

REPORT ON SERIOUS INCIDENT

Smoke in cabin due to audio jack overheat

M-06008/AIG-19

**TF-FIV
Boeing 757-200
Icelandair
Over Ireland
September 18, 2008**



The aim of the aircraft accident investigation board is solely to identify mistakes and/or deficiencies capable of undermining flight safety, whether contributing factors or not to the accident in question, and to prevent further occurrences of similar cause(s). It is not up to the investigation authority to determine or divide blame or responsibility. This report shall not be used for purposes other than preventive ones. In accordance with law on aircraft accident investigation, No. 35/2004 and Annex 13 to the Convention on International Civil Aviation.

Factual information

| Location and time | |
|-------------------|----------------------|
| Location: | Enroute over Ireland |
| Date: | September 18, 2008 |

| Aircraft information | |
|--------------------------------------|----------------|
| Type: | Boeing 757-200 |
| Registration: | TF-FIV |
| Year of manufacture: | 2001 |
| Serial number | 30424 |
| Certificate of Airworthiness: | Valid |

| Other information | |
|---------------------------|--|
| Type of flight: | Passenger flight |
| Persons on board: | 120 |
| Injuries: | None |
| Short description: | Smoke in cabin due to an audio jack overheat |
| Owner: | NBB Saga Lease Co. Ltd |
| Operator: | Icelandair |

On September 18, 2008 TF-FIV, a Boeing 757-200 operated by Icelandair, was over Ireland, enroute from Barcelona Airport (LEBL) in Spain to Keflavik Airport (BIKF) Iceland, when a passenger complained that smoke was coming from the audio jack in the seat's armrest. The armrest was hot and there was smell of electrical burning. The Senior Cabin Attendant notified the Commander, who then switched off the In-Flight-Entertainment system (IFE). The armrest cooled down and the rest of the flight was without further incident. The aircraft landed as scheduled at Keflavik International Airport (BIKF) in Iceland a few hours later.

The incident was notified to the Icelandic Aircraft Accident Investigation Board (IAAIB), which initiated an investigation into the cause of the incident. The system components were examined and tested at the manufacturer's facilities in the United States under supervision of a representative from the National Transportation Safety Board (NTSB). No root cause was established during the examination. It was however established that a voltage source of less than 32VDC caused the audio jack to overheat. See Figure 1.



Figure 1: Audio jack in the September 18th, 2008, incident

It was concluded that the occurrence was a single event and the manufacturer was going to monitor any future faults of this kind. The IAAIB decided not to investigate the incident further.

Second incident

On June 15, 2009 a second incident occurred of the same nature during pushback of a Boeing 757 aircraft from the terminal building at Keflavik Airport (BIKF) in Iceland.

A passenger in seat 5F reported a smell of something burning and that the armrest of his seat was getting hot. When the audio jack was touched it was burning hot. The doors were opened again and a technician unplugged seat 5F from the IFE system.

After a second push-back a passenger in seat 5D called and reported the same problem. The aircraft was brought back to the gate where technicians unplugged the electricity to both seats. After that the armrest cooled down and the aircraft departed Keflavik. See Figure 2.

