



AEROSPACE INFORMATION REPORT

AIR5784™

REV. A

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Superseding AIR5784

(R) Literature on Gas Turbine Engine Lubricant Composition and Degradation Relevant to Cabin Air Quality

RATIONALE

There continues to be interest in the quality of the environment within aircraft cabins and cockpits, especially in the commercial world. Cabin air quality has been at the core of a continuing discussion for decades. Some pilots and cabin crewmembers have raised concerns about potential contamination of cabin air by engine lubricants, especially the organophosphate (OP) and ultrafine particle (UFP) content. To contribute to the discussion, the SAE E-34 committee compiled literature on the composition and degradation of gas turbine engine lubricants, in addition to some relevant cabin air measurements and a description of stakeholder involvement. This revision is based on literature and information published from 2000 to 2023.

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1. SCOPE

The previous revision of AIR5784 summarizes some of the available literature on cabin air study, engine oil composition, decomposition, and toxicity testing. This revision of AIR5784 includes literature and information on stakeholder involvement, selected air sampling studies, oil composition, and oil degradation, published from 2000 to 2023. The entire contents of the reviewed literature are not necessarily endorsed by either SAE or the members of the study group who produced it.

This is not a comprehensive review but is intended to enable E-34 and other technical organizations to participate in informed discussions on the topic. Also, the review is intended to indicate where additional work may be necessary to properly gauge the potential role that turbine lubricants (and OPs) play in cabin air quality. The toxicology of oil fumes and their individual constituents is beyond the scope of this document and outside the remit of this committee.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (U.S. and Canada only) or +1 724-776-4970 (Outside U.S. and Canada), www.sae.org.

AIR4766/1	Air Quality for Commercial Aircraft Cabin Particulate Contaminants
AIR4766/2	Airborne Chemicals in Aircraft Cabins
AIR6945	Supplemental Information for Design of Measuring Devices for Measurement of Aircraft Cabin Air Quality
AIR7521	Measurement Data and Reference Values for Compounds Potentially Found in Aircraft Engine Bleed Air
ARP4418	Procedure for Sampling and Measurement of Aircraft Propulsion Engine and APU Generated Contaminants in Bleed Air
AS5780	Specification for Aero and Aero-Derived Gas Turbine Engine Lubricants
AS6923	Portable Measuring Devices/Systems for Maintenance Troubleshooting of Aircraft Cabin and Flight Deck Air Quality Issues

Nayyeri, S., Jones, B., and Hosni, M., "Characterization of Particulate Resulting from Oil Contamination of Aircraft Bleed Air," *SAE Int. J. Aerosp.* 14(1):45-62, 2021, <https://doi.org/10.4271/01-14-01-0002>.

2.1.2 ASHRAE Publications

Available from ASHRAE, 180 Technology Parkway NW, Peachtree Corners, GA 30092, Tel: 800-527-4723 (U.S. and Canada only) or 404-636-8400, www.ashrae.org. Some guidelines and standards are also available in read-only format on the ASHRAE website.

ASHRAE/ANSI S161 Air Quality within Commercial Aircraft

ASHRAE 1830-RP Experimental Characterization of Aircraft Bleed Air Particulate Contamination

ASHRAE G28 Air Quality within Commercial Aircraft.

Jones, B.W., Amiri, S.N., Roth, J.W., and Hosni, M.H. (2017, January 28-February 1). *The nature of particulates in aircraft bleed air resulting from oil contamination* (LV-17-C046) [Conference paper]. 2017 ASHRAE Winter Conference, Las Vegas, Nevada, USA.

2.1.3 EASA Publications

Available from European Union Aviation Safety Agency, Konrad-Adenauer-Ufer 3, D-50668 Cologne, Germany, Tel: +49 221 8999 000, www.easa.europa.eu.

Houtzager, M., Havermans, J., Noort, D., Joosen, M., Bos, J., Jongeneel, R., van Kesteren, P., Heusinkveld, H., van Kamp, I., Brandsma, S., and Westerink, R. (2017). *Characterisation of the toxicity of aviation turbine engine oils after pyrolysis (AVOIL)* (Publication No. EASA_REP_RESEA_2015_2). EASA.

<https://www.easa.europa.eu/en/document-library/research-reports/easareprese20152> or <https://perma.cc/TWD3-SAFP>.

Houtzager, M., Heslinga, D., Spek, F., Norde, E., Heine, P., Schafai, M., Bezold, A., Mayer, F., Forejt, L., Jongeneel, R., Cassee, F., Westerink, R., Koppen, G., Frijns, E., Spruyt, M., and Stranger, M. (2020). *Final report: Investigation of air quality levels inside the cabin of large transport aircraft and their health implications* (Publication No. FACTS-D7). EASA.

<https://www.easa.europa.eu/en/downloads/140417/en> or <https://perma.cc/U2VG-877M>.

Schuchardt, S., Bitsch, A., Koch, W., and Rosenberger, W. (2017). *Research project: Preliminary cabin air quality (CAQ) measurement campaign* (Publication No. EASA_REP_RESEA_2014_4). EASA.

<https://www.easa.europa.eu/en/document-library/research-reports/easareprese20144> or <https://perma.cc/3J3H-P4Y3>.

