

No. 14

Pan American World Airways, Boeing 707-321C, N 461, accident at Mount Kamunay, Antipolo, Philippines, on 25 July 1971. Report, dated 15 March 1972, released by the Civil Aeronautics Administration, Philippines

1.- Investigation1.1 History of the flight

Flight 6005 was a scheduled international cargo flight from San Francisco to Saigon with intermediate stops at Honolulu, Guam and Manila. The flight from San Francisco to Honolulu and Guam was uneventful. At 2125 hours GMT on 24 July 1971, the flight took off from Guam for Manila. Initial contact with the flight was established by Manila Control at 2400 hours and the controller provided the flight with the latest weather information for Manila.

At 0013 hours the flight reported having passed Jamalig one minute before, being at 67 DME and out of FL 200. It was then handed over by Manila Control to Manila approach control. The approach controller cleared the flight to BA and provided the crew with the following weather information: wind 280°/20 kts, visibility 7 kms, light rain, cloud 3/8 at 4 000 ft and 8/8 at 9 000 ft. At 0018 hours the flight was cleared for a VOR/DME approach to Runway 24 from the Bangbang Intersection and one minute later the flight reported commencing the approach. At 0021 hours the flight reported 22 DME out of 5 000 ft for 4 000 ft and 20 seconds later reaching 4 200 ft. This was acknowledged by the controller who, thereafter was unable to establish contact with the flight. It was subsequently found that at approximately 0023 hours the aircraft collided with Mt. Kamunay some 20 miles ENE of the Manila VOR, at an altitude of 2 525 ft.

Witnesses residing near the scene of the accident testified that they had heard the sound of an aircraft which ceased in an explosion, followed by two other explosions, one immediately thereafter and the second one a little later.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	4		
Non-fatal			
None			

1.3 Damage to aircraft

The aircraft was destroyed by the impact and subsequent fire.

1.4 Other damage

No other damage was mentioned in the report.

1.5 Crew information

The pilot-in-command, aged 61, held a valid Airline Transport Pilot's Licence No. 37004 issued by the U.S. FAA on 15 February 1960 with ratings on the Constellation, Lockheed, Douglas DC-4, DC-6/7, Boeing 707/720. The result of his last B707 proficiency check was satisfactory. He had flown a total of 17 011 hours in piston-engined aircraft and 8 248 hours in turbo-jet aircraft. He held a first class medical certificate dated 12 July 1971 with the following restriction: "holder shall possess correcting glasses for near vision while exercising the privileges of his airman certificate". He flew the subject route at least once a month.

The co-pilot, aged 36, held a valid Airline Transport Pilot's Licence No. 1407404 issued by the U.S. FAA on 14 June 1967 with ratings on the Boeing 707/727. His last B707 Flight Simulator Proficiency Check was on 2 July 1971. He had flown a total of 1 300 hours with the U.S. Army Air Corps and 3 277 hours in the B707. He had flown 3 hours and 38 hours during the last 24 hours and 30 days, respectively. He held a first class medical certificate dated 16 February 1971 with no waiver/limitation.

The second officer, aged 39, held a valid Airline Transport Pilot's Licence No. 1300811 issued by the U.S. FAA on 17 June 1968 with ratings on the DC-6/7 and B707/720. He passed his last proficiency check on 12 June 1971. He had flown a total of 6 842 hours of which 4 542 hours were in the Boeing 707. He had flown 3 hours and 42 hours during the last 24 hours and 30 days, respectively. He held a first class medical certificate dated 18 September 1970 with no waiver/limitation.

The flight engineer, aged 40, held a valid Flight Engineer's Licence No. 1740173 issued by the U.S. FAA on 23 March 1967. He also held a Commercial Pilot's Licence No. 1367795 issued by the U.S. FAA on 8 August 1969, with aircraft ratings on single and multi-engine land and an instrument rating. He passed his last proficiency check on 29 January 1971. He had flown a total of 4 460 hours, of which 2 960 hours were in the Boeing 707. He had flown 3 hours and 72 hours during the last 24 hours and 30 days, respectively. He held a first class medical certificate dated 10 March 1971 with no waiver/limitation.

All crew members had a 24-hour rest at Guam prior to the flight.

