Podcast 015 – Turkish flight 1951

Hello and welcome to another 737 Talk where this week we will be looking at a crash which happened in February 2009 involving a 737-800 at Amsterdam's Schiphol Airport. Turkish flight 1951 was a line flight under supervision with a training captain acting as instructor from the left seat as well as a safety pilot sat behind.

We'll have a look at the Dutch Safety Board report which we will of course include a link too on our various social media pages as well as with the podcast.

TK1951 which was arriving in Schiphol from Istanbul on 25th February 2009. The airplane crashed when on approach to runway 18R and ended up in a field approximately 1.5 kilometres from the runway threshold. As well as the 3 pilots there were 4 cabin crew and 128 passengers on board.

Tragically four crew members and 5 passengers died, along with 3 crew member and 117 passenger injuries.

The flight crew consisted of the captain who was also the instructor, the first officer who was line flying under supervision and another first officer who occupied the observer's seat as safety pilot. The first officer under supervision was the pilot flying. The captain had a total time of approximately 17,000hrs with over 10,000 of those on the 737. The FO under training had just over 4,000 hours with 44 hours on type and the safety pilot had over 2,000hrs total time with over 700 of those on type.

The right autopilot and the right flight director were selected and active as is normal when the first officer is flying. The left flight director was active for the captain as the pilot monitoring. The flight data recorder indicated that the left radio altimeter system provided erroneous readings, beginning shortly after take-off as the airplane climbed through roughly 400 feet. It is not known if the pilots were familiar with those readings.

The first officer started the approach briefing at 09.53 while flying over Germany at FL360. The crew had picked up the ATIS prior to the brief. The wind was light with a visibility of 3500m in mist and a cloud base of 1100ft. The temperature was 4°C with the runway in use 18R.

The first officer briefed the captain for an ILS to runway 18R and among other things mentioned, which standard route they would fly, a potential drop in visibility to 2500m and the fact that the decision height was 200 feet.

The crew contacted Amsterdam Area Control at 10.04 and were given various speed, altitude and heading changes as is the normal for an arrival to Schiphol.

In a seven-minute period between 10.15 and 10.22 which starts with radio contact with Schiphol approach and ends with the flight at 2000ft and flap 1, the landing gear audio warning can be heard 4 times.

As air traffic gave the instruction to descend to FL40 for an ILS 18R the audio landing gear warning could be heard. The warning continued for approximately one and a half minutes with a short interruption. The captain then made the remark “Radio Altimeter”. At 10.17 and 11 seconds the warning was activated again and could be heard for 2 seconds. Sometime after that the Captain made the comment “landing gear”, then one and a half minutes after that the warning repeated for anther 2 seconds.

According to flight data recorder data during the warnings a rad alt of -8ft was visible on the captains PFD. Shortly after this flight 1951 was instructed to descend to altitude 2000ft. At this point the Autothrottle was in MCP Speed.

The next phase between 10.22.38 and 10.24.08 starts with an instruction to fly heading 210° and clearance for the approach and ends with the selection of gear down flap 15.

The right autopilot had been active as from departure in Turkey. Here the crew now attempted to engage the second autopilot for a dual channel approach as was normal for their procedures. This resulted in a right AP disconnect and a failure of the Left AP to engage. The right AP was reengaged and no further attempt at left autopilot engagement was made.

At 10.23.34 flaps 5 and a speed of 170kts was selected. Nine seconds later the landing gear audio warning repeated and could be heard for 5 seconds, again with that -8ft showing on the Captains PFD. Immediately thereafter gear down, flap 15 and a speed of 160kts were selected.

The next time segment between 10.24.09 and 10.24.23 starts with localiser interception. The airplane was at 2000ft on the localiser but above the glideslope at a speed of approximately 175kts and decreasing with a distance to land of 5.5NM. Shortly after this the FD roll bar on the CPs PFD disappeared.

