

## A survey of health symptoms in BALPA Boeing 757 pilots

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This article was written in conjunction with the British Airline Pilots Association (BALPA).

A survey of health symptoms was undertaken in pilots who were members of the British Airline Pilots Association flying the Boeing 737, Boeing 757 and Airbus A320. Six hundred questionnaires were sent out to members, and 106 pilots responded. Survey respondents were predominantly male (104/106) and many had extensive flying experience. With regard to leak events (that is, leaks of engine oil and hydraulic fluids into the aircraft), 93/106 reported that they had been involved in at least one. The total number of incidents reported was estimated to be 1,674+, with all but seven occurring on the B757. Following exposure to the contaminated air, high rates of symptoms were reported by the pilots, including: irritation of the eyes, nose and throat; headaches, light-headedness and dizziness; fatigue, weakness and a decrease in performance; a general increase in feeling unwell; concentration difficulties and confusion; diarrhoea; nausea, vomiting and gastrointestinal problems; numbness (head, limbs, lips, fingers); short-term memory impairment; and joint pain/muscle weakness. These symptoms are a direct breach of US Federal Aviation Regulation 25.831, which includes a specific requirement that cabin air should not cause symptoms of discomfort, fatigue, irritation or toxicity.

### KEYWORDS

- AVIATION INDUSTRY
- BOEING 757
- AIRBORNE CONTAMINANTS
- HEALTH SYMPTOMS
- EPIDEMIOLOGICAL SURVEY

## Introduction

During the last several years, numerous reports were received by the British Airline Pilots Association (BALPA) from its members that they were experiencing exposures to contaminated air supplies while at work. The correct procedure for flight crew to follow after experiencing fumes in the flight deck is to fill in the aircraft maintenance technical log and, if it is felt that the incident is more than transient, to file an Air Safety Report (ASR). The airline then decides whether to send the ASR to the UK Civil Aviation Authority (CAA) under the Mandatory Occurrence Reporting Scheme (MOR) — unless the captain has specifically requested this by ticking the MOR box on the ASR form. Data from the CAA clearly indicated that the number of reports received was significantly less than the number of incidents that the crew were experiencing. Therefore, it was decided by the union to carry out a survey of short-haul pilots to determine the scale of the problem and to see if under-reporting of events was an issue.

The Australian Federation of Air Pilots (AFAP) had previously done a survey of its members in relation to problems that they had had with fumes on the British Aerospace 146 (BAe 146).<sup>1</sup> Since that survey had shown a significant pattern of symptoms and that under-reporting was of concern, it was felt that a survey among BALPA members might show a similar pattern.

## Methodology

The study population comprised all members of BALPA who were pilots on the Boeing 737, Boeing 757 and Airbus A320 in one United Kingdom airline.

A survey questionnaire was prepared which was divided into five sections: demographics; flying history; flight deck events; health survey; and other comments. The first four sections collected specific data from answers to specific questions. The last section was an open-ended section that allowed participants to provide personal observations.

Six hundred questionnaires were sent out to the survey population in October 2001. One hundred and six replies were received.

## Results

### Respondent demographics

Of the 106 respondents, 104 were male. Their ages were: 20–30 years ( $n = 18$ ); 30–40 years ( $n = 40$ ); 40–50 years ( $n = 25$ ); and above 50 years ( $n = 23$ ).

### Respondent flying history

The flying history of the respondents was: 1–2 years ( $n = 7$ ); 3–5 years ( $n = 12$ ); 6–15 years ( $n = 36$ ); 16–25 years ( $n = 24$ ); and 26+ years ( $n = 27$ ). Many pilots had a significant flying history, with nearly half of them having over 16 years' experience.

Most respondents reported that they were flying the B757: not specified ( $n = 1$ ); B737 ( $n = 2$ ); B757 ( $n = 102$ ); and A320 ( $n = 1$ ).

### Respondent flying events

When asked whether they had ever experienced a smoke or fume smell during the flight deck event, 96 respondents replied “yes”. When these 96 respondents were asked how many smoke or fume smells they had experienced, an estimated 1,674+ events were reported (with 1,667+ on the B757 from 93 respondents). By any standard, this is a large number of events.

