THE DUTCH SAFETY BOARD

PRELIMINARY REPORT

Classification:	Accident	
Aircraft type and registration:	Boeing 737-800, TC-JGE	
Number and type of engines:	2 CFM-56-7B26 turbofan engines	
Year of manufacture:	2002	
Date and time:[1]	25 February 2009, 10.26 hrs	
Location:	1,5 km North of runway 18R “Polderbaan” Amsterdam Airport Schiphol	
Type of flight:	Commercial air transport (passengers)	
Occupants:	crew - 7	passengers - 128
Fatalities:	crew - 4	passengers - 5
Injuries:	crew - 3	passengers - 83
Nature of damage:	Aircraft destroyed	
Information source:	Dutch Safety Board	

[1] Unless stated otherwise all times in this report are local times

This preliminary report contains facts which have been determined up to the time of issue. This information concerns the circumstances surrounding this accident and must necessarily be regarded as tentative and subject to alteration or correction if additional information becomes available.

The investigation

On February 25th around 11.00 hrs The Dutch Safety Board was notified that a Boeing 737-800 of Turkish Airlines had crashed near the Polderbaan (runway 18R) of Amsterdam Airport Schiphol at 10.26 hrs.[2] The investigation commenced immediately.

According to international agreements and guidelines (especially those within the European Union and the International Civil Aviation Organization) contact was made with the States involved, in this case Turkey as the State of registration and State of the operator, the Unites States of America as the State where the airplane was manufactured, and France as the State where the engines were manufactured. All parties and organisations concerned being the Turkish Directorate general for Civil Aviation, the Dutch Transport and Water Management Inspectorate, the United States National Transportation Safety Board, the aircraft operator, the aircraft manufacturer and the engine manufacturer have subsequently contacted the Safety Board. The British Air Accident Investigation Branch and the French 'Bureau d'Enquetes et d'Analyse pour la Sécurité de l'Aviation' have also offered their services in this stage of the investigation. On request of the Dutch Safety Board representatives of the Dutch cabin crew and the pilot associations have taken part in the investigation.

As a consequence of this accident nine people were killed, five passengers and four crew members. 86 people were injured.

History of the flight

The Boeing 737-800 of Turkish Airlines departed Istanbul International Ataturk Airport, Turkey for a flight to Amsterdam Airport Schiphol, The Netherlands. The flight crew consisted of three pilots: a line training captain who occupied the left seat, a first officer who carried out a line flight under supervision (LFUS) in the right seat and an additional first officer who occupied the flight deck jump seat.[3] The first officer under line flight supervision was the pilot flying. As far as known the flight proceeded uneventfully up until entering Dutch airspace .

The aircraft was directed by Air Traffic Control towards runway 18R for an 'instrument landing system' (ILS) approach and landing. The crew performed the approach with one of the two autopilots (autopilot B) and autothrottle engaged. The standard procedure for runway 18R prescribes that the aircraft is lined up at least 8 NM[4] of the runway threshold at an altitude of 2000 feet. [5] Air traffic control is allowed to offer a line up between 5 and 8 NM of the threshold and instructed the crew in such way that the aircraft lined up at approximately 6 NM at an altitude of 2000 feet. The air traffic control procedures and whether the line up is always performed at 2000 feet, regardless of the distance to the threshold being 5 of 8 NM, are still under investigation. The aircraft descended to 2000 feet above mean sea level[6] (amsl) and was vectored towards the localiser. The landing gear came down and flaps 15 were set.

The autothrottle system receives information about the altitude from the left radio altimeter during approach and landing. The recorded values on the digital flight data recorder was 8191 feet (this is the maximal value the digital flight data recorder has registered) during the most part of the flight. This value is not displayed inside the cockpit. The maximum value shown in the cockpit is 2500 feet. When the aircraft during approach descended below 8191 feet, the recorded value remained fixed at 8191 feet. At approximately 1950 feet the recorded value suddenly changed to -8 feet and remained at that value up until shortly before impact.

