



Federal Public Service
Mobility and Transport
Air Accident Investigation Unit

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Safety Investigation Report

INCIDENT TO AVRO RJ100 REGISTERED OO-DWK ON 27 OCTOBER 2009

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ANNEX: Examination Report of the Hydraulic Pipe

FOREWORD

This report is a technical document that reflects the views of the investigation team on the circumstances that led to the accident.

In accordance with Annex 13 of the Convention on International Civil Aviation, it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the determination of the causes, and define recommendations in order to prevent future accidents and incidents.

In particular, Art. 17.3 of EU Regulation 996/2010 stipulates that a safety recommendation shall in no case create a presumption of blame or liability for an accident, serious incident or incident.

Unless otherwise indicated, recommendations in this report are addressed to the Regulatory Authorities of the State having responsibility for the matters with which the recommendation is concerned. It is for those Authorities to decide what action is taken.

The investigation was conducted by L. Blendeman.
The report was compiled by L. Blendeman

NOTE:

For the purpose of this report, time will be indicated in UTC, unless otherwise specified.

Synopsis

Date and hour of the incident

27 October 2009 at 19:15 UTC

Aircraft

British Aerospace Avro RJ-100, msn E3360 registered OO-DWK

Accident location

Brussels Airport - EBBR, Belgium.

Aircraft Operator

Brussels Airlines

Type of flight

Commercial - Passenger.

Persons on board

Crew: 4 – Passenger:74

Departure Airport

EDDT – Berlin Tegel Airport

Destination Airport

EBBR – Brussels Airport

Abstract

1. Factual information.

1.1 History of flight.

The airplane landed on Brussels airport, coming from Berlin Tegel, Germany. There were 74 passengers on board and 4 crew. During taxi, the crew noticed the loss of the “green” hydraulic system, and the loss of nose wheel steering.

The cabin crew reported at the same time that fluid was leaking into the cabin, and that some passenger got contaminated by the fluid. The leak was located at row 7, having an effect between rows 3 to 9 F/E/D. The pressure caused the oil to escape in the cabin, causing panic amongst the passengers, and contamination.

The airplane stops at the inner 9 taxiway, and the crew proceeded to the evacuation of the passengers using the forward air stair.

Four passengers showed signs of skin irritation to the face and shoulder.

The Medical antenna of Brussels airport (MEDA) provided the first intervention before the arrival of ambulances. The four contaminated passengers were dispatched to the hospital of Brussels (AZ VUB) and of Leuven (Gasthuisberg – Leuven). They were released the same day.

Further examination of the hydraulic line showed a ruptured pressure pipe of the green hydraulic system.

Brussels Airlines notified AAIU(Be) and the Belgian CAA the next day in a meeting at BCAA's premises.

The UK AAIB was first notified of the event by BAE Systems and took immediately contact with AAIU(Be), with the designation of an accredited representative.

1.2 Injuries to persons.

Injuries	Pilot	Passenger	Other crew	Total
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	4	0	4
None	2	70	2	74
Total	2	74	2	78

1.3 Damage to aircraft.

The following equipment was contaminated by the hydraulic fluid:

- RH passenger servicing units including passenger oxygen system
- All electrical wiring between frame 25 & 26, mostly RH side
- Cabin lighting
- Cabin structure
- Cabin structure insulation
- All fuel processor units (5 ea)
- Fuel vapour bag (under centre tank)
- Engine start system in RH forward cargo
- Radio altimeter #2 system
- RH floor structure
- RH floor panels
- Floor proximity emergency lights
- Forward cargo RH roof panels
- Forward cargo floor & structure
- Hydraulic bay floor & structure
- Air conditioning ducts above and below floor level
- Cosmetic items: cabin roof panels, RH & LH overhead bins, side walls, carpets, passenger seats.

1.4 Other damage.

None.

1.5 Personnel information.

Pilot

Sex: male

Age: 50 years old

Nationality: Belgian

Airline Transport Pilot Aeroplanes Licence, first issued on June 10, 1999, last issued on May 8, 2009, valid until May 8, 2013.

Rating:

Avro RJ/BAe146, valid until 30 April 2010

Medical Certificate: Class 1.

Total Flight Experience: 9500 FH, including more than 5500 FH on Avro RJ type airplane.

