

# Investigation Report

## Identification

Type of Occurrence:	Serious incident
Date:	6 March 2003
Location:	Near Sharja / United Arab Emirates
Aircraft:	Airplane
Manufacturer / Model:	Boeing B747-230B
Injuries to Persons:	None
Damage:	Minor damage to aircraft
Other Damage:	None
Information Source:	Investigation by BFU
State File Number:	BFU 6X001-03

## Factual Information

### History of the Flight

The cargo airplane Boeing 747-230B of a German operator took off at 1302 hrs<sup>1</sup> from Sharjah Airport, United Arab Emirates, for a flight to Frankfurt Main Airport. The pilot, the co-pilot and a flight engineer were aboard.

Shortly after reaching cruising altitude in Flight Level (FL) 310, the autopilot B, the autothrottle and the electrical power supply to the galley shut themselves off. The al-

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

timer No 2 changed to the stand-by mode. Simultaneously the following circuit breakers tripped:

- Galley Power Control
- Trailing Edge Flap Asymmetry & Fail
- Alternate Leading Edge Flap Drive No 1 to 4
- Alternate Inboard Trailing Edge Flap Drive
- Inboard Flap Control Position

The autopilot, the autothrottle and the altimeter No 2 could be switched on again. A reset of the triggered circuit breakers was not conducted.

In the cockpit a slight smell of burnt wires was noticed. In the galley of the main deck the flight engineer noticed a stronger electrical burnt smell. However, no indications of fire or smoke could be detected in the cargo compartment behind the galley when checking it through a window in the galley.

The crew checked the aircraft systems whereby no further failures besides the tripped circuit breakers were found. The crew decided to continue the flight as planned. About every 15 minutes the area of the galley was checked.

During the approach to Frankfurt Main Airport slats No 1 and 3 could not be deployed. The Trailing Edge Inboard Flap Indication remained in the retracted position even though the flaps were extended. The approach was conducted with an approach speed 25 kt higher than usual. At 1619 hrs the aircraft landed safely in Frankfurt.

## Personnel Information

The 60-year old Pilot in Command (PIC) held an Air Transport Pilot's License (ATPL(A1)) valid until 10 May 2003 extended by six months. He also held a Commercial Pilot's License (CPL(A)) and a Private Pilot's License (PPL), both valid until 30 November 2003. His total flying experience was 11,700 hours; 4,400 hours of which as PIC on B 747.

The 26-year old co-pilot held an Air Transport Pilot's License (ATPL(A2)) and a Commercial Pilot's License (CPL(A)), both valid until 30 April 2004. He also held a Private Pilot's License (PPL) valid until 30 April 2005. His total flying experience was 1,720 hours; 30 hours of which were on B 747-200.

The total flying experience of the flight engineer was 12,596; 2,607 hours of which were on the B 747.

## Aircraft Information

The B747-230B manufactured by Boeing Company with the manufacturer's serial number 23287, is equipped with four CF 6-1985 turbofan engines and was initially released for service in 1985. Maximum take-off weight was 377,842 kg.

The airplane had flown a total of 12,700 flights with 73,500 flight hours until the serious incident.

In 1992 an Israeli company reconstructed the passenger/cargo version into a cargo airplane. During the reconstruction the original dado vent boxes were replaced by bigger ones. These boxes enable air circulation between the main and lower deck. In case of a decompression in the lower deck flaps open in these boxes and enable an increased air flow.

In 2002, after 70,500 flight hours a D-Check was conducted in Singapore.

At the time of the serious incident, the Hold Item List (HIL) did not contain any open items.

The airplane was under Luftfahrt-Bundesamt (German civil aviation authority, LBA) approved continuing airworthiness review.

## Airport Information

Frankfurt Main Airport is located on 50°02' 00" northern latitude and 8°34'14" eastern longitude. The landing occurred on runway 25L. Runway distance available is 4,000 m and the runway is 60 m wide. Runway elevation is between 329 and 364 ft above mean sea level.

## Flight Recorders

The parameters recorded by the Flight Data Recorder (FDR) were read out and analysed by the BFU. The Cockpit Voice Recorder (CVR) was not read out.

