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Method of evaluating the UV dose to airborne microorganisms transiting in-duct ultraviolet germicidal irradiation devices

Méthode d'évaluation de la dose d'UV pour les microorganismes en suspension dans l'air transitant par des dispositifs d'irradiation germicide aux ultraviolets raccordés

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 142, *Cleaning equipment for air and other gases*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Airborne microorganisms including some pathogens in indoor air may cause different types of diseases or adverse health effects on humans. Among different air disinfection techniques, ultraviolet germicidal irradiation (UVGI) has been used for several decades to effectively inactivate the airborne microorganisms in indoor air and thereby prevent the transmission of a variety of airborne infections.

In-duct UVGI device is a primary form of air disinfection method by UV lamps mounted in heating, ventilation and air-conditioning (HVAC) systems to irradiate the microorganisms in air with high intensities. However, other than the power supply, there is no standard or index available to characterize or understand the performance of the UVGI products made by different manufacturers. In addition, effective parameters derived from a standard method are lacking to predict the performance of the UVGI device on microorganism inactivation in a real HVAC system.

As microorganisms in air are irradiated by UV-C light emitted by an in-duct UVGI device, the inactivation rate of a specific microorganism primarily depends on the UV dose given by the device and the susceptibility of that microorganism. If the UV dose under a specific condition is known, the inactivation capacity and disinfection performance of the UVGI devices can be compared. Furthermore, the inactivation rate for specific microorganism can be calculated with its susceptibility data known.

Therefore, the development of a standard method to evaluate the UV dose of the in-duct UVGI device is very useful and necessary.

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Method of evaluating the UV dose to airborne microorganisms transiting in-duct ultraviolet germicidal irradiation devices

1 Scope

This document describes a method in laboratory to assess the performance of ultraviolet germicidal irradiation (UVGI) devices which will be mounted in-duct in heating, ventilating and air-conditioning (HVAC) systems.

The method includes the detailed requirements for test rig, microorganisms, procedures, data calculation and result report to determine the UV dose to model microorganisms by an UVGI device at several airflow rates. By the testing results, the capacity of in-duct UVGI devices for air disinfection can be evaluated and compared reliably.

If the susceptibility constant of a given microorganism is known, the inactivation rate of that microorganism by the tested UVGI devices can be further calculated.

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.

ISO 15858, *UV-C Devices — Safety information — Permissible human exposure*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

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

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

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1.1
airborne microorganism
microbial particle with an aerodynamic diameter up to 100 µm suspended in air

Note 1 to entry: Airborne microorganism includes bacterium, fungus, their spore or virus.

3.1.2
pathogen
infectious agent that causes diseases in its host

Note 1 to entry: Pathogen includes some virus, bacterium, prion, fungus, viroid, or parasite.

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3.1.3
test microorganism
microbial surrogate representing the typical *pathogen* (3.1.2)

Note 1 to entry: Test microorganism is chosen to be safer than the real pathogen in order to prevent the infection of testers or analysts.

3.1.4
air disinfection
process that can remove, inactivate or destroy the *airborne microorganisms* (3.1.1), especially *pathogen* (3.1.2) in air

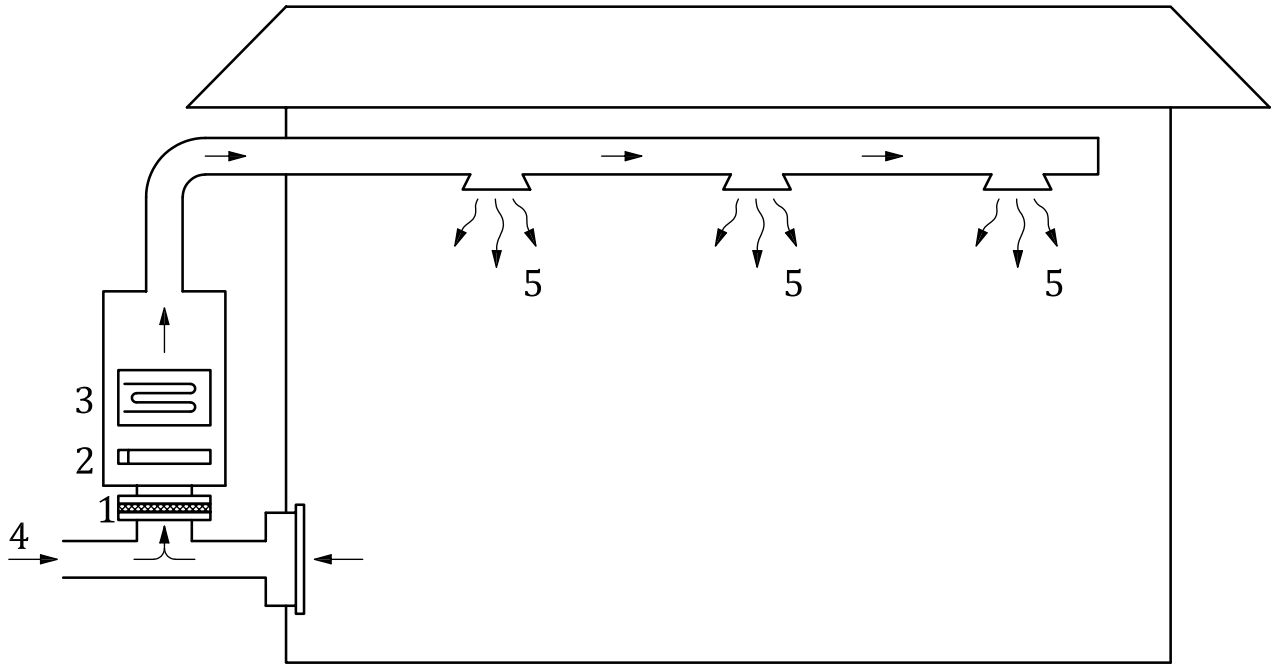
3.1.5
ultraviolet germicidal irradiation
UVGI
method for disinfection of air, water and object surfaces that uses radiation with wavelength in the range of 240 nm to 280 nm to kill or inactivate microorganism

Note 1 to entry: UV irradiation with a wavelength of 240 nm to 280 nm can cause damage to the DNA or RNA of the microorganisms.

[SOURCE: ISO 29464:2017, 3.6.20, modified — Note 1 to entry has been added.]

3.1.6
in-duct UVGI device
device consisting of UV lamps, ballast and other accessories, all of which could be mounted in ducts of an HVAC system to disinfect the air or a surface

Note 1 to entry: A typical diagram of in-duct UVGI device in an HVAC system is shown in Figure 1.



Key
1 filter
2 UV lamp
3 heating or cooling coil
4 fresh air
5 conditioned air

Figure 1 — Diagram of an in-duct UVGI device in an HVAC system

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