SLOVENSKI STANDARD
oSIST prEN 17199-3:2018

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[Not translated]

Workplace exposure - Measurement of dustiness of bulk materials that contain or release nano-objects or submicrometer particles - Part 3: Continuous drop method

Exposition am Arbeitsplatz - Messung des Staubungsverhaltens von Schüttgütern, die Nanoobjekte oder Submikrometerpartikel enthalten oder freisetzen - Teil 3: Verfahren mit kontinuierlichem Fall

Exposition sur les lieux de travail - Mesurage du pouvoir de resuspension des matériaux en vrac contenant des nano-objets et leurs agrégats et agglomérats - Partie 3: Méthode de la chute continue

Ta slovenski standard je istoveten z: **prEN 17199-3**

ICS:

13.040.30	Kakovost zraka na delovnem mestu	Workplace atmospheres

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Workplace exposure - Measurement of dustiness of bulk materials that contain or release nano-objects or submicrometer particles - Part 3: Continuous drop method

Exposition sur les lieux de travail - Mesurage du pouvoir de resuspension des matériaux en vrac contenant des nano-objets et leurs agrégats et agglomérats - Partie 3: Méthode de la chute continue

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 137.

If this draft becomes a European Standard, 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.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 17199-3:2017) has been prepared by Technical Committee CEN/TC 137 “Assessment of workplace exposure to chemical and biological agents”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document has been prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association.

Introduction

Dustiness measurement and characterisation provides users (e.g. manufacturers, producers, occupational hygienists and workers) with information on the potential for dust emissions when the bulk material is handled or processed in workplaces. They provide the manufactures of bulk materials containing nanoparticles with information that can help to improve their products and reduce their dustiness. It allows the users of the bulk materials containing nanoparticles to assess the controls and precautions required for handling and working with the material and the effects of pre-treatment (e.g. modify surface properties or chemistry). It also allows the users to select less dusty products, if available. The particle size distribution of the aerosol and the morphology and chemical composition of its particles can be used by occupational hygienists, scientists and regulators to further characterise the aerosol in terms of size and chemical composition and to thus aid users to evaluate and control the health risk of airborne dust.

This European Standard gives details on the design and operation of the continuous drop method that measures the dustiness of bulk materials that contain or release nano-objects or submicrometer particles in terms of dustiness indices or emission rates. In addition the test method characterizes the aerosol emitted by measuring the particle size distribution and emission rate using on-line methods and collects samples for off-line analysis (as required) for their morphology and chemical composition. This test uses the same dust generation methods and the same set-up including dimensions of the apparatus specified in EN 15051-3. The determination of the inhalable and respirable fractions (see EN 481 [1]) of the released dust from a bulk nanomaterial containing nanoparticles is carried out separately according to EN 15051-1 and EN 15051-3.

The continuous drop method is useful for addressing the ability of bulk solid materials including nanomaterials (in powder form), to release airborne particles (aerosol) during agitation, the so-called dustiness.

The continuous drop method provides a simulation of workplace scenarios and represents general bulk material handling processes, including processes where bulk material is tipped, poured, mixed, scooped, dropped or similar; either mechanical or by hand.

The continuous drop method presented here differs from the rotating drum, the small rotating drum and the vortex shaker method presented in prEN 17199-2:2017 [2], prEN 17199-4:2017 [3] and prEN 17199-5:2017 [4] respectively. The rotating drum and small rotating drum perform, both, repeated pouring or agitation of the same sample nanomaterial while the vortex shaker method simulates vigorous agitation of a nanomaterial.

This European Standard was developed based on the results of pre-normative research [4]. This project investigated the dustiness of ten bulk materials including nine bulk nanomaterials with the intention to test as wide a range of bulk nanomaterials as possible in terms of magnitude of dustiness, chemical composition and primary particle size-distribution as indicated by a high range in specific surface area.

1 Scope

This European Standard provides the methodology for measuring the dustiness of bulk materials that contain or release nano-objects or submicrometer particles, under standard and reproducible conditions and specifies for that purpose the continuous drop method.

In addition, this European Standard specifies the selection of instruments and devices and the procedures for calculating and presenting the results. It also gives guidelines on the evaluation and reporting of the data.

The methodology described in this European Standard enables

a) the measurement of the respirable and inhalable dustiness mass fractions,

b) the measurement of the number-based dustiness index of respirable particles in the size range from about 10 nm to 1 000 nm,

c) the measurement of the number-based emission rate of respirable particles in the size range from about 10 nm to 1 000 nm,

d) the measurement of the number-based size distribution of the released aerosol in the size range from about 10 nm to 10 µm, and

e) the collection of released airborne particles in the respirable fraction for subsequent observations and analysis by analytical electron microscopy.

This European Standard is applicable to the testing of a wide range of bulk materials including powders, granules or pellets containing or releasing nano-objects or submicrometer particles in either unbound, bound uncoated and coated forms.

