



PRELIMINARY REPORT

Serious incident

17-3-2016

involving

ATR42 500

LY-DAT



Certain report data are generated via the EC common aviation database

FOREWORD

This preliminary report reflects the opinion of the Danish Accident Investigation Board regarding the circumstances of the occurrence and its causes and consequences.

In accordance with the provisions of the Danish Air Navigation Act and pursuant to Annex 13 of the International Civil Aviation Convention, the investigation is of an exclusively technical and operational nature, and its objective is not the assignment of blame or liability.

The investigation was carried out without having necessarily used legal evidence procedures and with no other basic aim than preventing future accidents and serious incidents.

Consequently, any use of this preliminary report for purposes other than preventing future accidents and serious incidents may lead to erroneous or misleading interpretations.

A reprint with source reference may be published without separate permit.

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BULLETIN

General

File number: HCLJ510-2016-300
UTC date: 17-3-2016
UTC time: 20:43
Occurrence class: Serious incident
Location: Esbjerg Traffic Information Zone (TIZ)
Injury level: None

Aircraft

Aircraft registration: LY-DAT
Aircraft make/model: ATR42 500
Current flight rules: Instrument Flight Rules (IFR)
Operation type: Commercial Air Transport Passenger
Flight phase: Take-off
Aircraft category: Fixed Wing Aeroplane Large Aeroplane
Last departure point: Denmark EKEB (EBJ): Esbjerg
Planned destination: Denmark EKBI (BLL): Billund
Aircraft damage: None
Engine make/model: PRATT & WHITNEY (CANADA) (PW 127F)

SYNOPSIS

Notification

All times in this report are UTC.

The Aviation Unit of the Danish Accident Investigation Board (AIB) was notified of the serious incident by the Area Control Centre at Copenhagen Airport Kastrup (EKCH) on 17-3-2016 at 21:24 hours.

The Danish Transport and Construction Agency (DTCA), the International Civil Aviation Organization (ICAO), the European Aviation Safety Agency (EASA), the Directorate-General for Mobility and Transport (DG MOVE), the French Bureau d'Enquêtes et d'Analyses (BEA), the Transport Accident and Incident Investigation Division at the Ministry of Justice of the Republic of Lithuania (LRTM) and the Canadian Transportation Safety Board (TSB) were notified on 18-3-2016.

The French BEA and the Canadian TSB appointed accredited non-traveling representatives to the AIB safety investigation.

FACTUAL INFORMATION

History of the flight

The serious incident flight was a commercial IFR domestic flight from Esbjerg (EKEB) to Billund (EKBI).

Six crew members and seven passengers were onboard.

The flight was the last leg of an afternoon round trip routing EKBI – EKEB – Stavanger, Norway (ENZV) – EKEB – EKBI.

Before the first flight at EKBI, the aircraft was refueled. The indicated total fuel onboard was 3339 kilos (kg).

The flights EKBI – EKEB – ENZV – EKEB were performed as a line check of the left-hand seated pilot training for an upgrade to commander.

At EKEB, the trainee pilot had passed the line check and acted as commander of the serious incident flight from EKEB to EKBI.

The aircraft took off from runway 26 at EKEB and at around 1000 feet altitude mean sea level (msl) the right engine flamed out.

The flight crew performed the ‘engine flame out at take-off’ emergency checklist memory items.

When the aircraft was stabilized at 3000 feet (msl) altitude, and no engine damage was suspected, the flight crew performed the ‘engine restart in flight’ checklist.

For a few seconds, the engine interstage turbine temperature increased, but the engine did not restart.

After completion of the ‘single engine operation checklist’ and other remaining checklist items, the flight crew informed Esbjerg Aerodrome Flight Information Service (AFIS) about the engine flame out, and that the flight crew intended to continue the flight to EKBI.

Esbjerg AFIS informed Billund Air Traffic Control (ATC) about the situation.

The aircraft was transferred to Billund Approach (APP) and continued to EKBI with only the left engine operating.

On approach to EKBI, the flight crew got radar vectors from Billund Approach and established the aircraft on the localizer to runway 27.

