BSR/ASHRAE Addendum a to
ANSI/ASHRAE Guideline 28-2016

Public Review Draft

Proposed Addendum a to Guideline 28-2016, Air Quality within Commercial Aircraft

First Public Review (August 2018)
(Draft shows Proposed Changes to Current Guideline)

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ASHRAE, 1791 Tullie Circle, NE, Atlanta GA 30329-2305

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FOREWORD

The purpose of this addendum is to update the definition and reference for HEPA to the most recent definition published by IEST (2016).

Note: In this addendum, changes to the current guideline 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 a to Guideline 28-2016

Revise Section 8.1.2.4 (Respirable Particulate Matter) as shown below.

8.1.2.4 Respirable Particulate Matter (RPM). Respirable particulate matter consists of solid or liquid particles that, with diameters less than 10 µm, are easily suspended in air and inhaled by exposed persons. RPM on aircraft can be generated from a variety of sources. The relative contribution of different sources to RPM on aircraft is currently not known. A major source of RPM is the airplane occupants. Pollutants generated by occupants are distinct from other types of particle sources in that the emissions occur where an individual is located and the occupant is not always stationary, but rather can move around. Occupants can generate RPM that may contain viruses or bacteria that are suspended in mucus generated from coughing or sneezing and that are found in organic and inorganic compounds carried by larger particles such as skin flakes or clothing fiber. Another source of RPM on airplanes is accumulated dust, which is resuspended in the air by occupants as they move around the aircraft cabin. This dust could contain allergenic material such as endotoxins and mycotoxins, as well as other irritating and potentially toxic chemicals such as pesticides. Other sources of RPM include galley operations, episodic introduction of fluids such as fuel and oil via the ventilation system, spraying of pesticides and cleaners, and equipment operation. Fleecy materials (e.g., carpet, seating) can be sources of RPM as a result of occupant movement (SAE 2006a).

Particle diameter, chemical composition, airborne concentrations, duration of exposure to RPM, and individual sensitivity all play a part in the impact particles have on aircraft occupants. A recent study showed that during normal operations, the highest concentrations of particulate matter were present during boarding and deplaning (Dumyahn et al. 2000). At the same time, a number of studies, including ASHRAE Research Projects 957 (RP-957) (Pierce et al. 1999) and 959 (RP-959) (Nagda et al. 2001) have shown that mass concentrations of particles during cruise are very low during normal conditions, often in the range of 10 µg/m^3. In a typical aircraft ventilation system, air that is recirculated is usually passed through ~~high-efficiency~~ high efficiency particulate ~~arresting~~air (HEPA) filters. ~~removing particles with great efficiency.~~ ~~(~~HEPA filters ~~efficiency rating is~~provide a minimum of 99.97% collection efficiency for ~~at~~ 0.3 µm particles, as defined by Institute of Environmental Science and Technology (IEST 2016)~~)~~. Alternatively, the filters shall meet or exceed the requirements for filter class H13 to EN1822 (CEN, 2009) and shall provide a minimum of 99.95% overall collection efficiency at the most penetrating particle size. Outside air typically passes through the system without filtration but is not of concern as a source of particles since there are very few particles at altitude. The U.S. Environmental Protection Agency (EPA) has developed National Ambient Air Quality Standards (NAAQS) for PM2.5

(particulate matter with aerodynamic diameter <2.5 µm). PM2.5 is not regulated by the federal aviation regulations (FARs). They are included in this guideline because PM2.5 has been documented to cause adverse chronic health effects upon exposure and because particles in this size range have the ability to penetrate into the deepest areas of the human lung upon inhalation. The NAAQS maximums for PM2.5 are 15 µg/m^3 annual arithmetic mean (three-year average) and 65 µg/m^3 over 24 hours (three-year average of the 98th percentile of 24-hour concentrations). Canadian Expo- sure Guidelines place a limit of <100 µg/m^3 for a one-hour interval for particles having <2.5 µm mass median aerodynamic diameter. The U.S. EPA has also developed NAAQS for PM10 (particulate matter with aerodynamic diameter <10 µm). PM10 is not regulated by the FARs. They are included in this guideline because of their irritancy potential, although they are large enough that they will not penetrate to the deepest areas of the human lung when inhaled. The NAAQS for PM10 are 50 µg/m^3 annual arithmetic mean and 150 µg/m^3 over 24 hours.

To meet the NAAQS for PM2.5 and PM10, particulate matter is collected on filter media using certified air-sampling instrumentation and gravimetrically analyzed. The EPA recommends gravimetric determination of mass concentrations by collecting particulate matter on filters using certified air-sampling instrumentation since NAAQS are based on health effects studies that predominantly used gravimetric methods to characterize particular matter. In addition to mass concentrations, particle diameter and number concentrations are also very important parameters for describing airborne particulate matter. Particle deposition in the lungs upon inhalation is a strong function of particle size. Optical-laser particle counters (OPCs) are commonly used instruments that count the number of particles in sampled air as a function of particle diameter and time. However, very few of the health standards are based on characterization of particulate matter using optical particle counters. Typically, OPCs measure particles in the size range 0.1 to >10 µm, depending on the instrument and how it is calibrated. Particles smaller than 0.1 µm diameter are typically referred to as ultrafine particulate matter. Ultrafine particles are currently measured using condensation particles counters (CPC), which increase the diameter of the particle by using it as condensation nuclei until it is large enough to be detected optically by a laser. CPCs only provide total number of particles as a function of time and do not provide any sizing information. To size particles smaller than 0.1 µm, a CPC is usually coupled to an electrostatic classifier, which uses electrostatic forces to separate the particles according to size (Baron and Willeke 2001). Aerodynamic sizing instruments are also in common use. These instruments allow real-time measurement of aerodynamic diameter based on acceleration and time-of-flight principles (Baron and Willeke 2001). Typically, these instruments can measure particle diameters from about 0.5 to 100 µm.

Revise Section 9 as shown below. The rest of Section 9 remains unchanged.

9. REFERENCES

IEST. 2016. IEST-RP-CC001: *HEPA and ULPA Filters*, 6th Edition. Mt. Prospect, IL. Institute of Environmental Science and Technology.

CEN. 2009. EN1822: *High Efficiency Air Filters (EPA, HEPA and ULPA) - Part 1: Classification, Performance Testing Markings*. Brussels, Belgium: European Committee for Standardization.