ADDENDA

ANSI/ASHRAE Addendum f to
ANSI/ASHRAE Standard 161-2018

Air Quality within Commercial Aircraft

Approved by ASHRAE and the American National Standards Institute on January 31, 2023.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (www.ashrae.org/continuous-maintenance).

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 ISSN 1041-2336

Approved American National Standard
ANSI
www.ansi.org

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FOREWORD

The primary purpose of Addendum f is to remove the carbon-monoxide-specific language intended to address the continuous monitoring requirement for engine oil or hydraulic fluid contamination of the bleed air. As a result, the sensor requirement language in Sections 7.2, 8.2, and 9 now focuses more broadly on suitable marker compounds intended to reliably indicate the presence of engine oil or hydraulic fluid contamination of the bleed air. This addendum also adds a definition for "engine" to Section 3. The references to the descriptor "pyrolyzed" for engine oil was removed because, when oil is present, it is not always heated to a high enough temperature to be pyrolyzed.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum f to Standard 161-2018

Revise Section 3 as shown. The remainder of Section 3 is unchanged.

engine: either a propulsion engine or an auxiliary power unit engine.

Revise Section 7.2 as shown.

7.2 Bleed Air Contaminant Monitoring. Monitoring in the air supply system for specific sources of bleed air contaminants is intended to facilitate pilot and maintenance actions where necessary and to provide an indication of contaminants in the air supply system that are supplied to the cabin and/or cockpit.

Validation shall require investigating the effectiveness and feasibility of any sensor to ensure that it can be installed, while accounting for cost, reliability, accuracy, maintainability, and viability. Operational procedures shall be developed for both airline maintenance and air crew response to measured levels.

One or more sensors intended to identify particles and/or a chemical substance or chemical substances indicative of air supply system contamination by ~~partly or fully pyrolyzed~~ engine oil and hydraulic fluid, both individually and in combination, shall be installed. Each ~~The~~ indicator substance or substances shall

a. be shown to be consistently associated with the presence of ~~partly or fully pyrolized~~ engine oil contamination in the bleed air and/or consistently associated with hydraulic fluid in the bleed air;
b. have a sufficiently low background level that its presence can be reliably attributed to these contaminants; and
c. be measured with sufficient sensitivity to reliably detect the occurrence of these contamination events.

The sensor or sensors shall sample the airstream no less frequently than once every 60 seconds.

Supply air shall be sampled by at least one sensor before it enters the cabin or cockpit. A separate sensor is recommended for each air supply source, such as each engine and the APU, so that it is possible to identify and isolate the source of contamination in the event it is detected. Monitoring before the mix manifold is likely to provide better information to help identify the source of the contamination; however, this area may be more difficult to monitor.

Indication from the sensors shall be displayed in the flight deck and recorded anytime the concentration is at or above the trigger point. The trigger point is defined as a concentration that may not be high enough to be associated with a negative health impact on its own but rather indicates the presence of ~~partly or fully pyrolyzed~~ engine oil~~s~~ or hydraulic fluid~~s~~.

The trigger point shall be high enough above background levels to indicate contamination but not so high above background levels to miss events. An exceedance shall be defined as the trigger point concentration being maintained for a predetermined and appropriate sampling period (dependent on the contaminant) while in flight or on the ground. Any exceedance shall be recorded in the aircraft technical log and maintenance records, and appropriate action shall be taken immediately in accordance with the relevant regulations and effective and approved maintenance procedures to identify and address the potential source of contamination.

The record of the duration and levels of each exceedance shall be made available as follows for at least the 60 days following a flight on which an exceedance occurs:

a. To airline maintenance staff to aid in identifying appropriate corrective actions

b. To any occupants present on the given flight, including crew members or their representatives, with a medical record indicating symptoms that could reasonably be attributed to exposure to one or more relevant contaminants, in order to assist their physicians in diagnosis and treatment

The response to an exceedance will vary depending on the number, magnitude, and frequency of triggered events. For example, an unexplained single exceedance without reports of relevant symptoms from crew or passengers may require only a general check of main engine components for problems such as engine oil overfill, visible leaks, and hydraulic leaks. Higher-value exceedances or multiple triggered events (either during a single sector or on separate sectors), especially if they include reports of symptoms consistent with exposure to partly combusted engine oil or hydraulic fluid, will require a higher degree of maintenance investigation and action, such as swab testing of the bleed ducts to check for engine oil leaks.

