

# Investigation Report

## Identification

Type of Occurrence:	Serious incident
Date:	15 August 2011
Location:	Düsseldorf
Aircraft:	Airplane
Manufacturer / Model:	Airbus Industrie / A330-322
Injuries to Persons:	None
Damage:	Minor damage to aircraft
Other Damage:	None
Information Source:	Investigation by BFU
State File Number:	BFU 5X007-11

## Factual Information

### History of the Flight

At 1232 hrs<sup>1</sup> the aircraft took off from Düsseldorf Airport with 11 crew members and 383 passengers aboard.

Shortly after take-off the cabin crew member sitting next to door R2 heard a bang. The area around the work lamp installed in the door became black, it started to smoulder and flames became visible. The cabin crew member reported her observa-

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<sup>1</sup> All times local, unless otherwise stated.

tion via intercom to the senior cabin crew member. The senior cabin crew member instructed the cabin crew members seated in positions 1L and 1R to go to door R2 to help the cabin crew member fight the fire and reported the incident to the cockpit crew.

The cabin crew members sprayed Halon from a fire extinguisher onto the lamp and behind the door panel through existing openings. Afterwards no open flames could be determined. There was still smoke coming from the door panel, however.

After the cockpit crew had been informed they declared emergency and returned to the aerodrome of departure. The airplane landed there safely after a total of 13 minutes flight time.

A330-300



Cabin Layout Airbus A330

Source: Operator

## Aircraft Information

The Airbus A330-322 is a transport aircraft with a maximum take-off mass of 217 t. It was manufactured in 1996 and had the manufacturer's serial number 127. The airplane is equipped with two Pratt & Whitney PW4168 jet engines.

At the time of the incident total aircraft time was 58,214 hours and 16,168 cycles.

The last C-check was conducted on 1 December 2010 at 56,119 flight hours and 15,396 cycles. Since then no scheduled or unscheduled maintenance work or inspections were conducted on door R2 during which panels, seals or inspection lids were opened.

A work light (P/N 2LA006482-05) for the cabin crew members was installed in door 2R. The work light was fitted with a 10 watt halogen bulb designed for an operational voltage of 6 V. The work light was supplied with alternating voltage of 115 V with 400 Hz. In order to supply the halogen bulb with the necessary voltage a power unit (P/N 8ES004692-10) was installed. In order to prevent environmental influence, the circuit board of the power unit was covered on both sides with a coating material. In addition, the component side had a plastic cover.

The aircraft manufacturer in the function as design organisation described the power unit in more detail in a so-called Technical Answer Offer (No 3325 M1E0001 01). Chapter 2.4 Material and Production Process of this specification stipulated that the material used has to be ageing resistant. Chapter 2.5 Environmental Conditions stipulated that the components have to meet the RTCA/DO-160C requirements. The test to determine whether the equipment can withstand the effects of rain, condensation and sprayed water shall be conducted in accordance with the requirements for Category W equipment. In addition, the power unit shall meet the general technical requirements of the aircraft manufacturer. These requirements were described in document ABD 0007, Issue F.

The specification for the power unit did not stipulate a certain fitting position. The installation into the door of the Airbus A 330-332 was such that the circuit board was tipped by 45° and the connectors pointed downward. The cover cap was on the upper surface.

The Final Qualification Test Report of the component manufacturer for the power unit of 21 September 1992 had the No M004692-10. In the introduction the manufacturer referred to a power unit which had already been certified: P/N 8ES 004 692-00. Since the power unit was based on this almost all tests were already covered by this older

version. The drip proof was conducted as supplementary test based on Procedure M 004 692-00 and the result (no irregularities) documented in the protocol of 15 February 1993. The protocol did not contain any information in which fitting position the test was conducted. The BFU did not have the Procedure M 004 692-00.

The certification of the power unit occurred during the type certification of the A330/A340 and in the responsibility of the aircraft manufacturer in the function as design organisation.

Door R2, in which the work light was installed, is opened almost always whenever the airplane is on the ground since it is used as a service door. The door is pushed outward when it is opened and all sides are exposed to the weather. The examination of an aircraft of the same type showed that the upper side of the door has openings through which water can flow unhindered into the door. Between the door structure and the inner lining there are no seals which would prevent the water from penetrating. When the door panel of this airplane was removed it was determined that the insulation mats had partially collected substantial amounts of water.



