Report

Incident on **2 June 2010**
Bordeaux FIR, OLRAK Point
between the **A318** registered **F-GUGJ** operated by **Air France**
and the **PC 12** registered **EC-ISH**

BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile
Ministère de l'Écologie, du Développement durable, des Transports et du Logement

Foreword

In accordance with article 10 of Directive 94/56/THIS on accident investigations, a safety recommendation shall in no case create a presumption of blame or liability for an accident or incident. Article R.731-2 of the Civil Aviation Code specifies that those to whom safety recommendations are addressed should make known to the BEA, within a period of ninety days of reception, the actions that they intend to take and, if appropriate, the time period required for their implementation.

Consequently, the use of this report for any purpose other than for the prevention of future accidents could lead to erroneous interpretations.

SPECIAL FOREWORD TO ENGLISH EDITION

This report has been translated and published by the BEA to make its reading easier for English-speaking people. As accurate as the translation may be, the original text in French should be considered as the work of reference.

Table of Contents

Synopsis

Event:	Near-collision in flight
Consequences and Damage:	None
Aircraft:	1. Airbus A 318, registered F-GUGJ 2. Pilatus PC 12, registered EC-ISH
Date and Time[(1)]:	2 June 2010 at 14 h 30[(1)]
Flight regime:	1. IFR 2. IFR
Operator:	1. Air France 2. Private
Place:	Bordeaux FIR - OLRAK Point, FL 290
Type of Flight:	1. Public transport of passengers 2. Ferry
Persons on Board:	VMC conditions. Clear sky, visibility over 10 km

[(1)] All times in this report are UTC, except where otherwise specified. Two hours should be added to express official time in metropolitan France on the day of the accident.

1 - HISTORY OF FLIGHT

On 2 June 2010 at 14 h 11 min 07, the pilot of the PC 12, registered EC-ISH, en route from Buochs (Switzerland) bound for San Sebastian (Spain) contacted sector T of the en-route southwest ATC Centre at Bordeaux (CRNA/SO), stable at FL 270. He was cleared on a heading for OLRAK.

At 14 h 15 min 39, the pilot of the PC 12 informed ATC that one of his altimeters was indicating FL 270 and the other FL 290. He asked the controller if the latter could help clear up this uncertainty by checking his altitude if he put the transponder on stand-by. The controller answered that he could not do that but that he was going to ask for information from the military ATC.

At 14 h 16 min 25, the controller contacted the military coordination and control centre (CMCC), call sign Marengo, also based in the CRNA/SO and asked them if there was a way to check the exact altitude of EC-ISH "other than by the use of secondary radar, with a primary radar for example". Marengo answered that they only had a secondary radar image and that they would check it out.

At 14 h 17 min 55, the A318 crew contacted sector T of the CRNA/SO, in climb towards FL 230. The ATC answered that they would call back for a higher altitude.

At 14 h 18 min 10, Marengo contacted the control and detection centre (CDC) at Lyon Mont Verdun and asked if they could read the altitude of a civil aircraft without an alticoder, in code 2742, east of Clermont (this related to the PC 12). The controller at of Lyon Mont Verdun CDC answered that he "reads FL 270 in mode C for this airplane".

At 14 h 19 min 04, the A318 was cleared to climb to FL 290 on OLRAK. It was located behind the PC 12 on the same route. Its speed was about 170 kts more than that of the PC 12.

At 14 h 19 min 30, Marengo called back the controller at the CRNA/SO and relayed the information that indicated that the PC 12 was at FL 270.

At 14 h 19 min 48, the controller called PC 12 back to tell him that he was at exactly FL270 after a check via the military.

A 14 h 30 min 20, the pilot of the PC 12 informed the controller that an Air France airplane had passed very close to him and asked at what altitude this airplane was. The controller answered that this traffic was 2,000 feet above. The pilot answered that the traffic was just below and asked if the military were sure of the altitude that they had supplied.

At 14 h 31, the pilot of the A318 stated that he wanted to file an airprox as he had just overtaken an airplane at the same level while making an avoidance manoeuvre to the left. He stated that he had had no TCAS information.