There are clear criteria by which incidents involving the presence of contaminants in the cabin or aircraft must be reported. These are definable as defects or major defects. Few of these events were specified as events involving smoke: never ( $n = 74$ ); occasionally ( $n = 19$ ); sometimes ( $n = 6$ ); often ( $n = 1$ ); and no answer ( $n = 11$ ). However, many involved fumes on the flight deck which were not associated with another aircraft in the vicinity: never ( $n = 3$ ); occasionally ( $n = 42$ ); sometimes ( $n = 34$ ); often ( $n = 25$ ); and no answer ( $n = 1$ ). Of the 93 B757 respondents who reported a fumes event, 80 believed that the cause was oil contamination of the

air supply system. Of the 93 B757 respondents who experienced fumes, 89 indicated that both pilots had smelt the fumes, with events lasting from a number of seconds to hours. A breakdown of these events is shown in Table 1.

As noted above, a number of these findings were in contravention of company or CAA safety requirements. Soon after the survey, the airline took positive steps to ensure that its crew always adhered to company and CAA procedures in relation to oxygen use. The Civil Aviation Authority has since issued advice for crew to use oxygen when fumes are present. The airline also took steps to phase out a specific engine model which seemed to be significantly more troublesome than a newer engine model.

These findings indicate that leak events are occurring and are being under-reported by pilots, symptoms reported may be impairing the pilot's ability to fly, safety procedures (such as using oxygen) are often being ignored, and the significance of leak events is poorly understood by company medical personnel and crew. This is a similar trend to the extensive under-reporting that was found in Australia by the Australian Senate Inquiry into the BAe 146 problem.<sup>2</sup>

## Health survey

The questionnaire contained a number of questions about health problems, including symptoms, duration of symptoms, and the like. Of the 106 respondents, 104 respondents noted that their health was good before they began flying (the other two gave no answer).

Table 2 shows respondent answers to the question: "Have you experienced any of the following symptoms during your work pattern?"

These symptoms are indicative of at least discomfort, fatigue, irritation and/or toxicity. Symptoms reported as being "occasional" by at least 10 respondents include: irritation of the eyes, nose and throat (37%); headaches, light-headedness, dizziness (33%); fatigue, weakness, decreased

performance (30%); general increase in feeling unwell (27%); concentration difficulties, confusion (21%); diarrhoea (16%); nausea, vomiting, gastrointestinal problems (15%); numbness (head, limbs, lips, fingers) (12%); short-term memory impairment (11%); and joint pain, muscle weakness (9%).

Of all the data collected in this survey, the symptom severity data reveal the most about health problems from flying on the B757, namely:

- a wide range of symptoms was reported, in many body systems;
- some symptoms were reported at quite moderate rates (for example, irritation, headaches and fatigue);
- some symptoms occurred quite frequently (for example, confusion, memory impairment, diarrhoea and nausea); and
- some symptoms, such as coordination, fatigue or memory effects, presented significant safety problems.

These data show that the range of symptoms is extensive, and their frequency cannot be dismissed as being part of the normal health symptom background. Other symptoms, such as fatigue, coordination or memory problems, may have additional significance to safety.

Pilots were also asked about whether their health had suffered while flying on the B757. Most considered that the symptoms occurred not only following specified leak events, often occurred on duty after leak events, and improved after duty or on days off (see Figure 1).

These data suggest a substantial juxtaposition between occupation and effects.

Comments made under the section "other comments" in the questionnaire included:

- After my most noticeable occurrence, I experienced tingling in extremities for 24 hours, in addition to a feeling of lower than normal concentration and memory skills.

