GCAQE- April 2017

SELECTED EXAMPLES SHOWING EXPOSURE STANDARDS DO NOT APPLY IN AIRCRAFT & TCP DOES NOT HAVE AN EXPOSURE STANDARD…..

1.
House of Lords 2005 ([1])

- *"What exposure standards currently apply to any synergistic effects of simultaneous exposure to numerous chemicals which may be experienced by aircraft passengers and crew during a contaminated air event in a reduced pressure environment? None"*

2.
Mobil 1988,1990 & 1999

- *'Contrary to common belief, many components of TCP other than TOCP can be neurotoxic. For this reason it would be prudent to review the current workplace exposure standard, which applies only to TOCP.'* ([2])

- *'One might incorrectly imply that TOCP standards are adequately protective for products containing TOCP. However, TCP consists of a mixture of isomers.… This calls into question the adequacy of exposure standards which rely only upon the evaluation of the concentrations of the tri-o-isomer of TCP in the atmosphere. It is possible that the standard promulgated by US OSHA has been based upon the assumption that the tri-o-isomer was primarily or solely responsible for the neurotoxic properties of TCP.'* ([3])

- *"There was very little difference between the activities of TCP &TOCP…..We are under the impression that a commonly held opinion is that TCP with TOCP levels below 1% is not neurotoxic. Our results indicate that TOCP level in TCP is not a reliable indicator of potential neurotoxicity…. There is confusion over the appropriateness of using the TOCP level as an indicator of neurotoxic potential. After considering the weight of all available evidence, both published and our new data, we concluded that EPA and other users of TCP as a lubricant additive should be informed of our results."* ([4])

3.
Henschler (1958) ([5])

- *'Previous calculations of the toxic human dose were based on the amount of ortho cresol contained in a preparation and related this amount to TOCP, in belief that the bound proportions of meta-cresol and para-cresol have no effect on the toxicity of the total preparation. However since the meta and para isomers that are present can cause the formation of the mono-ortho and diortho esters.… The toxicity of the mixed esters is much greater than the TOCP, the old method of calculation, is invalid..'*
- *'It is no longer permissible to relate an analyzed proportion of ortho cresol to triortho- cresyl phosphate.' ...The term tri-ortho cresyl phosphate poisoning should no longer be used,*

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1. UK House of Lords (2005) House of Lords Hansard. Countess of Mar[HL 1761] October 2005
2. Craig P., Barth M (1990) An Assessment Of The Risks Of Delayed Neurotoxicity From Industrial And Commercial Uses Of TCP. Mobil Environmental H&S Dept., Jul 1990.
3. Craig P., Barth M. (1999) Evaluation of the Hazards of Industrial Exposure to TCP: A Review and Interpretation of the Literature. Journal of Toxicology & Environmental Health, Part B. Critical Reviews 2:281-300, 1999.
4. Mobil (1988) Letter from Mobil Research and Development Corporation to US EPA- Notification of Tricresyl Phosphate (TCP), July 21, 1988
5. Henschler D. (1958) Die trikresylphosphatvergiftung. Experimentelle Klärung Von Problemen Der Ätiologie Und Pathogenese (Tricresyl Phosphate Poisoning. Experimental Clarification Of Problems Of Etiology And Pathogenesis). Klinische Wochenscrifte 36: 663-674, 1958

instead the more general and more accurate tricresyl phosphate poisoning should be used..'

- *"Since the meta & para isomers that are present cause the formation of mono-ortho & di-ortho esters, and since,….. the toxicity of these mixed esters is much greater than that of the tri-ortho- cresyl phosphate, the old method of calculation, which only recently was again used to obtain an incorrect value for the toxic limiting dose is invalid."*

4.

WHO 1990 ([6])

- *"A clear "no-observed-effect" level for either delayed neuropathy or reproductive effects of exposure to TOCP is not apparent from the data available." (WHO, 1990).*
- *"Because of considerable variation among individuals in sensitivity to TOCP, it is not possible to establish a safe level of exposure … Both the pure ortho isomer and isomeric mixtures con- taining TOCP are, therefore, considered major hazards to human health."*
- *"There is also considerable variation in the rate of recovery from poisoning, some patients recovering completely and others still severely affected years later, after apparently similar exposure."*

5.

