

Department of Trade

ACCIDENTS INVESTIGATION BRANCH

Douglas DC6B. 00-VGB
Report on the accident at
Southend Municipal Airport, Essex
on 4 October 1974.

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<i>No.</i>	<i>Short title</i>	<i>Date of publication</i>
1/76	Sikorsky S-Blackhawk N671SA at Farnborough, Hampshire, England September 1974	April 1976
2/76	Hughes 269C Helicopter G-BABN at Beech Farm, Nr Barnby Moor, Notts January 1975	April 1976
3/76	Hot Air Balloon G-BCCG at Saltley Trading Estate, Birmingham October 1974	<i>(forthcoming)</i>
4/76	Handley Page Dart Herald 203 G-BBXJ at Jersey Airport, Channel Islands December 1974	<i>(forthcoming)</i>
5/76	Aero Commander 680 G-ASHI near Rochester City Airport Kent, February 1975	<i>(forthcoming)</i>

Department of Trade
Accidents Investigation Branch
Shell Mex House
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London WC2R 0DP

27 February 1976

The Rt Honourable Peter Shore MP
Secretary of State for Trade

Sir,

I have the honour to submit the report by Mr R D Westlake, an Inspector of Accidents, on the circumstances of the accident to Douglas DC6B. OO-VGB which occurred at Southend Municipal Airport, on 4 October 1974.

I have the honour to be
Sir
Your obedient Servant

W H Tench
Chief Inspector of Accidents

Accidents Investigation Branch
Aircraft Accident Report No. 6/76
(EW/C499)

Aircraft: Douglas DC6B. OO-VGB
Engines: Four – Twin Pratt & Whitney R2800 CB16/CB17
Owner & Operator: Delta Air Transport NV Deurne, Belgium
Crew: 6 – Uninjured
Passengers: 99 – 1 Seriously injured and 4 slightly injured during the evacuation phase
Place of Accident: Southend Municipal Airport, Essex. Latitude 51° 34'N
Longitude 00° 42'E
Date and Time: 4 October 1974 at 2001 hrs
All times in this report are GMT

Summary

During a night take-off the Flight Engineer selected the landing gear UP shortly after decision speed (V_1) had been called and the aircraft subsided on to its nose. The main landing gear legs remained fully extended and the aircraft came to rest close to the end of the runway without injury to its 105 occupants. One passenger was seriously injured and four were slightly injured during the emergency evacuation phase. Until the Flight Engineer raised the landing gear there had been no emergency and the take-off sequence was perfectly normal without any internal or external distractions. There is no evidence that either of the pilots said anything beyond the normal sequence of calls and commands defined in their approved take-off procedure and therefore it has not been possible to determine what led the Flight Engineer to believe that the Captain had ordered him to raise the landing gear.

1. Investigation

1.1 History of the flight

The aircraft landed at Southend from Antwerp at 0750 hrs on a day excursion. Following a 9 hour rest period, the crew reported for duty at 1830 hrs to prepare for the return flight. Start up and taxiing out were normal, and a limited power check was completed before take-off. The Captain, had given a full pre-take-off briefing before the aircraft left Antwerp that morning, and on this occasion only called for a 'standard briefing', but emphasised that the full abort procedures would be as given during his previous instruction. The First Officer was handling the aircraft from the right hand seat, and gave a shortened take-off briefing which included the actions required for engine failure before and after V_1 . Both pilots were wearing headsets, (not fitted with boom microphones) but were not using these for flight deck intercommunication purposes; the Flight Engineer was not wearing a headset.

The Captain, who controlled the only source of nose-wheel steering, lined up the aircraft at the beginning of Runway 24. Brakes were released and, after stabilising all four engines at 30 inches of manifold pressure, the First Officer advanced all the right hand throttle levers to take-off power. The Flight Engineer followed this movement with his left hand on the left-hand group of throttle levers and, when take-off power was achieved, held the throttle friction lever with his right hand. The Captain's left hand was on the nose steering wheel.

