

No. 6

Indian Airlines Corporation, Caravelle, VT-DPP, accident at Palam Airport, India, on 15 February 1966. Report No. 1/7/66-AS, dated 5 October 1967, released by the Director General of Civil Aviation, India

1. - Investigation1.1 History of the flight

Indian Airlines Corporation, Caravelle, VT-DPP, while on scheduled domestic passenger service from Calcutta Airport to Palam Airport on 15 February 1966, undershot the runway while attempting to land under conditions of poor visibility due to fog at Palam, with the result that it struck a cement pillar and subsequently several other obstructions until it came to rest on its belly near the threshold of the runway in use. Fortunately, all crew and passengers were able to get out before the aircraft was consumed by the fire which had broken out as a result of the earlier impact with obstructions. Some of the passengers received injuries and burns of varying degrees. Unfortunately, two passengers succumbed to their injuries subsequently. The aircraft was completely destroyed

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal		2	
Non-fatal		14	
None	7	57	

1.3 Damage to aircraft

Destroyed by fire.

1.4 Other damage

The aerodrome fencing and some approach lights were damaged.

1.5 Crew information

It is not necessary to say anything about the flight engineer and the cabin assistants as they played no significant part in the event, which is the subject matter of this investigation. It is proposed, however, to discuss at some length, the record and the flying competence of the two pilots.

The pilot-in-command, Capt. Mathews, began his training as a pilot with the Madras Flying Club in June 1946. He got his licence in 1947, and then flew with Airways India for about two years. In 1949, he joined a charter company. During all this time,

he was flying only DC-3 aircraft. In 1952, he joined Bharat Airways and continued with this company till August 1953, when, on the nationalization of the air transport business, he joined the Indian Airlines Corporation. With Bharat Airways also, he flew only DC-3 and DC-4 aircraft. In the Indian Airlines Corporation, he began to fly Viscounts also and got his endorsement for the Viscount in 1961. At the time of the accident, he held a valid licence for flying a Caravelle with a pilot-in-command endorsement. Up to 31 October 1965, he had flown, in all, 18 378.20 hours. His flying experience on the Caravelle on 31 December 1965, was as follows:

	<u>By day</u>	<u>By night</u>
As co-pilot	191.25 hours	148.20 hours
As pilot-in-command	96.55 hours	48.10 hours

It seems, however, that the requirements of Aircraft Rules were not fully complied with and Capt. Mathews was not entitled to the privileges set out in Section F, paragraph 6 to Schedule II to Chapter II. The last proviso to paragraph 6 - Privileges - is in the following terms:

"Provided further that for all flights as Pilot-in-Command or as Co-pilot on a transport aeroplane having an all-up weight exceeding 5 700 kg, he shall have undergone satisfactorily within the preceding six months of the intended flight appropriate proficiency checks in respect of that type of aircraft as required by the Director General".

In the passage quoted above, it is clearly stated that the privileges to which the pilot is entitled can only be enjoyed if proficiency checks have been carried out on that type of aircraft. In the present case, it has not been shown that this requirement was complied with. Indeed, the instrument rating flight tests and local checks were not carried out on the Caravelle but on other types of aircraft including Dakotas. It seems to the Court that this passage has been interpreted by the Indian Airlines Corporation as meaning that the checks can be carried out on any type of aircraft which the pilot has been flying and for which he holds a valid licence. With regard to the instrument checks, it was stated that the Viscount has some of the instruments which are installed in the Caravelle and so, a check on the Viscount is considered valid for the Caravelle. In the Court's view, however, this interpretation is erroneous and the rules require demonstration of proficiency and the carrying out of checks on the type of aircraft (having an overall weight exceeding 5 700 kg) in respect of which the privileges are to be exercised. The Viscount, the Caravelle and the Dakota have an all-up weight exceeding 5 700 kg, and though some instrumentation is common, the Caravelle is a pure jet aircraft, while the Viscount is a turbo-propeller type and the Dakota is a totally different type of aircraft. Therefore, a strict compliance with the rules necessitates that flying skill should be demonstrated on the Caravelle, and the proficiency checks must be carried out on the Caravelle before the pilot becomes entitled to exercise the privileges set out in paragraph 6 to Schedule II, at page 93 of the Aircraft Rules. It is to be observed that the IAC do not possess a Caravelle flight simulator and strict compliance with the above rules is, in the circumstances, all the more important.

