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COMMENTS
on the Statement by Jonathan Gillespie, FRAeS, concerning
Martinair MP495 accident investigation report

Reference(s)

A – Statement by Jonathan Gillespie FRAeS, 23 July 2013. Attached.
B – Portuguese Accident Investigation Report, DGAC No. 22/ACCID/GPI/92, 31-10-1994.
C – Analyse ongeval Martinair DC-10-30F, MP495 Faro, 21 dec. 1992, AvioConsult, dec. '12.
D – Independent investigation into the Martinair DC-10, PH-MBN accident at Faro, Portugal, 21 December 1992. Accident Investigation & Research Inc. AIR File #7355, 23 July 2013.
E – Comments on the Independent investigation into the Martinair DC-10 by Accident Investigation & Research Inc. AIR File #7355, 23 July 2013. AvioConsult, Nov. 2015.

Introduction

This report presents a limited number of comments on the Statement by Jonathan Gillespie (ref. A), which is included in the Attachment. The original text, if applicable and where needed, is included below in *Italics*. Text that is commented on is underlined; the comments are included following a •. The Portuguese accident investigation report (ref. B), which included data of the Digital Flight Data Recorder (DFDR – the 'black box'), was used as the basis for these comments. The accident was also analyzed by AvioConsult (ref. C); this analysis in the Dutch language is downloadable from website of AvioConsult. An English translation might become available too. Mr. Gillespie refers to the report by Accident Investigation & Research (AIR) Inc. by Mr. Heaslip (ref. D), on which comments by AvioConsult were presented in ref. E.

1. Access to Meteorological Information

1.1. In the experience of the Author, before during and after 1992, it was <u>not uncommon</u> practice for pilots to 'self-brief' the meteorological conditions prior to the flight, without physical attendance upon a meteorologist. Weather and other flight information was frequently conveyed to pilots either by computer systems or by hard paper copies. All commercial pilots have always been required <u>to demonstrate an in depth knowledge and understanding of meteorology</u> at the time of issue of their licence. The practice continues to the present and in fact very few pilots will have any contact with a meteorologist.

- The statements made by both the flight crew and the meteo forecaster did not match. The Martinair Basic Instructions Manual (BIM) prescribes, "the captain should have received a meteorological briefing before each flight" (Investigation report ref. B, § 1.17.1.3). A "briefing" is not a self-brief. The point here is that the flight crew did not follow the company rules, neither for meteo briefings, nor for inoperative thrust reversers either, whatever would have been "*common*" back in 1992. Back then, procedures were developed by higher level knowledgeable aviators and approved by authorities to be used by line pilots for aviation to ensure safety.

- The flight crew, at the time of the accident however, obviously did not *demonstrate an in depth knowledge and understanding of meteorology*, otherwise this accident would not have happened.

1.2. Any implication that a visit to a professional meteorologist prior to a flight was a pre-requisite to <u>the safe conduct of that flight is erroneous</u>, as evidenced by the multitude of flights <u>completed safely</u> without such a visit.

- This flight was not *completed safely*, but ended in a tragedy because the pilots under-estimated the weather. The crew did not follow the company rules; this can hardly be called *erroneous*.

2. Unserviceable Thrust Reverser Engine Number 2

The <u>KLM Aircraft Operating Manual</u> (AOM) Dispatch Deficiency Guide (DDG) 3.1.17 page A, a temporary instruction, stated that 'One fan thrust reverser may be unserviceable provided: Aircraft shall not depart a station where repair or replacement can be made.' The DDG entry was marked with a star (*) and AOM 3.1.0 page 1 sub-para 02 showed that this meant the engineer should 'consult' with the cockpit crew regarding the unserviceability and that following the consultation dispatch 'may or may not be acceptable'

- In 1992, a Martinair AOM applied, not a KLM manual. In the Portuguese accident investigation report (ref. B) no reference was made to any KLM manual, only to Martinair manuals.

A Martinair amendment to the <u>KLM AOM</u> on 3.3.6 page 2 stated 'Landing at Schiphol the use of reverse on all engines is compulsory' but also stated 'The use of reverse thrust on engine no 2 is always SCD' or subject to captain's discretion.

- Same comment. Was this also in the Martinair AOM? Investigation report ref. B § 1.17.1.4 lists AOM provisions on unserviceable thrust reversers: "Aircraft shall not depart a station where repair or replacement can be made". Again, the crew did not follow company rules.

2.2. The decision to depart from Schiphol with the No 2 engine reverser unserviceable and <u>locked in the stowed position was acceptable within the governing rules and guidance</u>. The fact that the access platform vehicle required to rectify the No 2 engine reverser was also unserviceable meant that a lengthy delay would have been incurred for <u>no tangible safety benefit</u>.

- Did KLM operate with DC-10 airplanes to the short runway of Faro? Martinair did. Departing with a stowed thrust reverser was not in accordance with the Martinair AOM, as presented in the Portuguese investigation report, ref. B. *…no tangible safety benefit*? There must have been a safety reason for the limitations in the Martinair AOM.

3. Selection of Flap 50 for Landing

The <u>KLM AOM 3.3.5 page 2 sub-para 02</u> indicated that the 'standard' flap/slat setting for landing was 35/LAND. However, this was overridden by a Martinair amendment on page 3.3.6 page 2 'Additional Information', which stated 'Standard flap setting for landing is 50°, alternate is 35°. This is due to the specific Martinair operation…'

- Martinair Flight Crew Operating Manual (FCOM) Vol II on page 03-50-08 prescribes: "Final flap selection is normally 35°. Use 50° flaps on short or contaminated runways (wet or covered by snow, ice or slush), or when in the opinion of the Captain landing distance will be adversely affected". The amendment was not reviewed by the Portuguese Accident Investigators; were the KLM AOM and amendment valid and relevant? Please show the Martinair amendments.

3.1. 50/LAND was the standard flap setting for landings for the Martinair DC-10.

- No, not true. 35° was the standard flap setting i.a.w. the Martinair FCOM Vol II on page 03-50-08. However, the use of 50° for landing on the short and wet runway of Faro airport was not against the Martinair procedures.
- When windshear is expected, the flap position should be 35°, as recommended by company procedures (Portuguese Accident Investigation Report, ref. B, § 2.2.3). It is obvious that the pilots did not expect or experienced any windshear. In 1992, and still in 2015, there was never ever any windshear measured at the European Airport of Faro. Faro is not on the list maintained by Eurocontrol on the SKYbrary website.

4. Approach Speed

4.1. Although 138 knots or even 134 knots were below the calculated threshold speed for the configuration and weight, a significant margin was still maintained above V_S and the aircraft continued in controlled flight. The calculated threshold speed of 139 knots was by definition 1.3 times V_S and therefore V_S was approximately 107 knots (139 ÷ 1.3 = 106.92).

- Are you questioning the 1.3 safety factor? It is there for a reason – for instance to compensate for a wet or dirty wing. For a LW 161,400 kg, power off and flaps 50: V_S = 105 kt (AOM). The minimum threshold speed is to be 1.3 V_S and was 139 kt (out of a table). Additives are required to provide an additional margin for a safe approach under different meteorological circumstances (winds and gusts). In this case, the additive was only 5 kt; the approach speed had to be at least 5 kt higher than the threshold speed (139 + 5 = 144 kt).
- Fact is that the airspeed overhead the threshold was 134 kt (DFDR data), 5 kt too low. The touchdown speed was 126 kt.

4.2. Throughout the approach the airspeed of Martinair 495 was well above the aerodynamic stall speed and therefore the assertion that the speed on approach was 'too slow' was incorrect.