The aircraft was transferred to Billund Tower (TWR).

Billund TWR informed the flight crew that the Instrument Landing System (ILS) category 1 was in operation and that the flight crew of the previously landed aircraft reported the approach lights in sight at an altitude of 200 feet above ground level.

On short final to runway 27, the commander (non-flying) observed that the left engine torque indication had dropped to zero, the autopilot disconnected, and the first officer (pilot flying) removed his left hand from the power lever and grabbed the control wheel with both hands.

The commander rapidly moved the left engine power lever forward.

At the same time, the flight crew and the cabin crew heard loud bangs from the left engine.

The cabin crew observed flames at the rear bottom of the left engine and reported 'engine fire' to the flight crew.

Shortly after, the aircraft landed on runway 27. The aircraft vacated runway 27 via taxiway C.

Because engine fire was reported by the cabin crew, the flight crew stopped the aircraft on taxiway C.

The flight crew pulled the fire handles and discharged the fire bottles of both engines.

The cabin crew observed no fire from the left engine.

The cabin crew evacuated the passengers via the airstair door located at the rear end of the cabin on the left side of the aircraft fuselage.

The fire and rescue services observed no fire from the engines.

The serious incident occurred in dark night and under instrument meteorological conditions (IMC).

Injuries to persons

<i>Injuries</i>	<i>Crew</i>	<i>Passengers</i>	<i>Others</i>
Fatal			
Serious			
None	6	7	

Damage to aircraft

There were no damages to the aircraft.

Aircraft information

Registration:	LY-DAT
Type:	ATR 42
Model:	500
Manufacturer:	ATR – GIE Avions de Transport Régional
Serial number:	445
Year of manufacture:	1994
Engine manufacturer:	Pratt & Whitney Canada Inc.
Engine type:	PW127F
Propellers:	Hamilton Standard, 568F-1
Aircraft total flight hours:	29600.64
Aircraft total flight cycles:	24436
Airworthiness' Review Certificate:	Valid until 25-2-2017

Fuel quantity indicating system

The loaded fuel quantity was indicated by:

- An electrical fuel quantity indicating system comprising five probes per tank and a dual digital indicator located on the upper center instrument panel in the flight compartment.
- A fuel quantity repeater and a pre-selector located at the refueling station.
- Two manual magnetic indicators per tank, which might be used on the ground.

