

Aviation Contaminated Air Reference

Manual overview

Norwegian SAFE & Norwegian
ALPA conference .



May 2008



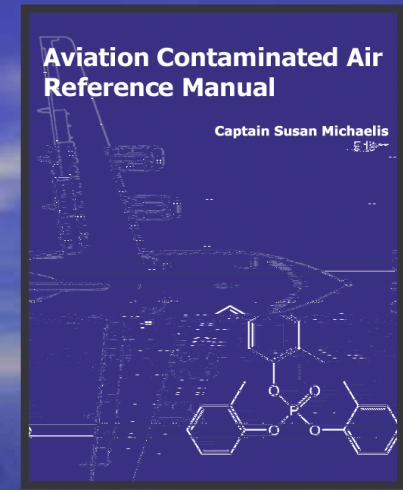
Susan Michaelis - Author

- Former Airline Captain.
- Head of Research - Global Cabin Air Quality Executive (GCAQE).
- PhD research student at the University of New South Wales in Sydney, Australia.

Background to ACARM

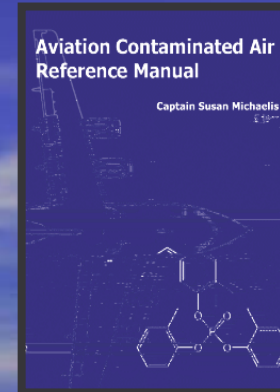
- Flying 1986 – 1997 – Australia
- Ill health retired 1997
- Commenced research 1997
- Called for Australian Senate Inquiry 1999
- Commenced Masters at UNSW 2002
- ACARM 2007
- Upgrade to PhD candidate 2008

Aviation Contaminated Air Reference Manual (ACARM)



- Published in 2007.
- 1st time data has been collated.
- 844 pages of key information.
- Aviation industry data from 1953 – 2007
- Data is fully referenced.
- Data taken from a wide variety of sources.

ACARM data taken from:



- Industry documents - wide variety
- Published papers
- Surveys
- Union reports
- Defect reports
- Regulator reports
- Medical reports
- Legal / insurance reports
- Government data
- Scientists & doctors
- Aircrew & passengers
- Media
- Bureaus of air safety
- Industry meetings & conferences

ACARM - Contents

- Everything you need to know
- 29 Chapters
- 12 Appendices
- Fully referenced
- Covers all main issues from incidents, monitoring, health effects and flight safety

RAAF Review: 2008 : see www.susanmichaelis.com

- **Book Review**

- **"Aviation Contaminated Air Reference Manual" (2007) By Captain Susan Michaelis**

- **ISBN 9780955567209**

- **Reviewer:**

- Dr Bhupi Singh

- Assoc. Prof. and Head of Research

- RAAF Institute of Aviation Medicine,

- RAAF Base Edinburgh SA, 5111, Australia

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- The Aviation Contaminated Air Reference Manual, by Captain Susan Michaelis, is the first-ever comprehensive and definitive attempt to document and encapsulate the problem of aircraft cabin air quality in one book. The problem of cabin air quality is complex, under-reported, and poorly understood. A significant part of the problem is a lack of authentic and published data. Hopefully this manual will fill at least a part of that lacuna.
- The Manual is organised into 29 chapters, and 12 appendices. The overall arrangement and organisation of the material may appear a bit overwhelming at first, but this could perhaps be attributed to the sheer volume of data that has been collected and presented. However the data is methodically set out in clearly labelled sections and is an important resource for those wanting to understand the particular issues involved with aircraft contaminated air.
- The manual starts by explaining the basics of the problem, followed by extensive documentation of events where aircrew or passengers were exposed to, and/or affected by, toxic fumes inside an aircraft cockpit or cabin. The "events" data pertains to a wide range of aircraft operators in many countries spread across the globe. All data is extensively researched and referenced, with its source clearly identified. In fact one of the strengths of the Manual is its extensive referencing.
- The Manual should be of interest to professionals dealing with the problem of health and well-being of not only the pilots and cabin attendants, but that of the travelling public at large. Occupational health professional, aircraft designers, and the regulators of civil and military aviation would find the contents informative, and perhaps help the aviation community address the problem, which goes well beyond being "just a nuisance" to causing genetic damage and leading to significant and long lasting neurological damage in some cases.
- A notable and distressing element of the data is the widespread prevalence of denial of the existence of the problem, particularly among the aircraft operators and aviation regulators. In keeping with the advances made by the humanity in improving and maintaining the health and well being of people in their work places, and of the general public during their interaction with technology, it is not unreasonable to expect responsible professionals in all walks of life to have at least an open mind when presented with a "new" problem. It is hoped that this manual will spur an objective and closer look at the issues involved. This Manual should make any reader sit up and ponder, and perhaps neutralise some of the scepticism prevailing among some sections of society about the reality of this problem.
- The manual is obviously a labour of love, and the dedication of the author is quite apparent, who needs to be commended for her ground-breaking and seminal work.