- Being well above the stall speed is not the point. A threshold speed, published in formal and approved airplane manuals, exists for pilots to be used, period. Pilots are not to argue the magnitude of the speed. The actual, not the published, stall speed is affected by many factors, for instance by precipitation, wet wings or sideslip; the safety factor (1.3 as Mr. Gillespie mentioned) accounts for this.
  Fact is that the pilots did not cross the runway threshold at the Martinair FCOM required airspeed, which was 139 kt. The required approach speed was 139 + minimum 5 kt additive = 144 kt, which was not set in the auto throttle system. The airspeed during the approach frequently increased to 144 kt for a few seconds (as DFDR data shows), because the auto throttle system compensated automatically for turbulence by increasing the throttle. The Martinair FCOM Vol. II on page 03-50-03 states: "Maintain threshold speed (V_{TH}) plus additive until initiation of flare". Hence, the Martinair FCOM required 144 kt, not 1.3 V_S, throughout the approach, overhead the threshold until initiation of the flare.
  Facts are (objective DFDR data) that the throttles were manually closed at 150 ft, and that the airspeed during the last 10 sec. of flight was decreasing; the threshold speed was 134 kt (NTSB), definitely too low. The variations in airspeed, and hence thrust, are an indication of an unstable approach, which should have been aborted (in accordance with Martinair procedures).
  An unprofessional attitude towards airspeed management, as presented here by Mr. Gillespie, leads to accidents, sooner or later. In his statement, Mr. Gillespie regrettably did not provide an unbiased approach speed review, as could have been expected from an experienced line pilot.

5. Source of Surface Wind Data

5.1. Except in the one or two seconds immediately prior to touchdown the wind encountered by the aircraft, reflected by the INS indicated wind, may differ significantly from the actual surface wind due to a number of factors, including gusts, down drafts, orographic and Coriolis effects and surface friction. In those last few seconds a pilot's attention will be focused on completing an accurate landing and not on the INS displays.

- The INS calculates the position of the airplane in space, measures the accelerations in all three axes and calculates the movements of the airplane in real time, hence including the effect of any external factor and is therefore the most reliable, accurate and actual source of information that can be used by the pilots, provided the airplane is flown with coordinated controls (is not side slipping). The captain read the wind from the INS 10 seconds prior to touchdown. Why Mr. Gillespie mentions one or two seconds prior to touchdown is unclear and of no use.
- The Martinair procedure called for checking the INS calculated wind. This is what the captain, as pilot not flying, did. Why? Not for fun or nice to know, but to be used. If INS wind increases above the limits, pilots are alerted that they are very close to, or even exceeding aircraft limits, which requires action. The very large wind correction angle during the last 7 nm of flight and the very large crab angle of 11° during final approach should also have been indications for a very strong crosswind.

5.2. The pilots would have had no reason to doubt the accuracy of the ATC reported surface wind for the touchdown point, any more than they would on any other flight, and there were no potentially more accurate sources available to them. The INS readings were not an adequate substitute or a reliable indication of surface wind.

- Conclusion should be that the ATC reported surface wind (150°, 15 max. 20 kt) exceeded the limits of the airplane both for a wet runway (15 kt) as well as for a flooded runway (5 kt), as stated in the Martinair AOM, i.a.w. the Portuguese Accident Investigation report (ref. B), § 2.2.3. A missed approach procedure should have been initiated. In addition to relying on the ATC reported surface wind, the INS readings had to be used according to company rules; an INS provides more actual wind data than ATC.
- For the ATC wind 150/20, the wind correction angle (WCA) during the approach would have to be 6°, hence the heading 111+6=117°. For an INS wind 190/20: WCA=8° and the required heading 111+8=119°. The heading of the airplane however was 125° (DFDR at 500 ft) – a difference of 14°! This would only occur with a steady 32 kt, 90° crosswind, which was impossible during the Faro approach; the pilots would have noticed such a wind, and executed a go-around, but they didn't. Instead, they continued the approach. Therefore the actual heading of the airplane, including a 14° correction angle, not only included the correction for the wind, but also the correction for (visual) steering towards the runway, i.e. for not maintaining the 111° approach radial.
  The 125° heading confirms that the airplane was not approaching on the 111° radial to the VOR station, but was still north of this radial, and that the approach was not stable as required in the Martinair procedures, and should have been aborted.

6. Calculation of Surface Crosswind Component

6.1. Lots of words that will not be repeated here.

- Once again: The Martinair procedure called for checking the INS calculated wind, whether this data is accurate or not. The data had to be read from the display by the crew, which they did, but they did not use the data; they did not initiate a go-around despite the fact that the actual wind was exceeding the DC-10 limitations.

6.2. Having established that the only accurate source of runway surface wind information available to the pilots of Martinair 495 was that reported by Faro ATC, it follows that the only *reliable calculation of surface crosswind component would be that based upon the ATC reported wind. The last ATC reported wind indicated a crosswind component that was within the limit of 15 knots specified for a 'wet' runway.*

- It is irrelevant to this case to establish the accuracy of a wind source. The Martinair rule maker determined that the INS wind had to be used anyway; the company required the pilot to observe the INS wind, and of course use it.
- A steady wind of 15 kt is within limits, ATC reported gusts to 20 kt are not. The last time these gusts were made known to the flight crew was at 1 min. and 5 sec. prior to touchdown; there was ample time to decide for a missed approach procedure.
- Even if they would only have used ATC reported winds, the airplane limits were exceeded by the pilots of MP495 for landing on both a wet and flooded runway.

7. Runway Condition

The DGAC Final Report stated that Faro ATC informed Martinair 495 that the runway was 'flooded', along with an instruction to report at 'minimums' or 'runway in sight', and that this message was acknowledged 9 seconds later. ICAO guidance described the term 'flooded' as meaning 'extensive standing water is visible' on the runway surface.

In subsequent statements the Captain of Martinair 495 indicated that <u>he was not familiar with use of the term 'flooded'</u> as a runway condition, and the First Officer stated that he had not heard the term before in that context.

- In his first statement, taken by the police on 22 Dec. 1992, the Captain stated that flooded "means standing water to me".
- The term 'flooded' was already standard ICAO phraseology for at least 20 years prior to the accident. Martinair pilots should have been made aware during training, etc. Manuals should have been amended.

7.1. Runway condition was and <u>is reported by ATC to allow pilots more accurately to calculate the landing distance required</u> in the prevailing conditions and if necessary to consider the relevant crosswind limitations, as modified by the effects of the reported conditions upon friction between the aircraft tyres and the runway surface. <u>Martinair 495 did not skid off the side of the runway, nor did it overrun the length of the runway</u>, prior to the accident and therefore <u>the condition of the runway was irrelevant to the outcome</u>.

- The pilots never re-calculated the landing distance required using the most recently received wind data, but continued to use the data received from Faro ATIS, that were at least 30 min. old. Not very accurate.
- Do you really mean. Mr. Gillespie, that MP495 was lucky to crash, so that *the condition of the runway* became *irrelevant to the outcome*?
- The crosswind gusts exceeded the airplane and the pilot limits, and so did the runway condition. The crew should already have initiated a missed approach at 9 nm and wait, or divert to another airport.
- Martinair 495 did not skid off the side of the runway, no, it just didn't make it completely to the runway, with all landing gears. The center gear touched down close to the left runway edge lights and the left main landing gear was even left of the runway. After blowing the tire, the rim of the center gear wheel caused the deep scratch in the asphalt. There was no airplane motion to the left; the airplane was not in a skidding motion to the left on touchdown due to windshear.
- Mr. Gillespie obviously did not independently review the Portuguese accident investigation report and analyze the accident, but copied what non-experts wrote.

7.2. The pilots of Martinair 495 did not understand the ATC report of 'flooded' to mean that there was standing water on the runway, and therefore comprehend the implications for required landing distance calculations and for crosswind limitations. <u>However, the runway condition had no bearing on the outcome of the accident</u>.

