

Interim Report

Identification

Type of Occurrence:	Serious incident
Date:	3 September 2012
Location:	Cologne Airport
Aircraft:	Airplane
Manufacturer / Model:	Boeing 737-800
Injuries to Persons:	11 persons with minor injuries
Damage:	None
Other Damage:	None
Information Source:	Investigation by BFU
State File Number:	BFU 5X007-12
Published:	November 2012

Factual Information

On the flight from Hanover to Cologne, smoke developed in cockpit and cabin after the landing in Cologne. The aircraft taxied to the scheduled stand and the passengers disembarked via the stairs. Eleven passengers with minor injuries received medical treatment.

History of the Flight

The following description of the course of events is based on the Flight Data Recorder (FDR) read-out, the Cockpit Voice Recorder (CVR) read-out and the aircraft and maintenance documentation and is supported by various witness' statements.

At 1139 hrs¹ on the day of the occurrence the aircraft took off from Hanover (HAJ) to a domestic flight to Cologne (CGN) with a later leg to Gaziantep, Turkey (GZT). In Cologne the crew was supposed to change. According to the Loadsheets and the Journey Log entry there were 196 passengers (186 adults and 10 children) and six crew members on board. The senior cabin crew member stated that during climb she had noticed some smell development in the cabin and had informed the commander accordingly. The flight was continued in Flight Level (FL) 200 cleared as cruising altitude. The commander described the flight as free of incidents.

During touch-down the senior cabin crew member noticed increased smoke development at one of the over-wing emergency exits. However, it was difficult for her to differentiate between smoke, steam and fog. She described the smell as acrid and foul, among others, which "had hit her lungs".

The commander conducted the flight as Pilot Flying (PF). The landing in Cologne occurred at 1209 hrs after a flight time of 30 minutes on runway 24 with flaps set to 40°. The commander described the touch-down as "slightly positive". The FDR had recorded a vertical acceleration of 1.4 g at the time of touch-down. Nine seconds after touch-down - at approximately 100 kt - the commander noticed black smoke entering the cockpit via the fresh air intakes and turned both air-conditioning packs off. Subsequently, he noticed a decrease in smoke. The co-pilot noticed the beginning "greyish" smoke development after touch-down and the decrease after the air-conditioning packs had been shut off. Both air-conditioning packs were shut off 47 seconds after touch-down. During taxiing the co-pilot opened the cockpit window on his side so that the remaining smoke or gas, respectively, could leave the cockpit.

In the cabin, the senior cabin crew member experienced arising "extreme unrest" among the passengers some of which got up and were "shouting". Above the seats A - C in row 13 the panels for the oxygen masks were pounded open so that the masks fell out. The senior cabin crew member informed the commander about the smoke and the further events in the cabin. She reported she had made several announcements to reassure the passengers. According to her memory, later the smoke began to decrease but a "sharp" odour remained. After the landing, air traffic control instructed to leave the runway via taxiway Bravo, to cross runway

¹ All times local, unless otherwise stated.

32L and continue taxiing via taxiways Bravo and Mike to stand D9. The commander stated that he decided to taxi to the instructed stand D9 and let the passengers disembark via the stairs due to the information by the senior cabin crew member that smoke had developed which had begun to decrease already. At 1212 hrs the right-hand air-conditioning pack was re-started. 46 seconds afterwards the left-hand air-conditioning pack was re-started as well. At 1215 hrs the airplane reached stand D9. Once the airplane had reached the stand the stairs were backed against the airplane. According to the commander's perception, the passengers did not disembark in a controlled fashion because they were upset and the aggressive potential was quite high. According to the senior cabin crew member's memory, quite a few passengers had been emotionally stressed and had partly been very aggressive.

Eleven passengers were taken to local hospitals. The next day all eleven passengers continued the flight to Gaziantep.

Personnel Information

Commander

The 30-year-old commander is an Italian citizen and held an Airline Transport Pilot's License (ATPL(A)) issued by the Federal Office of Civil Aviation (FOCA), Switzerland, in accordance with Part-FCL. Initially, the license was issued in Great Britain on 16 February 2001. The type ratings for B737 300-900 and the instrument rating entered in the license were valid until 30 April 2013. The commander had a total flying experience of 7,420 hours; 4,322 hours of which were on the Boeing 737.

