

## Contaminated air: is the 'but for' test saving air carriers?

### 1. Abstract

Cases concerning victims of presumed air cabin contamination are receiving ever more media attention. Meanwhile, experts are still trying to demonstrate that the so called 'fume events' might have consequences on human health. A recent study published in 2017 demonstrates a "clear cause and effect relationship has been identified linking the symptoms, diagnoses and findings to the occupational environment."<sup>1</sup> If other studies corroborate such findings, then carriers might face large amounts of litigation from former crew members who are suffering from chronic illnesses.

Although the problem has been known for over a decade, only a few cases have been successful, mainly because the victims used specific health-related legislation rather than general tort law. Basing itself predominantly on the Richard Westgate case, this article concludes that the famous English 'but for' test is preventing claimants from demonstrating any causal link between their illnesses and the fume events.

### 2. Introduction

Awareness that the air in aircraft could be contaminated was raised after various suspicious deaths of crew members. While air carriers and manufacturers are claiming those fume events are rare, and that even when they occur the air quality still exceeds the safety standards, a greater number of cases concerning sick or dead crew members are being reported, led by three scientists from universities in the UK and Australia and published in the World Health Organization journal, *Public Health Panorama* (hereafter 'the 2017 study'), who have concluded that the air in aircraft cabins is a toxic well of disease.<sup>2</sup> The researchers noted that, "A clear cause and effect relationship has been identified linking the symptoms, diagnoses and findings to the occupational environment."<sup>3</sup> The possible contamination is the result of a defect in most plane designs which allows air to come straight from the engine without being filtered

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<sup>1</sup> Susan Michaelis and others, Aerotoxic Syndrome: A New Occupational Disease?, 3 *Public Health Panorama* 198, (2017)

<sup>2</sup> Susan Michaelis and others, Aerotoxic Syndrome: A New Occupational Disease?, 3 *Public Health Panorama* 198, (2017)

<sup>3</sup> Susan Michaelis and others, Aerotoxic Syndrome: A New Occupational Disease?, 3 *Public Health Panorama* 198, (2017)

into the cabin, through the bleed air system. Bleed air has been used since the 1960s on commercial aircraft, although considered safe, this system is certainly not risk-free.<sup>4</sup> If these findings are accurate, this would result in innumerable lawsuits from current and former cabin crew members and would be disastrous for the aviation sector.

However, this issue is extremely complicated to solve, firstly because there is no agreed definition as to what constitutes a fume event, which currently ranges from thick smoke to the presence of a strong smell. Additionally, while various sources can contaminate the air, the media have most often focused on contamination by jet oil as it is deemed to be the most dangerous type of contamination. Secondly, their very nature poses great challenges in establishing with certainty any causal link between an event and an illness or death.

Interestingly, in 2010, a flight attendant was awarded damages by the Australian High Court after she demonstrated that she fell ill because of contaminated air.<sup>5</sup> This was the first time that a law court held an air carrier accountable for health damage caused by contaminated cabin air. Although this case seems to represent a significant global precedent, few cases have been successful. One of the reasons is that plaintiffs cannot prove the connection between their illness and onboard fume events. For instance, in the case of Richard Westgate's unexplained death, a possible connection between contaminated cabin air and his illness could not be established, although the first coroner concluded that exposure to organophosphate (OP) could be the cause of his death.

These cases and other persistent reports of "fume events" contaminating cabin air on flights by major air carriers are raising questions not only about a ventilation system used in nearly every commercial airliner worldwide, but also about why these claims have rarely succeeded. The answer is relatively simple: under English law, crew members have failed to demonstrate a causal link between their illnesses and the fume events. Additionally, there are various contradictory reports and studies; only a few have firmly concluded that air contamination could result in long-term diseases.

This article argues that the general English tort law test, known as the 'but for' test, is, at this stage of scientific advancement, makes it impossible to demonstrate the causal connection

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<sup>4</sup> Elizabeth Lambert-James and Nicola Williams, Fume events: the current position, *Aviation Bulletin* 7, (2014)

<sup>5</sup> *Turner v Eastwest Airlines Limited* [2009] NSWDDT 10

between illness or death and contaminated cabin air and safeguards carriers against unravelling lawsuits. Frequent flyers are in an even odder position as they might be travelling on various carriers over a short period of time, further breaking any causal link. Passengers seem to be in a better position if they can prove that they suffered an accident which resulted in bodily injury as a result of a fume event, under Article 17 of the Montreal Convention.

### 3. Contaminated air

Concerns have been raised by organisations representing pilots and cabin crew about the effects of air contamination in aircraft on their health, with particular concerns about organophosphate compounds (OPs). Jet engine oil contains additives and synthetic hydrocarbons, including an organophosphate known as tricresyl phosphate (TCP), which acts as a high-pressure lubricant. It is broadly accepted that a high concentration of OP has “direct toxicological influences on living cells.”<sup>6</sup> For instance, high concentrations of this compound are found in insecticides. Some have proven that repeated exposure to lower doses of OPs can have more subtle effects.<sup>7</sup> Additionally, TCP is recognized as a toxic mixture which “can cause a wide array of transitory or permanent neurological dysfunction when swallowed in a sufficient quantity.”<sup>8</sup> However, the amount that constitutes ‘sufficient quantity’ is still debated.

‘Aerotoxic syndrome’ is the term used to describe the symptoms of exposure to contaminated air, however the term is not an officially recognised medical diagnosis.<sup>9</sup> The debates oppose, on the one hand, many in the aviation industry, who deny its existence, and on the other, sceptics, including Dr. Susan Michaelis, who argue that the problem has been known by both carriers and the manufacturer for decades. Sceptics even claimed that both carriers and manufacturers have continued to rely on a system with a faulty design, instead of resolving the problem.<sup>10</sup> Their view is backed by various studies highlighting the potential danger of repeated

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<sup>6</sup> Susan Michaelis and others, *Aerotoxic Syndrome: A New Occupational Disease?*, 3 *Public Health Panorama* 198, (2017), p. 207

<sup>7</sup> Terry AV Jr., *Functional consequences of repeated organophosphate exposure: potential non-cholinergic Mechanisms*, 134 *Pharmacol Ther* 355, (2012)

<sup>8</sup> Professor Michael Bagshaw, *Health Effects of Contaminants in Aircraft Cabin Air*, Summary Report v 2.7, (2004)

<sup>9</sup> The term was first used in Chris Winder and Jean-Christophe Balouet, “Aerotoxic Syndrome: Adverse Health Effects following Exposure to Jet Oil Mist during Commercial Flights” in *Towards a safe and Civil Society. Proceedings of the International Congress on Occupational Health Conference*, held in Brisbane, Australia, 4-6 September 2000

