



DEBATE PACK

Number CDP 2016-0068, 15 March 2016

Debate pack: Cabin air safety and aerotoxic syndrome

This pack has been prepared ahead of the debate in Westminster Hall on Thursday 17 March 2016 at 1.30pm on **cabin air safety and aerotoxic syndrome**. The Members in charge are Jonathan Reynolds, Mr Graham Brady, and Dawn Butler.

Dr Sarah Barber

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The House of Commons Library prepares a briefing in hard copy and/or online for most non-legislative debates in the Chamber and Westminster Hall other than half-hour debates. Debate Packs are produced quickly after the announcement of parliamentary business. They are intended to provide a summary or overview of the issue being debated and identify relevant briefings and useful documents, including press and parliamentary material. More detailed briefing can be prepared for Members on request to the Library.

1. Summary

Background

For a number of years concerns have been expressed about possible health effects relating to the air in the cabins of commercial aircraft. Cabin crew and pilots have reported a number of symptoms that they believe are linked to repeated exposure to episodes of contaminated air within aircraft cabins. These symptoms have been referred to as aerotoxic syndrome.

Cabin air in commercial aircraft needs to be pressurised and heated. In order to do this, compressed air is taken from the engine and is cooled and conditioned before entering the cabin. It is thought that, where there is an engine oil seal failure, substances from the aircraft's engine oil supply can leak into the cabin through 'bleed air' from the engine.¹ The resulting episode of contaminated air in the cabin is referred to as a "fume event". The Committee on Toxicity (an independent scientific committee that provides advice to Government departments on matters concerning the toxicity of chemicals) have estimated that a fume event occurs in around one in every 2000 flights.²

The [Boeing Dreamliner aircraft has a new no-bleed air system](#) which uses a different process for providing air to the aircraft cabin and avoids these fume events.

Scientific reports and Government response

There has been a number of reports on the quality and safety of aircraft cabin air and potential links to health effects. The House of Lords Science and Technology Committee, the Civil Aviation Authority and the Committee on Toxicity have all looked at this issue. The most recent UK report on this issue was a [position statement](#) published by the Committee on Toxicity (COT) in 2013. This followed a review of the scientific evidence in this area.

The findings of COT in its 2013 position paper on cabin air were summarised by the Transport Minister, Robert Goodwill in [a letter to Louise Ellman MP](#) in November 2015:

1. The Committee concluded that there is evidence of the occurrence of contamination of cabin air by components and/or combustion products of engine oils. Peaks of higher exposure, lasting seconds, have been reported.
2. While many chemicals have been identified as being present in the bleed air from the aircraft engines, given the short duration of reported fume events, peak exposures of chemicals such as triaryl

1. [Committee on Toxicity. Non-technical lay summary. Statement on the review of the](#)

phosphates would have to occur at very much higher concentrations than was found during the studies to cause serious toxicity.

3. Episodes of acute illness have occurred in temporal relation to perceived episodes of contamination of cabin air. The sufferers of these illnesses have attributed the cause to the fume event.

4. The Committee noted that the range of symptoms reported following fume events was wide-ranging, whereas toxic effects of chemicals tend to be more specific.

5. While it is possible that the acute illness which occurred in relation to perceived episodes of contamination of cabin air might reflect a toxic effect of one or more chemicals, the Committee considered that a toxic mechanism as a cause for the reported illnesses was unlikely.

6. As a toxic mechanism was an unlikely cause for the reported illnesses, a nocebo effect was considered a plausible alternative. There is strong scientific evidence that nocebo effects can lead to illnesses that are in some cases severely disabling, from environmental exposures that are perceived as hazardous. However, there is no simple and reliable way of establishing that nocebo responses are responsible for individual cases of illness.