At about 75-80 knots, shortly before V_1 , the Captain instructed the Flight Engineer to adjust the power on engines 1 and 2 which were overboosting slightly. The Flight Engineer made this adjustment coincident with the Captain calling V_1 at about 88 knots, and very shortly afterwards the Captain saw the red 'gear unsafe' warning light illuminate. Unknown to the Captain or the First Officer the Flight Engineer had made an UP selection of the landing gear selector lever. He stated subsequently that he thought the Captain had instructed him to do so shortly after calling V_1 . The pilots maintain that no such order was given and that nothing additional to the normal procedural calls was said by either of them.

The aircraft subsided on to its nose and its propellers struck the runway; throttles were closed and the Captain attempted to maintain directional control by use of rudder. The aircraft came to rest 3 metres from the end of the runway with its nose on the ground and with the main landing gear still extended.

As soon as the aircraft came to rest the Flight Engineer, having closed the mixture controls to idle cut off and pulled the 'ganged switches' bar, left the aircraft through the right front exit door. On seeing exhaust fires in Nos. 2 and 3 engines he returned to the flight deck and carried out the appropriate engine fire drills. However No. 3 engine continued to burn, and he extinguished this fire with a portable CO_2 appliance.

During this period, evacuation drills were initiated, and the passengers left the aircraft in an expeditious and reasonably orderly manner, mostly through the front exit, but some by chute from the rear exit, and a few from an overwing emergency exit. The Airport Fire and Rescue Services were quickly on the scene and, after taking appropriate anti-fire precautions, assisted the passengers off the aircraft. During the evacuation phase, four passengers were slightly injured and one elderly lady passenger sustained a fractured ankle.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	—	—	—
Non-fatal	—	5	—
None	6	94	

1.3 Damage to aircraft

The aircraft was substantially damaged. The damage was consistent with the result of premature nose gear retraction plus some damage caused by flying debris as a result of the propellers striking the runway surface.

1.4 Other damage

There was some superficial damage to the runway surface caused by the aircraft's nose contact, and some deeper cuts inflicted by the propellers. The runway remained closed until repairs were effected by 1500 hrs on 5 October 1974.

1.5 Crew information

1.5.1 Commander:

Age: 47 years.
Licence: FAA Air Transport Rating validated by the Belgian Aeronautical Administration. The licence was endorsed to require spectacles to correct for near vision.
Aircraft rating: Endorsed for DC6B.
Last competency check: 27 September 1974.
Last medical examination: 15 May 1974.
Total flying hours: 21,000.
Total flying hours on type: Approximately 2,000.
Total flying hours in last 30 days: 54.45.

1.5.2 First Officer:

Age: 44 years.
Licence: Belgian Commercial Pilot's Licence.
Aircraft rating: Endorsed for DC6B.
Last competency check: 24 June 1974.
Last medical examination: 27 June 1974.
Total flying hours: 12,000.
Total flying hours on type: 3,000.
Total flying hours in last 30 days: 65.50.

1.5.3 Flight Engineer:

Age: 42 years.
Licence: Belgian Flight Engineer's Licence.
Last competency check: May 1974 (Qualification date)
Last medical examination: 18 January 1974.
Total flying hours: 150.
Total flying hours on type: 150.
Total flying hours in last 30 days: 6.00.

1.5.4 Three female cabin attendants were carried and were properly qualified in emergency procedures.

1.6 Aircraft information

The aircraft was manufactured in the United States of America in 1953. It had a valid Certificate of Airworthiness in the Public Transport Category, a Certificate of Registration, and a Certificate of Maintenance. The flying time since its last maintenance check, valid for 250 hours, was 92.05 hours. At the time of the accident it had flown a total of 43,017 hours.

The weight at take-off was below the maximum total weight authorised of 43,500 kg and the centre of gravity was calculated to be slightly aft of the mid-range (28.5 per cent MAC).

1.7 Meteorological information

The following weather conditions were recorded 10 minutes before the accident:

Surface wind:	280 ⁰ /8 knots.
Cloud:	5/8 stratus, base 1,600 feet.
Weather:	Nil, recent rain.
Visibility:	Greater than 10 kilometres.
QNH:	1010 mbs.
QFE:	1008 mbs.
Temperature:	9°C.
Humidity:	90 per cent.
Runway conditions:	Wet.

