SLOVENSKI STANDARD
SIST-TS CEN ISO/TS 24672:2024

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Nanotehnologije - Navodilo za merjenje številčnosti koncentracije nanodelcev (ISO/TS 24672:2023)

Nanotechnologies - Guidance on the measurement of nanoparticle number concentration (ISO/TS 24672:2023)

Nanotechnologien - Leitfaden für die Messung der Konzentration von Nanopartikeln (ISO/TS 24672:2023)

Nanotechnologies - Conseils pour la mesure de la concentration en nombre de nanoparticules (ISO/TS 24672:2023)

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07.120	Nanotehnologije	Nanotechnologies

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CEN ISO/TS 24672

September 2024

ICS 07.120

English Version

Nanotechnologies - Guidance on the measurement of nanoparticle number concentration (ISO/TS 24672:2023)

Nanotechnologies - Conseils pour la mesure de la concentration en nombre de nanoparticules (ISO/TS 24672:2023)

Nanotechnologien - Leitfaden für die Messung der Konzentration von Nanopartikeln (ISO/TS 24672:2023)

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Contents

Page

European foreword

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Endorsement notice

The text of ISO/TS 24672:2023 has been approved by CEN as CEN ISO/TS 24672:2024 without any modification.

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Nanotechnologies — Conseils pour la mesure de la concentration en nombre de nanoparticules

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Contents

Page

Foreword

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This document was prepared by Technical Committee ISO/TC 229, *Nanotechnologies*.

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

Nanoparticle number concentration refers to the number of nanoparticles per unit of volume or mass in a sample. It is an important measurand when analysing dispersions containing nanoparticles. Nanoparticle number concentration is also considered a useful metric for supporting materials toxicological assessments. Furthermore, the capability to accurately measure nanoparticle number concentration can help industry to increase product manufacturing quality control and implement quality assurance. Currently, in most applications, nanoparticle number concentration is estimated from indirect mass-balance considerations and validated direct techniques for this measurand are required.

This document provides an overview of commonly used methods for the measurement of nanoparticle number concentration. These are the ensemble measurement techniques of differential centrifugal sedimentation (DCS) (line start incremental disc-type centrifugal liquid sedimentation), multi-angle dynamic light scattering (MDLS), small-angle X-ray scattering (SAXS) and ultraviolet-visible spectroscopy (UV-vis) and the particle counting techniques of particle tracking analysis (PTA), resistive pulse sensing (RPS), single particle inductively coupled plasma mass spectrometry (spICP-MS), condensation particle counter (CPC), and differential mobility analysing system (DMAS).

This document focuses on the analysis of nanoparticles in suspensions (liquid dispersions) but also addresses aerosols measured using a CPC or a DMAS. Particles on surfaces or incapsulated in solid materials are not covered in this document. Nanoparticles rather than nano-objects are discussed as most techniques use the spherical approximation model to measure particle diameter which is more applicable to nanoparticles as opposed to nanofibres and nanoplates. Most of the techniques discussed can also analyse particles of size greater than the nanoscale.

This document provides guidance to help users to select the most appropriate techniques for nanoparticle number concentration measurements suitable for their applications.

Nanotechnologies — Guidance on the measurement of nanoparticle number concentration

1 Scope

This document provides an overview of the methods used to determine the nanoparticle number concentration in liquid dispersions and aerosols. The methods described are the ensemble measurement techniques of differential centrifugal sedimentation (DCS), multi-angle dynamic light scattering (MDLS), small-angle X-ray scattering (SAXS) and ultraviolet-visible spectroscopy (UV-vis) and the particle counting methods of particle tracking analysis (PTA), resistive pulse sensing (RPS), single particle inductively coupled plasma mass spectrometry (spICP-MS), condensation particle counter (CPC), and differential mobility analysing system (DMAS). This document provides information on the use of each technique, along with considerations on sample preparation, advantages and limitations.

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 80004-1, *Nanotechnologies – Vocabulary — Part 1: Core vocabulary*

ISO/TS 80004-6, *Nanotechnologies — Vocabulary — Part 6: Nano-object characterization*

ISO/TS 80004-8, *Nanotechnologies — Vocabulary — Part 8: Nanomanufacturing processes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 80004-1, ISO/TS 80004-6, ISO/TS 80004-8 and the following apply.

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

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

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

3.1
particle
minute piece of matter with defined physical boundaries

Note 1 to entry: A physical boundary can also be described as an interface.

Note 2 to entry: A particle can move as a unit.

Note 3 to entry: This general particle definition applies to nano-objects.

[SOURCE: ISO 26824:2022, 3.1]

3.2
nanoparticle
nano-object with all external dimensions in the nanoscale

Note 1 to entry: If the dimensions differ significantly (typically by more than three times), terms such as nanofibre or nanoplate are preferred to the term nanoparticle.

[SOURCE: ISO 80004-1:2023, 3.3.4]

3.3
primary particle
original source *particle* (3.1) of *agglomerates* (3.4) or *aggregates* (3.5), or mixtures of the two

Note 1 to entry: Constituent particles of agglomerates or aggregates at a certain actual state may be primary particles, but often the constituents are aggregates.

Note 2 to entry: Agglomerates and aggregates are also termed secondary particles.

[SOURCE: ISO 26824:2022, 3.1.4]

3.4
agglomerate
collection of weakly or medium strongly bound *particles* (3.1) where the resulting external surface area is similar to the sum of the surface areas of the individual components

Note 1 to entry: The forces holding an agglomerate together are weak forces, for example, van der Waals forces, or simple physical entanglement.

Note 2 to entry: Agglomerates are also termed secondary particles and the original source particles are termed *primary particles* (3.3).

[SOURCE: ISO 80004-1:2023, 3.2.4]

3.5
aggregate
particle (3.1) comprising strongly bonded or fused particles where the resulting external surface area is significantly smaller than the sum of surface areas of the individual components

Note 1 to entry: The forces holding an aggregate together are strong forces, for example, covalent or ionic bonds, or those resulting from sintering or complex physical entanglement.

Note 2 to entry: Aggregates are also termed secondary particles and the original source particles are termed primary particles.

[SOURCE: ISO 80004-1:2023, 3.2.5]

3.6
differential centrifugal sedimentation
DCS
analytical centrifugation in which the sample is introduced at a defined position in a rotating disc partially filled with a fluid

Note 1 to entry: Normally the fluid has a density gradient to ensure uniform sedimentation.

Note 2 to entry: Normally there is one detector at a pre-determined position and the times taken for the *particles* (3.1) to reach this detector are recorded.

Note 3 to entry: Depending on the effective density of the particles, the technique can measure particle size and particle size distribution between 2 nm and 10 µm, and can resolve particles differing in size by less than 2 %.

[SOURCE: ISO/TS 80004-6:2021, 4.4.5, modified — the term “line-start incremental disc-type centrifugal liquid sedimentation” has been removed.]