7. As neither a toxic mechanism nor a nocebo effect could be excluded beyond reasonable doubt as the source of symptoms reported, the Committee concluded more research would be beneficial. It stated, however, that when considering any new research project in conjunction to cabin air quality, it will be necessary to balance the likelihood that it will usefully inform further management of the problem against the costs of undertaking the research. The Committee suggested several lines of research, including database establishment, more monitoring of fume events and biomonitoring of cabin crew. Due to the unpredictability and rareness of the fume events, any new comprehensive research would incur severe costs without certainty of the procurement of any new meaningful evidence.

8. Finally, the Committee emphasised that an illness, whether caused by toxicity or a nocebo effect, can be severely disabling. Therefore, there is a continuing imperative to minimise the risk of the fume events which give rise to symptoms.³

The letter also provides information about ongoing and future work in this area. It states that the Government believe that the best approach is for further work in this area to take place on an international basis. The European Aviation Safety Agency is currently undertaking a preliminary in-flight cabin air measurement campaign, which will put in place the equipment required to undertake cockpit and cabin air measurements. The results of this campaign are expected in autumn 2016, and then a larger scale piece of research will be planned after this.

The Government have also said that the Aviation Health unit of the Medical Department of the Civil Aviation Authority will continue to monitor issues around cabin air quality as part of their role as specialist advisor to the Government on aviation health issues.⁴

³ [Deposited Paper DEP2015-0931](#) November 2015

⁴ [Written Question 8756: Aircraft: Air Conditioning](#), 9 September 2015

Campaign and concerns

Campaigners, including the trade union Unite, which represents passenger transport workers, [are calling for an independent public inquiry](#) into cabin air safety and potential health effects. Unite are also supporting a number of their members in pursuing legal claims regarding the symptoms they are suffering, [on 15 March they reported](#) that they were pursuing a legal case against airlines on behalf of 61 members of cabin crew staff.⁵

The potential health effects relating to cabin air were also highlighted during a Coroner's investigation of the death of a British Airways pilot, Richard Mark Westgate, in 2015. The Coroner sent a [report to prevent future deaths](#) to both British Airways (BA) and Civil Aviation Authority (CAA) raising concerns about the presence of organo-phosphate compounds in aircraft cabins and effects on health in February 2015.⁶ The Coroner has a legal power and duty to write a report following an inquest where the investigation reveals something that would give rise to a concern that there is a risk of deaths in the future and that action should be taken to reduce or eliminate that risk.⁷ The responses to this report must be sent within 56 days. The responses to the report from BA and the CAA have not been made public on the Courts and Tribunals Judiciary website.

The Civil Aviation Authority [responded to concerns relating to cabin air safety](#) in June 2015. It said that its priority is the safety of passengers and crew. It relies on the guidance from scientific experts based on independent studies and evidence reviews and the overall conclusions of these is that there is no positive evidence of a link between exposure to contaminated cabin air and possible health effects but such a link cannot be excluded:

Our priority is always the safety of passengers and crew and we continue to work with airlines, manufacturers and international regulators to drive improvements in safety standards across the industry.

We understand the concerns that have been raised about cabin air quality and we take very seriously any suggestions that people have suffered ill health from their experience of aviation.

We rely on guidance from scientific experts based on the results of a number of independent studies and evidence reviews - including Government commissioned research. The overall conclusion of those studies is that there is no positive evidence of a link between exposure to contaminants in cabin air and possible acute and long-term health effects, although such a link cannot be excluded. Accordingly, we support the steps being taken by the European Aviation Safety Agency (EASA), which maintains responsibility for approving the safety of aircraft and setting aviation standards for European airlines, and is carrying out further research into cabin air quality.