ACGIH – 2015 ([7])

- "The TLVs and BEIs represent conditions under which ACGIH believes that nearly all workers may be repeatedly exposed without adverse health effects.
- **Introduction – general Information:** The values presented in this book are intended for use only as guidelines or recommendations to assist in the evaluation and control of potential workplace health hazards and for no other use…..

- *Appx F: minimal oxygen content "Altitude- The physiological effects of oxygen deficiency and oxygen partial pressure variation with altitude for dry air containing 20.948% oxygen are given in Table F-1. No physiological effects due to oxygen deficiency are expected in healthy adults at oxygen partial pressures greater than 132 torr or at elevations less than 5000 feet. …. At oxygen partial pressures less than 120 torr (equivalent to an elevation of about 7000 feet or about 5000 feet)… symptoms in unacclimatized workers include increased pulmonary ventilation and cardiac output, incoordination, and impaired attention and thinking. These symptoms are recognized as being incompatible with safe performance of duties . Accordingly, ACGIH® recommends a minimal ambient oxygen partial pressure of 132 torr, which is protective against inert oxygen-displacing gases and oxygen-consuming processes for altitudes up to 5000 feet."*
- *AppxE: Threshold Limit Values for mixtures - " The additive formula applies to mixtures with a reasonable number of agents. It is not applicable to complex mixtures with many components (e.g., gasoline, diesel exhaust, thermal decomposition products etc.)"*
- *Appx H: Reciprocal Calculation procedure (RCP) for certain hydrocarbon solvent vapor mixtures – "The RCP does not apply to … lubricating oils"*
- *Application of TLVs to unusual ambient conditions: Sampling results obtained under unusual conditions cannot easily be compared to the published TLV, and extreme caution should be exercised if workers are exposed to very high or low ambient pressures."*

NB: Atmospheric pressure at :
MSL = 760 torr (mmHg)
8000 ft = 536.45 torr (mmHg)
http://www.calctool.org/CALC/phys/default/pres_at_alt

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6. WHO (1990) International Programme On Chemical Safety (IPCS) ©.WHO Geneva 1990)- (Tricresyl Phosphate Environmental Health Criteria 110

7. ACGIH (2008) American Conference of Governmental Industrial Hygienists. TLVs and BEIs, Appendix E- Threshold limit values for mixtures & Appendix F- Minimal Oxygen Content. 2008

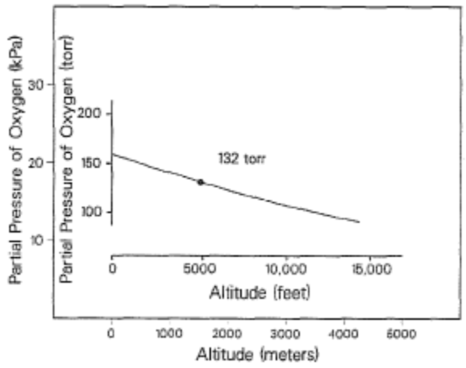

FIGURE F-1. Plot of oxygen partial pressure (pO_2) (expressed in torr and kPa) with increasing altitude (expressed in feet and meters), showing the recommended oxygen partial pressure of 132 torr.

Figure F-1 - refer Ref 7.

6.
ASMA - 2002 ([8])

- *"OSHA standards (and others throughout the world) are not applicable to aircraft cabin air. Rather they were designed for the industrial workplace."*

