

Podcast 30 – I-NEOT

Hello everyone and welcome to another episode of the 737 Talk where this week Ian and I will look at an incident involving a NEOS 737-800 at Bristol in June 2019. Ian and I know the airport well and due to surrounding airspace restrictions are all too aware of the difficulties it can present when being kept high while trying for a straight in approach to runway 27.

I-NEOT departed Verona for Bristol making first contact with Bristol approach at 1313 where they were advised they had 33 miles to touchdown and to expect the RNAV GNSS Runway 27 approach. The crew were then offered a shorter routing which would give them approximately 23nm which was accepted. At this point the aircraft was at FL100 with an airspeed of 280kts. It should be mentioned that the controller was a trainee controller supervised by an experienced controller, but it remains up to us as flight crew to decline such a request should we believe it will likely result in an unstable approach.

As descent began airport QNH of 1019 was set, speed brakes were deployed, and speed selected to 300kts. Passing 4,715ft the aircraft had a vertical speed of -3,000fpm with an airspeed of 303kts before starting to decrease.

ATC then cleared the aircraft to ELROV, the intermediate fix which was 9.8nm to the threshold where a speed limit of 210kts applies with an expected altitude of 2,500ft or above. I-NEOT crossed ELROV at 3,276ft and 271kts.

Approximately 11NM from touchdown the crew attempted to engage VNAV but after 24 seconds the mode disengaged reverting to LVL CHG as if the aircraft cannot converge to the required profile VNAV will not engage. so LVL CHG was selected instead. Two further unsuccessful attempts at VNAV engagement were made. The aircraft proceeded to descend along the approach path in LVL CHG with idle thrust, crossing the final approach fix 227ft below the designated path with the speed 70kts above the target final approach speed.

At 8nm the controller requested to “start reducing speed please, 190kts or less”, at that point the speed readout was 242kts. Passing 7nm the aircraft was handed to tower and tower was advised by approach that the aircraft was fast but as it was number 1 on the approach the tower considered it was safe to allow the approach to continue.

The crew progressively selected flaps as speed reduced selecting flap 40 at 1,147ft, bearing in mind that 601ft elevation, and 156kts.

Probably due to the high workload resulting in capacity being drained, crossing altitude calls required by company SOPs were omitted meaning no adjustments to vertical speed were made.

Again, due to that workload, and possibly the fact the crew were aware they were still in LVL CHG, the setting of the MCP for the missed approach was also omitted, which is usually set once the aircraft is established on the approach and at least 300ft below go-around altitude.

The MCP altitude remained at approach minima of 1000ft which meant as the aircraft approached this altitude the AFDS entered ALT AQ. Although the rate of descent decreased here the aircraft remained significantly below the designated path.

Between 5.8nm and 2nm on this approach the minimum obstacle clearance altitude is 1,130ft so due to being below the charted approach profile the aircraft had encroached on this minimum altitude.

At this point Bristol tower was engaged with a problem on a push back but the assistant drew attention to I-NEOT due to being concerned about the aircraft altitude. The controller considered the aircraft not to be in a position he would expect and instinctively gave the instruction to go-around. The aircraft was at 1,071ft at this point and with Bristol being 601ft elevation that meant a radio altitude at that point on the approach of 675ft with airspeed now being 151kts. The crew acknowledged the go-around instruction.

PF pressed TOGA and called for flap 15. As we all know and love the 737 at this point during a single channel approach will kick out the Auto pilot and hand over manual control to the pilot. The FDs commanded a pitch up, which was followed by the PF and the aircraft began to climb away as expected. However, the MCP selected altitude remained at 1,000ft with the go-around altitude being 3000ft.

As a result of this 17 seconds after PF had pressed TOGA the vertical mode changed to ALT ACQ and the FD began to command a descent. The A/T mode also changed to maintain current aircraft speed resulting in the thrust levers reducing to a low power setting.

As the aircraft was now gear up, F15 and low thrust the gear horn started to sound. For F15 this requires a thrust lever angle of below approximately 20° and the horn cannot be silenced. The aircraft had reached 1,302ft before it began to descend. After the engagement of ALT AQ the crew then selected the correct go-around altitude on the MCP but unfortunately this action caused the AFDS to revert out of ALT AQ into vertical speed mode which maintains the rate of climb or in this case the rate of descent at the time the mode was engaged. This was -300fpm in this case.

The PF followed the FD and the aircraft continued to descend to an altitude of 1,047ft or 457ft Rad Alt. The crew reduced the flap setting to F5 and further thrust was applied which silenced the gear horn which had been sounding for 27 seconds. This was followed by the mode 4a EGPWS call "TOO LOW GEAR, TOO LOW GEAR" which was triggered as the aircraft passed 500ft RA descending.

The crew then realised the error, the commander took control and adjusted attitude to begin a climb. Almost at the same time ATC noted the aircraft was not climbing and instructed a climb to 3,000ft again acknowledged by the crew.

During the GA the crew noted the message VNAV INVALID-PERF on the FMC. This is shown when there is an unhandled software expectation error or unresolved decent path construction error. The crew were unable to engage VNAV for the subsequent approach, and the investigation was unable to establish the cause of this message.

Radar vectors were then given for a second approach completed without incident.

As a bit of background to the event weather conditions were fine with a ridge of high pressure bringing warm, dry and mostly sunny conditions to the area with southerly winds averaging 10kts. Cloud was scattered at 3,900ft aal.

As a quick recap of TOGA mode, with a first press the A/T (if engaged) advances thrust levers to a reduced go-around setting which produces a 1,000 to 2,000fpm rate of climb. A second press increases thrust to go-around N1 limit. On single channel approaches the AP will disengage and the FD pitch command will provide guidance to 15° nose up. The FD maintains this guidance until the programmed rate of climb is reached at which point it will command a pitch target to maintain a pre-programmed airspeed for the current flap setting.