**TABLE 1**  
**Details of flying events**

<i>Question</i>	<i>Response</i>
How many smoke or fume smells on the flight deck events have you experienced?	96 respondents reported 1,674+ events
On which aircraft type did this/these occur?	1,667+ events were on the B757
What do you think, or what was the cause?	80/93 respondents believed that the cause was oil contamination of the air supply system
How long were you exposed to abnormal fumes during each event?	Answers varied from a number of seconds to up to four hours
How would you describe each event?	<p>Answers regarding the smell included:</p> <ul style="list-style-type: none"> <li>• banana smell</li> <li>• bitter taste</li> <li>• blueish mist</li> <li>• dirty socks smell</li> <li>• “funny” smell</li> <li>• hot oil smell</li> <li>• insidious smell</li> <li>• nauseating, oily smell</li> <li>• plasticine-type smell</li> <li>• vomit-type smell</li> <li>• smelly feet</li> <li>• taste of oil</li> </ul> <p>Answers regarding symptoms included:</p> <ul style="list-style-type: none"> <li>• bad smell</li> <li>• burning smell</li> <li>• dry throat</li> <li>• hazy smoke</li> <li>• head felt odd</li> <li>• headache</li> <li>• irritated nose</li> <li>• light-headiness</li> <li>• metallic taste</li> <li>• splitting headache</li> <li>• stinging eyes</li> <li>• tingling skin</li> <li>• tunnel vision</li> <li>• visible fumes</li> </ul>
Did both pilots experience the event, fumes or smells?	89/93 respondents said that both pilots experienced the fumes or smells (but a few commented that the fumes were sometimes detected to different degrees of strength by the pilots)

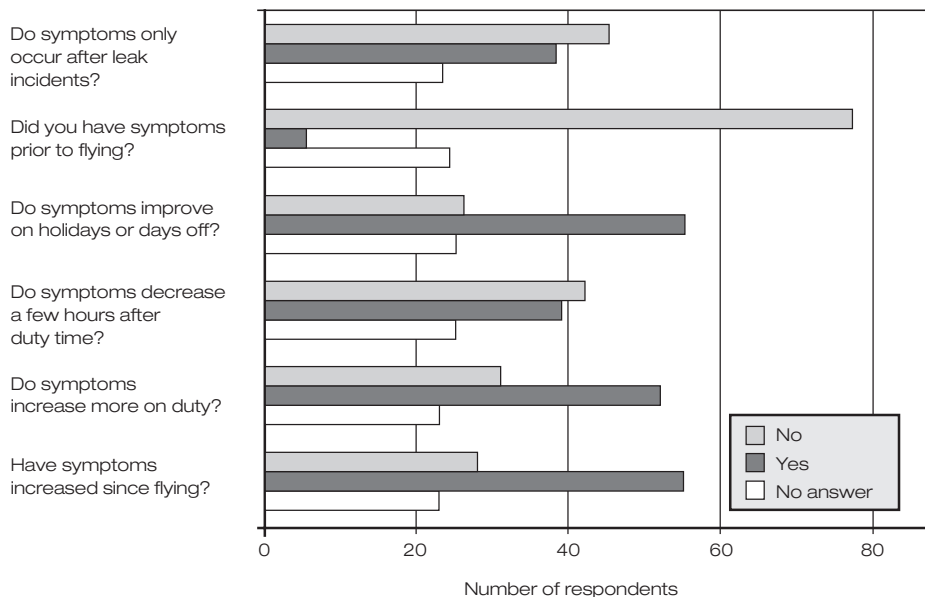
<i>Question</i>	<i>Response</i>
If you experienced an event, did you see or consider seeing a company doctor or your GP? If not, what influenced your decision not to see a company doctor or your GP?	<p>Most (90%) did not seek medical advice. Common statements for not seeking medical advice included:</p> <ul style="list-style-type: none"> <li>• the individual felt better when in the fresh air after the event</li> <li>• no perceivable ill effects</li> <li>• the event was short, so the respondent did not think it was a hazard</li> <li>• ignorance</li> <li>• the individual felt better after the fumes had cleared</li> <li>• the company doctor was inaccessible or not available</li> <li>• the company doctor said the symptoms were food poisoning, so go home and rest. I was not convinced</li> <li>• the respondent was too tired to hang about for the company doctor</li> <li>• the symptoms abated so I thought I was OK</li> <li>• devotion to duty</li> <li>• lack of ill effects</li> <li>• known problem</li> <li>• the respondent had another flight to do (commercial pressure)</li> <li>• the respondent was told no need to worry about long-term effects</li> <li>• the company said fumes had no long-term health effects</li> <li>• no tests were available</li> <li>• part of the job on the B757</li> <li>• the company health department said “no need to see a doctor”</li> <li>• unwilling to risk licence</li> <li>• company doctors are not to be trusted</li> <li>• night stopping, so only local doctors are available</li> <li>• events are so common, I would be going to the company doctor every tour</li> </ul>
If you saw a doctor or GP, what tests or advice was given?	<p>Of the 10% who sought medical advice/tests, advice included:</p> <ul style="list-style-type: none"> <li>• go and rest</li> <li>• the effects are fully reversible after fresh air exposure</li> <li>• the individual saw a company nurse who asked if they felt OK and then sent them home — no tests were done, only names put in a log</li> <li>• nothing to worry about</li> <li>• haemoglobin test</li> <li>• lung function test</li> <li>• blood test</li> <li>• blood pressure check</li> <li>• no known ill effects from oil smell inhalation</li> <li>• cholinesterase test — not done by the company</li> </ul>
Did you use flight deck oxygen?	<p>96 respondents said “no”. Comments included:</p> <ul style="list-style-type: none"> <li>• only when really bad</li> <li>• crew appeared to believe that short-exposure events without visible fumes were not worthy of using oxygen</li> </ul>
Did you report the event or file an ASR?	<p>There was substantial non-ASR-MOR reporting. Of the 1,667+ fume events on the B757, only 61 were reported in an ASR.</p>

