SLOVENSKI STANDARD
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[Not translated]

Water quality - General requirements and performance test procedures for water monitoring equipment - Automated measuring devices

Wasserbeschaffenheit - Allgemeine Anforderungen und Verfahren zur Prüfung der Leistungsfähigkeit für Geräte zum Wassermonitoring -Automatische Messgeräte

Qualité de l'eau - Exigences générales et modes opératoires d'essai de performance pour les équipements de surveillance de l'eau - Dispositifs de mesure automatiques

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Water quality - General requirements and performance test procedures for water monitoring equipment - Measuring devices

Qualité de l'eau - Exigences générales et modes opératoires d'essai de performance pour les équipements de surveillance de l'eau - Dispositifs de mesure automatiques

Wasserbeschaffenheit - Allgemeine Anforderungen und Testverfahren zur Leistungsprüfung von Geräten zum Wassermonitoring - Messgeräte

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (prEN 17075:2017) has been prepared by Technical Committee CEN/TC 230 "Water analysis", the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

Introduction

This European standard defines general requirements and test procedures for verifying the performance of measuring devices (MDs) used to monitor the quality of a wide range of waters including drinking waters, waste waters, and natural waters. It covers both portable measuring devices (PMDs) and fixed position measuring devices (FMDs). These devices include: sensors, single and multi-parameter instruments, discrete and batch instruments, probes and sondes. It excludes chemical test kits. For the purposes of this standard the acronym MD(s) is used except where it is necessary to be specific about the particular type (e.g. PMDs, FMDs) or component of a MD (e.g. sensor).

This European standard is associated to EN 16479 which covers automated sampling devices (samplers) for water and waste water.

The general requirements include several features that are necessary to meet users' applications and information that has to be included in associated documents.

The performance tests comprise testing carried out under laboratory and field conditions They are designed to determine, in a systematic and consistent way, the capability of MDs to make reliable measurements. The testing focuses on key performance characteristics. Statistical procedures are defined for evaluation of the test data.

The range of measurements over which the test procedures will be applied, the test range, is not specified. It is for the MD manufacturer to decide on the test range. Similarly, it is for the MD manufacturer to decide on the intended uses (applications) which will inform the design of the field trial.

Water monitoring equipment is widely used for compliance monitoring purposes under national and European regulations. This European Standard supports the requirements of the following EU Directives:

— industrial Emissions Directive (2010/75/EU) [1];

— water Framework Directive (2000/60/EC) [2];

— marine Strategy Framework Directive (2008/56/EC) [3];

— technical specifications for chemical analysis and monitoring of water status (2009/90/EC) [4].

1 Scope

This European Standard specifies general requirements and performance test procedures for portable and fixed position measuring devices (MDs) that are used in an in-line or online operating position to measure physical and chemical determinands in water. It excludes at-line devices, such as chemical test kits, and off-line devices, such as laboratory analysers.

The general requirements include functional facilities that MDs need to meet users' applications and information that need to be included in associated documents.

The test procedures specify uniform methods to be used when determining key performance characteristics of MDs. The performance tests comprise testing carried out under laboratory and field conditions.

Statistical procedures are defined for evaluation of the test data. It is recognized that for some devices certain test procedures are not applicable.

Example values for performance characteristics for a selection of MDs for monitoring waste water effluents and receiving waters are detailed in Annex A for guidance.

This European Standard requires the manufacturer of a MD to provide more technical data for verification than does EN ISO 15839:2006 [5]. Consequently, EN ISO 15839 will be of greater assistance to manufacturers wishing to characterize a new device whereas this European Standard is more focussed on user requirements for the verification of manufacturer's claims.

2 Normative references

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

EN ISO 5814:2012, *Water quality - Determination of dissolved oxygen - Electrochemical probe method (ISO 5814:2012)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
measuring device
MD
device, used in an in-line or on-line operating position, which continuously (or at a given frequency) gives an output signal proportional to the value of one or more determinands in waters which it measures

Note 1to entry: The device can be portable or fixed in position.

Note 2 to entry: The term "on-line measuring device" is often used for a MD used in an online position.

[SOURCE: EN ISO 15839:2006, 3.26, modified]

3.2
portable measuring device
PMD
measuring device that can be moved from one measuring point to another and used in an in-line or on-line operating position

3.3
fixed measuring device
FMD
measuring device that can be fixed in position and used in an in-line or on-line operating position

3.4
sensor
electronic device that senses a physical condition or chemical compound and delivers an electronic signal proportional to the observed characteristic

[SOURCE: ISO/IEC 19762:2016, 06.02.08]

3.5
in-line measuring device
***in situ* measuring device**
system of automatic measurement in which at least the sensor is sited in the body of water

[SOURCE: ISO 6107-2:2006]

3.6
on-line measuring device
system of automatic measurement in which the sample is taken from the body of water through a probe to the measuring device by means of an appropriate conduit

Note 1 to entry: Sometimes referred to as an extractive measuring device.