Co-pilot

The 26-year-old co-pilot is a German citizen and held a Commercial Pilot's License (CPL(A)) issued by the Luftfahrt-Bundesamt (German civil aviation authority, LBA) in accordance with JAR-FCL and valid until 4 January 2014. The license was initially issued in Germany on 4 January 2010. The co-pilot had a total flying experience of 485 hours; 322 hours of which were on Boeing 737. The type rating for the B737 300-900 as co-pilot and the instrument rating were valid until 31 October 2012.

Aircraft Information

The Boeing 737-800 is a twin-engine transport aircraft with a maximum take-off mass of 79,015 kg. According to the Flight Crew Operation Manual (FCOM) the maximum landing mass is 66,360 kg. The airplane is powered by two CFM56-7B26 jet engines.

The airplane in question was manufactured in 1998 and had the manufacturer's serial number 28218. Total Airframe Time (TAT) since production was approximately 45,462 hours and 15,837 flights.

The hold item list aboard the airplane did not show any entries. The last Airworthiness Review Certificate was issued on 4 May 2012 and valid until 3 May 2013.

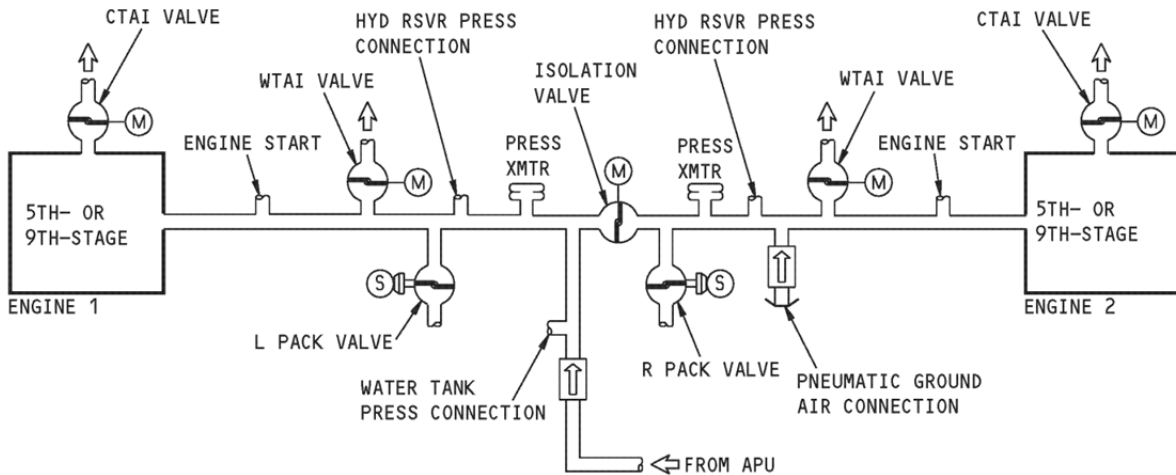
Pneumatic System

The Aircraft Maintenance Manual (AMM) describes the pneumatic system as follows:

The pneumatic system provides compressed air for the airplane. The system receives the pressurized air from the bleed air systems of the engines and the Auxiliary Power Unit (APU) or the pneumatic ground air connection. The engine bleed air systems provide air with a pressure of nominally 42 psi (2.9 bar) and a temperature of not more than 232°C.

The different source air is transferred to the manifold and from there distributed to the various users. Valves in the pneumatic manifold control the air flow into the manifold, isolate the left and the right side of the system and control the air flow to the users.

The pneumatic system supplies the engine start systems, air-conditioning and pressurisation systems, different anti-ice systems, the water tank pressurisation system and the hydraulic reservoir pressurisation system with compressed air.



Pneumatic Distribution System (schematic)