- Somebody did not make sure that the already 20 years old ICAO terminology was made known and understood by the pilots. If the pilots had understood (actually the captain did), the accident would not have happened.
- No bearing on the outcome? Again, do you mean the airplane was lucky to crash?

8. Approach Pattern

An '<u>alternative procedure'</u> was also shown on the chart whereby the aircraft would overfly the VFA beacon at a minimum of 4,000 feet and establish outbound on the 269° radial (for approach category C & D aircraft), descending to 2,000 feet. <u>At 8 miles (DME) the aircraft was to turn right to establish on the 291° radial (111° inbound) in order to commence the approach from the FAF.</u>

- This is not an *'alternative procedure'*. All airplanes navigate towards the VFA VOR at Faro airport, and then fly outbound for the approach, in this case with the current wind, for landing at runway 11. Category C/D airplanes (heavy, fast) to which a DC-10 belongs have to fly outbound on radial 269, while descending to the cleared altitude.
- Not at 8 miles the aircraft was to turn right, no, a fast and heavy Cat. C/D airplane like the DC-10 needs more space to establish safely on the required approach radial and therefore is required to initiate the turn towards the approach radial at 10 nm, in accordance with the approach procedure that applied in Dec. 1992. MP495 turned two miles too early for a safe approach. Not a professional statement, Mr. Gillespie.

Whichever of these routes was flown by an aircraft, <u>the approach from the FAF to the minimum descent altitude (MDA)</u> of 400 feet was the same, maintaining the 291° radial. The <u>chart also provided guidance for crossing altitudes</u> corresponding to each 1 mile (DME) from 6 to 2 miles, which would equate to a constant rate of descent between the FAF and the touchdown point. <u>It also included guidance on rates of descent that would correspond to a 5% descent gradient for a variety of aircraft groundspeeds</u>.

- Mr. Gillespie 'forgets' to mention that the DC-10 crew did not follow the correct approach path for a Category C/D airplane to which a DC-10 belongs, to the Final Approach Fix (FAF); the turn to the 291 approach radial (= 111° TO) should have begun at 10 nm, not at 8 nm. From 10 nm, the airplane was not on the correct track to cross the FAF (at 7 nm) on the inbound radial of 111°. The approach was still not stable at 500 ft, not within one dot, not even with a stable N1. A go-around should have been initiated.
- Neither the guidance for crossing altitudes, nor the rates of descent were printed on the approach plate that was included as formal approach chart of Dec. 1992 in the accident investigation report (ref. B). Was the approach chart that Mr. Gillespie used valid?
- The approach speed is an airspeed, not a groundspeed. A groundspeed which is only readable in real time from the INS display, which Mr. Gillespie doesn't like pilots to do, as he mentioned before. The PAPI glideslope was 5.2%. Martinair procedure was to set a ROD of 750 fpm in the vertical speed mode of the autopilot, then from 500 ft altitude use CWS, which the pilot flying did. This was also necessary, because the airplane descended below the PAPI glideslope, requiring 12 sec. of level flight to intercept the PAPI glideslope again. Some people explained this maneuver as microburst…

8.1. <u>Transcripts</u> of the radio transmissions in the DGAC Final Report indicate that Faro ATC <u>probably expected</u> Martinair 495 to fly the 'alternative procedure' published on Jeppesen chart 13-1 and described above, although that specific clearance was not issued. Therefore com-

mencement of the inbound turn from the 269° radial at 8 miles (DME) was correct and in accordance with the procedure.

- So, because ATC "*probably expected*"..., the turn at 8 nm was correct? There is nothing on this in the transcript! The procedure for a fast and heavy jet like the DC-10 requires a turn at 10 nm for stabilizing on the approach in time. That is why a Cat. C/D procedure exists. ATC did not approve an early turn towards downwind, but the Captain did. Don't blame the ATC controller.
- Procedures in aviation are never based on *probably expected*. Professional aviators do not fool around with documented procedures that are designed to prevent accidents, even under worst conditions. The early turn was definitely not in accordance with the procedure.

8.2. The pilots of Martinair 495 flew <u>the correct initial approach</u> track to the final approach fix (FAF).

- No, the crew definitely did not fly *the correct initial approach track* as documented with ground radar data in the Portuguese investigation report (ref. B), and as supported with the DFDR data. The default (blue dashed line) and the MP495 approach (yellow line) paths are shown in the figure below.
- MP 495 should have initiated the inbound turn at 10 nm (Cat. C/D), not at 8 nm which is for small slow airplanes. According to the ground radar data, MP 495 never crossed the Final Approach Fix (FAF - 7 nm) on the correct approach radial of 111°; the Autopilot, despite the strong southerly wind, perfectly intercepted a heading of 080°, as was selected by the Captain at the order of the copilot, the pilot flying (CVR).
- The Autopilot was not used to complete the final turn to the approach radial of 111°. The Autopilot would have correctly intercepted the approach radial, compensating for the strong crosswind, as it did for establishing on the 080 heading.
- The pilots never manually stabilized on the 111° approach track, but overshot the approach radial due to the strong southerly wind and failed to return to the 111° approach radial, which was required for a stable approach i.a.w. the Martinair procedure.
- The DFDR documented heading of 125° at a distance of 1.5 nm from the runway threshold also proves that the airplane was not on the correct approach path. 14° difference with the approach radial is very large, meaning that not only was corrected for the crosswind, but also for steering towards the runway. DFDR heading data proves that the extended runway centerline was never reached.

9. Tracking the Lateral Approach Course

Section 4.2 of the H Horlings Analysis suggested that Martinair 495 did not correctly intercept the VOR DME runway 11 approach course of 111˚ and subsequently did not track the approach course correctly. This was based upon data derived from an ATC surveillance radar located a long distance from Faro, data that were diagrammatically presented in the DGAC Final Report and replicated in the H Horlings Analysis.

- It is not a suggestion, it is evidence. Not only the position data originating from a long range radar, as included in the formal Portuguese accident investigation report, was used to verify the approach path, but also the CVR and DFDR data, and the settings of the autopilot. It all fits; no doubts whatsoever. Refer to the paragraph above and the figure.

Aircraft position and track data presented in the draft expert report by Terry Heaslip refined the surveillance radar data using data recorded by systems aboard the aircraft, working back from the known touchdown point of Martinair 495 on the runway at Faro. These data indicated that the aircraft flew the approach track within the normal tolerances of accuracy required for a non-precision approach.

- Please explain in great detail and in proper engineering terminology how this "refining" was accomplished. As a Flight Test Expert, I cannot believe what is written here. Show me, explain the method to me; I am convinced you can't.
- Terry Heaslip is not an aircraft expert; he produced an approach path that is neither in agreement with the ground radar data, nor with airplane motions, accelerations and speeds, with control inputs as recorded on the DFDR, and not even with the meteorological data, etc. (ref. D). An airplane path cannot be reconstructed working back from the known touchdown point, not even by somebody who can read and understand flight data. You cannot exactly duplicate the path of an automobile either by working backwards if the car was maneuvered under manual control and ended sliding on a road with a 'crab' angle of 11°. Mr. Heaslip will be challenged to explain how he "refined" the data.
- Terry Heaslip is not even a pilot and produced data that the customer (Martinair) wanted to see. He provided a misleading report and Mr. Gillespie seems to agree. With his comments in this statement, Mr. Gillespie demonstrates that a line pilot without any engineering background cannot read and understand both radar and DFDR recorded data.
- Actual DFDR data and recorded ground radar data are much more veracious than analyzed data (by an non-professional). Was the Heaslip method ever approved, other than by Martinair and Mr. Gillespie? I do, for instance, not believe that the Heaslip method accounts for uncoordinated flight, which the airplane did for at least 40 sec. prior to touchdown. And there is more.
- As was explained in paragraph 8.2. above, the approach track was definitely not flown within the normal tolerances of accuracy. Not very professional statements.

