

Investigation Report

Identification

Type of Occurrence:	Accident
Date:	07 June 2010
Location:	Münster / Osnabrück
Aircraft:	Airplane
Manufacturer / Model:	Embraer / ERJ 170-100 LR
Injuries to Persons:	None
Damage:	Aircraft seriously damaged
Other Damage:	None
Source of Information:	Investigation by BFU staff
State File Number:	BFU 1X002-10

Factual Information

History of the Flight

The transport aircraft took off on runway 25 of Münster/Osnabrück Airport at 1012 hrs¹. Four crew members and 54 passengers were aboard the airplane. The pilot actuated the landing gear lever after take-off. Thereby the copilot noticed that the right main landing gear was not retracted properly. According to the statements of the cockpit crew, the corresponding warning message LG LEVER DISAG was indicated on the display a short time later, at first only visually, later acoustically as well. The crew processed the warning message according to the check list ABNORMAL LANDING GEAR EXTENSION. After that, the landing gear was

extended completely and locked; the three green indicator lights on the display confirmed this.

During the processing of the warning message, the caution message HYD 2 LO PRESS appeared on the display. It was also processed according to the check list. After that the crew decided to continue the flight in Flight Level (FL) 120 with 230 knots and to perform a safety landing in Frankfurt/Main. An emergency was not declared.

According to the statements of the crew, an extensive briefing with respect to the expected approach and the subsequent landing under the given conditions was held prior to the beginning of the descent. The landing at Frankfurt/Main Airport with the technical restrictions expected by the crew, as e. g. failure of the inner brakes and the nose wheel control, was performed at 1054 hrs. The fire brigade inspected the landing gear after the aircraft had left the runway. Subsequently the aircraft was towed to the parking position.

Personnel Information

The 44-year-old Pilot in Command (PIC) held an Airline Transport Pilot's License (Aircraft) (ATPL (A)) issued according to JAR-FCL, German. The license was first issued on 18 February 2004 by the Luftfahrt-Bundesamt (LBA); it was valid until 26 November 2014. The class 1 medical certificate was valid until 26 November 2011. The pilot had an overall flight experience of 3,558 hours, 1,718 hours of which on the type in question. The type rating was valid until 14 September 2010.

The 34-year-old copilot also held an Airline Transport Pilot's License (Aircraft) (ATPL (A)) issued according to JAR-FCL, German. This license was first issued on 7 August 2002 by the LBA; it was valid until 7 January 2015. The class 1 medical certificate was valid until 23 July 2010. The copilot had an overall flight experience of 2,035 hours, 878 hours of which on the type in question. His type rating was valid until 14 September 2010.

Aircraft Information

The aircraft type ERJ 170-100 LR of the manufacturer Embraer is an all-metal low wing aircraft with retractable landing gear. The aircraft was equipped with two General Electric CF34-8E5 jet engines. The maximum take-off mass was 37,200 kg. The aircraft had the manufacturer number 17000006 and was built in 2002. It had an aircraft total time of 9,130 hours with 8,641 flight cycles.

The aircraft had a valid German certificate of registration and was operated by a German operator.

The manufacturer had issued the Service Bulletin (SB) No. 170-57-0008 which described the damage found on the aircraft. This SB states that fatigue tests had led to cracks in the main landing gear actuator support fitting. The recommendation to operators was to replace the support fitting by the 5,000 flight cycles at the latest.

Meteorological Information

During the approach to Frankfurt/Main Airport ground visibility was more than 10 kilometers, the wind came from 240° with 10 knots, in gusts with 27 knots. The air temperature was 18°C and the air pressure (QNH) was 1,013 hPa.

Flight Recorders

The aircraft was equipped with a Honeywell Digital Voice Data Recorder (DVDR), Model VDR p/n 980-6025-001 with the serial number 00311.

The data was available to the BFU for assessment purposes.

Wreckage and Impact Information

In the right wing, the support fitting for the retracting actuator of the right main landing gear was broken off including a part of rib 6 (Appendix, photo 1). The hydraulic cylinder of the actuator broke through rib 4A. The cylinder of the retracting actuator was externally damaged. The same applied to the connected hydraulic hoses.

The fixing lug of the unlocking actuator was torn off and its piston rod was bent.