<sup>10</sup> Susan Michaelis, “Implementation of the Requirements for the Provision of Clean Air in Crew and Passenger Compartments using the Aircraft Bleed Air System” (Master Thesis, Cranfield University, 2016); Susan Michaelis and others, *Aerotoxic Syndrome: A New Occupational Disease?*, 3 *Public Health Panorama* 198, (2017)

exposure to fume events. Dr. Michaelis noted that, “It was promptly recognized that air bled from the engine compressors was contaminated via internal engine oil leakage into the compressor air.”<sup>11</sup> She even claimed that the air inside aircraft does not meet the standard required by the Federal Aviation Administration (FAA) and the Civil Aviation Authority (CAA). However, not much has changed. Even more alarming, the Australian Civil Aviation Safety Authority has recognized - in a 2009 report titled Contamination of Aircraft Cabin Air by Bleed Air- that the potential for contamination of cabin air is important and concluded that there is still a lack of evidence on the potential consequences.<sup>12</sup>

The major issue with fume events is that, with the exception of the recent study by Dr. Michaelis, no other research has provided strong evidence linking fume events with long-term health effects for crew and passengers.<sup>13</sup> Indeed, most published studies concluded that air pollution in aircraft did not exceed the recommended health limits over the time in which they were carried out. For instance, a 2001 study by BRE demonstrated that the contamination in the cabin on a number of Boeing 757s as below the toxicological threshold for humans over 8 hours.<sup>14</sup> In 2007, the United Kingdom Committee on Toxicity (COT) published a report where it concluded that “whilst a causal association between cabin air contamination by oil mists and ill-health in commercial air crew could not be identified, a number of incidents with a temporal relationship between reports of oil/fume exposure and acute ill-health effects indicated that such an association was plausible.”<sup>15</sup> The COT recognised that an association was plausible based on the timing of the fume event and the onset of the health symptoms.<sup>16</sup> The report further advised that “it would be prudent to take appropriate action to prevent” air contamination incidents.<sup>17</sup>

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<sup>11</sup> Susan Michaelis and others, *Aerotoxic Syndrome: A New Occupational Disease?*, 3 *Public Health Panorama* 198, (2017), p. 198

<sup>12</sup> “Despite the large amount of information available to the Panel, there remain many unanswered questions in seeking to understand the potential for exposures to engine oil in aircraft cabins and the acute and chronic effects on a person’s health as the result of such exposures” p. xiii

<sup>13</sup> Chris Winder and Jean-Christophe Balouet, “Aerotoxic Syndrome: Adverse Health Effects following Exposure to Jet Oil Mist during Commercial Flights” in *Towards a safe and Civil Society. Proceedings of the International Congress on Occupational Health Conference*, held in Brisbane, Australia, 4-6 September 2000

<sup>14</sup> See: Professor Michael Bagshaw, *Health Effects of Contaminants in Aircraft Cabin Air*, Summary Report v 2.7, (2004)

<sup>15</sup> Professor Michael Bagshaw, *Health Effects of Contaminants in Aircraft Cabin Air*, Summary Report v 2.7, (2004), p.5

<sup>16</sup> Committee on Toxicity of Chems. in Food Consumer Prods. and the Env’t, *Statement on the Review of the Cabin Air Environment, Ill-Health in Aircraft Crews and the Possible Relationship to Smoke/Fume Events in Aircraft* (2007), <http://cot.food.gov.uk/pdfs/cotstatementbalpa200706> (accessed 12 September 2018)

<sup>17</sup> Committee on Toxicity of Chems. in Food Consumer Prods. and the Env’t, *Statement on the Review of the Cabin Air Environment, Ill-Health in Aircraft Crews and the Possible Relationship to Smoke/Fume Events in Aircraft* (2007), <http://cot.food.gov.uk/pdfs/cotstatementbalpa200706> (accessed 12 September 2018), p.24

Another scientist, Dr. Abou-Donia, has tried to demonstrate the toxicity of the exposure by evidencing that a long-term low-level exposure to very small doses of organophosphate compounds are more neurotoxic than a large single dose. According to his findings and the findings of Goran A. Jamal and others, the effects of the minimum threshold single dose of TCP - where threshold is established at 250 milligrams per kilogram of body weight - was met through 36 daily doses of half a milligram per kilogram of body weight, amounting to 18 milligrams.<sup>18</sup> This observation that long-term low-level exposure can be more damaging than a single large dose is of crucial importance as the airline industry argues that the low levels of exposure are what makes cabin air safe.

Scientists have had a hard time demonstrating, through objective evidence, that the chemicals are to blame. Quite the contrary, two recent studies published by the European Aviation Safety Agency (EASA) have concluded that “a causal link between exposure to cabin/cockpit air contaminants and reported health symptoms is unlikely.”<sup>19</sup> The main problem of EASA’s studies is that the findings are based on the analysis of 69 flights over a year period, which represents a relatively small sample compared to other studies.

The 2017 study concluded that both short and long-term illness were a direct result of the exposure of crew members to oil fumes and other fluid particles that could be found in the cabin. To obtain such results, the researchers have looked at more than 200 pilots and flights attendants to see if they had consistent health issues.<sup>20</sup> Additionally, they also looked at specific fuel leak incidents and the aircrew members involved. They found various recurrent illnesses such as headaches and dizziness, but also more serious issues such as respiratory and eye problems, as well as neurological and cognitive illnesses.<sup>21</sup> In other words, the experts

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<sup>18</sup> Abou-Donia, Organophosphorus Ester-induced Chronic Neurotoxicity, (2003) 58 Arch Environ Health 484, (2003); Goran A. Jamal and others, Low level exposures to organophosphorus esters may cause neurotoxicity, 181 toxicology 23, (2002)

<sup>19</sup> EASA, EASA publishes two studies on cabin air quality, <https://www.easa.europa.eu/newsroom-and-events/press-releases/easa-publishes-two-studies-cabin-air-quality>, (accessed 12 September 2018)

<sup>20</sup> Susan Michaelis and others, Aerotoxic Syndrome: A New Occupational Disease?, 3 Public Health Panorama 198, (2017)

<sup>21</sup> M.B Abou-Donia, Organophosphorus ester-induced chronic neurotoxicity, 58 Archives of Environmental Health 84, (2003); L. Coxon, Neuropsychological assessment of a group of BAe 146 aircraft crew members exposed to jet engine oil emissions, 18 Journal of Occupational Health and Safety (Australia & New Zealand) 313, (2002); S. Mackenzie Ross, A. Harper, and J. Burdon, Ill health following exposure to contaminated aircraft air: psychosomatic disorder or neurological injury?, 22 Journal of Occupational Health and Safety (Australia & New Zealand) 521, (2006); M.R. Montgomery, and others, Human intoxication following inhalation exposure to synthetic jet lubricating oil, 11 Clinical Toxicology 423, (1977)

uncovered a clear pattern of chronic symptoms.<sup>22</sup> For them, the source of the various illnesses they discovered is clear; it comes from low-level oil leakage although not demonstrated by other authors. On top of that, the study demonstrates that 88% of the persons examined were aware of their exposure to contaminated air<sup>23</sup>, which in itself raises red-flags, especially if the crew and pilots are briefed by the airlines about this problem but still airlines refuse to take responsibility for the consequences.

