ETUC input to inform the work in CEN TC 436 'Cabin Air Quality on civil aircraft - Chemical Agents' TG1

The members of CEN TC 436 TG1 were invited to submit their input for **the list of chemical marker compounds, including the rationale.** With this paper, we would like to send our views on the rationale for inclusion of chemicals on the TG1 list to the work of CEN TC 436.

Preamble

The time and resources available to TG1 and TC436 are limited. The outcome has to be achieved by consensus on a voluntary basis. It is therefore imperative that we should agree on goals that are logical, achievable and acceptable to all stakeholders. Conversely we should not undertake to measure anything that will not deliver an interpretable result or for which there is only a vague concept for a technical solution. The old adage of "We must do something, this is something, let's do that" simply won't do. There has to be a path to an achievable endpoint.

When starting a new project, it is usually good practice to ask everyone involved to perform a thought experiment about what needs to be measured and how an experiment can be designed to achieve that. Then as part of an examination of the proposed measurements the assumption is made that, notionally, we have the answer and then consider how that might help in the interpretation of the original question. This approach can save a lot of heartache and research effort in weeding out useless measurements. So far the deliberations of TG1 have not included such considerations in any structured manner.

Feasible endpoints

There appears to be general consensus on TC436 that some form of early warning system to inform pilots of engine oil seal malfunctions, to allow them to turn off the bleed air supply from the engine identified by the warning system. This would help in the avoidance of not only high dose 'fume events' but also of less obvious lower dose malfunctions. However this would be of no benefit in warning of lower level emissions in normal operations. The result of a functioning early warning system would be to protect passengers and crew from the higher doses of lubrication oil fugitive engine emissions, an end point that few if any could dispute on the grounds of logic. TC436 has been informed that there are technical solutions extant and in late development for detecting and measuring engine combustion products in real time that have been miniaturised to the extent that they could be integrated into aircraft. Engine emission detection instrumentation is a relatively mature area of technology. Therefore pursuit of an early warning system meets all three of the goals mentioned above (logical, achievable and acceptable to all stakeholders). Thus inclusion of chemicals addressing this aspect (eg PM2.5, ultrafine particles or PM0.1, CO2, CO, total carbon) in the TG1 list would make sense.

Useless endpoints

Any proposal to measure single chemicals at the relatively high concentrations quoted in Occupational Exposure Levels (OELs) or other threshold limit values would not be useful. Implementation of an early

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warning system would have the consequence of making it more or less impossible for OELs to be breached. (The reasons why OELs are not appropriate to apply in aircraft cabin environments have been well rehearsed in the TG1 forum and will not be repeated here.) The toxicological problem identified in aircrew is the result of chronic/continual low dose exposure to a complex mixture of toxic constituents of turbine engine oil, mixed in an aerosol of ultrafine particles (UFPs). Over a professional lifetime the exposure time can be as high as 20,000 hours. All chemical components of the mixture (not including UFPs) are present at concentrations far below the limit of detection of any equipment that could be routinely carried on commercial aircraft. Even if such a feat could be achieved by some technical breakthrough the measurement of single compounds would not address the basic toxicological problem – a very complex mixture of unknown composition. Therefore the setting of OELs would not logical because, to all intents and purposes, the limit would never be breached. Nor would it be achievable because of the current state of technology. It would certainly not be acceptable to all stakeholders because, although using an OEL as part of the standard gives absolutely no information of relevance to chronic low dose exposure to a toxic mixture, there is little doubt that it would be used by end-users, to imply that there were no hazards. Therefore the OEL approach fails on all three of the goals outlined above.

Conclusions

Simplifying matters, there are two broad classes of substances in engine bleed air – a) hydrocarbons from engine combustion processes and b) toxic chemicals based on triaryl phosphates. Substances under a) could contribute to an early warning system. Substances under b) are at too low a concentration to be amenable to monitoring at any meaningful level on a 'one chemical at a time' basis. Therefore TG1 should submit a list of substances that will solely assist in the development of a practical early warning system.

Such substances would include total carbon, particulate matter (PM2,5 and PM0.1), carbon monoxide, carbon dioxide. Some form of differential engine monitoring has been suggested where the level of the monitored substance is simultaneously measured at the engine air intake and the bleed air output. Continuous subtraction monitoring would be the deliverable.

We would appreciate if the members of CEN TC 436 TG1 could take the above into consideration in the drafting of the standard.

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