The co-pilot, Captain Bhagwagar, began his flying career with the Bombay Flying Club in 1946. In October 1949, he got his pilot's licence. At that time, he was flying the Tiger Moth. He then joined Bharat Airways and began to fly DC-3 and DC-4 aircraft. In August 1953, when the airlines were nationalized, he joined the Indian Airlines

Corporation. He then flew Dakota, DC-4, Fokker Friendship, and subsequently Caravelle when this type of aircraft was acquired by the Corporation. His total flying experience on 31 January 1966, was 14 887:30 hours. Of these, he had done, as co-pilot, 3 497:50 hours by day, and 1 174:25 hours by night. As pilot-in-command, he had done, 7 184:00 hours by day, and 2 776:55 hours by night. His Caravelle experience, as co-pilot, up to 31 January 1966, was 92:10 hours by day and 85:55 hours by night. It is needless to say that his experience as pilot-in-command was acquired on DC-3 and DC-4 aircraft.

In his case too, the local checks were not done on the Caravelle and the requirements of the Aircraft Rules were not complied with.

The Court, therefore, finds that though Captain Mathews and Captain Bhagwagar were in possession of valid Airline Transport Pilot Licences (ALTP), neither of them was competent to exercise the privileges mentioned in paragraph 6 of Schedule II to Chapter II of the Aircraft Rules.

1.6 Aircraft information

Caravelle VT-DPP was manufactured by Sud-Aviation in 1963 for the Indian Airlines Corporation. The records show that all mandatory inspections and modifications had been carried out on the airframes and engines, and at the time of the accident the aircraft had completed 5 411 hours flying.

The aircraft held a valid certificate of airworthiness which was last renewed on 14 January 1966. The weight of the aircraft and the centre of gravity were well within the prescribed limits.

The fuel used was D. ENG. R.D. 2494. The aircraft, the engines and the instrumentation, including the Instrument Landing System were in serviceable condition.

1.7 Meteorological information

The flight of the aircraft was normal in every respect up to the moment when the approach and landing procedure was commenced. No turbulence or high wind was experienced at any stage of the journey and the visibility was perfect.

The only aspect of the weather which concerns us is the visibility, particularly the surface visibility, in the vicinity of Palam and at the airfield itself. The meteorological briefing read out to the pilot-in-command at Dum Dum, indicated that temporary fog was expected at Palam between 0100 hours GMT and 0500 hours GMT. The visibility forecast was 400 m.

There was, in fact, a dense ground fog lying over the runway at 2230 hours GMT when the aircraft was due to land. This circumstance was observed by the Fire Brigade Unit sent out to make an inspection of the runway at 2200 GMT. Sansar Chand, Fire Operator, went to make the inspection in a jeep driven by Ram Nath. According to the statement made by Sansar Chand to Jagdish Chandra immediately after the inspection, the visibility was very bad, and at one stage the vehicle strayed off the tarmac because the driver could not see his way through the fog. The runway lights could not be clearly seen. While driving over the runway, Sansar Chand was not able to see more than one light, though at one stage, on the return journey, he saw two or three. The horizontal visibility at that time was, therefore, scarcely more than 400 ft or about 100 m. Jagdish Chandra felt alarmed that the aircraft was coming to land in such poor visibility conditions, and the fire-fighting crash crew was alerted.

In his report to the control tower, the fire operator made no mention of the fog and merely stated that, upon inspection, the runway had been found clear of any obstruction.

The visibility minimum laid down for a night landing of Caravelles at Palam was, at the time of the accident, 0.75 mile or a little over 1 kilometre (vide letter No. 32-9/61-ARI, dated 17 October 1964, from the Director General of Civil Aviation, to the Chief Operations and Planning Manager, Indian Airlines Corporation). It would seem, therefore, that according to the actual observation made by the Fire Inspection Unit, horizontal visibility was considerably below the permissible minimum.