The pilot of the PC 12 asked to descend to a level where he would be separated from all traffic. He stated that he had a problem with his 2 altimeters, which showed a variation of 2,000 feet and that the altitude displayed on the ATC control screens was apparently false.

Note: the pilot of the Pilatus used the co-pilot barometric system for the rest of the flight.

There was no triggering of the Short Term Conflict Alert (STCA) system at the control position or a TCAS alert on either of the 2 airplanes.

The minimum separation between the 2 airplanes could not be measured on the recording, the 2 radar plots being mixed together. The crews estimated that the separation was between 15 and 30 metres horizontally and about 100 feet vertically.

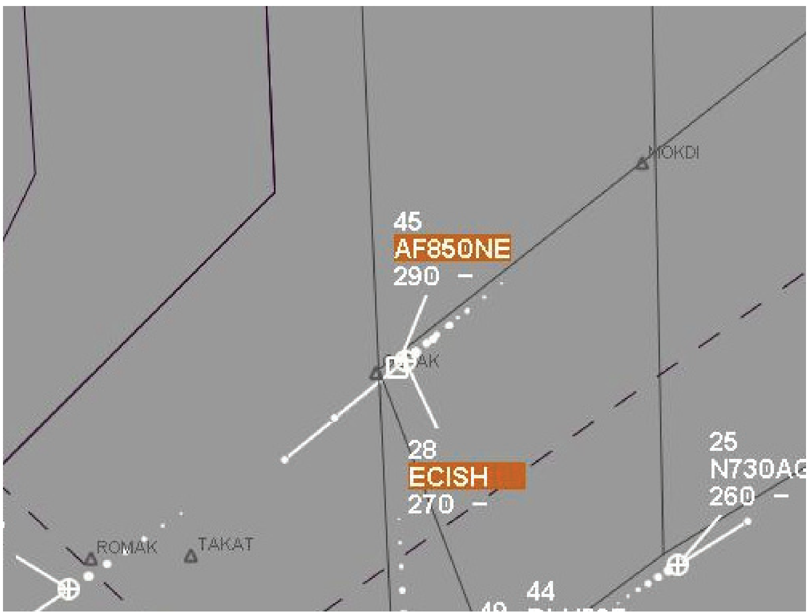

Figure 1: Radar image taken at the moment of the conflict

2 - ADDITIONAL INFORMATION

2.1 Testimony of the A318 crew

The Captain, pilot flying on the flight, and the co-pilot stated that they were preparing the arrival at Toulouse when they felt some "strange" slow roll oscillations of about 5 degrees maximum for about 5 seconds. Seeing nothing abnormal on their Primary Flight Display (PFD), they carried on with the preparation of the arrival.

Intrigued by fresh oscillations that made him think of wake turbulence, the co-pilot looked outside. He was then in visual contact with an airplane that was very close, slightly above and to the right. He disconnected the autopilot and made a pitch-down input to the left, keeping in constant visual contact with the other airplane while passing. He estimated that he had descended around 200 feet during this manoeuvre. During this time, he was watching his Navigation Display (ND) to be sure that no airplane was located below. He saw the white diamond symbol on the TCAS indicating an airplane then 2,000 feet below, without realising at that time that it was in fact the airplane that he had just passed.

2.2 Testimony of the PC 12 pilot

During this flight the pilot, holder of a CPL, was accompanied by another pilot, also holder of a CPL, in the right seat. The airplane being a single pilot type, the latter had no specific function, other than possible assistance for the pilot in case of need.

The pilot and the passenger in the right seat stated that during the initial climb, which was performed in steps, they began to observe a slight variation between the 2 altimeters.

A return to the departure aerodrome was considered, but the meteorological conditions at that field were mediocre. In addition, the aerodrome was in a mountainous region, with rough high ground, and a return to the field was risky since the crew didn't know which altimeter to depend on. It was also decided to continue the flight because the forecast meteorological conditions in cruise and at the destination were very good.