### Flight Data Recorder

FDR manufacturer: L-3COM

Model: FA 2100

P/N: 2100-4043-00

Number of parameters: 61

## Wreckage and Impact Information

After the cargo had been unloaded in Frankfurt the wall panels in the lower cargo compartment were removed. The whole area of the oxygen bottles up to the main cargo deck showed partially scorched insulation. Further removal work showed an about 5 cm x 10 cm big hole in the aluminium structure of the dado vent box at station (STA) 780 close to the main cargo deck caused by fire. Two wire bundles running behind the dado vent box and the insulation in this area showed severe fire damage. Smoke and heat traces were found on parts of the pressurised fuselage structure. There were also smoke and heat traces behind the wall panels of the lower cargo compartment underneath the damaged dado vent box. In this area about one square metre of insulation was scorched.

The oxygen supply for the cockpit crew did not show any damage.

The wire bundles in question were supply lines for the upper galley (115 V, 3 phases, up to 150 kVA) and one with more than 80 cables for different systems, like flap and slat control, ice protection and cargo handling.

When the other dado boxes were checked it was found that in several cases the boxes chafe against the cables running behind them. Whereas the wire bundles were installed during the manufacture of the airplane in 1985, the dado vent boxes were installed during the reconstruction in 1992.

The aircraft manufacturer determined that the dado box in question was several inches wider than the original. In addition and contrary to the delivery status, the supply line for the galley was connected with the wire bundle for the flap control with a plastic cable tie. These practises to connect supply lines with other wire bundles did not comply with the manufacturer's Standard Design Practices.

## Additional Information

The aircraft belonged to a series of reconstructed passenger airplanes with the designation B 747-200SF (Special Freighter). The reconstruction was designed and carried out by Bedek Aviation Group, Israel.

At the time of the serious incident the German operator had two more aircraft of this series in operation. All three B 747-200SF were checked regarding the distance between the dado boxes and the wire bundles behind them and the wire bundles in question were extra insulated.

Bedeck Aviation Group as design organisation for the reconstruction issued on 2 April 2003 the following pre-emptive action:

- After a status check, where necessary, change of the wire bundle routing and/or additional installation of a wire bundle bracket
- Installation of additional chafing protection on all wire bundles in question
- Dado boxes behind which run wire bundles and which have contact with the wire bundles will have to be supplied with an opening in that area
- The Bedeck company has modified the Illustrated Parts Catalogue (IPC) in accordance with the determined findings and changes made.

## Analysis

The discovered smoke and heat traces and the damage indicate a cable fire with open flames; the flames themselves had gone out. The primary power supply of the upper galley was damaged which caused a short circuit. This caused the damage of a parallel running wire bundle and tripped several circuit breakers. As a result the flap indication was faulty as well as the function of parts of the slats. The crew could not deploy slats No 1 and 3 during the approach and therefore conducted a landing with increased approach speed.

The investigation showed that it is highly likely that the cable fire was caused by the chafing of one of the dado vent box's (STA 780) bolts with the wire bundle of the supply lines for the upper galley which run behind it.

The cable fire extended from the point of origin to a wider area of the lower cargo compartment; the oxygen supply for the cockpit was not damaged. The fire's extension was aided by air-conditioned air circulating through the dado vent boxes.

In 2002 a D-Check was conducted. It is to be assumed that all dado vent boxes were removed and the wire bundles loosened as is common during such checks. It is likely

that during the re-assembly of the dado vent box in question and the wire bundle running behind it, the necessary distance was not adhered to. That the aircraft had been in service for 10 years without any such incident prior to the D-Check suggests an error when re-assembling the dado vent box during the maintenance action.

Other modifications of the dado vent boxes after 2002 did not become known.

The connection of the electrical supply line for the galley to the wire bundle for flap control resulted in their partial failure. Since this connection did not conform with the manufacturer's Standard Design Practices it is likely that this type of fastening occurred during the D-Check.

There are no significant and provable facts suggesting other reasons which could have caused the cable fire.

## Conclusions

### Findings

Members of the flight crew were licensed and qualified for the flight in accordance with the existing legal requirements.

The maintenance records indicate that the aircraft was equipped and maintained in accordance with existing regulations and approved procedures.

There was no indication of a system failure prior to the serious incident.

The dado vent box at STA 780 was dis-assembled and re-assembled during a D-Check in 2002.

