Podcast 29 – Airspeed Unreliable

Hi and welcome back to another episode of the 737 Talk, where this week we will be discussing the Airspeed Unreliable checklist and memory items; it's importance and relevance now of all times when aircraft have been sat around for some time. Even when operations are allowed to recommence, there is a good chance that aircraft will have prolonged turnarounds, especially at the beginning of the restart. We'll have a brief look at the recent history of unreliable speeds events and then look at the Boeing 737NG specific NNC, and the FCTM recommendations.

It is known that unreliable speed events can occur throughout the flight envelope. Even at Altitude, we are aware of the phenomenon of Ice crystal Icing, which as it happens has a specific non normal checklist itself. But the vast majority of events occur on the take-off roll, or shortly after take-off for reasons we'll discuss.

Since the beginning of 2020, Manufacturers have received an increasing number of reports of unreliable airspeed events at takeoff due to Pitot probe obstruction. Despite the existing prevention means and the preflight exterior walkaround, takeoffs with obstructed air data probes may happen. We'll discuss why it is so important for us as pilots to actively monitor the airspeed during the entire takeoff roll, to detect an airspeed discrepancy as early as possible, and safely reject the takeoff, if required to do so.

The majority of reported cases of unreliable airspeed at takeoff were due to obstruction of the Pitot tube. Obstructions can be caused by the presence of insects, sand, dirt, dust or any other foreign materials that could enter the Pitot when protective covers are not fitted to the aircraft when on the ground. In more than one reported case, the obstruction was because the protective covers were not removed before the flight.

Contamination of Pitot probes by insects does not happen only during long periods of parking or storage. Half of all reported Pitot contamination related events occured when the aircraft was parked for a time period of less than 48 hours. A significant number of reported occurrences of obstructed Pitots were on aircraft in transit and on the ground for less than two hours. Pitot probes are not always protected by covers during short duration transits.

The COVID-19 pandemic had the effect of a significantly reduced number of flights, which means aircraft spent more time on the ground between flights. In cases where the air data probe protective covers are not fitted, the exposure to the risk of Pitot contamination is greatly increased.

In about half of the reported cases, the flight crew detected the speed discrepancy and rejected the takeoff. For many of the reported rejected takeoffs, the speed discrepancy could have been detected earlier during the takeoff roll, which would have incited the flight crew to reject the takeoff at a lower speed.

The importance of closely monitoring the airspeed throughout the takeoff roll cannot be stressed enough. Both the Pilot Flying (PF) and the Pilot Monitoring (PM) have a role to play. While the PF maintains the aircraft on the centreline using external references, the PM must actively monitor the airspeeds from the start of the takeoff roll. This will allow for the PM to detect any inconsistent airspeed indications between instruments, an abnormal airspeed trend or absence of airspeed indications as early as possible.

There is a real importance of the 80 kt crosscheck, which is requested in the Standard Operating Procedure. It is the last line of defence in preventing a takeoff with an unreliable airspeed indication. The flight crew should be prepared to reject the takeoff at the time of the 80 kt crosscheck if an airspeed discrepancy is observed.

Takeoff with obstructed Pitot probes can happen for any flight. It is evidence of why it is essential to carefully monitor airspeed during every takeoff.

Airspeed unreliable indications may result from pitot/static blockages or freezing as well as a severely damaged radome. Something to be aware of is if you have a severely damaged radome antennas for the G/S LOC and Wx Radar may be damaged too. In this case the recommendation of finding an ILS approach needs thinking about as you may not be able to receive the signals.

As we mentioned above, Common reasons for blocked pitots are insect nests, covers that have not been removed, Volcanic ash and heavy rain. If the ram air inlet is blocked, pressure in the probe is released through the drain holes and airspeed slowly drops to zero. If the ram air inlet and the drain holes are blocked, trapped pressure reacts unpredictably giving erroneous airspeed indications. This could mean increasing airspeed in the climb, decreasing in the descent and unpredictable in the cruise. The Airspeed is basically acting like an altimeter with the added bonus of being unpredictable during level flight. Inflight icing of the pitot/static system, if it were to occur, would most likely take place when operating in icing conditions. It is therefore important to be aware of expected pitch/power settings and airspeeds when entering an icing area to allow early recognition and recovery of unreliable airspeed.

If you picture the system architecture, you'll recall that the AoA vane feeds in to the ADIRU's which in turn feed our display units so there is also the possibility of failures in these vanes causing erroneous instrument outputs including airspeed and altitude.

There are specific indicators of Airspeed unreliable. Clear and concise crew communications are needed to diagnose and ensure the correct memory items are actioned in a timely manner. A say what you see in-front of you is certainly a good start when noticing an instrument abnormality.