The final approach course was 111° inbound to the VOR beacon south of the Faro runway, whereas the runway centreline was 106° and in common with all 'offset' non-precision approaches this required the pilots to manoeuvre on to the runway centreline in the latter stages of the approach, primarily using visual references.

- But they never did maneuver the airplane onto the extended runway centerline which should have taken place at 1 nm in front of the runway threshold. DFDR data show that neither appropriate lateral control inputs, nor a resulting airplane heading change prove that the pilots maneuvered the airplane to reach the 106° runway bearing of the extended centerline from the 111° inbound radial at 1 nm, as they should have.

- The final approach below 500 ft and at a distance closer than 1.5 nm at Faro can only be conducted using visual references. There were no other lateral guidance references within 1 nm at Faro airport in Dec. 1992.

9.1. The <u>beam width determines the first and last pulse transmitted from the rotating antenna</u> that will be partly reflected by the target to the receiver – all pulses in between will also be reflected.

- It's the other way around: the number of RF energy pulses reflected by a single distant target are a measure of the beam width. At maximum radar range, a "target" is still painted at least 3 times by the radar pulses on one antenna sweep/pass. A flight path of 8 miles perpendicular to the radar beam will provide enough data and will be accurate enough to precisely record the flight path of a 'target'. There is a reason why the antennae of long range radars are so big: their beam is sufficiently narrow and their transmitted RF energy is large enough to accurately display individual 'targets' at maximum range.

- The range resolution of a surveillance radar does not change with the distance of a 'target', because the speed (of light) that the radar pulses travel with does not change with the distance traveled. As long as reflected pulses are received, the distance that the pulses traveled can be accurately determined, and therewith the range to the 'target'.

<u>It is impossible to achieve an infinitely narrow radar beam and the narrower a beam the lower the energy contained within it</u> and consequently the shorter useful range of the radar. <u>Surveillance radar does not require a high degree of accuracy</u> but benefits from a long range and therefore tends to have a wide beam width.

- As explained above, it is not necessary to achieve an *infinitely narrow beam*. By the way, the energy contained within a narrow beam, would be higher (per degree of width), not lower, if the magnetron or other RF source in which the microwaves are generated is outputting the same RF energy.

- If an infinite narrow beam would be the case, a radar would not be capable of receiving its own reflected pulses. If the antenna would rotate too fast, it would not either. The beam width of a surveillance radar needs to be wide enough, and its rotation slow enough, to receive at least three pulse returns from a single 'target' at maximum design range in one pass. Surveillance radars do require a high degree of accuracy for separating air traffic at the design range of the radar, which is the reason why their antennae are so big (and the rpm low). With a wide beam, an ATC radar would be useless, because one blip on the radar display could represent many different targets/airplanes; air traffic separation would not be possible.

<u>The distance between the target and the radar antenna is directly proportional to the horizontal distance described by the target detection arc of the radar</u>. A combination of the beam width of a surveillance radar and the significant distance between the radar antenna and Martinair 495 leads to the conclusion that the horizontal location data presented by the DGAC Final Report and replicated in the H Horlings analysis was of low accuracy and unreliable in terms of determining the precise position of Martinair 495 in relation to the approach course.

- The first sentence is more like this one: an apple is an apple.

- The accuracy of displaying the distance of an airplane to a radar does not change at increasing distances (radar pulses travel at the speed of light; the pulse speed in the atmosphere is constant, does not slow down at greater distances from the antenna). It does not make any difference for the range accuracy whether a target is 'painted' at short range or at long range. The attenuation of the radar pulses in the atmosphere and the rpm of the antenna determine the maximum range of the radar.
  The radar data included in the Portuguese accident investigation report was definitely

accurate enough to confirm that MP 495 did not follow the prescribed approach path of Faro runway 11.

- Mr. Gillespie obviously doesn't understand radio detection and ranging (radar), because of the lack of any, if not all engineering knowledge. Horlings has a degree in electronic engineering, besides a Test Pilot School diploma. Radar testing was part of the curriculum.

H Horlings <u>acknowledges these weaknesses of accuracy</u> in 4.1.3; '…unclear is whether the radar's range resolution… is sufficient for accurately reflecting the path followed in the horizontal plane…'

- It is not an acknowledgement of weaknesses of accuracy, but merely to indicate an uncertainty of the accuracy, because in a good report accuracies should be included, but these were not available. Nevertheless, the radar data showed a deviation of the approach path of MP495 of up to 1 km from the 111° approach radial. If this would have been 0.9 km due to lower accuracy, it still would be obvious that the approach path of MP495 was definitely inaccurate, and that that the approach path that Mr. Heaslip 'calculated', was not the 111° radial. Other DFDR data, such as the airplane heading and control deflections, support the theory of a large deviation from the approach radial.

The data presented by Terry Heaslip refined the surveillance radar data using data <u>from on board recordings</u> and <u>working back from the known touchdown position</u>. Hence these data could be <u>considered to possess a significantly greater degree of accuracy than the raw radar data</u>. These <u>data show that Martinair 495 followed the published approach tracks</u>.

- Which recordings? Working back from the touchdown position? You don't even have accurate wind data. Please explain thoroughly how Mr. Heaslip did do this.
- Radar data are very accurate and don't lie; inappropriate data reconstruction methods however do. An airplane doesn't fly backwards. Not only the radar data does show that MP 495 definitely did not follow the published approach tracks, also flight control inputs and actual Flight Data Recorder heading data do not agree with this conclusion.
- Obscure data reconstruction methods do not possess a greater degree of accuracy; on the contrary, objective data from a radar that acquires these data at a very high pulse repetition frequency possesses a much higher accuracy.
- Both radar data and DFDR data prove that MP495 definitely did not follow the published approach track.
- Does Mr. Gillespie know what raw data is? Does Mr. Gillespie really support that obscure data reduction methods possess a greater degree of accuracy than radar data? Mr. Gillespie decreases his degree of credibility with this statement.

In <u>most regulatory jurisdictions</u> the azimuth tracking accuracy for a VOR radial in flight examinations for the issue and renewal of a professional instrument rating is ± <u>5˚</u>. Whilst Martinair 495 may have been slightly displaced from the 291˚ radial for some of the approach, <u>the data presented by the DGAC and replicated by H Horlings were not adequate to conclude that the aircraft deviated more than the normal 5˚ tolerance from the radial</u>. The data presented by Terry Heaslip indicated that <u>Martinair 495 was well within this tolerance</u>. The <u>evidence</u> is entirely conclusive that the aircraft arrived at approximately the correct location on the runway so if it had at any time been significantly off track, that <u>deviation was clearly corrected</u> by the actions of the crew.

- It is not "*most jurisdictions*" that apply. Martinair procedures in the FCOM require ± 2.5°, not ± 5° for a stable approach. The data presented by Terry Heaslip are of obscure source, not scientifically derived.
- The objective radar data showed a deviation of approximately 1 km or 7°, almost three times the maximum approved deviation in the formal Martinair procedures.

- Evidence? There were no actions of the crew recorded on the DFDR that prove that the deviation was corrected. The aircraft heading and the control inputs of rudder and ailerons do not show at all that the crew adequately aligned the longitudinal axis of the airplane with the runway centerline as was required for the crosswind; at touchdown, the crab angle was still 11° but should have been 0°. Both Mr. Heaslip and Mr. Gillespie seem to have trouble reading and understanding objective DFDR data. There is no objective evidence. This statement is misleading.

<u>The choice of 080˚</u> as an intercept heading for the final approach course of 111˚ was <u>entirely consistent with the standard instrument flying practice of adopting a 30˚ offset</u>. This was an <u>effective balance</u> between achieving intercept within the distance available and ensuring that the angle was sufficiently small as to allow an accurate intercept.