Open door R2



Source: BFU

On 26 September 2000 the power unit manufacturer published the Service Information Letter (SIL) No 8ES004692-33-001. It stated that water could reduce the insulation resistance on the circuit board. To prevent this, the production process had been improved. The replacement of affected parts was offered free of charge.

On 8 February 2005 a revision of the SIL was published. It advised of the once again modified production process and recommended replacement of all units produced before July 2002.

On 21 February 2005 the aircraft manufacturer sent an Operator Information Telex (OIT) to all A330/340 operators. It advised that due to water penetration and condensation in the doors, the power unit could fail and a burnt smell might occur. It was reported that wet insulation mats surrounding the power units had been found. The aircraft manufacturer referred to the SIL of the component manufacturer and recommended the replacement of the power unit.

The component manufacturer stated that from the beginning of the production until 2011 about 10,700 power units had been delivered. About 3,400 of which had been produced before the production standard valid at the time of the occurrence had been implemented. About 400 power units were replaced since the SILs were published.

The aircraft manufacturer stated that until August 2011, 1,288 A330/340 airplanes were delivered. Depending on the specifications of the customer each airplane was equipped with four to eleven lamps. 517 airplanes were delivered prior to the implementation of the modified power unit. The aircraft manufacturer stated they had received reports of eight power unit failures so far and in neither of these cases a modified power unit had been affected. The aircraft manufacturer further stated this case was the first where fire occurred.

## Findings on the Aircraft

After the landing the interior panel of door 2R showed slight scorch marks in the area of the work light. After the lamp unit (P/N F925-90046-012-00-C) was removed it was determined that especially in the area of the power unit (P/N 8ES004692-10) heavy fire and heat traces were visible. The interior of the door showed fire and scorch marks on the insulation and the structure once the panel was removed.





Fire area on door R2 after the panelling was removed

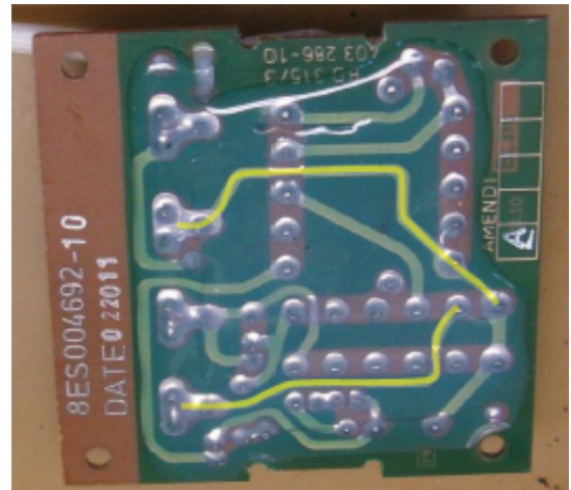
Photo: Operator



Lamp unit with fire and heat traces

Photo: BFU

The lamp unit was examined in the BFU laboratory. The circuit board of the power unit showed signs of high current flow along two circuit paths. These circuit paths were directly connected with 115 VAC/400 Hz and AC Return/GND.



Comparison of damaged and new power unit

Photos (2): BFU

## Fire

The fire in the area of the work light of door 2R was limited to a few square decimetres.

The cabin crew members used a fire extinguisher (P/N BA21741GSR-2) to fight the fire. The fire extinguisher was filled with 1.2 kg BCF (Halon 1211).



Fire extinguisher (example)

Photo: CMM

## Additional Information

### RTCA/DO-160C

Document DO-160C of the Radio Technical Commission for Aeronautics (RTCA) defined a series of environmental conditions and test procedures for airborne equipment.

Section 1.0, Purpose and Applicability, states: *The selection of the appropriate and/or additional environmental conditions and test procedures is the responsibility of the writers (authors) of the performance standards for the specific airborne equipment.*

Section 10 Waterproofness, Subsection 10.2 Equipment Categories stipulates: Equipment which is subject to falling water (generally the result of condensation) in the course of normal aircraft operations is identified as Category W. For such equipment the drip proof test procedure applies. Subsection 10.3.1 described the drip proof test as follows: *Mount the equipment according to the manufacturer's specifications with all connectors and fittings engaged. With the equipment operating, subject it to water falling at a uniform rate from a height of approximately one meter for a minimum of 15 minutes. The test equipment shall emit a volume of water greater than 280 l/m<sup>2</sup>h dripping from a dispenser with 0.33 mm drip holes on a 25 mm pattern. At the conclusion of the test, determine that no water has penetrated to the in-*



*side of the equipment and determine compliance with applicable equipment performance standards.*

The stipulated amount of water of 280l/m<sup>2</sup>h means that in 15 minutes 0.25 l water must drip on the surface of the power unit with a size of 6 x 6 cm.