According to the data recorded by the cockpit voice recorder several aural landing configuration warnings sounded (e.g. change landing gear configuration, flaps not selected) when the aircraft was already in Dutch airspace. This warning is to alert the crew that the configuration should be verified to the stage of the flight, in this case the landing. The first time the warning sounded was when the aircraft was still at

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2 A elapsed time 30 minutes between accident and notification of the Safety Board is not unusual.

3 Because the first officer carried out a line flight under supervision, a third pilot was on board as safety pilot in case the captain becomes incapacitated or the weather condition becomes to poor for a LFUS. The safety pilot has no other function in the cockpit.

4 NM = Nautical Mile, 1 NM = 1852 meter.

5 1 feet = 30,48 centimeter.

6 The elevation of Amsterdam Airport Schiphol is 11 feet below sea level.

high altitude above Flevoland. Later, during the approach the aural warnings again sounded for several times. The warnings sounded because the computer systems receive their data from the left radio altimeter, amongst others, which erroneously transmitted that the aircraft was near the ground. With the aircraft still above Flevoland there was no reason to select the landing configuration and when the aural warnings sounded during the approach, the landing configuration was completely according to the stage of the flight at that time. The cause of the aural warnings and the reaction of the crew to these warnings are still being investigated.

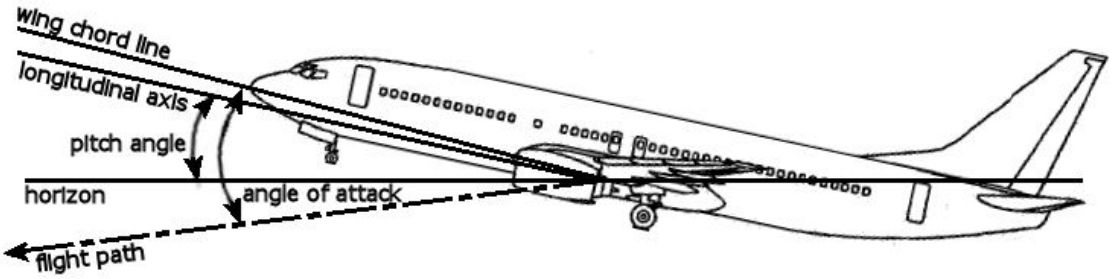
The values of the right radio altimeter and pressure altimeter were correct during approach.

The final approach speed of the aircraft was approximately 144 knots.[7] At the onset of the descent to the glide scope the speed was approximately 160 knots. According to radar data the localizer of the instrument landing system was intercepted at approximately 5,5 NM from the runway threshold. The standard procedure is that the glide path is approached from below. Because of the shorter line up for the runway at 2000 feet the glide path had to be approached from above. Once the localizer was intercepted the crew selected automatic pilot vertical speed mode, at descent speed of 1400 feet per minute, to catch the glide path. The autothrottle system entered the retard mode, the thrust levers were moved to the idle position and the autothrottle system remained in retard mode. Normally the retard mode is automatically engaged during landing flare just prior to touchdown. The glide path was intercepted at approximately 1330 feet and the aircraft was now also at the correct altitude for the approach of runway 18R. The aircraft speed had during the time the aircraft was in vertical speed mode increased to 165 knots, and decreased again when the aircraft followed the glide path.

At approximately 900 feet , the flaps were selected to 40 by the crew and the speed continued to decrease.

At approximately 770 feet, the crew set the selected airspeed to 144 knots. At that moment the actual airspeed was 144 knots. The autothrottle system should have maintained the speed selected by the crew but, with the thrust levers at idle and the autothrottle system still in the retard mode, speed continued to decay. Because the automatic pilot wanted to maintain the glide scope, the automatic flight system, in response, commanded increasing nose up pitch and applied nose up stabiliser trim.

