

TWO SIDES OF THE SAME COIN. HEALTH DAMAGE FROM TURBINE OILS IN OFFSHORE WORKERS AND FLIGHT CREW. HOW TO INVESTIGATE THOSE WHO ARE INJURED? INTERNATIONAL CONSENSUS ON ASSESSMENT OF HEALTH DAMAGE

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HMS KONFERANSE «GRENSELØST ARBEIDSLIV» OG
OMRÅDESAMLING 5. – 7. SEPTEMBER 2023

HE Halvor Erikstein <Halvor@ofsa.no>
Organophosphates in the offshore oil industry
To: webmaster@aopis.org <webmaster@aopis.org>

Other interested parties 28 October 2002 at 15:18

I'm an occupational hygienist in The Federation of Oil Workers Trade Unions, Norway. I want to say thank you for your home site on aviation organophosphates.

Organophosphates are not an area the Norwegian industry has any knowlegde of (a least officially). Do you have anything on maintenance of turbines on offshore installations?. I believe that may be using the same oils

Once again - THANK YOU

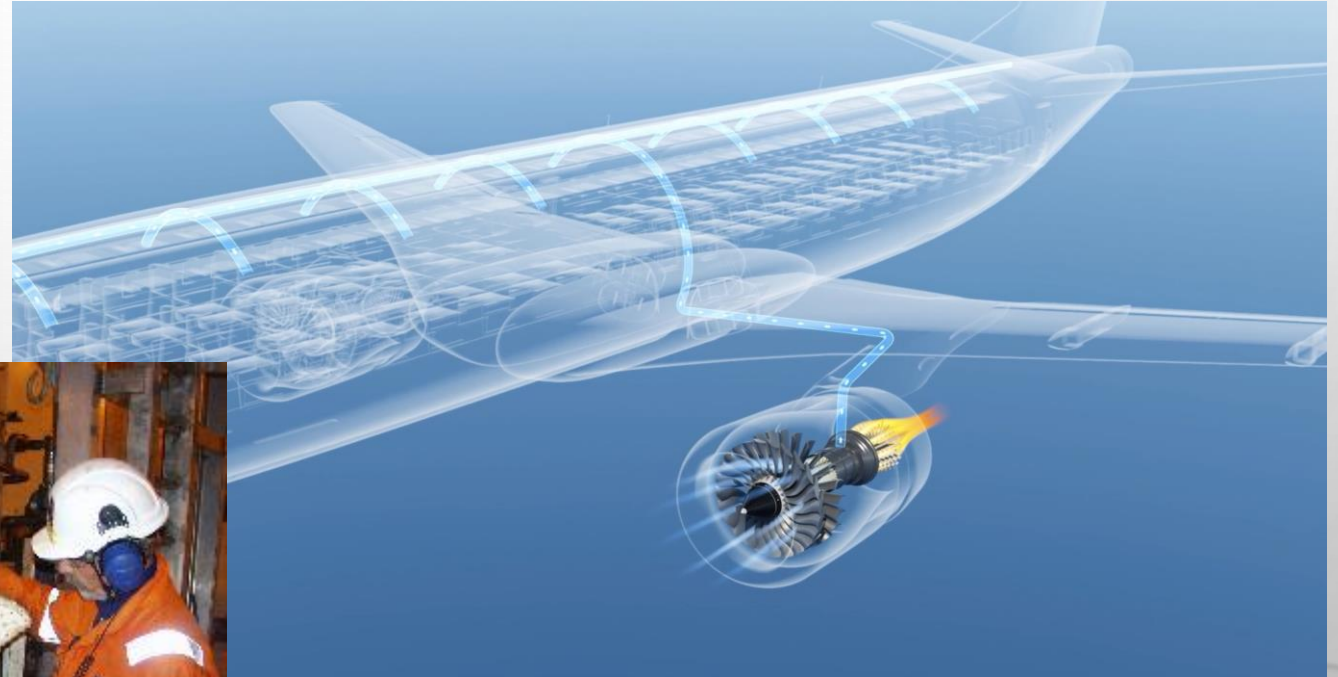
Regards,

Halvor Erikstein
Occupational Hygienist
The Federation of Oil Workers Trade Unions, Norway
www.ofsa.no

