FINAL REPORT

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In accordance with the provisions of S.I. 205 of 1997, the Chief Inspector of Accidents, on 3 June 1999 appointed Mr John Hughes as the Investigator-in-Charge to carry out a Field Investigation into this occurrence and prepare a Synoptic Report.

Aircraft Type and Registration:	B737-448, EI-BXI
No. and Type of Engines:	Two CFM 56 Turbofans
Aircraft Serial Number:	25052
Date of Manufacture:	April 1991
Date and Time (UTC):	3 June 1999 @ 05.45 hrs
Location:	Stand 34, Dublin Airport
Type of Flight:	Public Transport
Persons on Board:	Boarding in progress
Injuries:	Nil reported
Nature of Damage:	Nil
Commanders Licence:	ATPL
Commanders Flying Experience:	15,000 hours, of which 12,000 were on type.
Information Source:	Station Manager, ATC Dublin

SYNOPSIS

The Air Traffic Controller on duty saw smoke coming from the front of the aircraft on Stand 34 and alerted the Fire Services who responded. Flight 602 for Amsterdam was being boarded and most of the passengers had already taken their seats. The Captain ordered an immediate evacuation of the aircraft and this took place through the forward door, in an orderly way, under the guidance of the cabin staff. In the follow-up technical examination, it was found that metal braid on a hydraulic flexible pipe had caused a shorting of the electrical supply to the hydraulic pump. This shorting had also punctured the pipe causing the hydraulic fluid to escape.

FINAL REPORT

1. FACTUAL INFORMATION

1.1 History of the Flight

Flight 602 for Amsterdam was being boarded and between 114 and 119 passengers had already taken their seats. When the cockpit crew were performing their pre-flight actions, they were unable to pressurize the hydraulic "B" System electric pump. Assistance was provided by line maintenance to troubleshoot the system fault. During this process the ground fault protection circuit breaker (CB) was reset and when the pump was selected to "ON" and the pump pressurized, a cloud of smoke/vapour was observed passing the cockpit window. The pump was immediately selected to "Off". The Air Traffic Controller on duty saw smoke coming from the front of the aircraft on Stand 34 and alerted the Fire Services who responded. The Captain called the No.1 Cabin Crew Member (CCM) to the cockpit and told her that she might have to evacuate the passengers from the aircraft. The No.1 then informed the remaining members of the cabin crew who were beginning to smell heavy fumes in the cabin. Immediately after the No. 1 informed the CCMs in the rear of the aircraft of the possibility of an evacuation, the Captain came on to the public address (PA) and told the passengers to leave the aircraft as quickly as possible through the front door leading to the airbridge. Without hand baggage, all the passengers proceeded to leave the aircraft under the direction of the cabin staff. Two passengers became a little distressed but later recovered. There were no injuries reported. Most of the passengers went on to their destination in another aircraft.

1.2 Technical examination and rectification

In the follow-up technical examination, it was found that metal braid on a hydraulic flexible pipe had caused a chaffing of the insulation of the "C" phase wire of the electrical supply to the "B" Systems hydraulic pump. This pump is located in the right main wheel well **(**see photo, **Appendix A)**. As the insulation wore away in service, the wire became exposed. During this incident the voltage on the wire arced across to the metal braid, puncturing the hydraulic pipe and causing the hydraulic fluid to escape. This resulted in a large amount of smoke/vapour emanating from the wheel well.

The pressure line and the hydraulic pump were replaced. An operational and leak check were carried out and both found satisfactory. The aircraft was then released back to service.

During a transit inspection the next day a "burnt" odour was noticed and the aircraft was grounded for a more detailed inspection. This resulted in the replacement of one section of wiring and several units were placarded as suspect. All the items were sent to the aircraft manufacturer for analysis to test for evidence of heat damage. Tests carried out on the structure in the wheel well did not reveal any heat damage. The aircraft was then returned to service.

1.3 Personnel information

1.3.1 Crew Comments

The Captain said that she found it necessary to evacuate the aircraft due to hydraulic spillage on the ramp which posed a threat to the safety of the aircraft and its occupants. No.1 CCM went on the PA immediately and told the passengers to leave their hand baggage and go to the front of the aircraft. She continued to repeat this message all through the evacuation. Some of the passengers tried to take their bags with them. The other CCMs stood on seats at the overwing and aft exists of the aircraft urging passengers forward until all passengers had left the aircraft. The Fire Officer checked the cabin and gave the all clear for the passengers to re-enter the aircraft and retrieve their hand luggage There was no panic and many passengers complimented the CCMs on the way they handled the incident.

1.3.2 Witness Comments

The ground crew manager went to the aircraft when he was told that the flight crew were unable to pressurize the "B" Hydraulic system. Following a "quick look" around the pump in the main wheel well he went to the cockpit, gained access to the Ground Fault Protection CB and reset this CB. When the hydraulic pump was selected "on" there was a puff of greyish smoke/vapour passed the RH cockpit windows. The pump was then switched "OFF". He then ran from the cockpit to the wheel well, collecting a fire extinguisher en route. On arrival at the RH wheel well, hydraulic fluid was seen to be running out of the keel beam and spraying on to the back of the pump. The reservoir was then depressurised to stop the flow of fluid. There was a smell of burning and the area was full of vapour and hydraulic fluid. It was reported that the aircraft fire bell did sound but there was no evidence that the ground crew manager was made aware of this by the flight crew and no technical log entry was made by the flight crew.

