International Standard

ISO 13317-5

First edition
2025-01

Determination of particle size distribution by gravitational liquid sedimentation methods —

Part 5: Photosedimentation techniques

Détermination de la distribution granulométrique par les méthodes de sédimentation par gravité dans un liquide —

Partie 5: Techniques de photosédimentation

Reference number
ISO 13317-5:2025(en)

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Published in Switzerland

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Foreword

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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).

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

A list of all parts in the ISO 13317 series can be found on the ISO website.

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.

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Introduction

The principles of gravitational photosedimentation and its potential use for the granulometric characterization of particle systems have been known for several decades. Recent developments in optoelectronics and data processing have boosted the commercial success and popularity of this measurement technique, which is currently employed in manifold academic and industrial applications.

This document is a part of the ISO 13317 series that provides a general overview on the principles, techniques, methods and underlying physics of particle size analysis by gravitational sedimentation. Photosedimentation employs photometric signals (i.e. transmitted, reflected or scattered light) in order to monitor the changes in the local particle concentration, which arise by the downward or upward particle migration under gravity (called hereafter sedimentation). The temporal or spatial functions of these signals can be directly transformed to distributions of the sedimentation velocity, without referring to model assumptions or being restricted by essential preconditions. Provided the applicability of Stokes' law on particle mobility, one can derive equivalent diameters from the sedimentation velocities (the *Stokes diameter*) and the corresponding particle size distributions. Size fractions are then intrinsically weighted by photometric quantities (e.g. light extinction or scattered light intensity), which is in contrast to the sedimentation techniques described in ISO 13317-2, ISO 13317-3 and ISO 13317-4. However, conversion into volume-weighted distributions is often an integrated part of signal processing, which employs established models for light-particle interactions. A noteworthy feature of gravitational photosedimentation is its ability to finely resolve details in the particle distribution functions. This is related to the physical fractionating of particle systems under gravity and constitutes an advantage compared to spectroscopic ensemble techniques.

Gravitational photosedimentation facilitates the granulometric characterization of dispersed materials of non-zero density contrast to the continuous phase, including solid particles and emulsion droplets. The available measurement range depends on dispersed and continuous phase properties and typically amounts to 200 nm to 100 µm for aqueous samples, whereas the sedimentation velocity can be quantified for the range 0,6 µm/s to 10 mm/s. Also, the working range with regard to particle concentration is strongly affected by material properties and by particle size, yet it is typically well below 1 vol%. The data analysis relies on the assumption that all particles have the same density and comparable shape and do not undergo chemical or physical change in the continuous phase.

In addition, photosedimentation techniques that monitor gravity-induced concentration changes along the complete sample height, e.g. by position-scanning or time-resolved projection, facilitate the characterization of dense dispersion beyond particle size, e.g. with respect to clarification, segregation, agglomeration, consolidation and physico-chemical stability (see ISO/TR 13097). Gravitational photosedimentation is equally applicable in determining particle density (see ISO 18747 series) as well as the formation of sediments and cream layers.

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Determination of particle size distribution by gravitational liquid sedimentation methods —

Part 5: Photosedimentation techniques

1 Scope

This document specifies principles and methods for the use of gravitational photosedimentation techniques for the characterization of dispersed phases of suspensions and emulsions. These techniques monitor the gravity-induced phase separation of particulate materials dispersed in liquids by recording photometric signals (i.e. intensity of transmitted or scattered light) as a function of either vertical position or measurement time, or both.

This document does not cover particle migration by centrifugal, electric or magnetic forces, or sedimentation at high particle concentrations (e.g. zone sedimentation). Moreover, it does not cover the determination of properties other than sedimentation velocity and particle size (i.e. it does not cover particle concentration, particle shape, particle density, zeta-potential or apparent viscosity).

Additionally, this document does not cover alternative techniques for gravitational sedimentation including balance based and X-ray based techniques.

NOTE This document does not purport to address all the safety problems associated with its use.

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 9276-1, *Representation of results of particle size analysis — Part 1: Graphical representation*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
sedimentation
directional motion of *particles* (3.7) in a viscous liquid under the action of gravity or centrifugal fields

Note 1 to entry: For a positive *density contrast* (3.17), sedimentation occurs in the direction of gravitational acceleration; it is counter directed to this acceleration for a negative density contrast.

Note 2 to entry: A downward motion under gravity is also called “settling” or “falling”.

Note 3 to entry: An upward motion under gravity is also called “creaming” (e.g. droplets) or more generally, “rising” or “floating”.

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