The stick shakers activated at approximately 460 feet, warning the crew that the angle of attack (AOA) was too high. The data of the digital flight data recorder show that the thrust levers were immediately advanced but moved back to idle. When the thrust levers returned to idle, the autothrottle was disengaged. Whether these actions were performed by the crew or automatically is still under investigation. At that moment, the speed was approximately 110 knots, the pitch angle was approximately 11° Aircraft Nose Up (ANU) and the recorded AOA was approximately 20°.



[7] 1 knot = 1 NM/hour = 1,852 km/hour.

At 420 feet the autopilot was disengaged by the crew and attempts were made to recover. At 310 feet the pitch attitude had reached 8° nose down. Almost simultaneously the thrust levers were advanced to their most forward position after which the aircraft ascended somewhat and the pitch angle increased.

According to the last recorded data of the digital flight data recorder the aircraft was in a 22° ANU and 10° Left Wing Down (LWD) position when the recording ended.

Weather conditions

Weather conditions as described in the actual meteorological aerodrome report (METAR), that was issued shortly before the accident were:

- wind 200 degrees with 10 knots;
- visibility 4,500 m in mist; with a forecasted temporary deterioration to 2,500 meter;
- clouds scattered at 700 feet, broken at 800 feet, and overcast at 1000 feet above aerodrome level;
- temperature 4° Celsius and dewpoint temperature 3° Celsius;
- mean sea level pressure was 1027 hPa.

Data form the datarecorders

The aircraft was equipped with a 25 hour digital flight data recorder and a 2 hour cockpit voice recorder. The digital flight data recorder contains over 1,000 parameters. In addition to data from the accident flight data from nine previous flights have been recorded.

Data from the digital flight data recorder reveals that both engines responded normally to control inputs during the entire flight. An initial review of flight data indicates that the aircraft responded normally to control inputs throughout the entire approach phase of the flight.

The data recorded by the cockpit voice recorder are of good quality and are still being investigated.

Technical investigation

Accident site
The aircraft impacted farmland 1,5 km north of the Runway 18R threshold. The wreckage trail was approximately 100 m long and along a heading of approximately 160° magnetic. The initial impact ground marks are consistent with the shape of the aft part of the fuselage.

The horizontal stabilizer and the main landing gear were separated from the aircraft and located near the initial impact point. The left and right engines had separated from the aircraft and were found some distance away. The aft fuselage, with vertical stabilizer, was broken circumferentially forward of the aft passenger doors and had sustained significant damage. The fuselage had ruptured at the right side forward of the wings. The forward fuselage section, which contained the cockpit and seat rows 1 to 7, had been significantly disrupted. The rear fuselage section was broken circumferentially around row 28 (the rear-most row of seats on the left-hand side of the aircraft. At the right-hand side at the rear is a row 29).

All major items of the aircraft were accounted for, and there was no evidence of in-flight breakup. A significant quantity of fuel was found in both main fuel tanks and there was no evidence of any rupture of the tanks. There was no evidence of an in-flight explosion. There was no sign of fire.

Previous flights

Recorded flight data from the nine previous flights of the aircraft continues to be examined. The data showinstances of left radio altimeter malfunctions on some of the nine previous flights. In the recorded cases, the autothrottle also entered the retard mode above the intended flare altitude, and the thrust levers moved to idle, because of a malfunction of the left radio altimeter on two of the nine flights. The data of these flights are being investigated.

Autothrottle system

The autothrottle system positions the thrust levers so that the engine thrust is appropriate to system selections made by the flight crew. Thrust levers can be manually repositioned at any time. In this case the autothrottle system did not maintain the selected speed of 144 knots. This is one of the subject of ongoing investigation.

Radio altimeters

Two low range radio altimeter (LRRA) systems provide height above ground information to various aircraft systems including the instrument displays, autothrottle system, the two automatic pilots and configuration/ground proximity warning system. Each system consists of a transceiver and separate transmit and receive antennas, along with interconnecting coaxial cables. The antennas are mounted on the bottom of the aircraft fuselage. Height above ground is determined by the time taken for a radio signal from the transmit antenna to return to the receive antenna.

