
**Nanotechnologies — Requirements
and recommendations for the
identification of measurands that
characterise nano-objects and
materials that contain them**

*Nanotechnologies – Exigences et recommandations pour
l'identification des mesurandes qui caractérisent les nano-objets et les
matériaux les contenant*





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Published in Switzerland

Contents

	Page
Foreword.....	vii
Introduction.....	viii
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	1
3.1 General core terms.....	1
3.2 Measurand related terms.....	3
4 Abbreviated terms.....	6
5 Approaches to identify measurands to characterize nano-objects and their agglomerates and aggregates, and materials containing nano-objects.....	9
5.1 Procedure.....	9
5.2 Types of measurands.....	10
5.3 State of nano-objects.....	10
6 Measurands related to size and shape measurement of nano-objects and their agglomerates and aggregates.....	11
6.1 General.....	11
6.2 Measurands related to size and shape measurement.....	11
6.2.1 Overview.....	11
6.2.2 General relevant standards.....	12
6.3 Measurands related to size and shape measurement in aerosols.....	12
6.3.1 Overview.....	12
6.3.2 General relevant standards.....	13
6.3.3 Electrical low-pressure impaction.....	13
6.3.4 Cascade impactors.....	14
6.3.5 Differential mobility analysing system.....	14
6.3.6 Relevant standards.....	15
6.3.7 Optical particle counter.....	15
6.3.8 Relevant standards.....	15
6.3.9 Aerodynamic particle sizing.....	15
6.3.10 TEM combined with TEM grid samplers.....	15
6.3.11 Relevant standards.....	16
6.3.12 Scanning electron microscopy.....	16
6.3.13 Relevant standards.....	17
6.4 Measurands related to size and shape measurement in powders.....	17
6.4.1 Overview.....	17
6.4.2 Relevant standards.....	17
6.4.3 Scanning electron microscopy.....	18
6.4.4 Relevant standards.....	18
6.4.5 Gas adsorption, the BET method.....	18
6.4.6 Relevant standard.....	18
6.4.7 Laser diffraction.....	18
6.4.8 Relevant standard.....	19
6.4.9 X-ray diffraction.....	19
6.4.10 Relevant standards.....	19
6.4.11 Raman spectroscopy.....	19
6.5 Measurands related to size and shape measurements of nano-objects in liquid dispersions.....	20
6.5.1 Overview.....	20
6.5.2 Centrifugal liquid sedimentation.....	21
6.5.3 Relevant standards.....	21
6.5.4 Dynamic light scattering.....	21
6.5.5 Relevant standards.....	22

6.5.6	Laser diffraction.....	22
6.5.7	Relevant standard.....	22
6.5.8	Small angle X-ray scattering.....	22
6.5.9	Relevant standard.....	22
6.5.10	Particle tracking analysis.....	22
6.5.11	Relevant standards.....	23
6.5.12	Electron microscopy.....	23
6.5.13	Field flow fractionation.....	23
6.5.14	Relevant standard.....	24
6.5.15	Single particle ICP-MS.....	24
6.5.16	Relevant standard.....	25
6.6	Measurands related to size and shape measurement on surfaces (microscopy techniques).....	25
6.6.1	Overview.....	25
6.6.2	Scanning electron microscopy.....	25
6.6.3	Atomic force microscopy.....	25
6.6.4	Relevant standards.....	26
7	Measurands related to chemical analysis of nano-objects and their agglomerates and aggregates.....	26
7.1	General.....	26
7.2	Measurands related to surface chemical analysis of nano-objects and their agglomerates and aggregates.....	27
7.2.1	Measurands.....	27
7.2.2	Auger electron spectroscopy.....	28
7.2.3	Relevant standards.....	28
7.2.4	Electron energy loss spectroscopy.....	28
7.2.5	Relevant standard.....	28
7.2.6	Secondary ion mass spectroscopy.....	28
7.2.7	Relevant standards.....	29
7.2.8	X-ray fluorescence spectroscopy.....	29
7.2.9	Relevant standards.....	30
7.2.10	X-ray diffraction.....	30
7.2.11	Relevant standard.....	30
7.2.12	X-ray photoelectron spectroscopy.....	30
7.2.13	Relevant standards.....	31
7.2.14	Energy dispersive X-ray spectroscopy.....	31
7.2.15	Low energy ion scattering.....	31
7.3	Measurands related to the chemical analysis of nano-objects as bulk samples.....	31
7.3.1	Measurands.....	31
7.3.2	Fourier transform infrared spectroscopy.....	32
7.3.3	Relevant standards.....	33
7.3.4	Thermal analysis with evolved gas analyser plus FTIR or QMS.....	33
7.3.5	Relevant standards.....	34
7.3.6	Ultraviolet-visible spectroscopy.....	34
7.3.7	Relevant standards.....	34
7.3.8	Raman spectroscopy.....	34
7.3.9	Inductively coupled plasma techniques.....	34
7.3.10	Relevant standards.....	34
7.3.11	Contact angle.....	35
8	Measurands related to mass and density.....	35
8.1	General.....	35
8.2	Aerosols.....	35
8.2.1	Measurands.....	35
8.2.2	Relevant standards.....	35
8.2.3	Aerosol particle mass analyser.....	36
8.2.4	Time of flight mass spectrometry.....	36
8.3	Powders.....	36

