Overview of proposed indoor air quality standard ISO16000-34:
Strategies for the measurement of airborne particles

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DEKATI

World’s best fine particle
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DEKATI Ltd. –Excellence in Particle Measurement

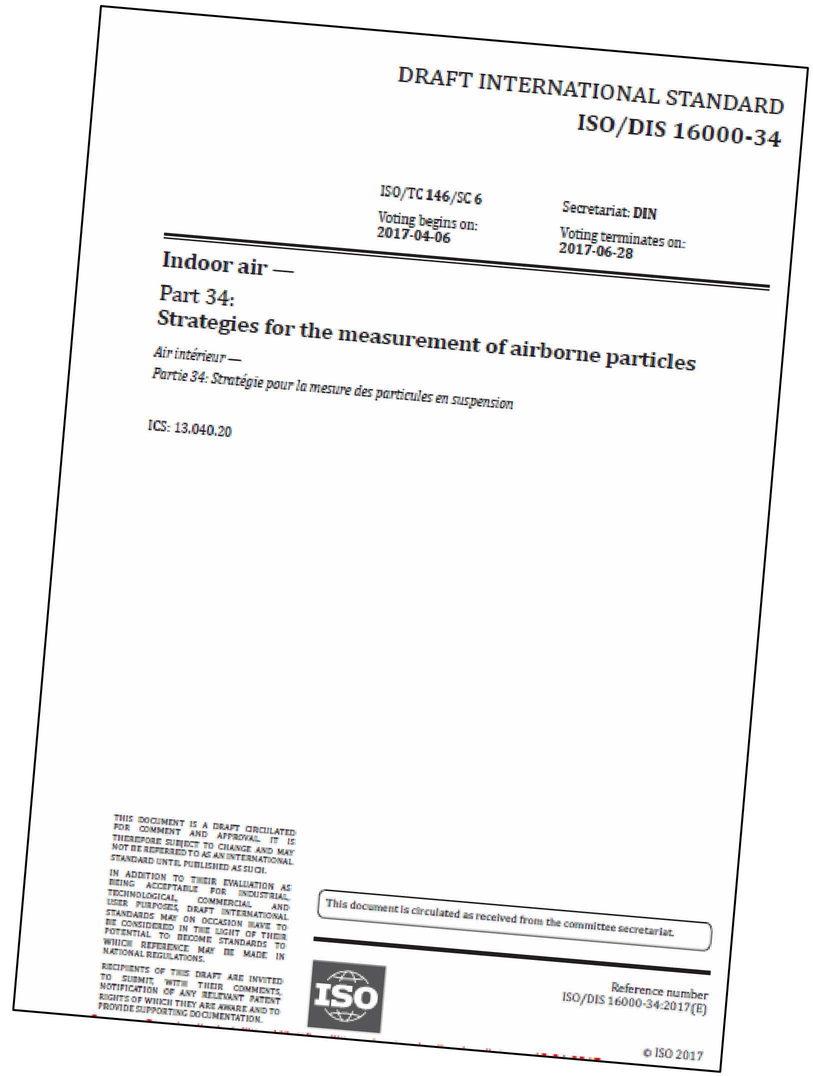
- Sales, manufacturing and development of fine particle (aerosols) measurement solutions (automotive/power plant emissions, pharmaceutical, air quality, nanotechnology, defence, science/R&D etc.)
- Core competence: Real-time fine particle size & concentration measurement and sample conditioning technologies
- Privately owned technology spin-off SME company from TUT Aerosol Physics Lab
- Located in Kangasala Finland
- Distributors in ~35 countries worldwide
- Successful operation for 25 years

Why are aerosol particle standards important?

