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**Particle size analysis — Particle
tracking analysis (PTA) method**

*Analyse granulométrique — Méthode d'analyse de suivi de
particule (PTA)*



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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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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).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html

The committee responsible for this document is Technical Committee ISO/TC 24, *Particle characterization including sieving*, Subcommittee SC 4, *Particle characterization*.

Introduction

Regulatory, scientific and commercial requirements for nanomaterial characterization or characterization of particulate suspensions where particle sizing and counting is required provide a strong case for further development of techniques such as Particle Tracking Analysis (PTA), also known as Nanoparticle Tracking Analysis (NTA) [14]. Due to the fact that the term PTA covers a larger size range and is more generic¹⁾, the term PTA is used throughout this document to refer to NTA and PTA. For all aims and purposes, the term PTA also means NTA in this document.

PTA is based on measuring the diffusion movement of particles in a suspension by means of laser illumination, imaging of scattered light, particle identification and localization, and individual particle tracking²⁾. In this case, 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 Stokes–Einstein equation.

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 fine bubbles began using the PTA technology for characterization. An ASTM standard guide (E2834–12) [10] was developed to give guidance to the measurement of particle size distribution by means of Nanoparticle Tracking Analysis. The present document aims to broaden the scope of the specification and to introduce system tests for PTA operation.

This document outlines the theory and basic principles of the particle tracking analysis method along with its limitations and advantages. It also describes commonly used instrument configurations and measurement procedures as well as system qualifications and data reporting. One of the key aspects is the meaning of the data and its interpretation. It should be noted that the key measurand obtained from PTA measurement is the number-based particle size distribution where the size is taken to mean the hydrodynamic diameter (3.11) of the particles in the sample. This size can be different from other sizes obtained with different techniques such as dynamic light scattering [6] or electron microscopy [4].

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

2) For the purpose of this document “tracking” will mean “following in terms of particle x and y position” and the “track” will mean “the path of that particle defined by such x and y coordinates of each step”

Particle size analysis — Particle tracking analysis (PTA) method

1 Scope

This document describes the evaluation of the number-based particle size distribution in liquid dispersions (solid, liquid or gaseous particles suspended in liquids) using the particle tracking analysis method for diffusion velocity measurements.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1

nanoscale

length range approximately from 1 nm to 100 nm

Note 1 to entry: Properties that are not extrapolations from larger sizes are predominantly exhibited in this length range.

[SOURCE: ISO/TS 80004-1:2015, 2.1]

3.2

nano-object

material with one, two or three external dimensions in the *nanoscale* (3.1)

Note 1 to entry: The second and third external dimensions are orthogonal to the first dimension and to each other.

[SOURCE: ISO/TS 80004-1:2015, 2.5]

3.3

nanoparticle

nano-object (3.2) with all three external dimensions in the *nanoscale* (3.1)

Note 1 to entry: If the lengths of the longest to the shortest axes of the nano-object differ significantly (typically by more than three times), the terms *nanofibre* or *nanoplate* are intended to be used instead of the term nanoparticle.

[SOURCE: ISO/TS 80004-4:2011, 2.4]

3.4

particle

minute piece of matter with defined physical boundaries

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