The information conveyed to the aircraft was, however, totally different. The taped messages which passed between the aircraft and the control tower show that at 2210½ hours GMT, the control tower informed the aircraft that at 2200 hours GMT visibility was 3.5 km, "trend airfield visibility gradually reducing to 2 000 metres." Five minutes later, another message informed the aircraft that visibility was 2.2 km. At 2221 hours GMT, the aircraft told the control tower that the runway was in sight. The altitude of the aircraft at that time was a little below 10 000 ft. A minute later, the message from the aircraft was: "I would like to have the intensity of runway lights fully on." To this, the control tower replied: "My lights are on maximum intensity." Therefore, at that stage, the intensity of runway lights, as viewed from the aircraft, was in all probability reduced by fog to such an extent that the pilot-in-command thought the lights had not been put on full intensity. Three minutes later, he stated that in case he could not make the landing at Palam, he would like to have the Agra weather. This message was passed at 2224 hours GMT and the aircraft had not yet descended to the height of 3 500 ft. At 2226 hours GMT, the control tower enquired from the aircraft if the runway lights were in sight and the aircraft replied: "This is affirmative."

The pilot-in-command did not think that there was anything unusual about the weather conditions. He had received no message about any fog over the airfield and the runway lights were visible. So he continued to descend.

Therefore, although on the one hand a dense fog had been observed by the Fire Brigade Unit, information of this circumstance was not passed on to the control tower nor was it given to the aircraft at any time during the approach and descending procedure. The vertical visibility apparently was good while horizontal visibility was extremely poor, and this accounts for the runway lights being visible to the pilot from a height of 3 500 ft and not from the jeep of the Fire Inspection Unit. Horizontal visibility only comes into play when the aircraft is low, as then the rays of light have to travel a longer distance through fog than when the aircraft is higher up. The question, therefore, arises whether timely information could have been sent to the aircraft about the extremely poor visibility conditions at the Palam Airport, and if the giving of this information might have made the pilot change his plan to land at Palam, and whether, as a consequence, the accident could have been averted. In this context, it has to be considered (a) whose responsibility is it to supply accurate information about visibility conditions and (b) the time factor.

The procedure for giving weather information to the aircraft is set out in Notice to Airmen No. 5 of 1955 (No. ARI-32-23-(53) dated 9 April 1955). The relevant paragraphs of this Notice are quoted below:

"Operational Control

"According to Annex 6 to the Convention of International Civil Aviation, an operator or his designated representative is responsible for the exercise of operational control over the movements of his aircraft.

2. "Operational control is defined as 'the exercise of authority over initiation, continuation, diversion or termination of a flight.'

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6. "Aerodrome weather observations for the purpose of applying the appropriate minima shall be made, except as provided in paras. 7(a) and 7(b) only by Meteorological Observers approved for this purpose by the Director General of Observatories, Director General of Civil Aviation or the Air Headquarters.

7(a) "In the case of difference of opinion regarding visual observations of the current weather, air traffic control will pass, on a written request from operational control, a supplementary observational message to the aircraft affected. In all such cases, the messages must be clearly labelled to indicate that the observations are those of the operators' operational control and not those of the official meteorological observer. In the case of instrumental observations, the observations of the official meteorological observer will be decisive.

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10. "Let-down procedures: When a diversion has been advised in agreement with the operational control, a pilot will not have the option of attempting a 'let-down'. If, however, the operator does not exercise operational control on the ground, the pilot will have the discretion of attempting a 'let-down' to the critical height for the type of radio aid in use. If, after descending to the critical height over the facility, the pilot reports that he can land by visual reference to the ground, he may be permitted to do so irrespective of the observed weather."

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In this case the weather information conveyed to the aircraft, as revealed by the transcript of the tape recording, shows that only the weather observed by the meteorological observer was given to the aircraft. The Court has already stressed the point that this did not correspond with the actual state of affairs as experienced by the Fire Inspection Unit. It is to be observed that the Indian Airlines Corporation does not exercise operational control at Palam. In the absence of such control, there was no question of complying with the provisions of para. 7(a), nor could diversion have been advised as contemplated by para. 10.

Therefore, the position is that though horizontal visibility over the runway was extremely poor and below the minima laid down, information of this circumstance was not conveyed to the aircraft and, indeed, could not according to the rules of procedure laid down. The conclusion is irresistible that had operational control been exercised by the Indian Airlines Corporation at Palam, timely information about poor visibility could have been conveyed to the aircraft as contemplated by paras. 7(a) and 10 of the Notice to Airmen quoted above, and the pilot might well have chosen to go round and not run the risk of landing in such poor visibility conditions.

