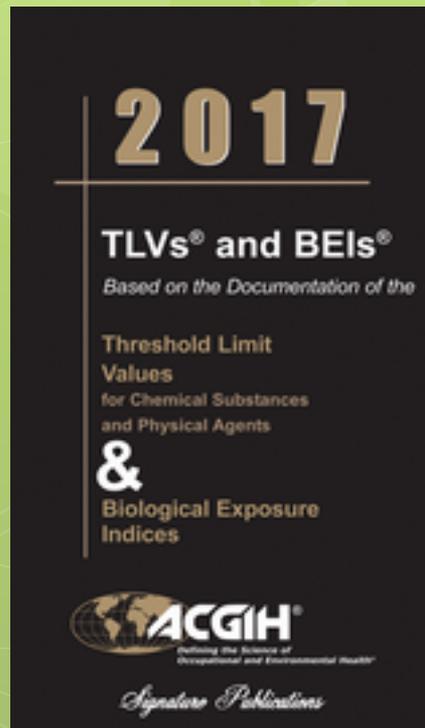


# The Use of Exposure Standards in Aviation



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## Who says what?

- 'The results show that the cabin/cockpit air quality is similar or better than what is observed in normal indoor environments (offices, schools, kinder gardens or dwellings). No occupational exposure limits and guidelines were exceeded.' (EASA 2017)
- 'No evidence for target pollutants occurring in the cabin air at levels exceeding available health and safety standards and guidelines.' (Cranfield, IEH, 2011)
- **ARE THEY CORRECT??**

<https://www.easa.europa.eu/newsroom-and-events/press-releases/easa-publishes-two-studies-cabin-air-quality>

Cranfield University, IEH, 2011



## Use of TLVs- ACGIH

- Not consensus standards
- Use only by people trained in industrial hygiene
- One of multiple factors to be considered
- Health based limit that nearly all workers may be repeatedly exposed to without adverse effects
- Not fine lines between safe & dangerous
- Not indicator of toxicity/ disease/adverse effects
- Airborne concentrations
- Some individuals may experience discomfort, more serious adverse effects at/below the TLV



## Use of TLVs- ACGIH

- Sensitization may occur
- Susceptibility varies – differing work demands
- Care to be taken comparing results with TLVs in unusual ambient conditions ( -normal:25degC, 760 torr/barometric pressure- MSL)
- Care required for unusual work schedules > 8 hour days
- Skin absorption notation: air sampling insufficient to quantify exposure levels
- Only available for limited substances
- Not all up to date



## Use of TLVs- ACGIH

- Apply to single substances
- Not applicable to complex mixtures with many components eg: thermal decomposition products
- No physiological effects of oxygen deficiency at oxygen partial pressures(pp)  $> 132$  torr or below 5000 feet.
- Additional work practices required at Oxygen pp  $< 132$  torr/5000ft.



## Use of TLVs- ACGIH

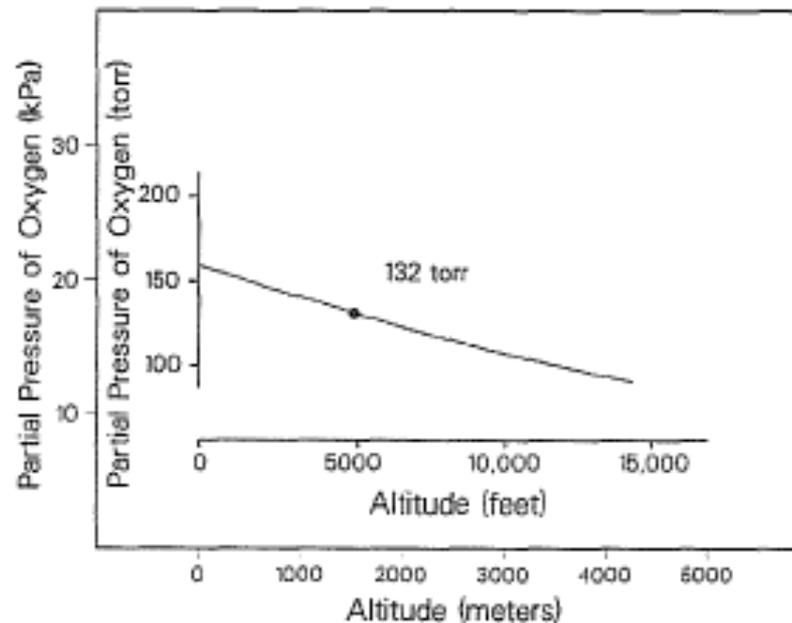


FIGURE F-1. Plot of oxygen partial pressure ( $p_{O_2}$ ) (expressed in torr and kPa) with increasing altitude (expressed in feet and meters), showing the recommended oxygen partial pressure of 132 torr.