Interestingly, in 2017 EasyJet announced that it will be fitting its aircraft with specially designed filters to stop toxic fumes entering the cabin. Although the existence of an aerotoxic syndrome is still debated, the fact that carrier equipped its aircraft with special filters might be a passive acknowledgement of the problem.<sup>24</sup> Similarly, Boeing adopted a new air system on board its 787 Dreamliner, drastically diminishing the risk of fume events.<sup>25</sup> This might be a step forward in one of the biggest denials of the airline industry, despite the consistent pilot and flight attendant reports and hospitalisations.

A 2014 Australian report has highlighted the fact that more than 1000 fume events were reported during a five years period.<sup>26</sup> Most of these events were found to be minor in consequences, with only one crew incapacitation event and 11 minor injury events to crew members. The report also noted that, in several cases, crews performed forced landings because of the fumes and crewmembers were incapacitated for several months. In a 2009 occurrence, one of the technical crew members on board a Qantas flight, which had to be diverted, could not return to work for eight months.<sup>27</sup> The report pointed out that BAE 146 aircraft were the

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<sup>22</sup> Chris Matyszczyk, New Study Says Contaminated Air on Flights Is Making People Sick (and Airlines Know It), <https://www.inc.com/chris-matyszczyk/new-study-says-contaminated-air-on-flights-is-making-people-sick-and-airlines-know.html> (accessed 12 September 2018)

<sup>23</sup> Susan Michaelis and others, Aerotoxic Syndrome: A New Occupational Disease?, 3 Public Health Panorama 198, (2017), p. 200

<sup>24</sup> Julia Corderoy, British airline to develop new cabin filter system over health concerns, <https://www.news.com.au/travel/travel-updates/incidents/british-airline-to-develop-new-cabin-filter-system-over-health-concerns/news-story/35c6737bcd3a0b864e0b78a51b254fc3> (accessed 12 September 2018)

<sup>25</sup> Select Committee on Science and Technology, Memorandum by the Boeing Company, <https://publications.parliament.uk/pa/ld200708/ldselect/ldsctech/7/7we07.htm> (accessed 12 September 2018)

<sup>26</sup> ATSB transport Safety Report, A joint initiative of Australian aviation safety agencies: An analysis of fumes and smoke events in Australian aviation, 2008 to 2012, Australian Transport Safety Bureau, 2014

<sup>27</sup> Matthew Benns special report, Staff seek answers as report reveals rising incidents of toxic fume exposure across all airlines, <https://www.news.com.au/national/staff-seek-answers-as-report-reveals-rising-incident-of-toxic-fume-exposure-across-all-airlines/news-story/5419c321491723499f55923573c17ff5>, (accessed 12 September 2018)

worst in terms of fume events, as well as ageing Boeing 767s.<sup>28</sup> Interestingly, the report has shown that the reporting of fumes incidents in Australia tripled between 2008 and 2012.

A 2014 American study on used bleed-air filters detected tricresyl-phosphate (TCP) in 90% of the 185 tested used filters, which evidences that contamination by TCP is relatively common.<sup>29</sup> Interestingly, Exxon mentions in its notice for the Mobil Jet Oil II that the “product may decompose at elevated temperatures or under fire conditions and give off irritating and/or harmful (carbon monoxide) gases/vapours/fumes. Symptoms from acute exposure to these decomposition products in confined spaces may include headache, nausea, eye, nose, and throat irritation.”<sup>30</sup> Even the manufacturer of the oil, Exxon, used in aircraft warns against the possible health hazards and admits the possibility of harmful fumes resulting from the heating of the oil. One of the scientists’ assumptions in proving the existence of the aerotoxic syndrome is that it comes from the heating of the oil which is then bled into the cabin. Some of the health hazards acknowledged by Exxon are identical to the symptoms described by some cabin crew members. On the 2017 version of the safety data sheet, one of the hazard risks linked to the use of the product was “damage to organs through prolonged or repeated exposure.”<sup>31</sup> In this report, under precautionary statements, the manufacturer warns against the inhalation of mist or vapours. Finally, Exxon guarantees the usage of this oil between -40 and 246 degrees Celsius, while jet engines operate typically at a temperature exceeding 500 degrees Celsius and therefore well above the temperature guaranteed by Exxon.<sup>32</sup>

Compared to other jobs with similar characteristics - long hours, shift work and high stress- it seems that there are more deaths in crew members than in other occupations.<sup>33</sup> Although denied by carriers, which claim that the death rate matches the age demographic in the general

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<sup>28</sup> D. G. Newman, Pilot Incapacitation: Analysis of Medical Conditions Affecting Pilots Involved in Accidents and Incidents 1 January 1975 to 31 March 2006, Aviation Research and Analysis Report – B2006/0170, Australian Transport Safety Bureau: NS, 2007

<sup>29</sup> J. Eckels and others, Aircraft Recirculation Filter for Air-Quality and Incident Assessment, 51 J. Aircr. 320, (2014)

<sup>30</sup> Exxon Mobil, Safety Data sheet, Mobil Jet Oil II, (30 August 2018)  
[file:///Users/dd/Downloads/MSDS\\_743589.pdf](file:///Users/dd/Downloads/MSDS_743589.pdf) p.2 (accessed 12 September 2018)

<sup>31</sup> Exxon Mobil Safety Data sheet, Mobil Jet Oil II, (21 September 2017)  
[file:///Users/dd/Downloads/MSDS\\_83793.pdf](file:///Users/dd/Downloads/MSDS_83793.pdf) (accessed 12 September 2018)

<sup>32</sup> Exxon Mobil Safety Data sheet, Mobil Jet Oil II, (21 September 2017)  
[file:///Users/dd/Downloads/MSDS\\_83793.pdf](file:///Users/dd/Downloads/MSDS_83793.pdf) (accessed 12 September 2018); C. Van Netten and V Leung, Hydraulic Fluids and Jet Engine Oil Pyrolysis and Aircraft air, 56 Arch Environ Health 181, (2001)