7.
Nagda,, Rector, Li & Space – D Space- Boeing - 2000 ([9])

P222 *"Unfortunately, occupational exposure standards are applied too often to public health situations without acknowledging differences in population characteristics, exposure conditions or protection goals. Public health goals usually seek to minimize risk for a population comprised of all age groups and all states of health…….. Although workplace standards are often applied to non-occupational settings using a safety factor, the American Industrial Hygiene Association disapproves the practice of applying workplace standards to non occupational situations.*
The airliner cabin is a unique environment since it is simultaneously occupied by passengers (ie: a segment of the general public) and flight attendants (ie: a segment of the worker population). The standards and guidelines for public exposure are more stringent than occupational levels. Thus it is not appropriate to use occupational standards or guidelines as criteria for the cabin environment. The FAA standards and in the absence of cabin air quality standards, NAAQS standards are appropriate criteria for the cabin environment (table 3). If safety factors to account for differences in exposures of workers and the general public are considered, then the application of other standards and guidelines could be considered."
NAAQS = USEPA – ozone, CO, NOx, Sox, particulate matter & lead. See table 2 of the 2000 Nagda paper, P221
FAA standards ozone, CO2, CO and cabin pressure

P220 "FAA airworthiness standards defining acceptable levels for ozone, carbon dioxide, carbon monoxide and air pressure represent the only regulations that currently apply to the aircraft cabin. To address other pollutants, investigators often compare data with regulations and standards developed for ground based environments. Such comparisons, however, do not always recognize underlying differences related to population characteristics and the special nature of the aircraft

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8. Rayman R. (2002) Cabin air quality: An Overview. Aviation Space and Environmental medicine. Vol 73 No 3 March 2002 – Aerospace medical Association

9. Nagda N. Rector H, Li Z, Space D. (2000) Aircraft cabin air quality: A critical review of past monitoring studies. Air Quality & comfort in Airliner cabins, ASTM STP 1393. N.L. Nagda, Ed, American Society for Testing and materials, 2000.

cabin environment, including the differences between aircraft and building designs."

8.
AIHA –American Industrial Hygiene Association (1998) ([10])
P 5/6- point 6: " *It is therefore inappropriate and scientifically unjustifiable to use these* (PELS, TLVs & WEELs) *limits in non-occupational applications."*

PEL – OSHA Permissible Exposure Limits
TLVs - (ACGIH) Threshold Limit Values – American Conference of Governmental Industrial Hygienists
WEELs – AIHA - Workplace environmental exposure limits

9.
CONE 2005 ([11])
"Federal regulatory agencies, other than the US FAA (with its limited set of airline cabin environmental standards), such as US OSHA and US EPA have not established exposure limits for the unique environment of aircraft, nor are their existing standards necessarily appropriate for this environment."

10.
ASTM- 2011 ([12])
"*Workplace exposure guidelines cannot simply be extended to address exposures in aircraft cabin environment. (passengers & crew occupy environment simultaneously & longer shifts)"*

11.
Ernsting: (1988) ([13])

"Certain difficulties arise in the application to flight of threshold limit values derived for use in industry. Thus a transient slight impairment of performance that may be quite acceptable in a factory is unacceptable in a pilot. The exposure may occur in combination with stressors common in flight: low pressure, high temperature, sustained acceleration. These can modify considerably the intensity and nature of the effects produced by the noxious substance. More than one agent may be present, so that the combined toxicity must be considered. Furthermore, exposures in flight tend to be short but intense. Finally, the continual changing gaseous environment in the crew compartments of aircraft in flight tends to produce wide and rapid fluctuations in chemical composition of the air. Thus TLVs must be applied with caution in aviation and are no more than a general guide, especially for the relative toxicity of different materials."

12.
Cranfield cabin air sampling report (2011) ([14])
"Table 14 lists the UK workplace exposure limits (WEL) for an 8 hour exposure period set by the UK Health and Safety Executive for occupational environments (HSE 2005) for several of the substances monitored. These are appropriate for the protection of the health of a working adult

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[10]. AIHA (1998) White Paper on Permissible Exposure Limits. American Industrial Hygiene Association, 1998

[11]. Cone J. (2005) Aircraft cabin air quality trends relative to ground level standards. In Springer Verlag Berlin Heidelberg. Hdb Env Chem, Vol 4, Part H, (2005): 293-315

[12]. ASTM (2011) Standard Guide for Deriving Acceptable Levels of Airborne Chemical Contaminants in Aircraft Cabins Based on Health and Comfort Considerations. D7034-11