The right radio altimeter had provided correct information to, amongst others, the display of the first officer while the left radio altimeter provided a faulty altitude of -8 feet to, amongst others, the captains display. This data is particularly used as input for the automatic systems, and required for CAT II and III instrument landing system approaches. Pilots generally don't use this information but make use of the information provided by the pressure altimeters, which is prominently positioned at the display, instead. In

general pilots only use the information of the radio altimeter shortly before the actual landing of the aircraft in addition to the data from the pressure altimeter.

Survivability factors
The aircraft is fitted with 4 main cabin doors and 4 over-wing exits. Investigators of the Dutch Safety Board found the aircraft with the two right-hand side over-wing exits and the forward left-hand over-wing exit open as well as the two front main cabin doors. None of the evacuation slides were deployed. The vast majority of the seats in the economy class area were still in their seat tracks. The floor in the aft cabin was deformed. Most cabin damage was found in the business class area. There was no evidence of smoke or fire in the cabin.

The door between the cabin and the cockpit was found partly opened. The interior of the cockpit was heavily damaged.

All passengers and crew seats as well as cabin equipment have been examined and documented for further investigation.

Air Traffic Control

Preceding traffic
During final approach the aircraft was preceded by a Boeing 757. For the wake turbulence categories 'Heavy' (e.g. Boeing 757) and 'Medium' (e.g. Boeing 737) international and national regulations require a minimum separation of 5 NM. According to radar information at the moment the Turkish Airlines Boeing 737 received the approach clearance, the distance between the two aircraft was approximately 6,5 NM. The preceding Boeing 757 was at that moment at approximately 2 NM from runway 18R threshold.

Instrument landing system
The instrument landing system of runway 18R at the time and date of the accident was suitable for CATIII approach as this one was. Data from the Remote Monitoring and Control System indicate a stable operation and no deviations.

Communication
Air traffic control communication with the aircraft did not point at any irregularity on board. The controller on duty at tower West provided landing clearance at approximately 10.25 hrs. Shortly after clearance the aircraft disappeared from radar and he did not see the aircraft on the radar again nor did he gain sight of it when looking outside in the approach direction. He subsequently sounded alarm. No distress call was received by ATC. The impact area was not visible from the ATC control tower.

Search and rescue

The airport activated the emergency response plan according to procedures**.** Reports from witnesses enabled emergency services to locate the scene, and rescue operations began. Survivors were transported to nearby medical facilities for treatment after a initial assessment (triage) by medical personnel.

Safety warning

The Dutch Safety Board has issued a warning to Boeing is which extra attention is asked for a part of one of the manuals (737 Dispatch Deviations Guide) of the Boeing 737. In this guide is stated that if, preceding flight, the radio altimeters are malfunctioning, the associated automatic pilots and autothrottle systems cannot be used for approach and landing. The Board has given Boeing into consideration to investigate if these procedure should also be valid during all phases of a flight.

Boeing has issued a Multi Operator Message' (MOM) the same day concerning malfunction of the radio altimeters.

Continuing investigation

The investigation by the Dutch Safety Board continues, with the assistance of the Turkish Directorate General for Civil Aviation, the Dutch Transport and Water Management Inspectorate, the United States National Transportation Safety Board, the United Kingdom Air Accidents Investigation Branch, the French 'Bureau d'Enquetes et d'Analyse pour la Sécurité de l'Aviation', Air Traffic Control The Netherlands, the aircraft operator, the aircraft manufacturer, engine manufacturer, component manufacturers and representatives of flight and cabin crew associations. The investigation will examine technical, operational, survivability, ATC procedures, human factors and safety management aspects. Several avionics components, including the LRRA transceivers, autothrottle computers, flight control computers and flight management computers have been removed from the aircraft for further investigation.

Furthermore emergency response and post crash management will be investigated.