Stable at FL 100, they informed Bern, with which they were in contact, that they had a variation between the 2 altimeters, and asked the controller to check that they were in fact at FL 100. The Bern controller answered that he read FL 100 on the radar screen.

During the climb towards FL 270, they noticed that the differences in altitude and speed between the 2 barometric and speed units were increasing. Stable at FL 270, they saw on the first unit, on the pilot's side, FL 270 and an indicated speed of 90 kts and on unit 2, on the right side, FL 290 and an indicated speed of 160 kts. The crew tried to dispel this doubt with the GPS but the GPS altitude was between 27,000 feet and 29,000 feet and did not allow them to dispel the doubt (see note below).

Note on the use of GPS:
The direct readout of the altitude supplied by the GPS does not make it possible to dispel any doubts. In fact, this altitude is based on a geometric calculation while the altimeters are barometric. The barometric altitude is specifically influenced by the characteristics of the air mass (pressure and temperature). The 2 values thus differ with a variation that depends on the characteristics of the air mass.
It is also important to note that, in terms of the regulations, altitude information supplied by the GPS must not be used as a means of navigation.

When they were informed by the CRNA/SO that they were exactly at FL 270, they considered that the altitude information supplied by the left unit was valid since this was a second confirmation by the controller.

They were however intrigued by the speed on this unit, which was lower than the predicted speed in the altitude and weight conditions at that moment. In doubt, the pilot maintained cruise thrust and kept his attitude constantly under surveillance, as instructed in the flight manual.

A short time later, the A318 passed them and they realised that they were at FL 290. They performed the rest of the flight with the aid of information supplied by the n° 2 unit. The flight continued thereafter with no further problems until landing.

Photos of the instrument panels were taken by the crew during the flight, before the incident, in order to explain the problem encountered to the manufacturer (see below).

Figure 2:
Left side barometric and speed unit

Figure 3:
Right side barometric and speed unit

2.3 Pilatus procedures

2.3.1 Pitot and static system failure

The flight manual of the PC12 indicates, in the “Emergency procedures“ section, a case of failure of the Pitot and of the static system.

« Pitot/static system failure »

Probe switch : check on

A) If airspeed indicator malfunction :
In cruise and descent : only using known power settings and aircraft attitudes

B) If altimeter malfunctions

Below 10 000 feet : depressurize aircraft
Cabin altitude selector : select actual aircraft altitude on outer scale

When cabin pressure differential approaches zero
Cabin press switch : dump
Use cabin altimeter to give approximate aircraft altitude

2.3.2 Speed in cruise

The flight manual performance tables show that:

- at FL 290, at maximum cruise – the power usually used in cruise - with weight of 3,800 kg and at ISA +2°C (conditions at that moment) the indicated airspeed is 158 kts.
- at FL 270, in the same conditions, the speed is 165 kts.

Thus the speed displayed on the right side unit was consistent with the flight conditions at that moment.

2.4 ATC

In French civil control centres, the controllers only have information available from secondary radars. The call sign, the flight level and the speed of the airplane appear next to the plot symbolising the airplane on the screen. The flight level displayed is the information that comes from the airplane.

In this particular case, the level read by the Bordeaux ATC centre controllers was that transmitted by the mode C (erroneous) of the PC12.

Having no way to dispel the doubts raised by the pilot of the PC 12, the CRNA/SO controller made a phone call to the Military Coordination and Control Centre (CMCC). The role of the CMCC is to undertake air security tasks, coordination and control of military aircraft in the south-west airspace. This centre is located in the same room and has the same radar image as that of the CRNA/SO.

The request from the CRNA/SO to the CMCC was expressed as *"I have, at LERGA, an EC-ISH at FL270. Do you have any means of seeing his exact altitude by other means than with the radar image that we supply you with? Have you got a primary or something that lets you*" (unfinished phrase).

The CMCC answered *"I only have the secondary here"*. The CRNA/SO controller then told his correspondent that the pilot of the PC 12 would like to check his altimeter and know his exact altitude and asked the CMCC if the latter had any means to do so. The CMCC answered that he would *"see with his colleagues if there's a solution"*.