[13]. Sharp G. (1988) Toxic Gases and Vapours in Flight. Aviation Medicine, 2nd Edition. Edited by Air Vice Marshall J Ernsting RAF ret and Air Vice Marshall Peter King RAF Ret. 1988, Revised by D. Anton, 1998

[14]. Crump, D., Harrison, P. and Walton, C. (2011) Aircraft Cabin AirSampling Study; Part 1 of the Final Report . Institute of Environment and Health, Cranfield University (2011).

exposed in a workplace and are not applicable to other groups such as children or elderly persons or to other environments that are not workplaces"

13.
EH40/2005 Workplace exposure limits - UK ([15])
"WELs are British occupational exposure limits and are set in order to help protect the health of workers"
"WELs are approved only for application to people at work"

14 .
EU DIRECTIVE ([16])
COMMISSION DIRECTIVE 2009/161/EU

1) Pursuant to Directive 98/24/EC, the Commission is to propose European objectives in the form of indicative occupational exposure limit values (IOELVs) for the protection of workers from chemical risks, to be set at Community level.

15.
European Commission (2013) ([17])

p 8: *"OELs….. should not be used as a basis for assessing the acceptability of non-occupational exposure"*

4.3 Individual susceptibility, special risk groups and sensitisation
"SCOEL will take into account available information on groups of people at special risk and this will be reflected in the advice it gives to the Commission. However, the variability of response between individuals at the same level of exposure, and the existence of special risk groups, may mean that the recommended OEL may not provide adequate protection for every individual. Depending on the specific chemical database, SCOEL might not recommend a health-based OEL for certain chemicals (Chapter 2, page 3).
Groups at higher risk in relation to a specific compound will be identified in the corresponding recommendation and available information provided, but the OELs are established for healthy workers."

6.3 The occupational situation
"very young, sick and old people do not form part of an occupationally exposed population."

16.
ASHRAE Guideline 2013 ([18])

S. 8 *"Except for industrial workplaces and certain specialized environments, such as spacecraft, indoor air quality standards do not exist for most indoor or confined environments, including aircraft cabins."*

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[15]. EH40/2005 Workplace exposure limits Containing the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulations (as amended) EH40 (Second edition, published 2011)

[16]. COMMISSION DIRECTIVE 2009/161/EU of 17 December 2009 establishing a third list of indicative occupational exposure limit values in implementation of Council Directive 98/24/EC and amending Commission Directive 2000/39/E

[17]. European Commission (2013) Methodology for the Derivation of Occupational Exposure Limits - Scientific Committee on Occupational Exposure Limits (SCOEL) . Key Documentation (version 7) - June 2013 Employment, Social Affairs Inclusion

[18]. ASHRAE (2013) Air Quality Within Commercial Aircraft: Standard 161-2013. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Atlanta, GA

"Table 8.2.2 lists health, safety, and comfort-related guidelines for exposure to various chemicals. There are currently no federal regulations governing levels of exposure to chemicals measured in aircraft cabin air other than those for carbon dioxide, carbon monoxide, and ozone. The table provides a way for users to compare their measurements with standards that have been adopted by various agencies and organizations. Most of these guidelines were developed for ground-based applications. They do not apply to the general public (ACGIH 2010) and do not account for the fact that crewmembers often work duty days of 14 hours or more. Also, they do not account for extremes in temperature or RH (ACGIH 2010), and chemical exposures at these levels may not protect against impairment to high-level cognitive functions, although such functions must be maintained by pilots in particular throughout flight (Singh 2005)."

17.

SCOEL ([19])

"The Scientific Committee on Occupational Exposure Limit Values (SCOEL) was set up in 1995 with the mandate to advise the European Commission on occupational exposure limits for chemicals in the workplace. It does this through the preparation of scientific recommendations for the Commission which are used to underpin regulatory proposals on occupational Exposure Limit Values (OELVs) for chemicals in the workplace."

18.

SHK (2001) ([20])

" Overheated oils can be transformed into a large number of different types of hydrocarbons, carbon monoxide, carbon dioxide, organic phosphor compounds and so on. Information about what substances are included in petroleum products, knowledge of toxicology and the medical basis on which to state a distinct limit between harmful and non-harmful content is often lacking. Even less is known about the substances that are formed at high temperatures and what possible interactive effects arise through the simultaneous exposure to several air pollutants. It is even possible that an eventual poisonous affect can be intensified by the reduced oxygen partial pressure that normally occurs in a pressurized cabin during flight."

