

ISO 13322-2:2021-12 (E)

Particle size analysis - Image analysis methods - Part 2: Dynamic image analysis methods

Contents		Page
Foreword.....		v
Introduction.....		vi
1	Scope	1
2	Normative references	1
3	Terms, definitions and symbols	1
	3.1 Terms and definitions.....	1
	3.2 Symbols.....	5
4	Principle	6
	4.1 Key components of a dynamic image analyser.....	6
	4.2 Illumination.....	8
	4.2.1 Time performance.....	8
	4.2.2 Direction of illumination.....	8
	4.2.3 Spectrum of illumination.....	9
	4.2.4 Stability of the light source.....	9
	4.2.5 Special types of illumination.....	9
	4.3 Particle motion.....	9
	4.4 Particle positioning.....	10
	4.5 Optical system.....	11
	4.5.1 General.....	11
	4.5.2 Lens design.....	11
	4.5.3 Optical magnification.....	11
	4.5.4 Optical resolution.....	12
	4.5.5 Lens errors.....	12
	4.6 Image capture device.....	12
	4.6.1 Matrix camera.....	12
	4.6.2 Line scan camera.....	12
	4.6.3 Exposure time.....	12
	4.6.4 Frame rate/line rate.....	12
	4.6.5 Sensor resolution.....	12
	4.7 Image analysis methods.....	13
	4.7.1 Image analysis process.....	13
	4.7.2 Robustness of the image analysis method.....	13
	4.7.3 Image correction.....	13
	4.7.4 Segmentation methods.....	14
	4.7.5 Particle classification.....	14
	4.8 Conversion to meaningful particle descriptors.....	14
	4.9 Statistical representation of descriptors.....	14
	4.10 Particle dispersion technique.....	15
	4.11 Systematic corrections dealing with set-up characteristics.....	15
5	Operational procedures	15
	5.1 General.....	15
	5.2 Instrument set-up and calibration.....	15
	5.2.1 Preliminaries.....	15
	5.2.2 Site of installation.....	15
	5.2.3 Magnification and sensor resolution.....	15
	5.2.4 Illumination.....	16
	5.2.5 Segmentation.....	17
	5.2.6 Contamination.....	17

5.3	Dispersing systems.....	18
5.3.1	Preliminary considerations.....	18
5.3.2	Particle velocity.....	18
5.3.3	Frame coverage.....	19
5.3.4	Medium.....	19
5.3.5	Homogeneous dispersion and segregation.....	19
5.4	Operational qualification.....	20
5.5	Image enhancement algorithms.....	20
5.6	Measurements.....	20
5.6.1	Particle size and shape.....	20
5.6.2	Pixel to length conversion.....	20
5.6.3	Size class limits.....	21
6	Sample preparation.....	21
6.1	Sample splitting and reduction.....	21
6.2	Touching particles.....	21
6.3	Number of particles to be counted.....	21
7	Accuracy and instrument qualification.....	22
7.1	General.....	22
7.2	Trueness.....	22
7.2.1	General.....	22
7.2.2	Qualification test.....	23
7.2.3	Qualification acceptance.....	23
7.3	Repeatability.....	23
7.3.1	General.....	23
7.3.2	Repeatability test.....	23
7.4	Intermediate precision.....	24
7.4.1	General.....	24
7.4.2	Qualification acceptance.....	24
8	Test report.....	25
8.1	General.....	25
8.2	Sample.....	25
8.3	Dispersion.....	25
8.4	Image analysis instrument.....	25
8.5	Analyst identification.....	26
	Annex A (informative) Theoretical background.....	27
	Annex B (informative) Comparison between particle size distributions by number and by volume.....	30
	Annex C (informative) Recommended particle velocity and exposure time.....	31
	Annex D (informative) Particle diameter dependence on threshold selection.....	34
	Annex E (normative) Requirements for reference material.....	38
	Annex F (informative) Robustness and ruggedness of the image analysis method.....	41
	Annex G (informative) Optional methods.....	44
	Annex H (informative) Typical examples of sample feed and image capture systems.....	45
	Bibliography.....	53