

No. 18

Indian Airlines Corporation, Hiper DC-3, VT-AUL, accident near Pathankot, India, on 3 June 1963. Report released by the Indian Ministry of Civil Aviation on 30 September 1964.

1. Investigation1.1 History of the flight

The aircraft was on a scheduled domestic flight from Amritsar to Srinagar. It took off at 1115 hours (local time) with 29 persons on board and 7 minutes later it reported its position, 25 miles from Amritsar. No further communication was received from the aircraft. Shortly after 1200 hours a report was received by telephone at Amritsar, stating that the aircraft had crashed in a field near the Sarna railway station, about five miles from Pathankot. The crash took place at a point where the aircraft had to make a left turn of 70° to proceed on its normal course to Srinagar. Eyewitness evidence indicates that the aircraft made a left turn, went out of control and lost height rapidly. It then attained a climbing attitude, broke up and crashed to the ground, catching fire on impact.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	4	25	
Non fatal			
None			

1.3 Damage to aircraft

The aircraft was destroyed.

1.4 Other damage

None reported.

1.5 Crew information

The pilot-in-command and the co-pilot each had considerable experience, the first had flown 2 700 hours as pilot-in-command on DC-3's and the second 4 000 hours as co-pilot on DC-3's. However, neither had had much experience with the Hiper DC-3; during the past six months the pilot-in-command had flown Hiper DC-3's for less than 16 hours, and the co-pilot for 51 hours. Both pilots had flown the subject aircraft on 1, 2 and 3 June.

Although impact and fire had totally destroyed and consumed the bodies so that positive identification was impossible, there was evidence to indicate that the co-pilot was flying the aircraft from the left seat.

Note: Other information on the crew was contained in an Appendix to the report, but the Appendices were not received by ICAO.

1.6 Aircraft information

VT-AUL originally was a C-47 manufactured in 1944. In 1956 it was converted into a Hiper Dakota, the main changes being the installation of more powerful engines (Pratt & Whitney R-2000-D 5), of a geared rudder trim tab (servo trim tab), and bungee springs to the rudder controls. The purpose of the geared rudder trim tab was to reduce the rudder forces to be applied at minimum control speed on one engine. This increased the tendency to rudder force reversal or rudder lock, which was already existing on normal DC-3. To correct this the conversion also included installation of bungee springs to the rudder controls. There was evidence that these bungee springs were neither installed asymmetrically as specified in the drawings provided for the conversion nor rigged strictly in accordance with specifications and that this was not corrected during subsequent overhauls. The auto-pilot was a Jack & Heintz A-3A type. There was a placard on the instrument panel prohibiting the use of the auto-pilot and a second placard, affixed in December 1961, stated:

"Possible sudden force reversal and/or sudden lock may be experienced in this aircraft if sudden application is not co-ordinated with lateral control. Avoid yawed flight."

The aircraft had a Certificate of Airworthiness valid until 21 January 1964. The last 200-hour check took place on 18 May 1963.

The all-up weight of the aircraft was within the permissible limit. No information about the centre of gravity position was available.

The type of fuel used was not mentioned in the report.

1.7 Meteorological information

There was no turbulence. Windspeeds were low - 3 to 4 kt at lower levels, 10 to 15 kt between 5 000 - 10 000 feet altitudes. Visibility was good and there was no cloud.

1.8 Aids to navigation

Not pertinent.

1.9 Communications

Communications were normal until 1123 hours, the time of the last message from the aircraft.

1.10 Aerodrome and ground facilities

Not pertinent.

1.11 Flight records

Not mentioned in the report.

1.12 Wreckage

Fire destroyed the aircraft completely. However, indication of break-up in the air was given by the finding of components of the aircraft lying in a small area north east from the main wreckage. This confirmed that the aircraft was in a left turn before it crashed.

1.13 Fire

Fire occurred after impact, and could not be checked.

1.14 Survival aspects

None.

1.15 Tests and research

None mentioned in the report.

