SLOVENSKI STANDARD
SIST EN 17199-1:2019

01-september-2019

Izpostavljenost na delovnem mestu - Meritve prašnosti razsutih materialov, ki vsebujejo ali sproščajo respirabilne nanopredmete ter njihove agregate in aglomerate (NOAA) in druge respirabilne delce - 1. del: Zahteve in izbira preskusnih metod

Workplace exposure - Measurement of dustiness of bulk materials that contain or release respirable NOAA and other respirable particles - Part 1: Requirements and choice of test methods

Exposition am Arbeitsplatz - Messung des Staubungsverhaltens von Schüttgütern, die Nanoobjekte oder Submikrometerpartikel enthalten oder freisetzen - Teil 1: Anforderungen und Auswahl des Prüfverfahrens

Exposition sur les lieux de travail - Mesurage du pouvoir de resuspension des matériaux en vrac contenant ou émettant des nano-objets et leurs agrégats et agglomérats (NOAA) ou autres particules en fraction alvéolaire - Partie 1: Exigences et choix des méthodes d'essai

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EUROPEAN STANDARD

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Workplace exposure - Measurement of dustiness of bulk materials that contain or release respirable NOAA and other respirable particles - Part 1: Requirements and choice of test methods

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 17199-1:2019) 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 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of an identical text or by endorsement, at the latest by September 2019 and conflicting national standards shall be withdrawn at the latest by September 2019.

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Introduction

The control of the emitted and released airborne NOAA and other respirable particles during the handling and transportation of bulk materials is an important consideration for workers' exposure and the design and operation of many industrial or research processes. It is therefore important to obtain information about the propensity of bulk materials to release NOAA and other particles and thus assist in assessing the risk for exposure to a hazardous material, especially if they penetrate to the alveolar region (respirable fraction).

Dustiness data have been recommended for nanomaterials exposure assessment by the Organisation for Economic Co-operation and Development [1]; these are also already in use as an input parameter in some control banding tools for nanomaterials or to predict the likelihood of exposure by modelling. Finally, dustiness data can provide the manufacturers of nanomaterials with information that can help to improve their products (e.g. by selecting less dusty nanomaterials) or the users to improve their processes or their technical prevention approaches.

Dustiness depends on a number of factors including:

— the physical state of the bulk material (e.g. powder, granules, pellets and moisture content),

— the physicochemical properties of the particles contained in the bulk material (e.g. particle size and shape, relevant density, type of coating, hydrophobicity and hydrophilicity properties, aggregation of particles),

— the environment (e.g. moisture, temperature),

— the condition of the bulk material,

— the type of aerosol generation (activation energy or energy input, time characteristics of the energy input),

— the interaction between particles during agitation (e.g. friction shearing, van der Wall forces), and

— the sampling and measurement configuration.

The aim of dustiness testing is to simulate typical powder processing and handling in order to enable a comparison of the relative dust release potential of different bulk materials. Data derived from dustiness testing can be used as input for qualitative or quantitative exposure assessment. Dustiness involves the application of a given type and amount of activation energy or energy input, to a stipulated amount of test material during a stipulated time, whereby particles are dispersed into the air and are described quantitatively. No single dustiness method is likely to represent and reproduce the various types of processing and handling used in the workplace. Therefore, there are a number of methods for the design of dustiness devices and different values will be obtained by different test methods. However, the test and the variables including the sampling and measurement configuration demand to be closely specified to ensure reproducibility.

Conventional dustiness methods for micrometre-size particles estimate the airborne dust generated in terms of dustiness mass fraction (e.g. respirable, thoracic, inhalable), given in mg/kg. The current EN 15051 standard series for conventional dustiness provides two methods: the rotating drum method and the continuous drop method. Although these methods are accepted standards for micrometre-size particles, the biological behaviour of NOAA, because of their small particle size and surface area, has raised the question whether the dustiness can be adequately characterized by their mass fraction only.

Therefore, particle number concentration and particle size distribution are other important measurands for measuring and characterizing the dustiness of bulk material containing NOAA[1]. The test provided in this document is also applicable to powders not falling under the EC recommended nanomaterial definition, which nevertheless might release airborne NOAA during handling.

This document together with EN 17199-2 to EN 17199-5 establish test methods that measure the dustiness of bulk materials containing NOAA in terms of health related dustiness mass fraction, number-based dustiness index and number-based emission rate. In addition, it establishes test methods that characterize the aerosol from its particle size distribution and the morphology and chemical composition of its particles. It also gives guidance on the choice of a test method from four methods: the rotating drum, the continuous drop, the small rotating drum and the vortex shaker. These methods require different amount of test material and allow the application of a wide range of energy inputs to those materials. The rotating drum methods differ from the continuous drop and the vortex shaker methods. In the rotating drum, the bulk material is repeatedly dropped while in the continuous drop, it is dropped only once but continuously. In the vortex shaker, the bulk material is subjected to a much higher energy input. The principle of the rotating drum method is similar to that of the small rotating drum method.

