
**Air quality — Assessment of uncertainty of
a measurement method under field
conditions using a second method as
reference**

*Qualité de l'air — Évaluation de l'incertitude d'une méthode de mesurage
sur site en utilisant une seconde méthode comme référence*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 13752 was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 4, *General aspects*.

Annexes A, B and C of this International Standard are for information only.

Introduction

Performance characteristics for air quality measuring methods are defined in ISO 6879. Corresponding test procedures are given in ISO 9169 except for accuracy, which is dealt with in this International Standard as measurement uncertainty following the concepts of the *Guide to the expression of uncertainty in measurement* [5].

The measurement uncertainty under field conditions is also covered in ISO 7935 and ISO 10849. However, the procedure given in these International Standards is limited to either the determination of a concentration-independent systematic deviation, assuming a concentration-independent dispersion, or a concentration-proportional systematic deviation, assuming a concentration-proportional dispersion.

Air quality — Assessment of uncertainty of a measurement method under field conditions using a second method as reference

1 Scope

This International Standard specifies a method for assessing the measurement uncertainty of a calibrated measurement method (test method) applied under field conditions using a second method as a reference (reference method). The reference method may not necessarily be a legally prescribed measurement method. The measurement uncertainty is derived from measurements made in parallel on real samples by comparing the measured values of the test method with those of the reference method. The result is only valid within the range of the measurements obtained. The test is designed especially for method validation.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 6879:1995, *Air quality — Performance characteristics and related concepts for air quality measuring methods*.

ISO 9169:1994, *Air quality — Determination of performance characteristics of measurement methods*.

3 Symbols and abbreviated terms

For the purposes of this International Standard, the following symbols and abbreviated terms apply.

a_0, a_1, a_2	coefficients of the variance function
AQC	Air Quality Characteristic (usually concentration)
b_0, b_1	coefficients of the linear regression function or calibration function
F	F statistic
k	coverage factor
L	likelihood
$\ln$	logarithmic likelihood
N, N_1, N_2	number of pairs (x_i, y_i) and number of pairs of subpopulation 1 and 2 respectively

$P(y_i)$	probability of y_i
r_i	residual at x_i
s, s_i	standard deviation as a function of AQC and at value x_i of AQC respectively
s'	transformed standard deviation as a function of AQC
s_{a0}, s_{a1}, s_{a2}	standard deviation of a_0, a_1 and a_2 respectively
s_{b0}, s_{b1}	standard deviation of b_0 and b_1 respectively
s_x, s_y	standard deviation of all values x_i and y_i respectively
$s_{y\text{cor}}$	standard deviation of the measured y -value after correction for the systematic error (bias)
$s_{\Delta y}$	standard deviation (uncertainty) of the systematic error (bias)
U	expanded uncertainty (coverage factor $k = 2$) as a measure of measurement uncertainty
X	variable of x -method
x, x_i	value of AQC and i -th value of AQC respectively
x'_i	transformed value x_i
$\bar{x}, \bar{x}_w, \bar{y}$	mean and weighted mean of all values x_i and mean of all values y_i respectively
Y	variable of y -method
y_i	measured value of y -method at x_i or output value of y -method at x_i
y'_i	transformed value y_i
$\hat{y}$	estimated value of Y at value x of AQC
$\hat{y}_i$	estimated value of Y at value x_i of AQC
y_{cor}	measured value of the y -method after correction for the systematic error (bias)
Δy	systematic error (bias) at value x of AQC
ε	random number from normal distribution with central value 0 and standard deviation 1
ω_i	weighting factor at x_i

4 Principle

A number N of pairs of measured values $[(x_1, y_2), \dots, (x_N, y_N)]$ are obtained from parallel field measurements. The measured values from the reference method (x -method) are considered as true values. The difference between the values of a measurement pair is attributed to measurement deviation of the test method (y -method).

It is assumed that there is a linear relationship between the X and Y variable estimated by:

$$y = b_0 + b_1 x \quad \dots(1)$$