~~If in-service testing demonstrates that carbon monoxide (CO) will be an effective chemical marker for oil or hydraulic fluid contamination of the bleed air supply system, and it is selected as the indicator substance, the trigger point for data recording and display shall be set at 9 ppm, and an exceedance shall be defined as either (a) a ten-minute time-weighted average concentration at or above 9 ppm or (b) a 60 second peak value at or above 50 ppm.~~

Revise Section 8.2 as shown.

8.2 General

	Control Measures
Design	a. The APU and engine inlets can potentially be entry points for hydraulic fluid, fuel, oil, and deicing fluid. Means to limit the ingestion of these fluids should be evaluated during the design phase (prevention through design). One example is the use of dedicated compressors for outside air supply, rather than the more traditional bleed air systems, which may minimize the potential entry of engine/APU contaminants into the cabin air. Other design considerations that have been implemented include changing the location of the APU inlet and/or installing a physical barrier either around or in front of the inlet to physically divert contaminants from entering the inlet (Informative Note: e.g., raising the APU inlet off the surface of the aircraft or installing a diverter ahead of the APU inlet). Airlines and manufacturers should consider the necessity and feasibility of applying these measures to the fleet. b. Air-cleaning technologies to reduce contamination in bleed air sources before it is introduced to the cabin and cockpit may be considered.
Monitoring	a. An appropriate marker for bleed air contamination ~~Carbon monoxide or an alternate contaminant, as appropriate,~~ shall be monitored in accordance with Section 7.2 of this standard. b. Ozone should be continuously monitored on flights where ozone is expected to be encountered. See FAA Advisory Circular 120-38[12] for more information. c. Measurements that exceed the limits described in this standard shall be recorded. d. Sampling and monitoring devices that are reliable and easy to operate would be useful in the cabin and flight deck as an additional source of information to validate and/or quantify certain types of contamination events. e. An international database of factual information from flights where suspicion of contaminated air exists should be established; see SHK RL 2001:41eR3[13] for guidance.
Remedies	a. Responsible employees shall be given training, supplies, and time to clean contaminated surfaces in order to mitigate potential health hazards associated with crew or passenger contact; see Circular 344-AN/202 11[11] for guidance. b. If a buildup of residue is noted in the APU/engines, air-conditioning packs, and ducts, the affected components shall either be removed and cleaned or replaced to prevent additional contamination. If the pack burn air is not dumped overboard, passengers and crew shall not be on board during a pack burn. Maintenance workers shall be educated on the need to avoid exposure to contaminants in the bleed air system during pack burn and associated system inspection and cleaning procedures. When it is not possible to effectively clean airborne contaminants that deposit on high surface-area components, such as acoustical duct lining, water separator coalescer bags, ozone converters, and heat exchangers, those components shall be removed and either cleaned or replaced. (Informative Note: See also Section A3, "ECS Cleaning Procedures.") c. To address air supply contamination, the pilot shall first identify the location of the source and isolate it (pack management) and then document it according to airline procedures. d. If symptoms that could reasonably be attributed to exposure to one or more contaminants associated with an episodic event, such as smoke/fumes in the cabin/flight deck or other evidence of internal air supply contamination or ozone exposure, are reported to the pilot and involve one or more passenger or crew member as evidenced by an aircraft maintenance log entry, the aircraft shall be turned over to maintenance prior to next dispatch to identify and address the source of air supply contamination according to airline maintenance manual procedures. e. Ground-based air supply systems/equipment (including high and low pressure) shall be inspected and serviced at least every three months in order to prevent the contamination of aircraft systems and to ensure the integrity of the equipment.

Revise Section 9 as shown.

9. MEASUREMENTS

The section specifies measurements that shall be made when determining whether specific requirements of this standard are met. Continuous measurement of environmental variables is not mandated by this standard, with the exception of bleed air contamination markers in accordance with Section 7.2 of this standard. ~~carbon monoxide.~~

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

ASHRAE · 180 Technology Parkway · Peachtree Corners, GA 30092 · www.ashrae.org

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