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English Version

**Workplace atmospheres - Calculation of the health-related
aerosol fraction concentration from the concentration measured
by a sampler with known performance characteristics**

Atmosphères des lieux de travail - Calcul de la
concentration en fractions d'aérosols liées à la santé à
partir de la concentration mesurée à l'aide d'un dispositif de
prélèvement ayant des caractéristiques de performances
connues

Arbeitsplatzatmosphäre - Berechnung der
gesundheitsbezogenen Fraktion der Aerosolkonzentration
anhand der mit einem Probenahmegerät mit bekannten
Leistungseigenschaften gemessenen Konzentration

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Contents

Page

Foreword.....	3
Introduction	4
1 Scope	5
2 Normative references	5
3 Method to produce improved concentration data	5
4 Data needed to calculate the concentration of a health-related aerosol fraction	6
5 Calculation method	6
Annex A (informative) Numerical example of calculation	9
Annex B (informative) Field sampling example	12
Bibliography	14

Foreword

This document (CEN/TR 15547:2007) has been prepared by Technical Committee CEN/TC 137 "Assessment of workplace exposure to chemical and biological agents", the secretariat of which is held by DIN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

Introduction

Exposure assessment of workers to particulate matter dispersed into the air at the workplace is generally achieved through aerosol sampling by using instruments designed for measuring health-related aerosol fractions as defined in EN 481. EN 13205 gives a methodology to evaluate sampler performance. The knowledge of the sampling efficiency of a sampler is used to calculate the bias and the accuracy in concentration for log-normally distributed aerosols. Bias and accuracy maps give an overall indication on sampler performance when sampling health-related aerosol fractions. This performance varies with particle size distribution of sampled aerosol.

Many different samplers can be used for the same purpose, depending on local circumstances or the current practice in the country where these measurements have to be performed. Even with samplers whose performances are quite similar, some significant differences in measured concentrations can occur between these samplers, depending on the aerosol measured. Furthermore, the concentration measured by a sampler is not actually the conventional concentration even if the sampler fulfils the performance criteria stated in EN 13205. This is due to the fact that the particle-size selectivity of the sampler does not generally coincide exactly with the conventional sampling curve over the whole particle-size range.

In the revision of EN 482 presently under way, the uncertainty estimate of a measurement procedure should be expanded to meet the requirements of ENV 13005 complying with GUM (ISO Guide to the expression of Uncertainty in Measurements). This requires that all uncertainties encountered by the use of a measurement procedure (except interlaboratory variation) have to be accounted for. For the special case of aerosol sampling this means that the uncertainty in an expected bias of the sample due to non-ideal collection characteristics will only be estimated for a very wide range of size distributions. The calculations presented in this Technical Report can help to significantly reduce this uncertainty by first estimating a restricted range of size distributions in which the sampler was actually used, and then estimate the bias uncertainty only over this narrow range of size distributions. For an aerosol sampler, the variability due to bias is in many cases a major component of the uncertainty.

1 Scope

This Technical Report specifies a method for calculating and expressing the relevant aerosol fraction concentration and its confidence interval, rather than the actually measured concentration. This can be done for any sampler satisfying EN 13205:2001, Annex A.

The calculation method follows the way developed and described in EN 13205:2001, Annex A and Annex F. This Technical Report explains practically how to perform the calculation.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references the latest edition of the referenced document (including any amendments) applies.

EN 13205:2001, *Workplace atmospheres — Assessment of performance of instruments for measurement of airborne particle concentrations*.

3 Method to produce improved concentration data

The method is based on the knowledge of sampler's particle size-selectivity and the estimation of the aerosol size distribution. The results with lowest uncertainty are obtained when the concentration measurements are accompanied by measurement of aerosol size distribution. When the size distribution is not known, an estimate can be used. The accuracy of this estimation will have a direct influence on the confidence interval of the concentration value. The estimation of particle size distribution is not an easy exercise, however in many cases the knowledge of the aerosol nature (mineral dust, fumes, oil mists, etc.) allows an approximate estimation to be made.

This approach facilitates a comparison measured health-related aerosol concentrations obtained in different European countries, whatever the samplers used.

The method cannot be used to calculate the respirable aerosol fraction from the thoracic aerosol fraction, or vice versa.

Using the aerosol concentration measured by a sampler and the information provided by the application of EN 13205, it is possible to calculate the concentration of the aerosol conventional fraction of interest and therefore to assess the exposure as mentioned in EN 689 independently of the sampler used. This calculation method leads to less bias relative to the intended conventional health-related aerosol fraction (see [1]).

Using the calculation described in this document is not compulsory. However, there are several circumstances when using the proposed method could help to obtain higher quality results from routine aerosol measurements. Of course, there is no need to use this calculation when the selectivity of the aerosol sampler meets exactly the conventional target curve, i.e. its performance is ideal for all particle sizes.

More accurate values of aerosol concentrations related to some conventional fraction can be needed in some special cases:

- in epidemiological studies consistent exposure data from old and recent periods of time are simultaneously required in order to be correlated with human health effects;
- when data from various sampling techniques and different countries need to be interpreted. The proposed method helps to make the results of measurements more consistent by recalculating them in terms of concentrations of the relevant health-related aerosol fraction. The method allows a comparison of exposures measured at different times and work places provided the performances of the samplers used are known.