<sup>33</sup> Kate Leahy, 'There are hundreds of sick crew': is toxic air on planes making frequent flyers ill?, <https://www.theguardian.com/science/2017/aug/19/sick-crew-toxic-air-planes-frequent-flyers-ill> (accessed 12 September 2018)

population, the average age of deceased crew members is around 40 which raises red flags, alongside the fact that other crew members are fighting to recover their health.<sup>34</sup> Some are unable to work again due to long-term impairments such as serious headaches.<sup>35</sup> For instance, in a Dutch case, a pilot requested as a provisory measure to stop flying while receiving his wage, which was refused by the Amsterdam court.<sup>36</sup>

On top of the health implications, there could also be a safety question. Such air contamination led, at least in one reported incident, to the Malmo incident of 1999, and the impairment of both pilots. Another similar incident occurred in 2010 when both the first officer and captain were obliged to put their oxygen masks on after experiencing numbness in both arms and legs, with the captain deciding to land without completing the pre-landing duties. Thankfully, the aircraft was able to land safely, but both pilots were deemed unfit for work for six months.<sup>37</sup> These events are of particular significance since the desire to cut costs might lead to a reduction in maintenance standards and, therefore, render fume events more frequent.

Estimates of the occurrence of fume events vary widely depending on the source of information: carriers, manufacturers and regulatory authorities tend to understate the problem while trade union representatives tend to amplify it. A 2007 report estimated that fume events occur on approximately 0.05% of flights, while a more recent review estimated that the officially documented fume events in the USA account for 0.02% of flights.<sup>38</sup> Nevertheless, it has been recognized that “although there have been many attempts to determine the frequency of oil fume events from available reports, underreporting is widely recognized.”<sup>39</sup> Whatever the actual frequency, as the latest study and other cases demonstrate, the exposure to these fumes could have particularly adverse effects on the health of the crew members and passengers.

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<sup>34</sup> See: Dee Passon, The Angel Fleet Story, <http://www.angelfleet.net/the-angel-fleet-story/4594069052> (accessed 12 September 2018)

<sup>35</sup> Kate Leahy, 'There are hundreds of sick crew': is toxic air on planes making frequent flyers ill?, <https://www.theguardian.com/science/2017/aug/19/sick-crew-toxic-air-planes-frequent-flyers-ill> (accessed 12 September 2018)

<sup>36</sup> C / 13/547894 / KG ZA 13-1016 HJ / PV, 18.09.2013

<sup>37</sup> Elizabeth Lambert-James and Nicola Williams, Fume events: the current position, Aviation Bulletin 7, (2014)

<sup>38</sup> Committee on Toxicity of Chemicals in Food Consumer Products and the Environment, “Statement on the Review of the Cabin Air Environment, Ill Health in Aircraft Crews and the Possible Relationship to Smoke/Fume Events in Aircraft.” Final Report: London, 2007; M. Shehadi, B. Jones, and M. Hosni, Characterization of the frequency and nature of bleed air contamination events in commercial aircraft, Indoor air 1, (2015)

<sup>39</sup> Susan Michaelis and others, Aerotoxic Syndrome: A New Occupational Disease?, 3 Public Health Panorama 198, (2017), p. 206

#### 4. Cases

The major problem with possible contamination, as suggested by the 2017 study, is that not all potential contamination can be detected through simple checks, such as smell events. So how could crew members demonstrate any causal link between their illness and possible fume events? Looking at various cases, some of which had broad media coverage, the answer seems to be simple: they cannot prove it. The only case in which a flight attendant was successful in demonstrating a causal link is an Australian case related to an event occurring in 1992. In 2010, a flight attendant was awarded damages by the Australian High Court after she demonstrated that she fell ill because of contaminated air.<sup>40</sup> This was the first time that a law court held a carrier accountable for health damage caused by contaminated cabin air. In 2008, the Telegraph Travel published an investigation which revealed that British pilots had reported a staggering hundreds of fume events.<sup>41</sup> In 2010, a controversial undercover investigation was carried out by ADR, a German television network, and Schweizer Fernsehen, Swiss television, whereby 31 swab samples were taken from aircraft and analysed. Out of these 31 swabs, 28 samples presented high levels of organophosphate.

One case that attracted wide media coverage and raised public awareness, is that involving Richard Westgate's unexplained death in December 2012. For some time before his sudden death, Richard Westgate suffered pain and discomfort, including frequent severe headaches, paraesthesia, ataxia, fatigue and cognitive deficits. He also suffered chest pain, and experienced bouts of sleep apnea. Mr. Westgate went to several specialists and doctors, but no diagnosis was achieved. Before his death, he was diagnosed with nerve and brain injury, most probably caused by neurotoxic contamination. Following his death, two autopsies were conducted, one directed by the Dutch Minister for Justice and Security and the other by the deceased's family. Both confirmed the presence of lymphocytic myocarditis as well as pentobarbital in his blood at a potentially lethal levels. Additionally, one of the autopsies revealed an "extensive injury to the deceased's peripheral nervous system (PNS) in the form of lymphocytic infiltration, axonal blockage and demyelination of various nerves of his PNS, which is consistent with exposure to toxic and neurotoxic exposure."<sup>42</sup> The test on the brain tissue by Professor Abou-Donia

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<sup>40</sup> East West Airlines Ltd v Turner [2010] HCATrans 238

<sup>41</sup> Charles Starmer-Smith, Is cabin air making us sick?, <https://www.telegraph.co.uk/travel/travelnews/759562/Is-cabin-air-making-us-sick.html> (accessed 12 September 2018)

<sup>42</sup> Bleed free, Westgate Evidence part 1, <http://bleedfree.eu/wp-content/uploads/2015/10/WESTGATE-EVIDENCE-part-1.pdf>, (accessed 12 September 2018) p. 2

demonstrated brain damage consistent with organophosphate exposure. The injuries were deemed consistent with the symptoms the deceased complained about. Finally, Professor Abou-Donia noted that such symptoms were identical to symptoms reported by crew members after documented contaminated cabin air events. The major difficulty in this case is that the deceased took pentobarbital to ease his symptoms, therefore breaking the causal chain which led to a dismissal of any claim by his family. Such concurrent cause, a possible overdose of pentobarbital, was regarded as the cause of the death by Dr. Simon Fox QC in the final inquest, ruling out the findings of the coroner at the initial hearing, who warned against the risks of further deaths “unless action is taken.”<sup>43</sup> The initial coroner based his conclusions on the fact that “organo-phosphate compounds are present in aircraft cabin air” and “that the occupants of aircraft cabins are exposed to organo-phosphate compounds with consequential damage to their health.”<sup>44</sup> Interestingly, Richard Westgate had begun legal action against his former employer, British Airways, not long before he died.