[SOURCE: ISO 6107-2:2006+A1:2012, 71]

3.7
percentage error
error in measurement expressed as a percentage of the reference value

Note 1 to entry: Percentage error is calculated using the following equation:

$$x_j = \frac{measured\ value - reference\ value}{reference\ value} \times 100 \tag{1}$$

3.8
bias
estimate of a systematic measurement error

[SOURCE: ISO/IEC Guide 99:2007, 2.18]

3.9
repeatability
measurement repeatability
precision under a set of repeatability conditions of measurement

[SOURCE: ISO/IEC Guide 99, 2.21]

Note 1 to entry: In this standard the ability of a MD to provide closely similar indications for repeated applications of the same determinand under the same conditions of measurement

3.10
limit of quantification
LOQ
stated multiple of the limit of detection, for example two or three times the limit of detection, at a concentration of the determinand that can reasonably be determined with an acceptable level of accuracy and precision

Note 1 to entry: Limit of quantification can be calculated using an appropriate standard or sample, and may be obtained from the lowest calibration point on the calibration curve (excluding the blank). See ISO 6879 [11].

[SOURCE: ISO 6107-2:2006+A1:2012, 61]

3.11
linearity
degree to which there is a straight-line relationship between the (mean) result of measurement (signal) and the quantity (concentration) of the component to be determined

[SOURCE: EN ISO 11885:2009, 3.9, modified]

3.12
drift
slow change of output, at a constant input, of a measuring system

[SOURCE: ISO 15796:2005, 2.8]

3.13
response time (t90)
time interval between the instant when a continuous measuring device is subjected to an abrupt change in determinand value and the instant when the readings cross the limits of (and remain inside) a band defined by the 90 % and the 110 % of the difference between the initial and final value of the abrupt change

[SOURCE: EN ISO 15839:2006, 3.3, modified]

Note 1 to entry: In laboratory testing, the response time of the measuring device is measured.

3.14
performance characteristics
set of parameters describing the performance of a MD

[SOURCE: EN ISO 15839:2006, 3.27]

3.15
measurement uncertainty
uncertainty of measurement
uncertainty
non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used

Note 1 to entry: The parameter may be, for example, a standard deviation called standard measurement uncertainty(or a specified multiple of it), or the half-width of aninterval, having a stated coverage probability.

Note 2 to entry: In general, for a given set of information, it is understood that the measurement uncertainty is associated with a stated quantity value attributed to the measurand. A modification of this value results in a modification of the associated uncertainty.

Note 3 to entry: Measurement uncertainty includes components arising from systematic effects, such as components associated with corrections and the assigned quantity values of measurement standards, as well as the definitional uncertainty. Sometimes estimated systematic effects are not corrected for but, instead, associated measurement uncertainty components are incorporated.

Note 4 to entry: Measurement uncertainty comprises, in general, many components. Some of these may be evaluated by Type A evaluation of measurement uncertainty from the statistical distribution of the quantity values from series of measurements and can be characterized by standard deviations. The other components, which may be evaluated by Type B evaluation of measurement uncertainty, can also be characterized by standard deviations, evaluated from probability density functions based on experience or other information.

[SOURCE: ISO/IEC Guide 99:2007, 2.26]

3.16
combined performance characteristic
combination of individual performance characteristics expressed as an expanded measurement uncertainty (with a coverage factor of 2)

3.17
standard measurement uncertainty
standard uncertainty of measurement
standard uncertainty
measurement uncertainty expressed as a standard deviation

[SOURCE: ISO/IEC Guide 99:2007, 2.30]

3.18
expanded measurement uncertainty
expanded uncertainty
product of a combined standard measurement uncertainty and a factor larger than the number one

Note 1 to entry: Expanded measurement uncertainty is termed“ overall uncertainty” in paragraph 5 of RecommendationINC-1 (1980) (see the GUM) and simply “uncertainty” in IEC documents.

Note 2 to entry: The factor depends upon the type of probabilitydistribution of the output quantity in a measurementmodel and on the selected coverage probability.

Note 3 to entry: The term “factor” in this definition refers to acoverage factor.

