IEC PAS 63086-3-1

Edition 1.0 2023-05

PUBLICLY AVAILABLE SPECIFICATION

colour inside

Household and similar electrical air cleaning appliances – Methods for measuring the performance
Part 3-1: Method for assessing the reduction rate of key bioaerosols by portable air cleaners using an aerobiology test chamber

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IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INTERNATIONAL
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Part 3-1: Method for assessing the reduction rate of key bioaerosols by portable air cleaners using an aerobiology test chamber

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IEC PAS 63086-3-1 has been processed by subcommittee 59N: Electrical air cleaners for household and similar purposes, of IEC technical committee 59: Performance of household and similar electrical appliances, in co-operation with ISO technical committee 142: Cleaning equipment for air and other gases.

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The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
59N/28/DPAS	59N/33/RVDPAS

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Words in **bold** type in the text are defined in Clause 3.

A list of all parts in the IEC 63086 series, published under the general title *Household and similar electrical air cleaning appliances*, can be found on the IEC website.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This Publicly Available Specification (PAS) contains test procedures for measuring the reduction by the air cleaner of micro-organisms suspended in the air in the specified test chamber. It also prescribes a method for measuring the operating power and stand-by power of the air cleaner. The test procedures may be applied to any brand or model of household and similar electrical air cleaners within the stated confines of the standard limits of measurability for measuring performance.

The annexes to this PAS are included for informative purposes only unless the annexes are noted as normative.

Warning – The tests given in this document shall be performed by expert staff trained to handle microorganism-related techniques and in properly equipped laboratories under the supervision of a skilled microbiologist. Some of the test micro-organisms might be facultative pathogens for humans, animals and plants and require a laboratory of an appropriate bio-safety level. National and international safety procedures for working with infectious biomaterials shall be followed to prevent any contamination of laboratory staff, apparatus, working place or environment in compliance with national standards or regulations. This document does not purport to address all of the safety aspects, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and ensure compliance with any national, regional or international regulatory conditions.

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HOUSEHOLD AND SIMILAR ELECTRICAL AIR CLEANING APPLIANCES – METHODS FOR MEASURING THE PERFORMANCE –

Part 3-1: Method for assessing the reduction rate of key bioaerosols by portable air cleaners using an aerobiology test chamber

1 Scope

This part of IEC 63086 specifies a method to evaluate the capability of portable household air cleaners to reduce the concentration and viability of key experimentally generated bioaerosols in a specified chamber.

Indoor air free of harmful microbes is important to the health of occupants. This is particularly relevant with regard to increased time spent indoors.

Air cleaners are used to reduce the concentrations of microorganisms in indoor air.

The efficiency of such air cleaners to reduce airborne microorganisms can be assessed in test chambers at controlled air temperature and relative air humidity.

The test is applicable to portable air cleaners commonly used in single room spaces such as those based on mechanical filtration, ultraviolet (UV), ionizers, photocatalytic oxidation, and ozone generators in-unit technology.

If the air cleaner does not claim to have the function of reducing microorganisms, this document may not be applicable unless it is being used to simply evaluate the performance.

This document deals with measurement procedures regarding the reduction of the microbial contamination related to electrical air cleaner appliances for household and similar use.

This document does not apply to appliances intended to be used in medical, veterinary, or pharmaceutical applications.

This document does not address sanitization, disinfection, or sterilization measures.

This document does not support, by itself any health-related claims or conclusions about prevention or treatment of a disease or health improvement.

NOTE 1 IEC 63086-3-1 is created for household and similar electrical air cleaners and is not intended to conflict with or replace standards for commercial or industrial consumers.

NOTE 2 In this document, we do not suggest performance test methods that measure the by-products of either the interaction between microbes or between the air cleaner and the microbes tested in this document. The formation of by-products is an important subject. The subject of measuring by-products is under study, and AHAM will address this in future documents.

NOTE 3 This document does not apply to appliances intended for use in medical treatment locations, such as surgical suites, laboratories, medical treatment rooms, etc.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 63086-1:2020, *Household and similar electrical air cleaning appliances − Methods for measuring the performance − Part 1: General requirements*

ASTM E741-11:2017, *Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
air cleaner
electrically powered household, or similar, appliance that employs one or multiple technologies to reduce, destroy, and/or inactivate one or more types of indoor air pollutants

Note 1 to entry: The term "air purifier" is defined as an Electrically powered device that is basically built of a fan and a set of components possessing the ability to capture and/or (partially or totally) destroy air pollutants [Source: ISO 16000-36] but PAS 63086-3-1 has chosen to not use this term in this document as it may not be possible to totally destroy an air pollutant.]