Another suspicious death of a British Airways crew member is that of Warren Brady in 2014. The 46 year-old flight attendant died during a flight from Sao Paulo to Heathrow after working for 19 years on BA’s long-haul fleet. The autopsy could not establish the cause of death; as a result, the West London coroner ruled the death as a cardiac arrest despite a healthy heart. During the autopsy, however, tissue samples were taken and sent to Dr. Frank Van De Goot, a forensic scientist in the Netherlands, for further study. Dr. Frank Van De Goot found that high number of t-lymphocytes in the diseased heart. The same phenomenon was discovered in the hearts of Richard Westgate and Matthew Bass. One of the possible causes of lymphocytic heart muscle inflammation is the presence of toxic substance- the two others, namely cancer and bacterial or viral inflammation- having been ruled out by the autopsy.

Terry Williams is believed to be the first person to have won an out-of-court settlement against Boeing after prosecuting the manufacturer for faulty aircraft design in the US in 2011.<sup>45</sup> Other claims for product liability suits have flourished around the world. The *Sabatino v. Boeing*

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<sup>43</sup> Sheriff Stanhope Payne, Regulation 28: Report to Prevent Future Deaths (2), <https://www.judiciary.uk/wp-content/uploads/2015/03/Westgate-2015-0050.pdf> (accessed 12 September 2018)

<sup>44</sup> Point 5 (1) and (2) of the report

<sup>45</sup> Elizabeth Lambert-James and Nicola Williams, Fume events: the current position, *Aviation Bulletin* 7, (2014), p.8; Mike Danko, First Settlement in Bleed Air Fume Event Case, <https://www.aviationlawmonitor.com/2011/10/articles/lawsuits-1/first-settlement-in-bleed-air-fume-event-case/> (last visited 12 September 2018)

*Corp*<sup>46</sup> seems to have focused more on procedural issues and *forum non conveniens* motions than the events in themselves and might have been settled. Indeed, the plaintiffs, United Kingdom residents, brought a suit for personal injuries against Boeing and others resulting from their exposure to fumes onboard a Boeing aircraft in the Circuit Court of Cook County, in 2009. Two pending lawsuits against Boeing, *Woods v. The Boeing Co.* and *Escobedo v. The Boeing Co.*, could bring some change to the picture. In *Dray v BAE System PLC*<sup>47</sup>, the district court of Western Australia held that the action was viable if the claimant could prove that her “injury was of a foreseeable kind, type, or character of injury.”<sup>48</sup> The Daily Telegraph claims to have reviewed documents of a settlement between British Aerospace and two Australian airlines for alleged design flaws which contained confidentiality clauses.<sup>49</sup> In a 2016 case, a claimant received a payout from British Airways for a fume event.<sup>50</sup> These demonstrate that, in some cases, carriers agree to settle out of court, probably with non-disclosure agreements to avoid the details being divulged.

##### 5. Causation v correlation: The but for test as a safeguard

The various cases above demonstrate that most claims have been brought against carriers, while only few were brought against the manufacturers. Trying to sue the carrier can be a good solution for employees who have worked for some time. However, in the case of crew members who have worked for various air carriers over a relatively short period of time, the establishment of the causal link is more complicated. For instance, if a flight attendant has worked for five years for Lufthansa, then three years for Swiss Air and finally for two years with British Airways, before he starts to fall ill, British Airways might try to reject the fault and blame the other carriers, leaving the claimant in a difficult position.

The but for test could be what is saving air carriers from unravelling lawsuits. Indeed, under general principles of English tort law, a claim for negligence arises when a person or entity fails to exercise a duty of care toward another person or entity. The core idea conveyed by the tort

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<sup>46</sup> Docket No. 2009-L-001056 (Cir. Ct. Cook Cty., Ill.)

<sup>47</sup> [2015] WADC 60

<sup>48</sup> Para 20

<sup>49</sup> Charles Starmer-Smith, Is cabin air making us sick?,

<https://www.telegraph.co.uk/travel/travelnews/759562/Is-cabin-air-making-us-sick.html> (last visited 12 September 2018)

<sup>50</sup> Kate Leahy, 'There are hundreds of sick crew': is toxic air on planes making frequent flyers ill?,

<https://www.theguardian.com/science/2017/aug/19/sick-crew-toxic-air-planes-frequent-flyers-ill>, (last visited 12 September 2018)

of negligence is that people should exercise reasonable care when they act.<sup>51</sup> This idea was also expressed by Lord Blackburn in *The Dublin, Wicklow, and Wexford Railway Company v Slattery*.<sup>52</sup> For the injured person to receive compensation, he or she has to prove that the other person acted negligently, breaching his or her duty of care, which caused his/her injury. The concept of duty of care was first established in *Donoghue v. Stevenson*.<sup>53</sup> The duty of care means that the person should perform an activity that could foreseeably harm others with reasonable care.<sup>54</sup> The test established in *Donoghue v. Stevenson* is also called the neighbour test and has been further divided by the courts into two requirements: reasonable foresight of harm<sup>55</sup> and a relationship of proximity<sup>56</sup>.

In *Caparo Industries Plc v. Dickman*<sup>57</sup>, the threefold test establishing a duty of care was introduced. According to that case, the harm must be (1) reasonably foreseeable (2) there must be a relationship of proximity between the plaintiff and the defendant and (3) it must be 'fair, just and reasonable' to impose liability. Employers in the UK owe a duty of care under Section 2 of the Health and Safety at Work Act 1974 to ensure the health, safety and welfare at work of all employees. Even without this provision, it would be reasonable to impose on an employer a duty to provide a safe environment for staff, and the relationship of proximity is easily established. Moreover, as the Australian court found in *Turner v Eastwest Airlines Limited*, the risk of smoke from leaking oil entering the cabin is foreseeable as is the failure of the oil seal.<sup>58</sup> Once it has been established that the defendant owes a duty to the plaintiff, whether the duty was breached or not is easily settled.<sup>59</sup> The test is both subjective and objective.