The ALT Disagree PFD alert indicates that a 200ft difference between the CP and FO's altitude has existed for more than 5 seconds

The AOA DISAGREE indicates a difference of greater than 10° for 10 seconds between CP and FO values and the IAS DISAGREE indicates a difference of more than 5kts for more than 5 seconds again between the CP and FO instruments. Be aware that the IAS DISAGREE checklist sends you straight to the Airspeed Unreliable checklist and therefore its memory items.

If as a flight crew we are aware of the problem, flight without valid airspeed can be safely conducted and should present little difficulty. Early recognition requires knowledge of correct pitch power settings associated with the flight phase and a knowledge of aircraft systems. A delay in recognition can result, as we all sadly know, in loss of airplane control.

This is one of a few NNCs that has memory items and knowing these and committing to muscle memory is of vital importance. They must be accomplished as soon as it is suspected that airspeed indications are incorrect. These items put the airplane into a safe regime until the NNC can be referenced. Maintain current flap position until the airplane is stabilised, and you are referencing the Airspeed unreliable QRH.

As PM you need to make sure all memory items are correctly actioned and call any omissions. There's your aviate. Next, make sure the aircraft is going in a safe direction i.e., not straight toward high ground on the departure, that's your navigate. Now you should think about your communicate. You will of course be directed by the PF to access the QRH for Airspeed Unreliable but here, when the aircraft is stabilised and heading in a safe direction, is the time to let ATC know you have unreliable instruments and perhaps get an altitude block on request to clear traffic around you in the form of a PAN or a Mayday call.

As we then get in to the QRH we are given a list of what we can rely on instrument wise allowing for some form of cross checking of reliable instruments.

The flight deck may be a very noisy and uncomfortable place with stick shaker, overspeed and AIRSPEED LOW warnings possibly happening simultaneously. You need to focus yourself on flying those pitch/power settings and then referencing those PI QRH tables.

A top tip here is to remove those tables from the QRH to save you going back and forward. Please don't do this in the simulator though as you may find a slightly unhappy TRI/TRE sat behind you. This is a tip purely for a real-life jet event where a new QRH is at the bottom of the list of priorities.

When using the PI QRH tables be sure to read the table title carefully to make sure you are using the figures for the correct flight phase.

Step 9 starts with the line "When in trim and stabilized". If your event has been on take-off, as many are, then you will need to get yourself to MSA before levelling off and applying the PI QRH table. Don't forget your radio altimeter can be relied on so should at least help a little in confirming you are a certain altitude above terrain.

PM can now tell you the pitch and thrust setting to use for level flight, perhaps typing it in to your CDU for easy reference. Once stable under the conditions shown here you can cross

check the airspeed indicators to each other, and in regard to the airspeeds shown on the tables. The tables for the terminal area show airspeed in relation to Vref 40 so you'll need to access the Approach page on the CDU and make a calculation. Aircraft groundspeed is also valid and useful as a cross check.

The NNC effectively asks you whether you have a reliable speed, and if so - use it, and the systems related to it. If not, you are stuck with the PI QRH tables for the remainder of flight.

Both QRH flows end with the choice about altitude reliability. If you can't ascertain a reliable altitude, through cross checking the CP, FO and STBY altimeters along with the Radio altimeter if it's available, then you must put the transponder to standby to stop the unreliable altitude being fed to ATC. This has caused confusion in a couple of accidents when pilots have asked ATC for an altitude readout and then were given back the unreliable altitude reading that the airplane was itself giving to ATC in the first place. You can't ask ATC for an altitude readout in these events. You can, however, ask for a groundspeed reading.

If altitude is unreliable then your vertical speed and FPV indications are also questionable. Do not use the FPV. In this case EGPWS may be erroneous too as it uses not only GPS but also ADIRU inputs.

There is some useful guidance in the QRH about how to fly the approach with no reliable speed, including to maintain visual if possible, establish landing configuration early, use electronic and visual glide slope indicators, do not use AP, AT or FD's and do not use TO/GA for a GA or missed approach.

The new QRH now gives the option to deactivate the nuisance stick shaker should you have one. A tip here is that next time you're onboard to just take a look at the newly collared circuit breakers so you know their whereabouts should you need them in anger. This deactivation of one side assists in stall recognition on the other.

When changing phase of flight or airplane configuration, the recommended technique is to not change configuration until the airplane is trimmed and stabilised at the current configuration.

The FCTM recommends to then change thrust followed by pitch and then configuration and then trim allowing time for the aircraft to settle at the new speed. To remember this we have come up with the acronym TAF which stands for Thrust, Attitude, Flap and is also what people who originate from Ian's neck of the woods are affectionately known as.

It is important to remember this as all the changes of phase and configuration you will be doing between the event and landing should be done in this order.

