
**Test method to measure the efficiency
of air filtration media against
spherical nanomaterials —**

**Part 1:
Size range from 20 nm to 500 nm**

*Méthode d'essai pour mesurer l'efficacité des médias de filtration
d'air par rapport aux nanomatériaux sphériques —*

Partie 1: Spectre granulométrique de 20 nm à 500 nm



This document is a preview generated by ERS



COPYRIGHT PROTECTED DOCUMENT

© ISO 2018

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms, definitions, symbols and abbreviated terms	1
3.1 Terms and definitions	1
3.2 Symbols and abbreviated terms	2
4 Principle	3
5 Test materials	4
5.1 General	4
5.2 Liquid phase aerosol	4
5.2.1 DEHS test aerosol	4
5.2.2 Liquid phase aerosol generation	5
6 Test setup	6
6.1 General	6
6.2 Specification of setup	8
6.2.1 Aerosol generation system	8
6.2.2 Tubing	8
6.2.3 Dryer	8
6.2.4 DEMC	9
6.2.5 Equilibrium charge distribution and neutralization of aerosol particles	11
6.2.6 Neutralization of aerosol particles	11
6.2.7 Make-up air line	12
6.2.8 Test filter medium mounting assembly	13
6.2.9 CPC	14
6.2.10 Final filter	16
6.3 Detailed setup for test using DEHS particles	16
6.4 Determination of the filter medium velocity	17
7 Qualification of the test rig and apparatus	17
7.1 CPC tests	17
7.1.1 CPC — Air flow rate stability test	17
7.1.2 CPC — Zero test	18
7.1.3 CPC — Overload test	18
7.1.4 Counting accuracy calibration	18
7.2 DEMC tests	21
7.3 Qualification of aerosol neutralization	21
7.3.1 General	21
7.3.2 Qualification of neutralization by checking the multiple charge fraction on the particles passing through the neutralizer	21
7.3.3 Qualification of the aerosol neutralizer using corona discharge balanced output	21
7.3.4 Qualification of neutralization according to ISO/TS 19713-1	22
7.4 System leak checks	22
7.4.1 Air leakage tests	22
7.4.2 Visual detection by cold smoke	22
7.4.3 Pressurization of the test system	22
7.4.4 Use of high efficiency filter media	22
7.5 Uniformity of the test aerosol concentration	22
8 Test procedure	23
8.1 Determination of the correlation ratio/zero efficiency test	23
8.2 Protocol of filtration efficiency measurement	24

8.2.1	Preparatory checks	24
8.2.2	Equipment preparation	24
8.2.3	Aerosol generator	24
8.2.4	Aerosol generator — Neutralizer	25
8.2.5	Filter medium neutralization	26
8.2.6	Filter medium neutralization according to ISO 29461-1	26
8.2.7	Air flow measurement	28
8.2.8	Measurement of the pressure drop	29
8.2.9	Zero count test	29
8.2.10	Air leakage test	29
8.2.11	Loading effect test	29
8.2.12	Reported values	29
8.2.13	Measurement of filtration efficiency — DEHS particles	29
8.3	Test evaluation	31
8.4	Measurement protocol for one sample — Summary	31
8.4.1	Using one CPC to measure the upstream and downstream particle concentrations	31
8.4.2	Using two CPCs to measure the upstream and downstream particle concentrations	32
9	Maintenance items	33
10	Measurement uncertainties	34
11	Reporting results	35
11.1	General	35
11.2	Required reporting elements	35
11.2.1	General	35
11.2.2	Report summary	35
11.2.3	Report Details	36
Annex A (informative)	Instruments specifications	40
Annex B (informative)	Statistical analysis for precision of an experiment (according to ISO 5725-2)	44
Annex C (informative)	Safe use of IPA	49
Annex D (informative)	Safe handling of radioactive devices	50
Bibliography		51

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 the European Committee for Standardization (CEN) Technical Committee CEN/TC 195, *Air filters for general cleaning*, in collaboration with ISO Technical Committee TC 142, *Cleaning equipment for air and other gases*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 21083 series can be found on the ISO website.

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.

Introduction

Nano-objects are discrete piece of material with one, two or three external dimensions in the nanoscale (see ISO/TS 80004-2) and are building blocks of nanomaterials. Nanoparticles, referring to particles with at least one dimension below 100 nm, generally have a higher mobility than larger particles. Because of their higher mobility and larger specific surface area, available for surface chemical reactions, they can pose a more serious health risk than larger particles. Thus, particulate air pollution with large concentrations of nanoparticles can result in an increased adverse effect on human health and an increased mortality (see Reference [17]).

With the increased focus on nanomaterials and nanoparticles, the filtration of airborne nanoparticles is also subject to growing attention. Aerosol filtration can be used in diverse applications, such as air pollution control, emission reduction, respiratory protection for human and processing of hazardous materials. The filter efficiency can be determined by measuring the testing particle concentrations upstream and downstream of the filter. The particle concentration may be based on mass, surface area or number. Among these, the number concentration is the most sensitive parameter for nanoparticle measurement. State-of-the-art instruments enable accurate measurement of the particle number concentration in air and therefore precise fractional filtration efficiency. Understanding filtration efficiency for nanoparticles is crucial in schemes to remove nanoparticles, and thus, in a wider context, improve the general quality of the environment, including the working environment.

A large number of standards for testing air filters exist such as the ISO 29463 series and the ISO 16890 series. The test particle range in the ISO 29463 series is between 0,04 μm and 0,8 μm , and the focus is on measurement of the minimum efficiency at the most penetrating particle size (MPPS). The test particle range in the ISO 16890 series is between 0,3 μm and 10 μm . The ISO 21083 series aims to standardize the methods of determining the efficiencies of filter media, of all classes, used in most common air filtration products and it focuses on filtration efficiency of airborne nanoparticles, especially for particle size down to single-digit nanometres.

Test method to measure the efficiency of air filtration media against spherical nanomaterials —

Part 1: Size range from 20 nm to 500 nm

1 Scope

This document specifies the testing instruments and procedure for determining the fractional filtration efficiencies of flat sheet filter medium against airborne nanoparticles in the range of 20 nm to 500 nm. The testing methods in this document are limited to spherical or nearly-spherical particles to avoid uncertainties due to the particle shape.

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 5167 (all parts), *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full*

ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

ISO 15900, *Determination of particle size distribution — Differential electrical mobility analysis for aerosol particles*

ISO 27891, *Aerosol particle number concentration — Calibration of condensation particle counters*

ISO 29463-1, *High efficiency filters and filter media for removing particles from air — Part 1: Classification, performance, testing and marking*

ISO 29464, *Cleaning of air and other gases — Terminology*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5725-2, ISO 15900, ISO 27891 and ISO 29464 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/>