The CMCC contacted the Detection and Control Centre (CDC) at Lyon Mont-Verdun, in whose airspace the PC 12 was located. The request was made as "*I have a civil aircraft that is currently to the east of Clermont, code 2742, and there they no longer have an alticoder, nothing*".

The CDC at Lyon Mont-Verdun then answered that they saw this airplane on the screen and that it was at FL 270, while stating that the level was transmitted by the mode C of the airplane.

It was this information that was then retransmitted to the crew by the CRNA/SO.

Note: Some military control centres can obtain information on the vertical position of an airplane based on primary radar data.
The precision of the measurement depends on the position of the airplane and its distance in relation to the primary radars used. The values obtained are precise enough for military needs but do not allow the altitude of an airplane to be determined with precision.
In the case under consideration, the military radars would not have allowed the exact level of the PC 12 to be determined.

2.5 Information on the Pilatus PC12

The Pilatus PC-12 is a single pilot airplane with a pressurised cabin that can carry up to 9 passengers. It is equipped with a Pratt & Whitney Canada PT6 turboprop. Its operational ceiling is 30,000 feet.

EC-ISH, delivered in October 2003, was series number 498. It was equipped with 2 independent barometric and airspeed units, an autopilot, 2 transponders and a TCAS. Maintenance of the airplane was always undertaken in the workshops of Pilatus at Buochs.

2.5.1 Barometric and airspeed unit

The PC 12 is equipped with 2 barometric and airspeed units, one on the pilot's side and one on the right side, each of which has:

- 2 static pressure sensors on each side of the airplane on the rear part of the fuselage,
- a Pitot tube located under a wing,
- an air speed indicator (ASI),
- an altimeter,
- a vertical speed indicator (VSI).

In addition, an Air Data Computer (ADC) uses the pneumatic system on the pilot's side to supply the information required by the autopilot.