8.3.1	Measurands	36
8.3.2	Pycnometry	36
8.3.3	Relevant standards	36
8.4	Liquid dispersions	37
8.4.1	Measurands	37
8.4.2	Relevant standards	37
8.4.3	Centrifugal liquid sedimentation (isopycnic method)	37
8.4.4	Static light scattering	37
8.4.5	Resonant mass measurement	38
9	Measurands related to charge — Liquid dispersions	38
9.1	Measurands	38
9.2	Relevant standards	38
9.3	Electrophoretic light scattering	38
9.4	Electroacoustic phenomena measurements	39
10	Measurands related to crystallinity	39
10.1	Measurands	39
10.2	Small-angle/wide-angle X-ray scattering	40
10.3	X-ray diffraction	40
10.4	High-resolution transmission electron microscopy	41
10.5	Electron backscattered diffraction	41
10.6	Neutron diffraction	41
10.7	Reflection high-energy electron diffraction and low-energy electron diffraction	41
10.8	Differential scanning calorimetry	41
10.9	Relevant standards	42
10.10	Solid state nuclear magnetic resonance crystallography	42
10.11	Raman crystallography	42
10.12	Relevant standards	42
11	Optical properties measurands	42
11.1	General	42
11.2	Measurands	43
11.3	Spectroscopy techniques	43
11.4	Relevant standards	44
12	Electrical and electronic measurands	44
12.1	Measurands	44
12.2	Techniques	45
12.2.1	2- or 4-point conductance measurements	45
12.2.2	Angle-resolved ultraviolet photoemission spectroscopy	45
12.2.3	Scanning tunnelling microscopy	45
12.2.4	Conductive atomic force microscopy	45
12.2.5	Piezoforce microscopy	46
13	Magnetic measurands	46
13.1	General	46
13.2	Measurands	46
13.3	Techniques	47
13.3.1	Superconducting quantum interference device	47
13.3.2	Vibrating sample magnetometer	48
13.3.3	Mössbauer spectroscopy	48
13.3.4	Electron paramagnetic resonance spectroscopy	48
13.3.5	Magneto-optical Kerr-effect	48
13.3.6	Magnetic force microscopy	48
13.3.7	Scanning Hall effect microscopy	48
13.3.8	Spin-polarized scanning tunnelling microscopy	49
13.3.9	Relevant standards	49
14	Thermal measurands	49
14.1	Measurands	49

14.2	Techniques.....	49
14.2.1	Measurement of specific heat capacity.....	49
14.2.2	Scanning thermal microscopy.....	49
14.3	Relevant standard.....	50
15	Other performance related measurands.....	50
15.1	General.....	50
15.2	Powders — Dustiness.....	50
15.2.1	Measurands.....	50
15.2.2	Relevant standards.....	50
15.3	Liquid dispersions.....	51
15.3.1	Measurands.....	51
15.3.2	Viscosity.....	51
15.3.3	Dispersibility.....	53
15.3.4	Relevant standard.....	53
15.3.5	Solubility and rate of dissolution.....	53
15.3.6	Relevant standards.....	54
15.4	Mechanical properties.....	54
15.4.1	General.....	54
15.4.2	Measurement of elastic constants by static methods.....	55
15.4.3	Relevant standards.....	55
15.4.4	Measurement of elastic constants by dynamic methods.....	55
15.4.5	Relevant standards.....	56
15.4.6	Measurement of elastic and plastic properties by instrumented indentation methods.....	56
15.4.7	Relevant standards.....	56
15.4.8	Measurement of surface properties and wear.....	56
15.4.9	Relevant standard.....	57
	Bibliography.....	58

