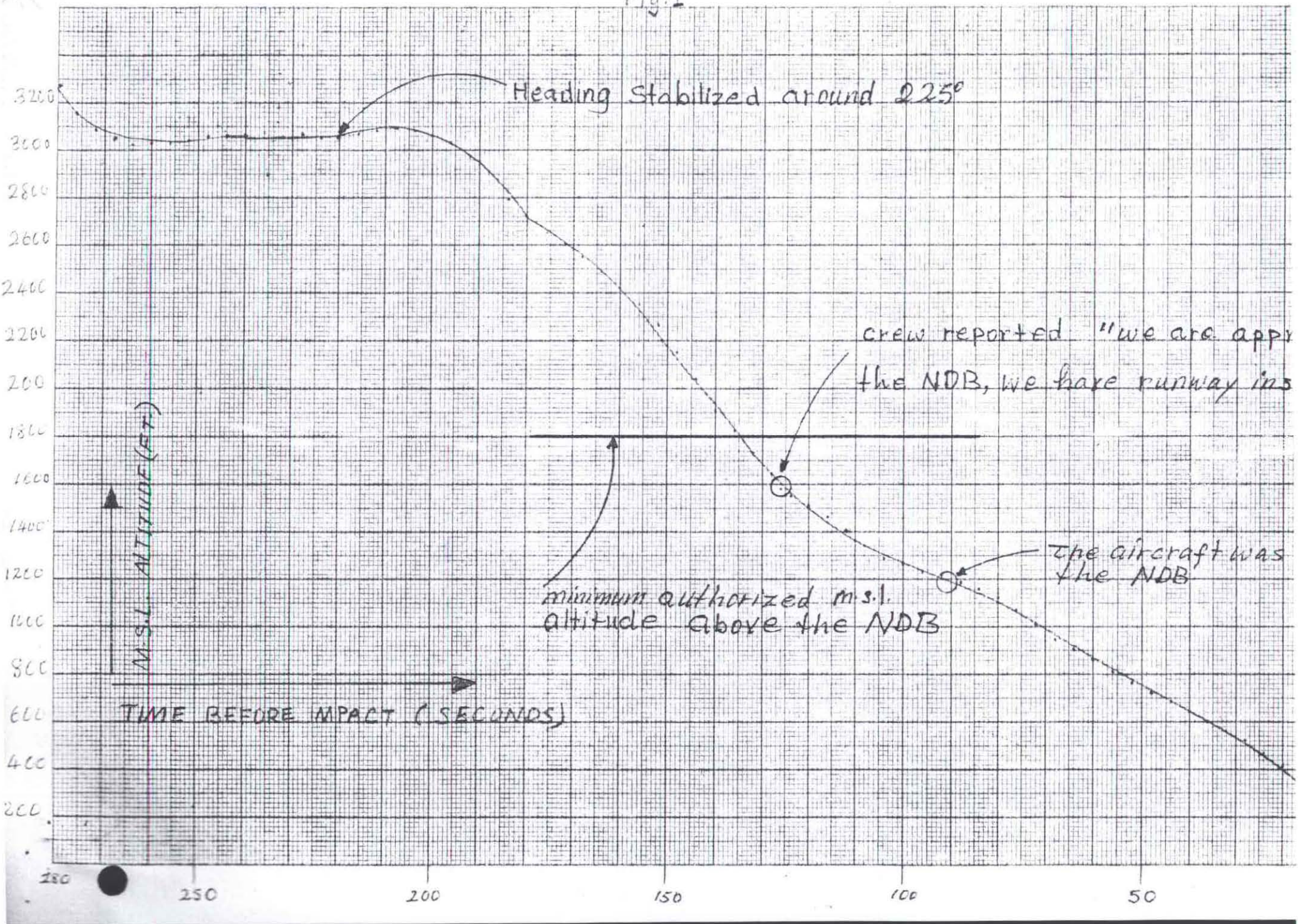