[Source: IEC 63086-1:2020, 3.1, modified – "destroy, and/or inactivate" and the note to entry have been added]

3.2
background concentration
quantity of **microbes** in the chamber after the chamber has undergone cleaning and prior to any testing or addition of **microbes** via nebulization

3.3
bacteria
prokaryotic, single-celled, microscopic organism with peptidoglycan cell wall

3.4
bacteriophage or phage
group of **viruses** that infect **bacteria** or **fungi**

3.5
bioaerosol
airborne particle that is composed of or derived from biological matter (such as a bacterial cell, fungal or bacteria spore, **virus**, or endotoxin)

3.6
biological safety levels
BSL
series of protections relegated to autoclave-related activities that take place in particular biological labs

Note 1 to entry: This includes individual safeguards designed to protect laboratory personnel, as well as the surrounding environment and community. For BSL level expectations, a lab should follow the most recent version of the WHO Laboratory Biosafety Manual, the CDC Biosafety in Microbiological and Biomedical Laboratories (BMBL) or the Canadian Biosafety Standards and Guidelines.

3.7
CADR
clean air delivery rate
measure of **air cleaner** performance by this test procedure

Note 1 to entry: Clean Air Delivery Rate (CADR) is defined as the measure of the delivery of contaminant-free air, within the defined particle size range, by an **air cleaner**, expressed in cubic feet per minute (cfm) or cubic meters per hour. Clean Air Delivery Rates are the rates of contaminant reduction in the test chamber when the **air cleaner** is turned on, minus the rate of **natural decay** when the **air cleaner** is not running, multiplied by the volume of the test chamber as measured in cubic feet or cubic meters (see 8.5). CADR values are always the measurement of an **air cleaner** performance as a complete system, and they have no linear relationship to air movement per se or to the characteristics of any particular particle removal methodology.

Note 2 to entry: For this document, we use the designation of m-CADR which is the clean air delivery rate for microbes.

3.8
colony forming units for bacteria and fungi
CFU
unit of measurement by which the number of culturable **microbes** (***Bacteria*** *and* ***fungi****)* is expressed

3.9
device under test
DUT
test sample of the **air cleaner** undergoing examination

3.10
fungi
multicellular eukaryotic organisms without chlorophyll and with cell walls

3.11
impaction
sampling of the airborne **microbe** by inertial separation on a semisolid agar surface

3.12
impinger method
glass or plastic device for the collection of air samples into a liquid medium through a scrubbing action.

Note 1 to entry: The liquid volume is subsequently utilized for dilution and inoculation of counting plates.

3.13
initial concentration
concentration of **microbes** inside the chamber immediately at the start time of sampling of either the **natural decay** or the total decay

3.14
maximum performance mode
through manual operation the DUT is set to the highest flow rate with all air cleaning functions switched on, set to maximum, where applicable, and with all filters in place

Note 1 to entry: If the DUT has zero flow rate, the m-CADR is measured with all air cleaning functions switched on.

3.15
microbes
microorganisms
microscopic living beings that cannot be seen with the naked eye, including **bacteria**, protozoa, **viruses** and **some fungi**/fungal components

Note 1 to entry: They are common in the environment as well as in/on our own bodies.

3.16
microbial reduction
reduction rate of viable **microbe** is measured by comparing the concentration of the microbe after nebulizing a microbial suspension inside the chamber with the concentration determined after a defined running time (testing time) of the **air cleaner**

Note 1 to entry: The microbial reduction rate is expressed as natural log reduction over time.

3.17
natural decay
rate of reduction of the airborne concentration of viable microbiological contaminants as measured without an air-cleaning device operating in an aerobiology chamber

Note 1 to entry: The **natural decay** rate is expressed as natural log reduction over time.

3.18
plaque forming units
PFU
unit of measurement by which the number of viable **viruses** is expressed

3.19
virus
group of microorganisms with a simple structure composed of RNA or DNA and protein outer coat which are specialized in intracellular infection and replication

4 Principle

The efficiency of **air cleaners** is tested using one or more nebulized and homogeneously distributed microbial suspensions inside an enclosed test chamber at controlled air temperature and relative air humidity. The efficacy is calculated by the **reduction** rate of the test **microbe** in a defined period of time, considering the rate of **natural decay** of the test **microbe**.