- Company doctors cannot be trusted. This is too big.
- Captain had degraded attention and I could not allow him to fly the approach or landing.
- How much did my company know about this but chose not to mention?
- I feel that, as a regular reporter of fumes on the flight deck, engineering is not taking my reports seriously as I am a “regular complainer”.
- My worst experience was when I was asked to “report further” on oily smells on the flight deck. On return to my departure airport — because they were so bad and because we both felt ill — I grounded the aircraft (Report and ASR).
- I don’t think the company is doing nearly enough to resolve the obvious problem on the B757. The engineering department certainly appears unsympathetic in this regard.
- It is my impression that hot oil smells during take-off and the first few minutes have recently become a much more regular event on the B757s. Of 20+ events, most have been in the last year.
- First time on I was on the B757, the smell was not so prevalent, second time, much more often.
- I am now on the B737, partly because of the fumes, and now feel much better.
- Long-term feeling of fatigue.
- I reckon that every 3rd or 4th sector on the B757 I can detect oil vapour.
- I am concerned that I may have suffered long-term/permanent damage.

**TABLE 2**  
Health problems in pilots

<i>Symptom</i>	<i>No answer</i>	<i>Occasionally</i>	<i>Some-times</i>	<i>Often</i>	<i>Long term</i>	<i>Never</i>
Irritation of eyes, nose and throat	3	39	19	4	1	40
Blurred vision, tunnel vision	9	4	1	0	0	92
Respiratory distress difficulties	10	4	2	0	1	89
Headaches, light-headedness, dizziness	4	35	15	3	2	47
Balance/coordination difficulties	10	3	2	0	0	91
Disorientation	12	9	3	0	0	82
Memory impairment (short-term)	8	12	4	1	2	79
Numbness (head, limbs, lips, fingers)	5	13	3	1	0	84
Fatigue, weakness, decreased performance	7	32	18	5	1	43
Concentration difficulties, confusion	7	22	7	2	1	67
Skin irritations	10	8	7	6	0	75
Nausea, vomiting, gastrointestinal problems	9	16	5	0	1	75
Diarrhoea	12	17	11	2	1	63
Joint pain, muscle weakness	9	10	5	1	0	81
General increase in feeling unwell	6	29	7	2	3	59
Immune system disorders	10	3	2	0	0	91
Intolerance to foods/alcohol	10	4	4	1	2	85
Intolerance to chemicals/odours	10	4	11	1	0	80
Cancer (please state type)		2	(1 basal cell carcinoma and 1 prostate)			

**FIGURE 1**  
Symptom incidence in pilots



— When reported, I was told unless you use oxygen nothing will be done.

