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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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Contents

	Page
Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols and abbreviated terms	4
5 Principles	4
5.1 General.....	4
5.2 Key physical parameters.....	5
5.3 Detection limits.....	5
5.3.1 Lower size limit.....	5
5.3.2 Upper size limit.....	6
5.3.3 Sample and sampling volume.....	6
5.3.4 Maximum particle number concentration.....	6
5.3.5 Minimum particle number concentration.....	7
5.4 Measurement precision and uncertainties.....	7
5.4.1 General.....	7
5.4.2 Measurement precision.....	7
5.4.3 Size range.....	8
5.4.4 Counting efficiency.....	8
5.4.5 Sizing accuracy.....	9
5.4.6 Size resolution.....	9
6 Apparatus	10
7 Procedure	11
7.1 General.....	11
7.2 Sample preparation.....	12
7.3 Instrument set-up and initialisation.....	12
7.4 Measurement.....	13
7.4.1 Sample delivery.....	13
7.4.2 Sample illumination.....	13
7.4.3 Particle imaging and tracking.....	14
7.4.4 Track analysis.....	14
7.5 Results evaluation.....	14
7.5.1 General.....	14
7.5.2 Particle size evaluation.....	14
7.5.3 Distribution analysis.....	14
7.5.4 Data analysis and reporting.....	14
8 System qualification and quality control	15
8.1 General.....	15
8.2 System installation requirements.....	15
8.3 System maintenance.....	15
8.4 System operation.....	15
8.5 System qualification.....	16
9 Data recording	17
10 Test report	17
Annex A (informative) Theory	20
Annex B (informative) Apparatus settings and best practice	23
Bibliography	25

Foreword

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

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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”