The surface wind passed to the aircraft prior to take-off was 290⁰/10 knots. Light conditions at the time of the accident were total darkness with no moon. The weather is not considered to be a factor in the accident.

1.8 Aids to navigation

Not relevant.

1.9 Communications

Not relevant.

1.10 Aerodrome and ground facilities

1.10.1 Runway 24 at Southend is 1,607m long and 37m wide. Its surface is of coarse aggregate and camber provides adequate drainage. At the time of the accident, the runway was wet, but no standing water was reported. Neither runway length nor surface condition was a factor in the accident.

1.10.2 Airport Fire and Rescue Services

Having been alerted aurally and by visual observation, the main force of the Fire and Rescue Service reached the scene of the accident within 3 minutes. This force was augmented by the Essex Fire Service and the Essex Ambulance Service supplemented by the St John's Ambulance Brigade; these units arrived about 15 minutes later. The Airport Fire Service and the associated Rescue Services carried out their duties in an efficient and exemplary manner.

1.11 Flight recorder

No Flight Data Recorder or Cockpit Voice Recorder was required to be fitted to the aircraft, and none was fitted.

1.12 Wreckage

1.12.1 Examination of the runway indicated that at a point approximately 680m before the end of Runway 24, the nose of the aircraft had dropped sufficiently to cause Nos. 2 and 3 engine propellers to strike the surface of the runway. Some 8m further on the nose itself had touched the ground, bounced, and then remained in contact with the runway surface; at that point No. 3 engine had shed its cowlings. A series of propeller slash marks associated with No. 2 engine propeller continued for a further 40m before it had become detached together with its reduction gear. Shortly afterwards Nos. 4 and 3 engine propellers and reduction gears separated, No. 4 propeller having shed one complete blade. Only No. 1 propeller assembly was still attached to its engine although it had suffered tip damage and associated blade distortion. The evidence suggests that the left inboard main wheel tyre was punctured by No. 2 propeller shortly after the initial nose impact. Calculations based on the propeller slash marks, assuming 2,800 rpm, indicate a speed of 93.5 knots at the time of nosegear collapse.

1.12.2 Examination of the aircraft

The aircraft had stopped 3m from the end of Runway 24, and about 8m to the left of the centre line, resting on its nose with the main gear still fully extended. Both left tyres were deflated, the inboard tyre having a 15 inch gash across the crown of the tread. Visual inspection of the disc brakes on all four main wheels showed them to be in a satisfactory condition. There was damage to the nose section and to areas of the right fuselage, wing, fin and rudder which had been penetrated by flying debris. There was a substantial gash in the right wing outboard of No. 4 engine from which fuel was leaking.

1.12.3 Nosegear

The landing gear lever was found to be selected DOWN with the baulk in position. (See 1.17.1).

On raising the nose of the aircraft, the nosegear doors were found to be in the closed position and badly worn due to sliding contact with the runway. When the doors were prised open, the noseleg was seen to be in the fully retracted position; it had entered the up-lock with sufficient force to break the sliding links and the left lower shoe on the door retraction saddle assembly. Examination of the noseleg assembly, and in particular the down-lock strut and associated bungee unit, revealed no apparent defects.

1.12.4 Landing gear hydraulics system

There were no hydraulic leaks in the region of the nosegear main jack, bungee or associated piping. The main accessories compartment had been extensively damaged by penetration of a section of No. 3 engine propeller blade, but it was possible to pressure test the relevant parts of the landing gear system, using a mobile pressure rig. Three thousand psi was held without fluid leakage or unacceptable pressure lapse rate.

The section of propeller blades had damaged the gear selector unit upper bell crank and associated push-pull rods and, in addition, had caused local separation of the selector unit/manifold interface due to impact forces on the landing gear UP pipe. The gear selector unit shuttle valve was found in the gear DOWN position, but due to the damaged push-pull rods, the pre-impact position could not be ascertained.

The hydraulic manifold, comprising pressure regulator, pressure relief valve and gear selector valve, was then removed and bench tested. All units were found to function satisfactorily.

