



This is a preview of ISO 19430:2024. [Click here to purchase the full version from the ANSI store.](#)

# Determination of particle size distribution and number concentration by particle tracking analysis (PTA)

*Détermination de la distribution granulométrique et de la concentration en nombre par l'analyse de suivi de particule (PTA)*

**ISO 19430**

**Second edition  
2024-08**

This is a preview of ISO 19430:2024. Click [here](#) to purchase the full version from the ANSI store.



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2024

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

This is a preview of ISO 19430:2024. [Click here to purchase the full version from the ANSI store.](#)

<b>Foreword</b> .....	<b>v</b>
<b>Introduction</b> .....	<b>vi</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Symbols and abbreviated terms</b> .....	<b>6</b>
<b>5 Principles</b> .....	<b>7</b>
5.1 General.....	7
5.2 Measurement types.....	7
5.2.1 General.....	7
5.2.2 Particle detection.....	8
5.2.3 Brownian motion tracking.....	9
5.2.4 Gravitational motion tracking.....	9
5.3 Key physical parameters.....	10
5.4 Limits of detection.....	10
5.4.1 General.....	10
5.4.2 Lower size limit of detection.....	11
5.4.3 Upper size limit of detection.....	11
5.4.4 Particle number concentration measurement limits.....	12
5.4.5 Sample and sampling volume.....	13
5.5 Measurement precision and uncertainties.....	13
5.5.1 Size measurement uncertainty.....	13
5.5.2 Counting efficiency.....	14
5.5.3 Size resolution.....	15
5.5.4 Polydispersity.....	15
5.5.5 Sensing volume.....	15
<b>6 Apparatus</b> .....	<b>17</b>
6.1 General.....	17
6.2 Sample cell (with sample in dispersion).....	17
6.3 Illumination.....	17
6.4 Optical image capturing.....	18
6.5 Image analysis, tracking and data processing computer.....	18
<b>7 Measurement procedure</b> .....	<b>20</b>
7.1 General.....	20
7.2 Sample preparation.....	20
7.3 Instrument set-up and initialisation.....	21
7.4 Sample delivery.....	21
7.5 Sample illumination.....	22
7.6 Particle imaging and video capture.....	22
7.7 Track analysis.....	22
7.8 Measurements.....	23
7.8.1 Particle sizing and number-based size distribution.....	23
7.8.2 Total particle number measurement.....	24
7.8.3 Particle background count.....	24
7.8.4 Volume concentration.....	24
7.9 Results evaluation.....	24
7.9.1 General.....	24
7.9.2 Particle size evaluation.....	24
7.9.3 Particle count results interpretation.....	24
7.9.4 Distribution analysis.....	25
7.9.5 Data analysis and results display.....	25
<b>8 System qualification and quality control</b> .....	<b>25</b>

This is a preview of ISO 19430:2024. [Click here to purchase the full version from the ANSI store.](#)

8.3	System maintenance .....	25
8.4	System operation.....	26
8.5	Instrument qualification (for sizing).....	26
8.6	Instrument qualification (for number concentration).....	27
<b>9</b>	<b>Data recording</b> .....	<b>27</b>
<b>10</b>	<b>Test report</b> .....	<b>28</b>
<b>Annex A</b>	<b>(informative) Theory</b> .....	<b>30</b>
<b>Annex B</b>	<b>(informative) Comparative study of number concentration evaluation of gold nanoparticles in suspension</b> .....	<b>33</b>
<b>Annex C</b>	<b>(informative) Using sedimentation data with PTA</b> .....	<b>35</b>
<b>Annex D</b>	<b>(informative) Serial dilution experiment</b> .....	<b>37</b>
<b>Bibliography</b>	.....	<b>40</b>

This is a preview of ISO 19430:2024. [Click here to purchase the full version from the ANSI store.](#)

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 document 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](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 24, *Particle characterization including sieving*, Subcommittee SC 4, *Particle characterization*.

This second edition cancels and replaces the first edition (ISO 19430:2016), which has been technically revised.

The main changes are as follows:

- Inclusion of particle counting and number concentration measurements.
- Inclusion of information on gravitational motion tracking.
- Inclusion of information on simultaneous multispectral detection.
- Inclusion of particle number concentration comparison to other methods.
- Inclusion of information on serial dilution for PTA.

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](http://www.iso.org/members.html).

This is a preview of ISO 19430:2024. [Click here to purchase the full version from the ANSI store.](#)

Regulatory, scientific and commercial requirements for nanomaterial characterization or characterization of particulate suspensions where particle sizing and counting is used provide a strong case for further development of techniques such as particle tracking analysis (PTA), also known as nanoparticle tracking analysis (NTA).<sup>[1]</sup> Due to the fact that the term PTA covers a larger size range and is more generic,<sup>1)</sup> the term PTA is used throughout this document to refer to NTA and PTA.

PTA is based on measuring the diffusion movement of objects (particles, droplets or bubbles) in a dispersion, but can also be used to undertake gravitational migration tracking by means of laser illumination, imaging of scattered light, particle identification and localization, and individual particle tracking.<sup>2)</sup> This document covers two tracking regimes.

— Brownian motion tracking for smaller particles.

— Gravitational fall tracking for larger particles.

In both cases, the suspension is an even dispersion of particles, gas bubbles or other liquid droplets. The hydrodynamic diameter of the individual particles, droplets or bubbles is related to Brownian motion parameters via the Einstein equation and via Stokes law for gravitational migration dynamics.

In recent years, the academic community working in fields such as liposomes and other drug delivery vehicles, nanotoxicology, viruses, exosomes, protein aggregation, inkjet inks, pigment particles, cosmetics, foodstuffs, fuel additives and ultrafine bubbles began using the PTA technology for characterization. ASTM E2834-12 was developed to give guidance to the measurement of particle size distribution by means of NTA. This document aims to broaden the scope of the specification and to introduce system tests for PTA operation as well as to extend the particle size range from nanoscale to microscale sizes. One way to do this is to combine Brownian motion tracking with gravitational migration tracking in the same device on the same sample.

For a number of years, the stakeholders working with nanomaterials safety, regulation, compliance and fundamental research into applications such as biomedicine, catalysis, fuel additives and others were looking for a method (or a combination of methods) for counting and sizing particles in a wide size range (larger than 1 nm to 100 nm). Particle size distributions are often used to evaluate nanomaterials for regulatory purposes (see Reference [41] on the definition of nanomaterial) or for material specification compliance. A number of techniques are available for such characterization, but samples need to be monodisperse. A bigger challenge is to provide an accurate particle count. Techniques such as PTA, electron microscopy, spICP-MS or electrical sensing zone (see ISO 13319-1) allow particle count but have method-specific issues.

One of the key aspects of PTA is the interpretation of data. The key measurand obtained from PTA measurement is the number-based particle size distribution where the size is taken to mean the hydrodynamic diameter of the particles in the sample. The hydrodynamic particle diameters measured with PTA can be different from equivalent particle diameters obtained with different techniques<sup>[3]</sup> such as dynamic light scattering (DLS) (see ISO 22412:2017) or electron microscopy (see ISO 21363 and ISO 19749).

---

1) NTA is the most recognised abbreviation for the technique described in this document. However, PTA includes NTA in its size range of measurements.

2) For the purpose of this document, “tracking” is intended to mean “following in terms of particle’s x and y position”; “track” is defined in 3.32.