- Yes, a 30° angle to manually, or by using the heading mode of the autopilot to, intercept a VOR radial is standard practice. But overshooting the VOR approach radial is not standard. When the needle of the VOR indicator indicates approaching the approach radial, the pilot should change the airplane heading to prevent overshooting the approach radial, but the pilot flying did not do this; he did not anticipate the ultimate deviation that would be a consequence of the existing wind. He should have been more assertive because of the ATC reported wind, to avoid being blown too far from the approach radial, which actually happened, as objective and accurate radar data shows.
- This was not *an effective balance*; the airplane never intercepted the radial thereafter. At 500 ft, the airplane still was not within the required 2.5° as required for a stable approach in the Martinair procedures. A missed approach procedure should have been initiated.

Flying a heading of 123˚ with an apparent drift angle of 12˚ would be <u>normal practice</u> to ensure a ground track of 111˚, in this case the approach course. The fact that the aircraft arrived at the threshold of runway 11 indicates that this strategy was largely successful. Had the aircraft been significantly north of the approach course as indicated in the DGAC Final Report (and replicated in the H Horlings Analysis), a ground track of 111˚ would have resulted in the aircraft paralleling the approach course and arriving at a point an equivalent distance to the north of the runway, which it did not.

- *Normal practice*? A wind of 150°/20 kt at a TAS of 140 kt results in a drift angle of 5°; the approach heading would have to be 111+ 5°=116°. For the last mile, the heading would have to be 106+6=112°. The airplane heading however, was 125° (while rudder input zero – DFDR data). With the INS wind of 190/20, the wind correction angle would have to be +9°, a heading of 106+9=115°. Why this 10° difference with 125° as recorded on the DFDR? Because the airplane was north of the approach radial, as radar data shows, and had to use a larger heading to get to the runway on this visual approach.
- This large crab angle also proves that there was no tail wind component. The wind correction angle would be smaller.

The pilots <u>correctly manoeuvred the aircraft through an 'S' turn</u> on short final approach in order to transition from the 'instrument' approach course of 111° to the landing course of 106°.

- DFDR data do not show an 'S' turn on short final, only inadequate line-up rudder and aileron control inputs. During the last 12 sec. of flight, the roll angle was never to the right to counter the crosswind from the right as would be part of a correct maneuver. The longitudinal axis of the airplane never reached the runway heading; the crab angle at touchdown was still 11° to the right (DFDR and NTSB data).

9.2. The pilots of Martinair 495 flew the published approach course <u>within the normal tolerances of accuracy</u>. The <u>'S' turn to line up with the runway was correctly executed</u>.

- Not true, how can you say this? Refer to the DFDR data and also to the NTSB letter on mishandling the CWS by the pilot. There was no 'S' turn at all. The airplane never lined up with the runway heading; it touched down with a crab angle of 11° (as the DFDR data proved). This statement is very misleading.

10. Instrument versus Visual Flight Rules

The VOR DME approach to runway 11 at Faro was a 'non-precision approach' (NPA) in that it provided guidance in azimuth (lateral guidance) but not in elevation (vertical guidance), allowing an aircraft to be navigated with reasonable accuracy to a point from which it may be manoeuvred visually to the landing threshold. The approach guidance was limited by the MDA (see above), below which the instrument guidance was no longer valid.

- A VOR/DME station never provides vertical guidance. Vertical guidance was provided by a PAPI. The Captain called out DME and corresponding altitudes for some, though inaccurate altitude guidance.
- Faro did not offer "*instrument guidance*". Just a VOR for VOR/LOC approaches for lateral guidance and a PAPI for vertical guidance on the glidepath.

The approach lateral guidance required the aircraft to follow the 291° radial from VFA, which intersected the extended runway axis of 106° only a short distance to the west of the runway 11 threshold.

- No, not *follow the 291 radial from*, but the 111 to the VFA VOR station.
- Not a short distance, but exactly one nm as presented on the Faro approach chart. At that point, a 5° turn to the left would have been required, but could not be found on the DFDR data. This correction was never made, because the airplane never reached this intersection; it was still north of the approach path, which is also proven by the airplane heading and the ground radar data.

10.1. Martinair 495 was operated in accordance with IFR throughout the flight, including the final approach.

- A VOR/LOC approach (as defined in the Martinair FCOM) is definitely not an IFR approach.

Unless ATC issues a specific new clearance for a 'visual approach' the constraints and provisions of IFR remain.

- Faro does not offer an IFR/ instrument approach; only visual approaches. This is published on the approach charts and does not specifically have to be included in a (new) clearance.

The VOR DME approach to runway 11 would always require the aircraft to be manoeuvred laterally and visually on final approach because the 291° radial from VFA was not precisely aligned with the runway axis.

- So, your first statement under 10.1 is not correct after all? This offset is announced on the approach chart as well.

10.2. Martinair 495 was operated for the entire flight, including the approach to land in Faro, under instrument flight rules (IFR) and was entitled to expect a full air traffic control (ATC) service throughout.

- Once again, a VOR approach is not an IFR approach. The pilots were responsible for the visual VOR approach, not ATC. This was adequately published on the airport approach chart. ATC personnel are not to be blamed.

11. Use of the Automatic Pilot Systems

11.1. CMD was a highly automated mode by which the aircraft responded to pilot instructions, not via the control column as in manual flight, but via a number of remote interfaces. These allowed the pilots to command aircraft behaviour in terms of its attitude, and hence speed, altitude and heading, while the necessary deflections of the flight controls were commanded by the autopilot.

- CMD is an automated mode, but the pilot has to enter, to command, the instructions manually, for instance the heading, or connect the autopilot to for instance the VOR receiver. Heading 080 was set as instruction in the autopilot for the final turn, but thereafter the VOR should have been selected as lateral steering input for the airplane to automatically return to the approach radial (111°) of the VOR. The pilots did not make the proper input selection for the autopilot. As alternatives, they did not use the CWS mode of the autopilot appropriately (NTSB) for control assist and did not manually control the airplane to correctly approach the airport.
- Speed is mainly controlled by the throttles. Throttle handles were operated by a separate Auto Throttle System (ATS), but during the final phase overruled by the hand of the copilot.

AOM 2.3.1 page 1 sub-para 02 showed that any of the following would lead to a mode change from CWS to OFF:

- In the list that follows, the most important one, the one that actually disconnected the CWS mode, is missing: Opposite/ conflicting control inputs from the left and right control columns. The Captain took control of the airplane without informing the copilot (with a verbal "my controls").

There was also evidence produced that indicated opposing control inputs from both pilots would cause a reversion from CWS to OFF. However, there was no evidence which if any of these conditions caused the mode change to OFF on the final approach of Martinair 495.

- Captain and copilot entered opposite / conflicting roll control inputs. That being the case, the CWS mode of the Autopilot is made to switch itself off, and warn the crew with a warning light. The DFDR data reported this (confirmed by the NTSB).

11.2. The CWS mode of the autopilot system was an early automated technology that was intended to reduce the dynamic inputs required by the pilot. CWS was disengaged late on approach but the cause of disengagement was not apparent and the pilots were probably unaware it was disengaged. However, the aircraft remained entirely flyable in conventional manual flight and therefore the disengagement of CWS mode was not relevant.

- The cause is described in the comment above. Crew procedure was inadequately applied (for instance not calling "my controls"). This in itself was relevant.
- The co-pilot continuously overruled the CWS mode by applying unnecessary control forces, causing unnecessary airplane motions. The NTSB also concluded that "the CWS and ATS functions were inappropriately used by the flight crew".

12. Required Landing Distance

… The crew of Martinair 495 recorded their calculated required landing distances as 1905 metres for 'good' braking action, equivalent to that expected on a dry runway, and 2400 metres for 'medium' braking action, equivalent to a wet runway. Also recorded was the required landing distance of 3055 metres for 'poor' braking action, equivalent to standing water. Martinair procedures required the addition of 200 metres to the calculated landing distance as a safety margin.