The locking strut of the right landing gear was bent.

The support fitting for the retracting actuator of the left main landing gear showed two cracks between the spar and the left and right fixing flange in the upper area of the connection to rib 7 (Appendix, photo 2).

Both, the broken support fitting of the right wing and the cracks in the support fitting of the left wing were fatigue fractures.

Fire

There was no fire.

Organizational and Management Information

The airline prepared a Work Order on 2 May 2008 with the intention to implement the SB 170-57-0008. This work order also triggered the ordering of the new parts to be installed. The aircraft had performed 4,616 flight cycles at that time.

The work order was not carried out. According to the statements of the operator, the installation of the new parts was scheduled for the next C check of the aircraft, which had been scheduled at a date after the day of the accident.

Additional Information

During the full scale fatigue test performed by the design organisation, which means during the test for the endurance strength of the overall scheduled lifetime of the aircraft type, cracks at the main landing gear actuator support fitting were found after 8,281 simulated flight cycles. Both parts, in the left as well as in the right wing, showed the same signs in the area of the connection to rib 7. After that, an additional fatigue test was performed at the main landing gear actuator support fitting in the right wing of another test aircraft. After approximately 5,000 cycles, a crack similar to the one of the first test appeared, and the test was cancelled after 7,900 cycles when the crack had a length of 30 mm.

In 2004, the design organisation submitted a design change resulting from those tests to the Brazilian certification authority as Design Change Approval No. 170-57-2680/2004. Further tests showed that in the worst case scenario a retraction of the landing gear becomes impossible after a component failure. Due to this result, the certification authority did not classify the necessary change as an airworthiness directive, but instead as a service bulletin.

At the time of the accident, four of the aircraft affected by SB 170-57-0008 were still not equipped with the modified support fitting. Three of these were in maintenance in the course of which the modified part was to be installed. The fourth aircraft was equipped with the part shortly after the accident. Thus, all aircraft affected by the service bulletin have been retrofitted with the part.

Analysis

The spar of the right main landing gear actuator support fitting failed due to a fatigue fracture. As a consequence, a piece broke out from rib 6, and the hydraulic cylinder of the actuator then broke through rib 4A.

The design organisation had already determined a failure which was the cause for the severe subsequent damage during her own fatigue tests and described this in SB 170-57-0008. The test of the design organisation did not result in the same severity of the subsequent damage as the accident showed. This resulted in the fact that the design organisation issued a SB recommending that the action to be taken is to retrofit the aircraft with modified components. The responsible certification authority did not issue an Airworthiness Directive (AD).

The SB indicated all affected aircraft with the fragile support fitting, and it was recommended to replace these with the modified support fitting by the 5,000 flight cycles at the latest.

The aircraft in question performed 8,641 flight cycles until the accident.

Conclusions

The right main landing gear retracting actuator support fitting, which should have been replaced after 5,000 flight cycles at the latest, according to the manufacturer's service bulletin, broke during the 8,641 flight cycles and caused the severe damage to the aircraft.

Safety Recommendations

As an immediate action, the BFU issued safety recommendations to the Brazilian aviation authority, Agência Nacional de Aviação Civil (ANAC).

Recommendation No.: 16/2010

The ANAC, Brazil responsible for the type certificate of the aircraft should ground the aircraft identified in Service Bulletin 170-57-0008 "Wings – Replacement of the Main-Landing-Gear Actuator Support Fitting" and initiate an inspection in regard to cracks in the support fitting and pins before the next flight.

Recommendation No.: 17/2010

The ANAC, Brazil responsible for the type certificate of the aircraft should upgrade the Service Bulletin 170-57-0008 "Wings-Replacement of the Main-Landing-Gear Actuator Support Fitting" to an Airworthiness Directive (AD).

With the implementation of the service bulletin for the remaining four aircraft, the safety recommendations were factually complied with. An upgrade of the service bulletin to an Airworthiness Directive is therefore no longer necessary because there are no aircraft left this would apply to.