RAAF Review

- "...first-ever comprehensive and definitive attempt to document and encapsulate the problem of aircraft cabin air quality in one book."
- **"..ground-breaking and seminal work."**
- "A notable and distressing element of the data is the widespread prevalence of denial of the existence of the problem, particularly among the aircraft operators and aviation regulators."

ACARM – Key Facts

- Flight safety is being compromised.
- Passengers and crews suffering short and long term health effects.
- Data confirms FAA position of under reporting of events is significant.
- Fume events are NOT rare.
- Aviation old OH&S regulations not being met.
- Oil and hydraulic fluid contaminants are being found in various studies.

Chapter 1 – understanding the problem

- Overview

Chapter 2: Flight Safety aspects of contaminated air

- Flight Safety is definitely being compromised
- Global issue
- Impairment is occurring in flight: Cabin crew & Pilots
- Regulations are not being met
- Airline industry is not treating contaminated air adequately as a flight safety issue: Often dismissing as an OH&S issue

Chapter 3: What is in Contaminated air?

- Extensive mixture of contaminants
- Hazardous substances
- Synergistic mix of contaminants
- Adequate testing has not been done
- TCP is being found in aircraft swab samples, air monitoring & pilots blood
- Appendix 10 – monitoring studies
- Appendix 3 & 4 : Contaminants found

Chapter 4: The toxicology debate

- TCP : Neurotoxin , OPICN , Other Ortho isomers: Increased toxicity known since 1958
- PAN: sensitizer

Chapter 5: Mislabelling of the oils

- MSDSs minimize risk
- Hazards are not adequately advised on labels & MSDS
- Operators uncritically accept MSDS findings & use this to minimize risk.

Chapter 6: Effects on crews & passengers: Symptoms seen & Reported

- Various surveys show similar pattern of effects
- discrete occupational Syndrome: Aerotoxic Syndrome
- Aerotoxic Syndrome (AS): Short & long-term effects
- 2007 BAe 146 UK Pilot survey:
 - 86% smelt contaminated air
 - 57% report short-long term AS effects
 - 25% report medium – long-term AS effects
 - >8% appear to have lost medical certificate related to AS

Chapter 7: Medical Side: Doctors & Scientists

- **Short term**

These may include some or all of the effects listed:

- Nausea, vomiting
- Disorientation
- Skin Rashes
- Tingling or numbness
- Stupor
- Tunnel vision
- Tremor
- Vertigo
- Headaches
- Sore nose, eyes, throat
- Chest pains
- Breathing difficulty
- Lethargy
- Difficulty concentrating
- Short term memory problems
- Light headedness etc....

