PD ISO/TS 5973:2024

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Laser diffraction measurements — Good practice

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Full document details: PD ISO/TS 5973:2024

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This Published Document is the UK implementation of ISO/TS 5973:2024.

The UK participation in its preparation was entrusted to Technical Committee LBI/37, Particle characterization including sieving.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Published by BSI Standards Limited 2024

ISBN 978 0 539 24440 3

ICS 19.120

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 July 2024.

Amendments/corrigenda issued since publication

Date	Text affected

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Technical Specification

ISO/TS 5973

Laser diffraction measurements — Good practice

Mesures par diffraction laser — Bonnes pratiques

First edition
2024-07

Reference number
ISO/TS 5973:2024(en)

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Foreword

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Introduction

The laser diffraction technique has evolved such that it is now a dominant method for determination of particle size distributions (PSDs). The success of the technique is because it can be applied to a wide variety of particulate systems. The technique is fast and can be automated, and a variety of commercial instruments are available. Nevertheless, the proper use of the instrument and the interpretation of the results require caution. ISO 13320 has had multiple revisions to date and covers the principles of the technology and information on evaluating the accuracy of the instrument with a view to qualification. ISO 13320 does not, however, cover the use of the technology on samples in great detail, and therefore, this document is intended to be used in conjunction with ISO 13320, as this document provides practical advice for the measurement of real samples, guidance on obtaining consistent results with good quality data and data interpretation.

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Laser diffraction measurements — Good practice

1 Scope

This document gives guidance on the determination criteria for when laser diffraction is the most appropriate method for the analysis of samples, the appropriate preparation of samples, the verification of the correct functioning of instruments, the interpretation of data, and the assessment of data quality. This document focuses on the practical steps needed to obtain results of good quality, rather than on theoretical considerations, and covers not only the measurement of solid particles (in wet and dry measurement configurations), but also emulsions and bubbles. Result variation expectations of real samples are also considered in this document.

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 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
absorption
reduction of intensity of a light beam not due to *scattering* (3.14)

[SOURCE: ISO 13320:2020, 3.1.1]

3.2
accuracy
closeness of agreement between a test result or measurement result and the true value

Note 1 to entry: In practice, the accepted reference value is substituted for the true value.

Note 2 to entry: The term “accuracy”, when applied to a set of test or measurement results, involves a combination of random components and a common systematic error or bias component.

Note 3 to entry: Accuracy refers to a combination of trueness and *precision* (3.8).

[SOURCE: ISO 3534-2:2006, 3.3.1]

3.3
intermediate precision
precision (3.8) under *intermediate precision conditions/reproducibility conditions* (3.4)

Note 1 to entry: Reproducibility is an alternative term for intermediate precision used in a specific case where a comparison of different instruments in different locations is required.

[SOURCE: ISO 3534-2:2006, 3.3.15, modified — Note 1 to entry has been added.]

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3.4
intermediate precision conditions
<laser diffraction> measurement conditions where independent test results or measurement results are obtained on different laser diffraction instruments and in different test or measurement facilities, with different operators using the same prescribed method

Note 1 to entry: There are four elements to the operating condition: time, calibration, operator and equipment. Tests involving varying the first three are technically intermediate *precision* (3.8) tests, most notably when the operator is changed, however when the equipment location is varied then it is a reproducibility test.

Note 2 to entry: Method transfer between sites is a test of reproducibility. The conditions described above would be termed reproducibility conditions in this case.

[SOURCE: ISO 13320:2020, 3.1.11, modified — the conditions to different equipment and measurement facilities have been expanded.]

3.5
multiple scattering
consecutive *scattering* (3.14) of light by more than one particle, causing a *scattering pattern* (3.15) that is no longer the sum of the patterns from all individual particles

[SOURCE: ISO 13320:2020, 3.1.12]

3.6
transmission
<particle size analysis> fraction of incident light that remains un-attenuated by the particles

Note 1 to entry: Transmission can be expressed as a percentage.

Note 2 to entry: When expressed as fractions, *obscuration* (3.7) plus transmission equals unity.

[SOURCE: ISO 13320:2020, 3.1.29]

3.7
obscuration
fraction of incident light that is attenuated due to extinction [*scattering* (3.14) and/or *absorption* (3.1)] by particles

Note 1 to entry: Obscuration can be expressed as a percentage.

Note 2 to entry: When expressed as fractions, obscuration plus *transmission* (3.6) equals unity.

[SOURCE: ISO 8130-13:2019, 3.1, modified — words “percentage” and “during a laser diffraction measurement” have been removed from the definition and Notes 1 and 2 to entry have added.]

3.8
precision
closeness of agreement between independent test/measurement results obtained under stipulated conditions

Note 1 to entry: Precision depends only on the distribution of random errors and does not relate to the true value or the specified value.

Note 2 to entry: The measure of precision is usually expressed in terms of imprecision and computed as a standard deviation of the test results. Less precision is reflected by a larger standard deviation.

Note 3 to entry: Quantitative measures of precision depend critically on the stipulated conditions. *Repeatability conditions* (3.10) and reproducibility conditions are particular sets of extreme stipulated conditions.

[SOURCE: ISO 3534-2:2006, 3.3.4, modified —"measurement results" has been removed from Note 2 to entry.]

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