Source: 737-600/700/800/900 AMM, adapted by the BFU

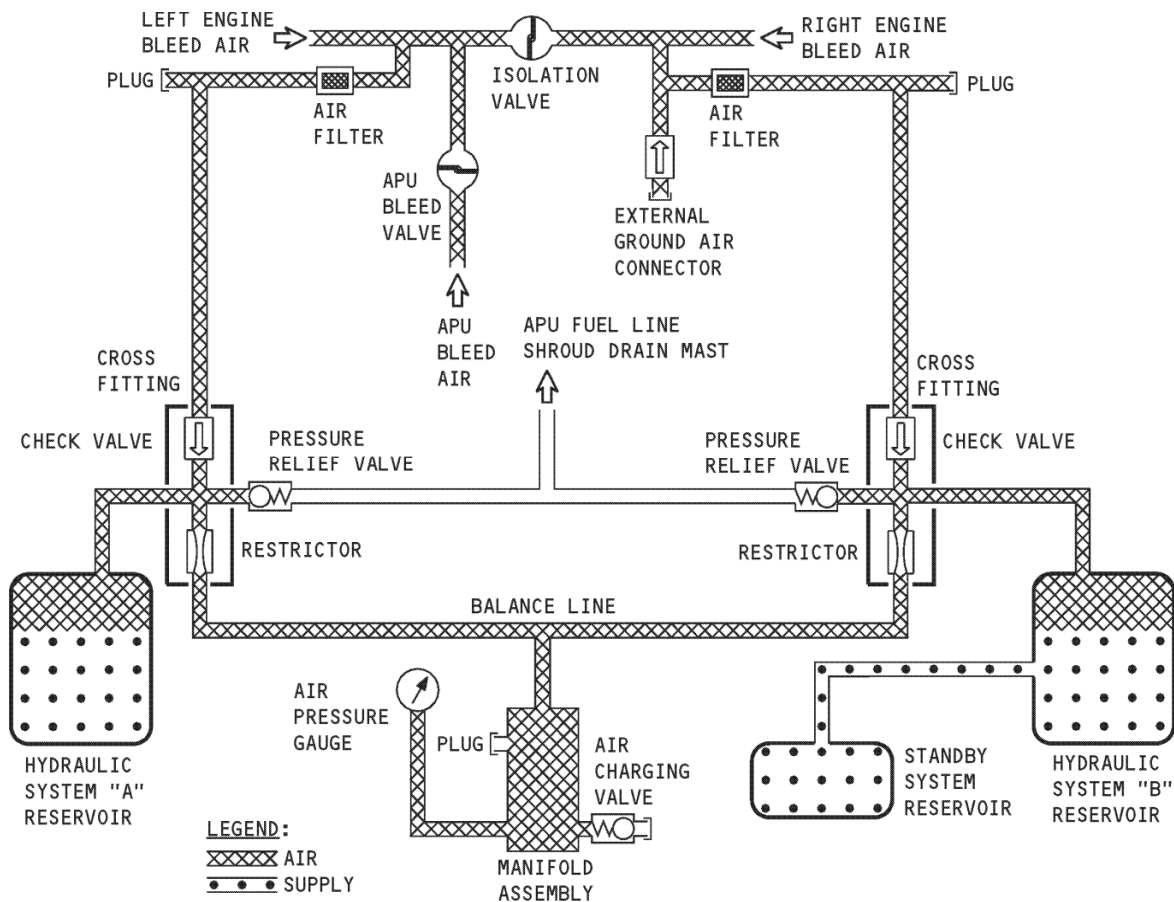
Hydraulic Reservoir Pressurization System

The AMM describes the hydraulic reservoir pressurisation as follows:

The hydraulic reservoir pressurisation system supplies the two hydraulic reservoir systems (A and B) with filtered air from the aircraft pneumatic system.

The reservoirs can also be charged directly with pressure by means of a separate connector; for this process the pneumatic system of the airplane does not have to be activated.