TWO SIDES OF THE SAME COIN



ÅTTE SYKE: Dagbladet.no avslører at en tredjedel av personene i turbinavdelingen på Staff
Foto: Scanpix





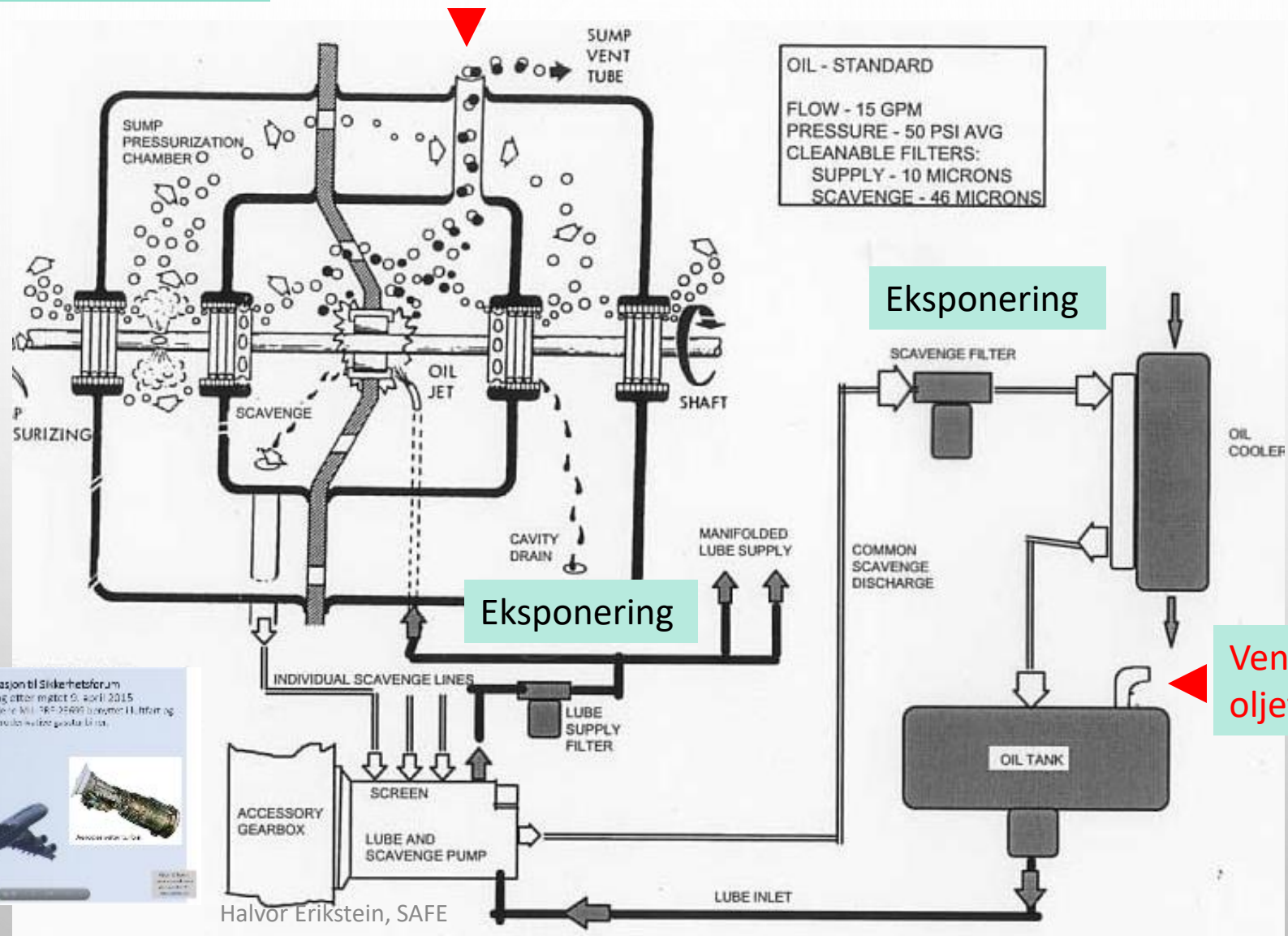
**SEALS
MINIMISE
LEAKAGE**



Avluftingspunkter

Sump vent

Smøresystem gasturbin (aeroderivativ turbin)



