

Smoke in cabin during boarding, evacuation of passengers

Aircraft	Boeing 777-300 registered F-GSQA
Date and time	28 July 2013 at about 23 h 00 ⁽¹⁾
Operator	Air France
Place	Paris Charles de Gaulle Airport (95)
Type of flight	Public transport
Persons on board	Captain, 2 co-pilots, including one reserve, 14 cabin crew, 298 passengers
Consequences and damage	1 passenger seriously injured

⁽¹⁾Unless otherwise mentioned, the times given in this report are expressed in local time.

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

Note: the following elements are based on data from the maintenance Quick Access Recorder (QAR), the Cockpit Voice Recorder (CVR)⁽²⁾, radio communications recordings and crew testimony.

⁽²⁾The CVR recording started at 22 h 21 min 31.

The crew prepared the flight to Shanghai and arrived at the aeroplane at 22 h 20, about one hour before the scheduled departure time. The flight crew prepared the cockpit and started up the APU⁽³⁾ in order to air condition the cabin. Fuelling was under way.

⁽³⁾Auxiliary Power Unit.

The passengers started to board about twenty minutes after the arrival of the crew and entered via doors 1G and 2G (see diagram below).

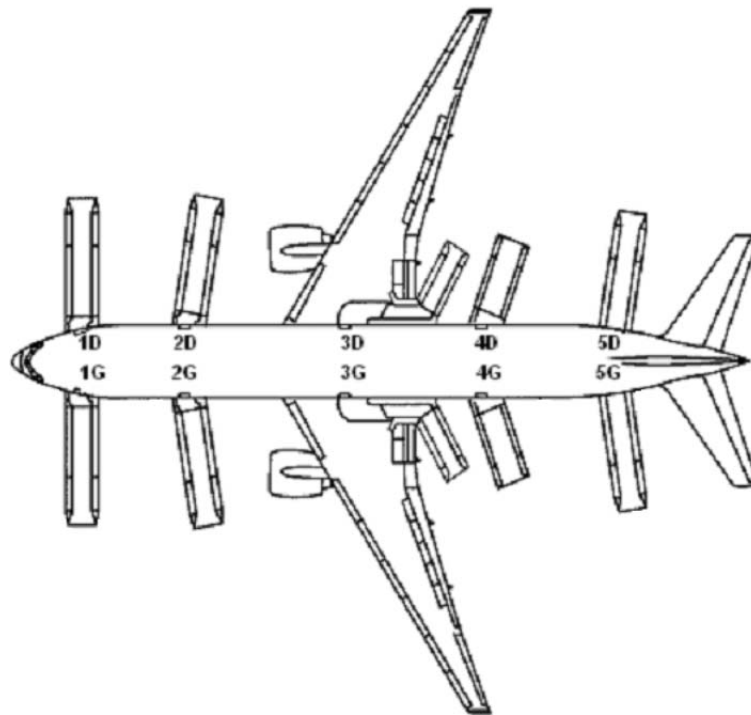


Diagram of the evacuation doors on a Boeing 777
(the doors are always fitted with emergency chutes)

⁽⁴⁾The term “pair of doors” is used for doors facing each other, e.g. 1L/1R.

⁽⁵⁾In accordance with airline instructions.

⁽⁶⁾SMOKE REST UPPER DOOR 1 which corresponds to smoke detection at the level of the crew rest quarters by door 1.

⁽⁷⁾Engine-Indicating and Crew-Alerting System.

At least one member of the cabin crew was present at each of the five pairs of doors⁽⁴⁾the latter were not armed for emergency evacuation⁽⁵⁾.

The Captain and the two co-pilots carried out the departure briefing and the pre-flight checklist. These actions were completed at 22 h 54.

The Ramp Area Manager contacted the crew to inform them that the quantity of fuel requested had been delivered.

The flight crew reported a “burnt” smell at 22 h 54 min 44. The Captain and the reserve co-pilot left the cockpit to look for the source of the smell. Twenty-five seconds later, the cabin crew member located at door 3 contacted the cockpit and reported to the co-pilot a smell of sulphur in the area of door 5. He added that the passengers at the rear seemed worried and were asking questions about the origin of the smell.

The Captain, who was still in the cabin, asked the chief flight attendant and the reserve co-pilot to check the ovens in the galleys (kitchens). When he arrived at door 2, he noticed the smell and observed that it was accompanied by a slight pall of smoke throughout the aeroplane.

In the cockpit, the co-pilot saw the message SMOKE REST UPR DR 1⁽⁶⁾ appear on the EICAS⁽⁷⁾, associated with a continuous two-note aural warning. This warning would last about two minutes. The chief flight attendant and the flight attendant noticed this warning on the Cabin Management System Control Panel. The fire detection light above the door of the crew rest area located at the front of the aeroplane was lit up. At the same time the chief flight attendant received a call on the interphone from a second flight attendant informing him of the smell of sulphur while he was in the area of door 5G.