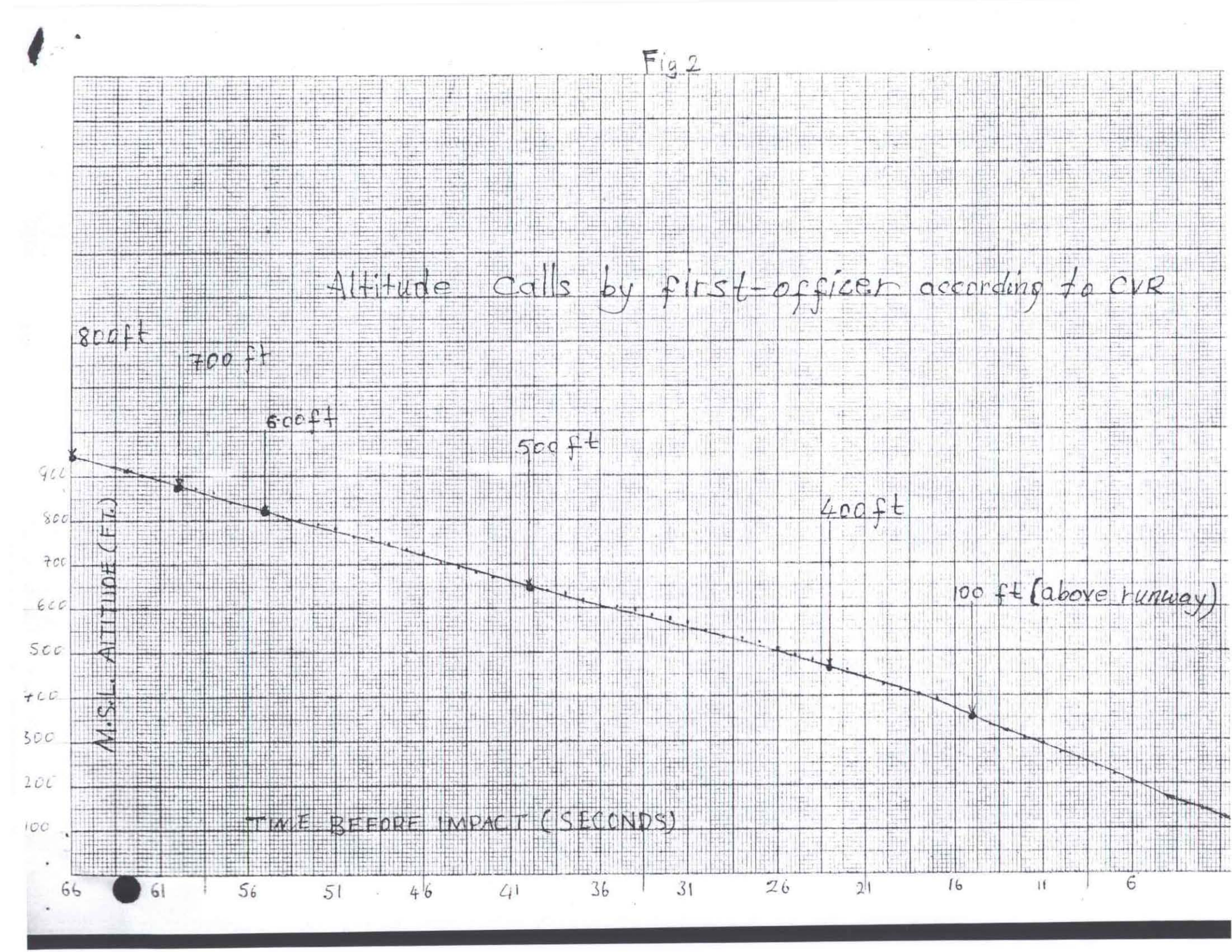