⁵ Unite, [Toxic air legal cases rise as MPs prepare to debate cabin air safety](#), 15 March 2016

⁶ Sheriff Stanhope Payne, [Regulation 28, Report to prevent future deaths](#), 16 February 2016

⁷ Chief Coroner, [Chief Coroner's Guide to the Coroners and Justice Act 2009](#)

It is important that we continue to support this work, which we believe will help significantly improve the global aviation industry's understanding of what, if any, impact exposure to fumes has on people's long-term health.⁸

⁸ CAA, [CAA statement on cabin air](#) quality, 19 June 2015

2. Press Articles

The Telegraph

Toxic cabin air campaigners call for detectors in planes; Mystery plane illness at Heathrow prompts calls for air quality warning systems in cabins

29 Jan 2016

Natalie Paris

<http://www.telegraph.co.uk/travel/news/Toxic-cabin-air-campaigners-call-for-detectors-in-planes/>

The Telegraph

Cabin crew sue Boeing over 'toxic cabin air'; Four flight attendants blame contaminated cabin air on ill health after 'fume event' on board Boeing plane

24 June 2015

Hugh Morris

<http://www.telegraph.co.uk/travel/news/Cabin-crew-sue-Boeing-over-toxic-cabin-air/>

Financial Times

UK Airlines face legal action because of quality of cabin air

8 June 2015

Peggy Hollinger

<http://www.ft.com/cms/s/0/3009f22c-0def-11e5-8ce9-00144feabdc0.html#axzz42b5GRqDI>

The Telegraph

Warning over toxic fumes in plane cabins

Coroner urges action to prevent deaths after warning toxic fumes in cabin air pose a health risk to frequent fliers and aircrew

21 February 2015

Andrew Gilligan

<http://www.telegraph.co.uk/news/aviation/11427509/Warning-over-toxic-fumes-in-plane-cabins.html>

3. Press releases

Unite

Toxic air legal cases rise as MPs prepare to debate cabin air safety 15 March 2016

Britain's largest union Unite, revealed today (Tuesday 15 March), that it was pursuing legal action against a number of UK airlines on behalf of 61 cabin crew after they were exposed to 'toxic cabin air' while working on board aircraft.

The news of the individual legal cases comes ahead of Thursday's (17 March) Westminster Hall debate in the House of Commons on cabin air safety and aerotoxic syndrome, which was secured by Jonathan Reynolds MP.

Concern has been mounting over 'fume events' and exposure to contaminated cabin air, with the number of legal cases being pursued by Unite increasing from 17 to 61 in recent months amid calls by the union for an independent inquiry.

Unite is also supporting the family of Matthew Bass, a Unite member, who had a 15 year career as cabin crew before his sudden death in January 2014. Matthew was found to have died from 'chronic exposure to organophosphates.'

In most modern aircraft unfiltered 'bleed air' from jet engines is used to supply the cabin, but faults with engine seals and seepage can lead to contaminated fumes containing toxins such organophosphates entering the cabin air. Such instances are known as 'fume events'.

Both long and short-term exposure to contaminated air can lead to what is known as aerotoxic syndrome which affects the peripheral central nervous system and the brain. Symptoms include migraines, fatigue, difficulty thinking, numbness, aches and pains, breathing problems and digestive problems.

In more serious cases, aerotoxic syndrome is suspected to have caused the death of both pilots and cabin crew.

Commenting, Howard Beckett Unite executive director for legal affairs said: "The issue of toxic cabin air is so serious that our cabin crew members are likening it to the impact of asbestos in the building industry.

"Increasing numbers of our members have come forward, seeking help and advice since we set up our toxic air helpline a few months ago. Some have been involved in one-off 'fume events' while others fear they have suffered long-term exposure to contaminated cabin air.

"This is a health issue which the airline industry has been aware of for some time and one which they need to address as a matter of urgency. Continuing to brush it under the carpet will not wash, which is why this

parliamentary debate is so important and a fuller public inquiry is needed.

“Unite believes in a safety first approach and is also calling on airlines to monitor cabin air quality and for aircraft manufacturers to fit detectors and filters and ‘design out’ the use of bleed air, therefore reducing the risk of fume events.

“We will not have passengers and our members put at risk and will not rest until the industry acts to eliminate the risk of aerotoxicity and justice is achieved for those whose lives have been blighted by contaminated cabin air.”