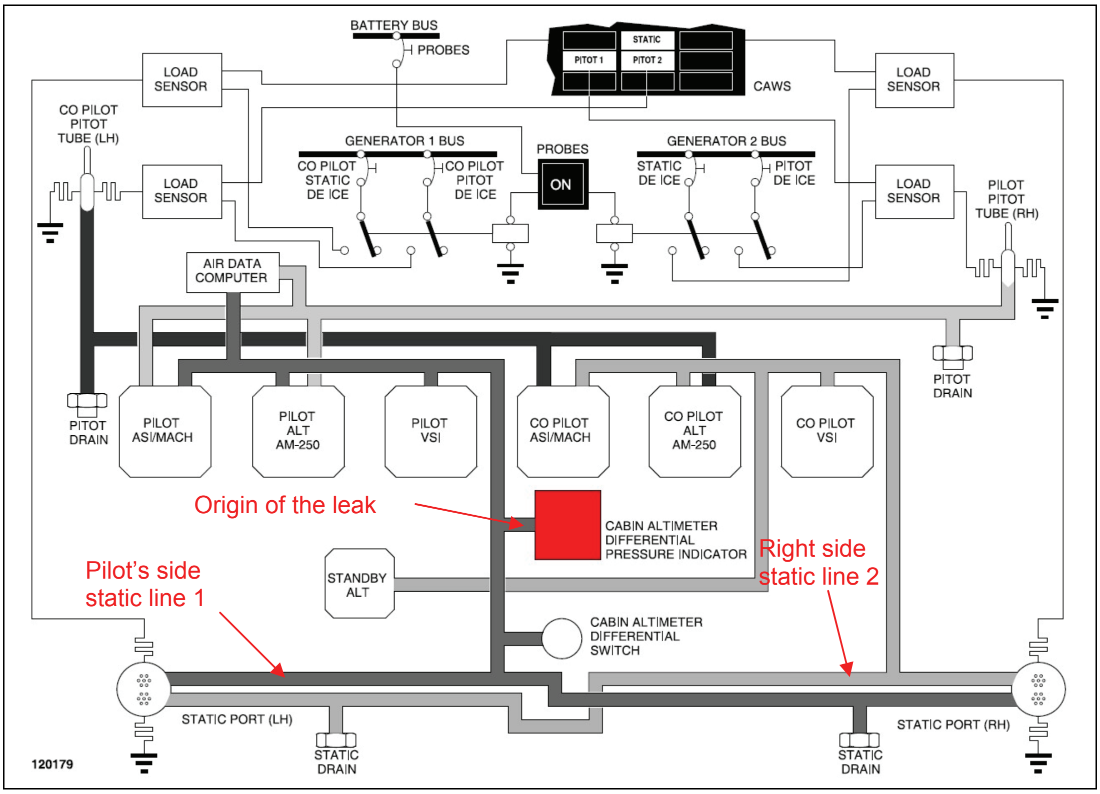

Figure 4: Synoptic of the speed installation on the PC-12

2.5.2 Origin of the altimeter error

The airplane being pressurised, it possesses a cabin differential pressure indicator that uses the static pressure pneumatic line on the pilot's side to develop its indication (in red in figure 4).

The search for the failure on the airplane the day after the incident showed that the pilot's side static line (see figure 4) had a leak on a connector that joined this line and the cabin differential pressure indicator (parts referenced 3 and 4 on figure 5).

Thus, a part of the pressurised air in the cabin was able to penetrate the static pressure line and increase the value of this pressure. This increase in pressure was, at FL 290, equivalent to a value of 2,000 feet.

Due to this, as soon as the cabin was pressurised, the instruments on the pilot's side indicated an altitude and a speed that were lower than they were in reality.

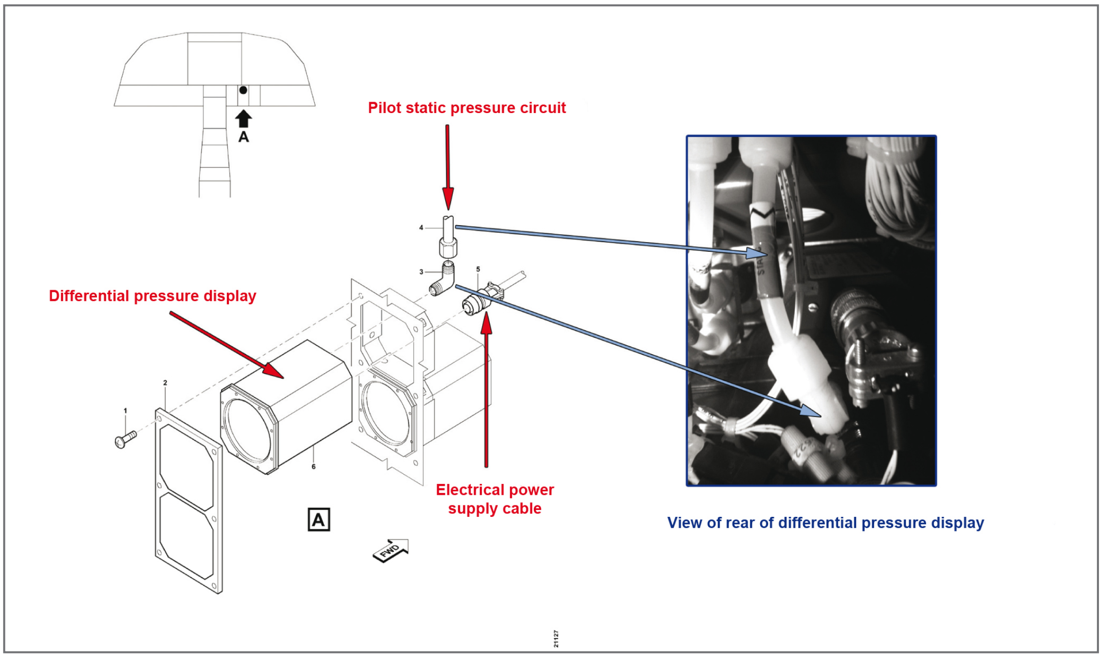

Figure 5: Schema and photo of installation

2.5.3 Context of the flight and maintenance of the PC 12

The PC 12 had just completed an annual maintenance check that had lasted 5 days. During this calendar check, both static pressure lines were subjected to impermeability tests. These tests did not require removal of the various parts that made up the lines.