As a useful aid for a safe manoeuvre speed or approach speed, if our aircraft is equipped with an AoA indicator we should look to maintain the needle in approximately the 3 o'clock position.

Careful decent planning is needed, especially if there is significant altitude to lose after the event. You will see from the tables that a 60T aircraft will achieve between 1700-2300fpm depending on the altitude. This is probably less that we're sometimes used to doing on the line so give yourself plenty of time and, fuel dependant, you can always ask for extra track miles from ATC to make sure you get this approach right the first time.

If possible, choose an airfield with numerous approach aids and a long into wind runway. There is an argument for using a coastal runway with an approach over the sea if it's available to you when you have unreliable altitude as you could then easily use the radio altimeter when below 2500AGL. This is a point of airmanship.

If the airspeed unreliable isn't from a severely damaged radome then an ILS or GLS is a good idea and taking everything in slow time by configuring early will help with capacity and approach stabilisation.

You will also notice that to control rate of descent you should use the thrust to maintain the vertical glide path as required.

When landing fly the aircraft onto the runway, don't try to finesse the touchdown as this may lead to a float. If you have to use manual brakes make sure adequate brake pressure is applied until a safe stop is assured.

If the event occurs prior to the approach and NNCs are complete with no reliable airspeed indication available, ensure you have the Go-around pitch power setting available to you. Again, a message typed into your CDU would be a good idea.

The call Go around F15 is still made and you will fly the procedure to your normal GA SOP's with the omission of pressing the TO/GA button. The difference here is that at a safe altitude you now use your QRH-PI table for the current configuration.

What the QRH doesn't mention however is that the pitch power settings for level flight at Flaps15 with gear up, which is the configuration you would be in after the GA, is not in the tables.

Our Flap 15 limit speed on the 737-800 is 200kts, this is for SFP aircraft. if we were to set the F5 pitch power we would be looking at a speed of Vref 40 + 30 which even at max landing weight is not going to be near 200kts. Our technique, and I stress this isn't Boeing approved and your operator SOP would take preference, would be to lower the nose first to Flap 5 pitch, reduce power to the Flap 5 level flight setting and then select flap 5. We suggest this as the FCTM technique is aimed at slowing the aircraft down whereas here you are going from a low speed in the go around to a higher Flap 5 manoeuvring speed.

From there we would recommend maintaining F5 for vectors for another go, obviously depending on the reason for the GA.

If the Airspeed unreliable event has occurred during the approach and a go around is necessary, you will not have referenced any NNC or PI QRH tables. If this is the case, again

don't use TO/GA and set GA thrust with an initial pitch attitude of 15°. At a safe altitude you are now to apply the Airspeed unreliable memory items and continue the drill from there including negotiating that block altitude with ATC.

In summary, we will try and stop the event happening in the first place through a vigilant walk around and correct probe heat procedure. We can also try to avoid flight through known icing areas if possible.

To counter that startle factor, know the recognition signs and the fact you may well end up in a very distracting noisy environment – much nosier than listening to Ian chomp his way through a raw alliaceous stick of Leek. This event is a good opportunity to show your prioritisation competency and your ability to gather the required information.

Show good application of procedures through timely execution of the memory items as soon as the unreliable speed is diagnosed and do this through smooth accurate flying demonstrating competent FPM.

This is a real Teamwork exercise, help each other out. Assign tasks and support and if mistakes are made admit to them quickly and correct them together. And now it time for

Tech Ten intro

Q1: For takeoff what does the white bug on the speed tape indicate and what protection does it give?

Q2: Flap 5 is set. What does the bottom of the hollow amber bar on the upper side of the speed tape represent?

Q3: For landing what does the white bug on the speed tape represent?

Q4: When is the pitch limit indication displayed on the PFD and what does it represent?

Q5: If you select both a DA and DH and then place the minimums reference selector in the RADIO position how are DA and DH displayed to you?

Q6: What does the AOA DISAGREE flag indicate?

Q7: What would be the effect on airspeed of the ram air inlet into the pitot head being blocked?

Q8: What would be the effects on airspeed should both the ram air inlet and the drain holes of the pitot be blocked?

Q9: What are the effects on airspeed and altitude readouts of a blocked static port only?

Q10: If weather conditions require a takeoff alternate aerodrome what flight time does it need to be within for the 737 and are there any other stipulations to this?

Outro

So, that's it for this week and thanks for joining us again. Remember those tech answers are over on b737talk.com. We'll look forward to seeing you in a couple of weeks to share more 737 information with you and please do join us over on social media and sign up for our newsletter over on B737talk.com for more information on what we're up too. For more airspeed unreliable information, we look at the event in the briefing room and the simulator over on our online learning platform at b737training.org. Until next time though, fly well, and be safe.