1.12.5 *Gear lever baulk mechanism*

The plunger type baulk mechanism on the undercarriage selector lever was function tested via the micro-switch on the right main gear torque links and found to operate satisfactorily on every occasion. The setting of the micro-switch was checked and found to operate when the right main gear oleo was within 1.125 inches of full extension. This was within the acceptable tolerance of 1 inch \pm 0.125 inches. The main gear oleo extensions were measured at 8.5 inches on both sides.

1.12.6 *General*

Except for damage and defects resulting directly from the accident there was no evidence of any malfunction of the aircraft's systems, engine or flying controls.

1.13 **Medical and pathological information**

Not relevant.

1.14 **Fire**

Small fires in the exhaust of No's. 2, 3 and 4 engines were extinguished by the aircraft's engine fire extinguishing system supplemented by action by the Flight Engineer with a portable extinguisher and by the Airport Fire Service. As a precautionary measure the Airport Fire Service laid foam in the area of the fuel leak from the right wing.

1.15 **Survival aspects**

All passengers were correctly strapped in, and had been briefed and asked to read the safety instructions before take-off. No-one was injured when the nose undercarriage collapsed, and there is no evidence that the nose-down attitude impeded the subsequent evacuation. Most of the passengers left the aircraft through the front right exit door, but about ten left through the rear main passenger exit, using the emergency escape chute. A few others left through the right overwing exits against the advice of a stewardess until further use of this exit was prevented by the Captain. During the evacuation phase, the limited emergency lighting in the cabin was augmented by hand torches carried by the cabin staff. Although there was a loudhailer in the aircraft, it was inaccessible to the front cabin stewardess who was hindered by the concentration of passengers blocking the aisle. Five passengers were taken to hospital with minor injuries sustained during the evacuation: one elderly lady suffered a fractured ankle when she fell as a result of being pushed while still in the aircraft; this passenger was detained in hospital over-night. The remaining four were discharged after treatment.

1.16 **Tests and research**

None.

1.17 **Other pertinent information**

1.17.1 *Crew evidence*

During the post-accident examination of the aircraft the landing gear selector lever was found in the DOWN position and with the baulk in position. Initially there was no evidence from any source to suggest that it had been raised to UP during the take-off roll. It was therefore assumed that there had been some form of failure in the hydraulic system/gear selector mechanism and an appropriate investigation was initiated.

It was not until some three days after the accident that evidence was provided to the effect that, unknown to the pilots, the selector had been prematurely moved to UP by the Flight Engineer during the take-off because he thought the Captain had ordered him to do so. After this came to light, further questioning of the pilots revealed that, after the post-accident evacuation procedures had been completed, they had returned to the flight deck to collect their equipment and the Captain then noticed that the selector lever was UP. In the belief that it had been so selected mistakenly by someone during the post-accident phase he returned it to the DOWN position to guard against inadvertent retraction of the main gear legs.

1.17.2 *Take-off drills*

The Operations Manual defined the calls and commands to be used during the take-off and, *inter alia*, stated that there was to be no other talking except for radio communication procedures. There was no radio communication to or from ATC during the take-off groundroll.

According to the defined procedure, after V_2 had been called by the non-handling pilot (in this case the Captain), the handling pilot (in this case the First Officer) would call 'Gear Up', The Flight Engineer would then call 'Coming Up' as he raised the landing gear lever, and 'Gear Up' when all landing gear lights were out.

Since the accident the operator has revised this part of the drills to expand the landing gear retraction command to 'Positive Climb – Gear Up' and the Flight Engineer is required to make a visual check of the altimeter and confirm the climb before repeating the order. Only then does he take the action of raising the landing gear selector lever.

2. Analysis and Conclusions

2.1 Analysis

There is no evidence to suggest that any pre-crash defect or malfunction of the aircraft had been a factor in the accident and there is no doubt that it resulted directly from the premature movement of the landing gear selector to UP by the Flight Engineer.

The baulk mechanism, which is designed to prevent UP movement of the landing gear selector whilst the weight of the aircraft is on the main landing gear, was correctly adjusted and was found to be operating correctly after the accident. It is therefore apparent that, at the time the selector was moved, sufficient lift must have been generated to take the majority of the aircraft's weight off the main landing gear and allow the baulk mechanism to withdraw.

