

No. 15

KLM/VIASA, DC-8, PH-DCL, crashed into the Atlantic Ocean 3 km off the coast of Fonte da Telha, Almada District, Portugal, on 30 May 1961. Report, dated 1 March 1963, released by the Director General of Civil Aviation, Portugal.

Circumstances

Flight VA 897 was a scheduled* flight from Rome to Madrid, Lisbon, Santa Maria (Azores) and Caracas, Venezuela. It landed at Lisbon Airport at 0006 hours where it was inspected by KLM maintenance personnel. Following a crew change, the aircraft left for Santa Maria at 0115 hours. Four minutes later it reported passing over Caparica radio beacon (LS) and climbing through flight level 60 (1 800 m). This message ended with two quickly spoken sentences. There was no further contact with the aircraft which crashed into the sea to the left of the original track at about 0120 hours GMT killing all 14 crew and 47 passengers aboard. The aircraft was destroyed.

The wreckage was located on 31 May in the Bay of Caparica, 7 km south of the beacon, 3 km off the coast and at a depth of 30 m.

Investigation and EvidenceThe Aircraft

Certificates of registration and airworthiness were issued for PH-DCL on 1 May 1961. The aircraft had a category A licence. On 2 May 1961 it was issued a maintenance certificate valid until the next periodic inspection after 300 hours of flight time. During the aircraft's life several transit inspections had been carried out after each landing as well as four more extensive inspections. Its total flight time upon arrival in Lisbon on 30 May was 209:30 hours, i. e. less than 300 hours. Therefore, no block inspection had been carried out on the aircraft. It had flown 32 hours since its last type 1 inspection.

An extensive investigation was made of the aircraft's maintenance history. No serious malfunctions had occurred. Although the logs for the flights Rome - Madrid - Lisbon showed no complaints, the statements of the incoming crew indicated that there were minor deficiencies, however, they did not affect the airworthiness of PH-DCL.

At take-off the weight and centre of gravity of the aircraft were within the authorized limits.

The Crew

The crew complement was as follows: 3 pilots, a radio operator, 2 flight engineers, 2 pursers, 3 stewards and 3 stewardesses.

The flight crew had had a two-day rest in Lisbon, and there was no indication that any crew member was fatigued on the day of the accident.

The pilot-in-command, who was acting as check pilot on the subject flight, had been flying with KLM as pilot since 1946. His Netherlands airline transport pilot's licence was last renewed on 26 April 1961, and he was authorized to fly as pilot-in-command on DC-6, Convair 340, Constellation 749 and 1049 and DC-8 aircraft. The DC-8 rating was endorsed on 16 March 1961. He had flown a total of 12 886 hours including 9 040 hours in command. On the DC-8 his experience was as follows:

pilot-in-command	60 hours	These
first officer	75:30 hours	hours had
type training	16:50 hours	all been
DC-8 simulator	37:30 hours	flown
		during the
		90 days
		prior to
		the accident.

* KLM (operator) lists this as a charter (non-scheduled) flight. VIASA (Venezuela) lists this as a scheduled flight.

On 27 May he had made one flight from Amsterdam to Lisbon.

The co-pilot had a lengthy career as captain on Constellation aircraft over the Atlantic. His route qualifications in this respect were still valid. He had various licences including an airline transport pilot's licence last renewed in March 1961 and valid until September 1961. His training as a DC-8 captain was satisfactorily completed in April 1961, and he was granted a DC-8 rating. He had made several flights as co-pilot of DC-8 aircraft on the Mid-Atlantic route. In April 1961 he had carried out two application training flights on this route with satisfactory results. On the subject flight he was to have his route application check. His experience on DC-8 aircraft was:

DC-8 simulator	62 - hours instead of the normal 36 hours	He had difficulty with the use of the integrated instrument system.
flight training	16:55 - hours (during the previous 90 days)	

The results of his type rating examination were above standard.

He had a total of 12 913 flying hours to his credit of which 10 578 hours were when in command and 55 hours were as first officer on the DC-8. The week prior to the accident he had flown one trip on the DC-8 from Amsterdam to Lisbon.

All other crew members were fully qualified, had considerable experience and were medically fit.