Jonathan Reynolds MP for Stalybridge and Hyde said: “In the twenty first century, people deserve to know the air they breathe at work is clean and safe. Bleed air contamination happens more often than the industry acknowledges, and aerotoxic syndrome can kill.

“For the sake of both passengers and cabin crew, we need to take decisive action to prevent these leaks and understand the dangers to human health.”

Unite is urging cabin crew and the public to get in contact, if they have been involved in a ‘fume event’ or believe they may be suffering from aerotoxic syndrome via the union’s free helpline on: 03330 146 569.

For further information please contact Unite head of media and campaigns Alex Flynn on 020 3371 2066 or 07967 665869.

Notes to editors:

- Unite is Britain and Ireland’s largest trade union with over 1.4 million members working across all sectors of the economy. The general secretary is Len McCluskey.

What is aerotoxic syndrome?

- Aerotoxic syndrome is the term given to the illness caused by exposure to contaminated air in jet aircraft.
- Air enters aircraft through the jet engines, a process known as ‘bleed air’.
- In this process bleed air contaminants can become mixed in with the air due to failures in the seals within the engines, and this results in fumes or smoke entering the cabin (and is known in the industry as ‘a fume event’).
- Such contaminants include engine oil, hydraulic fuel and anti-freezing fluid, all of which contain a number of harmful chemicals.
- Symptoms which can arise from exposure include fatigue, blurred vision, headaches, memory loss and nausea to name but a few.

Recent developments

- A senior coroner recently issued a warning to the industry urging action to avoid further deaths caused by toxic fumes in cabin air.

- Unite is acting for the family of Matthew Bass with a preliminary hearing scheduled with the Coroner for this summer.

The problem

- There has been knowledge that heated jet engine oil causes problems since 1954.
- The airline industry fails to recognise the problem.
- There is insufficient monitoring and research.

New technology

- The new Boeing 787 Dreamliner removes the problem because instead of bleed air it has a system whereby air is supplied directly from the atmosphere and not through the engines.

European Cockpit Association The concerns of Cabin Air Quality need to be addressed 29 February 2016

The debate over cabin air quality (CAQ) on commercial aircraft is not a novelty. And yet, the issue lingers. The lack of conclusive scientific evidence on the negative impact of aircraft air used via the '*bleed air system*' is lagging behind the growing number of personal experiences voiced by crew and pilots. As ECA's recent position paper shows, however, to minimise the flight safety implications of 'fume events' in an aircraft, and to prevent the potential short- term or long-term health effects, there are many steps that can and should be undertaken already today.

The cabin air on commercial aircraft is produced through a so-called bleed air system that compresses the air taken from the engines and let it to the cabin without filtering. The problem arises when the system – used by all the operational aircraft except for the new Boeing 787 Dreamliner – gets contaminated with oil fumes leaking from the hot section of the engine.

Since these fume events are considered rare, highlighting their safety risks and quantifying the magnitude of the problem remains a challenge.

Where is Europe today?

The possible air contamination by chemicals is acknowledged by the widest spectrum of the industry. From regulatory authorities and oil manufacturer through scientists and airlines occupation doctors to crew associations; the issue is known and requires answers. Since EASA announced an external research tender on air contamination measurements in 2014, the CAQ matter is now set higher up on the European agenda once again.

The research is vital and it aims at implementing a preliminary in-flight measurement campaign to use adequate instruments to measure cabin/cockpit air contamination and providing concrete indications of the cabin/cockpit air quality level.

In parallel, the systematic reporting of fume events - in line with the principles of [Just Culture](#) - was made mandatory in Europe since November 2015. This allows crew members to report any occurrences while also protecting the author of the report against the inappropriate use of safety information, marking another important step in addressing the CAQ related questions.

Where does ECA stand?