5 Apparatus and materials

5.1 Apparatus

NOTE As a wide variety of specialized pieces of equipment exist and are commercially available, the following list gives only the preferred list of equipment that have the desired primary critical characteristics. Alternates are allowed when they have been shown to be equivalent. Equivalency specifications or data should be included showing the alternate equipment can be considered equivalent.

5.1.1 Test chamber

The chamber shall be constructed to the following characteristics:

- Be accepted by OSHA (U.S. Occupational Safety and Health Administration) or other national bodies;
- The chamber size is (30 ± 1,5) m^3; Height = (2,5 ± 0,1) m. The width shall be within 85 % and 100 % of the length;
- The walls should be made from a suitable smooth non-porous material that emits minimal levels of volatile organics, is corrosion-resistant, and is repeatedly washable (i.e., constructed of stainless steel, epoxy, glass or other documented nonreactive material with minimum volatile organic hydrocarbon emission potential). The material should not quench ionization, be non-reflective for visible and ultraviolet light (which is measured as between 5 % and 20 % reflectance at the operational wavelength of the device under test), and be well-grounded;
- It shall maintain sufficient airtight capacity. The test chamber air exchange rate is to be less than 0,05 air changes per hour (ACH) as determined by ASTM E741 (Standard Test Method

for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution) or an equivalent method;

- The test environment shall be kept clean and free from extraneous microbial contamination. It shall have a suitable environmental control system to maintain a controlled level of air temperature and humidity. To achieve this, the test chamber should include the following:
  - A system capable of removing contamination and maintaining aseptic condition inside the chamber, such as an UV lamp;
  - A facility to transfer items into and out of the chamber without cross-contamination (this can include a special system, such as a glove box, etc.);
  - The chamber may be fitted with an anteroom to allow for staging;
  - A facility to control the power inside the chamber from outside;
  - The chamber should be equipped such that tests can be witnessed externally;
  - A facility to generate an aerosol of test **microbe** inside the chamber and to ensure its homogeneity (this can be achieved by using a nebulizing inlet through which **microbes** are nebulized, connected to an atomizing nozzle in the chamber, with a fan to ensure homogeneous distribution of the **microbe** inside the chamber);
  - A sampling port should be 1,20 m (± 0,12 m) high from the floor. The port should be a minimum of 0,305 m (± 0,03 m) from the wall and a minimum of 0,914 m (± 0,09 m) away from the device and out of the airflow of the **air cleaner** exhaust or intake. See 7.2.2. for unit positioning;
  - An air conditioning system inside the chamber capable of controlling air temperature and relative humidity in a stable and precise manner; the air conditioning system shall be switched off during the test. No other external temperature or humidity manipulating equipment for the chamber shall be operated during the test:
    - the initial test air temperature and acceptable range of variation shall be (20 ± 3) °C;
    - the initial test relative humidity and acceptable range of variation shall be (50 ± 10) %;
    - the test chamber shall be equipped to continuously monitor and record humidity and temperature;
  - A facility to use negative pressure airflow to flush the chamber post-testing;
  - A filter to prevent contamination from the outside during ventilation. A HEPA filter is recommended to be used in the incoming and outgoing air to prevent lab contamination from entering the chamber or residual **microbes** contaminating the surrounding space.

See graphics of an example test chamber in Annex A.

5.1.2 Nebulizer

The nebulizer shall be capable of nebulizing microbial suspensions into particles (0,05 µm to 5 µm) to produce, as far as possible, discrete particles. It typically comprises a pump to generate a defined air pressure to nebulize, a clean air supply unit and a dehumidifier to remove excess water from the generated culture medium. A compressed air cylinder can also be used to operate the nebulizer.

- Collison 6-jet nebulizer (BGI Inc. Waltham MA), or equivalent, driven by purified filtered house air supply or equivalent

5.1.2.1 Nebulizer fluid

The nebulizer reservoir should be filled with a combination of test microbial suspension, deionized water, antifoaming agent and phosphate-buffered saline (PBS). The concentrations in the mixture the lab uses should be specified in the report (see Clause 9).