Meteorological situation

The actual conditions existing at the scene of the accident around 0120 hours

are not known. There is no meteorological station at that location. However, the conditions must have been similar to those at Lisbon Airport. The following are considered to be most probable:

ceiling 600 m; visibility 8 km;
wind 270°/18 kt; temperature 13.5°C;
dew point 12°C; clouds 4/8 strato-cumulus at 600 m 8/8 altostratus;
light rain; light to moderate turbulence;
no thunderstorms or icing had been observed.

The crew were properly briefed on the conditions before departure. The weather conditions were not believed to have contributed to the accident.

The Flight

As the ground engineers were not present when the aircraft arrived from Madrid the transit inspection was carried out by the second flight engineer under the supervision of the first flight engineer, a licensed ground engineer and some mechanics.

The flight plan, prepared by the flight operations officer, was checked and signed by the captain. The aircraft was to take a magnetic track of 273° after passing the LS beacon at Caparica. An Air Traffic Control instrument flight rules flight plan was also filed for flight level 310 with Lisbon and Lajes as alternates.

At take-off from Lisbon the pilot-in-command was probably in the right-hand seat, and the co-pilot was in the left-hand seat.

Departure from runway 23 was at 0115 hours on course to NDB "LS". The pilot had been asked to report the cloud base and to call over the LS beacon. At 0118:37 the aircraft advised that the cloud base was at 3 700 ft and changed to the Lisbon area control frequency. It reported again at 0119:25 to Lisbon Control that it was "over LS at 19 climbing through FL 60", but the communications were suddenly interrupted, after two quickly spoken

sentences; the first one, not definitely established, could have been "eh... take care of" and the second one was "we are climbing out". Last contact with the flight was at 0119:50 hours,

Witnesses at Caparica stated that they had heard a loud noise, like an explosion, shortly after the aircraft had passed over.

As a result of salvage action during the period 14 June to 6 July, approximately 40 000 kg of wreckage were recovered from the sea. About 75% of the total structural weight of the aircraft and 60% of the aircraft's skin were recovered during 375 dives covering a total diving time of 260 hours.

Configuration of the aircraft at impact

Evidence showed that the aircraft hit the water in a northwesterly direction. Its pitch angle was approximately 25° nose down, and it was probably banking 30° to the right. Indications were that the aircraft was intact and flying at a speed of 450 - 500 kt when it crashed. No small parts had broken off in flight. The rudder, ailerons and elevator were in the neutral position. The aircraft's configuration was normal for a climb to cruising level.

The hydraulic system was functioning normally, and there was electric power on all four buses. At the time of impact the engines were operating far below cruising power. However, engine power might have been reduced some seconds before impact, possibly when the aircraft came out of the clouds.

Reconstruction of flight path based on evidence

Although there was little data available, a flight path consistent with all evidence was calculated connecting a point about 6 000 ft above Caparica with the place of the wreckage. According to this flight path, the aircraft would have started

a spiral dive to the left during the last message, banking to the left to 90° within about 20 seconds and ending in the water after another 15 seconds. During the last 15 seconds, the bank was overcorrected to the right, and the steep dive was checked to some extent. This calculated flight path was tested on a DC-8 flight simulator and checked by analogous computations. The flight path was such that during the vital initial phase the deviations could only be noticed by the pilots on the instruments.

Somewhat steeper or somewhat flatter and longer flight paths may have been possible. With a steeper dive there was a chance that the overspeed warning signal had sounded during the radio communications. Tests showed that the overspeed warning can be heard clearly through normal radio communications. It was not heard. Moreover, the course deviation cannot have been sufficient to put the aircraft in a northerly direction at impact. Therefore, a much steeper dive was not possible.

A flatter flight path would have taken more time. It cannot have been too flat as that would have been inconsistent with the statements of witnesses.

Investigation of unintentional flight path deviations

At the beginning of the investigation the Commission's attention was drawn to some cases in which jet aircraft were unintentionally brought into a dive or a spiral dive. The main characteristic of these cases was that the deviation became large within a short time before it was noticed by the crew. In a few cases the pilots were initially misled by a defective artificial horizon. The possibility was considered that the accident to PH-DCL might have been caused by such a flight path deviation.

