# ISO 13318-1:2024-10 (E)

## Determination of particle size distribution by centrifugal liquid sedimentation methods - Part 1: General principles, requirements and guidance

## Contents

Page


**Foreword** ..... **v**

**Introduction** ..... **vi**

**1 Scope** ..... **1**

**2 Normative references** ..... **1**

**3 Terms and definitions** ..... **1**

**4 Symbols and abbreviated terms** ..... **7**

**5 Measurement principle and technical realisations** ..... **10**
5.1 General measurement principle ..... 10
5.2 Technical realisation of sedimentation-based centrifugal measurement techniques ..... 13

**6 Measurement data and basic rules of data evaluation** ..... **15**
6.1 Primary and derived measurands in centrifugal liquid sedimentation ..... 15
6.2 Spatial distribution of particles in centrifugal fields ..... 17
6.3 Determination of distribution functions ..... 18
6.3.1 General remarks ..... 18
6.3.2 Distribution analysis for incremental techniques —homogeneous-start method (HSM) ..... 19
6.3.3 Distribution analysis for incremental techniques — line-start method (LSM) ..... 20
6.3.4 Distribution analysis for integral techniques ..... 21
6.3.5 Conversion with respect to the type of quantity ..... 21
6.3.6 Total quantity of dispersed phase and non-normalised particle size distributions ..... 22
6.3.7 Measurement analysis with respect to sedimentation and diffusion ..... 23
6.4 Deviations from Stokes-based analysis ..... 25
6.4.1 General ..... 25
6.4.2 Upper limit for sedimentation velocity and particle size ..... 25
6.4.3 Lower limits for particle size ..... 26
6.4.4 Limits for particle concentration ..... 27
6.4.5 Handling of porous and heterogeneous particles ..... 27
6.4.6 Handling of non-spherical particles and particle agglomerates ..... 27

**7 Performing size analyses** ..... **28**
7.1 General ..... 28
7.2 Sampling ..... 28
7.3 Continuous phase and primary sample preparation ..... 28
7.4 Secondary sample preparation (sample conditioning) ..... 29
7.5 Instrument preparation ..... 30
7.6 Measurement ..... 30
7.6.1 General procedures for CLS ..... 30
7.6.2 Procedures for homogeneous-start method (HSM) ..... 31
7.6.3 Procedures for line-start method (LSM) ..... 31
7.6.4 Criteria for adjusting the rotational speed ..... 32
7.7 Data analysis ..... 32
7.8 Reporting ..... 33

**8 System qualification and quality control** ..... **34**
8.1 General remarks ..... 34
8.2 Reference materials ..... 35

8.3 Installation, operational and performance qualifications ..... 36
8.4 Sources of measurement uncertainty ..... 36
8.5 Accuracy and measurement of uncertainty of particle velocity and particle size ..... 38
8.6 Combined and expanded uncertainty of particle velocity and particle size measurement (Stokes diameter) ..... 38

**Annex A** (informative) **Particle sizing techniques based on centrifugal liquid sedimentation (CLS)** ..... **41**

**Annex B** (informative) **Remarks on particle density** ..... **44**

**Annex C** (informative) **Sedimentation beyond the validity of Stokes' law** ..... **50**

**Annex D** (informative) **Trueness, reproducibility and uncertainty determination for velocity and particle size** ..... **57**

**Annex E** (informative) **Multiwavelength approach** ..... **62**

**Annex F** (informative) **Spatial distribution of particles in centrifugal fields** ..... **64**

**Annex G** (informative) **Additional particle and dispersion characteristics based on centrifugal sedimentation velocity and sedimentation coefficient** ..... **73**

**Bibliography** ..... **74**