With regard to the weather, therefore, the Court's conclusion is that a dense surface fog over Palam Airport gave a wrong impression to the pilot about the visibility conditions for landing when he was at a high altitude. He was informed that visibility was 2.2 km, which was well above the minima. It was not till he was very near ground level that he realised how deceptive his own observation and the information conveyed to him had been. It is, therefore, essential that visibility conditions should be observed with greater care and correct information passed on to the approaching aircraft with the least possible delay. The installation of a FVR is an urgent requirement.

1.8 Aids to navigation

The following facilities were available at Palam Airport: VOR, ILS, NDB, VDF.

1.9 Communications

The aircraft established normal VHF radio contact with Palam Approach.

1.10 Aerodrome and ground facilities

The airport is installed with Instrument Landing System facility. The Localizer transmitter operates from a transmitter antenna system located 1.78 NM from the night threshold. The signal from this transmitter can be normally picked up at a distance of 25 NM from the airfield at a height of 2 000 ft above ground level, but the normal range at which signals can be picked up is much more, depending upon the height of the aircraft. The Outer Marker and the Locator Beacon are situated at a distance of 4.56 NM from the night threshold while the Middle Marker is located at .74 NM from the night threshold. The Instrument Landing System complex provides a radio path inclined at 2.75° nominal. After intercepting the glide path, the pilot follows the path maintaining a steady rate of descent. After crossing the Outer Marker station, which he should do at about a height of 1 411 ft above ground level, the pilot tunes for the Locator Beacon of Middle Marker unit and homes on it as he continues to fly along the glide path. Over the Middle Marker station, he intercepts the Marker Beacon signal at a height of about 268 ft transmitted by the Middle Marker. This warns the pilot of his position from the various thresholds of the runway he is approaching. After crossing the Middle Marker station, the pilot has to make a safe visual landing. At the time of the accident, the runway and approach lighting (high intensity centre line) were at 100% intensity. There were no reports of any lighting unserviceability.

1.11 Flight recorders

None fitted.

1.12 Wreckage

The main fuselage lay in one piece at the site where the aircraft finally came to rest. Other parts of the aircraft lay scattered in an area along the path from the point of first impact with a cement pillar to the final resting place, a distance of some 3 385 ft short of the displaced night threshold. Inspection at the scene of the accident showed that on hitting the cement pillar, the undercarriage was badly damaged. A little distance further, the aircraft made its first impact with the ground and the aircraft travelled along it leaving marks of both wheels on the grass. The aircraft once again became airborne and hit the ground a second time at a distance of about 400 ft from its first touchdown point. The port wheel then travelled along the ground for a distance of

247 ft and once again the aircraft was airborne. For the third time the aircraft touched ground at a distance of little more than 1 100 ft from the cement pillar and travelled along the ground leaving wheel and flap marks. Portions of the aircraft then began to fall off, the undercarriage disintegrated and, after another jump, the aircraft slid along the runway and came to rest just short of the day threshold on the grassy margin. The fire, which had broken out, quickly spread and began to destroy the aircraft.

1.13 Fire

Fire had broken out before the aircraft came to rest after first impact, probably as a result of fuel from the burst wing tanks being ignited by the hot engine. The fire intensified after the aircraft came to rest, and in spite of the best efforts of the Airport Fire Brigade which arrived on the scene within two to three minutes, the aircraft was destroyed by fire. However, all the passengers and crew were able to evacuate the aircraft before that. A few passengers sustained burn injuries of varying degrees.

1.14 Survival aspects

Although fire had broken out before the aircraft came to rest, all the crew and passengers were able to evacuate the aircraft before it was completely consumed by fire. This was probably due to the fact that high-grade kerosene was used as fuel. Had petrol been used, it would not have given as great a chance to the occupants to escape as it did in this case by the use of kerosene. The aircraft could not be saved because fire spread rapidly.

1.15 Tests and research

None.

1.16 Other pertinent information

None.