An Audio call bell from the cabin can be heard at this time but was not responded too, perhaps showing how busy the crew were getting.

The crew selected a lower altitude, first 1200ft and after 10 seconds 700ft on the MCP. A vertical speed of 1400fpm was selected. The auto throttle FMA then changed to “Retard” on both PFD’s. This caused the thrust levers to go automatically to the idle position. The speed was approximately 168kts when the descent was started.

Now we look at the timeline from 10.24.24 to 10.25.22 which starts with contact being made with Schiphol tower. Just before contact was made with tower the safety pilot remarked that they had a radio altimeter failure which the captain confirmed.

At 10.24.46 the airplane intercepted the glideslope at approximately 1300ft. Shortly after this the FD pitch bar on the CPs PFD disappeared. During the time in Vertical speed mode the airplanes speed had first decreased to 158kts and then increased to 169kts and then, started to decrease again from glideslope intercept. The selected speed for interception had been 160kts.

At 10.24.48 landing clearance was received and confirmed by the captain, this was the last contact with ATC. The captain made the 1000ft call and at 10.25.10 at approximately 900ft AGL F40 was selected. Subsequently the speed brake lever was moved in and out of the arm position several times and both the 'speed brake armed' and 'speed brake do not arm' lights illuminated. At around 800ft the speed of 144kts associated with F40 was selected.

At 10.25.17 the captain says "yes, not in checklist completed'. Then he listed the items in the landing checklist that the first officer had to answer to demonstrate they had been executed correctly. In the meantime, the horizontal tailplane was trimmed by the autopilot and the safety pilot reported he had received the cabin secure for landing call.

In this next phase between 10.25.23 and 10.25.46 we see the airspeed start to drop below the selected value and the aircraft descend to 500ft with approximately 2.5 miles to run. Here would normally expect an altitude of approximately 750ft.

Before the last item of the landing checklist was executed the captain called out '500ft' and the first officer responded correctly with the instruction to switch on the landing lights as per airline procedures.

The last item of the landing checklist was to ensure the cabin crew had been warned which the captain delegated to the safety FO who carried out the instruction. At this time the airplane was flying just below 500feet with a speed of approximately 110kts.

A second later at approximately 460ft AGL the stick shaker activated. The safety pilot then warned about the too low speed.

Nearly immediately the thrust levers were moved forward by slightly more than halfway but were immediately pulled back to idle by the still active autothrottle. The captain reacted immediately to the activation of the stick shaker and took control stating as much. Here the speed was 107kts with the nose approximately 11 to 12 degrees above the horizon. The safety pilot pointed out the speed two more times.

3 seconds into this one of the pilots deactivated the autothrottle with the thrust levers still in the idle position. One second later at 420ft AGL the AP was deactivated, and the control column pushed forward. Four seconds after AP deactivation the stick shaker stopped but again activated two seconds later. The pitch attitude was eight degrees below the horizon at that moment.

6 seconds after the autothrottle was deactivated with the levers still at idle they were pushed forward to attain maximum thrust. Spool up time was less than four seconds and full thrust was achieved before ground contact.

A sink rate warning as well as pull up warning were heard just before ground impact some 1.5km before the runway 18R threshold. According to the last data the nose attitude was 22 degrees above the horizon with a bank angle of 10 degrees to the left.

The aircraft was destroyed as a result of the impact with the tragic loss of life as was mentioned earlier.

The investigation into the crew training records showed no peculiarities and the aircraft maintenance documents did not contain any defects or unresolved technical issues.

The Dutch safety board reached a main conclusion that due to the incorrect signal from the left radio altimeter leading to a display of -8 feet on the left PFD the 'retard flare' mode had activated. This mode automatically reduced the thrust on both engines to a minimum value, approach idle in this case, in preparation for the last phase of the landing.