#### ABD0007, Issue F

In document ABD0007, Issue F the aircraft manufacturer (in the function as design organisation) stipulated the general technical requirements of equipment. Chapter 3-5.1 stated that water would not be expected to accumulate in appreciable quantities on equipment in the air conditioned zones of the aircraft. Category W equipment shall be tested for their resistance toward condensation from cold surfaces.

#### Preceding Events

In January 2005 there was smoke development aboard an Airbus A340 in the area of the work light which was installed in a door. The smoke development ended after five minutes. The airplane returned and landed safely. The investigation on the ground conducted by technicians determined that the insulation mats in the vicinity of the lamp were very wet. The photo below shows that the insulation material of the door was partially pyrolyzed.



Traces behind the door panelling (overview and detail)

Photos (2): Operator

## Analysis

### Flight operations

The BFU is of the opinion that the speedy and target-oriented communication among the crew, the quick decision of the cockpit crew to land immediately and the fire-fighting action of the cabin crew were professional.

### Fire

The traces of high current flow on the circuit board of the power unit, the heat and fire traces on the lamp unit and on the insulation and the door panelling allow the conclusion that the short circuit in the power unit caused a fire which spread to the surrounding area. The fire was limited to a few square decimetres. The BFU is of the opinion that it cannot be determined conclusively if this was owed to the properties of the material used or the immediate use of the fire extinguisher. It is doubtful, however, that enough extinguishing agent could penetrate through the available openings to extinguish the fire. This is even more important because the fire extinguisher was

not equipped with a hose allowing the extinguishing agent to be fully brought behind the panelling. It is likely that the fire would not have propagated and had gone out even if the crew had not intervened.

The BFU is of the opinion that the short circuit was definitely caused by water ingress in combination with a power unit coating insufficient for this particular environment since

- the manufacturer had already determined that penetrating water can reduce the insulation resistance of the circuit board,
- the structurally reinforced door area in an aircraft cabin has the tendency for increased condensation,
- the door which was not sealed against rain had been opened on a regular basis,
- in the insulation of other airplane doors water was found.

### Design, Certification and Airworthiness of the Power Unit

The tests conducted during the certification process show that the power unit is basically suited to meet the TRCA/DO160C Category W requirements to withstand the effects of rain, condensation and sprayed water. The failures of some units during subsequent operation show, however, that a sufficient protection of the circuit board was not always given. The manufacturer had determined this and had developed a technical remedy and implemented it into the production process.

The BFU is of the opinion that the estimation of the environmental conditions and the resulting classification of the power unit as Category W equipment in accordance with RTCA/DO-160C were not appropriate.

Furthermore, it could not be determined whether the fitting position during the test and the actual fitting position matched.

The BFU is of the opinion that the OIT the aircraft manufacturer had published was insufficient. During the occurrence aboard the Airbus A340 in January 2005 a fire had occurred as the pyrolysis of the insulation including smoke development shows. The Operator Information Telex (OIT) only mentioned the possible failure of the power unit and smell of burning. It did not indicate that in addition to the simple failure of the power unit a fire and subsequent smoke and heat development may occur. Thereby important information was withheld from the airplane operators which would have illustrated the urgency to replace the power units.

## Conclusions

Due to the climatic conditions in the door area condensation developed. Furthermore, whenever the door was open water could penetrate from the outside.

The water reached the power unit.

The BFU is of the opinion that the classification of the power unit as category W equipment in accordance with RTCA/DO-160C was not appropriate. The protection of the power unit against environmental conditions was sufficient in regard to the test procedures but not always in the real fitting situation.

In combination with the water the insulation resistance of the circuit board was reduced and resulted in a short circuit.

The energy set free by the short circuit resulted in fire.

The fire was noticed by the cabin crew which immediately initiated appropriate actions.

The fire was confined.

The BFU is of the opinion that to date the measures initiated by the manufacturer in the function as design organisation to remedy the known deficiency were insufficient to prevent in-flight fire.

Investigator in charge: Kostrzewa

Assistance: Berndt

Lampert

Braunschweig:

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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