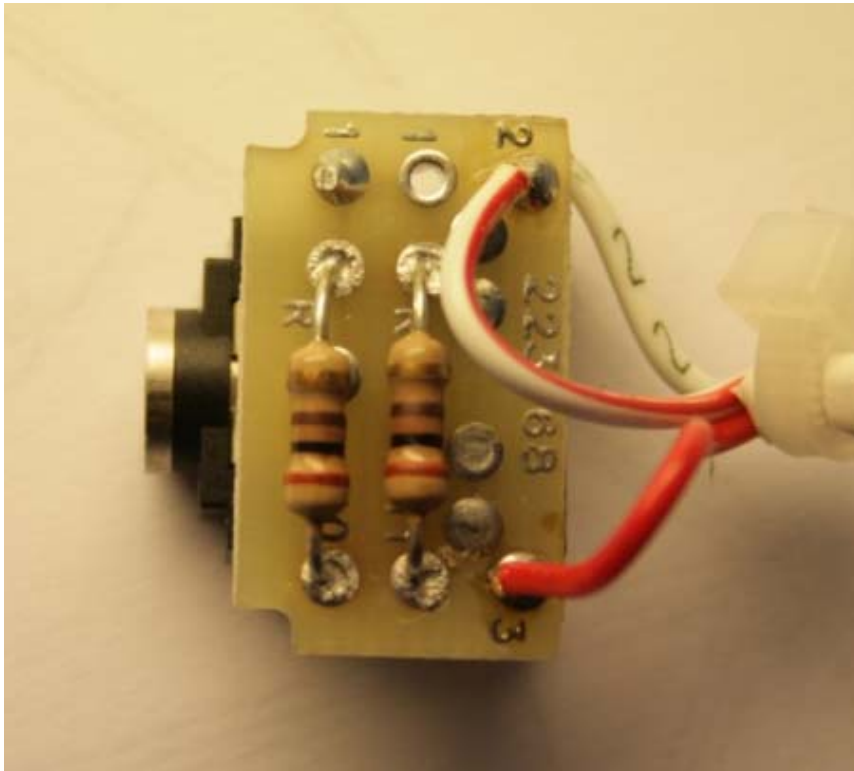


Figure 2: Audio jack in the June 15th, 2009, incident

The incident was notified to IAAIB and following initial review IAAIB decided to initiate an investigation into the incident and reopen the previous investigation. IAAIB initiated an investigation into these events along with representatives from the National Transportation Safety Board (NTSB), the Federal Aviation Administration (FAA), the European Aviation Safety Agency (EASA), the manufacturer of the entertainment system (Thales) and Icelandair.

The emergency response

The first incident occurred during flight. Volume II of the Cabin crew manual requires that the cabin crew report anything unusual (such as fire and smoke) that the flight crew may not be aware of. This was done when the Senior Cabin Attendant notified the Commander of the smoke coming from the arm rest.

According to the B757 Quick Reference Handbook (QRH), chapter 8.12, the flight crew is to act according to part 11 as follows:

▼ Smoke or Fire or Fumes continued ▼

11 Choose one:

- ◆ Source of the smoke, fire or fumes is both **obvious and** can be **extinguished quickly**:
 - Isolate and extinguish the source.
 - If possible remove power from the affected equipment by switch or circuit breaker in the flight deck or cabin.
 - ▶▶ **Go to step 12**
- ◆ Source of the smoke, fire or fumes is **not obvious or cannot be extinguished quickly**:
 - ▶▶ **Go to step 13**

The source of the smoke was from an audio jack in a passenger seat, which is part of the In-Flight Entertainment system (IFE). Therefore, when the Commander switched off the IFE, the source was isolated and its power removed.

The smoke dissipated and the armrest cooled down, which was necessary as seen per part 12 below for the flight to continue:

12 Choose one:

- ◆ Source is visually **confirmed** to be extinguished **and** smoke or fumes are **decreasing**:
 - Continue flight at the Captain's discretion.
 - Restore unpowered items at the Captain's discretion.
 - ▶▶ **Go to the Smoke or Fumes Removal checklist on page 8.26 if needed**
 - ■ ■ ■
- ◆ Source is visually **not confirmed** to be extinguished **or** smoke or fumes are **not decreasing**:
 - ▶▶ **Go to step 13**

The commander's decision to continue the flight to Iceland was therefore in accordance with the established procedures.

The second incident was dealt with prior to flight, when an aircraft technician unplugged seats 5D and 5F from the IFE system.

In-flight-entertainment system

The in-flight-entertainment system in question is named i4500 and was manufactured by Thales in the United States of America. Thales has substantial experience in in-flight-entertainment products and systems. The i4500 system was at the time of the incident installed in eight Boeing 757 operated by Icelandair. The same system was also installed on a total of 197 Air Canada aircraft.

The in-flight-entertainment system was installed in the Icelandair B757 fleet in conjunction with passenger seat retrofit by an installation design provided by EAD Aerospace and approved under their EASA Part 21J.053 design approval.