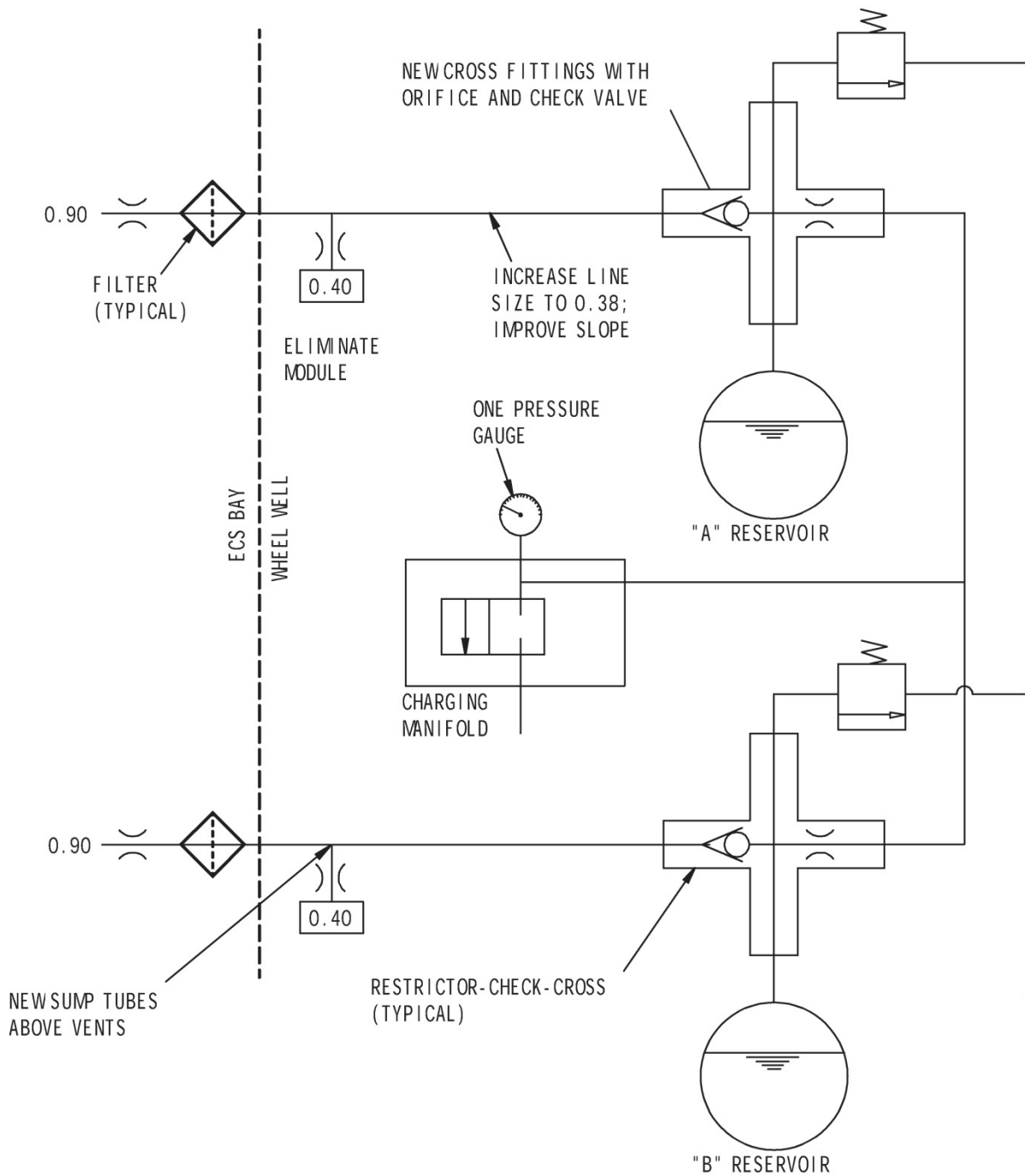
The system provides a positive supply of hydraulic fluid to the pumps, maintains normal return pressure in the hydraulic system and also helps to prevent foaming in the reservoirs. A constant pressure of approximately 45-50 psi (3.1 to 3.4 bar) is normally supplied to the reservoirs by the pneumatic system. Pressure control valves, which open between 60 and 65 psi (4.1 to 4.5 bar), protect the reservoirs from excess pressure.



Schematic depiction of the hydraulic reservoir pressurization systems

Source: 737-600/700/800/900 AMM

On 23 December 2002 the aircraft manufacturer in his function as design organisation issued a Service Bulletin (SB) regarding the modification of the system. The modification shall prevent loss of pressure due to freezing water within the system during long and in great altitudes conducted flights. The operator stated that the Service Bulletin, Revision 1 of 15 May 2003 had been implemented in the aircraft involved.



Schematic depiction of the hydraulic reservoir pressurization systems

Source: Boeing SB737-29-1106 Rev 1

The Boeing Customer Support issued a Maintenance Tip on 28 June 2004 which was revised on 28 June 2012 (737 MT 12-002) which advises that at a filling level of more than 100% in one of the hydraulic reservoirs hydraulic fluid can penetrate the pneumatic system

and reach the air-conditioning. Hence, Boeing recommends filling the hydraulic reservoirs to not more than 92%.

Maintenance

The operator submitted documentation which shows that in the night of 2 September to 3 September 2012 various scheduled and regular recurrent maintenance work was conducted. In addition, the starter of the left engine was replaced due to an internal leak. At 0230 hrs after the work was completed, the maintenance personnel released the airplane for service.