OIL - STANDARD
 FLOW - 15 GPM
 PRESSURE - 50 PSI AVG
 CLEANABLE FILTERS:
 SUPPLY - 10 MICRONS
 SCAVENGE - 46 MICRONS

Eksposering

Eksposering

Vent oljetank



Halvor Erikstein, SAFE

WHY IS A NARRATIVE REVIEW OF BLEED AIR EXPOSURES AND FUME EVENTS AND MEDICAL PROTOCOL NECESSARY?

EXPOSURE TO AIRCRAFT BLEED AIR IS OCCURRING

- INTRODUCTION OF SYNTHETIC JET ENGINE OILS - EARLY 1950s
- EXPOSURE HAPPENS IN 2 WAYS (DOCUMENTED)

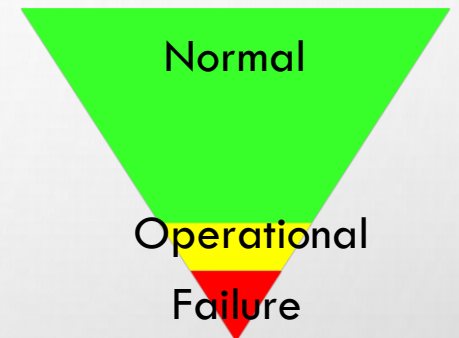
1. NORMAL OPERATION

BACKGROUND EXPOSURES – CHRONIC LOW LEVEL

TRANSIENT POWER/ AIR SUPPLY CHANGES....