This European Standard is applicable to all bulk materials containing nanoparticles or releasing nanoparticles while being handled.

NOTE 1 Currently no number-based classification scheme in terms of dustiness indices or emission rates have been established. Eventually, when a large number of measurement data has been obtained, the intention is to revise this European Standard and to introduce such a classification scheme, if applicable.

NOTE 2 The methods specified in this European Standard have not been evaluated for nanofibers and nanoplates.

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.

EN 1540, *Workplace exposure - Terminology*

EN 13205-2, *Workplace exposure - Assessment of sampler performance for measurement of airborne particle concentrations - Part 2: Laboratory performance test based on determination of sampling efficiency*

EN 15051-1, *Workplace exposure - Measurement of the dustiness of bulk materials - Part 1: Requirements and choice of test methods*

EN 15051-3, *Workplace exposure - Measurement of the dustiness of bulk materials - Part 3: Continuous drop method*

prEN 17199-1:2017, *Workplace exposure - Measurement of dustiness of bulk materials that contain or release nano-objects or submicrometer particles - – Part 1: Requirements and choice of test methods*

EN 16897, *Workplace exposure - Characterization of ultrafine aerosols/nanoaerosols - Determination of number concentration using condensation particle counters*

EN ISO 13137, *Workplace atmospheres - Pumps for personal sampling of chemical and biological agents - Requirements and test methods (ISO 13137)*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1540, EN 15051-1 and prEN 17199-1:2017 apply.

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

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

4 Symbols and abbreviations

APS®[1]	Aerodynamic Particle Sizer
BET	Brunauer–Emmett–Teller
CDD	Continuous Drop Device
CPC	Condensation Particle Counter
d_{50}	a lower particle size at which the counting efficiency is 50 %
DMA	Differential Mobility Analyser
NOAA	Nano-objects and their Agglomerates and Aggregates
RH	Relative Humidity
SEM	Scanning Electron Microscopy
SMPS	Scanning Mobility Particle Sizer
TEM	Transmission Electron Microscopy

5 Principle

The continuous drop method described in this European Standard measures the dustiness of bulk materials containing or releasing nano-objects in terms of

— the health-related dustiness mass fraction,

— the number-based dustiness index, and

1) APS® is the trade name or trademark of a product supplied by TSI Instruments Ltd. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by CEN of the product named. Equivalent products may be used if they can be shown to lead to the same results.

— the number-based emission rate.

In addition, this European Standard describes the procedures by which the aerosols can be further characterised in terms of their particle size distributions and the morphology and chemical composition of their airborne particles (see Table 1).

Table 1 — Summary of the measurands, that can be obtained by the continuous drop method

Measurand	**Method / device specific to measurand**	**Recommended / optional measurand**
Respirable dustiness mass fraction (mg/kg)	Filters according to EN 15051-1 and EN 15051-3	mandatory
Inhalable dustiness mass fraction (mg/kg)		optional
Number-based dustiness index of particles in the size range from about 10 nm to 1 µm (1/mg)	CPC[a] covering the particle size range from about 10 nm to 1 µm	mandatory
Number-based emission rate (1/mg.s)		mandatory
Number of modes of the time-averaged particle number-based size distribution as $dN/d\log D_p$	SMPS/APS® combination covering the particle size particle from about 10nm to 10 µm	mandatory
Morphology and chemical characterisation of the nano-objects, the particles and agglomerates/aggregates	Sampling device, e.g. filters, according to EN 15051-1 and EN 15051-3	optional

[a] However, see 6.2.8 for possible alternate solutions.

The determination of the inhalable and respirable dustiness mass fractions of the released dust from a bulk material containing nanoparticles can be carried out within the same test run according to EN 15051-1 and EN 15051-3.

