

Cabin Fire during Cruise

Aircraft	Boeing 777-228ER registered F-GSPK
Date and time	8 December 2010 at 6 h 10 ⁽¹⁾
Operator	Air France
Place	In cruise above the Atlantic Ocean, at FL 380
Type of flight	Scheduled international public transport of passengers
Persons on board	Captain (PF); Copilot (PNF); 219 passengers
Consequences and damage	Passenger seat damaged

⁽¹⁾Except where otherwise stated, the times shown in this report are expressed in Universal Time Coordinated (UTC).

This is a courtesy translation by the BEA of the Final Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference.

1 - HISTORY OF FLIGHT

The crew took off from Atlanta Hartsfield on a flight bound for Paris Charles de Gaulle airport. In cruise at FL 380, a cabin crew member noticed a smell characteristic of an electrical fire at the level of seat 4F in Business Class. He turned off electrical power to the general video system, removed the seat covering and noticed the presence of flames. He later explained that he had extinguished the fire by reflex by throwing water onto the flames.

A cabin crew member checked that the fire did not start again and the flight continued without further incident.

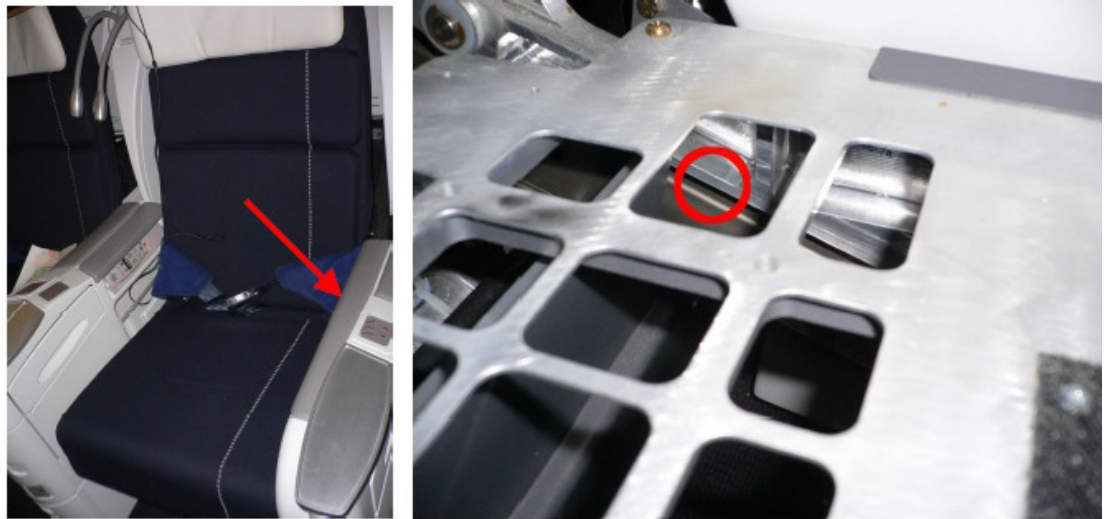
2 - ADDITIONAL INFORMATION

2.1 Examination of the Seat and the Battery

The seats in Business Class installed on F-GSPK were convertible into sleepers with the aid of an electrically controlled mechanism.

On the ground, during dismantling of the seat, a spare external battery from a passenger's electronic device was found severely damaged in the structure of the seat. It showed traces of fire. This Lithium-Polymer-type (Li-Po) battery has a capacity of 1 Ah and delivers 5 V and 500 mA. It is intended to extend the capacity of electronic equipment such as mobile phones, tablets, audio equipment etc.

The battery was crushed in the slide identified on the photo below. It is possible that it slipped under the seat covering, behind the armrest or down the side of the seat.



Seat identical to that in the incident

An X-ray examination showed that the active elements in the battery had disappeared and the electronic control circuits had been destroyed. The crushing of the battery in the seat mechanism likely caused a short-circuit, leading to an increase in the internal temperature. The exposure of the lithium electrodes to the air caused a fire, and oxygen contributed to the combustion.

2.2 Risks Associated with Lithium Battery Fires

Lithium batteries are used in the majority of mobile electronic equipment. There are two main categories: non-rechargeable lithium-metal batteries and rechargeable lithium-ion batteries. These batteries can be subject to overheating, in particular lithium-ion. In some cases, overheating can lead to thermal runaway and ignition. The batteries being made up of several cells, thermal runaway from one of them can spread to the others.

The oxygen in the air not being the combusive element, just extinguishing the flames does not stop the phenomenon, except if the battery is then cooled. Extinguishing actions and cooling are necessary to stop the internal reaction. During the incident, throwing water on the fire achieved this.

Throwing water on a lithium battery fire can, however, revive the flames and make it more difficult to extinguish because of the reduction of lithium in water, which leads to the release of hydrogen, which is highly inflammable.

2.3 Procedures and Steps Taken by the Airline

Transporting lithium batteries in the cabin to supply power to personal electronic devices is not subject to any regulations or harmonised preventive measures between airlines. Some airlines have chosen to ban carrying them in checked-in hold baggage.