ISO 16000-34 & 37 indoor air measurement

Work of ISO Technical Committee ISO/TC 146, Air quality, Subcommittee SC 6, Indoor air

- Indoor air — Part 34: General strategies for the measurement of airborne particles (published)
- Indoor air — Part 37: Strategies for the measurement of PM 2.5 (upcoming)



DRAFT INTERNATIONAL STANDARD
ISO/DIS 16000-34

ISO/TC 146/SC 6 | Secretariat: DIN
Voting begins on: 2017-04-06 | Voting terminates on: 2017-06-28

Indoor air —
Part 34:
Strategies for the measurement of airborne particles

Air intérieur —
Partie 34: Stratégie pour la mesure des particules en suspension

ICS: 13.040.20

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ISO

Reference number
ISO/DIS 16000-34:2017(E)

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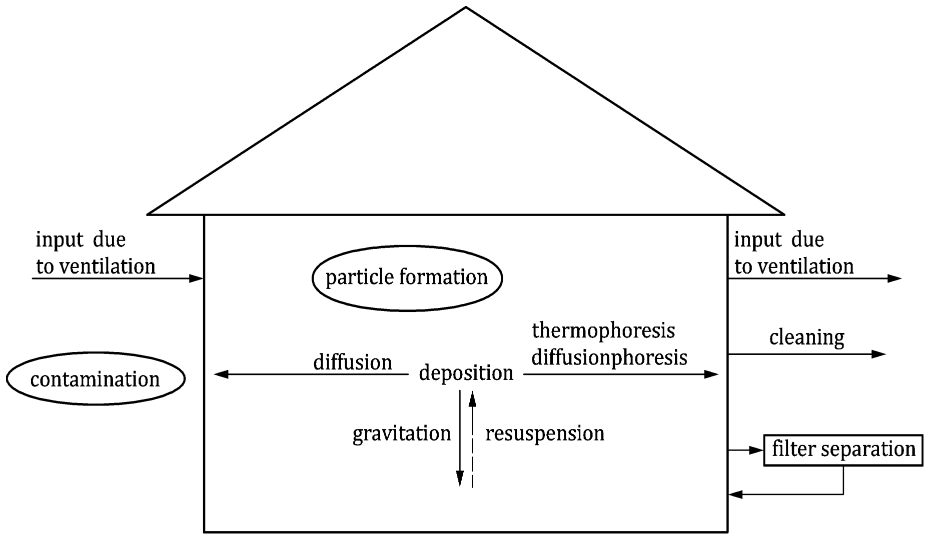
16000-34: what it is

- Determining the concentration of airborne particles indoors from app. 1 nm to 100 um, including PM10, PM2.5 and UFP-fractions
- Describes methods for identifying typical indoor sources
- General recommendations for obtaining representable sample
- Description of varying measurement methods and their advantages and disadvantages
- Giving measurement strategies and reference case studies with more specific sampling recommendations
- Determination of measurement uncertainty and minimum reporting requirements

What it is not

- Not for biological particles
- Not for particles inside automotive cabins or public transportation
- No limit values
- Not a catch –all solution, you have to know what you are doing

