No. 57

Aerolíneas Argentinas, DC-4, LV-AHZ, crashed in the vicinity of Bolívar (Province of Buenos Aires), Argentina, on 8 December 1957. Investigation Report No. 918 released by the Ministry of Aeronautics, Argentine Republic.

Circumstances

The aircraft took off from Ezeiza Airport at 1554 hours local time on a scheduled flight direct to San Carlos de Bariloche with Comodoro Rivadavia as alternate. Six crew and fifty-five passengers were aboard. Clearance was granted by the Regional Centre Control Area for an IFR flight outside airways, with 1 200 metres as safety height as far as Neuquén and 2 400 metres up to the destination aerodrome. The aircraft carried out routine communications with the airport control tower and with the approach control office until it reached Lobos, where it was authorized to use telegraphy. From that moment there was no further information available concerning the flight. It was later established that at 1645 hours the aircraft had crashed 25 kilometres south-east of Bolívar. All occupants were killed and the aircraft was destroyed by the impact and the fire which broke out subsequently.

Investigation and Evidence

Crew Information

The pilot-in-command had flown 10 527 hours with the airline, of which 2 196 were on instruments, 1 795 by night and 45 on ground trainer. He had been piloting the subject aircraft since 25 November 1956 and had flown a total of 936 hours in it and was thoroughly familiar with the route overflown.

The co-pilot had logged a total of 10 088 hours flying time with the airline - 1 253 hours on instruments, 1 677 at night and 209 on ground trainer. He had logged 251 hours on LV-AHZ since 4 August 1957.

Weather

LV-AHZ was dispatched on a forecast drawn up at 1030 hours for another aircraft, LV-AEU, which had been delayed since the day before because of poor weather conditions and which finally took off from Ezeiza at 1519 hours on 8 December on the same route and bound for the same destination as LV-AHZ. This 1030 forecast was drawn up on the basis of a 0600 hours map and an 0900 report, i.e. data gathered 6-3/4 hours prior to departure.

The 1030 hours forecast read as follows:

"On the route from Ezeiza to Bariloche, isolated showers. Visibility 5/8 km; Clouds 6/8 nimbostratus and stratus, cumulus, base 300/500 metres; 3/8 cumulonimbus at 1 200 metres base and 5/8 altocumulus with a 3 000 metres base. Upper winds between Ezeiza and Santa Rosa at 2 400 metres, 340° 30 knots; between Santa Rosa and Bariloche at 2400 metres, 270° 25 knots. WARNINGS: Upper cold front in Santa Rosa sector is moving NE with showers and storms. Terminal and alternate forecasts: Bariloche, between 2300 and 0100Z clouded 15 km visibility, 5/8 stratocumulus at 800 metres, 5/8 stratocumulus at 3 000 metres. Bahia Blanca, between 2300 and 0200Z, showers, visibility 5/8 km, 8/8 nimbostratus at 200 metres; 8/8 altostratus at 3 000 metres. Comodoro Rivadavia between 2300 and 0200Z, clouded, visibility 10 km, 5/8 stratocumulus at 500 metres, 7/8 altostatus at 3 000 metres."

Before starting out the pilot of LV-AHZ went to the meteorological office

to inquire about the weather conditions. He was informed that the frontal zone's activity had increased and that there were cumulonimbus conditions caused by frontal movements. He then replied that he would try to get through and the meteorologist on duty indicated that there was no other alternate aerodrome outside Ezeiza.

It was considered that dispatch was inadequate for the following reasons:

1) Flight plan - a flight altitude of 1 200 metres was chosen as far as Neuquén although the forecast indicated that at such an altitude there was cumulonimbus (3/8) covering the whole route;

2) Comodoro Rivadavia was chosen as an alternate although in all warnings it had been recorded - upper cold front, moving eastward with showers and thunderstorms;

3) Direct IFR flight was requested although the prevailing meteorological conditions required the use of the airway for this type of flight;

4) The flight plan was drawn up on the basis of a forecast valid according to regulations, to be used at 1430 hours, in which unfavourable meteorological conditions had been reported, which required the personnel responsible for the airlines operations to bring the said forecast up to date - especially, since it was known that the LV-ACE aircraft had returned to base because of unsatisfactory weather conditions in Bahía Blanca.

Characteristics of the Meteorological Phenomenon as Analyzed after the Accident

The phenomenon which is the subject of this study showed characteristics which are far from common. The analysis revealed the following:

1. Cold surface front; severely active.

2. Position:

   The front spread over Argentine territory from Villa Dolores, Pehuajó, Bolívar and Tres Arroyos.

3. Movement:

   ENE at a velocity of 70/80 km per hour, as it entered the Province of Buenos Aires.

4. Depth:

   The free frontal zone was the most active on an area of 10-15 km with a moderate activity area of 60 km.

5. Height of system:

   The pre-frontal instability can be estimated as 10 000 m.