TOGA mode will terminate once ALT ACQ engages although this does not occur before the aircraft reaches the pre-set rate of climb.

Regarding stable approaches, something that regulators worldwide as well as airlines have been emphasising is their importance for reducing accidents and incidents in the landing phase. Data recorded on accidents between 2011-2015 showed that unstable approaches were identified as a factor in 14%.

The report by the Air Transport Association defines a stable approach as:

‘One during which several key flight parameters are controlled to within a specified range of values before the aircraft reaches a predefined point in space relative to the landing threshold (stabilization altitude or height), and maintained within that range of values until touchdown. The parameters include attitude, flight path trajectory, airspeed, rate of descent, engine thrust and aircraft configuration. A stabilized approach will ensure that the aircraft commences the landing flare at the optimal speed, and attitude for the landing.’

As a matter of interest, the operator of I-NEOT includes in its ops manual stability criteria which must be met by 1,000AAL IMC or 500AAL VMC or a go-around must be initiated. They are:

- The aeroplane is in the planned landing configuration
- The aeroplane is on the correct flight path
- The aeroplane is at the target final approach speed -5kts/+10kts
- The ROD is less than 1,000fpm for a 3° or nominal 3° approach
- The aeroplane is on the correct lateral and vertical flight path
- Only small changes in heading/pitch are required to maintain correct flight path
- The thrust setting is appropriate for aeroplane configuration and speed (idle thrust must not be used below 500ft aal)
- The checklist must be completed no later than 500ft aal

For the incident aircraft, given the metrological conditions, these requirements needed to be met at 500aal. As the aircraft passed this point it was 15kts fast, the landing checklist had not been completed and the aircraft was 278ft below profile. Engine thrust was still idle, the ROD

was 1,300fpm and F40 was selected one second earlier. There was no discussion between the crew approaching this point about the stability of the approach.

The AAIB analysis, we will of course put a link to the report over on B737talk.com, states that as a result of the shorter routing the aircraft had too little distance to both descend and reduce speed ready for the approach. As a result, VNAV could not be used, and approach was begun in LVL CHG. Using this mode meant the crew were unable to reset the GA altitude as directed in the operator's procedures. Had they done so the aircraft would have climbed straight away because the AP was engaged.

The operators stable approach criteria were not met with procedures requiring a Go-around. However, the passing of the stable approach barrier went unmentioned and was followed shortly afterwards by ATC instructing a go-around.

The go-around instruction was based on an instinctive reaction from an experienced controller and whilst the crew were not expecting it and could not at the time understand its reason, all crews must be prepared to perform a go-around at any time during an approach. The incorrectly set MCP in this event caused a significant deviation from a normal go-around, with the aircraft descending, unnoticed by either crew member, for a significant period. During the initial go-around the aircraft descended below 500ft AGL.

The crew experienced a tech issue with VNAV after the go-around rendering it unusable for the second approach. This, however, was not the reason for VNAV disconnecting on the first which was due to the significant excess speed. This is a reminder for crews that we must have a reversion up our sleeves should our anticipated modes fail for any reason.

In the wake of this event the aircraft operator introduced into its' recurrent training syllabus, stabilised approach criteria, a review of applicable rules and FDM statistics as well as a presentation on this event. The operators FDM system was improved to identify events such as this unstable approach and continued development of the system was planned to make the process easier and more rapid.

For us as operating crew there are a few big points we can take away from this incident. These being:

- Don't be rushed into an approach, it is up to us as a crew whether to accept a clearance and we must consider the effect on meeting our specific operator's stability criteria and of course the safety of the Jet must never be compromised.
- At the briefing stage we should discuss potential back-ups should the mode we intend to fly the approach with become unusable.
- Know the company's stability criteria and use those gates, be it 500ft or 1000ft to be vigilant in assessing and communicating whether they are met. You may well use the technique of having personal gates further back from here which will assist you in meeting these non-negotiable points later.
- Mentally prepare for a go around at any point on the approach and perhaps discuss at the briefing stage what your actions would be if one becomes necessary at a point

other than our usual practised minimums point. This will take the element of surprise away leaving hopefully only a minor startle to deal with.

Some definite food for thought with this one and perhaps a bit of armchair flying to do imagining we were in the same situation at different points on the approach. It's always nice and comfortable to do that and made a lot easier with the benefit of hindsight. There were a few points in this scenario where the error chain could have been broken so try to recognise them and hopefully if you ever find yourself being led down this path, you'll be able to intervene appropriately and early.

That all said it's time for this weeks (Talks Tech Ten).

Q1: What are the conditions under which VNAV mode is terminated?

Q2: When in ALT HOLD the V/S mode will be armed when changing the MCP altitude by more than how many feet?

Q3: What autothrottle mode is annunciated during a vertical speed descent?

Q4: In order to engage LNAV more than 3NM away from the active route, what angle must the intercept course be?

Q5: In normal operation what provides the N1 limits and target N1 values?

Q6: With an inoperative RA what happens to the autopilot during an ILS approach?

Q7: On a normal approach below 2000ft what will the A/T do if engaged and TO/GA is pressed once?

Q8: What is the maximum fuel temperature?

Q9: Where is engine fuel flow measured?

Q10: What is the maximum allowable altitude difference at sea level between the Captains and FOs altimeters for RVSM operations?

Thanks again for listening and don't forget to head over to the social media sites @B737talk to continue the talk and check out the website b737talk.com where there are transcripts to all the podcasts as well as report links including this one and the ability to sign up to the newsletter for early info on the podcasts and hopefully future competitions. We'll be back in a couple of weeks but until then, from Mark and I, fly well and be safe.