This document was originally developed based on the results of pre-normative research [3]. This project investigated the dustiness of ten bulk materials (including nine bulk nanomaterials) with the intention to test as wide a range of bulk materials 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.

Although dustiness can be considered as a factor determining the exposure, the results of the selected test method cannot be directly used as an estimate of workplace exposure in the intended application.

1) CEN ISO/TS 12025 [2] provides general methodology for the quantification of nano-object release from powders as a result of treatment, ranging from handling to high energy dispersion, by measuring aerosols liberated after a defined aerosolization procedure. However, it does not establish test methods.

1 Scope

This document provides the methodology for measuring and characterizing the dustiness of a bulk material that contains or releases respirable NOAA and other respirable particles. In addition, it specifies the environmental conditions, the sample handling procedure and the method of calculating and presenting the results. Guidance is given on the choice of method to be used.

The methodology described in this document enables:

a) the quantification of dustiness in terms of health related dustiness mass fractions,

b) the quantification of dustiness in terms of a number-based dustiness index and a number-based emission rate, and

c) the characterization of the aerosol from its particle size distribution and the morphology and chemical composition of its particles.

NOTE 1 Currently, no number-based classification scheme in terms of particle number has been established for particle dustiness release. Eventually, when a large enough number of measurement data has been obtained, the intention is to revise this document and to introduce a number-based classification scheme.

This document is applicable to all bulk materials, including powders, granules or pellets, containing or releasing respirable NOAA ad other respirable particles.

NOTE 2 The vortex shaker method specified in part 5 of this standard series has not yet been evaluated for pellets and granules.

NOTE 3 The rotating drum and continuous drop methods have not yet been evaluated for nanofibres and nanoplates.

This document does not provide methods for assessing the release of particles during handling or mechanical reduction by machining (e.g. crushing, cutting, sanding, sawing) of nanocomposites.

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.

CEN ISO/TS 80004-2, *Nanotechnologies - Vocabulary - Part 2: Nano-objects (ISO/TS 80004-2)*

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 15051-2, *Workplace exposure - Measurement of the dustiness of bulk materials - Part 2: Rotating drum method*

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

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

EN 17199-2, *Workplace exposure - Measurement of dustiness of bulk materials that contain or release respirable NOAA and other respirable particles - Part 2: Rotating drum method*

EN 17199-3, *Workplace exposure - Measurement of dustiness of bulk materials that contain or release respirable NOAA and other respirable particles - Part 3: Continuous drop method*

EN 17199-4, *Workplace exposure - Measurement of dustiness of bulk materials that contain or release respirable NOAA and other respirable particles - Part 4: Small rotating drum method*

EN 17199-5, *Workplace exposure - Measurement of dustiness of bulk materials that contain or release respirable NOAA and other respirable particles - Part 5: Vortex shaker 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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1540, EN 15051-1, CEN ISO/TS 80004-2 and the following 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

3.1
background particle
particle infiltrated from the laboratory

3.2
bulk material
any solid material, which can be tipped, mixed, scooped, or similar, either mechanically or by hand including powders, granules or pellets containing or releasing nano-objects or submicrometer particles in either unbound, bound uncoated and coated forms

3.3
nanomaterial
material with any external dimensions in the nanoscale or having internal structure or surface structure in the nanoscale

[SOURCE: CEN ISO/TS 80004-1:2015 [4]]

3.4
number-based dustiness index
ratio of the number of particles released over the duration of the test to the test mass for the respective dustiness test method

3.5
number-based emission rate
ratio of the number of particles released per second over the duration of the test to the test mass for the respective dustiness test method

3.6
particle size distribution
distribution of particles as a function of particle size

Note 1 to entry: Particle size distribution can be expressed as cumulative distribution or a distribution density (distribution of the fraction of material in a particle size class, divided by the width of that class).

Note 2 to entry: Adapted from EN ISO 14644-1:2015 [5].