ECA has published its in-depth [position paper](#) in December 2015, in which, it calls for a continuous development of new technologies that can assist in further reducing the occurrence and effects of fume events. The position paper also emphasises the importance of distinguishing between the possible safety repercussions stemming from abnormal situations (e.g. fume events in the cockpit or the cabin) and the potential long-term health effects of such events. Whereas the latter one requires a reliable factual backup, the need to address the likely hazard of fume events is immediate.

For this reason, ECA outlined the most essential actions in regards to CAQ to avoid any compromise on flight safety. Among others, it recommends the continuous improvements of filtering and detections systems with the long-term aim of bleed-free aircraft designs, better crew training to reduce safety risks, and more explicit harmonised operation procedures for fume events.

Fume events continue to occur and so should the dialogue around them. The results of the scientific research are expected to be published in autumn 2016, but until then, stakeholders should keep on ensuring that safety remains a top priority in European aviation.

**CAA statement on cabin air quality
Civil Aviation Authority
19 June 2015**

We understand the concerns that have been raised about cabin air quality and we take very seriously any suggestions that people have suffered ill health from their experience of aviation.

A CAA spokesperson said:

"Our priority is always the safety of passengers and crew and we continue to work with airlines, manufacturers and international regulators to drive improvements in safety standards across the industry.

"We understand the concerns that have been raised about cabin air quality and we take very seriously any suggestions that people have suffered ill health from their experience of aviation.

"We rely on guidance from scientific experts based on the results of a number of independent studies and evidence reviews - including Government commissioned research. The overall conclusion of those studies is that there is no positive evidence of a link between exposure to contaminants in cabin air and possible acute and long-term health effects, although such a link cannot be excluded. Accordingly, we

support the steps being taken by the European Aviation Safety Agency (EASA), which maintains responsibility for approving the safety of aircraft and setting aviation standards for European airlines, and is carrying out further research into cabin air quality.

"It is important that we continue to support this work, which we believe will help significantly improve the global aviation industry's understanding of what, if any, impact exposure to fumes has on people's long-term health."

Unite chief in public inquiry call to allay health fears over cabin air safety **21 April 2015**

Britain's largest union, Unite, today (21 April 2015) called for a public inquiry into the health effects of 'fume events' on airliners amid warnings that there is insufficient monitoring and research into aerotoxic syndrome.

Speaking to ITV News, Unite general secretary Len McCluskey said that more needed to be done to understand illnesses caused by exposure to contaminated cabin air on jet aircraft and that airlines should be required to monitor air quality during all flights.

Announcing that Unite had set up a helpline for its 20,000 cabin crew members on aerotoxic syndrome, McCluskey told ITV News that the union was also establishing a fume event register to monitor and collect data on fume incidents.

The union which represents cabin crew across the airline industry said it was responding to mounting concern among its members and was supporting the family of Matthew Bass through the inquest into his death. Matthew, a Unite member who worked as cabin crew for two airlines in a 15 year career, died suddenly last January, aged just 34. Speaking to ITV News Len McCluskey said that it is Unite's "intention to make certain that aerotoxic syndrome doesn't become a silent killer," saying that "literally all of our cabin crew members will have experienced a fume event at some time. It occurs not regularly, but it occurs sufficiently often for people to be concerned about."

He went on to add that "we want debate and discussion, we want to make certain that manufacturers looking to the future of aviation start to develop new methods of producing aeroplanes."

Since the 1950s jet engines have been designed to take air from the engine and use it to supply the cabin. Most modern aircraft work in the same way, so in the event of a leak fumes can end up inside the aircraft in what is commonly known as a 'fume event'. Repeated exposure to 'fume events' is believed to cause aerotoxic syndrome (see notes). Calling for a public inquiry, Len McCluskey told ITV news that: "We want the manufacturers and airlines to treat this [aerotoxic syndrome] seriously and we are not going to allow a position where our members and indeed members of the public are exposed in a way that people simply shrug their shoulders and say 'well there is nothing wrong'.

“We don’t want to constantly have fatalities of decent working people, who go to work and should be protected, to build up and up and up before somebody decides to finally say ‘well perhaps we should do something about this’.”