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 Technical Committee ISO/TC 229, *Nanotechnologies*, and IEC/TC 113, *Nanotechnology for electrotechnical products and systems*.

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

The term “nano-object” applies to materials having one, two or three external dimensions in the nanoscale (therefore in the range of approximately 1 nm to 100 nm). Specific size dependent properties are usually exhibited in this size range, even if they do not disappear abruptly beyond these limits. Nano-objects, either natural or manufactured, can be found in the form of nanoplates (one dimension in the nanoscale), nanofibres (two dimensions, or the diameter, in the nanoscale), and nanoparticles (three dimensions in the nanoscale). Nano-objects exhibit higher specific surface areas than larger objects. They are particularly prone to aggregation and agglomeration phenomena due to attractive interactions during their life cycle.

There is increasing use of nano-objects in research and development, industry and commercial applications. Characterization of nano-objects, and their agglomerates and aggregates (NOAAs) plays an essential role in basic and applied research, through process and product quality control and commercialization to health and environmental protection. Characterization of nano-objects is key to determine their physical and chemical properties, performance and lifetime. The methods available for characterization of larger scale materials are often difficult to apply to nano-objects, sometimes due to restrictions of the test systems (e.g. low sensitivity, inadequate resolution of equipment). This has resulted in the development of new techniques and adaptation of existing ones.

The method selection is often strongly influenced by its initial cost and availability, time and sample compatibility. However, an aspect that is easily forgotten is whether the selected method truly targets the physical or chemical material property that is intended to be measured (“the measurand”). This can sound trivial, but in practice, insufficient knowledge or consideration about the actual measurement principle and/or the property measured can impede a correct assessment of the measurement results.

Measurement techniques and methods are typically classified according to the material properties they can measure. One definition of “measurand” used in many ISO standards is the “quantity intended to be measured”. In nanotechnologies popular material properties often considered as this “intended measurand” can be size, shape, chemical composition, surface charge. However, in reality, due to their different underlying physical measurement principles, results obtained by different techniques, for a common material property, can differ significantly. The logical reason for this is that these different techniques measure not the intended measurand but different measurands, which are specific to the technique but are closely related to the intended measurand.

For intended use in biological systems and therapeutic purposes, additional characterization beyond those mentioned in the document may be required.

This document describes measurands used to characterize nano-objects, and their agglomerates and aggregates. This document is split into 10 main clauses covering:

- [Clause 6](#): size and shape measurands;
- [Clause 7](#): chemical analysis measurands;
- [Clause 8](#): mass and density;
- [Clause 9](#): charge measurands;
- [Clause 10](#): crystallinity measurands;
- [Clause 11](#): optical properties measurands;
- [Clause 12](#): electrical and electronic measurands;
- [Clause 13](#): magnetic measurands;
- [Clause 14](#): thermal measurands;
- [Clause 15](#): other performance related measurands.

Nanotechnologies — Requirements and recommendations for the identification of measurands that characterise nano-objects and materials that contain them

1 Scope

This document specifies requirements and recommendations for the identification of measurands to characterize nano-objects and their agglomerates and aggregates, and to assess specific properties relevant to the performance of materials that contain them. It provides recommendations for relevant measurement.

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 20579-4, *Surface chemical analysis — Guidelines to sample handling, preparation and mounting — Part 4: Reporting information related to the history, preparation, handling and mounting of nano-objects prior to surface analysis*

ISO/TS 80004-1:2015, *Nanotechnologies — Vocabulary — Part 1: Core terms*

ISO/TS 80004-2:2015, *Nanotechnologies — Vocabulary — Part 2: Nano-objects*

ISO/TS 80004-6:2021, *Nanotechnologies — Vocabulary — Part 6: Nano-object characterization*