2.1.4 U.S. Government Publications

2.1.4.1 Congress Publications

Copies of these documents are available online at <https://www.congress.gov/>.

Vision 100—Century of Aviation Reauthorization Act, Pub. L. No. 108-176, 117 Stat. 2490, Sec. 815: Air quality in aircraft cabins (2003). <https://www.congress.gov/108/statute/STATUTE-117/STATUTE-117-Pg2490.pdf>.

FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, 126 Stat. 11, Sec. 320: Study of air quality in aircraft cabins and Sec. 917: Research and development of equipment to clean and monitor the engine and APU bleed air supplied on pressurized aircraft (2012). <https://www.congress.gov/112/statute/STATUTE-126/STATUTE-126-Pg11.pdf>.

FAA Reauthorization Act of 2018, Pub. L. No. 115-254, 132 Stat. 3186, Sec. 326: Aircraft air quality (2018). <https://www.congress.gov/115/statute/STATUTE-132/STATUTE-132-Pg3186.pdf>.

2.1.4.2 Department of Defense Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

MIL-PRF-7808 Lubricating oil, aircraft turbine engine, synthetic base

MIL-PRF-23699 Lubricating oil, aircraft turbine engine, synthetic base, NATO code numbers: O-152, O-154, O-156 and O-167

2.1.4.3 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

Day, G.A. (2015). *Aircraft cabin bleed air contaminants: A review* (Report No. DOT/FAA/AM-15/20). Federal Aviation Administration. <https://rosap.ntl.bts.gov/view/dot/57184> or <https://perma.cc/CY35-2469>.

Fox, R.B., and Jones, B.W. (2023). *Aircraft air quality and bleed air contamination detection: Engine stand tests, sensor technologies and chemical sampling (Phase 2, Volume 1)* (Report No. DOT/FAA/TC-23/46, V1). Federal Aviation Administration. <https://doi.org/10.21949/1528259>.

Fox, R.B., and Jones, B.W. (2025). *Aircraft air quality and bleed air contamination detection; On-wing tests, sensor technologies, and chemical sampling (Phase 2, Volume 2)* (Report No. DOT/FAA/TC-23/46, V2). Federal Aviation Administration. <https://rosap.ntl.bts.gov/view/dot/79601> or <https://perma.cc/MBT7-UPGM>.

Jones, B.W. (2022). *Aircraft air quality and bleed air contamination detection* (Report No. DOT/FAA/TC-21/45). Federal Aviation Administration. https://rosap.ntl.bts.gov/view/dot/62770/dot_62770_DS1.pdf or <https://perma.cc/55UW-EXEC>.

Spengler, J.D., Vallarino, J., McNeely, E., and Estephan, H. (2012). *In-flight/onboard monitoring: ACER's component for ASHRAE 1262, Part 2* (Report No. RITE-ACER-CoE-2012-6). Federal Aviation Administration. https://www.faa.gov/sites/aa.gov/files/data_research/research/med_humanfacs/cer/In-FlightOnboardMonitoring.pdf or <https://perma.cc/6UH8-97AE>.

2.1.4.4 National Research Council Publications

Copies of these documents are available online at <https://nap.nationalacademies.org>.

NRC. (2002). *The airliner cabin environment and the health of passengers and crew*. U.S. National Academies Press. <https://doi.org/10.17226/10238>.

2.1.5 Other Publications

Amiri, S.N., Jones, B., Mohan, K.R., Weisel, C.P., Mann, G., and Roth, J. (2016). Study of aldehydes, carbon monoxide, and particulate contaminants generated in bleed-air simulator. *Journal of Aircraft*, 54(4), 1-11. <https://doi.org/10.2514/1.C034133>.

Burdon, J., Budnik, L.T., Baur, X., Hageman, G., Howard, C.V., Roig, J., Coxon, L., Furlong, C.E., Gee, D., Loraine, T., Terry, A.V., Jr., Midavaine, J., Petersen, H., Bron, D., Soskolne, C.L., and Michaelis, S. (2023). 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*, 22, Article 43. <https://doi.org/10.1186/s12940-023-00987-8>.

CAA. (2004). *Cabin air quality* (CAA Paper 2004/04). <https://www.caa.co.uk/publication/download/12750> or <https://perma.cc/89ME-7K3C>.

CASA. (2010). *Contamination of aircraft cabin air by bleed air – A review of the evidence*, Section 3.4, pp. 39-52.

CEN. (2022). *Cabin air quality on civil aircraft - Chemical compounds* (Technical Report 17904).

Denola, G., Hanhela, P.J., and Mazurek, W. (2011). Determination of tricresyl phosphate air contamination in aircraft. *The Annals of Occupational Hygiene*, 55(7), 710-722. <https://doi.org/10.1093/annhyg/mer040>.

Denola, G., Kibby, J., and Mazurek, W. (2008). Determination of ortho-cresyl phosphate isomers of tricresyl phosphate used in aircraft turbine engine oils by gas chromatography and mass spectrometry. *Journal of Chromatography A*, 1200(2), 211-216. <https://doi.org/10.1016/j.chroma.2008.05.035>.