



Standard Practice for Calibration of an Airborne Particle Counter Using Monodisperse Spherical Particles¹

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1. Scope

1.1 This practice covers procedures for calibrating and determining performance of an optical discrete airborne particle counter (DAPC) when presented with a challenge aerosol of near-monodisperse spherical particles. The practice is directed towards determination of accuracy and resolution of the DAPC for particles which have entered the sampling inlet of the DAPC. Consideration of inlet sampling efficiency is not part of this practice.

1.2 The procedures covered here include inlet sample flow rate, zero count level, particle sizing accuracy, particle sizing resolution, particle counting efficiency, and particle concentration limit.

1.3 The particle size parameter that is reported is the equivalent optical diameter based on projected area of a particle of known refractive index which is suspended in air. The minimum diameter that can be reported by a DAPC is normally specified by the manufacturer and the maximum diameter that can be reported for a single sample is determined by the dynamic range of the DAPC being used. Typical minimum diameters are in the range from approximately 0.05 μm to 0.5 μm and a typical dynamic range specification will be between 10 to 1 and 50 to 1.

1.4 The counting rate capability of the DAPC is limited by temporal coincidence for the specific instrument and by the maximum counting rate capability of the electronic sizing and counting circuitry. Coincidence is defined as the simultaneous presence of more than one particle within the DAPC optically defined sensing zone at any time. The coincidence limit is a statistical function of the airborne particle concentration and the sensing zone volume (1).² This limitation may be modified by the presence of particles with dimension so large as to be a significant fraction of the sensing zone dimension (2).³ The

saturation level or maximum counting rate of the electronic counting circuitry shall be specified by the manufacturer and is always greater than the DAPC counting rate for the challenge aerosol used for any portion of this practice.

1.5 Calibration in accordance with all parts of this practice may not be required for routine field calibration of a DAPC unless significant changes have been noted in operation of the DAPC or major DAPC component repairs or replacements have been made. In that situation, the DAPC should be taken to a suitable metrology facility for complete calibration, following necessary repairs or modifications. Normally, the routine field calibration may consist of determination of inlet flow rate, zero count level, and particle sizing accuracy. The DAPC functions to be calibrated shall be field or metrology facility calibrations shall be determined by agreement between purchaser and user, but shall not exceed 12 months, unless DAPC stability for longer periods is verified by measurements in accordance with this practice.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

D 1193 Specification for Reagent Water⁴

D 1356 Terminology Relating to Sampling and Analysis of Atmospheres⁵

E 20 Practice for Particle Size Analysis of Particulate Substances in the range of 0.2 to 75 μm by Optical Microscopy⁶

D 3195 Practice for Rotameter Calibration⁵

2.2 U.S. Federal Standard:

U. S. Federal Standard 209E, Airborne Particulate Cleanliness Classes in Cleanrooms and Clean Zones⁷

2.3 Japanese

¹ This practice is under the jurisdiction of ASTM Committee E29 on Particle and Spray Characterization and is the direct responsibility of Subcommittee E29.02 on Non-Sieving Methods.

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² Jaenicke, R., "The Optical Particle Counter: Cross Sensitivity and Coincidence: Journal of Aerosol Science Vol. 3, 1972, pp. 95-111.

³ Knapp, J.Z. and Abramson, L.R., "A New Coincidence Model for Single Particle Counters. I. Theory and Experimental Verification" *Journal of Pharmaceutical Science and Technology*, Vol. 48, 1994, pp. 255-294.

⁴ *Annual Book of ASTM Standards*, Vol 11.01.

⁵ *Annual Book of ASTM Standards*, Vol 11.03.

⁶ *Annual Book of ASTM Standards*, Vol 14.02.

⁷ Available from U.S. General Services Administration, Federal Supply Service Standardization Division, Washington, DC 20406.