1.16 Auto-pilot

In view of the placard prohibiting the use of the Jack & Heintz auto-pilot enquiries were made regarding the suitability of this auto-pilot on Hiper DC-3. It was confirmed that this type of auto-pilot was considered satisfactory but that each aircraft so fitted should be flight tested after conversion to ensure that the follow-up ratio adjustment of the rudder was correct, otherwise oscillations in yaw might occur. It appeared that this was not done by the operator and therefore the placard was not removed. However, there was evidence that during their conversion to Hiper DC-3, pilots were told that they could use the auto-pilot between 125 and 180 mph and that some pilots did in fact use it although the auto-pilot control was supposed to be wire locked. Several instances of loss of control were reported by pilots, in some cases the aircraft went into a spiral when the pilot engaged or disengaged the auto-pilot. Although the operator was aware of the infringements to the ban and of the resulting incidents no action was taken. Any malfunction or mishandling of the auto-pilot has greater consequences on a Hiper DC-3 than on the normal DC-3, because of the greater sensibility of the rudder installed on the Hiper DC-3.

2. Analysis and conclusions

2.1 Analysis

The aircraft, which was flying at approximately 8 000 feet in excellent weather conditions, went into a spiral to the left at a point of its route where normally a 70° left-hand turn was initiated.

No indication of malfunction or failure of the engines was found.

Ten instances of malfunction were reported before and after the placard regarding the possible rudder force reversal and/or rudder lock was placed in the Hiper aircraft. Pilots had experienced malfunctioning of the rudder and a consequent loss of

control both in calm weather and in turbulent conditions. In almost all cases there was no obvious defect or explanation of this malfunctioning. In most of these cases, reports of the incident were made by the pilots and test flights were in some instances carried out without establishing any positive result. In three cases the malfunctioning was experienced while engaging or disengaging the auto-pilot. In other cases, the aircraft was being turned when the rudder lock or reversal occurred. The malfunctioning might have resulted from an uncoordinated turn or from an unanticipated malfunctioning of the auto-pilot which produced conditions leading to loss of control. Flights aimed solely at testing the capacity and functional efficiency of the auto-pilot were never undertaken although the manufacturers and the CAA repeatedly emphasised the absolute necessity of specifically testing the adequacy of the auto-pilot and accomplishing its approval in accordance with the instructions laid down. The recovery was made sometimes by kicking the opposite rudder pedal with considerable force, once by the use of differential engine power but, more frequently, by working the trim tab. The matter was not investigated and no technique for effecting recovery was evolved or recommended nor were steps taken to check the rudder rigging or to investigate the auto-pilot system. Ground tests cannot be accepted as proof of the matching of the auto-pilot system, because of the aerodynamic forces on an aircraft in flight. With more powerful engines and a greater air speed, the follow-up ratios might well need alteration or some other adjustment might become necessary.

According to the evidence, neither the pilot-in-command nor the co-pilot had had any experience of rudder lock or rudder reversal, though they might have heard of it. The pilot-in-command contrary to the categorical directive, occupied the right-hand seat when the aircraft left Amritsar and it may be assumed that during the next half hour he continued to occupy the same seat. It should be noted that from this place he was not in a position to reach easily the rudder trim tab control. It was concluded that when the turn was being effected whether with or without the auto-pilot engaged, the rudder became locked. It is not known what and how soon corrective action to make a recovery was taken, but it proved ineffective. In the course of the rapid descent following the loss of control, speed built up rapidly and during an effort to "pull up" structural failure occurred due to overstressing. The loss of control, was in all probability, due to one or several of the following causes:

- (1) The rudder bungee system was not installed correctly and this accentuated the tendency of the rudder to lock or reverse.
- (2) The Jack & Heintz A-3A auto-pilot had not been specifically tested for its suitability in this aircraft.
- (3) An improper handling or malfunctioning of the auto-pilot at the time of taking the turn might have caused rudder lock.
- (4) The pilot might have made an inadvertent yawed turn which caused the rudder to lock and the aircraft to turn sharply to one side.
- (5) The fact that neither the pilot-in-command nor the co-pilot had previous experience of this type of malfunctioning might have retarded the process of effecting a recovery. Neither of them might have thought of using differential engine power or operating the trim tab handle and insufficient force was applied to unlock the rudder.