6. Differences in the masses:

   a) Temperature: the difference is of 14°C from the surface up to a level of 500 millibars.

   b) Isallobaric curves: the differences in pressure between 0900 and 1200 show a highly negative isallobaric nucleus (minus 4 millibars) based on the W and S of the Province of Buenos Aires. There is a positive nucleus of 17 millibars, based East of the Malvine Islands and a further positive nucleus exceeding 11 millibars based on the Island of Juan Fernández in the Pacific.

7. Frontal passage over Bolívar:

   The Bolívar barogram fixes the frontal passage at 1630 hours; over Pehuajó to the NW of Bolívar at 1600 hours, and over Azul (to the SE of Bolívar) at 1800 hours.

8. Turbulence:

The barograms studied show clearly that there were rapid fluctuations, a clear symptom of chaotic movements in the upper winds. The severe turbulence was due to the vertical gusts in accelerated and short air flows, very irregular and in the order of 20 metres per second.

9. Pre-frontal clouds:

Broken stratocumulus with a ceiling of approximately 800 metres. In the advanced frontal zone cumulonimbus of the "Arcus" type.

10. Horizontal visibility in the hot air mass:

Good (10 km) reduced to 100 metres on the pre-frontal zone by a dust devil.

11. Intensity of system:

The frontal zone grew in intensity from moderate to heavy when entering the Province of Buenos Aires from the West, where mass-differentiation is well-defined. From examination of the recorder strips of the different stations located before and after the front, it appears that the system's unusual activity increased beginning at the above mentioned area. It became very intense in the centre of the Province of Buenos Aires, especially in the area between Pehuajó, Bolívar and Azul.

12. Origin of the frontal activity area studied:

It would seem from analysis to have been due to a deep trough from the West causing cold frontogenesis on the surface following a San Carlos (Mendoza) - Unión (San Luis) - Santa Rosa (La Pampa) and Carmen de Patagones (Province of Buenos Aires) line.

13. Direction and Intensity of Wind:

Rotating from N to S, its intensity was of the order of 70 kilometres per hour with gusts of 120 km per hour.

Meteorological Information Gathered by the Investigator in the Area and at the Site of the Accident

Information gained by the investigator showed the front's unusual violence. An official of a gliding centre near the accident area described the phenomenon in the following terms:

"The front moved in a characteristic manner, i.e. its centre was at a height of about 150 feet with two more centres above and behind, in a strung-out shape. When observed from a short distance, it could be seen to be extremely violent and we were able later to ascertain that its speed was of 100 km per hour with gusts and an electric storm, very heavy rain and hail, and that we considered that from an aircraft in flight at a height not exceeding 300 metres the front could easily be observed at a distance of more than 20 kilometres, since it was a well-defined front extending over a wide area which, being very dark with a centre detaching itself clearly from the dark parts, showed beyond doubt that it was very violent."

On the other hand, an owner of a farm near the site of the accident described the way in which the phenomenon appeared. He stated that the front could be seen after 1500 hours and added that at 1600 hours one could see distinctly the sandstorm over the ground and the cumulonimbus on the front and more particularly the existence of cumulonimbus precisely in the area to be crossed by the aircraft.

Visual Inspection - Site of the Accident

The site of the accident was completely flat terrain with a hard surface; there were no obstructions and it was suitable for emergency landing.

The aircraft struck the ground at a descent angle of roughly 35°, banked 25° leftward, with an 80° heading and a speed estimated to have been above 400 km per hour.

The wreckage followed the same direction as the heading of the falling aircraft, with a length up to 125 metres and a width of 25 metres. Its engines were buried in the soil down to a depth of 1.5 metres.

No. 1 propeller was found with its blades at approximately feathering angle. There were no signs of impacts through rotation. No. 2 propeller showed severe distortion of the blade through rotation with power. No. 3 was in the same state with one of its blades broken at the root. No. 4 was distorted through power rotation. All had become detached through breakage of the reduction gear casing and the last three were in high pitch.

The central section of the wing, most of which had melted, showed a fracture of the joint of the left wing, at 50 centimetres from the bolted end, and all the extremity of the left wing was missing. The right wing had fallen off on impact. The landing gear and the nose-wing were in the retracted position, including their jacks; the flaps appeared in the retracted position and all the flight controls had been destroyed on impact or through fire. As regards the aircraft instruments, only the tachometer of the No. 2 engine was found jammed at 2 550 rpm; all the other instruments were destroyed. The panel and switches of the electric system were also destroyed with the exception of one of the sets of switches of the radio equipment which was found switched on for the VHF equipment and switched off as regards radio compasses.

On-Site Investigation of the Process of In-Flight Disintegration of the Aircraft

On examining the fixed and mobile tail surfaces, it was established that they had been destroyed through severe impact before falling and were torn off the tail cone as a result of structural failures. The tail cone revealed a fracture on the fuselage immediately before the reinforced attachment joints of the fin and the tail plane.