The noseleg is raked slightly forward and also retracts in a forward direction. This, in combination with any forward pressure being applied to the control column to maintain firm nosewheel contact with the runway during the take-off, would probably have served to accelerate nosewheel retraction immediately the selector was raised to UP and hydraulic pressure was applied to the locking strut. The main legs also retract forward but have a slight rearward raking and this, and the forward motion of the aircraft, apparently served to prevent main gear retraction. Subsequently this situation would have been assisted by the increasing weight on the main gear as the aircraft decelerated. It would have been impossible for the pilots to have prevented the nose from dropping even if they had been instantaneously aware of the premature movement of the landing gear selector. In fact they did not know of the Flight Engineer's action until some considerable time after the accident.

In conformity with the procedure defined in the operation manual, and with the pre-take-off briefings given by the Captain and the First Officer, the Flight Engineer could have been expected to know that on this take-off, in which the First Officer was the handling pilot, it would be the First Officer who would call 'Gear Up' and that he would do this only after the Captain (the non-handling pilot) had called 'V₂' unless perhaps some emergency occurred. During the take-off ground roll, up to the time the Flight Engineer lifted the selector just after the Captain had called 'V₁' there had been no emergency, and therefore no reason for him to expect, or imagine, that the Captain would call 'Gear Up' at that time, ie before 'V₂' had been called.

The pilots maintain that except for the Captain's order to the Flight Engineer to adjust the power, something which is allowed for in the defined take-off procedure and which was given before the call of 'V₁', nothing further was said. There was no external distraction such as speech noise from ATC and the three crew members are in such close proximity that despite a relatively high noise level during take-off, it is not possible to see what could have led to the Flight Engineer's mistaken belief that he had been instructed to raise the landing gear.

Whatever may have caused the initial misinterpretation, the subsequent actioning of the supposed command, when considered in the entirely normal and 'non-emergency' atmosphere which existed on the flight deck, would appear to involve a compound failure to realise that the aircraft was still on the ground, that the command had come from the wrong source and, furthermore, a possible confusion between V₁ and V₂ since the 'order' was obviously out of sequence. In the circumstances it has not been possible to establish any satisfactory explanation for the Flight Engineer's action in prematurely raising the landing gear selector. Although the operator has subsequently revised the take-off drills to incorporate the phraseology 'Positive Climb – Gear Up', and to require the actioning crew member to refer to the altimeter and confirm the climb before raising the selector, it is questionable whether even this improved procedure would have served to prevent this particular accident.

2.2 Conclusions

(a) Findings

- (i) The crew were correctly licensed and were fit for duty.
- (ii) The aircraft was correctly loaded and its take-off weight was within the authorised limits.
- (iii) The aircraft had been properly maintained, and there were no pre-accident defects.
- (iv) Radio intercommunication was not used during the take-off, nor did Company procedures require it to be used.
- (v) The landing gear was prematurely selected UP by the Flight Engineer because he mistakenly thought the Captain had instructed him to do so.
- (vi) Post-accident checks showed that the adjustments of the landing gear micro switches were within the specified tolerances, and the landing gear baulk mechanism was confirmed as operating correctly.
- (vii) Although the nose landing gear retracted as a result of the movement of the landing gear selector handle to the UP position, the main gear did not retract.
- (viii) The airport Fire and Rescue Services took effective and appropriate action in an expeditious manner.
- (ix) There was no emergency nor any distraction or other interference with normal take-off procedures until the Flight Engineer raised the landing gear.
- (x) There is no evidence to indicate or suggest the origin of the Flight Engineer's mistaken belief that the Captain ordered him to raise the landing gear.
- (xi) By actioning the supposed order in a wholly 'non-emergency' situation the Flight Engineer apparently failed to realise that the aircraft was still on the ground, that the supposed order was completely out of sequence, and that it had not come from the handling pilot.

(b) Cause

The accident was caused by the Flight Engineer's action in selecting landing gear UP before the aircraft was airborne. He did this in the mistaken belief that the Captain had ordered him to do so.

R D Westlake
Inspector of Accidents

Accidents Investigation Branch
Department of Trade

February 1976