Nevertheless an EASA Airworthiness Directive (reference 2006-0265) imposed a test on airplanes equipped with transponders using the Gilham altitude coding system like that which equipped the PC 12.

On the PC 12, before performing this test, it is necessary to disconnect the N°1 static line at the level of the cabin differential pressure indicator in order to protect it from the high pressures used during the test. This disconnection is done by unscrewing the connector located on the rear panel of the differential pressure indicator (see figure 6). At the end of the test, the connector is screwed back on. This manipulation is made tricky due to the limited space and the presence of an electrical plug near the pipes.

At the end of this test, the static circuit is subjected to an impermeability test. In this case, this test did not reveal a leak.

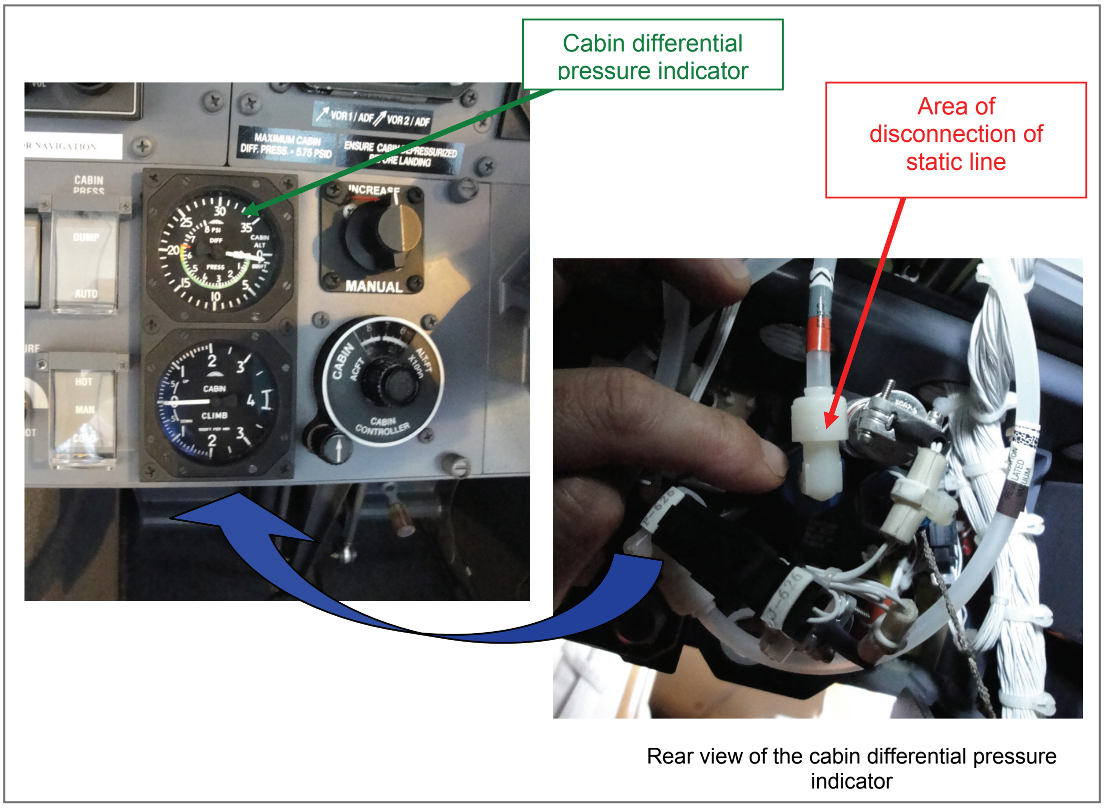

Figure 6

2.5.4 Examination of the defective part

The connector that was the cause of the leak was analysed. There was shrinkage of a circumferential groove at the level of the joint with the cabin differential pressure indicator (see figure 7 below).