## Discussion

Overall, the survey provided information about the health issues for pilots flying on (mainly) the B757:

1. The oils used in aircraft engines contain toxic ingredients which can cause irritation, sensitisation and neurotoxicity.<sup>3</sup> This does not present a risk to crew or passengers *as long as the oil stays in the engine*. However, if the oil leaks out of the engine, it may enter the airconditioning system and cabin air. This is a direct contravention of the US Federal Aviation Authority's and the European Joint Aviation Authorities' airworthiness standards for aircraft ventilation (FAR/JAR 25.831):

“(a) Each passenger and crew compartment must be ventilated and each crew compartment must have enough fresh air (but not less than 10 cubic ft per minute per crew member) *to enable*

*crew members to perform their duties without undue discomfort or fatigue.*

(b) Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapours.” (emphasis added)

This study has shown that contamination of the cabin and flight deck air supply causes toxic exposures to, and adverse health effects in, crew (on the flight deck, these fume events are sometimes producing effects in both pilots).<sup>2,4</sup>

2. Although there is a perception by aircraft manufacturers and airline operators that “a little bit of contamination” should not be regarded as an operational problem, the author believes that this problem should at least be defined as a defect (as required under the aviation regulations).

3. The findings of the present survey are consistent with other studies previously published on this issue, including a study undertaken by the author on

health symptoms reported by Australian BAe 146 pilots.<sup>1,5-7</sup> Both the BAe 146 pilots and the B757 pilots reported a similar pattern of extensive symptoms at high to moderate rates (including eye, nose and throat irritation, headaches and dizziness, fatigue, feelings of being unwell, concentration difficulties, memory impairment and nausea), although the symptoms were at a higher frequency and with more long-term effects among the BAe 146 pilots. In addition, symptoms occurred not only after specified leak events but also during “non-event” flights, and were more prevalent on the B757 and BAe 146 than other aircraft.

4. Residual contamination (as well as specified leak events) may be causing problems.

5. There is a lack of understanding by pilots regarding the toxicity of the oil leaks, the health effects on OHS and the necessity to use oxygen. This is further compounded by the airline health professionals who, when confronted with a pilot who has been exposed in a fume event and who is concerned about its consequences, have a poor understanding of the short and long-term medical issues that may arise.

6. Pilots continue to fly when experiencing discomfort or symptoms.

## Conclusion

The findings of this survey (including the number of crew reporting fume events, the number of fume events themselves, and the relatively high correlation of some groups of symptoms) suggest that, at least for the B757, this is a problem that must not be marginalised.

Pilot exposure to contaminated air that causes discomfort or symptoms such as irritation, headache or fatigue is a clear contravention of the airworthiness regulation FAR 25.831, which includes a specific requirement that cabin air should not cause symptoms of discomfort, fatigue, irritation or toxicity.

Contaminants in the air of an occupational environment should, under normal circumstances, alert management to a potential problem. Proper medical and scientific research needs to be undertaken in order to help airline management and crew to better understand both the short-term and long-term medical effects of being subjected to air contamination.

Over the past 50 years, the concept of duty of care has emerged as one of the most important legal responsibilities for employers. In the workplace, the duty of care of an employer to its workers has been crystallised into OHS legislation. Aviation safety is something that a person outside of the industry would understand to cover all aspects of safety, including the health and safety of its workers.<sup>8</sup> However, this does not seem to be how all industry insiders see it. Many in the industry see aviation safety as being about making sure the planes keep flying. Both the aviation regulators and the airlines themselves think that OHS is not their business — which is strange, because if *they* do not look after the health and safety of workers in the industry, who will?<sup>9</sup> The most important message that BALPA would like to send to its members who have experienced fume events is:

- no matter where a report of fumes or odours comes from, take it seriously;
- recording every fume event provides the union with the data required to present detailed arguments to the airline companies. It is only from such a position of strength that the union is able to work effectively with the companies to address such problems;
- record all relevant details related to the event, including aircraft registration, flight and cabin crew affected, flight details, time, place and any underlying issues, and provide these to your employer and the CAA via ASR/MOR reports and inform the Air Accident Investigation Branch if deemed necessary;



- enter every defect/incident in the aircraft technical maintenance log for engineering action; and
- use oxygen (if appropriate) in line with company policy, manufacturer's checklists, CAA guidelines and basic airmanship.

More scientific and medical research is needed on the short and long-term effects of exposure to contaminated air and, until this is completed, all areas of the aviation industry should take fume exposure events seriously. It is vital that the above recommendations are taken seriously; they should be seen as an important part of educating crew and the aviation industry, thereby addressing the problem.

## Acknowledgment

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