## Use of OELs: other

- Not binding
- Very few updated
- How to apply when aircraft fly over different states/countries?
- (UK) - WELs only applicable (900-1100 mb) = 3241 ft – minus 2290 ft



## Industry awareness that TLVs/OELs do not apply to cabin environment- examples

- **No Exposure standard for oil mixture** – ExxonMobil-2013; House of Lords-2005
- **TOCP exposure standard does not apply to TCP exposure** – Mobil-1988,1999, Henschler-1958

***“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 containing TOCP are, therefore, considered major hazards to human health.”*** WHO, 1990

- OSHA & other global standards not applicable to aircraft cabin air as Industrial standards. Aerospace med Assoc -2002; Ernsting-1988 (RAF ret);



## Industry awareness that TLVs/OELs do not apply to cabin environment- examples

- **Not applicable to the public in non occupational settings** – Nagda 2000; AIHA-1998; ASTM-2011; Cranfield-2011; EH40/2005; ASHRAE- 2013; European Commission-2013....

***“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.”*** –ASHRAE 2013

***“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.”*** – SAE 2005

*Similar FAA-2009; Airbus-2005*

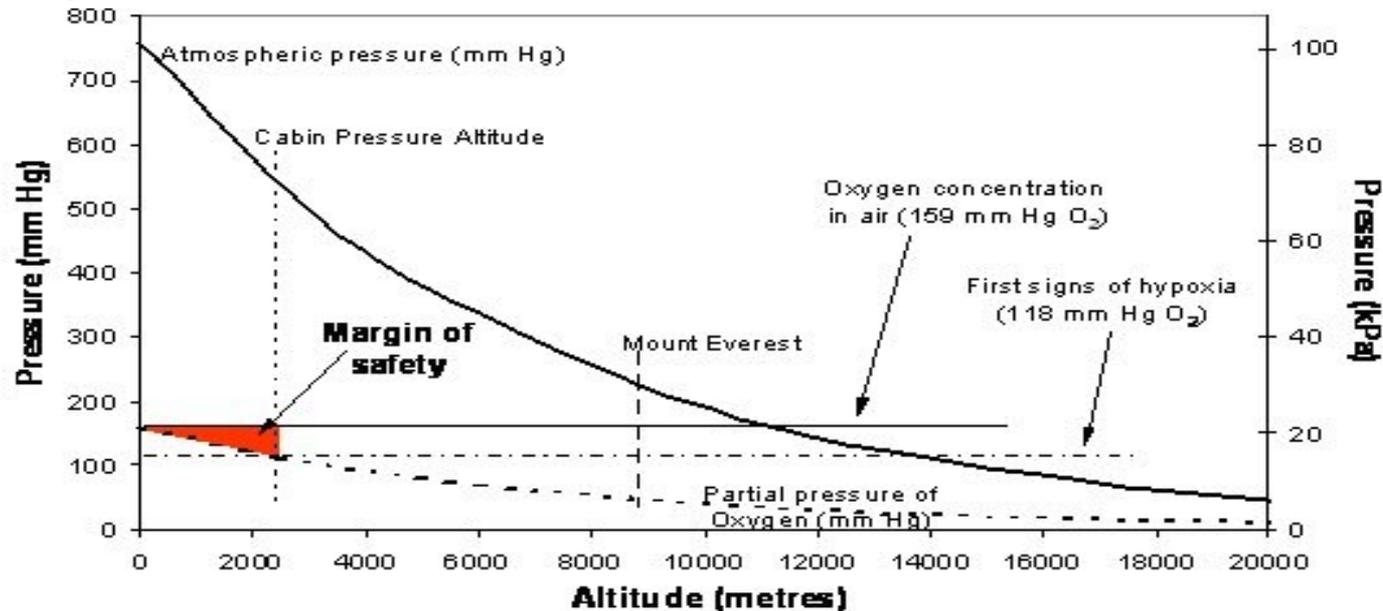


EASA says it all:

- *“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.”*

*EASA-CAQ study 2017*

# Hypoxic environment?



*Minimum O<sub>2</sub> concentration for work is around 132 mm Hg:*

*Minimum O<sub>2</sub> pp of 118 mm Hg (8000 ft) required to prevent hypoxic cabin air*

*There is little margin of safety in people working at altitude....*

*workers may be beginning to become hypoxic*



## Conclusions

- TLVs, OELs should not be applied to the aircraft cabin environment- aircraft contaminated air
  - Reduced partial pressures of oxygen
  - Complex heated mixtures
- This environment is unique without the possibility to escape
- The aircraft cabin should not be compared to ground based workplaces
- Avoidance is required/ hierarchy of controls