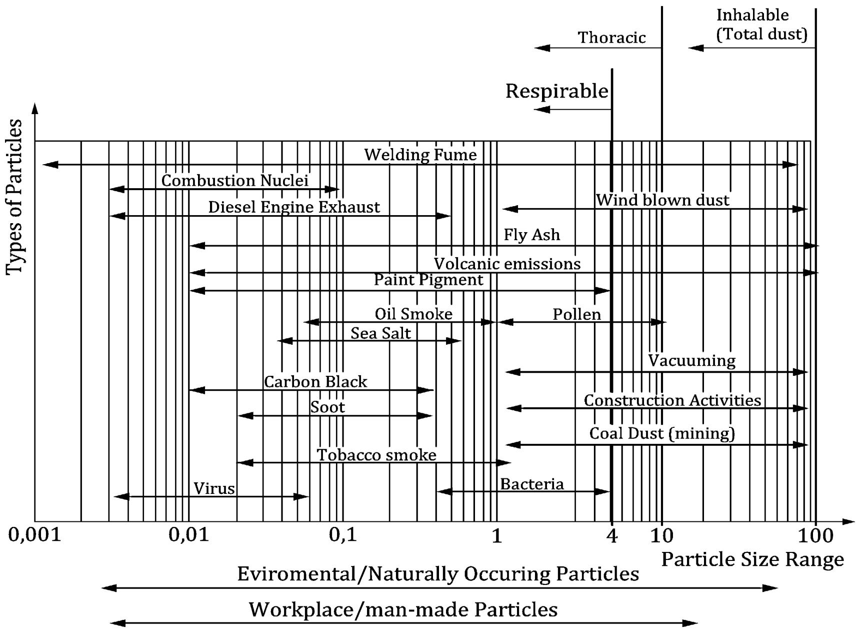
Origin of indoor air particles



Source of indoor particulate matter
Typical indoor sources
Influence of the premises
Particle size range generated by typical sources

Particle dynamics indoor
Particle sinks
Variations of the particle spectrum
Effect of air-conditioning
Conditions of room use

Origin of indoor air particles



- Origin and properties
- Significance for health

Measurands

- PM
- PN
- LDSA
- Surface area
- Volume

Overview of particle measurement methods

			Equivalent Diameter (µm) — no sizing, Electrical Mobility, Inertia, Optical, Aerodynamic Mobility; 0,001 0,01 0,1 1 10 100	Measurand	Lower limit	Upper limit	Sample flow	Typical time resolution	Traceability	Standards: ISO 27891	ISO 15900	ISO 21501-1	ISO 29904 TR 27628	ISO 11801	ISO TR 25597 ISO TR 13271	EN 12341
Physical particle size separator	Fine particles	Cyclone		SD	1 $\mu g/m^3$	< 100 mg/m^3	1 - 20 l/min									
		Impactor		SD	0,1 $\mu g/m^3$	< 2,5 mg/m^3	< 30 l/min		X				X		X	X
	Fine and ultrafine particles	LPI		SD	0,1 $\mu g/m^3$	< 2,5 mg/m^3	< 30 l/min									
		MOI		SD	0,1 $\mu g/m^3$	< 2,5 mg/m^3	≈ 30 l/min									
		DMA		SD	< 100 cm^{-3}	E7 cm^{-3}	> 10 l/min		X	X	X					
		AMS		SD	< 100 cm^{-3}	E7 cm^{-3}	> 5 l/min									
Collection on media (Low time resolution)	Gravemetry	AMM		MC	0,1 $\mu g/m^3$	< 100 mg/m^3 [b]	≈ 1 - 3 m^3/h	1 h - 24 h	X							
		OMB		MC	0,1 $\mu g/m^3$	< 100 mg/m^3	≈ 3 l/min	1 h - 24 h	X				X	X		
	attenuation	BRA		MC	0,1 $\mu g/m^3$	< 1 mg/m^3	≈ 20 l/min	1 h - 24 h	X					X		
	microscopy	OM		SD	0,1 $\mu g/m^3$	< 100 mg/m^3	≈ 1 - 3 m^3/h	1 h - 24 h								
		SEM		SD	0,1 $\mu g/m^3$	< 100 mg/m^3	≈ 1 - 3 m^3/h	1 h - 24 h								
		TEM		SD	0,1 $\mu g/m^3$	< 100 mg/m^3	≈ 1 - 3 m^3/h	1 h - 24 h								
High time resolution aerosol measurement	Individual particle analysis	LSAS		NC, SD	> 1 cm^{-3}	E7 cm^{-3}	< 5 l/min	> 5 s	X			X				
		TOF AS		NC, SD	> 1 cm^{-3}	E7 cm^{-3}	< 1 l/min	> 1 s								
		CPC		NC	0,1 cm^{-3}	E5 cm^{-3}	< 1,5 l/min	1 s	X	X	X					
		UF CPC		NC	0,1 cm^{-3}	E5 cm^{-3}	< 1,5 l/min	1 s	X	X	X					
		CPC with SES		NC	0,1 cm^{-3}	E5 cm^{-3}	< 1,5 l/min	2 s		X	X					
		LSAS+DMA+CPC		NC, SD	> 1 cm^{-3}	E7 cm^{-3}	< 1,5 l/min	> 5 s		X	X	X				
	Integral or accumulative particle analysis	CPC photometric mode		NC	0,1 cm^{-3}	E8 cm^{-3}	< 1,5 l/min	1 s								
		FCAE		NC	≈ 375 cm^{-3} [a]	≈ E7 cm^{-3} [a]	< 5 l/min	1 s	X	X						
		DMA+CPC		NC, SD	< 100 cm^{-3}	E7 cm^{-3}	< 1,5 l/min	≈ 60 s	X	X	X					
		DMA+FCAE		NC, SD	≈ 1 000 cm^{-3}	E7 cm^{-3}	< 5 l/min	≈ 60 s	X	X						
		AMS+CPC		NC, SD	< 100 cm^{-3}	E7 cm^{-3}	≈ 1,5 l/min	> 1 s								
		AMS+FCAE		NC, SD	≈ 1 000 cm^{-3}	E7 cm^{-3}	≈ 1,5 l/min	≈ 60 s								
		FRAS		NC, SD	< 100 cm^{-3}	E7 cm^{-3}	≈ 10 l/min	1 s								
		LPI+E		NC, SD	≈ 375 cm^{-3} [a]	≈ E7 cm^{-3} [a]	< 10 l/min	1 s								
		MOI+OMB		NC, SD	≈ 40 $\mu g/m^3$	< 2,5 mg/m^3	≈ 10 l/min	5 min								