First Officer

Sex: male

Age: 28 years old

Nationality: Belgian

Airline Transport Pilot Aeroplanes Licence, first issued on 17 September 2007, valid until 17 September 2012

Rating:

Avro RJ/BAe146, valid until 30 September 2010

Total Flight Experience: 2900 FH, including more than 2600 FH on Avro RJ type airplane.

1.6 Aircraft information.

Airplane general information.

The Avro RJ is a high-wing cantilever monoplane with a T-tail. It has four turbofan jet engines mounted on pylons underneath the wings, and has retractable tricycle landing gear. The aircraft has very quiet operation, and has been marketed under the name Whisperjet. It sees wide usage at small city-based airports. In its primary role it serves as a regional jet, short-haul airliner or regional airliner. The Avro RJ series are upgraded developments of the BAe-146 family and like the 146 was built in three fuselage length variants, the RJ70, RJ85 and RJ100. The last RJ was delivered in 2002. In total 170 Avro RJ aircraft were built, of which 87 RJ85. Current major European operators are Brussels Airlines, Blue1 (Finland), Lufthansa CityLine, Malmö Aviation (Sweden) and Swiss International Airlines.

The Avro RJ100 type certificate data sheet No. BA16 prescribes the conditions and limitations under which the aircraft meets the airworthiness requirements of the UK CAA.

The RJ100 was certificated on 2 July 1993.

Brussels Airlines is the only owner of Belgian registered Avro RJ and has, on the issue date of this report, 10 RJ85 and 12 RJ100 aircraft in its fleet.

Characteristics of Avro RJ100:

Crew:	2
Capacity:	118 passengers maximum. Brussels Airlines uses the configuration of 97 passengers.
Length:	31 m
Wingspan:	26,34 m
Height:	8,59 m
Wing area:	77,3 m ²
Maximum zero fuel weight:	37421 kg
Max takeoff weight:	44225 kg
Engines:	4 AlliedSignal/Honeywell LF-507-1F turbofan engines

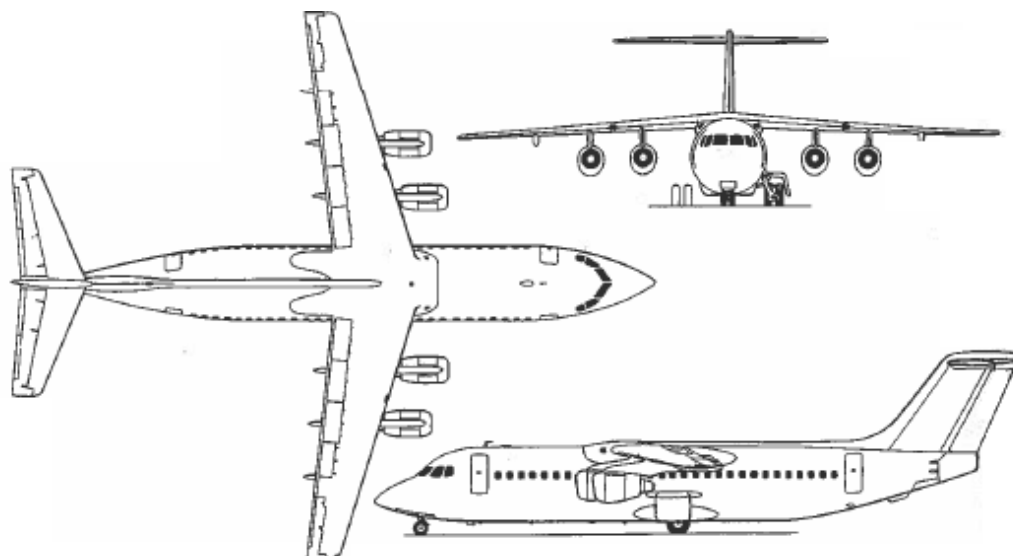


Figure 1: BAe AVRO RJ100

Airframe:

Manufacturer:	BAe Systems (Operations) Ltd
Type:	AVRO 146 Series RJ100
Serial number:	E3360
Built year:	1999
Registration:	OO-DWK
Certificate of registration:	N°4895 issued May 29, 2008
Certificate of airworthiness:	EASA Form 25 issued December 12, 1995
Airworthiness Review Certificate:	EASA Form 15B, Last issued on July 06, 2010. Valid until August 03, 2011
Accumulated Flight Hours:	23298FH
Accumulated Flight Cycles:	17457FC