After a breach of the duty is found, the causal link between the harm and the breach of the duty must be established by proving that the particular acts or omissions were the cause of the loss or damage sustained. The test is the 'but for' test, requiring the claimant to demonstrate that without the breach of the duty owed to him by the defendant, the claimant would not have suffered harm.<sup>60</sup> However, the chain of causation can be broken by another element, therefore

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<sup>51</sup> Jay Feinman, Law 101. (Oxford University Press, 2010)

<sup>52</sup> (1878) 3 App. Cas. 1155 at 1206

<sup>53</sup> [1932] AC 532

<sup>54</sup> *Hedley Byrne & Co Ltd v Heller & Partners Ltd* [1964] AC 465

<sup>55</sup> *Topp v London Country Bus* [1993] 1 WLR 976; *Home Office v Dorset Yacht Co Ltd* [1970] AC 1004

<sup>56</sup> *Bourhill v Young* [1943] AC 92

<sup>57</sup> [1990] UKHL 2

<sup>58</sup> *Turner v Eastwest Airlines Limited* [2009] NSWDDT 10

<sup>59</sup> *Bolton v. Stone* [1951] AC 850

<sup>60</sup> *Barnett v Chelsea & Kensington Hospital* [1969] 1 QB 428; *Chester v Afshar* [2004] 3 WLR 927

excluding the liability of the defendant.<sup>61</sup> It is this part of the test that crew members have difficulty proving. Indeed, crew members face great challenges in proving a clear connection between their illness and fume events due to the ephemeral nature of the events and the lack of scientific evidence. If the findings of Dr. Abou-Donia- that a long-term low-level exposure results in the same risks as a larger one-time exposure- are supported by other scientific evidence, it could help crew members to demonstrate that their illness is due to this low-level exposure. Indeed, the main argument on which air carriers rely is that the exposure is too-low to produce any adverse effect on human health and that the minimum threshold at which the oil could produce such effects is not met. Since the claimants have to demonstrate the causal link, while the carrier only has to rebut the claim, the findings of Dr. Abou-Donia, if verified, would prove causation.

What renders these cases even more complicated is the fact that the symptoms are “so broad and nonspecific and can have many causes that it is difficult to define or discern a precise illness or syndrome,”<sup>62</sup> therefore it can be easily misdiagnosed. The multiple cases of illnesses on a single flight increase the association but do not provide causation. The only manner of proving causation is ruling out all the other causes but sometimes, for instance in the Richard Westgate case, it is impossible to do so. A related issue is linked to the relatively recent studies demonstrating aerotoxic syndrome and its symptoms. Few doctors are aware of the syndrome, and it often takes time, through the exclusion of all other possible illnesses, before a crew member is diagnosed with aerotoxic syndrome.<sup>63</sup> In a Canadian case, the Tribunal was not satisfied that a causal link existed between the chemical contamination and the symptoms of the employees.<sup>64</sup> However, in another decision related to the Air Canada’s obligations to inform its employees of any “known or foreseeable health and safety hazard,”<sup>65</sup> the tribunal established a breach of Air Canada’s duty.<sup>66</sup> The main difference between the two cases is that under the Labour Code, the information duty does not require any symptoms or risk of harm but rather the likelihood of harm. The Federal Court looking at both judgments held that one of the

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<sup>61</sup> *McKew v Holland* [1969] 3 All ER 1621; *Baker v TE Hopkins & Son Ltd* [1959] 1 WLR 966; *Reeves v Commissioner of Police of the Metropolis* [2000] 1 AC 360

<sup>62</sup> National Research Council, *The airliner cabin environment and the health of passengers and crew*, Consensus Study Report, (2002)

<sup>63</sup> See for instance the story of Porter Lafayette, FUME EVENT "Aviation's Biggest Lie" (e-book, 2016); Dee Passon, *The Angel Fleet Story*, <http://www.angelfleet.net/the-angel-fleet-story/4594069052> (accessed 12 September 2018)

<sup>64</sup> *Diaz Delgado et al v Air Canad* (2015) OHSTC 15

<sup>65</sup> Paragraph 125(1) of the Canadian Labour Code

<sup>66</sup> *Air Canada v Canadian Union of Public Employee* (2015) OHSTC 14

problems of the first decision was that it required scientific certainty instead of the balance of probabilities to prove causation. Consequently, the Federal Court requested a new judgment.<sup>67</sup>

Finally, even if crew members demonstrate causation, they still might not recover damages unless they can prove that the breach caused a pecuniary injury. The pecuniary injury should also be foreseeable, otherwise the plaintiff will only be awarded nominal damages.<sup>68</sup> Remoteness of damage relates to the requirement that the damage must be of a foreseeable type. The first test was the direct consequence test,<sup>69</sup> which was considered unfair and was overruled in *Wagon Mound no 1*.<sup>70</sup> Once the damage is regarded as foreseeable, the defendant is liable for the full extent of the damage no matter whether the extent of the damage is foreseeable.<sup>71</sup>

The study by Dr. Michaelis highlighted that individual susceptibility is one factor for the high variability of the symptoms caused by OP exposure. “Some people have constitutionally low levels of liver enzymes, such as paraoxonases, that detoxify OPs in the liver. It was demonstrated that farmers with lower paraoxonase levels are more likely to suffer from dippers flu as a result of exposure to OP sheep dips.”<sup>72</sup> Such factors would explain the difference in the symptoms of crew members who are affected by fume events. In this situation, the eggshell skull rule would play an important role for crew members as it requires defendants to take their victims as they find them.<sup>73</sup> This means that if some crew members are of a more fragile constitution, carriers will still be obliged to pay for all the damages they suffered.

A way to avoid reliance on the ‘but for’ test and still obtain compensation can be through labour law. For instance, in Germany, the Freiburg Labour Court concluded that a flight attendant, having considerable health problems which occurred after a flight, had suffered from an accident and thus became a victim of a workplace injury.<sup>74</sup> The court based its judgment on the assumption that the applicant was, with high certainty, a victim of a work injury.

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<sup>67</sup> Canadian Union of Public Employee v Air Canada (2017) FC 554, para 72

<sup>68</sup> Constantine v Imperial Hotels Ltd [1944] KB

<sup>69</sup> Re Polemis & Furness Withy & Company Ltd. [1921] 3 KB 560

<sup>70</sup> [1961] AC 388

<sup>71</sup> Hughes v Lord Advocate [1963] AC 837; Doughty v Turner Manufacturing Company [1964] 1 QB 518

<sup>72</sup> Susan Michaelis and others, *Aerotoxic Syndrome: A New Occupational Disease?*, 3 Public Health Panorama 198, (2017), p. 208

<sup>73</sup> Smith v Leech Brain [1962] 2 QB 405; Page v Smith [1996] 1 AC 155; Corr v IBC Vehicles Ltd [2008] 2 WLR 499

<sup>74</sup> DGB Rechtsschutz GmbH v Berufsgenossenschaft für Transport und Verkehrswirtschaft, Sozialgericht Freiburg, 13.06.2017, S 9 U 1210/15

Under Section 6 of the Control of Substances Hazardous to Health Regulations 2002 (COSHH), an employer cannot expose his employees to any substance hazardous to health unless suitable and sufficient assessments have been carried out.<sup>75</sup> Additionally, Section 7 stipulates that “every employer shall ensure that the exposure of his employees to substances hazardous to health is either prevented or, where this is not reasonably practicable, adequately controlled.” Airlines are clearly failing to comply with this obligation as it is clear from the various reports that fume events are not controlled at all but instead are reported after occurring. The reliance on Section 6 could result in similar outcomes as in the German or Australian cases. For instance, in the *Joanne Turner v. Eastwest Airlines*, the victim was awarded damages, in Australia, based on Section 11(1) of the Dust Diseases Tribunal Act 1989 and Sections 151G and 151H of the Workers Compensation Act 1987 but not on general tort law. This case creates a precedent for pilots and cabin crew but will probably be confined to the type of airplane, BAE 146, because these airplanes are recognized as the worst for fume events.

