Cabin Air Quality—Reducing Smoke and Fume Events

In recent years, concerns have risen about air quality, smoke, and fumes in commercial aircraft. Due to a combination of factors, passengers and crew may be suffering from the deleterious effects of certain contaminants in cabin and flight deck air, even when the aircraft are equipped with High-Efficiency Particulate Air (HEPA) filtration systems.

Many commercial aircraft historically use pneumatic "bleed air" taken directly out of the engine compressor section to supply compressed air to various systems such as cabin air conditioning, cabin pressurization, wing and engine anti-icing, and engine start systems. In theory, the compressor section of a jet engine is forward of the combustion/turbine section (where fuel is introduced) and thus should be "clean" air. But any part of a jet engine will have lubricants (oil) as well as metal components present, creating a risk of particulates in the air supply. To combat this, aircraft are equipped with High-Efficiency Particulate Air (HEPA) filters which trap 99.97% of airborne particles of .3 microns or more. Jet aircraft engine emissions are similar to diesel engine emissions, and both can have particulate emissions down to the .03-.5 micron range. This means that these particles, if present in bleed air routed to the air conditioning packs of commercial aircraft, can in fact bypass HEPA filters. The amount of these particles that make it into an aircraft cabin, the toxicity thereof, and time of exposure thereto, varies widely and per individual.

The recent uptick in reports of "Smoke and Fume Events" among both passengers and crew highlights these issues. When seals or filters fail, bleed air can introduce carcinogenic contaminants like engine oils, hydraulic fluids, and other chemicals into the cabin, and some of these contaminants contain compounds such as tricresyl phosphate (TCP) which may have neurotoxic effects. Some smoke and fume events have no known cause, while others have resulted from oil leaks, electrical faults, or malfunctioning cabin systems. Such events can cause symptoms like headaches, nausea, respiratory irritation, and in rare cases, more severe neurological symptoms. Due to repeated and prolonged exposure, smoke and fume events are a pervasive occupational hazard for commercial flight crew, and an acute threat to the flying public.

In response to these concerns, there is ongoing research and regulatory debate about improved filtration systems, better cabin air quality monitoring, and clear protocols for handling fume events to protect passengers and crew. Multiple legislative efforts have focused on addressing the issue of toxic fumes in commercial aircraft cabins. Most notably, the bipartisan **Cabin Air Safety Act** (S.615; introduced in March 2023 and referred to the Senate Commerce, Science, and Transportation Committee) has been reintroduced in both the U.S. Senate and House to ensure the safety of airline crew and passengers from harmful contaminants in cabin air. This proposed legislation aims to ***create standards for air quality on planes, mandate carbon monoxide detectors, and require annual training for crew members on identifying and responding to fume events.*** It also requires the Federal Aviation Administration (FAA) to establish a standardized reporting system and publicly share incident data quarterly, increasing transparency and encouraging preventative measures. The Cabin Air Safety Act also proposes to ***mandate air quality***

monitoring technology on aircraft and would empower the FAA to investigate fume incidents that result in medical attention. The entire industry is in dire need of consistent monitoring and response protocols.

A longer-term method to address smoke and fume events and their associated risks is to gradually **modernize the commercial aircraft fleet**. Newer aircraft, namely the 787, include a "no-bleed" architecture that replaces the traditional pneumatic system. These "bleedless" systems utilize two variable-frequency electrical generators per engine to power air-demand systems. Bleedless systems utilize fresh external ambient air for cabin pressurization and air conditioning instead of engine bleed air, removing the possibility of contamination from engine or APU combustion or exhaust particulates. No-bleed air systems also extract less energy from the engines, allowing them to operate at a lower relative power setting for the same thrust, saving fuel and wear on the engine. Removing the "plumbing" of a traditional bleed air system also reduces aircraft weight and simplifies maintenance, altogether accounting for a more efficient aircraft, with cleaner air for passengers and crew.

The Allied Pilots Association supports increased attention and greater regulation of cabin air quality in commercial aviation, including common-sense reforms such as the ones proposed in the Cabin Air Safety Act. We also look forward to the continued delivery of modernized aircraft with no-bleed air systems.

For questions or additional information please email GAC-Chairman@alliedpilots.org

Current as of November 30, 2024