According to the Journey Log the last Technical Pre-flight / 72-hrs Release Check was conducted on 3 September 2012 and the aircraft released for service at 0330 hrs. This check includes the inspection of the filling level of the hydraulic reservoirs, among other things.

Preceding Events

On 3 September 2012 a direct flight from Hanover to Gaziantep, departure at 0420 hrs, was planned. At about 0435 hrs engine start-up occurred during push-back from the stand. After the air-conditioning packs had been switched on the cockpit crew noticed smell development. The commander noticed slight fumes which seemed to emanate from the fresh air ducts. The co-pilot noticed "acrid smelling white smoke". In his estimation, the opening of the cockpit's side window was necessary to have proper vision.

The senior cabin crew member noticed an "extreme smell" after the first engine had been started. Immediately afterwards the cockpit crew had informed her about the smoke in the cockpit. Due to the smoke development in the cockpit the airplane was taxied back to the stand.

According to witness' statements an engine ground run, which produced "residual smell" but was otherwise normal, was conducted at the stand.

At about 0512 hrs the airplane took off from Hanover Airport for the flight to Gaziantep. The senior cabin crew member noticed another smell development after take-off. She described the smell as "acrid and caustic and smelling of lacquer and oil", among other things. In the cockpit strong smell and slight smoke development were noticed again also and it was decided to return to the aerodrome of departure.

The commander stated, prior to the landing they wanted to burn some more fuel to reduce the landing mass. That is why at 0524 hrs the landing gear was extended again. At about 0559 hrs the aircraft landed again in Hanover.

According to the Journey Log the maintenance personnel of the operator conducted the trouble shooting in compliance with the actions 21-00-806 described in the Fault Isolation Manual for smoke and smell of unknown origin. Causes could not be determined. Afterwards, task 21-00-01-100-801 (oil contamination removal from air conditioning) described in the Aircraft Maintenance Manual was conducted. At about 0828 hrs a ground run was performed with both engines running for approximately one minute at N1 70%. There were no irregularities and the aircraft was released to service.

Meteorological Information

At the time of the occurrence the following aviation routine weather report (METAR) was valid:

METAR EDDK 030750Z 15003KT 9999 SCT028 BKN031 14/13 Q1025 NOSIG

In plain language:

Report of the 3rd day of the month at 07:50 UTC (0950 hrs local time), slight wind from 150° (south-east) with 3 kt, visibility 10 km or more, broken clouds in 2,800 above aerodrome elevation, temperature 14°C, dewpoint 13°C, QNH (mean sea level pressure) 1,025 hPa.

Aerodrome Information

Runway 24 of Cologne/Bonn Airport is oriented to the south-west and has a length of 2,459 m and a width of 45 m. The following graph shows the taxi routeing of the airplane.

Flight Recorder

The memories of the Cockpit Voice Recorder (CVR) and the Flight Data Recorder (FDR) were read out at the BFU in Braunschweig.

Cockpit Voice Recorder

Manufacturer: L-3COM
Model: FA 2100
P/N: 2100-1020-00
S/N: 494474
Medium: Solid State
State of the recorder: No damages (visual inspection)

Read-out equipment: Portable Interface PI, OEM for Fairchild Modell FA2100
Analysis equipment: PC Software "VEGAS"

Recording configuration: 2 hours, 4 channels

Recording quality: Good

Contents:

2 hours: Channel 1: CM 1
Channel 2: CM 2
Channel 3: Area
Channel 4: Spare

Flight Data Recorder

Manufacturer: Honeywell
Model: SSFDR
P/N: 980-4700-042
S/N: 3480
Medium: Solid State
State of the recorder: No damages (visual inspection)

Recording length: Approximately 27 hours flight data

Parameter list: Dataframe B737-3A

The recording of the data began on 1 September 2012 at 0714:44 hrs aircraft time. The parameter HYD_QTY-A showed values of more than 100% during the entire recording time while the airplane was on the ground.

Additional data from the FDR memory relevant for the investigation was depicted in the report.