2.2 Conclusions

Findings

The aircraft held a valid Certificate of Airworthiness.

The aircraft loading was within permissible limits though the centre of gravity had not been determined.

The members of the crew held valid licences.

The navigational equipment on board the aircraft was adequate for the flight.

The installation of the rudder control system was improper inasmuch as the bungees were not properly installed and adjusted during the initial rigging and this was not corrected during subsequent overhauls. There was no item relating to the rigging of the bungees or attending to the trim tab in the overhaul schedule and therefore it had probably escaped the attention of the engineers and mechanics carrying out the overhaul.

The pilot and the co-pilot had flown this very aircraft on the 1st, 2nd and 3rd June without experiencing loss of control.

The pilot's seat was occupied not by the pilot-in-command, but by the co-pilot while the pilot-in-command sat on the co-pilot's seat.

The rudder installed on the Hiper Dakota is more sensitive than the one on standard Dakota and it had a greater tendency to lock or reverse in certain conditions.

The Jack & Heintz A-3A auto-pilot which was originally installed on the aircraft before its conversion was not after conversion tested by means of specific test flights. This type of auto-pilot is not being used in the U.S.A. on civil aircraft and in the opinion of the Federal Aviation Agency, approval of this auto-pilot "should be accomplished in accordance with the instructions contained in note 13(g) of FAA Specification A-669." This was not done by the operators.

No proper investigation regarding the question of the suitability of the auto-pilot was made by the operators and although a placard forbidding its use during flight was prominently displayed in the cockpit, pilots continued to disregard this injunction and used the auto-pilot.

Mishandling of the auto-pilot at the time of engaging or disengaging it, uncoordinated turn or a sudden side gust of high intensity can, in the case of Hiper Dakota, cause sudden reversal or rudder lock.

As many as nine previous instances of similar loss of control, though not resulting in an accident, had been experienced and reported by pilots to I. A. C.

The weather at the time of the accident was calm and free from turbulence.

The Department of Civil Aviation did not take the initiative to enquire into the suitability of the auto-pilot and by remaining passive, allowed a curiously anomalous state of affairs to continue whereby despite the tacit approval of the auto-pilot, a placard

banning its use continued to be displayed and yet most pilots, disregarding the injunction, brought the auto-pilot into use and even broke the wire-lock when they found that the auto-pilot had been rendered inoperative by this means.

Loss of control was experienced during the course of a turn and structural failure of the aircraft followed in an attempt at recovery.

Cause or
Probable cause(s)

The accident was caused by structural failure of the aircraft in the air following over-stressing as a result of loss of control.

The loss of control was caused by improper rigging of the rudder bungee system which helps to prevent the marked tendency of the rudder of the Hiper Dakota to reverse or lock under conditions of yawed turn and/or on encountering a severe side gust. It is equally likely that malfunctioning or improper operation of the auto-pilot may have initiated a yaw and accentuated the tendency of the rudder to lock.

3. Recommendations

- 1 If Hipers are to be flown in India, they should be subjected to the tests suggested by the U. S. Federal Aviation Agency, both for the removal of the placard relating to yawed flight and achieving the approval of the Jack & Heintz type of auto-pilot. Until this is done, the widest publicity of the characteristics of the Hiper Dakotas must be given to the pilots after making sure of the proper rigging of the rudder. Also the use of the auto-pilot must be prohibited.
- 2 The Indian Airlines Corporation's machinery for reporting, tabulating and co-ordinating reports on malfunctioning particularly those relating to incidents involving loss of control of aircraft must be improved and remedial action should be taken promptly. A suggestion during the investigation was made that certain directions were given by the Director General of Civil Aviation as a result of a meeting. These directions must be enlarged and implemented with greater vigour and promptness.
- 3 The Indian Airlines Corporation should have a proper engineering department, other than its normal maintenance staff, to assess the aerodynamic and structural problems arising out of modifications, evaluate their implications to the operator and suggest practical methods of implementing them.
- 4 When similar aircraft are used by civil operators and the Air Force, there should be a prompt and reciprocal exchange of information on all significant defects and incidents experienced by each. Steps should be taken to implement this on a high priority.