Discussion of evidence

No parts of the aircraft were found outside the wreckage area.

No pre-crash defects were found. However, the possibility that they existed could not be excluded. Structural failure due to turbulence was excluded because there was only light to moderate turbulence in the vicinity of the accident site. Fatigue failure was considered unlikely. The aircraft was practically new, and no indications of this type of failure were found. It was definitely established that the engines operated properly up until the time of the accident. Although no indications were found of failures or malfunctions, they could not be definitely excluded because insufficient parts were recovered, especially of the systems, and all recovered parts were heavily damaged at impact.

There was no indication of fire in the air or of a lightning strike. Although there was no evidence of sabotage, the possibility of explosion or a malicious act could not be definitely excluded. Collision with another aircraft was also excluded, no other aircraft being present in that area at the time.

During the investigation several cases of loss of control became known. The loss of control had resulted in a dive or a diving spiral because of the pilot's inattention. Another accident had occurred because during the take-off climb the pilot concentrated on a blocked artificial horizon bar. A stall had resulted.

During tests made in a DC-8 simulator the PH-DCL flight was simulated. It was proved that, due to a failure of the artificial horizon in bank, a pilot could be misled in such a way that he would lose control of the aircraft.

If it is assumed that the pilot began to lose control of PH-DCL during the last message, the last sentences heard over the radio could be interpreted as a warning coming from the pilot-in-command to the pilot at the controls. The uncertainty of the exact wording and meaning of the last two sentences gives, however, insufficient grounds for considering such a pilot error as a probable cause of the accident.

There was no evidence regarding the possibility of other crew errors.

Probable Cause

Notwithstanding a very thorough, time-consuming investigation, in which many authorities and experts co-operated, it was not possible to establish a probable cause of the accident.

Recommendations

PH-DCL was not equipped with a flight recorder. A recorder would have been of considerable assistance to the investigators and would probably have provided some indication as to the cause of the accident. Follow-up action in the field of air safety might have been taken. It was, therefore, strongly recommended that turbine-powered transport aircraft should be equipped with crashproof flight recorders.

The possibility that the aircraft crashed into the sea following an unintentional spiral dive could not be excluded. The flight characteristics of modern jet aircraft with swept back wings require continuous alertness on the part of crew members. More attention should be given to making aircraft and flying procedures safe from human errors. International co-operation of all interested parties in this field should be promoted.

Additional comments by the State of Registry (Netherlands)

It may be assumed that the flight proceeded normally as far as the LS beacon and that the aircraft was being flown manually.

On passing the beacon the course had to be altered to the right, i. e. from 225° M to 273° M, and this can only be done by means of the ailerons. About one minute after passing the beacon the aircraft crashed not to the right of the original heading, which would have tallied with the change of heading, but to the left of it.

In view of these facts, the Board was inclined to believe that there must have been some connexion between the actions necessary to effect the alteration in course and the introductory cause of the accident.

It is possible that after the aircraft changed course the ailerons remained slightly deflected so that a slow rolling movement to the left commenced, which was not noticed by the pilot in time and/or could not be observed in time due to the possible failure of the artificial horizon.

The aircraft got into a steep bank which sent it into a spiral dive during which it lost altitude so rapidly that the aircraft struck the water before the attitude for level flight could be restored.

The foregoing hypothesis is supported by flight simulator tests made after the accident. Nevertheless, it is by no means certain that the accident occurred in this way.

In view of the fact that nothing in the investigation points to disintegration having occurred during flight or intentional descent, for instance, to make a forced landing or to return to the airport, the pilot must have lost control of the aircraft through unknown causes.

Though there are no direct indications in this respect, the Board regards it as possible that the accident was due to the pilot or pilots being misled by instrument failure, in particular of the artificial horizon, or to the pilot having been distracted, so that a serious deviation from the normal flight path was not discovered in time.

Recommendations

It is more essential than ever that the entire complex of cockpit equipment and cockpit procedures should be such as to ensure the timely detection of any defects in vital instruments or of pilot errors. Accordingly, the Board has noted with pleasure that KLM puts more emphasis than ever before on training pilots in the timely detection of instrument failures.