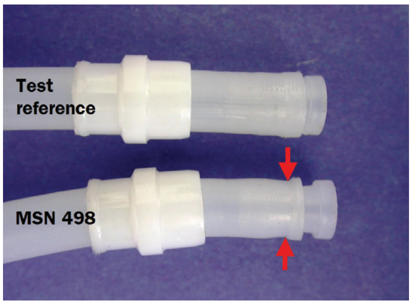

Figure 7: Shrinkage of the cross-section of the connector

The tests performed for the needs of the investigation consisted of putting the circuit under pressure then depressurizing it. The connector was tightened manually, ending with slight tightening up with a spanner, as is done during maintenance operations (there is no recommended tightening torque).

It was possible to establish, during these tests, that the deformation observed on the connector made a perfectly impermeable joint impossible between the pipe and the cabin differential pressure indicator. Due to this, the tube (see "A" figure 8) could be moved in the longitudinal direction though it is, normally, immobilised by the tightening. Without manipulating this tube, no notable leak occurred. As soon as it was displaced in a longitudinal direction (see "B" figure 8), a leak appeared.

Thus, during the impermeability tests performed by Pilatus, on the airplane on the ground, no leak was detected. During departure of the PC 12, the vibrations in flight, as well as the stresses created by the climb with pressurisation of the cabin, very likely led the tube to move, thus causing the leak at the level of the connector.

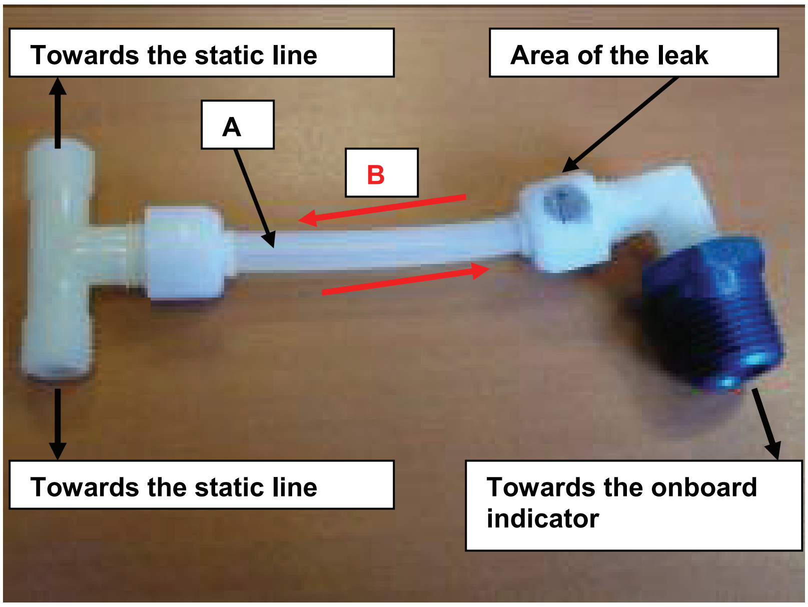

Figure 8: Photo of the pipes

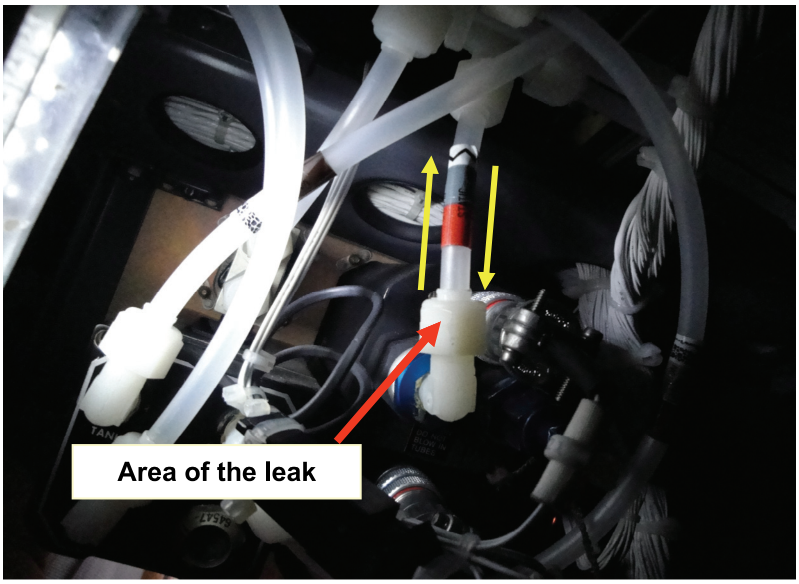

Figure 9: Location on airplane

There is no limit life or specific limitation on this type of connector.