Inspection of the damage to the fin and the starboard portion of the tail plane, clearly indicated that it had been caused by severe impact by the end of the port wing as it fell off carrying with it the added weight of the fuel left in its containers.

Examination of the wing tip indicated that it reached the ground sideways, in other words, that the tip of the wing slid onto the ground first and was followed by its lower surface; the scorings and small damage confirmed this conclusion. Consequently, the leading edge, the aileron, upper surface of the wing, trailing edge and the fracture zone were intact, and thus permitted observing the scorings left in the leading edge by the impact and the friction marks on the fin and the right stabilizer, where the leading edge deicers left pieces of rubber sticking to the skin of the tail, which caused dents and scratches on the side of the leading edge of the detached wing.

The fracture on this side of the wing was about 1 metre long and the stressed skin was torn off. The flange and web of the wing spar were obviously broken with upward and downward distortions following a similar fracture of the wing through simultaneous torsional deflection.

The accident was not due to lightning, fire or explosions on board the aircraft.

Laboratory tests

Tests carried out on test pieces taken from the structural parts of the wing, namely the bottom and top flange plates of the spar of the torn left wing, the web of the same and the outer panel, proved that the material met more than adequately the specifications laid down in respect of aircraft structure.

The bottom flange plate of the spar showed a combined torsion and flection

fracture running in a perpendicular line to its axis.

Microscopic observation showed no signs of corrosion and the structure was that of a normal lamination product.

It was concluded that fracture was due to combined stress above the design stress of the parts concerned.

The violence of the front in provoking gust velocity above 20 metres per second when the aircraft found itself caught in the turbulence at cruising speed, subjected the aircraft to a strain above the load factor established for one of its type because the allowable limits laid down by the manufacturer for flights under turbulent conditions had been exceeded.

The Flight

As contact with the aircraft was lost from the moment when it began to operate on telegraphy, the investigation was directed to making inquiries in the vicinity of the accident. It was ascertained that the aircraft was flying at an altitude estimated at not more than 100 - 150 metres for a distance approximately 35 - 40 kilometres from the accident site. There was good visibility and a northeast wind. The engines did not seem to show any abnormalities and the aircraft had deviated 21 kilometres to the left of its intended route.

It is assumed that the pilot, realizing the front's characteristics - which at 1530 (according to meteorological information and witnesses statements) had reached its maximum intensity at Ciudad de Bolívar, over which the aircraft route passed - and being aware that it was an upper front, descended in an attempt to fly below it, hence the deviation and the flight altitude adopted.

The aircraft flew into the front at its most active part with a course parallel to the intended route and on a flight line. Then it took a sharp climb angle and disappeared within the front. At roughly 2 500 metres a witness heard the engines accelerating and saw the aircraft crashing to the ground. It was then at a nose dive angle and caught fire.

Probable Cause

The aircraft disintegrated in flight due to breakage of parts of the left wing followed by the falling off of the tail section when the equipment was subjected to stresses above those envisaged by the manufacturer. This was brought about as a direct result of the pilot's decision to attempt to cross a cold surface front under turbulent conditions of extreme severity.

The following were contributing causes -

1. The pilot's recklessness in descending on a track well below the minimum safety flight altitude established for this type of operation.

2. The absence in the flight plan of a forecast showing the intensity of the meteorological phenomena encountered.

3. Inadequate operational dispatch of the aircraft.

The Pilot's Technical Conduct

The pilot's technical conduct showed, in the Investigator's opinion, the following errors:

1. On the basis of the forecast handed to him, the flight plan should have been modified as far as altitude was concerned, and the flight should have been performed on Green Airway No. 44.

2. Having reported to the Terminal Control Area on departure a flight altitude of 2 100 metres rising to 2 400 metres, the aircraft was seen

35 - 40 km before the site of the accident flying towards the front and trying to cross it. At that time it had deviated 21 km from its track and was flying at a height not above 100 - 150 metres, which constituted a breach of No. 189, para. 1 of the Flight and Air Traffic Control Regulations for visual flights and was far below the minimum safe flight altitude entered in the pilot's flight plan.

3. The pilot tried to continue to fly on IFR below all the safety limits established for the type of operation carried out.

4. He decided to continue flying by crossing the front, although the weather conditions required that he should return just as other aircraft had done. The danger was increased by the fact that the aircraft did not communicate with the ground or with other in-flight aircraft after leaving the terminal control area.

5. The pilot did not defer departure until he had gathered more up-to-date information in spite of the fact that in Mendoza he had been told that morning of the dangerous nature of the front.

Recommendation

It was recommended that a Committee be set up both to study the question of the co-ordination of services and of a better use of means available, and to review operational and flight protection rules in force in order to revise them if necessary.

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FIGURE 40

LV-AHZ - Wreckage of the aircraft destroyed by impact and subsequent fire.

FIGURE 41

Aerolíneas Argentinas, DC-4, LV-AHZ - left wing tip torn free in flight showing fractured area.