The Operator's Redcap, who was at the RH wing, indicated to him that he thought he saw a flash coming from the aircraft. However, he did not recollect seeing any fire.

The Fire Services officer who raised the alarm stated that he was coming out of the terminal building when he saw a flame, followed by smoke, coming from the aircraft. He estimated that the flash was about 10 square feet and lasted for about 5 to 10 seconds. The Fire Service turnout was recorded at 05.53 hrs.

1.4 Fire

The mechanic who was performing the transit inspection also confirmed that there was a lot of smoke/vapour in the wheel well. A mechanic from an adjacent A321 approached with a fire extinguisher as he saw thick black smoke coming from the wheel well. The firemen had then arrived and use of the extinguisher was not required as there was then no evidence of flash or flame.

1.5 Tests and research

The aircraft manufacturer has issued several service letters on the subject of the possible chafing of the hydraulic hose against the electrical wiring of the B System pump (reference SL 737-24-50-B January 1989 first issue 1987 and SL B737-29-51 issued May 1991). As a result of these, a modification was issued to the Operators fleet in August 1991 requiring that the affected elbow from the acoustic filter be "clocked" at the appropriate angle as per the instructions contained in the B737 Maintenance Manual **(**see diagram, **Appendix A)**. SL B737-29-062 was also issued in April 1994 covering this area The instruction is contained in AMM 29-15-22 dated November 1998 (current issue).

The offending pump was changed during the "D" inspection in February 1999. The person who installed the pump at this time was asked if he was aware of the requirement to "clock" the fitting at a particular angle. He said he was not. However, due to the time lapse since the pump change he could not particularly remember very much about it.

As the pump change was already in progress immediately following this incident, an exact measurement of the clock angle was never made although the engineer felt there was approximately ¼ inch between the hose and the wires prior to disturbance.

1.6 Organizational and management information.

After this incident the following actions were immediately carried out by the Maintenance Organisation:

- An immediate fleet inspection of "clock" position.
- A test on the ground fault protection system of EI-BXI.
- Notification to other customers for whom maintenance on their B737 hydraulic B Systems had been accomplished, to request them to inspect the clock position of the acoustic filter elbow.

1.7 Additional information

The aircraft hydraulic fluid used was Skydrol 500B-4 which has a flash point of 160ºC. The flash point of a fluid is the temperature at which vapour given off will ignite when an external flame is applied under test conditions.

2. ANALYSIS

Hydraulic fluid would not normally be inflammable in liquid form. The auto-ignition temperature is given as 398ºC. However, this fluid was under pressure and escaped from the pipe in the form of an oil spray such that the product could easily have vaporised. This fluid emitting at pressure through the ruptured pipe appears to have ignited causing a flash over of the vapour for approximately 5 seconds. It is likely that the CB protection activated at that point, the arcing ceased, the hydraulic pressure reduced and consequently the flash could no longer be sustained. Both the flight crew and the cabin crew of this aircraft reacted very positively and did an exceptionally good job. This was reflected in the passengers compliments.

3. CONCLUSIONS

3.1 Findings

The distance between the hydraulic pressure hose and the electrical cable was insufficient to ensure safety.

3.2 Causes

An electrical short between the supply to the "B" System hydraulic pump and the metal braid on the flexible hydraulic pipe caused that pressure line to burst.

4. SAFETY RECOMMENDATIONS

4.1 The Maintenance Organisation should instruct their staff to always ensure reference to the current issue of the fitting instruction when completing a specific task**. (SR No. 7 of 2004)**

In July 1999 the Maintenance Organisation issued a Quality Advisory Notice to staff informing them of the requirement to refer to the Aircraft Maintenance Manual Chapter 29-15-17 and 29-15-22 when fitting an hydraulic pump or acoustic filter to this aircraft type.

In July 2000 the IAA issued an Aeronautical Notice A61 requiring that Operators of Irish Registered B737 series aircraft carry out a once off inspection within 60 days and thereafter at each subsequent "C" checks or every 18 months (whichever comes first)