3.7
particle size
linear dimension of a particle determined by a specified measurement method and under specified measurement conditions

[SOURCE: ISO 26824:2013[6]]

4 Symbols and abbreviations

AES	Atomic Emission Spectroscopy
APS®2)	Aerodynamic Particle Sizer
BET	Brunauer–Emmett–Teller
CPC	Condensation Particle Counter
d_{50}	A lower particle size at which the counting or sampling efficiency is 50 %
DEMC	Differential Electrical Mobility Classifier
DMAS	Differential Mobility Analysing System
ELPI®3)	Electrical Low Pressure Impactor
EM	Electron Microscopy
ICP	Inductively coupled plasma
MS	Mass Spectrometry
NOAA	Nano-objects, and their aggregates and agglomerates > 100 nm
RH	Relative Humidity
SEM	Scanning Electron Microscopy
TEM	Transmission Electron Microscopy
XRF	X-ray fluorescence

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5 Principle

5.1 General

Figures 1 and 2 show flow charts to provide the user of this document a route through the necessary stages that shall be taken into account to obtain values of the dustiness parameters of a given bulk material.

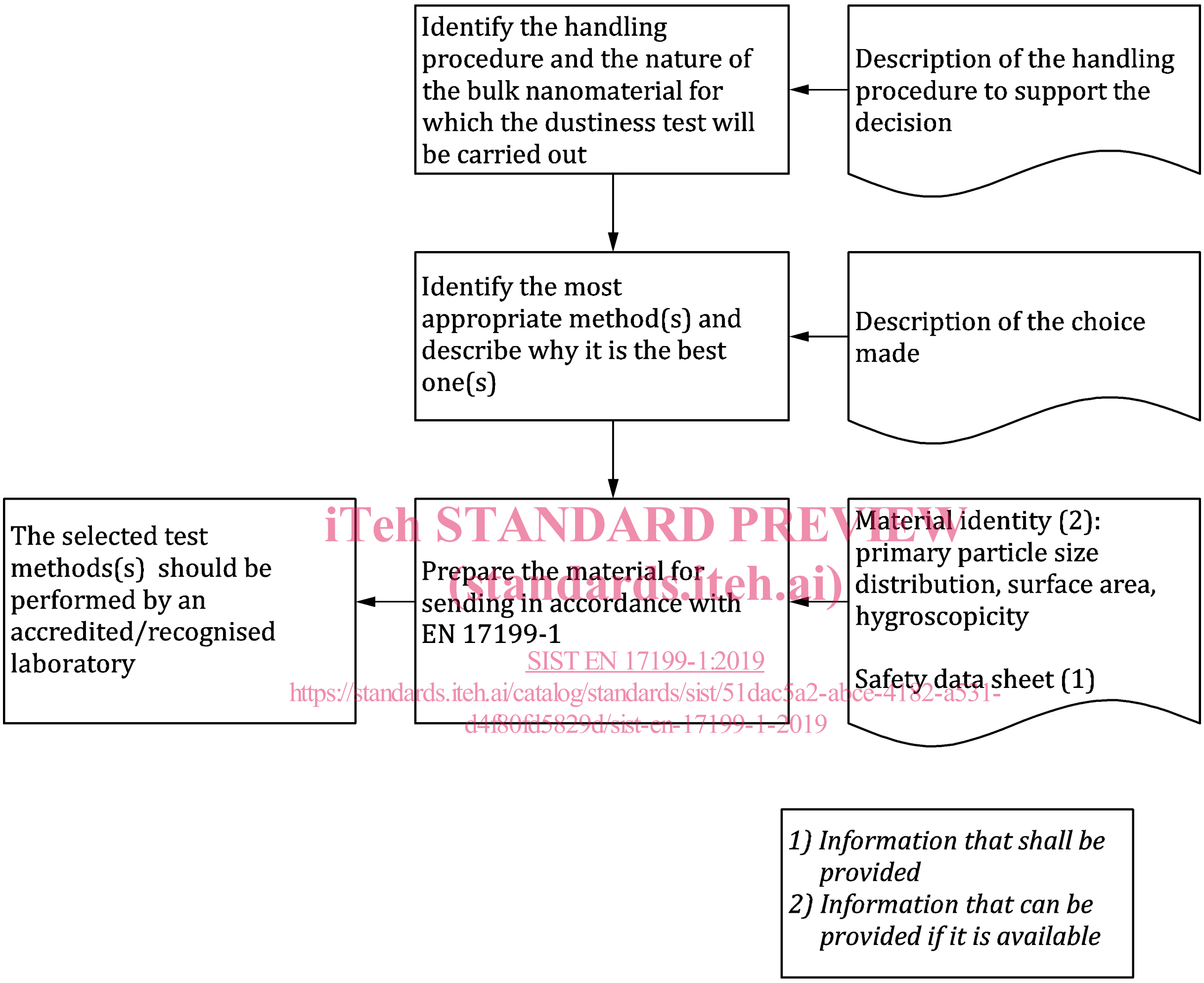

Figure 1 — Flow chart decision for the supplier of the bulk material