At the Captain’s request, the cabin crew at the front of the aeroplane donned fire protection (protective breathing equipment and fire extinguisher) and entered the forward rest quarters.

The flight attendant at door 3 called the cockpit again to report the presence of a considerable quantity of smoke in the cabin. The co-pilot informed him that smoke was also penetrating the cockpit.

On returning to the cockpit, the Captain noticed the presence of smoke. The co-pilot suggested contacting air traffic control to obtain assistance from the fire brigade. The co-pilot told the Captain that the SMOKE REST UPPER DOOR 1 warning had triggered and that he had turned off both air conditioning units due to the presence of smoke in the cockpit. The Captain then decided to evacuate the aeroplane and announced via the Public Address (PA) “*this is the cockpit, cabin crew to your stations*”. The co-pilot contacted ATC at the same time and declared an emergency situation: “*Mayday Mayday Mayday, ... We need immediate fire assistance*”.

Noting the onset of panic, the chief flight attendant asked the passengers via the public address to remain in their seats. The flight attendants at doors 3 and 4 armed the evacuation slides. The flight attendants at doors 3G, 4 and 5 explained to the respective passengers their role as facilitators in the evacuation procedure.

The Ramp Area Manager contacted the crew and reported to them that the smoke seemed to be coming from the APU. The crew shut down the APU.

Forty-five seconds after his initial message, the Captain announced via the PA *“Cabin crew this is the cockpit, evacuate the passengers via the doors, only via the doors”*.

Passenger evacuation started. The cabin crew ordered the passengers to leave quickly. More and more of the passengers were moving towards doors 3G/3D. The cabin crew were stressed by this situation. A cloud of thick smoke formed under the cabin ceiling. It was moving from the aft towards to the front of the aeroplane. On request from the cabin crew, the flight attendants at doors 5G/5D took out breathing equipment, flashlights and the megaphone from their storage.

The two co-pilots opened the windows in the cockpit in order to ventilate it. They decided not to use the oxygen masks.

From the cockpit the Captain had the feeling that evacuation was taking place normally. He noted that the smoke in the cockpit disappeared.

The flight attendants at doors 4G/4D initially planned to evacuate passengers through these doors, then finally decided to direct them to the front of the aeroplane.

The flight attendants at doors 3G/3D opened the doors, taking into account the following:

- the expressions used by the Captain (which they heard distinctly) could have led them to think an evacuation through this door was authorised;
- visual contact with the flight attendants located at doors 2 and 4 was made impossible by the open overhead lockers, the passengers standing in the aisle and the partitions between classes;
- the panicking passengers demanded very loudly that the doors be opened;
- they had no precise information about the causes of the phenomena experienced in the cabin;
- their current experience seemed to them to be of a critical nature.

The flight attendant who was checking the forward crew rest quarters came out while the evacuation was underway. He helped to expedite the evacuation. He did not find any signs of a fire, only the presence of thick smoke.

The reserve co-pilot saw the deployment of the door 3 slides. The Captain then moved towards the rear of the cabin, and noticed that the doors were open and went through each of these doors to ask the passengers who were still on the wings to return inside the cabin.

The passengers evacuated by the slides were assisted by ground personnel and taken to the terminal. One of the passengers fractured his elbow during the evacuation.

The chief flight attendant checked the cabin and confirmed to the flight crew that the evacuation was over.

Seeing no more smoke on board the aircraft, the flight crew and the chief flight attendant held a debriefing in the cockpit on how the evacuation had taken place.

2 - ADDITIONAL INFORMATION

2.1 Personnel Information

The Captain (PF) totalled 20,732 flying hours, of which 3,415 on type. His last training on emergency evacuation took place on 24 October 2012.

The co-pilot (PM) totalled 10,792 flying hours, of which 4,773 on type. His last training on emergency evacuation took place on 15 May 2013.

The reserve co-pilot totalled 6,008 flying hours, of which 3,374 on type. His last training on emergency evacuation took place on 15 April 2013.

The cabin crew's emergency evacuation training was undertaken in accordance with the twelve-month regulatory cycle.

2.2 Examination of the APU

The APU was examined in an approved workshop, in collaboration with Honeywell, the manufacturer.

The ball race located at the level of the air compressor on the ventilation system was found to be damaged. The deterioration of this ball race led to actual movement on the compressor module. The latter then wore several parts, including the carbon seal that ensured the sealing of the bearing in question. This loss of sealing resulted in the oil lubricating this bearing passing into the compressor.

The cause of the deterioration of the ball race could not be determined. It had been replaced by Honeywell during the last APU overhaul in 2009.