No other failure of this type has been reported to the manufacturer on a fleet of more than 1,000 PC 12's in service in the world with over 3 million flight hours.

The tests performed in the context of the investigation did not make it possible to reproduce, on a new part, the deformation observed on the part in question and consequently to identify the origin of this (manufacturing problem of the part or poor manipulation during the maintenance operations, for example).

3 - CONCLUSION

This incident was due to a leak at level of the static pressure line supplying the left side barometric and speed unit. This leak caused erroneous altitude and speed information to be supplied and led the PC 12 to fly at a level that was in conflict with flight AF 850 NE, without the risk of collision between the 2 airplanes being detected either by the ATC, or by the anti-collision systems such as the STCA or the TCAS.

The flight level displayed on the ground systems did not make it possible to dispel the doubt and thus led all of those involved (crew and controllers) to believe a flight level for the airplane that was erroneous. Due to this, the crew did not search any further for the causes of the inconsistency in the speed observed on the left side unit.

4 - SAFETY RECOMMENDATIONS

Note: In accordance with EC Regulation 996/2010, a safety recommendation shall in no case create a presumption of blame or liability for an accident, serious incident or incident. The addressee of a safety recommendation shall acknowledge receipt of the transmittal letter and inform the safety investigation authority which issued the recommendation within 90 days of the receipt of that letter, of the actions taken or under consideration, and where appropriate, of the time necessary for their completion and where no action is taken, the reasons therefor.

4.1 ATC Services

This type of particularly serious incident has a specific feature in that it is undetectable by ATC services and by the various conflict detection systems, such as the short term conflict alert system or the TCAS. Further, under the existing regulations, there is no provision for the specific management of a flight when a pilot casts doubt on his vertical position.

This led the BEA to recommend, on 26 August 2010:

❒ *that the DSNA implement, in the shortest possible time, an emergency procedure so that ATC ensures that there is a safety space around an aircraft as soon as the crew casts doubt on its vertical position, without waiting for the latter to declare a distress or emergency situation.*

4.2 Crew Procedures

In addition, the investigation showed that the crew possessed information to detect the pilot side speed error. On the other hand, reading the altimeters alone did not allow the error to be detected.

Considering the design of the circuits, a failure on a barometric and speed circuit can have consequences on the values indicated on board, such as the indicated speed, the flight level and the vertical speed. For example, an inconsistency in indicated speed can be linked to an error in the altitude displayed and vice versa.

A study undertaken among several airplane manufacturers showed that the procedures for the course of action for crews to follow in case of inconsistency in altitude are either incomplete, or non-existent.

Consequently the BEA recommends to EASA:

❍ **that procedures in the flight manual relating to situations of doubtful or erroneous altitude be completed or developed by manufacturers;**

❍ **that these cases be considered as emergency situations that must be declared without delay by crews to the ATC services.**

5 - SAFETY LESSONS LEARNED

It is important that crews be informed:

- *that they must strive to maintain external visual vigilance and to pay attention to "weak signals". In the case under consideration, only the visual detection of the PC12 following a perception of "oscillations" by the A318 crew made it possible to avoid a probable collision in flight.*
- *that the protection systems onboard (TCAS) and on the ground (STCA) are based on the altimeter values transmitted by the airplane via the transponder. Consequently, a false altimeter value makes it impossible for these systems to play their role as the final safety system.*
- *that ATC controllers do not have equipment that allows them to dispel any doubts expressed by a crew concerning its altitude. In fact, the only altitude information available on the ground comes from mode C, transmitted by transponders.*

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