One of the bolts of the dado vent box had worked itself by chafing into a wire bundle for the power supply to the galley.

The power supply lines for the upper galley were scorched in the area of the cockpit oxygen supply in the lower cargo compartment. The oxygen supply itself was not damaged. A wire bundle with 80 cables for the galley power supply was severely damaged. The insulation behind the wall panels of the lower cargo compartment was partially scorched. The dado vent box at STA 780 showed a hole the size of the palm of a hand.

### Causes

The cause for the cable fire was an insufficient distance between the dado vent box at STA 780 and the wire bundle running behind it. The short circuit and cable fire

were caused by the continued chafing of a bolt of the dado vent box with a wire bundle for the power supply for the galley. The faulty re-assembly of the dado vent box in connection with the wire bundle running behind it probably occurred during a D-Check in Singapore in 2002.

The non-existent separation of supply lines with other lines caused the partial failure of the flaps.

The air circulation between the main and lower deck through the dado vent boxes probably aided the extension of the fire.

Investigator in charge: Kostrzewa

## Appendices

1. Damages to the upper cargo compartment
2. Damages to the lower cargo compartment

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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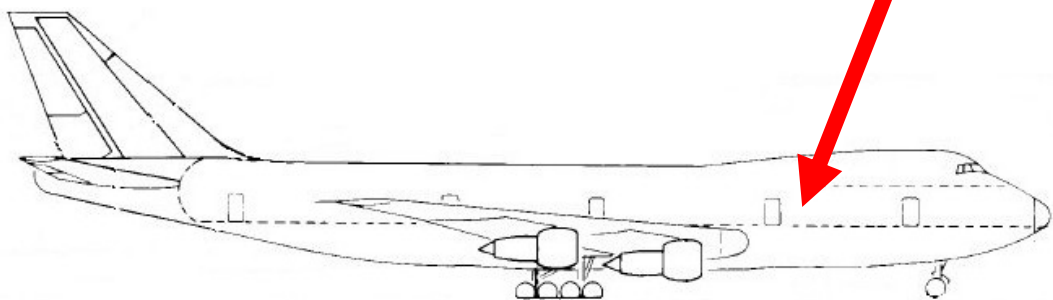
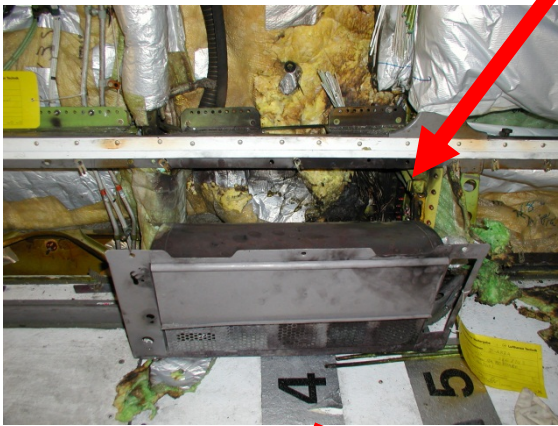
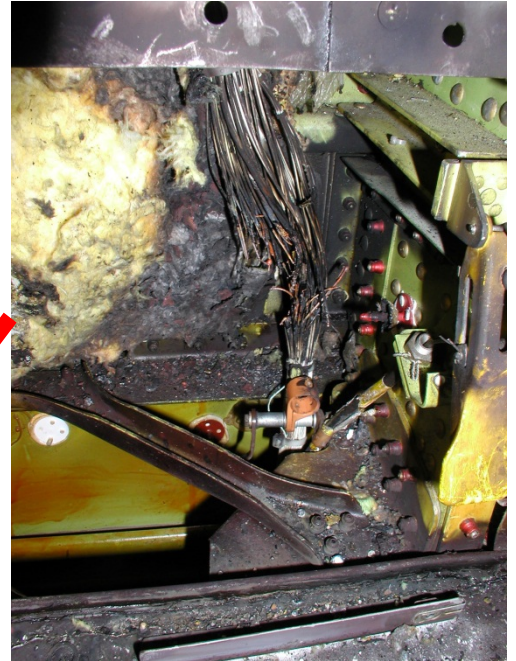
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Appendix 1: Damages to the upper cargo compartment



Appendix 2: Damages to the lower cargo compartment