1.6 Aircraft information

The Certificate of Airworthiness of the aircraft was valid and the aircraft had been maintained in accordance with approved maintenance procedures. From the aircraft maintenance log it appeared that all actions to correct discrepancies noted by crews had been taken and properly accomplished.

The weight and centre of gravity of the aircraft at the time of the accident were computed to be within prescribed limits. However, due to the destruction of the cargo by the impact and subsequent fire it was impossible to ascertain whether the load had been distributed as reflected by the load manifest prepared at Guam.

The aircraft had been serviced at Guam with sufficient fuel and oil for the flight. The type of fuel was not mentioned in the report.

1.7 Meteorological information

The crew was provided with the en-route weather and terminal forecast obtained from the U.S. Navy at Guam.

A typhoon with a maximum wind of 120 kt near the centre, 65 kt within 140 nautical miles of the centre, and 25 kt within 350 miles, was located ENE of Antipolo moving in a north westerly direction.

The 2400 hours GMT weather observations at Manila and at Quezon City Science Garden, 15 kms NNW of the crash site, were respectively as follows on 25 July 1971:

Manila: Wind 270°/16 kt; visibility, 9 km; 4/8 cumulus at 2 400 ft; overcast at 9 000 ft; temperature 25°C, dew point 21, QNH - 1005.5.

Quezon: Wind west at 12 kt; light rain showers; visibility 15 km; clouds 6/10 of cumulus estimated at 660 m; 10/10 overcast alto cumulus 2 400 m.

The crews of three Philippine Airline flights testified that while flying over the Manila VOR and the outer locator marker there was a strong wind coming from 240°.

Witnesses residing near the crash site reported that at the time of the accident it was raining heavily in the area. The crash site was completely obscured by clouds. The weather cleared in the afternoon.

1.8 Aids to navigation

The following navigational aids were available for an instrument approach to the Manila International Airport and were operating normally at the time of accident:

The Manila VOR "MA" (116.5 MHz) and Manila DME "MA" (channel 112 X) located 512 m beyond the threshold and on the northern side of Runway 06.

The outer locator "OM" (304 MHz) located 3.9 NM before the threshold of Runway 24 and on its extended centre line.

1.9 Communications

All communication facilities were operating at the time of the accident and there were no communication difficulties with the aircraft throughout the flight.

1.10 Aerodrome and ground facilities

Not pertinent to this accident.

1.11 Flight recorders

The aircraft was equipped with a Lockheed flight data recorder Model 109-C and a Fairchild cockpit voice recorder Model A-100.

The flight data recorder was recovered and sent to the U.S. National Transportation Safety Board. The foil was found to be mechanically damaged; however, after cleaning, examination showed all parameter traces operating and recording legibly until an altitude of 2 525 ft when they commenced an erratic and abnormal pattern. The

recording indicated that the flight descended from its cruising altitude (34 950 ft) to the altitude of impact (2 525 ft) in 16:53 minutes and that the rate of descent during the final 18 sec before impact was 1 083 ft/min. Vertical acceleration during these 18 sec increased both in amplitude and frequency, with peaks of + 1.37 and + 0.33 g. During that same time the heading trace revealed that the aircraft was in a left turn from 258° to 252° at impact. No evidence was found of a mechanical or electrical malfunction prior to impact and nothing indicated that the crew became aware of the impending accident and took any action to avoid it.

The cockpit voice recorder was also recovered and sent to the Audio Laboratory of the U.S. National Transportation Safety Board. Although severely damaged by the crash and post-impact fire, it yielded an unusually good readable tape and a transcript of the last 23 minutes of the flight was made (shown in following paragraphs as CVR time).

A review of the tape revealed that the pre-descent checklist items were called out in accordance with company procedures, and in particular that both the pilot-in-command and the co-pilot checked their radio altimeters at this time. (An 800 Hz tone was present separately on each of the pilots' audio circuits of the CVR.)

Farther on in time, the co-pilot announced to the pilot-in-command that the Cabanatuan NDB was set up on one of the ADF's and provided him with a 153° cross bearing to help him in cross-checking the Bangbang Intersection/DME fix. There was no aural evidence that the pilot-in-command used this information during the approach.