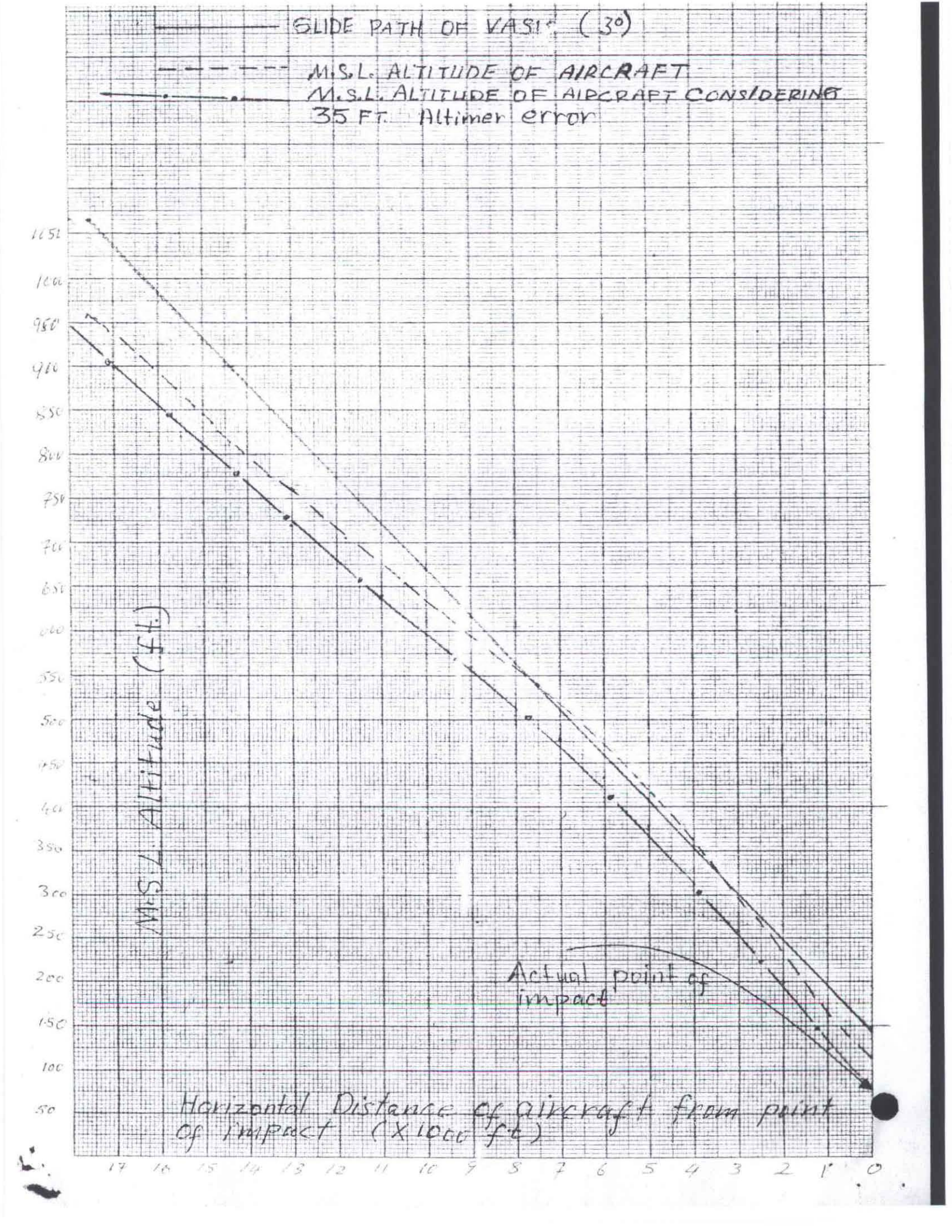