2.3 Air Conditioning

On the ground, when the engines are not running, air conditioning is generally carried out by the APU.

2.4 Smoke Toxicity

The oil used for APU lubrication (Mobil Jet Oil II) is the same as that used for the engines. This oil contains high pressure anti-wear additives. When they reach a high temperature (pyrolysis), these lubricants can release volatile organic substances that are potentially dangerous, like the TriCresyl-Phosphates (TCP) which are neuro-toxic. It was not possible to determine if such substances were released during the event.

No blood tests were performed after this event. Examination of the breathing equipment did not make it possible to determine if the people on board had been exposed to TCP.

There is a type of oil supplied by the NYCO company, certified for APU, that does not release TCP. However the operator had decided not to use this oil, to ensure that it was not erroneously put into the engines, for which it is not certified.

2.5 Emergency Evacuation

The decision to carry out an emergency evacuation is taken by the Captain when he deems that circumstances require it.

Any emergency evacuation on a Boeing 777 is carried out through all of the evacuation doors available.

IATA⁽⁸⁾ specifies that two situations may occur:

- planned emergency evacuation: the information and time available make it possible to programme an evacuation;
- unplanned emergency evacuation: an emergency situation occurs without an associated warning and requires immediate evacuation.

Managing an evacuation when the aeroplane is still at the ramp with air bridges connected to the aeroplane is complex (see the Flight Safety Foundation publication *"Rapid deplaning by Airbridge"*⁽⁹⁾). The manner in which the evacuation is performed depends on the Captain's decision. Some airlines define appropriate instructions.

IATA in its guide for best practices for cabin crews states the following on *"rapid deplaning"*:

«There may be a situation when an evacuation is not required but when passengers and Crew should be deplaned immediately and quickly (e.g. a serious situation such as fuelling emergencies). In this instance rapid deplaning would be appropriate. A rapid deplaning may be initiated by pilots or in their absence; the Senior Cabin Crew. The following is sample SOP:

Two prong PA

1. First PA to alert Cabin Crew (Cabin Crew should return to their doors - where time permits)
2. Second PA to initiate rapid deplaning

Actions

Ensure bridge or stairs are in place.

- *Direct passengers to go the designated exit(s) and to leave their baggage behind: "Leave the aircraft immediately (specify from which door(s) and please leave all of your personal belongings behind".*
- *Cabin Crew closest to the entry door(s) or a designated ABP will lead passengers into the terminal.*
- *Cabin Crew must remain alert in case an evacuation is required.*
- *Rapid deplaning is complete when the last passenger or Crew member leaves the aircraft.*
- *If no bridge or stairs are in place an evacuation may need to be initiated.»*

⁽⁸⁾<http://www.iata.org/publications/Pages/cabin-safety-guide.aspx>

⁽⁹⁾http://flightsafety.org/ao/ao_mar_apr02.pdf

2.6 Airline Procedures

The “Smoke, Fire or Fumes” procedure makes it possible to rapidly extinguish the sources of fire through the following actions:

8.6 **AIRFRANCE**

777 Flight Crew Operations Manual

Smoke, Fire or Fumes

Condition: Smoke, fire or fumes occurs.

Objective: To remove power from the Ignition source.
To land the airplane as soon as possible, if needed.

- 1 Diversion may be needed.
- 2 Don oxygen masks and smoke goggles, if needed.
- 3 Establish crew and cabin communications.
- ⋮ **777-200ER, 777-300ER**
- 4 IFE/PASS SEATS switch OFF
- ⋮ **777-200ER, 777-300ER**
- 5 RECIRC FANS switches (both) Off
- ⋮ **777F**
- 6 RECIRC FANS switch Off
- 7 APU BLEED AIR switch Off
- 8 **Any time** the smoke or fumes becomes the greatest threat:

Air France has not defined a procedure equivalent to “rapid deplaning”

The only emergency evacuation procedure provided for in the airline's instructions corresponds to an emergency evacuation procedure as follows:

Back Cover.2 **AIRFRANCE**

777 Flight Crew Operations Manual

Evacuation

Condition: An evacuation may be needed.

⋮	1	Parking brake. Set	C
		777-200ER, 777-300ER	
	2	Call "ICI LE POSTE DE PILOTAGE, PNC à vos postes".	C
	3	OUTFLOW VALVE switches (both) . . MAN	F/O
	4	OUTFLOW VALVE MANUAL switches (both) Hold in OPEN until the outflow valve indications show fully open to depressurize the airplane	F/O
	5	FUEL CONTROL switches (both) CUTOFF	C
⋮			
	6	Advise the tower.	F/O
	7	Engine fire switches (both) Pull	F/O
	8	APU fire switch. Override and pull	F/O
	9	If an engine or APU fire warning occurs: Related fire switch. Rotate to the stop and hold for 1 second	F/O
⋮			
	10	If evacuation is required: Call: "ÉVACUATION PASSAGERS".	C
⋮			
		Evacuation COMMAND switch. . . . ON	C
		■ ■ ■ ■	

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Back Cover.2 **October 18, 2012**

2.7 Individual Protection Procedures in the Event of Fire/Smoke

The crews have anti-fire protection including an autonomous breathing system known as PBE (Protective Breathing Equipment).