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Braunschweig, 4 May 2011

Appendices



Photo 1: Right wing, support fitting torn out

Photo: BFU

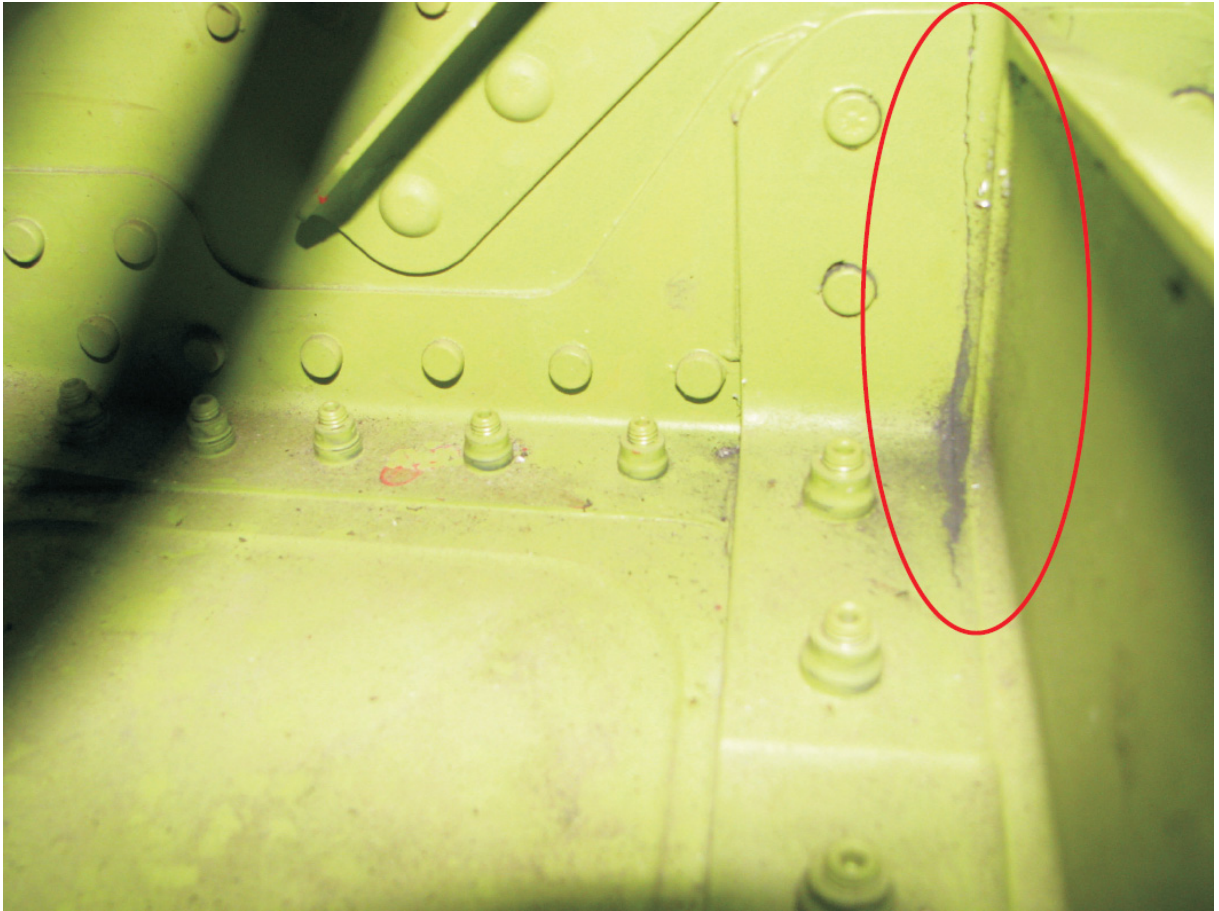


Photo 2: Left wing, incipient cracks at the support fitting flange at the connection to rib 7

Photo: BFU

This investigation was conducted in accordance with the regulation (EU) No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and the Federal German Law relating to the investigation of accidents and incidents associated with the operation of civil aircraft (*Flugunfall-Untersuchungs-Gesetz - FIUUG*) of 26 August 1998.

The sole objective of the investigation is to prevent future accidents and incidents. The investigation does not seek to ascertain blame or apportion legal liability for any claims that may arise.

This document is a translation of the German Investigation Report. Although every effort was made for the translation to be accurate, in the event of any discrepancies the original German document is the authentic version.

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