- The Landing Data Card showed the actual landing distances, which includes the 200 m Martinair safety margin; no addition required. Mr. Gillespie does not mention the touchdown zone (that might consume the 200 m). So, what's the point here?

- The numbers, by the way, do not match with the used KLM AOM Landing performance data, nor with the Landing Field Length in the Martinair FCOM Vol. II, 06-87-05. Therefore there are doubts about the validity of the data used by the MP495 crew.
- The Portuguese report (ref. B) mentioned that even a wet runway would be too short for a DC-10 to land for the prevailing wind direction and speed.

12.1. Certified required landing distances include a 'safety factor', or distance increment, typically equal to 67% of the 'actual' landing distance in dry runway conditions, as demonstrated during the aircraft certification programme. This increment is to allow for unknown variables in environmental conditions and pilot performance. In this case the safety factor would have been 1705 (1905 metres minus 200 metres Martinair margin) ÷ 167 x 67 metres, or 684 metres. Therefore in addition to the margin of 45 metres landing distance available in excess of the calculated required landing distance for a wet runway (2400 metres), a further safety margin of 684 metres was also built into the calculation.

- Additional analysis is required to confirm the 67% statement, if that would become necessary.
- 684 m for a wet runway? And for a flooded runway? A pilot has to use the numbers and not argue the applied margins. Fact is that the runway was not long enough for landing under the existing weather conditions – no discussion necessary to alleviate any margins, etc. The pilots did not apply the landing data out of their approved manuals, otherwise they would have conducted a missed approach procedure.

The application of a required landing distance calculation is primarily to reduce the risk of an aircraft departing the end of the runway due to insufficient distance in which to disperse the kinetic energy at touchdown through braking, reverse thrust, lift dumping and drag devices and friction with the air and runway surface. Martinair 495 did not depart the end of the runway prior to the accident and therefore required landing distance was not relevant to the outcome.

- This is not the point. The crew should not argue the numbers on the Landing Data Card, but only use them appropriately. Fact is that the wind data listed on the Landing Data Card, as used for landing performance calculation, was not valid anymore and that landing on a flooded runway would not have been in accordance with the requirements in the Martinair manuals as approved by the aviation authorities, whatever the safety margins might have been.
- Are you serious about the last sentence? Are you really a former VP-Flight Safety?

12.2. The pilots applied the correct landing distance calculation for landing on a 'wet' runway and the runway length available was sufficient. However, the landing distance required and the runway length available had no influence on the outcome of the accident.

- But the pilots did not apply the data for a flooded runway while they knew that flooded meant standing water.
- No influence? Again, if the touchdown would have been successful, the aircraft would have overrun the flooded runway, resulting in an accident. Only if the landing would have been aborted, then an accident would not have happened. VP-Flight Safety?

13. Landing with Main Wheel Brakes Applied

13.1. AOM 1.14 page 6 sub-para 'The anti-skid system' stated 'A touchdown protection releases all brake pressure (free-wheeling) when ground-sensing mechanism is in flight mode… until spin-up of the aft wheels'. It was therefore not possible for the brakes to have been active at touchdown, whether or not the brake pedal was depressed by the pilot because all brake pressure was automatically released until the aft main wheels began to rotate. Thereafter the normal antiskid protection would have functioned to prevent wheel 'lock-up', skid and excessive mechanical loads.

- Was this AOM applicable to the Martinair DC-10? Did you check whether the front bogie wheels were also 'protected'? Ref. FCOM page 14-10-04 (Horlings' § 4.6.12): "The system incorporates locked wheel touchdown protection, to the rear bogie wheels only, to prevent inadvertent landing with the brakes applied".
- The landing gears were also provided with shear pins to avoid the landing gear from puncturing the fuel tanks in the wings. The pins are designed to shear off at excessive horizontal loads. Did you investigate this?

13.2. The wheels of Martinair 495 were not 'locked' at touchdown.

- The Portuguese investigators reported in § 1.12.8 the brake assemblies 3, 4 and 7 of the right main landing gear to be locked, brake 8 unlocked.

14. Effect of Reducing Airspeed on Final Approach

H Horling's analysis 4.3.5 stated that 'As from 10 seconds prior to touchdown, the speed of flight decreased… to a level that was too low, namely 134 kt'.

Data presented in the draft expert report by Terry Heaslip indicated that in those final few seconds the airspeed reduced to 125 knots.

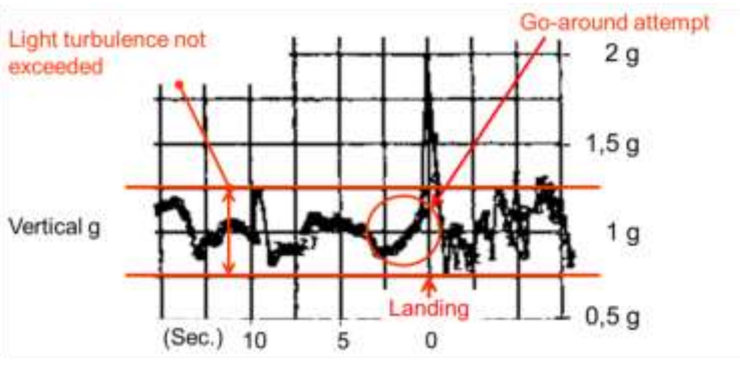
- The threshold speed was 134 kt as determined by the NTSB and copied by me. Thereafter, the speed further reduced; touchdown speed was 126.0 kt, again according to the NTSB in the cover letter of the DFDR data read-out.

14.1. The only significant variables at play over a short period, such as a few seconds, are the coefficient of lift and the airspeed and because the airspeed has an exponential influence on the equation, changes in airspeed have the most substantial short term effect on lift.

- Airspeed does not have an exponential influence (e^V), but the lift is proportional to the square of the airspeed (V^2), which is a quadratic function of airspeed, not exponential.
- Angle of attack has a more substantial short term effect on lift, because changes in angle of attack can be very fast, while changing the airspeed of a big heavy jet takes considerable time. The pitch angle data of the DFDR shows this.

The reducing airspeed on final approach would have led to a reduction in the exponential V^2 (airspeed squared) component of the lift equation and consequent reduction in lift itself, such that the downward force of the aircraft weight exceeded the upward force of lift, thereby inducing an increased rate of descent.

- Loss of lift caused by reducing airspeed is normally compensated with an increasing angle of attack if the flight path has to be maintained. Angle of attack is also represented in the lift coefficient, which is $C_{L\alpha}$, not only C_L. During the last 5 seconds of flight, the DFDR data show an average increase of the pitch angle, which equals to an increase of the angle of attack, such that the upward force of the lift started exceeding the downward force of aircraft weight, thereby inducing an decrease of the rate of descent and an increase of normal acceleration g, as illustrated in the figure below (go-around attempt). At this time, the thrust of all three engines started to increase as well.
- The DFDR vertical g data in the figure below shows a decrease in rate of descent, ra-

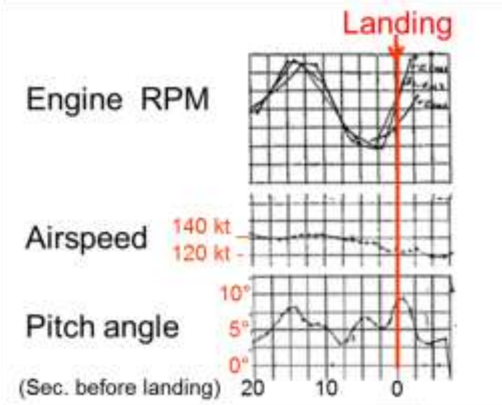


ther than an increase in the last 2.5 sec. of flight. Actually, the downward motion of the airplane decreased, even reversed to a more positive value because of the increasing pitch angle for the go-around attempt and the spooling up of the engines.