The Pan American's B-707 Operations Manual provided, in part, that after a check is performed on the radio altimeter at top of descent, the "bug" shall be set at 2 000 ft, and thereafter at the Minimum Descent Altitude (MDA), which in this case was 400 ft above field elevation. From examination of the topographical features of the land over which this approach was executed, it appeared that the sound of the aural alarm from the co-pilot's radio altimeter system, which occurred during a radio transmission was triggered by the aircraft reaching a point 2 000 ft above the ground. On the other hand, the pilot-in-command's radio altimeter could not have been set at 2 000 ft, since no aural alarm was heard on his CVR audio circuit at the same time the alarm was heard on the co-pilot's circuit. His alarm did not sound until 6 seconds prior to initial impact, corresponding to a "bug" setting of 400 ft.

The CVR tape did not reveal any evidence of powerplant distress, altimetry problems, or system failures except for a failure of the pilot-in-command's DME. The CVR revealed that the pilot-in-command's DME was not operating and that he was depending on the co-pilot to call out the DME mileage. The following extracts are pertinent to the operation of the DME and descent procedures.

CVR Time

11.57 (PIC) This DME is gone, you've got thirty-three. There it is.

13.15 (PIC) Is yours workin' cause my, my DME is out.

13.17 (C-P) Right, I'm twenty-seven DME now.

(PIC) Okay.

(C-P) And it agrees right up here (long pause) on your Doppler.

- 13.44 (C-P) Three miles to go, then you go down to 4 200. (This infers that they were at 26 DME.)
- 14.03 (C-P) Okay, you've two miles to go about five hundred, five hundred (short).
- 14.34 (C-P) Twenty-three, now you're cleared down to four two.
- 15.00 (C-P) Okay, at twenty miles out you are cleared down to three thousand.
- 15.18 (PIC) Three thousand.
- 15.18 (C-P) Three miles to go.
- 15.27 (C-P Transmission) Six zero zero five, we're twenty-two DME now.
- 15.57 (PIC) Now we go to twenty-five uh?
- 15.57 (C-P) Okay, now you are, now you are cleared down to twenty-five hundred.

Good correlation existed between the cockpit voice recorder and flight data recorder readouts, the derived ground track and altitude profile, and the evidence from on-the-scene investigation.

1.12 Wreckage

The wreckage was located at an elevation of 2 525 ft on the northern slope of 3 762 ft Mt. Kamunay. The aircraft wreckage was scattered in a rectangular area of about 300 m long by 50 m wide. From the cut in the trees, it was determined that the aircraft was in shallow descent between 10 and 20 degrees and on a heading of 258°. The break up of the aircraft from initial impact with the trees to the final impact was progressively destructive and covered a distance of approximately 250 m. The nose section, fuselage and tail finally settled at the bottom of a 50 ft deep ravine and a fire developed.

Examination of the wreckage did not reveal any evidence of pre-impact structural failure or fire or lightning strike. It was determined that at the time of initial impact the landing gear was extended, the flaps were in a 40° position and all engines were in forward thrust developing low power (approximately 46 per cent).

Both VOR's were set on the Manila VOR frequency (116.5 MHz) and both DME's were selected on normal. One ADF control panel was found set to 345 KHz, which was the Cabanatuan NDB frequency. The digital counter of the TAS indicator was found frozen at 180 Kt, and the digital altitude reporting indicator was found frozen at FL 26 with the red warning flag indicating "OFF". A Doppler "drift/ground speed/off-set miles" indicator was found but a readout could not be attained.

One of the altimeters was recovered and identified as the co-pilot's altimeter; it was set at 29.92 in Hg.

A Jeppesen manual was found with all the Manila Approach plates removed indicating that the crew were following the PAN AM procedure of removing the approach plates for ready availability. It was noted that these charts provided for transition from 29.92 in Hg to field pressure setting at a Transition Level of 4 000 ft.

1.13 Medical and pathological information

None mentioned in the report.

1.14 Fire

Fire broke out at impact.

1.15 Survival aspects

None mentioned in the report.

1.16 Tests and research

None mentioned in the report.

2.- Analysis and Conclusions

2.1 Analysis

There was no evidence to indicate that the aircraft was not in airworthy condition at the time of the accident. The crew of the flight who were in constant communication with the approach controller never reported any operating difficulty. The FDR and CVR readouts revealed no evidence of any aircraft abnormality during any part of the flight prior to the accident. The crew never recognized any impending disaster until initial impact at approximately 0023Z when a member of the crew shouted "look out".