Description of measurement method

- Measurand
- Size range
- Concentration range
- Time resolution
- Operation principle
- Advantages and disadvantages
- Related standards

Protocol example

Annex A
(normative)

Protocol for the measurement of indoor airborne particles

For later assessment of the measurement results, it is mandatory to document accurately the conditions under which sampling took place. The protocol shown in Table A.1 summarizes the information required for assessing the results. Where necessary and justified, certain parts of this scheme may be omitted or others added to it. Table A.1 shall be added to the final report to allow a better understanding of the measurement premise.

Table A.1 — Example of survey

1	**Reason for the measurement**	**Note**
	Compliance with specified assessment values needs to be investigated	
	Fine dust sources indoors need to be detected/identified	
	The effectiveness of a clean-up needs to be checked	
2	**Details of the measurement**	
	Job or sample number	
	Particle fraction(s) to be measured	
	Start of measurement/sampling (date/time)	
	End of measurement/sampling (date/time)	
3	**Sampling/measurement method**	

GENERAL SAMPLING RECOMMENDATIONS

- Instrumentation and sampling system
- Measurement location
- Measurement time and duration
- Estimated concentration scale (minimum, maximum accuracy)
- Background concentration
- Impact of outdoor air quality
- Impact of room conditions
- Impact of the measurement itself

ISO 16000-37: Indoor air — upcoming
Part 37: Strategies for the measurement of PM 2.5

- Specifies measurement methods for indoor PM2.5
- Reference method = gravimetrical filter + pre-separator impactor
- Follows EN 12341 (ambient EU PM2.5-standards)
  - Few differences (pre-preparation, time of sampling, parallel measurement)
- NO equivalent method approval !
- Gives procedures for parallel real-time measurement to supplement gravimetrical results
  - Cannot replace gravimetrical
  - Cannot be used for correlation to gravimetrical

Future

- Comprehensive overview and guidance on indoor air ultrafine and nanoparticle measurement methods and protocols
  - recommendations for the instrumentation, uncertainty evaluation, quality assurance and typical cases of reference studies
  - Impact to the PM and PN measurements in indoors
  - Gives unified structure and best practises for particle measurements
- 16000-37: PM vs real-time parallel measurement
  - Comparison with ambient PM 2.5 now easier
  - Indoor/outdoor ratio measurement

Happy to provide related instruments for you

Thank you for your attention!

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