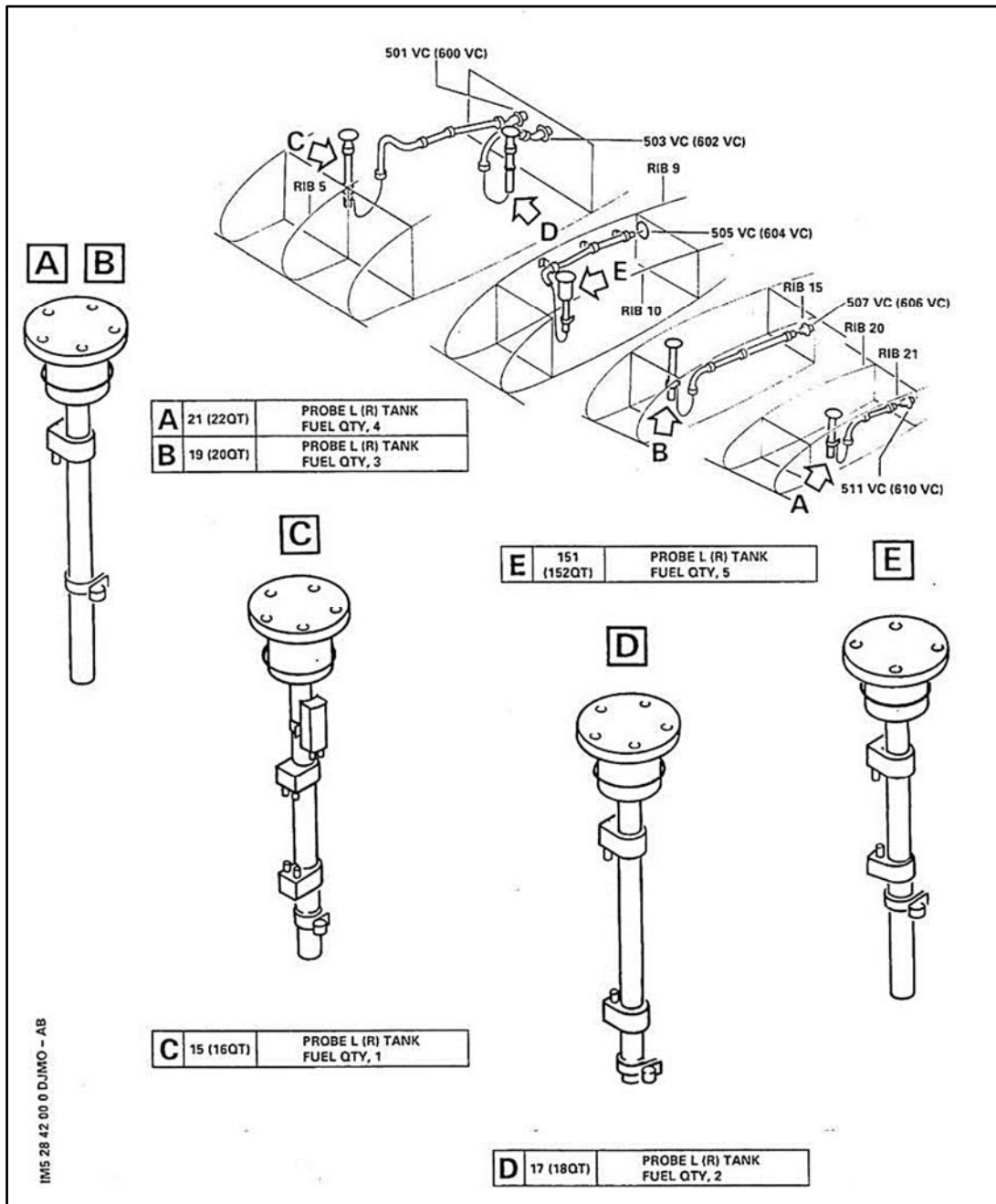
Probes and electrical harness

The fuel mass was measured by capacitance probes. Any change in the fuel quantity resulted in a change in probe immersion and a consequent change in probe capacitance.

The electric harnesses installed inside the tank connected the probes to the bulkhead connectors.

The fuel tank and probe systems are shown in the drawing.

Left wing.



Dual fuel quantity indicator system

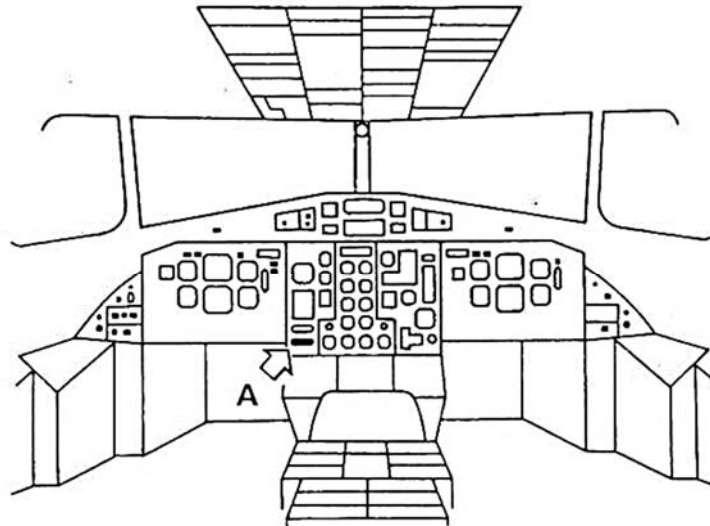
The fuel quantity indicator indicated the fuel mass in each tank. The two indications were given in digital form in kg.

The indicator included two independent channels, one for each tank. They were supplied with 28 VDC.