The Board was of the opinion that in view of the dangers inherent in the failure of the artificial horizon, a system should be designed and installed which immediately detects differences in the pilot's and co-pilot's horizon readings and gives warning by means of a visible and audible signal. A comparison with the "stand-by" horizon would then reveal which horizon has gone wrong.

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the coast of Portugal, 30 May 1961

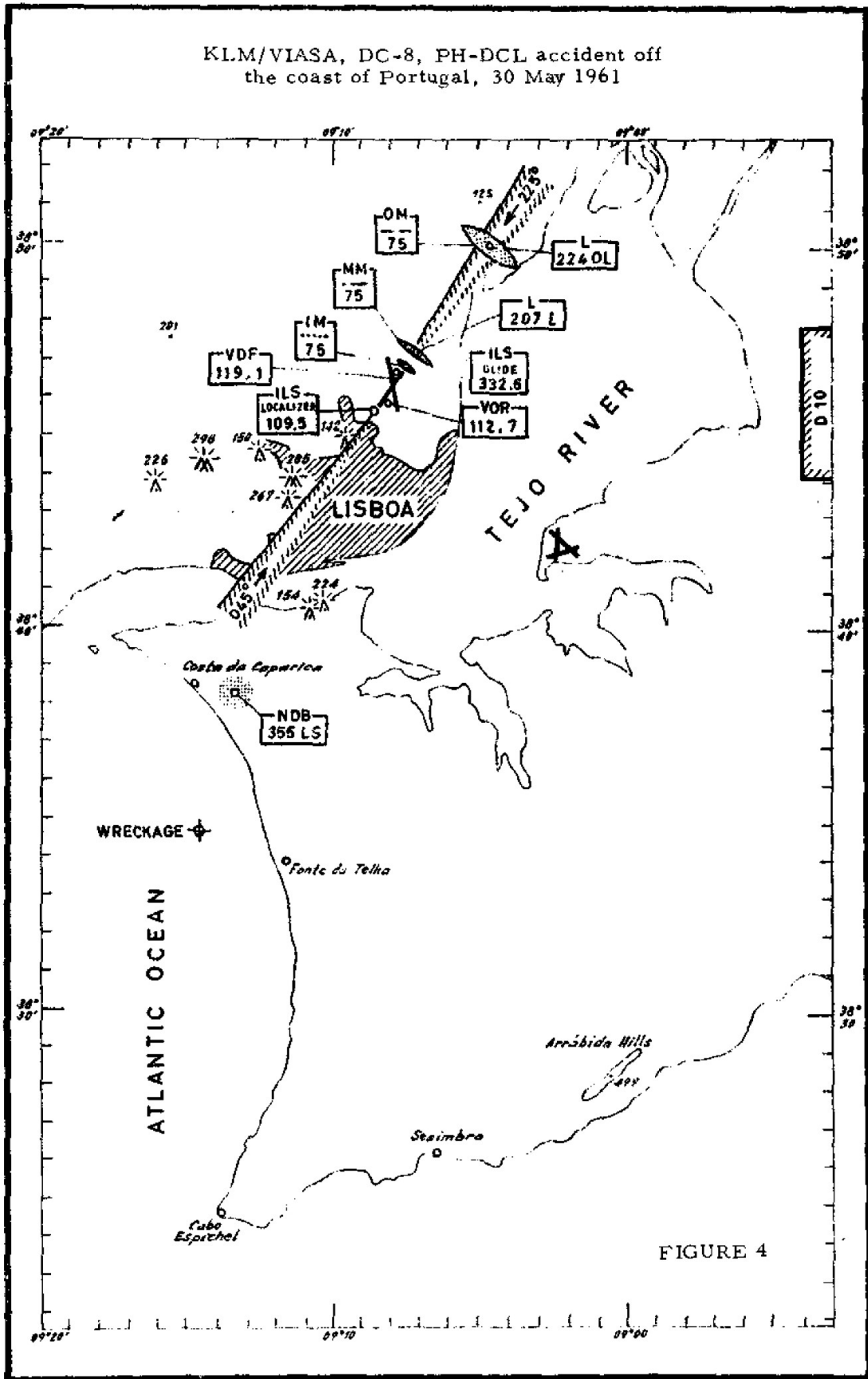


FIGURE 4