Chapter 7: Medical Side: Doctors & Scientists

- **Long-term** effects include:
 - Neurological effects: CNS,PNS: Jamal 1997, Jamal, Julu... 2002, 2005
 - Autonomic nervous system effects: Jamal, Julu... 2002, 2005
 - Working memory / cognitive problems. (neuropsychological), Coxon 2002 / Mackenzie Ross 2006
 - Chronic neurotoxicity (OPICN): Abou-Donia 2004
 - Neuronal brain cell death: Abou-Donia
 - Respiratory disorders: Burdon 2005
 - Immune system effects, fatigue, chemical sensitivity etc..
 - Blood pathology disorders
 - Strong occupational link: Cone 1983,1999 / Harper 2005
 - Individual susceptibility: Furlong

Chapters 8 – 11: Fume events

- 1997 Kolver Incident – Australia & various ATSB investigations
- 1999 Malmo Incident – Sweden
- 2000 G-JEAK – UK
- 2003 G-CPER – B757 - UK

Chapter 12: Frequency of events

- Refer Appendix 2, 6, 7, 9
- Less than 4% of events are reported
- Wide range of data available
- Events are increasing
- Fume events are NOT rare
- Source of fumes is predominantly oil

Chapter 12 – Frequency of events

- Global issue: **Example of UK data**
 - Number of events increasing over the years.
 - Events occur on many aircraft types.
 - Less than 4% of events ever reported to airlines of which only 48% of these events are reported to the regulator.
 - **32% of reported CA events involved some degree of crew adverse impairment.**
 - 20% of CA events involve at least 1 pilot impairment.
 - **9% of CA events involved 2 pilot impairment**

Chapter 12 – Frequency of events

- **Oxygen used by 1 pilot only 4% of the time and both pilots 12% of the time and usually temporarily only.**
- Engineering is often not finding source of the problem on first inspection.
- Crew errors are being made.
- Crews continue flight duty after exposure events.
- Fume events often seen as normal or a nuisance only.

Chapters 13 & 14

- ASHRAE

- ITF

Chapter 15: Regulations to protect crews & passengers

- Aviation Regulations exist
- OH&S regulations exist
- REGULATIONS ARE NOT WORKING OR BEING ENFORCED BY AIRLINE INDUSTRY OR GOVERNMENT BODIES

Chapter 16: The exposure standard debate

- An aircraft is a discrete occupational environment
- Exposure standards do NOT apply
- *'It should be noted that that current safety standards differ from air quality levels that will provide a perceived acceptable level of customer and crew satisfaction. Contaminant levels may be well below recommended levels in currently accepted safety standards yet generate complaints, because they act in synergy with other contaminants or because some standards may be outdated and not have incorporated more recent scientific and medical evidence. In addition, extenuating circumstances on board aircraft (including humidity and cabin pressure) have not been studied to the extent that a new standard can be proposed - that incorporates these factors or identifies interactions between factors.'* - Honeywell

Chapter 17: What they knew & what they did – BAe 146 case study

- See appx 5
- Long history of oil fumes
- Service Bulletins, service Information leaflets, All Operator Messages, Airworthiness Directives.....
- There is NO secret

Chapter 18 & 19

- The Inquiries
 - Australian Senate
 - US NRC
 - UK HOL
- The Conferences
 - Australia: UNSW/ADFA
 - UK: BRE
 - UK: BALPA

Chapter 20 & 21

- CAA Cabin Air Quality- 2004
- US Perspective

Chapter 22: The airline industry misinformation campaign

- Major misinformation is occurring around the globe
- This is continuing today

Chapter 23 & 24

- OHRCA
 - www.ohrca.org
- SAE

Chapter 25: UK Committee of Toxicity (COT)

- See also appx 8, 11, 12
- COT review is seriously flawed & inappropriate – Critique underway

Chapters 26 -28

- Filtration
- Canadian Perspective
- Selected dates in the chronology of the contaminated air debate
 - 1953 - 2007

Chapter 29: Solutions

- Contaminated air detection systems must be fitted.
- Bleed air filtration or bleed free supplies needed.
- Crew education to ensure 100% emergency oxygen always used.
- Enforcement and education of the reporting system.
- Regulations such as 25.831 enforced.
- Full scale epidemiological survey of crews.
- Less toxic oils and hydraulic fluids.....
- Address design issues
- TCP Biomarker blood test & gene toxicity studies - occurring
- Inhalation studies of breathing oils & hydraulic fluids
- B787
- Regulators must become independent & regulate
- Appropriate Inquiries & studies: US FAA funded OHRCA;CASA 2008?, NIOH....
- GCAQE



**Thank you for your
attention.**

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susanmichaelis.com