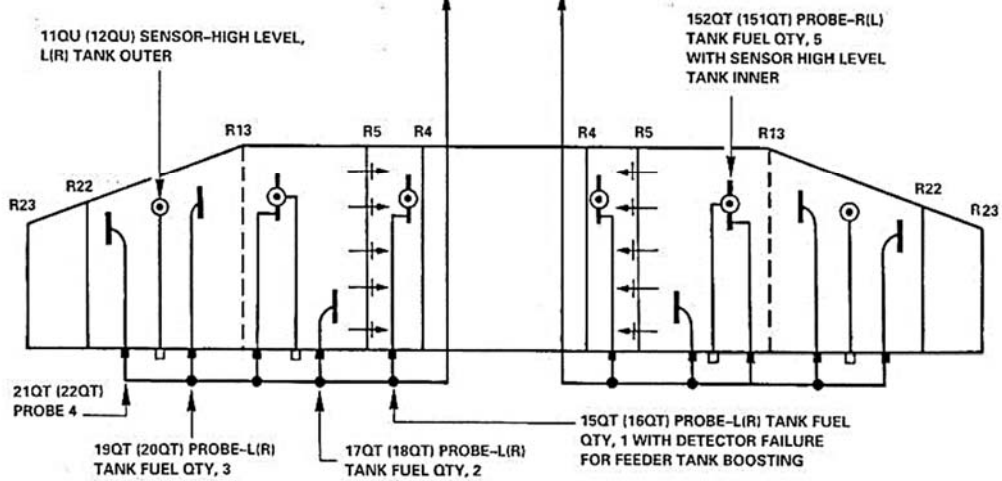
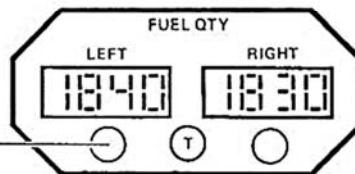
The channels included a low level detection system. The detection threshold was set to 160 kg for each tank.

The fuel system design was not equipped with an independent fuel low level measurement system. The fuel low level measurement system was an integrated part of the dual fuel quantity indicator system.

The fuel quantity indication system is illustrated in the drawing on next page.



A 3QT
IND-FUEL QTY



IMS 28 42 00 0 ADIMO - AC

Meteorological information

Aerodrome forecast (TAF)

TAF amd ekbi 171925z 1719/1818 27010kt 3000 br bkn003 tempo 1719/1801 0500 bcfg bkn001
becmg 1801/1803 34008kt 8000 nsw bkn015 tempo 1803/1808 1200 bcfg bkn001=
TAF ekbi 171725z 1718/1818 27010kt 3000 br bkn003 tempo 1718/1801 1200 bcfg bkn001
becmg 1801/1803 34008kt 8000 nsw bkn015 tempo 1803/1808 1200 bcfg bkn001=

Aviation routine weather report (METAR)

METAR ekbi 172150z 29008kt 0600 r09/1100n r27/1100n fg ovc001 04/04 q1021=
METAR ekbi 172120z 28009kt 0600 r09/1200d r27/1100n fg ovc001 04/04 q1021=

Flight recorders

Solid State Flight Data Recorder (SSFDR)

Manufacturer: L-3 Aviation Communications, Part Number 2100-4043-00 (Serial Number 000600674)

The SSFDR appeared undamaged, and the recovered flight data were useful to the preliminary safety investigation.

Solid State Cockpit Voice Recorder (SSCVR)

Manufacturer: L-3 Aviation Communications, Part Number 2100-1020-02 (Serial Number 000341835)

The SSCVR appeared undamaged.

The SSCVR data were recovered and were useful to the preliminary safety investigation.

Presence of fire

The preliminary investigation revealed no traces of fire.

AIB safety investigation

Engine investigation

The preliminary investigation of engine # 1 (left engine):

- The visual inspection revealed no findings.
- A borescope inspection revealed incrustation, deposits and sod on the internal parts of the engine.
- No internal mechanical faults were revealed.