- Objective DFDR radar altitude data do not prove an increased rate of descent during the last 8 sec. of flight either:

14.2. The <u>airspeed of Martinair 495 reduced in the last few seconds</u> of the approach (see 15. below for the cause of the reduction), thereby reducing the lift generated by the wings and <u>potentially increasing the rate of descent</u> immediately prior to touchdown.

- The airspeed decreased during the last 7.5 sec of flight (DFDR data – adjacent figure) because the engines rpm was reduced to flight idle, and because the pitch angle was increased, therewith increasing the angle of attack, and increasing the lift generated by the wings. The increase of pitch angle also did increase the drag of the airplane, leading to a decrease of airspeed. Despite maximum throttle, the airspeed decrease could not be reversed because it took too much time for the engines to spool up from near flight idle; the airspeed continued to decrease.



- The vertical g data of the DFDR (figure in paragraph 14.1 above) show that the rate of descent did not increase immediately prior to touchdown, but decreased, indicating the effect of the increasing pitch angle, of increasing the angle of attack and hence, of the wing lift. Regrettably the pitch angle increase (to 8° - DFDR data) and the rate of increase of thrust were not large enough for the airspeed to increase and the wings to develop a high enough lift force to enable the captain-initiated go-around 3 sec. before touchdown.

15. Cause of the Reduction in Airspeed on Final Approach

H Horling's Analysis 4.3.5 states that the airspeed at 10 seconds prior to touchdown was 141 knots and that it was later 134 knots <u>but does not indicate the speed at touchdown</u>. The Statement of Claim 6.7.5 states that the airspeed 10 seconds prior to touchdown was 140 knots and that the airspeed at touchdown was 126 knots. <u>The draft report by Terry Heaslip showed the airspeed at 10 seconds prior to touchdown as 146 knots and the airspeed at touchdown as 127 knots.</u>

- 134 knots was the last recorded airspeed in the Annex, because recording stopped 3 sec. prior to touchdown. 134 kt was the threshold speed, and was 5 kt too low. The touchdown speed of 126 kt was recorded on the DFDR and is listed in (Horlings) paragraph 4.6.16 on touchdown and go-around.

- The DFDR data shows an airspeed of 141 kt at 10 sec. prior to touchdown, not 146 kt, decreasing to 126 kt at touchdown. The NTSB confirmed the touchdown speed to be 126.0 kt, not 127 kt. Mr. Heaslip did not present the correct data; Mr. Gillespie obviously did not verify.

The Statement of Claim 6.7.4 implied that the reduction in airspeed <u>*was solely due to closure of the aircraft throttles*</u>*.*

- The reduction in airspeed during the last 2.5 seconds of flight was not solely due to the throttles being held closed by the copilot, but also due the increasing pitch angle, which caused an increase in drag, because the slow thrust increase from idle could not timely overcome this increased drag. Throttle closure was a pilot error.

15.1. The data from Terry Heaslip indicated that in the period of 10 seconds prior to touchdown the airspeed decreased by 19 knots, an average of 1.9 knots every second. Converted to metres per second per second (m/s^2) <u>*this deceleration*</u> *equates to 0.97744 m/s^2. Using simple* <u>*Newtonian equations it can be calculated that, if this rate of deceleration was maintained*</u> *from the touchdown airspeed of 127 knots the aircraft would have come to rest after 2183.5 metres, less than the runway length at Faro, without allowing for any additional retardation due to friction, braking, lift dumping or engine reverse.*

- Are you serious about this calculation? The deceleration occurred when the airplane was still in the air; do you think the same deceleration continues on the runway? Why are the landing distances different for different runway conditions? '*Newtonian*'? Do both Mr. Heaslip and Mr. Gillespie really know about Newton? Heard a bell ringing … Mr. Gillespie, as for a shoemaker: please stick to your last. Or ask an engineer. By the way Mr. Gillespie, the airplane crashed; the acceleration was considerable larger.
I recommend not using this paragraph any further; it is completely irrelevant and so ridiculous.

<u>*It is simply not possible that aerodynamic drag upon an aircraft in flight can equate to the combined decelerating forces acting on an aircraft during a normal landing, which also include the component of aerodynamic drag.*</u>

- Do you really understand what is written here? Both drag and the other mentioned forces are to the aft. What do you mean by *equate*? The mentioned forces enlarge each other. There is more, ask an engineer.

An alternative cause for the reduction in airspeed would be a strongly increasing tailwind component. In such cases the air through which the aircraft is flying is <u>*effectively catching it up*</u>*, reducing the relative speed at which the aircraft is passing through the air mass. The inertia of the aircraft would for some time maintain the speed of passage over the ground until, in the absence of other influences, the aircraft's airspeed would* <u>*increase*</u> *due to the reduced drag from its flight through the air at a lower airspeed.*

- What are you trying to say? Does the air catch up an airplane that had an airspeed of 140 kt? The airspeed might decrease a few knots, but this can easily be overcome by an increase in pitch which was already underway. The airspeed was well above the stall speed, as was mentioned by you before. *<u>In</u>crease* is a typo?

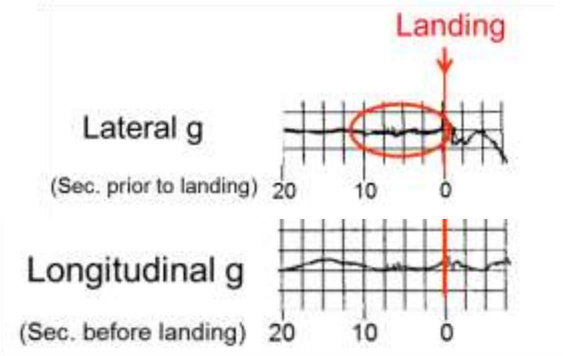
The data in the draft report by Terry Heaslip indicated that during the last 10 seconds prior to touchdown, as the airspeed reduced by 19 knots, <u>*the ground speed remained approximately constant at 143 knots.*</u> *This confirms that the aircraft was not decelerating in its passage through space relative to the ground but rather the air mass in which it was flying was accelerating from behind it,* <u>*effectively reducing the airspeed*</u>*. Had the airspeed been decreasing in a static or constant air mass then the ground speed would have decreased accordingly over the same time.*

- Where is this ground speed data from? Made up? Above, Mr. Heaslip mentioned an airspeed of 146 kt at 10 sec. prior to touchdown. A ground speed of 143 kt means the presence of a small headwind component, not a tail wind. The small headwind component and the heading of 125° mean that the actual wind was almost perpendicular to the flight path, most probably from 190° with 20 kt, as the INS indicated. Too much for a safe landing. The Heaslip data cannot be right, there was no tailwind.

- The data recorded on the DFDR (airspeed, accelerations, heading, etc.) do not support the existence of a tail wind component. If you indeed have ground speed data, you can also compute the actual wind direction and strength during the approach. Did you? Why not present the data? Because your analysis would fail.

15.2. The reduction in airspeed in the last 10 seconds of the approach was predominantly due to a windshear encounter manifested by an increasing tailwind component, not the aerodynamic drag of the aircraft following closure of the throttles.

- You cannot prove this using objective data. You have not mentioned all sources of drag that caused the decrease of airspeed. Again, look at the DFDR data traces of pitch and airspeed. And what drag would a sideslip angle of 11° at touchdown cause if you persist in the on-centerline approach path that Mr. Heaslip "calculated"?
- The Martinair FCOM definition of windshear (Vol II page 05-60-04) is: "Severe windshear may be defined as a rapid change in wind direction and/or velocity that results in airspeed changes greater than 15 knots or vertical speed changes greater than 500 feet per minute". This never happened to MP495.
- The lateral and longitudinal acceleration (g) data do not show any evidence of a windshear.