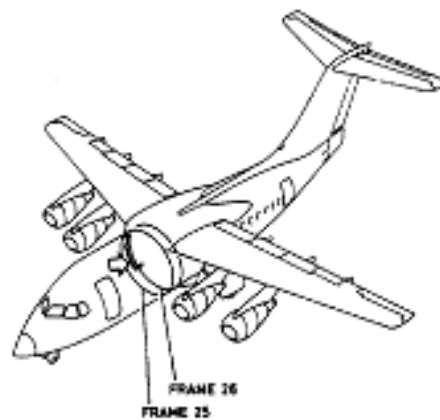
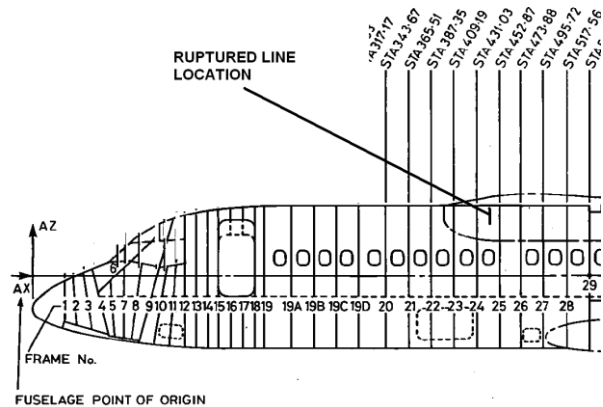
Maintenance:

The last C-Check was completed on 28/4/2009 when the airplane accumulated 22063FH and 16657FC.

The pipe

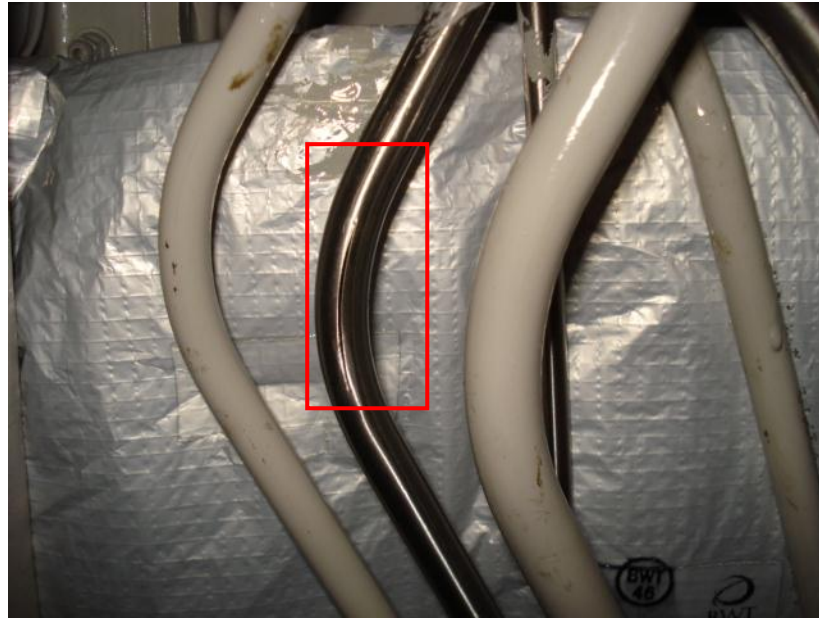
The ruptured pipe is a stainless steel pipe used to transport the hydraulic fluid of the Green hydraulic system from the hydraulic bay to the RH wing spoiler control valve and flap system.

The pipe, pn HC279B004-000 ruptured at the RH side, between frame 25 and 26.



The fracture (crack) is longitudinal and 2.5 cm long, located in a curve of the line.

The hydraulic line was installed during aircraft production, and was neither removed nor replaced during the operational life of the airplane.



Hydraulic System

The hydraulic power for the RJ-100 is provide by two independent hydraulic systems (yellow and green) operating at 3100 psi using Type IV phosphate ester fluid.

The green system operates the following services:

- Flaps,
- One rudder actuator,
- Nose gear steering,
- Four lift spoilers,
- Wheel brakes,
- Airbrakes,
- Standby generator,
- Landing gear,

1.7 Meteorological conditions.

Not relevant

1.8 Aids to navigation.

Not relevant

1.9 Communication.

Not relevant

1.10 Aerodrome information.

Not relevant

1.11 Flight recorders.

The airplane is equipped with flight recorders, but owing to the nature of the incident, no download was requested.

1.12 Wreckage and impact information.

Not relevant

1.13 Medical and pathological information.

Not applicable

1.14 Fire.

There was no fire.