2. - Analysis and Conclusions

2.1 Analysis

It will be remembered that the flight of the aircraft was, in every respect, normal until the approach and let-down procedure was commenced. So, it is from this stage onward that the conduct of the pilots and of the aircraft must be examined.

There is one other point which must be mentioned in this connection. Capt. Bhagwagar stated that he changed the altimeter setting from QNH (1 014 mb) to QFE (987 mb) at some stage between the Outer Marker and the Middle Marker. His statement at the preliminary investigation, the correctness of which was admitted at the inquiry, was to the same effect. Capt. Mathews also stated that he (Mathews) set his altimeter when the aircraft was between the Outer Marker and the Middle Marker. If these statements are correct, it was scarcely possible for the pilots to make the adjustment accurately and, at the same time, concentrate on the monitoring of the ILS and watch the airfield visually. The resetting of an altimeter from 1 014 mb to 987 mb cannot be done in a hasty or casual manner without running the risk of getting faulty readings.

If the altimeter gave an erroneous reading, it could have been due to a faulty resetting of the barometric value when it was altered from ONH to QFE. The altimeter had been checked before starting from Calcutta - during the flight - as testified by Capt. Mathews. It seems that there was some confusion in the cockpit during the descent and landing procedure. There was lack of co-ordination between the pilot-in-command and the co-pilot, and if both of them were engaged in altering the setting of their altimeters, neither of them could have monitored the ILS nor was it possible to cross-check the altimeter setting which, according to Capt. Fischl, is very important at this stage. Quite understandably, Capt. Bhagwagar, at the preliminary investigation, admitted that he did not cross-check his altimeter with the pilot-in-command's, while Capt. Mathews said that Bhagwagar had set his altimeter on QNH and he (Mathews) saw this being done. In his supplementary statement, Capt. Mathews had stated: "Our procedure is that during this approach we have the pilot's altimeter on the QFE and the co-pilot's ONH values. The co-pilot would naturally carry out the difference between the QNH and QFE indications when calling out the height." The evidence of the pilots, therefore, reveals a lamentable state of affairs in the cockpit.

At the preliminary inquiry, Capt. Mathews and Capt. Bhagwagar said quite categorically that the aircraft remained on the glide path till the Middle Marker. At this stage, Capt. Mathews could see the runway lights quite clearly as well as the night threshold, but suddenly he found that he had greatly undershot and the aircraft had come down to the ground considerably short of the runway. Capt. Mathews was asked how this could be possible because if he were at 300 ft over the Middle Marker, the aircraft could not have touched ground at the spot where it actually did. At the inquiry he changed his statement and stated that he abandoned the ILS at a height of 700 or 800 ft and, since he could see the runway lights and the night threshold quite clearly, he came down visual. Capt. Bhagwagar was positive that the aircraft was over the Middle Marker at a height of 300 ft. Capt. Mathews had made the same statement earlier. Capt. Bhagwagar stated that he did not see the blips over the Middle Marker but he was positive that the altimeter showed a height of 300 ft. In order to explain the undershooting, he stated that there may have been some error in the altimeter. The altimeters were, however, checked and this explanation cannot be accepted.

These contradictions and inconsistencies in the statements of the two pilots arise from an apprehension that they had not handled the aircraft in a competent manner and were guilty of doing something not strictly correct according to the proper procedure for landing a Caravelle aircraft. It seems to the Court that what happened was that the Captain erroneously abandoned the ILS at too early a stage. There was low dense fog and this led the pilot to believe that the runway was nearer than it actually was. He may also have lacked complete confidence in adhering to the ILS until the Middle Marker stage. During the course of his training and checks, he had not displayed the same degree of aptitude and competence in the matter of ILS landings as many other competent pilots. The Court feels, therefore, that in the circumstances obtaining at the relevant time, the pilot erroneously changed over to visual control when he did. Also, the co-pilot did not competently perform his duties in giving information about the correct height and in monitoring his instruments. There was, thus, lack of co-ordination between the pilots in the matter of their specific duties during the ILS approach. The monitoring of instruments, viz., the altimeter and the vertical speed indicator, was faulty, and if both pilots were, at the critical stage of approach, engaged in adjusting their altimeters, there occurred a serious distraction in their attention when concentration was most essential. It is also in evidence that the landing lights were used, and these, in the presence of ground fog, must have affected the vision of the crew. Both Capt. Mathews and Capt. Bhagwagar stated that there was glare caused by the reflection of the landing lights. Capt. Mathews called it a blinding glare which prevented him from seeing the runway.