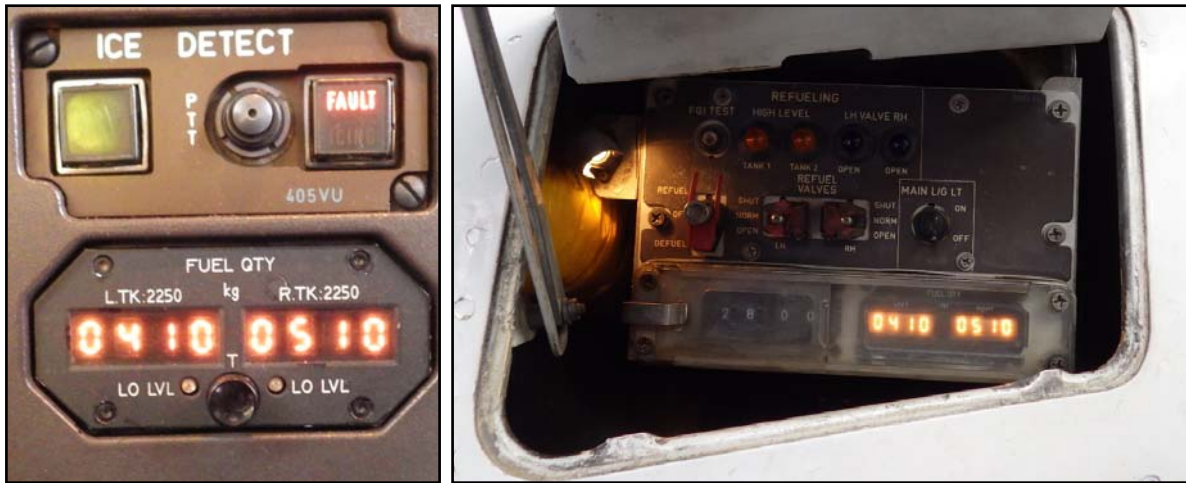
The preliminary investigation of engine # 2 (right engine):

- The visual inspection revealed no findings.
- A boroscope inspection revealed no findings, the engine was internally clean.
- The fuel pump and gearbox drive train to the high pressure turbine (HPT) was checked without remarks.

Airframe fuel system investigation

The preliminary investigation of the airframe fuel system:

1. The right fuel tank was empty.
2. The fuel quantity indicator in the cockpit and the fuel quantity indicator repeater located at the refueling panel on the right side of the aircraft below the wing root indicated:
 - Left fuel tank 410 kg, which corresponded to the fuel amount in the tank.
 - Right fuel tank 510 kg, despite the fuel tank was empty.
 - Right fuel tank low level light (LO LVL) did not illuminate on the fuel quantity indicator, despite the fuel level was below 160 kg.



The fuel quantity indicator and the repeater were replaced with new units. The new indicators indicated the same values as presented above. The original indicators were reinstalled.

A fuel quantity probe capacitance test was performed with the probes still installed in the fuel tanks.

Before the test, the tanks were completely drained.

The test showed the following results:

Probe No	Probe part and serial numbers (PN / SN) (Right tank shown)	Check Values Pico farad (PF)	PF Value right tank	PF Value left tank
1	798-038 / 702	6.4 +/- 0.8	6.6	6.7
2	766-046-2 / 642	13.22 +/- 0.5	13.3	13.4
3	766-047-2 / 692	36.5 +/- 0.5	40.2	36.9
4	766-048-2 / 667	17.3 +/- 0.5	18.0	17.6
5	768-055 / 675	28.1 +/- 0.5	28.6	29.5

Probe No 3 PF value was significantly out of limit.

The total capacitance of the electrical channels for each fuel tank were measured from the connectors to the fuel quantity indicator in the cockpit with the following result:

The total capacitance value must be included between 100.2 PF and 105 PF.

The left fuel tank channel total capacitance: 105.2 PF.

The right fuel tank channel total capacitance: 115.5 PF.

The right fuel tank channel PF value was out of limit.

The aircraft was refueled 200 kg at a time to full tanks.