The i4500 is an all-digital system providing the following services or features:

- Audio On Demand
- Video On Demand
- Video Announcements
- Passenger Address Support
- In-Seat Applications:
 - Moving Map (ASXi)
 - Games
 - Surveys

As of October 2, 2009 the i4500 system had accumulated an estimated 1.42 million total flight hours. Out of that the i4500 system on-board Icelandair aircraft had accumulated an estimated 42,000 flight hours.

Testing and generation of fault

The cable assembly (Thales CA ASSY DUAL SVDU¹ p/n 179169-117) from the failed seats were inspected and the following was noted:

1. Ethernet wire screen (CHAS GND, pin 12 on Thales drawing 179169, sheet 3) was not connected to the plug shield and pin #12 (ground) was also disconnected from the plug.
2. Inspection of a serviceable cable assembly on a different seat revealed that the wire screen was not protected and could easily disconnect from the plug shield. See Figure 3.
3. The cable assembly plug (P2) was then connected to a J1 port of an SVDU and the plug (P2) wiggled back and forth until the SVDU powered off. The voltage drop across ground to pin 1 and pin 3 in the audio jack cable (p/n 171334-07) was measured using a voltmeter. Before wiggling the plug around the measured voltage was less than 1VDC.
4. At a certain time when wiggling the plug around the SVDU powered off a ~30VDC load was measured at pin 3 AUDIO RTN (pin 1 also measures the same) in the audio jack cable (p/n 171334-07). This condition could only be achieved with the Ethernet wire screen and pin 12 disconnected.
5. An experiment was conducted, on a working plug from the (P1) same cable assembly where pin 12 was disconnected and the Ethernet wire screen was cut. With the grounding removed, this simulated fault generated ~30VDC in the audio return circuit.

¹ Smart Video Display Unit

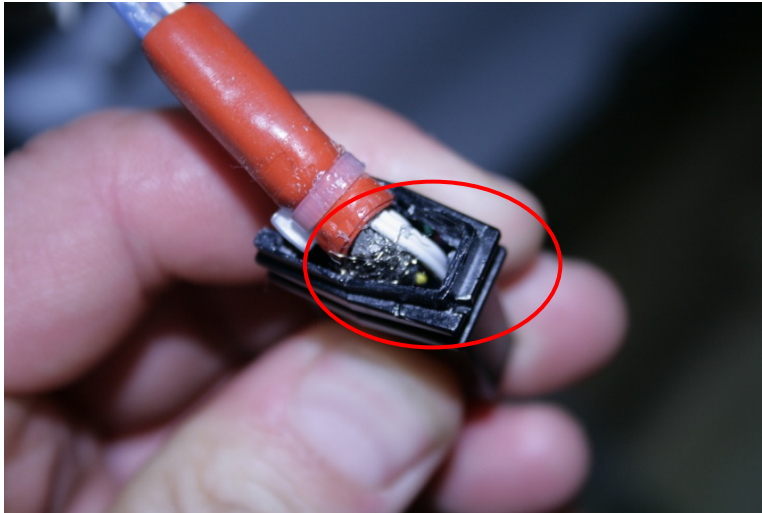


Figure 3: Serviceable P2 plug showing unprotected Ethernet screening

Findings as to causes and contributing factors

The Ethernet wire screen (ground) and pin 12 in the P2 plugs in cable assembly p/n 179169-117 were found disconnected from the plug and plug shield. See cut-out from drawing 179169 in Figure 4 below. Disconnected wires highlighted in yellow.