It is, therefore, of the utmost importance that pilots flying a jet aircraft should have a good training record in the use of instruments, and at the time of an ILS approach, under poor marginal visibility conditions, the instruments, particularly the altimeter, should be properly monitored up to the critical height.

2.2 Conclusions

(a) Findings

The aircraft held a valid certificate of airworthiness at the time of the accident.

The aircraft loading and passenger complement were within permissible limits, and the centre of gravity was also within permissible limits.

The navigation aids and instrument installations for the let-down procedure including the Instrument Landing System, were adequate for the flight and for effecting safe landing.

The pilot-in-command and the co-pilot held valid licences.

Neither the pilot-in-command nor the co-pilot was competent to exercise the privileges of a holder of an airline transport pilot's licence for the Caravelle type of aircraft within the meaning of paragraph 6 of Section 'F' to Schedule II to Chapter II of the Aircraft Rules (page 93 of the Aircraft Manual), because they had not undergone the appropriate proficiency checks, as required by the Director General of Civil Aviation, in respect of the Caravelle type of aircraft which has an all-up weight exceeding 5 700 kg.

There was a dense surface fog covering the airfield at the time of the accident and horizontal visibility was below the aerodrome minimum.

The pilot-in-command abandoned the use of the Instrument Landing System during the let-down procedure when he was at too early a stage and much before he was over the Middle Marker. He changed to visual flying sooner than he should have in the conditions prevailing.

The presence of ground fog resulted in a misleading and inadequate visual reference to effect a safe landing.

The use of landing lights in the presence of fog caused glare and further increased the landing hazard.

The measure of visibility as conveyed to the aircraft was not based on a correct account of the actual conditions prevailing at the time. The actual visibility was below the prescribed minima.

The instruments, particularly the altimeter, were not properly monitored during the final approach.

Poor horizontal visibility and an unduly early abandonment of the Instrument Landing System during the let-down procedure caused the aircraft to undershoot the airfield and make contact with the ground 3 385 ft short of the night threshold.

As a result of undershooting, the aircraft made several impacts with the ground causing damage to its structure and smashing the undercarriage. It finally came to rest on its belly.

Fire broke out before the aircraft came to rest.

All the passengers and crew were able to leave the aircraft alive.

Several of the passengers received burn injuries as they were leaving the aircraft.

Two of the passengers subsequently succumbed to their burn injuries.

The aircraft was totally destroyed by fire.

The fire-fighting equipment available at Palam is below the Standard required by the International Civil Aviation Organization, but in this case the aircraft could not be saved because fire spread rapidly.

(b) Cause or
Probable cause(s)

The Government of India has accepted that the aircraft undershot and crashed as a result of the abandonment of the ILS approach at too early a stage during an attempt to land under conditions of poor visibility in fog.

Contributory causes were:

- (i) Lack of information with the pilot regarding the true conditions of surface visibility, which was in fact below the minimum prescribed for a night landing by Caravelle aircraft on runway 28 at Palam.
- (ii) Lack of proper monitoring and possibly incorrect setting of altimeter(s) during the approach to land.
- (iii) The use of landing lights which resulted in glare during the final stages of the approach in foggy conditions.

3. - Recommendations

The Court made the following recommendations:

1. A recommended Instrument Landing System procedure defining the respective responsibilities of the pilot-in-command and co-pilot should be set out in the Indian Airlines Corporation operations manual for the guidance of pilots.
2. There should be more rigid supervision and strict compliance with the Aircraft Rules in the matter of exercise of privileges under the Airlines Transport Pilot's Licence. This is all the more important because no Caravelle simulator is available with the IAC.
3. A detailed reconsideration of the IAC training of pilots and the procedure for issuing licence by the DGCA should be made, so that there can be a more accurate assessment of the competence and proficiency of IAC pilots.

4. The installation of RVR measurement apparatus should be expedited at Palam Aerodrome.
 5. The Indian Airlines Corporation should provide operational control over its aircraft at major aerodromes.
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