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BSI Standards Publication

In situ test methods for high efficiency filter systems in industrial facilities

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National foreword

This British Standard is the UK implementation of EN ISO 16170:2016. It is identical to ISO 16170:2016.

The UK participation in its preparation was entrusted to Technical Committee MCE/21, Filters for gases and liquids.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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EUROPÄISCHE NORM

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English Version

In situ test methods for high efficiency filter systems in industrial facilities (ISO 16170:2016, Corrected version 2017-04)

Méthodes d'essai in situ pour les systèmes filtrants à très haute efficacité dans les installations industrielles
(ISO 16170:2016, Version corrigée 2017-04)

Verfahren zur Prüfung von Luftfiltersystemen mit sehr hohen Wirkungsgraden im eingebauten Zustand (ISO 16170:2016, korrigierte Fassung 2017-04)

This European Standard was approved by CEN on 5 May 2016.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



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European foreword

This document (EN ISO 16170:2016) has been prepared by Technical Committee ISO/TC 142 "Cleaning equipment for air and other gases" in collaboration with Technical Committee CEN/TC 195 "Air filters for general air cleaning" the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2017, and conflicting national standards shall be withdrawn at the latest by January 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 16170:2016, Corrected version 2017-04 has been approved by CEN as EN ISO 16170:2016 without any modification.

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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 on 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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#).

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

This corrected version of ISO 16170:2016 incorporates the following corrections.

All figures have been replaced with higher quality diagrams.

In [C.3.2](#) the key and cross-references within the text to [Figure C.3](#) have been corrected.

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Introduction

Methods for measuring the performance of high efficiency gas cleaning devices are described in a number of existing standards. These specify procedures for quality assurance following manufacture (e.g. ISO 29463 and EN 1822).

Some other standards specify the filter medium used in such devices, how they are constructed and how they are installed within industrial facilities.

Installations of high efficiency particulate filters are extensively used within nuclear and toxic material processing plants and laboratories to confine these materials within the facility and prevent their discharge to the environment.

Radioactive and other toxic materials are confined within processing facilities inside containment zones bordered by barriers. Air and gases vented from these zones are decontaminated by passage through a series of highly efficient particulate filters before final discharge to the environment. The membrane (filter medium) of the filters acts as part of the containment barrier. In view of its perceived fragility, confirmation of its integrity is required on a periodic basis because operational safety cases depend on the knowledge that the effectiveness of these filters is maintained at all times. These periodic checks are made by the procedure(s) known as "in-situ" or "in-place" testing.

The basic principles of *in situ* tests on installed filters are the same as for laboratory tests, such as those described in EN 1822 and ISO 29463, insofar as known quantities of a challenge aerosol are dispersed into the airstream upstream of the filter installation; the particulate contents of the unfiltered and filtered air are sampled and analysed to determine whether the integrity of the filters has been compromised.

In the case of testing a single unit (manufacturer's production test or in the case of a laboratory testing on a single filter unit), the purpose is to confirm that the unit performance [efficiency/penetration at Most Penetrating Particle Size (MPPS) and other parameters] lies within specified limits, and further, that the results are globally reproducible. To achieve this requires the use of a laboratory test rig setup with full dispersion of a challenge aerosol, prescribed geometry of the test rig, and to obtain and analyse fully representative particulate samples both upstream and downstream of the test filter. Some ventilation systems are highly complex and it should be noted that many facilities use ventilation systems in which a high percentage of the air is recirculated.

The purpose of an *in situ* test is to detect any adverse change in the filtration performance of the installation and to compare it with the expected efficiency or decontamination factor. Such a change might be caused by deterioration of a unit or units or a faulty sealing system and would be manifested by the appearance of a proportion of unfiltered aerosol in the effluent airstream. Testing methodologies developed in this International Standard do not cover the other requirements that relate to filters in terms of mechanical resistance, burst strength or temperature and moisture resistance.

It is neither fully necessary nor useful for the results of an *in situ* test to replicate the results of production tests on the individual filters in the installation, nor is it necessary to confine the test aerosol size distribution to one which replicates that used in production tests.

No International Standard for general *in situ* testing of high efficiency filters has been produced before, explaining the needs for such an International Standard.

This International Standard describes the requirements for test equipment, data interpretation and reporting for the *in situ* testing of HEPA and ULPA air cleaning installations designed for the removal of airborne particulate contamination in high-integrity ventilation systems.

This International Standard includes specification of the test interval, aerosol type, aerosol mixing and measurement methods, i.e. the following:

- aerosol: solid or liquid, monodisperse or polydisperse;
- mixing: degree of mixing, mixing lengths, etc.;

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— method: injection, detection.

This International Standard proposes an outline testing philosophy to highlight the following:

- principle of the method;
- prerequisites;
- preparatory conditions;
- injected aerosol properties;
- qualification and selection of measuring devices;
- qualification of test personnel;
- test setup;
- test sequence;
- evaluation and reporting.

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In situ test methods for high efficiency filter systems in industrial facilities

1 Scope

This International Standard specifies *in situ* test methods for high efficiency particulate air filters used to limit releases towards the environment (e.g. from nuclear facilities or facilities with aerosol toxic or biological releases). This applies where installations of these filters are used to clean effluent air before discharge to the environment from industrial (including nuclear) installations where toxic/radioactive/biological materials are handled or processed.

This International Standard excludes the application already covered by ISO 14644-3.

The scope of this International Standard includes detail of two methods, either of which applies to the periodic testing of high efficiency filters which are used in demanding applications aiming at protecting the environment, such as the nuclear industry.

In the case of nuclear applications, this International Standard is applicable to installations covered by ISO 17873 (applications other than nuclear reactors) and ISO 26802 (nuclear reactors).

The two reference methods specified in this International Standard are not equivalent, but related to, the requirements to be addressed by the test results. The choice of which of the two methods is adopted in any specific case depends on whether the outcome requires an integrity test or a statutory efficiency accountancy test.

For industries handling or processing radioactive or toxic materials giving rise to a risk of possible release, the main goal of the tests is to confirm that the filter installation is fit for purpose. In the case of integrity tests ([Annex B](#)), this is to confirm that no significant leakage of toxic aerosols through the filter installation is possible.

In the case of efficiency accountancy tests ([Annex C](#)), the test is designed to make an accurate measurement of decontamination factor with respect to the MPPS size range of particles.

The reference method described in [Annex B](#) (integrity test) requires a test aerosol of dispersed oil particles mainly submicrometre in size range, which is stable during the test procedure and compatible with other installation components. Particle concentrations are measured in real time by light scattering instrumentation (optical detectors).

The reference method described in [Annex C](#) (efficiency accountancy test) requires a test aerosol of particles having a narrow size range centred on MPPS size range for HEPA filter media. Their concentration both upstream and downstream the filters is measured by fluorimetric analysis of aqueous solution obtained by washing the membrane sampling filters.

It should be noted that the requirements for an efficiency accountancy test also cover the requirements of an integrity test, which is considered to be a minimum requirement.

Test methods developed in this International Standard do not cover the other *in situ* performance requirements, such as mechanical resistance, bursting resistance or humidity resistance. Specific systems operating at high temperature or with specific gaseous effluents might require specific test methods.