2. ABNORMAL OPERATION: **OIL OVERFILL, OPERATIONAL / FAILURE CONDITIONS**

- > ORGANOPHOSPHATES, AMINES, ESTERS, THERMALLY DEGRADED COMPLEX MIXTURE



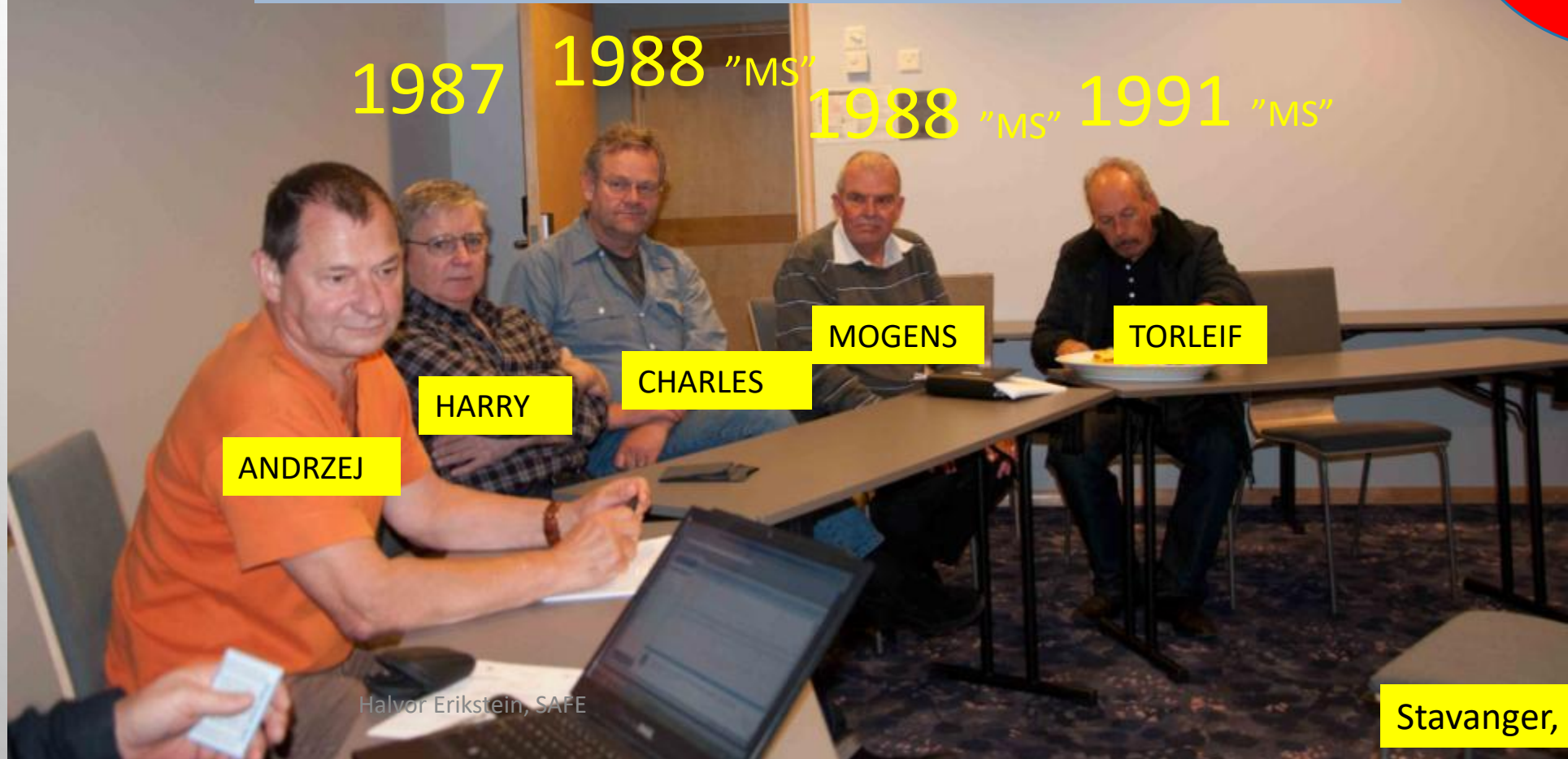
5 turbinteknikere fra Statfjord

Tre hadde levd med multippel sklerose (MS) diagnoser i mer enn 20 år, men mener de er feildiagnostisert.

To ble sendt til undersøkelse med mistanke om MS.

Alle er sikre på at det jobben som har forårsaket helseskadene
Avvist som yrkesbetinget fordi det vi vet i dag ikke var kjent.

MS-saken
på
Statfjord



Halvor Erikstein, SAFE

Stavanger, oktober 2011

CREW



METHODOLOGY

Open Access



Health consequences of exposure to aircraft contaminated air and fume events: a narrative review and medical protocol for the investigation of exposed aircrew and passengers

Jonathan Burdon¹, Lygia Therese Budnik^{2^}, Xaver Baur^{3,4}, Gerard Hageman⁵, C. Vyvyan Howard⁶, Jordi Roig⁷, Leonie Coxon⁸, Clement E. Furlong⁹, David Gee¹⁰, Tristan Loraine¹¹, Alvin V. Terry Jr.¹², John Midavaine¹³, Hannes Petersen¹⁴, Denis Bron¹⁵, Colin L. Soskolne¹⁶ and Susan Michaelis^{17*}

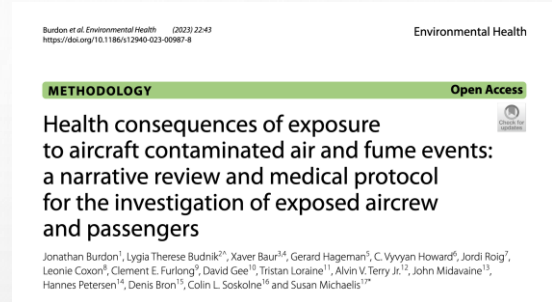
WHO ARE WE ?