16. Failure of the Landing Gear at Touchdown

The skid mark from the right main landing gear wheel tyre was not conclusive evidence that the main gear leg collapsed due to forces other than rate of descent.

- Have you looked at a possible shear pin failure of the landing gear? These pins are to prevent a landing gear from puncturing the fuel tanks in the wings. And, as mentioned before, at locked (front bogie) wheels due to applied brakes during touchdown? The pins are designed to fail to prevent the landing gear from puncturing the fuel tanks in the wings under high aft load forces on the landing gears. The gear failed approximately 60 m from the touchdown point.
- The deep skid mark in the runway asphalt was caused by the rim of center gear, after the tires were blown.

17. Conclusions of AvioConsult on the Gillespie Statements.

Main conclusions.

Mr. Gillespie, being a former line pilot and safety manager, obviously did not read and analyze the objective DFDR data out of the Portuguese Accident Investigation Report (ref. B) himself, but seemed to agree with an even worse, inconversant report by Mr. Heaslip, AIR Inc. (ref. D), who is not even an aviator himself, in which the data used were not the DFDR data, but data that must have been 'fabricated' to draw the attention of the readers away from the fatal errors by the MP495 flight crew. Comments on this AIR report by AvioConsult are presented in ref. E. The findings listed in both the Portuguese accident investigation report (ref. B) and in the analysis by AvioConsult (ref. E) that were evidence of inappropriate crew actions, were not used by Mr. Gillespie.

Mr. Gillespie in his Statement, did not produce high aviation-level expert statements, but only seemed to undermine the official Portuguese accident investigation report and the analysis by

H. Horlings of AvioConsult, with inappropriate and unverified statements that, without him realizing, only show his engineering and aeronautical ignorance.

Mr. Gillespie presented too many incorrect and misleading statements, making him not a reliable expert at all. Mr. Gillespie should be required to show appropriate diploma's, if he has any. A pilot license is not a license to investigate accidents; being an FRAeS does not mean being a competent airplane accident investigator or commenter.

Below, the most important conclusions per paragraph out of the Statements by Mr. Gillespie (ref. A) are presented.

Conclusions in order of paragraph.

17.1. The flight crew, at the time of the accident however, did not *demonstrate an in depth knowledge and understanding of meteorology*, otherwise this accident would not have happened. This flight was not *completed safely*, but ended in a tragedy because the pilots underestimated the weather. The crew did not follow the prescribed company rules (§ 1).

17.2. Mr. Gillespie frequently refers to KLM manuals, but the Portuguese Accident Investigation Report (ref. B) does not; this report quotes Martinair procedures, which it should. The KLM manuals might not have been applicable to Martinair operations on the day of the accident, 21 Dec. 1992 (§ 2, § 3).

17.3. Mr. Gillespie did not check the formal Martinair DC-10 Operating Manuals, or the Portuguese Accident Investigation report (ref. B), because his statements on the use of flaps did not agree with these manuals (§ 3).

17.4. Mr. Gillespie does obviously not mind that the approach speed was too low. He does not conclude that the pilots did not follow procedures, but simply concludes that the airspeed was well above the stall speed; of course it did, except for the last seconds. But there is more than stall speed, this is not the only point. Pilots have to follow procedures, but this flight crew did not (§ 4). The airspeed was below the airspeed required by the Martinair procedures.

17.5. Mr. Gillespie might not have seen the Martinair procedure that requires the pilots to monitor the INS-calculated and displayed winds. Not only the INS wind reading exceeded the airplane limits, but the large wind correction and crab angles required during the approach should also have alerted experienced pilots of the presence of a very strong crosswind, higher than the airplane limits. The approach should have been aborted (§ 5).

17.6. The flight crew had to use the INS wind data; they looked, but did not act accordingly. The ATC reported wind data included gusts to 20 kt and was exceeding the airplane limits for both a wet and a flooded runway (§ 6). The last time the ATC wind data was made known to the flight crew was 1 min. and 5 sec. prior to touchdown; there was ample time to decide for a missed approach procedure.

17.7. Mr. Gillespie did not notice that the wind data used for approach planning was long overdue. A missed approach should have been initiated already at 9 nm. Mr. Gillespie states that the runway condition had no bearing on the outcome of the accident; this can be interpreted as the airplane was lucky to crash, otherwise it would have overrun the runway.

17.8. Mr. Gillespie might not have used the VOR/LOC approach procedure to runway 11 of Dec. 92. He mentions an alternative procedure, while it is the normal VOR procedure. He does not mention that the airplane took a short cut (§ 8).

17.9. Mr. Gillespie concludes that the pilots of Martinair 495 flew the correct initial approach track to the final approach fix (FAF). But this was not true, as radar data proves. The airplane did not follow the prescribed approach path to runway 11 and had to decide at 500 ft to continue the approach or execute the missed approach procedure (§ 8).

17.10. Mr. Gillespie spends many paragraphs on radar and makes it clear that he has no understanding of the operating principals of a (ground) radar because he concluded that the accuracy was inadequate to be used to reconstruct the approach path of the airplane. Ground radar data however, is the most accurate source of both angular and range data, at short range as well as at long range (§ 9).

17.11. Mr. Gillespie concludes that the airplane flew the published approach within the normal tolerances. This however, cannot be confirmed by objective radar and DFDR data. These data prove that Mr. Gillespie is not telling the truth (§ 9.2). The airplane approach path deviated up to 1 km from the prescribed approach path, making the approach not stable. A missed approach should have been conducted i.a.w. established Martinair procedures.

17.12. It seems that Mr. Gillespie blames Faro ATC for not providing full ATC services for approach to land at Faro under instrument flight rules, but Faro was not equipped for instrument approaches. The published approaches to Faro were however VOR/DME approaches only (§ 10.2).

17.13. Mr. Gillespie started disputing the safety margins in the landing data. However, pilots are not authorized to do so; they have to apply the data in their formal airplane and operations manuals which are approved by aviation authorities as part of the airworthiness criteria of the airplane. It is illegal to deviate from that data; it renders the certificate of airworthiness of the airplane invalid (§ 12).

17.14. Many DC-10 airplanes have locked wheel touchdown protection on the rear bogey wheels only. Mr. Gillespie refers to an AOM that is not the Martinair AOM, and concludes without any further research that the wheels of Martinair 495 were not 'locked' at touchdown. He cannot be sure without further research § 13).

17.15. Mr. Gillespie states a number of engineering misinterpretations and statements that convinces competent readers that he obviously cannot read DFDR data and therefore should not be qualified to conduct airplane accident investigations or write comments on the work by qualified engineers and investigators. He throws in several 'pilot interpretations', while the formal DFDR data should be used as leading and reliable data. Mr. Gillespie is wasting our time (§ 14).

17.16. Mr. Gillespie uses *'simple Newtonian'* and other engineering principles and practices, but he does obviously have no engineering knowledge and experience at all, but believes he has; an error many line pilots often make (§ 15.1).

18. Recommendations by AvioConsult

18.1. Mr. Gillespie is obviously not very experienced in investigating airplane performance and flying qualities, especially in reading and understanding DFDR data and understanding the limitations in airplane flight manuals. He seems to be willing to allow aircrew to 'bend' the rules and procedures which are prescribed in formal manuals that are approved by certificating authorities and hence, that are required to be adhered to for the airplane to be airworthy. Therefore his comments are not of high value.

The statement by Mr. Gillespie should not be used any further and certainly not in any court proceeding either. It is strongly recommended to withdraw the Gillespie statement.

Harry Horlings
Lt-Col RNLAF ret'd,
Graduate USAF Test Pilot School
Owner AvioConsult

Attachment:
Statement by Jonathan Gillespie FRAeS