19.

ASTM- D 7034-11 (2011) ([21])

5.3 – "An important feature of the aircraft cabin environment is that both passengers (public) and flight attendants (worker population) occupy it simultaneously Therefore workplace exposure guidelines cannot simply be extended to address exposures in aircraft cabin environment. Also the length of flights and work-shift can vary considerably."

20.

SAE (2011) ([22])

"Occupational and public exposure limits apply only to exposures to a single chemical at a time. They do not reflect the actual situation in aircraft cabins, where contaminants may be present in a blend, and the possible effects of altitude on toxicity mechanisms. Also, exposure standards or limit values do not exist for all chemical species, or the various possible isomers."

21.

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[19]. SCOEL (2016) The Scientific Committee on Occupational Exposure Limits (SCOEL) http://ec.europa.eu/social/main.jsp?catId=148&intPageId=684&langId=en

[20]. SHK (2001) Report RL 2001 : 41e. Incident Onboard Aircraft SE-DRE. Sweden, 12 November 1999. Stockholm: Statens haverikommission (SHK) Board of Accident Investigation.

[21]. ASTM- D 7034-11 – Standard Guide for deriving Acceptable Levels of Airborne Chemical Contaminants in Aircraft Cabins Based on Health and Comfort Considerations.

[22]. SAE (2011) AIR 4766/2- Airborne Chemicals In Aircraft Cabins, Development. Warrendale: SAE.

FAA (2009) ([23])

"It is well established that the toxicity of individual substances differ from their mixture(s). Such difference would be because of the interactive effects of chemicals present in the mixture(s). Thus, the overall toxicity would be the result of additive, potentiation, synergistic, and/or antagonistic type of interaction(s) among chemicals present in the mixtures in relation to the toxic effects exerted by the individual components of the chemical mixtures (106). In other words, the chemicals found in the carbonaceous material may not necessarily be individually toxic at the found concentrations, but if they are mixed together at those concentrations, the mixture might be highly toxic. Interaction of chemicals would also play a crucial role in exhibiting characteristic odor, which may not necessarily be consistent with the odor exhibited by an individual chemical itself."

22.

Airbus (2005) ([24])

" Existing standards also do not address the specific environment of the aircraft cabin in detail, if at all. The aircraft cabin environment is unique when compared to other indoor spaces due to the combination of elevated cabin altitude, low humidity, high pressure density, the long sedentary position of the passengers and flights across time zones."

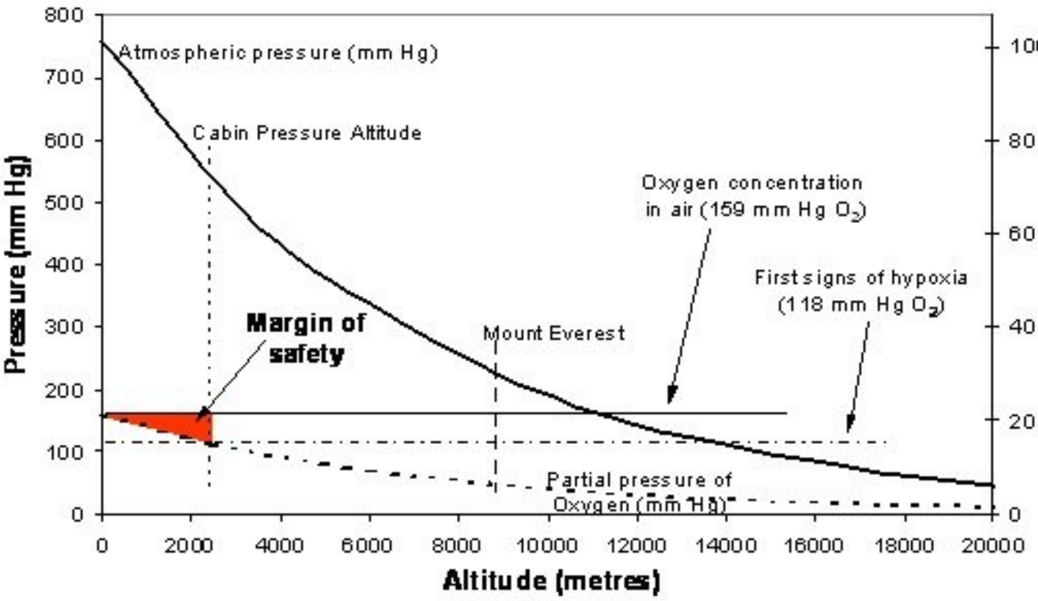
23.

