THE UNIVERSITY OF NEW SOUTH WALES

Health And Flight Safety Implications From Exposure To Contaminated Air In Aircraft.

by

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1.4 Abstract

This thesis examines the five decade use of unfiltered aircraft bleed air, taken from jet engines to supply breathing air in the flight decks and passenger cabins of commercial and military transport aircraft. During this time numerous flight safety issues and adverse effects from exposure to contaminated bleed air have been reported. The research undertaken in this thesis investigated previous investigations into these matters and the consequences of using bleed air on flight safety and crew and passenger health. This research examined: (a) health issues reported by aircrew as a consequence of exposure to contaminated bleed air whilst flying by way of several descriptive surveys; (b) various aviation air monitoring studies previously undertaken were reviewed to assess the knowledge base of the chemicals present during contaminated air events; (c) air sampling data was evaluated for its usefulness in determining any potential adverse health effects; (d) a review was undertaken of the frequency of contaminated bleed air events; (e) a review was undertaken of some of the information known by the aviation industry and others about contaminated bleed air. Analysis of the evidence that bleed air, contaminated by synthetic jet engine oils and hydraulic fluids, is a regular occurrence and far more common than previously accepted and is a consequence of the current bleed air system design. There are significant short and long-term health effects being reported as a direct result to documented exposure events that validate claims of adverse health effects in exposed individuals. The thesis argues that the precautionary principle, occupational health and safety guidelines and aviation regulations are being ignored by the aviation industry, who continue to claim that cabin air is safe. The systemic misuse of available data is widespread, secondary to commercial objectives, and places passenger and crew health and flight safety at serious risk. The thesis concludes that the use of bleed air on commercial aircraft with no form of contaminated air detection or filtration system present should be discontinued. The risk to health and flight safety is no longer acceptable.

2 Introduction

When the air supplied for passengers and crew to breathe onboard a commercial or military aircraft becomes contaminated with aircraft lubricants, such as synthetic jet engine oils, de-icing or hydraulic fluids, these events are known as *'contaminated air'* events.

Contaminated air events primarily occur because all commercial jet aircraft built since the early 60s (with the exception of the Boeing 787 which first flew in December 2009), take air directly from the compression section of the engines (known as 'bleed air') and duct this air, after pressurisation and cooling, directly into the aircraft cabin unfiltered. When this air becomes contaminated with oils used to lubricate the engine or hydraulic fluids used in various aircraft systems, passengers and crew will be exposed. This design flaw introduced into military aircraft in the 1940s and commercial jet aircraft in the mid 1950s became universally introduced into all commercial jet aircraft manufactured from the early 1960s onwards.

Synthetic jet engine oils and hydraulic fluids contain a number of hazardous ingredients such as the organophosphates tricresyl phosphate and tributyl phosphate as well as the sensitiser N-phenyl-1-naphthylamine. The organophosphates which are neurotoxic and likely immunotoxic, are just some of the very large number chemicals present during a contaminated air event and which are released into the air supply when lubricating oils or hydraulic fluids are exposed to the extreme temperatures present in aircraft engines.

Contaminated air exposures occur in a hypoxic environment and may include a synergistic effect of exposure on passengers and crews, which can lead to additional adverse impacts on flight safety and or health.

The flight safety impacts of exposure result from the fact that:

1. no aircraft currently flying has any form of detection system fitted to warn crews when the air has become contaminated;

2. there is a lack of training and crew awareness of the adverse consequences of contaminated air exposures in the cockpit and cabin; and

3. crews are becoming impaired or incapacitated in flight as a direct consequence of these exposures.

The health effects of exposure can range from immediate, short or long term effects. Many of the short term health effects of exposure are accepted as occurring by many within the airline industry. However, all long term health effects as a consequence of exposure to contaminated air are denied by the airline industry.

How often exactly contaminated air exposures occur; and what the exact chemical makeup and concentrations of these chemicals are during such exposures is largely unknown. This lack of data is a consequence of 1) the fact no aircraft has any form of fitted detection systems fitted, 2) inappropriate monitoring of the air to date and 3) an ineffective reporting system. This lack of data and scientific knowledge is then cited by many within the aviation industry and some Governments, as an excuse not to act to prevent further exposures occurring, whilst ignoring volumes of data supporting the clear fact that contaminated air events are occurring, impacting flight safety and resulting in adverse health effects in many of those being exposed.

Limited studies have been carried out to investigate which chemicals are present in the aircraft environment but none effectively to date have successfully measured these contaminants during a contaminated air event. Despite this accepted knowledge gap, many in the aviation industry, including some Governments, advise that all chemical levels measured in aircraft cabins are below exposure standards recommended for working environments. These statements are made, whilst knowing they are unaware of what chemicals or concentrations are present in contaminated air events and also in the knowledge that exposure standards do not apply to workers working in hypoxic environments or to passengers or to the unique aviation environment these exposures occur in.

The military and commercial aviation industry has known of the risks of exposure to contaminated air for about sixty years, yet have failed to address the problem even though many accept that oil leaks do result in contaminated air events. Some limited aviation regulations exist and state what maximum amounts of a few chemicals, such as carbon monoxide, can be present in the aircraft; however, there is no system installed to monitor levels of these chemicals. Aircraft have cabin altimeters to show the cabin altitude of the aircraft but nothing to monitor the quality of the air being supplied. This is the air, on which all occupants of an aircraft depend on to survive in flight.

Scientific papers were published over five decades ago warning of the dangers of contaminated air exposure, yet commercial and vested interests have dealt with this clear design flaw by risking passenger and crew health in a manner previously seen with smoking, asbestos and other long fought battles of denial and corporate bias. Politicians have revealed how money has been paid for silence (for example, the confidential agreements between manufacturers and airlines tabled in the Australian Senate) and data has been falsified, in an effort to prevent crews and the travelling public from obtaining complete access to knowledge about this problem. Thus the genuine health and flight safety issues remain unaddressed at an industry wide level.

Oil and hydraulic products have almost exclusively only been tested as cold products in animal tests and have never been evaluated in the context in which exposure to these chemicals is occurring in flight i.e., exposure to the pyrolised product at reduced pressure via inhalation. The very limited 1950s inhalation testing data undertaken by the military that showed a serious problem did indeed occur when the oils were heated has been ignored. Despite the near total lack of testing data, agencies with the responsibility to do so, fail to ensure these products are properly evaluated or tested under actual exposure conditions.

Passengers are not advised when they are exposed to contaminated air and airlines are failing to comply with their duty of care to protect their employees and those that chose to fly with them. Airlines simply manage the situation by denial and marginalisation, in the knowledge that to date, health and safety agencies and aviation regulators, some of which are entirely funded by the

industry they regulate, have failed to control and prevent exposures from occurring.

Only in time and with proper independent research will the full long term impact of contaminated air exposures be revealed.