## 6. Passengers

The general framework of the Montreal Convention of 1999 or the Warsaw Convention of 1929 would govern passengers’ claims against air carriers but not against manufacturers. The passengers will have to demonstrate bodily injury as understood by Article 17 of both Conventions. This article imposes liability upon the carrier only if the plaintiff proves: (1) an accident, (2) causing, (3) death or bodily injury, (4) while the passenger was on board the aircraft or was in the course of embarking or disembarking.<sup>76</sup> With regard to what constitutes an “accident” within the meaning of Article 17, the term spawned much litigation before the U.S. Supreme Court addressed the issue. It seems that, currently, a uniform interpretation is to determine whether there is an unexpected or unusual event or happening external to the passenger.<sup>77</sup> The accident cannot be caused by the passenger’s own reaction to the normal conditions of a flight.<sup>78</sup> Additionally, the U.S. Court of Appeals for the Third Circuit found in *Abramson v. Japan Airlines*,<sup>79</sup> that “aggravation of a pre-existing injury during the course of a

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<sup>75</sup> The Control of Substances Hazardous to Health Regulations 2002 <http://www.hse.gov.uk/pUbns/priced/l5.pdf>

<sup>76</sup> *E. Airlines v. Floyd*, 499 U.S. 530, 111 S. Ct. 1489 (1991).

<sup>77</sup> *Krys v. Lufthansa German Airlines*, 119 F.3d 1515 (11th Cir. 1997); *Air France v. Saks*, 470 U.S. 392 (1985). Paul Dempsey, Robert Hardaway and William Thoms, *Aviation Law and Regulation* (Lexis Pub, 1993).

<sup>78</sup> *Abramson v. Japan Airlines*, 739 F.2d 130, 133 (3d Cir. 1984) (“[A]ggravation of a pre-existing injury during the course of a routine and normal flight should not be considered an ‘accident’ within Article 17.”). *Stone v. Cont’l Airlines & John Doe*, 905 F. Supp. 823 (D. Haw. 1995).

<sup>79</sup> 739 F.2d 130.

routine and normal flight should not be considered an ‘accident’ within Article 17.”<sup>80</sup> Similarly, in *Air France v. Saks*,<sup>81</sup> the U.S. Supreme Court denied recovery to a passenger who suffered from deafness as a result of depressurisation during landing. The Court was of the opinion that the passenger’s injury was caused by “internal” problems rather than by an unusual event during the flight.<sup>82</sup> The major question courts will have to answer is whether a fume event constitutes an “accident” within the meaning of the Convention, namely by proving that the event was “unexpected or unusual” from the passenger’s perspective.

It seems that a noticeable fume event involving smoke might well be considered an accident because a passenger would not expect such an event during the flight. If a passenger were to suffer bodily injury as a result of a noticeable fume event, the air carrier would most likely be liable because the injury would have been caused by an usual, normal, and expected event during the operation of the aircraft. However, the result will be less clear if a passenger claims bodily injury as a result of a smaller amount of exposure without any noticeable smoke or smell. In this case, the court will have to determine the level of contaminants in the cabin air acceptable during a normal flight. Only contamination above that level would constitute an accident under the Convention. On top of establishing that minimum level and in line with the *Air France v. Saks* decision, the court will have to determine whether the injury was caused by the claimants own internal reaction or not. So if, as in the *In re UAL Corp* decision<sup>83</sup>, only two passengers on the aircraft become sick, the court will most likely find that the illness is due to the passengers’ own sensitivity to usual level of contaminants. The passengers will then have difficulty demonstrating the level of contaminants in a non-noticeable fume event. Finally, as stated above, frequent flyers seem to be in a similar position to crew members arguably in a more difficult position as they might travel with various carriers in a short period of time. Any bodily injury that could be the result of a long-term exposure is unlikely to be within the scope of the definition of ‘accident’ in the Montreal Convention. Instead, it can be argued that including such cases would be stretching the definition of an accident too far.

The passenger will also have to convince the court that he suffered bodily injury, which is a term that has deeply troubled the courts. In the earlier cases involving the Warsaw Convention,

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<sup>80</sup> Id. at 133.

<sup>81</sup> *Saks*, 470 U.S. 392.

<sup>82</sup> Id. at 406.

<sup>83</sup> 310 B.R. 373 (Bankr. N.D. Ill. 2004)

such as *Rosman v. Trans World Airlines Inc.*, the court only agreed to compensate passengers in respect of their “palpable, conspicuous physical injury” but not their “mental injury with no observable ‘bodily’ as distinguished from ‘behavioral’ manifestations.”<sup>84</sup> Some newer cases reiterated the old approach, such as *Eastern Airlines, Inc. v. Floyd*, where the United States Supreme Court reversed a Federal Appeals Court decision and concluded that “an air carrier cannot be held liable under Article 17 when an accident has not caused a passenger to suffer death, physical injury, or physical manifestation of injury.”<sup>85</sup> In reaching its ruling, the Supreme Court relied primarily on its interpretation of *lésion corporelle* in the Warsaw Convention. Other courts awarded damages when the mental injury was associated with bodily injury. For instance, in the Australian case of *Kotsambasis v. Singapore Airlines Ltd.*,<sup>86</sup> Stein JA balanced the radical approach of sticking to the wording of the Convention by adding that “where mental anguish follows and is caused by physical injury, recovery for both injuries is covered” by the Convention and that “if the psychological injury is proven to be a species of bodily injury, then it would constitute ‘bodily injury’ within the article.”<sup>87</sup> Some courts are even more flexible and have allowed recovery without any concomitant bodily injury, such as in the case of *Husserl v. Swiss Air Transport Co., Ltd.*<sup>88</sup> The court in this case looked closely at the history, case law, and drafters’ intent before concluding that “bodily injury” concerns mental and psychosomatic injuries. The court concluded that “there is absolutely no indication in either the language of the Convention or its legislative history that the drafters intended to preclude all liability for some types of injury.”<sup>89</sup> One explanation for this reasoning is the increasing recognition by science that injuries are not prone to categorisation as either mental or physical.<sup>90</sup>

In *Morris*<sup>91</sup>, Lord Hobhouse took a broader view of what could constitute bodily injury. Lord Nicholls, agreeing with Lord Hobhouse, rejected the submission based on *Rosman* that bodily injuries were confined to those which are “palpable [and] conspicuous.”<sup>92</sup> He noted, “the brain is part of the body. Injury to a passenger’s brain is an injury to a passenger’s body just as much

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<sup>84</sup> 314 N.E.2d 848, 855 (N.Y. 1974).