Len McCluskey’s interview airs this evening on ITV news at 6:30pm and 10pm and is part of a report by ITV’s business editor Joel Hills into the latest developments on aerotoxic syndrome.

ENDS

For further information please contact Unite head of media and campaigns Alex Flynn on 020 3371 2066 or 07967 665869.

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4. Parliamentary material

4.1 PQs

[Aircraft](#)

Asked by: The Countess of Mar

To ask Her Majesty's Government what assessment they have made of the 2010 PhD study by Susan Michaelis *Health and flight safety implications from exposure to contaminated air in aircraft* showing that 63 per cent of studied pilots experienced short-term effects from cabin air contamination, and 13 per cent were no longer able to maintain their pilot medical certification because of chronic ill health which bore a close temporal relationship to cabin air contamination; and what support is offered to pilots, crew and passengers who are affected by fume events.

Answering Member: Lord Ahmad of Wimbledon

The Government has not made any assessment of the study referred to. However, the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment has reviewed a number of earlier reports by the author when conducting its own research into cabin fume events, which has informed the Government's assessments.

Support for those concerned that their health has been impacted by air travel is offered through the National Health Service. The Government would encourage any pilots, crew or passengers with health concerns relating to fume events in the first instance to contact their GP, who can assess their case and refer on to specialist services where appropriate.

HL 16 Dec 2015 | Written Questions | HL4164

Asked by: Countess of Mar

To ask Her Majesty's Government further to the Written Answer by Lord Ahmad of Wimbledon on 22 July (HL1265), how they reconcile their claim that 95 per cent of the cabin air samples taken in the Cranfield air quality study showed no detectable amounts of tri-cresyl phosphate (TCP) or tri-ortho-cresyl phosphate (TOCP) when Part 2 of the final report shows that TCP and TOCP were detected in 25 per cent of the 100 samples.

Answering member: Lord Ahmad of Wimbledon

The study itself concludes that "It is notable that no detectable amount of TOCP or other TCPs were found in over 95% of the cabin air samples." The Government has taken this peer-reviewed finding at face value and sees no reason to dispute the conclusions of the report.

The study was published in two parts, Part 1 containing the conclusions and Part 2 setting out the raw data. During analysis some of the data

samples in Part 2 were discounted from the study due to various reasons such as fault with the equipment.

HL Deb 16 Dec 2015 | Written Questions | HL4163

[Aircraft](#)

Asked by: The Countess of Mar

To ask Her Majesty's Government, further to the Written Answer by Lord Ahmad of Wimbledon on 8 July (HL831), how many of the recorded fume or smell events during the 100 flights referred to in that answer were reported to the Civil Aviation Authority under the mandatory reporting scheme.

Answering Member: Lord Ahmad of Wimbledon

No fume event occurred during this study (Aircraft Cabin Air Sampling Study, Cranfield University, 2011) which triggered the airline's formal reporting procedures to the Civil Aviation Authority.

HL Deb 10 Nov 2015 | Written Questions | HL3215

4.2 Deposited Paper

Deposited paper on the position of the Committee on Toxicity of Chemicals in Food, Consumer Products & the Environment

http://data.parliament.uk/DepositedPapers/files/DEP2015-0931/Letter_re_Toxicity_of_Chemicals_in_Food.pdf

30 Nov 2015

4.3 Written Statement

Aircraft Cabin Air Quality

The Minister of State, Department for Transport (Mrs Theresa Villiers): Cranfield university are today publishing their research into aircraft cabin air sampling on commercial aircraft in scheduled operation. A link to the report is being provided on the Department for Transport website.

The consideration of this matter by the Committee on Toxicity (COT) in 2007 provided an important opportunity to examine this issue in depth. Further scrutiny was provided by the investigation carried out by the House of Lords Science and Technology Committee.

The Department commissioned this independent research in 2008 (once tests had been completed to find suitable scientific equipment for the task) as a result of a recommendation by the COT—the first time such a study had been carried out by any country in the world.