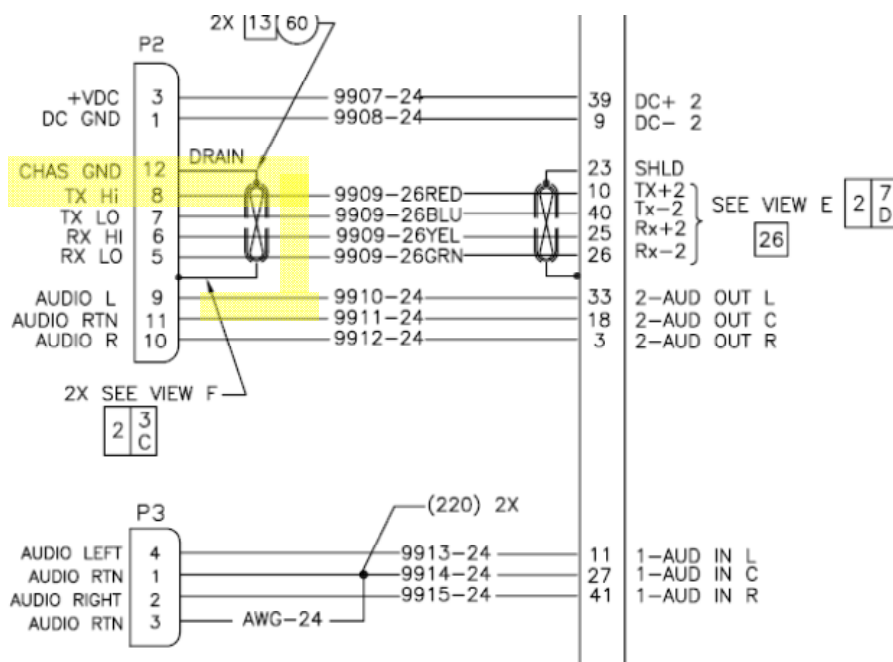


Figure 4: Wire diagram showing disconnected ground wires in Ethernet cable

This fault can cause a ~32VDC load to feed through the SVDU and through the audio jack return lines, causing the resistors in the audio jack to overheat and burn as shown on Figure 5 (32 volts directly applied).

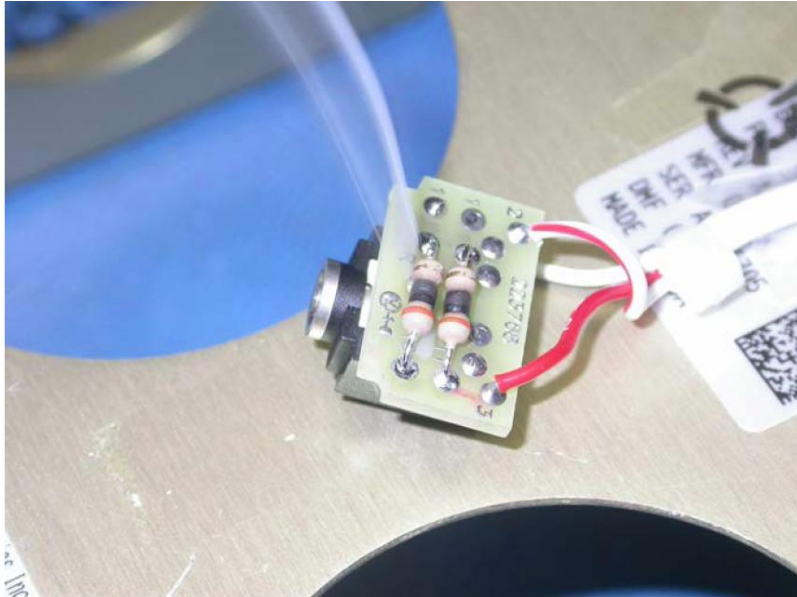


Figure 5: Simulated failure using direct 32 VDC current

Safety action taken

A solution suggested by the IFE System manufacturer in order to reduce likelihood of recurrence was to replace current USB couples for new ones (re-design) which will, if loose cable plug situation arises, ensure that grounding will always occur and therefore prevent higher than normal voltage entering to the audio jack and prevent overheating.

The design holder of the installation (EAD Aerospace), in cooperation with the seat manufacturer (Aviointeriors), released SB 17/10. This SB was based on recommendation by the IFE System manufacturer (Thales). At the time the SB was released, a total of 10 Icelandair airplanes were affected.

Icelandair has already installed this design change on its fleet of ten B757 airplanes, which were affected.

Safety recommendations

None.

Reykjavik, January 25, 2013
Aircraft Accident Investigation Board of Iceland