S. Michaelis PhD:- Sect 2.5 The exposure standard debate ([25])

Michaelis, S. (2010) PhD in Safety Science - 'Health And Flight Safety Implications From Exposure To Contaminated Air In Aircraft.'
http://handle.unsw.edu.au/1959.4/50342

Figure 2-12: Pressures and oxygen concentrations at altitude

(from [182])



24:

23. Chaturvedi, A. (2009) DOT/FAA/AM-09/8. Aerospace Toxicology: An Overview. Oklahoma City: FAA, CAMI.

24. Dechow, M. and Nurcombe, C. (2005) 'Aircraft Environmental Control Systems', in Hocking, M. (ed.) Air Quality in Airplane Cabins and Similar Enclosed Spaces. Berlin: Springer (The Handbook of Environmental Chemistry), pp. 3–24.

25. Michaelis S. (2010) PhD Thesis. 'Health And Flight Safety Implications From Exposure To Contaminated Air In Aircraft.'

C. Winder (2002) – jet oils ([26]) - see page 19- above graph.

- *"Atmospheric pressure at sea level is 760 mm Hg, with the corresponding partial pressure of oxygen in air is 159 mm Hg (20.9% or 760 mm Hg). The minimum O2 concentration for work is considered to be about 136 mm Hg (18 kPa or 18%) O2 in air at sea level. A minimum oxygen partial pressure of 118 mm Hg (equivalent to an altitude of 2438 m/8000 ft) is required to prevent hypoxic cabin air in commercial aircraft during normal operations. This partial pressure is maintained by the cabin pressure system (a second requirement for release of oxygen dispensing units at 4572 m/15,000 ft is recommended).*

- *The altitude at which the partial pressure of 136 mm Hg is reached is also quite close to the pressure at which airplane cabins are pressurised (118 mm Hg). There is little margin of safety in people working at altitude, and in many cases, such workers may be beginning to become hypoxic. This shown in the Figure below, where the area bounded by the dashed partial pressure of Oxygen in Air curve, and the dotted line representing the minimum physiological demand line represents the margin of safety at which workers can be considered to have sufficient oxygen to work safely). Further, the position of the cabin pressurisation line shows that in some cases, workers at altitude may not be obtaining enough oxygen for their physiological requirements".*

25.

C Winder (2001)- Misuse of Exposure standards ([27])

- *"the term exposure standard is poorly understood and is subject to misuse*"…….

26.

Winder (2006) ([28])

"…For these reasons, the application of conventional occupational health and safety procedures to this specialised environment are inappropriate. Examples of these include:

- ventilation rates for buildings;
- absence of safety information, risk assessment and advice on control of risks;
- the use of permissible exposure standards. A common assertion by aviation companies is that "all chemical exposures are within acceptable TWA exposure standards". However, these
- apply only to the specified chemical;
- protect 'nearly all workers', not all workers;
- cannot protect sensitive workers;
- are NOT no effect levels;
- poorly consider periods of peak exposure;
- ignore skin exposure;
- ignore exposures to other contaminants;
- must not be applied to people other than workers (ambient standards for the general public are often 100-1000
  times lower);
- must not be applied to unusual environments (for example, the cabin of an airplane)

Extenuating circumstances on board aircraft (including humidity and cabin pressure) have not been studied to

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[26]. Winder C., Balouet JC. (2002) The Toxicity of Commercial Jet Oils. Environmental Research. Section A 89,146-164, 2002

[27].Winder C. Misuse Of The Exposure Standard Concept . Journal of Occupational Health & Safety-Aust & NZ 1998, 14 (2) 107-110

[28]. Winder C. (2006) Hazardous Chemicals on Jet Aircraft: Case Study-Jet Engine Oils and Aerotoxic Syndrome. Current Topics in Toxicology. Vol 3 2006

the extent that a suitable exposure standard can be identified that incorporates these factors or identifies interactions between factors.