The erroneous right fuel quantity indication remained during the fuel uplift sequence.

The left tank indicated normal during the fuel uplift sequence.

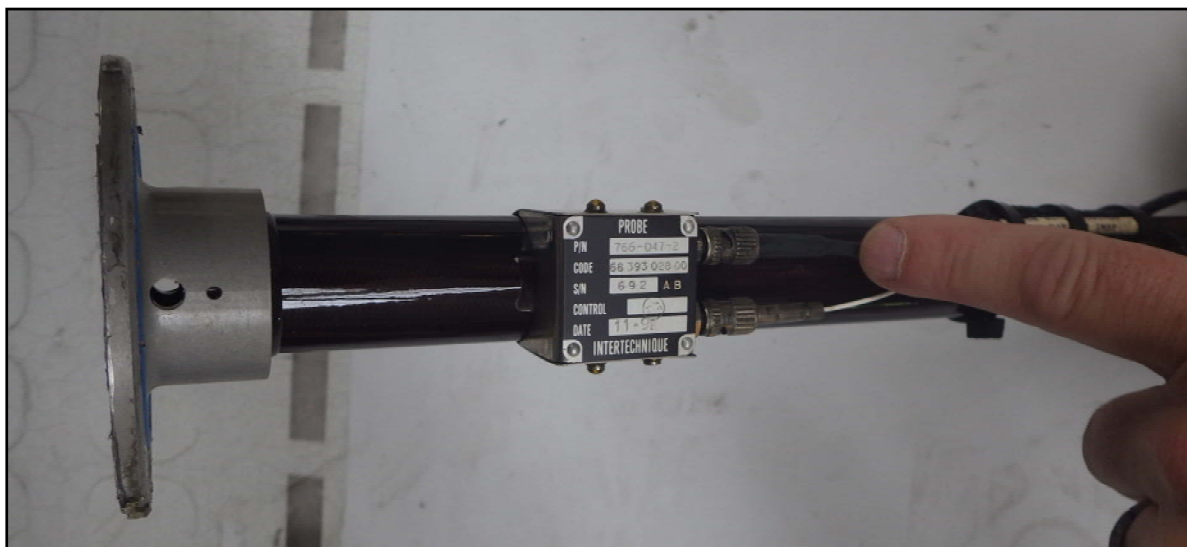
Right fuel tank probe test and investigation

The fuel quantity probes were uninstalled from the right fuel tank and placed on the aircraft wing.

A fuel quantity probe capacitance test was performed with the following results:

Probe No	Probe PN / SN (Right tank shown)	Check Values PF	PF Value probes on the wing
1	798-038 / 702	6.4 +/- 0.8	6.6
2	766-046-2 / 642	13.22 +/- 0.5	13.4
3	766-047-2 / 692	36.5 +/- 0.5	40.2 – 44.6 – 47.5
4	766-048-2 / 667	17.3 +/- 0.5	18.0
5	768-055 / 675	28.1 +/- 0.5	28.6

The values of probe No 3 changed when the brown wire (covered by heat-shrinkable tubing) was manipulated close to the connector (pointed out in the picture below).



The values changed between the first test value measured 40.2 PF to 44.6 PF and 47.5 PF.

The heat-shrinkable tubing was removed from the brown wire.

The brown wire was in connection with the connector as shown in the picture below.



When further manipulated, the PF value turned back to the normal value of 36.7 PF, which was a value within limit.

Thereafter, it was not possible to recreate the fault value(s) by moving the wire and/or the connector.

With the PF value on probe No 3 back to normal, the fuel quantity indicators indicated the correct value of 0000 kg, with all the probes on the wing.

It was possible to turn on the amber fuel low level (160 kg) light by installing probe No 1 and thereafter, slowly move probe No 2 down into the fuel tank.

AIB PRELIMINARY ANALYSIS

The right engine flameout was caused by fuel starvation.

The preliminary AIB investigation revealed that the fuel quantity indication failure was related to the right tank probe No 3 and / or the associated wiring.

The Danish AIB continues the operational and technical safety investigation.