Heading Stabilized around 225°
crew reported "we are appr
the NDB, we have runway ins
The aircraft was
the NDB
minimum authorized m.s.l.
altitude above the NDB
M.S.L. ALTITUDE (FT.)
TIME BEFORE IMPACT (SECONDS)
3200
3000
2800
2600
2400
2200
200
1800
1600
1400
1200
1000
800
600
400
200
250
200
150
100
50

Fig 2


Altitude calls by first-officer according to CVR
800ft
700 ft
600ft
500 ft
400ft
100 ft (above runway)
M.S.L. ALTITUDE (FT.)
900
800
700
600
500
400
300
200
100
TIME BEFORE IMPACT (SECONDS)
66
61
56
51
46
41
36
31
26
21
16
11
6


SLIDE PATH OF VASI (3°)
M.S.L. ALTITUDE OF AIRCRAFT
M.S.L. ALTITUDE OF AIRCRAFT CONSIDERING 35 FT. Altimer error
M.S.L. Altitude (Ft.)
1050
1000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
Actual point of impact
Horizontal Distance of aircraft from point of Impact (X 1000 ft.)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0

Appendix A1

time
GMT

5130- İstanbul TWR Saudia 5130
TWR - Roger 5130 TWR Good morning
5130- Roger We're leaving 190 for 170 and we are two minutes to Yalova
TWR - Saudia 5130 cleared to the top BCN via Yalova then Bravo point to descent and maintain fligth level 110 expect runway 24, expect NDB approch
5130- Okey we copied okey we are cleared to descent 110 now
(0421) TWR- 5130 report over Yalova
5130- Okey will do
(0422) 5130- Saudia 5130 we are leaving Yalova this time
TWR- Saudia 5130 call over Bravo point descent and maintain 60
(0423) 5130- Okey we going Bravo point descending 60 and leaving 150 this time
TWR - Roger
(0427) 5130- Saudia 5130 over Bravo intersection
TWR - Roger Saudia descend and maintain 3000 feet
5130- Okey lieving 110 for 3000 feet
(0429) 5130- Saudia 5130 over the station on the holding pattern
TWR - Roger Saudia 5130 sleared for NDB number 3 aproach for runway 24 call leaving 3000 outbound top
5130- Okey will report leaving 3000 and will report inbound and outbound of the NDB
(0430) TWR - Roger
(0431) 5130- from 5130 procedure turn inbound 3000 feet
TWR - Roger
(0432) 5130- Saudia 5130 descending to 1800 feet
TWR - Roger
(0433) TWR - Saudia 5130 call leaving the station please
5130- Roger
5130- Saudia 5130 we approaching the NDB We have the runway insight
TWR - Roger Saudia 5130 the wind 210 degrees 08 knots clear to land on runway 24
(0434) 5130- Clear to land runway 24
(0437) TWR - Aircraft on fire

Appendix B

Captain Robert H.Love, age 56, held Airline Transport pilot certificate No.482194 with an airplane multi-engine land rating. He held type ratings in the Douglas DC-4; DC-6; DC-7; DC-8 and DC-10 Aero Commander 1121 with commercial priviliges; single-engine land. He was originally employed by overseas National Airways during their reorganisation on July 16,1965 as chief pilot on the DC-8 aircraft. His first-class medical certificate was dated November 4, 1975 with no waivers or limitations. He was qualified initially as pilot-in-command on may 1973. He was designated equipment check airmen on the DC-10 June 25, 1975 and line check airmen September 24, 1975. At the time of accident, he had accumulated approximately 26,564 hours, of which 1,883 were in the DC-10 type aircraft. He flew 51 hours in the last 30 days. 119-1 in the last 60 days; 165.9 in the last 90 days. All of this time was a DC-10 captain. He comleted his last proficiency check on September 29, 1975 and recurrent ground training February 21, 1975. His latest line check was August 31, 1975. During his employment with overseas National Airways, the captain satisfactorily completed all required training without rechecks or repeats.

First officer Pablo Molo, an Argentina National Citizen, age 42 held Airline Transport pilot certificate No. 1633664 with an airplane single-engine land and commercial priviliges; multi engine land. He was originally employed by overseas National Airways on December 11, 1967 as a DC-9 Co-pilot His second-class medical certificate was dated March 3, 1975 with no waivers or limitations. He was upgraded to a DC-8 co-pilot on November 2, 1968 and a DC-10 co-pilot on November 6, 1975. At the time of the accident, he had accumulated approximately 6,200 flying hours, of which 72.9 were in the DC-10 type aircraft. He flew 33.2 hours in the last 30 days; 63-9 in the last 60 days and 72.9 in the last 90 days. His last proficiency check was satisfactorily completed on October 29, 1975 and his line check was satisfactorily completed on November 3, 1975. His latest recurrent training was completed October 6, 1975.