As of the day of the incident, Air France cabin crew had been trained to use CO₂ or halon⁽²⁾ extinguishers on electrical fires, avoiding any means containing water. However, the airline's operations manual did not include any specific instructions relating to lithium battery fires.

On 13 December 2010, that's to say five days after the event, Air France published a cabin flight safety bulletin (*Flash Sécurité des Vols Cabine*) dedicated to electrical fires and smoke in the cabin that mentioned this incident. This publication, intended for

⁽²⁾Halon extinguishers can be a risk to health.

the airline's flight crew, states that « H_2O on an electrical fire = risk of spreading it » and « never pour water on an electrical source even by reflex ». It did not present any specific instructions relating to lithium battery fires.

On 4 August 2012, Air France published a cabin flight safety bulletin (*Flash Sécurité des Vols Cabine*) specifically dedicated to fires on mobile electronic devices. In it the standard procedure to use in the first instance is stated to be using a halon extinguisher, cutting off the electrical power supply to the area in question, then cooling the device with water.

In December 2012, the airline revised its emergency procedures relating to cabin fire in the safety manual (*Manuel Sécurité Sauvetage - MSS Généralités*). This document specifically states that in case of a fire on an electronic device, the cabin crew should:

- Use an extinguisher;
- Disconnect the device without removing the battery;
- Pour water on the device to cool the battery and avoid it spreading to nearby objects;
- Not move the device (risk of internal short-circuit).

The procedure allows the cabin crew to fight the fire, following just one procedure applicable to any electrical fire. It is only after extinction of the flames that they can identify the exact source of the fire and take the appropriate action to use water to cool an electronic device that may contain a lithium battery.

2.4 Publications and Information

ICAO published a bulletin (EB 2011/7) relating to the transport of lithium batteries, essentially as cargo. This bulletin highlighted how dangerous these materials are and stated that several incidents had already occurred, some of which led to emergency landings. It invited the Member States to establish rules and procedures relating to the transport of this type of battery. The instructions for transporting them as cargo are covered in ICAO document Doc 9284 relating to hazardous materials

In the United States, the FAA published a Safety Alert for Operators referenced SAFO 09013 in order to improve awareness of the risks of lithium batteries contained in mobile electronic devices. In it, the FAA recommends the use of halon or water to extinguish the flames and, in all cases, water to cool the batteries.

EASA has not published similar information for European operators.

2.5 Studies

Many studies are currently under way relating to the transport of lithium batteries as cargo. The hazards of the latter have been identified. Nevertheless, none of these studies relates to batteries of mobile electronic devices transported in the cabin.

2.6 Similar Events

On 2 May 2013, a similar event to that to F-GSPK occurred on board the Air France Boeing 777 registered F-GSQU during a flight from Paris Charles de Gaulle to São Paulo (Brazil). Shortly before the beginning of the descent, a mobile phone that was being recharged caught fire under a cushion on a passenger seat. The cabin crew put out the fire with a halon extinguisher. The telephone was then placed under running water until the end of the flight.

3 - LESSONS LEARNED AND CONCLUSION

The fire in the cabin was due to the crushing of a lithium battery that fell into a seat mechanism. The crushing caused an internal short-circuit and overheating that caused the fire.

Turning off the video system electrical power supply before any other action was an effective protection against the risks associated with the many items of equipment installed in the seats.

The cabin crew member then put out the fire by reflex by throwing water onto the flames. Throwing the water put out the flames and cooled the damaged battery. Nevertheless, this could have revived the fire and made its extinction more difficult, due to the release of hydrogen generated by the reduction of lithium in the water.

The new procedure put in place by Air France that recommended initial use of halon resolved this difficulty but implied the emission of a potentially noxious gas that is bad for health. Its use in the cockpit could clearly be dangerous.

In the United States, the FAA recommends a slightly different procedure: it suggests turning off the electrical power supply, putting out the flames with halon or water, then cooling the device in order to stop internal reactions.

No procedure has been universally established to contain this type of fire in the cabin or the cockpit.

4 - RECOMMENDATION

Note: In accordance with Article 17.3 of European Regulation (EU) 996/2010 of the European Parliament and Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation, a safety recommendation shall in no case create a presumption of blame or liability for an accident, a serious incident or an incident. The addressee of a safety recommendation shall inform the safety investigation authority which issued the recommendation of the actions taken or under consideration, under the conditions described in Article 18 of the aforementioned Regulation.

Many studies are currently under way on the danger relating to transporting the various types of lithium batteries in cargo holds. Nevertheless, the danger represented by transporting them in the cabin has not been taken into account.

Faced with a lithium battery fire, actions to extinguish the flames then to cool the components are required to stop any internal reaction. There is no consensus on the procedure to apply, specifically on the use of water during extinction of the flames. During this incident, this use proved to be effective for extinguishing the flames and cooling the battery. Nevertheless, it could have made extinction more difficult. Furthermore, the use of halon extinguishers is risky for health.

Consequently, the BEA recommends that:

- **EASA evaluate the risks associated with fires to batteries contained in mobile electronic devices transported in cabins by passengers and crew, and propose appropriate procedures in case of a fire on this type of equipment. [Recommendation FRAN-2014-004]**