Due to the approach heading and altitude given to the crew by ATC the airplane had to intercept the glideslope from above. This obscured the fact the autothrottle had entered retard mode due to the low thrust setting necessary anyway to recapture the desired profile. Also, the crew's capacity would have been less due to the high workload involved.

Passing 1000ft the approach was not stabilised so a go around should have been initiated. The right autopilot using data from the right radio altimeter followed the glideslope signal and as the airspeed continued to decay the nose pitch attitude continued to increase.

The crew failed to recognise the airspeed decay and pitch increase until the moment the stick shaker was activated. Subsequently the approach to stall recovery procedure was not executed properly, causing the aircraft to stall and crash.

Sub conclusions included that a problem with radio altimeter systems in the 737-800 fleet had been affecting several airlines, including Turkish, for many years and were known to Boeing and the FAA. Most of the problems regarding the radio altimeter systems went unreported. Perhaps if more reports had been received, Boeing might have recognised the need for renewed analysis.

The issue was regarded as a technical problem rather than a hazard to flight safety. As a result, pilots were not informed of the issue.

The investigation failed to find a single cause for the origin of the erroneous radio altitude values.

In regard to the ATC instructions given for the final line up. A turn-in whereby interception takes place at between 6.2 and 5nm, with no instruction to descend to an altitude below 2000ft is in deviation of ICAO's guideline specifying that the aircraft must be flying level on its final approach course before the glide slope is intercepted. This method of lining up is used however for over 50% off all approaches on this runway.

The crew, already under a high workload to try and re-establish the approach, did not have information regarding the interrelationship between the failure of the left radio altimeter and the operation of the autothrottle. Only a single indication pointed to the incorrect autothrottle mode, namely the Retard FMA.

With the knowledge available to them at the time, the crew had no way of understanding the actual significance of these indications and warning signals and could not have been expected to determine the pending risk accurately.

Another conclusion of note was that the whole crew, including the safety pilot, were working to complete the landing checklist and no one was focusing on the primary task of monitoring the airplane flight path and speed. It can therefore be concluded that the system based around the presence of a safety pilot on board flight TK1951 did not function effectively.

The Dutch safety board also concluded that the requirements in regard to stall training were too limited and that recovery from a stall should also be included in recurrent training programmes. At the time the information featured in the Quick reference Handbook regarding the use of the AP, the AT and the need for trimming in the approach to stall recovery procedure is unclear and insufficient. I'm sure we are all aware that this procedure has seen significant changes in the years since this accident.

Following these conclusions, the report came up with a number of recommendations. These included:

Boeing should improve the reliability of the radio altimeter system, and the FAA and EASA should ensure that the undesirable response of the AT and flight management computer caused by the incorrect radio altimeter values is evaluated, and that the AT and flight management computer is improved in accordance with the design specifications.

The investigation revealed that the available indications and warnings in the cockpit were not sufficient to ensure that the cockpit crew recognised the too big decrease in speed at an early stage. This led to the recommendation:

Boeing, the FAA and EASA should assess the use of an auditory low-speed signal as a means of warning the crew and if it proves effective, mandate its use.

In regard to the stall recovery procedure the board recommended that it be reviewed by Boeing and that the DGCA, ICAO, FAA and EASA should change their regulations in such a way that airlines and flying training organisations see to it that their recurrent training programmes include recovery from stall situations on the approach.

The lack of reporting of problems concerning the radio altimeter systems also needed to be addressed by both the authorities and Boeing making renewed efforts to make airlines aware of the importance of reporting.

Finally, it was recommended that Air traffic control the Netherlands should harmonise its procedures for the lining up of aircraft on approach as set out in the Rules and instructions air traffic control. It should also be ensured that controllers adhere to these rules.

That’s a brief summary of this tragic event. As mentioned, we’ll put that full report up for you to digest in your own time. The report shows the candid nature the industry looks at accidents in order to take as many learning points away to improve future safety as possible. You may well have recognised the implementation of those recommendations in the time since the accident.