<sup>85</sup> 499 U.S. 530, 552, 111 S. Ct. 1489, 1502 (1991).

<sup>86</sup> [1997] 42 NSWLR 110 (Austl.).

<sup>87</sup> *Id.* at 121.

<sup>88</sup> 388 F. Supp. 1238. But see *Rosman v. Trans World Airlines, Inc.*, 314 N.E.2d 848, 854–57 (N.Y. 1974) (refusing recovery for mental injury when there was no manifest bodily injury).

<sup>89</sup> *Husserl*, 388 F. Supp. at 1248.

<sup>90</sup> In the words of the court: “Mental reactions and functions are merely more subtle and less well understood physiological phenomena than the physiological phenomena associated with the functioning of the tissues and organs and with physical trauma.” *Husserl*, 388 F. Supp. at 1250.

<sup>91</sup> *Morris v. KLM Royal Dutch Airlines; King v. Bristow Helicopters Ltd.* [2002] UKHL 7, [2002] 2 AC 628

<sup>92</sup> 314 N.E.2d at 855.

as an injury to any other part of his body. Whether injury to a part of a person's body has occurred is, today as much as in 1929, essentially a question of medical evidence. It may be that, in the less advanced state of medical and scientific knowledge 70 years ago, psychiatric disorders would not have been related to a physical impairment of the brain or nervous system. Even if that is so, this cannot be a good reason for now excluding this type of bodily injury, if proved by satisfactory evidence, from the scope of Article 17. This does not mean that shock, anxiety, fear, distress, grief or other emotional disturbances will as such now fall within Article 17. It is all a question of medical evidence."<sup>93</sup> This means that if a passenger can demonstrate some brain injury as a result of exposure to contaminated air, then the carrier will be required to compensate them. However, as the recent Australian decision in *Pel-Air Aviation Pty Ltd. v. Casey*<sup>94</sup> has shown psychological harm such as PTSD, is not considered as bodily injury and therefore is not recoverable under the Conventions.

If the court finds that a fume event constitutes an accident and is convinced that the passenger suffers bodily injury, then the carrier could be liable. The only reported case was filed in 2014 by Christopher Kamyszek against Delta Airlines and Airbus before the Circuit Court of Arlington County, for alleged loss of ability to earn a living, loss of enjoyment of life and damages for mental pain and debilitating physical injury as a result of a fume event.<sup>95</sup> No trial took place and the motion was dismissed by the claimant himself.

## 7. Conclusion

Although generally considered safe, the process of bleed air is not entirely risk-free. It is clear that fume events do occur, either due to seal failure or engine over-servicing, and they expose crew members and passengers to hazardous fumes, of which the effects on human health is still unclear. Additionally, there is no agreed definition of what constitutes a fume event, which ranges from hazy smoke to the presence of a strong smell. While various sources can contaminate the air, the media has most often focused on contamination by jet oil as it is deemed to be the most dangerous type of contamination. Toxic cabin air claims already represent a very small percentage of the aviation tort cases filed, but the number of toxic cabin air claims filed represents only a fraction of all fume events. Media coverage and public awareness could

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<sup>93</sup> [2002] UKHL 7, [2002] 2 AC 628 ¶¶ 3–4.

<sup>94</sup> [2017] NSWCA 32 (9 March 2017) (Austl.).

<sup>95</sup> *Kamyszek v Delta Airlines Inc et al*, Case No. 1:14-cv-01377

increase the number of claims filed. However, proving these claims seems to be a long and complicated journey.

The majority of the reports ordered by airlines and civil aviation authorities show that the level of organophosphate is too low to affect human health. However, two studies have demonstrated a link between the exposure and long-term illnesses or death due to the long-term low-level exposure which seems more damaging than a single large dose. The issue comes from a faulty design, which has been known by both airlines and manufacturers for decades and is sometimes referred to as one of the biggest cover-ups of the industry.

Due to its nature and the low levels of reporting, presumably due to fear of the working pilots and crew to jeopardize their positions, proving any causal link between any illnesses or death and the fume events is complicated. Indeed, if carriers admit the existence of health-related issues due to contaminated air, it would open the floodgates for litigation. However, if they continue to deny their existence, then crew members will have to meet the threshold of the 'but for' test. The testimonies of crew members from various carriers and the many reports suggesting possible air contamination, increase the odds but, unless a flexible interpretation of the 'but for test' is applied, all these cases will fail due to the impossibility proving causation. Similarly, the fact that the newest plane from Boeing, the 787 Dreamliner, is equipped with another system also supports the argument of their being design defect in older aircraft but still does not establish causation. Interestingly, the few successful cases have been based on other legislation than general tort law. The best option for crew members would, therefore, be to bring a product liability claim against the manufacturer rather than to sue their employer.

Passengers seem to be in a more comfortable position if they prove that the fume event was an accident, under the meaning of Article 17 of the Montreal Convention, and that it resulted in bodily injury. However, it seems apparent that the severe symptoms are not developed directly but instead develop as a result of frequent exposure, which might render the case more complicated to fight. Frequent flyers, who use different carriers, seem to be in the most complicated category as the causal link between exposure and any illness is even more diluted.

As Dr. Michaelis noted, “the lack of an internationally accepted protocol for investigating aircraft fume events hampers our understanding of the consequences of such exposure.”<sup>96</sup> It is, therefore, time that international aviation organisations investigate this matter thoroughly and demand that adequate action is taken. Until then, crew members will continue to fall ill or die and will most likely lose any legal actions against carriers due to the near impossibility of proving a causal link between their symptoms and contaminated air.

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<sup>96</sup> Susan Michaelis and others, *Aerotoxic Syndrome: A New Occupational Disease?*, 3 *Public Health Panorama* 198, (2017), p. 207