INTERNATIONAL FUME EVENTS TASK FORCE

- 10 COUNTRIES
 - MEDICAL EXPERTS: NEUROLOGICAL, NEUROBEHAVIOURAL, PATHOLOGY & TOXICOLOGY, RESPIRATORY, AVIATION MEDICINE, EPIDEMIOLOGY, ENT, OCCUPATIONAL HEALTH.....
 - SCIENTISTS: PHARMACOLOGY, MEDICAL GENETICS & GENOME SCIENCES
 - OTHERS: SAFETY SCIENCE, AIRLINE PILOT/TECHNICAL EXPERT, POLLUTION & POLICY

WHY IS THIS DIFFERENT? 1/2

- NEW APPROACH
- 1ST SYSTEMATIC, COMPREHENSIVE & TIMELY GUIDANCE
- CONSENSUS APPROACH TO RECOGNITION, INVESTIGATION AND MANAGEMENT OF PEOPLE EXPOSED TO BLEED AIR CONTAMINANTS AND FUME EVENTS



WHY IS THIS DIFFERENT? 2/2

- Not Reliant On Exposure Limits- Where They Exist – Industry & Regulators **X**
- Not Looking For TOCP/OPIDN Only **X**
- Not Reliant On Industry In Vitro/In Vivo Studies Of High
- Dose Exposure Scenarios – FACTS 1 & 2 (EU Funded) **X**



EPIDEMIOLOGICAL APPROACH - SUPPORTED BY LITERATURE

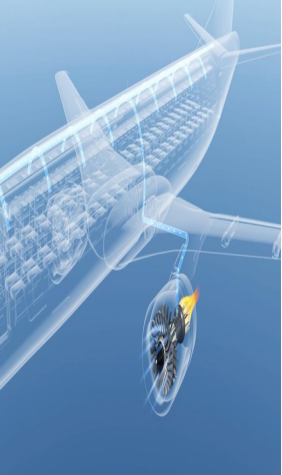
WHAT IS HAPPENING TO PEOPLE ?

- Diffuse Non Specific Pattern Of Acute And Chronic Effects
- Consistent Pattern Internationally
- Clear Pattern Of Cause & Effect (Michaelis 2017)
- New Occupational Disorder
- Neurological, Neurobehavioural, Respiratory, Cardio, GI, General (Rheumatological, Soft Tissue, Fatigue, Chemical Sensitivity...), Irritation, Skin, Sensitization...