Altimetry was ruled out as a potential causal factor based on the cross checks of the altitude alerting system, whose aural signal was heard on the CAM channel at flight data recorder-correlated altitudes within the system tolerance of settings at 7 000 and 4 200 ft, as well as the correlation of the co-pilot's comments with the flight data recorder.

A detailed examination of the flight profile followed by the aircraft versus the instrument approach procedure profile revealed that the pilot-in-command, who was executing the approach, failed to comply with the minimum altitude of 7 000 ft at the 23 mile DME fix. Based on a 29.92 in Hg setting on the altimeter recovered at the crash site, the altitude of the aircraft was already 6 095 ft when the co-pilot called out "twenty-three, now you're cleared down to four two". (CVR time 14.34.)

Both pilots were perfectly in accord until CVR time 15.00 when the co-pilot stated "okay, at twenty miles out you are cleared down to three thousand". This statement was similar to the statement made by the co-pilot at 14.34 - "Twenty-three, now you're cleared down to four two" - except for the words, "okay" and "at". From the ensuing events, it was evident that the pilot-in-command missed the word "at" and interpreted the statement to mean that the aircraft was then at the 20-mile point and that descent was now authorized to 3 000 ft. This interpretation of events is confirmed by the pilot-in-command's statement at 15.18 - "Three thousand" and the co-pilot's reply - "three miles to go". This reply from the co-pilot must have been misconstrued by the pilot-in-command to mean that they still had three miles to go to 17 DME over which the minimum altitude was 3 000 ft. In fact, the co-pilot must have meant that they still had three miles to go before reaching 20 DME and starting the descent from 4 200 ft to 3 000 ft. This assumption is sustained by the IAP which provided a 3-mile segment between 23, 20 and 17 miles DME.

At this juncture, the pilot-in-command was actually flying the IAP one segment ahead of where the aircraft was, and was also one segment ahead of the co-pilot. When the co-pilot replied to Manila Approach Control's request to report leaving 5 000 ft with a report of "we're...at, ah, four thousand", it is probable that his altimeter was reading 3 620 ft. Realizing that even the 4 000 ft value was below the minimum IAP altitude for 22 DME, he hastily changed this altitude report to 4 200 ft, and when he suspected that both he and the controller had been talking simultaneously, he repeated this report. At the time of the repeated report, the aircraft was at an indicated altitude of 3 420 ft.

It appears that the pilot-in-command was not paying attention to this exchange of communications, or cross-checking the distance and altitude values against either his instruments or the IAP chart. After travelling for approximately three miles and believing that the aircraft had passed 17 DME, the pilot-in-command stated at 15.57: "Now, we go to twenty five uh?" This confirms that mentally he was one approach segment ahead of the aircraft. At this juncture the co-pilot's reply indicated that he had become confused and/or misread the IAP chart profile, for he agreed with the pilot-in-command that further descent was authorized by replying (15.57) "okay, now you are, now you are cleared down to twenty five hundred". At this point, the accident was inevitable as long as the aircraft remained in cloud.

The CVR confirmed that the mountains were covered with cloud and that there was heavy rain in the area at the time.

2.2 Conclusions

(a) Findings

The crew were properly certificated and the pilot-in-command had proper experience in the aircraft and on the route flown.

The aircraft had a valid Certificate of Airworthiness and had been properly maintained. Its weight and centre of gravity were within allowable limits.

The weather conditions at the time of the accident were IMC and high ground in the approach path of the aircraft was in cloud, with some heavy rain falling.

All aids to navigation for approach to Manila International Airport were operating properly. The pilot-in-command's DME was out of service but the co-pilot's DME was operating properly.

The aircraft was nearly 1 000 ft below the minimum required altitude of 7 000 ft at 23 DME and apparently flew one segment ahead of the approved descent procedure. This was due to misinterpretation by the pilot-in-command of the equivocal statements of the co-pilot regarding the position of the aircraft and the flight profile to be followed.

(b) Cause or Probable Cause(s)

The Board determined that the probable cause of the accident was improper crew co-ordination which resulted in the premature descent of the aircraft.