The main conclusion of Cranfield's research was that there was no evidence of pollutants occurring in cabin air at levels exceeding available health and safety standards and guidelines. Levels observed in the flights that formed part of the study were comparable to those typically experienced in domestic settings.

The study monitored a total of 100 flights in five different aircraft types: Boeing 757, Airbus 319, 320 and 321 and the BAe 146. A series of air samples were taken at defined points on all flights, with additional samples taken during any "fume events" if any occurred. All flight crew, cabin crew and researchers were requested to complete a post-flight questionnaire, including questions about any fumes or smells that occurred during the flight.

The study's objective was to analyse cabin air for volatile organic compounds, semi-volatile organic compounds, particles and carbon monoxide in normal operations during all phases of flight (e.g. climb, cruise, descent); and to detect and characterise any anomalous elevations of these elements during any "fume events" where unusual smells or similar occurrences were reported.

The European standard "Aircraft internal air quality standards, criteria and determination methods" sets safety, health and comfort limits for a number of substances, including two that were measured in the study—carbon monoxide and toluene. The study's results indicate that concentrations of both carbon monoxide and toluene remained within these limits. In the absence of specific cabin air standards for the other pollutants measured in the research, the study referred to other standards and guidelines established, for example, for domestic (home) or occupational environments. Again, none of these standards or guidelines was exceeded.

I am grateful to Cranfield university for their rigorous and painstaking work. I am also grateful to the participating airlines which made their flight staff and management time and their aircraft available to the project. Without this invaluable practical help, the research would not have been possible.

The Department will always take the health of persons on board aircraft very seriously and I hope the publication of this thorough and independent analysis by Cranfield university will provide reassurance on this issue. We will continue to keep in close touch on all aviation health matters with the UK's aviation regulator, the Civil Aviation Authority.

The Department will now take forward the one remaining cabin air study outstanding—the swab test research being conducted by the Institute of Occupational Medicine in Edinburgh.

When that has been finished all the completed research projects will be submitted to the Committee on Toxicity for their consideration so that the public can be assured that this matter has been thoroughly investigated.

5. Useful links and further reading

BALPA *Position on Cabin Air Quality* 2013

<http://www.balpa.org/About-BALPA/Publications/Position-Statements/Cabin-Air-Quality/BALPA-Position-on-Cabin-Air-Quality-2013-01-01.aspx>

Department for Transport

<https://www.gov.uk/government/publications/cabin-air-quality-faq/cabin-air-quality-main-issues>

Guidance

21 June 2012

Cranfield University

Aircraft Cabin Air Study

Part 1:

<https://dspace.lib.cranfield.ac.uk/bitstream/1826/5305/1/AircraftCabinAirSamplingStudyPart1FinalReport%2020110420.pdf>

Part 2:

<https://dspace.lib.cranfield.ac.uk/bitstream/1826/5306/1/AircraftCabinAirSamplingStudyPart2FinalReport%2020110420.pdf>

April 2011

Institute of Occupational Medicine (IOM)

Research paper

http://www.iom-world.org/pubs/iom_tm1106.pdf

March 2012

Committee on Toxicity

Position Paper on Cabin Air

<http://cot.food.gov.uk/sites/default/files/cot/cotpospapcabin.pdf>

Coroner's "Report to Prevent Further Deaths"

<https://www.judiciary.gov.uk/wp-content/uploads/2015/03/Westgate-2015-0050.pdf>

16 Feb 2015

Boeing

http://www.boeing.com/commercial/aeromagazine/articles/qtr_4_07/article_02_1.html

Global Cabin Air Quality Executive (GCAQE)

<http://gcaqe.org/>

House of Lords Science and Technology Select Committee *Air Travel and Health* 15 November 2000

<http://www.parliament.the-stationery-office.co.uk/pa/ld199900/ldselect/ldscitech/121/12101.htm>

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