1.15 Survival aspects.

Not applicable.

1.16 Tests and research.

The hydraulic pipe, part number HC279B0004-000, was removed from aircraft, and a length of the pipe containing the crack was cut out and dispatched to the Metallurgy Laboratory of BAE Systems in Woodford, United Kingdom on the 3rd November 2009. The workscope was defined between AAIB, BAe Systems, SN Brussels engineering and AAIU(Be).

2. Analysis.

2.1. Examination of the hydraulic pipe.

The full report from BAE Systems Metallurgy Laboratory, dated 27th November 2009, bears the reference MAT/3694, and is in appendix.

The conclusion of the report is as follows:

“There was a linear defect running along the inner surface of the pipe. The defect coincided with the base of the weld in the pipe and appeared to be associated with a low level of weld penetration.

The pipe had failed at one of the bends where the weld and linear defect were oriented at 90 degrees to the top of the bend. The higher level of fluctuating stresses acting on the pipe in this position were thus concentrated on a particular area of weakness of the pipe.

The pipe had failed due to fatigue originating at the edge of the linear defect and progressing through to the outer surface.

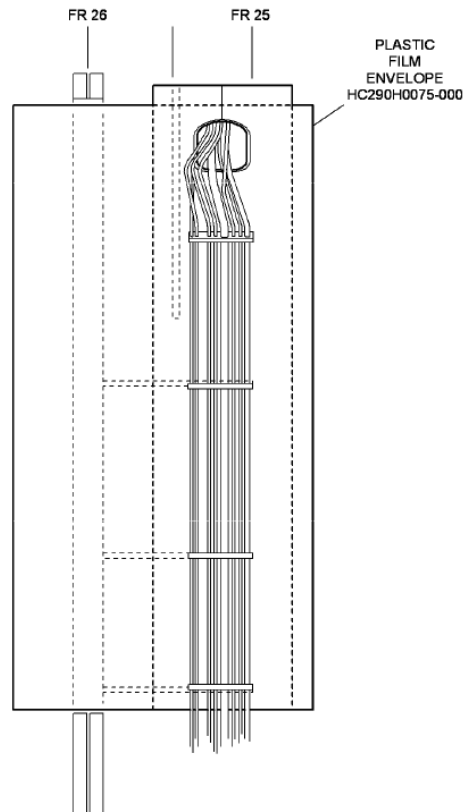
Fatigue crack growth had also occurred at some of the other bends in the pipe. The greatest degree of fatigue crack growth had occurred at another of the bends which was aligned in the same way with respect to the weld.”

2.2. BAE Systems reaction.

BAE Systems sent an All Operator Message (ref 09/019V) dated 30th October 2009 to notify the event to all operators, requesting to report any similar events.

Further to the results of the metallurgical analysis, BAE Systems developed a Service Bulletin to introduce a system to contain any fluid escaping from a failed pipe and channel it to the cabin floor. The SB 29-048-30676A was first issued on 18 October 2010, and further revised until the last current version (revision 2) issued on 23 December 2010.

The SB concerns the installation of a sealed plastic contained envelope around the hydraulic system pipes mounted on the fuselage sides in the passenger cabin between frames 25 and 26 (LH and RH).



2.2. EASA reaction.

The European Aviation Safety Agency issued an Airworthiness Directive (AD 2011-0220) to mandate the installation of the hydraulic fluid containment system in accordance with the BAE Systems Service Bulletin.

The Airworthiness Directive 2011-0220 was posted on 23 September 2011 as PAD 11-101 for consultation until 21 October 2011. The AD was eventually issued on 11 November 2011.

2.3. Belgian airlines reaction.

Brussels Airlines has launched a modification campaign to install the hydraulic fluid containment system on all concerned airplane during the upcoming C-Checks. Seven RJ100 are already modified.

TNT is operating 2 BAe 146-200QC, from which one is already modified, and the second one will be modified during C-Check in end January 2012.

3. Conclusions.

3.1 Findings.

- The airplane was airworthy.
- The failed hydraulic line was installed during the original manufacturing of the airplane.

3.2 Causes.

The rupture of the hydraulic pressure line was caused by metal fatigue at the weld joint of the pipe, associated with a low level of weld penetration.

4. Safety recommendations.

As a result of the actions taken by the manufacturer, EASA and the operators, this investigation does not sustain any Safety Recommendation.

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