Flight Engineer, William E.Whitesell, age 45 held Flight Engineer Certificate No.1365202 reciprocating engine powered and an airframe and powerplant mechanic certificate No.1341296. He was originally employed by overseas National Airways as a maintenance representative on December 27, 1965. His second-class medical certificate was dated April 21, 1975 with no waivers or limitations. He was originally checked out as a Douglas DC-7 flight engineer on January 3, 1966; Douglas DC-8 July 1, 1966 the DC-10 on may 3, 1973. At the time of the accident he had accumulated approximately 10,502 flying hours, of which 1,244 were in the DC-10 type aircraft. He flew 56.3 hours in the last 30 days; 66.4 hours in the last 60 days and 94.5 hours in the last 90 days. All of the last 90 days of flying time were in the DC-10. He completed his original DC-10 flight engineer transition check on February 3, 1973. His latest flight engineer proficiency check was on October 5, 1975 and his latest line check August 21, 1975. His latest recurrent training was completed on October 3, 1975.

Appendix C

The aircraft daily maintenance log sheets from November 30, 1975 to January 2, 1976 (which were available in Istanbul) were examined and there were no significiant items noted.

The maintenance Records Group was established by NTSB (National Transportation safety Board, U.S.A.) on January 7, 1976 for the purpose of reviewing all pertinent records for N1031F. The search encompassed a detailed review of the aircraft's daily maintenance log sheets and the scheduled maintenance inspection and service program forms. Areas of interest relative to the accident activity were reviewed and no unusual maintenance trends were disclosed. Particular attention was given to the pilot/static inspection and maintenance program. All records relative to the maintenance of N1031F from October 1, 1975 through December 31, 1975 were examined by the Records Group. A brief summary of the results were;

Total airframe time	9848 : 59 hours
No.1 Engine total time	5785 : 31 "
No.2 Engine total time	5479 : 49 "
No.3 Engine total time	6881 : 34 "

The last "C" maintenance check was accomplished on June 26, 1975. The aircraft total time was 8044:02 hours. Time since the C check was 1804: 57 hours.

The last aircraft weight check was performed on April 10, 1975 as follows:

weight	Arm	Moment
261,000	1380.4	360,295,035

The maintenance recorde showed that the last two pitot/static checks were performed on the following dates:

October 27, 1975 "A" check Total Time 9095:18 hours
December 28, 1975 " " total time 9797:33 hours

Appendix D

1. Borescope

(a) Compresser inspected in stages 1,5,6,12 and 14. No damage or evidence of tip rub. Much earth and or sand in all stages.

(b) Combustor inspected in port B2 and B3 no recent damage noted There was some cracking in both inner and outer liner bands, both within manual limits and considered normal deterioration

(c) No damage in first stage high pressure turbine nozzle.

(d) Three blades of first stage H.P.T. had small dents on the convex side, leading edge, approximately 1/2 from tip. The complete stage had a leading edge buildup of earth deposits, plus all blades were covered with a black powdery carbon like film. This film had little depth and was flaking off in places. The first stage H.P.T. shroud was in good condition with no signs of heavy rubbing.

(e) No damage noted in second stage H.P.T., only traces of the buildup and blacking as noted in the first stage H.P.T. No signs of heavy shroud rubbing.

(f) Turbine mid frame only inspected through the 4 O'clok port, but appeared to be undamaged.

(g) Stages of 1 and 2 of the L.P.T. were undamaged as far as could be seen (could not rotate rotor). Stages 3 and 4 were severly damaged as a result of contact with the ground and the turbine rear frame was missing from 4 to 7 O'clock.

2. General

(a) Fan rotor. All blades were in undamaged condition and had not come into contact with the case, the abradable shroud being undamaged

(b) Accessories. The accessory gear box split in two, the break point being to the left of the transfer gear box. The main fuel filter and fuel/oil heat exchanger had the lower extremeties ground off and holed. The transfer gearbox was undamaged.

(c) Fire damage. There was evidence of fire damage from 4 O'clock to 10 O'clock, aft looking forward and going clockwise. The fire was heaviest in the area 4 to 7 O'clock. Some "p" clamp rubber coverings were charred through and the outer coverings of some wire bundles also showed the same distres, however, the inner ceverings were intact and no melted wires. The fire had appearance of being not very intenseor of long duration.

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(d) Cowlings. The inlet cowl was destroyed, however, all attachment points to the fan frame were secure, the sheet metal to these still being in place. The fan cowls were missing. The fan reversers were in place and all latches and attachment points secure. The core cowls were also in place and the forward two latches secure.

There was no external evidence of fire in the areas of either cowling, however, they were all badly damaged as a result of contact with the ground.