6 Equipment

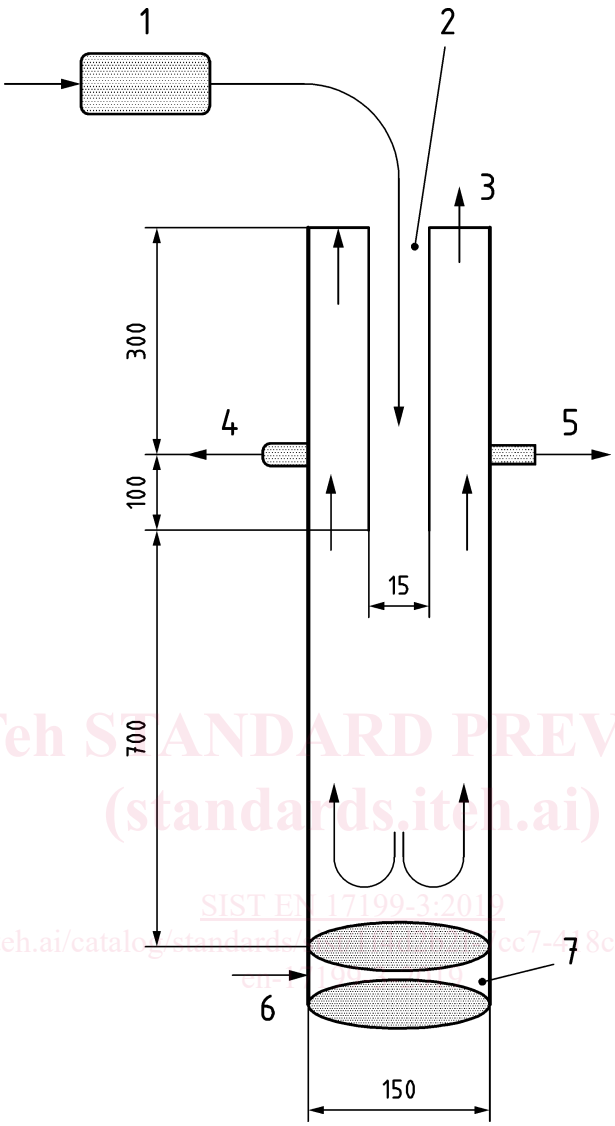
6.1 General

The test set-up used shall comply with all requirements of EN 15051-3.

The test apparatus required in order to determine the dustiness by the continuous drop test method is shown in Figure 1.

An illustration for an experimental test set-up example is given in Annex B.

Dimensions in millimetres



Key

1 feeder (6.2.2)
2 drop pipe (6.2.3)
3 main pump
4 sampler for gravimetric analysis (6.2.7) , e.g. cyclone respirable mass
5 online monitors
6 conditioned air, 53 l/min
7 receptacle (6.2.6) for fallen powder/ feed rate check

Figure 1 — Test apparatus

6.2 Test apparatus

The usual laboratory apparatus and, in particular, the following.

6.2.1 Continuous drop device, with characteristics as described in EN 15051-3.

6.2.2 Feeder, comprising of

a) a **sample tank**, large enough to hold the entire volume of the test substance for an entire test run;

b) a **metering device**, which does not change the composition and properties of the test material, e.g. by compacting or other mechanical processes, or, if some influence cannot be prevented, it should be minimized.

The metering device shall be suited at least for mass flows in the intended range from 3 g/min to 30 g/min, and should be suited for smaller mass flows as well.

The whole feeder shall be made from inert material, e.g. stainless steel. It shall be closed off during the experiments and no air leakage may enter the system via the feeder during the experiments.

NOTE A vibrating chute with adjustable feed rate has been shown to work well.

6.2.3 Drop pipe, with an inner diameter of 15 mm

The drop pipe shall be made from inert and electrically conducting material, e.g. stainless steel.

The drop pipe is a thin-walled tube.

6.2.4 Backflow pipe, round with an inner diameter of 150 mm

The backflow pipe shall be manufactured from an inert and electrically conducting material, e.g. stainless steel. Within the backflow pipe a vertical air speed of 0,053 m/s, measured below the end of the drop pipe (6.2.3) shall be generated. It is critically important that a constant vertical air speed of 0,053 m/s is maintained as the sum of the main pump's flow rate and those of all sampling/measuring devices employed in the tests. For this purpose a suitable instrument (e.g. a mass-flow controller (6.2.5)) to control the air flow generated by the main pump shall be in place.

The backflow pipe needs to be equipped with suitable openings/probes to connect the sampling devices. All openings shall be situated in one measurement plane (i.e. in an identical distance from the metering device 100 mm above the end of the drop pipe. They shall be situated in a symmetrical way around the drop pipe (i.e. for example if two openings are needed, they shall be opposite one another, if three are needed they shall be situated in a 120° orientation). Additionally in the case of different sampling flow rates of the applied devices, they shall be oriented in such a way as to generate as homogenous distributions of sampling flows (out of the backflow pipe) as possible, in order to avoid inhomogeneous lift air flows in the vicinity of the end of the drop pipe.

6.2.5 Mass-flow controller, or another suitable instrument to control the air flow generated by the main pump

6.2.6 Receptacle, made from inert material, e.g. stainless steel

The receptacle for the fallen powder shall be mounted to the backflow pipe (6.2.4). It is used to collect the dropped powder and shall be suited for weighing.

In addition, the external air which generates the upstream air flow within the backflow pipe (6.2.4), shall be cleaned of environmental particles by use of a suitable filter (a target particle number concentration of less than 20 particles/cm^3 shall be guaranteed) and pass through the collector tank.

6.2.7 Sampler for gravimetric analysis, according to EN 15051-3

The sampling of the respirable fraction of aerosol shall comply with EN 13205-2, and the respective pumps shall comply with EN ISO 13137.