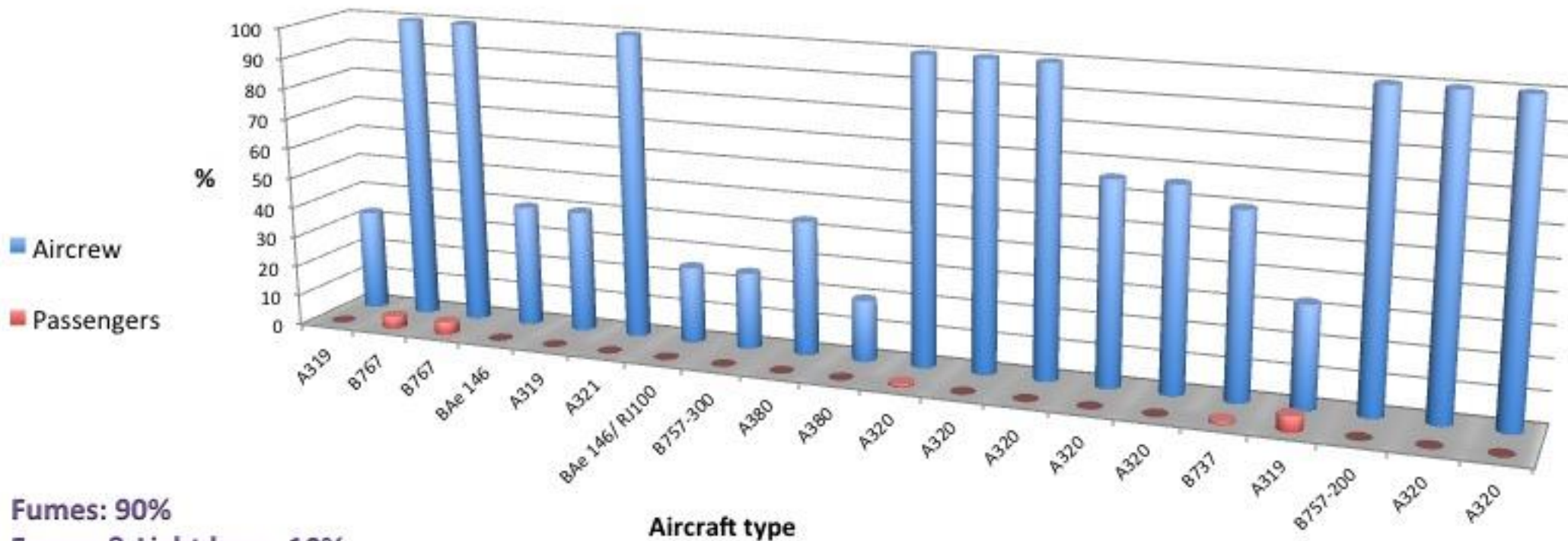
- **DIFFUSE ENCEPHALOPATHY**

**NON SPECIFIC
PROTEAN
NOT CLEAR**

**Localising Pattern Recognizable As A Syndrome
DIFFUSE NEUROLOGICAL SYNDROME
(Aerotoxic Syndrome)**



Medical attention sought or hospitalisation by crew/passengers after fume events



Fumes: 90%

Fumes & Light haze: 10%

Oil fumes: 55%

Oil, hydraulic, deicing, ECS fluid leakage: 70%

DATA SOURCE: PUBLICLY AVAILABLE SOURCES:
OFFICIAL & INCIDENT REPORTS/MEDIA

DOSE

[Table 4: TCP Internalised dose during crew working lifetime

Dose = concentration x volume

TCP (mixed isomers) dose

	Study A (maximum) B (mean)	Conc. µg/M³ (TCP)	Vol M³	Dose mg	Notes
A	Cranfield (2011) (Crump et al.)	37.7	9000	339	Minor fume events noted by researcher in 25% of flights. (Assumed, incorrectly, to be minor and therefore not reportable)
B	Cranfield (2011)	0.22	9000	1.9	As above
A	EASA (2017) (Schuchardt et al.)	1.51	9000	13.6	No fume event/ oil leakage identified-T-CAC
B	EASA (2017)	0.009	9000	0.081	No fume event
A	Honeywell/Malmo (1999)	20.3	9000	183	Fume event - pilot incapacitation
A	Rosenberger *(2018)	0.981	9000	8.8	Fume event/ diversion in 1 of 17 flights. *Averaged over 17 flights
B	Rosenberger *(2018)	0.065	9000	0.58	Fume event/ diversion in 1 of 17 flights. *Averaged over 17 flights
A	De Ree et al. (2014)	0.155	9000	1.4	No fume events
B	De Ree et al. (2014)	0.0069	9000	0.062	No fume events

ULTRAFINE PARTICLES

- UFPs LINKED TO WIDE RANGE OF ADVERSE EFFECTS
- UFPs commonly identified in aircraft air- power turbines
- Associated with oil leakage/ oil droplets (Fushmi et al 2019)
- Normal flight

Environmental Health

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Ultrafine particle levels measured on board short-haul commercial passenger jet aircraft

Susan Michaelis, Tristan Loraine & C. V. Howard

Environmental Health 20, Article number: 89 (2021) | [Cite this article](#)

6454 Accesses | 7 Citations | 45 Altmetric | [Metrics](#)

Abstract

Background

Airline crew members report adverse health effects during and after inhalation exposure to engine oil fumes sourced to the air supply system onboard commercial and military aircraft.

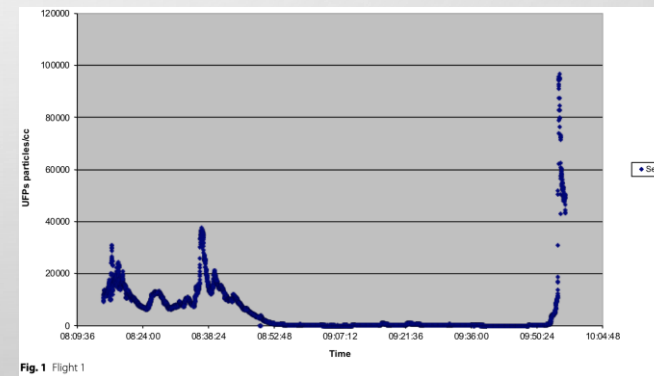



Fig. 1 Flight 1

WHATS COMING?