It is incorrect to assume the exposure standard for TOCP as being "adequately protective" for a TCP containing mixture of TCP isomers as other ortho isomers (MOCPs, DOCPs) are at least 5-10 times more toxic than TOCP

Procedures for assessing the risks of exposures to more than one chemical, that may act in synergy to produce toxicity (for example, carbon monoxide and lowered oxygen); under circumstances of exposure to mixtures of contaminants, levels may be well below recommended levels in currently accepted exposure standards - yet still generate complaints or signs and symptoms, 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.

Occupational exposure standards must also not be applied to non-workers, for example passengers."

27. EASA (2016) – AVOIL oil pyrolysis study ([29])

- *"the conditions in cabin air may differ from the standard conditions on which exposure limits are normally based, for example the air pressure, humidity and longer working hours. These aspects need further consideration. In addition, also possible effects relating to mixture toxicology need further investigation."*

28. CAQ-EASA ([30])

- *'The assessment of the acceptable pollutant concentrations in aircraft is difficult from regulatory point of view because the aircraft is a workplace for the crew and a public place for the passengers.'*

29. ACER (FAA)/Boeing study ([31])

- *"Typical concentrations found in aircraft can cause transitory symptoms in healthy individuals questioning the adequacy of current standards."*

Exposure standards for oils, hydraulic & deicing fluid substances

http://limitvalue.ifa.dguv.de/

Chemical, CAS	Fluid	Exposure standard – 8 hrs	Level
TCP 1330-78-5 all isomers	oil	No	
TOCP 78-30-8 Not other ortho isomers	oil	Yes - many	0.1mg/m3
TCP 78-32-0	oil	No	

[29]. EASA (2017) European Aviation safety Agency. Final Report EASA_REP_RESEA_2015_2. Research Project: AVOIL. Characterisation of the toxicity of aviation turbine engine oils after pyrolysis (AVOIL). EASA, Cologne

[30]. EASA (2017) European Aviation safety Agency. Final Report EASA_REP_RESEA_2014_4. Research Project: CAQ. Preliminary cabin air quality measurement campaign. EASA, Cologne

31. Weisel CP, Fiedler N, Weschler CJ, et al. Human Symptom Responses To Bioeffluents, Short-Chain Carbonyls/Acids and Long-Chain Carbonyls in a Simulated Aircraft Cabin Environment. Indoor Air 2017; 38: 42–49.

(non ortho isomers)			
TXP- trixylyl phosphate 25155-23-1	oil	Canada only	0.1mg/m3
PAN 90-30-2 N-1-naphthylaniline	oil	No	
BNA 91-59-8 2-naphthylamine (contaminant of PAN)	oil	France	0.001 ppm
PBN N-2-naphthylaniline 135-88-6 (contaminant of PAN)	oil	No	
ALKYLATED DIPHENYLAMINES 68411-46-1	HYD	No	
TBP- Tributyl phosphate 126-73-8	HYD	Yes	2.2-5 mg/m3
Triphenyl phosphate TPP 115-86-6	HYD	Yes	3 mg/m3
dibutyl phenyl phosphate 2528-36-1	HYD	yes	0.1-3.5mg/m3
butyl diphenyl phosphate 2752-95-6	HYD	No	
2,6-di-tert-butyl-p-cresol 128-37-0	HYD	Yes	2-10mg/m3
2-ethylhexyl 7-oxabicyclo[4.1.0] heptane-3-carboxylate or Aliphatisches Epoxide 62256-00-2	HYD	No	
Ethylene glycol CAS 107-21-1	De-icing	Finland	
Propylene glycol 57-55-6	De-icing	No	