Findings on the Aircraft

At the day of the occurrence, technicians of the operator's maintenance organisation conducted an examination of the aircraft in the presence of BFU staff. The area of the left engine's high pressure turbine was inspected visually regarding outer oil leakages and with the help of a borescope of inner oil leakages. Extraordinary oil traces could not be found. The examination of the pneumatic manifold using the borescope showed contamination of the entire pipe circumference with hydraulic fluid. The contamination began inside the left pneumatic manifold in the area of the connector for the hydraulic reservoir pressurisation system and continued in flow direction along the pneumatic system. Inside the right side of the pneumatic manifold no contamination was found.



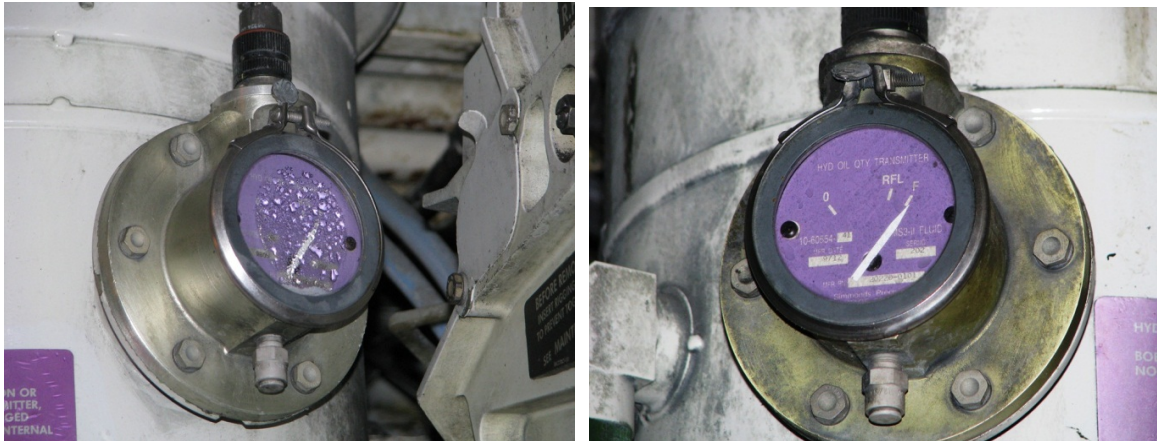
Oil-wetted surface inside the pneumatic manifolds

Photo: Operator

Serious amounts of hydraulic oil were found in the connecting pipe and the filter of the hydraulic reservoir pressurisation system of system A.

The filling level indicator of the hydraulic reservoir of system A was close to marking "F". Reading the exact position was not possible because the indication was fogged over from the inside.

The filling level indicator of the hydraulic reservoir of system B was approximately a half indicator width right of marking "F".



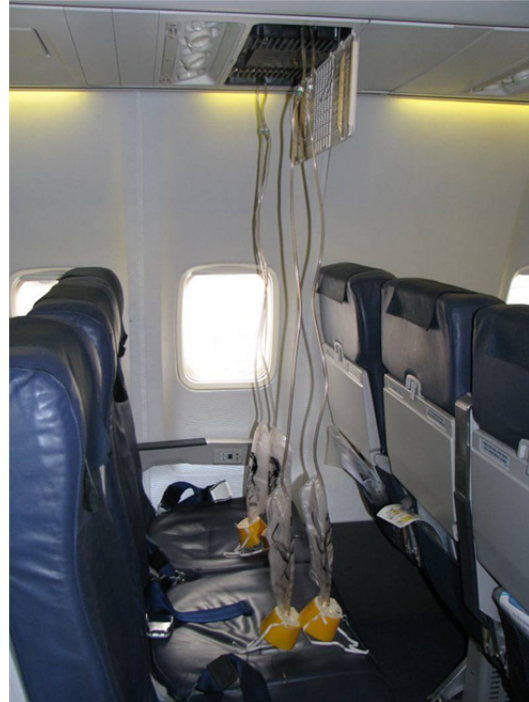
Filling level indication of the hydraulic reservoirs of systems A and B

Photos (2): BFU

In the cabin the panels for the oxygen masks above seats 13 A, B and C were open. The oxygen masks hung down. The control strip on the oxygen generator showed a dark colouring. The bags on the masks were flat. According to the maintenance personnel this indicates that the generator had been triggered but the masks had not been donned.



Oxygen masks in the cabin



Photos (2): BFU

Fire

With the exception of the smoke development described above there were no indications regarding a fire during the flight or on the ground.

Investigator in charge: Kostrzewa

Field Investigation: Kostrzewa, Just, Berndt

This investigation is 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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