APPENDIX A

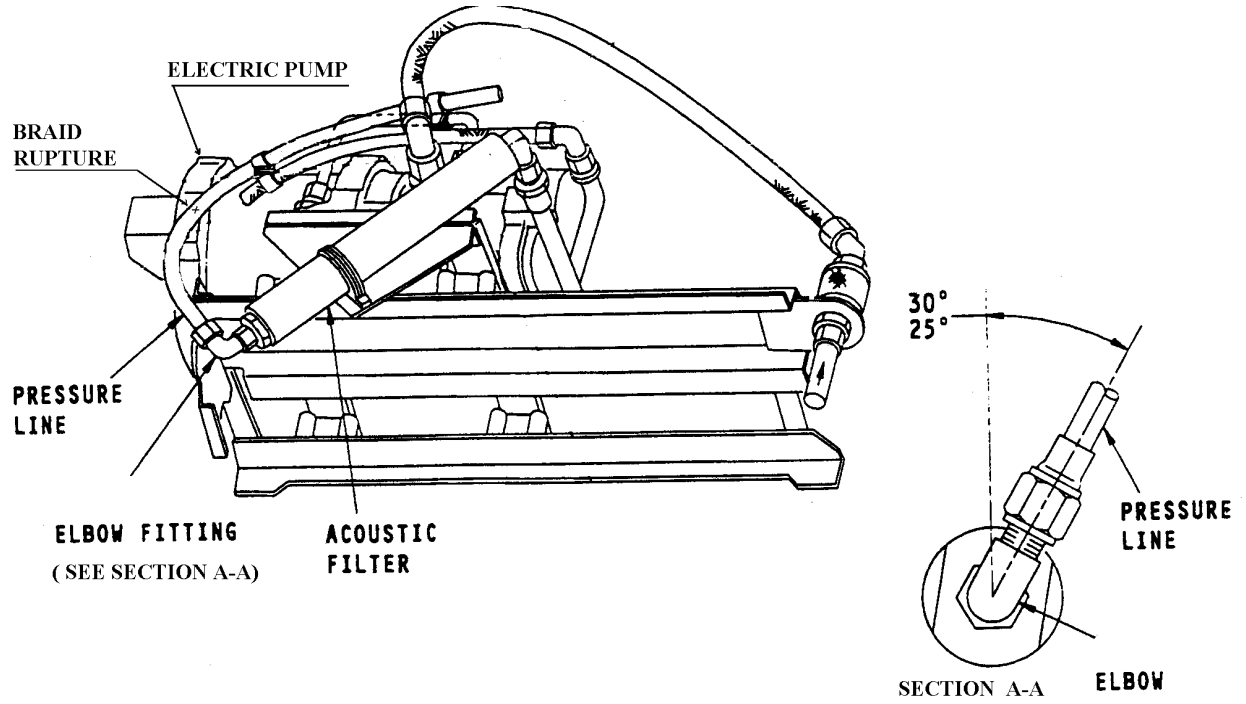
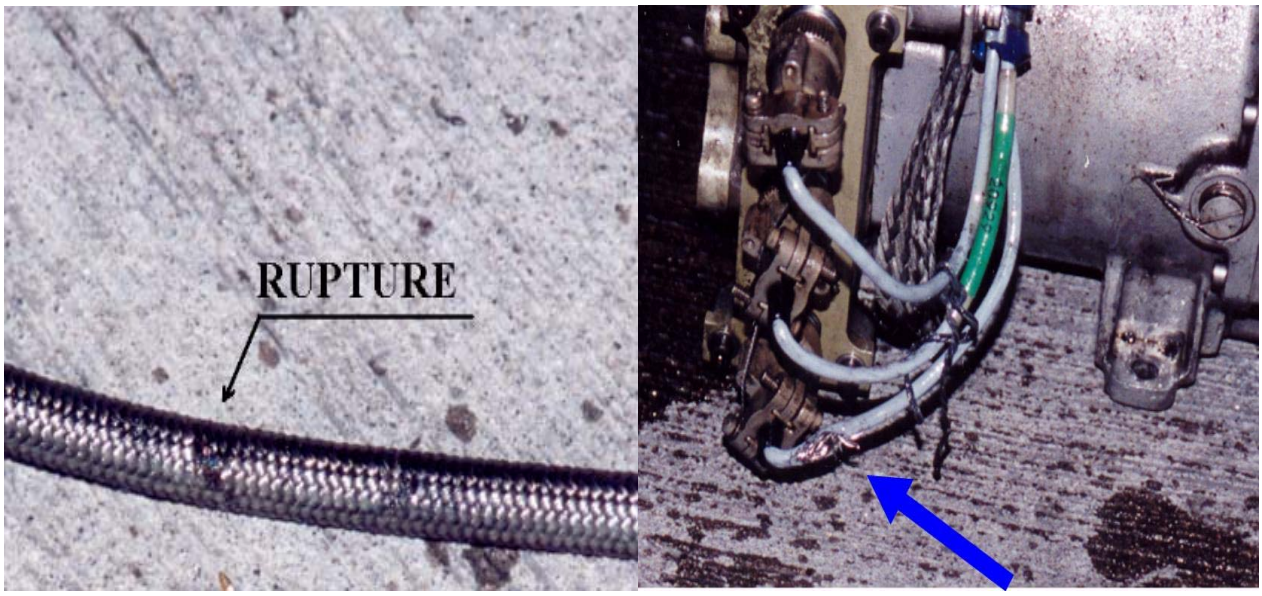


Diagram from the Maintenance Manual showing correct "clocking" of the pressure line when fitting the hydraulic pump to the aircraft.



Left photo, showing part of the ruptured flexible pressure hose which chaffed the insulation of phase "C" supply to the electrical hydraulic pump. The arrow at right indicates the resulting damage to this insulation.