The operator recommends crew members put on this protection as soon as the presence of smoke or fire is detected.

In the case of this accident, five cabin crew members put on this protection:

- three cabin crew members positioned at door 5;
- one cabin crew member positioned at door 3;
- one cabin crew member positioned at the front who went to check the presence of smoke in the rest quarters.

2.8 Boeing 777 Interphone Function

In the event of an emergency, the Boeing 777 interphone makes it possible to call all of the cabin stations (general emergency call) and to ensure a means of communication between all of the cabin crew.

3 - LESSONS LEARNED AND CONCLUSION

3.1 Crisis Situation Management

The flight crew detected the presence of a suspicious smell. The Captain immediately decided to leave the cockpit with the reserve co-pilot to determine the origin of this smell. The absence of the Captain from the cockpit had the following consequences:

- he did not perceive the situation experienced by the flight attendant at door 3;
- the co-pilot took the initiative of shutting down the air conditioning units without consulting the Captain.

The Captain therefore did not have all of the information when he returned to the cockpit. However he immediately planned to carry out an emergency evacuation, and then after receiving the information of the presence of smoke at the APU level, he asked for the aeroplane to be evacuated by the passenger air bridges. The cockpit may be considered the command post. As this event illustrates, it appears useful that the Captain remains in the cockpit. In this way he may rely on the procedures available, especially those for “*smoke, fire or fumes*” and on his crew to inform him of the situation in the cabin.

If this event had occurred during flight, the crew would probably not have left the cockpit. It would seem opportune to reflect on the difference in crew behaviour when in flight and on the ground.

Nevertheless this single event does not make it possible to reach a conclusion on the strategy to adopt in all the emergency situations which may arise on the ground and in flight.

3.2 Evacuation

The airline operations manual does not provide for evacuation of the aeroplane by the boarding doors. The terms used by the Captain when he planned the evacuation were: *"this is the cockpit, cabin crew to your stations"*. These words are those associated with the emergency evacuation procedure and result in preparing the cabin crew for this possibility. The Captain indicated 45 seconds later *"Cabin crew this is the cockpit, evacuate the passengers, evacuate the passengers through the doors, only through the doors"*. These words do not make it possible to understand unambiguously that the Captain is requesting evacuation through the boarding doors.

Door 3 cabin crew were in a considerably stressful context. They perceived the situation as being critical and, being in doubt about the order given, they decided to proceed with evacuation with the slides.

The Captain did not have a procedure associated with the strategy he wished to implement: rapid disembarkation at the ramp. He therefore used language which was not fully suited to the situation. In the absence of procedure, the cabin crew were in doubt about the order given and also therefore about the terms of its performance. Some airlines have thus defined a procedure for this sort of situation.

3.3 Smoke Toxicity

The airline had decided to use an oil for which pyrolysis may generate toxic gases. This choice had been made on the basis of technical considerations and human factors relating to the activity of mechanics. The airline had not assessed the possible consequences in the event of the oil overheating by the APU for the aeroplane occupants. It may be helpful to consider these aspects in the framework of a safety study.

3.4 Wearing Protection

The crew was exposed to smoke that may have been toxic. The majority of the crew members did not wear the protection they had available. When in doubt, the crew members must wear suitable protection to ensure their duty of safety.

3.5 Causes

Smoke in the cabin and in the cockpit was generated by pyrolysis of oil at the level of the APU in the ventilation system. The presence of oil was due to a leak in a seal caused by failure of an APU ball race.

The flight crew decided to disembark the passengers quickly. The cabin crew positioned at doors 3 did not understand the Captain's intentions and decided to carry out an emergency evacuation by opening the emergency exits. During this evacuation one passenger was seriously injured.

The imprecise language used by the Captain contributed to the misinterpretation of the order given.

The absence of a dedicated procedure for quick deplaning contributed to the Captain's imprecise language and to erroneous interpretation by the cabin crew at door 3.

4 - AIR FRANCE SAFETY ACTIONS

The operator conducted an internal investigation after this event in the context of its safety management system. Six corrective actions were defined, bearing on:

- the use of breathing protection in the event of persistent smell;
- consolidation of flight crew knowledge of intercommunication resources;
- the creation of a “*precautionary deplaning*” procedure;
- the difficulty in putting on breathing protection;
- training of ground personnel in emergency evacuation;
- the study of risks linked to the toxicity of smells and fumes from lubrication oils.