- NEW OILS
- BLEED AIR FILTRATION
- CONTAMINATED AIR SENSORS?
- TAP BLOOD TEST
- BLEED FREE DESIGNS
- PROTECTIVE EQUIPMENT
- MEDICAL PROTOCOL 
- DUTCH NATIONAL CABIN AIR ADVISORY GROUP (NAC) - ADVISORY NOTE
- [HTTPS://WWW.TWEEDEKAMER.NL/DOWNLOADS/DOCUMENT?ID=2023D34144](https://www.tweedekamer.nl/downloads/document?id=2023D34144)

(19) **United States**

(12) **Patent Application Publication**
FAYE et al.

(10) **Pub. No.: US 2021/0363455 A1**

(43) **Pub. Date: Nov. 25, 2021**

(54) **USE OF OILS COMPRISING
NON-NEUROTOXIC ANTI-WEAR
ADDITIVES**

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(72) Inventors: **Djibril FAYE**, Eragny (FR); **Marion
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SEVERAC**, Gargenville (FR);
Jean-Louis MANSOUX, Le
Plessis-Bouchard (FR); **Grégoire
HERVE**, Paris (FR)

(21) Appl. No.: **16/878,857**

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C10M 105/32 (2006.01)

C10M 133/12 (2006.01)

(52) **U.S. Cl.**

CPC *C10M 137/04* (2013.01); *C10N 2030/06*
(2013.01); *C10M 133/12* (2013.01); *C10M*
105/32 (2013.01)

(57) **ABSTRACT**

Disclosed is an oil that does not include tricresyl phosphate and includes as an anti-wear additive at least one diphosphorus compound for the prophylaxis of aerotoxic syndrome, especially in case of fume event. It also relates to a lubrication method utilizing such oil.

FURTHER READING

- Michaelis S, Loraine T, Howard CV. Ultrafine Particle Levels Measured On-board Short-haul Commercial Passenger Jet Aircraft. *Environmental Health*. 2021; 20(89): 1-14. Doi: 10.1186/S12940-021-00770-7
- Michaelis S, Burdon J, Howard CV. Aerotoxic Syndrome : A New Occupational Disease ? *Public Health Panorama (WHO)*. 2017; 3: 198-211. <https://Apps.Who.Int/Iris/Handle/10665/325308>
- Burdon J, Budnik LT, Baur X, Hageman G, Howard CV, Roig J, Et Al. Health Consequences Of Exposure To Aircraft Contaminated Air And Fume Events: A Narrative Review And Medical Protocol For The Investigation Of Exposed Aircrew And Passengers. *Environmental Health*. 2023; 22(1): 43. Doi: 10.1186/S12940-023-00987-8. <https://Doi.Org/10.1186/S12940-023-00987-8>
- Michaelis S. Aircraft contaminated air: A Brief Outline. *International Journal of Sustainable Aviation*. 2022; 8(3): 249-59. DOI: 10.1504/IJSA.2022.10047170
- Roig J, Domingo C, Burdon J, Michaelis S. Irritant-Induced Asthma Caused by Aerotoxic Syndrome. *Lung*. 2021; 199: 165-70. DOI: 10.1007/s00408-021-00431-z
- SAE. Airborne Chemicals in Aircraft Cabins. AIR 4766/2. Warrendale, PA, USA: SAE Aerospace; 2021. <https://www.sae.org/standards/content/air4766/2a>. Accessed 1 December 2022
- Fushimi A, Saitoh K, Fujitani Y, Takegawa N. Identification of Jet Lubrication Oil as a Major Component of Aircraft Exhaust Nanoparticles. *Atmospheric Chemistry and Physics*. 2019; 19(9): 6389-99. DOI: 10.5194/acp-19-6389-2019
- [2023 \(NAC ADVISORY NOTE\) HTTPS://FLYAWARE.NL/EN/SHORT-ARTICLES/ADVISORY-NOTE-NAC/](https://FLYAWARE.NL/EN/SHORT-ARTICLES/ADVISORY-NOTE-NAC/)
- Many more: e.g. gcaqe.org; susanmichaelis.com

”Huston we have a problem”



James Lovell, Apollo 13, http://en.wikipedia.org/wiki/Jim_Lovell