[SOURCE: ISO/IEC Guide 99:2007, 2.35]

3.19
measurement error
error
error of measurement
measured quantity value minus a reference quantity value

Note 1 to entry: The concept of 'measurement error' can be used both

a) when there is a single reference quantity value to refer to, which occurs if a calibration is made by means of a measurement standard with a measured quantity value having a negligible measurement uncertainty or if conventional quantity value is given, in which case the measurement error is known, and

b) if a measurand is supposed to be represented by a unique true quantity value or a set of true quantity values of negligible range, in which case the measurement error is not known.

Note 2 to entry: Measurement error should not be confused with production error or mistake.

[SOURCE: ISO/IEC Guide 99:2007, 2.16]

3.20
test range
range of measurements over which the MD is tested

3.21
output
reading, or a digital, analogue or wireless electrical signal, generated by a MD in response to a determinand

3.22
rated operating conditions
operating condition that must be fulfilled during measurement in order that a measuring instrument or measuring system perform as designed

Note 1 to entry: Rated operating conditions generally specify intervals of values for a quantity being measured and for any influence quantity.

[SOURCE: ISO/IEC Guide 99:2007, 4.9]

3.23
interferent
physical, biological or chemical property of the sample, excluding the determinand, that affects the output signal

[SOURCE: EN ISO 15839:2006, 3.16, modified]

3.24
adjustment of a measuring system
adjustment
set of operations carried out on a measuring system so that it provides prescribed indications corresponding to given values of a quantity to be measured

Note 1to entry: Types of adjustment of a measuring system include zero adjustment of a measuring system, offset adjustment, and span adjustment (sometimes called gain adjustment)

Note 2 to entry: After an adjustment of a measuring system, the measuring system usually needs to be recalibrated.

Note 3 to entry: Adjustment of a measuring system should not be confused with calibration, which is a prerequisite for adjustment.

[SOURCE: ISO/IEC Guide 99:2007, 3.11]

3.25
reference method
method, material or device to be used to obtain the determinand value of the test waters, against which the readings from the MD under test can be compared

3.26
determinand
property/substance that is required to be measured

[SOURCE: EN ISO 15839:2006, 3.13, modified]

3.27
reference operating condition
operating condition prescribed for evaluating the performance of a measuring instrument or measuring system or for comparison of measurement results

[SOURCE: ISO/IEC Guide 99:2007, 4.11]

3.28
flow cell
housing within which a sensor can be held and through which the test water can be directed

3.29
up-time
fraction of the total time for which usable measuring data are available from the MD

3.30
warm-up period
interval between switching on power to the measurement circuit and the instant when the PMD produces a stable value when measuring a stable solution

4 Symbols

For the purposes of this document, the following symbols apply.

b Bias

$t90$ Response time

X_L Error due to variations in linearity

S_r Repeatability

X_{IN} Error due to variations in interferents

X_{SC} Error due to incorrect salinity compensation

X_{LX} Error due to variations in incident light

X_T Error due to variations in ambient temperature

X_{RH} Error due to variations in relative humidity

X_{ST} Error due to variations in sample temperature

X_{SQ} Error due to variations in sample flow-rate

X_{SP} Error due to variations in sample pressure

X_O Error due to variations in output impedance

X_V Error due to variations in supply voltage

X_D Error due to variations in drift

W_D Warm–up drift

U_C Combined performance requirement

5 Principles

The general requirements are based on experience of users' needs when operating a MD in online or in-line measuring positions in a range of applications.

The performance characteristics are parameters that identify the capability of a MD to provide reliable measurements. They are determined as measurement uncertainty and expressed as percentage error (see 3.7) except for bias and repeatability which are expressed as relative values in percentage. For low concentration measurements where the reading approaches zero the percentage error value becomes inapplicable. At low concentrations the uncertainty should be expressed as an absolute value. The tables at Annex A list example values relevant to monitoring waste water effluents and receiving waters.

Measurement reliability includes:

— the MD's measurement bias, LOQ, linearity, drift, repeatability and response time;

— operational influences arising from variations in supply voltage, output impedance, sample temperature, sample flow-rate and sample pressure;

— environmental influences arising from variations in ambient temperature, relative humidity, interferents and incident light.

The overall measurement reliability of a MD is captured by bringing the individual performance characteristics together in the form of a combined performance characteristic expressed as measurement uncertainty.

The laboratory performance tests are designed to determine the values for the specified performance characteristics in a systematic and consistent way. Laboratory testing is used to determine each performance characteristic in turn in a highly controlled environment.

Statistical procedures are defined for evaluation of the laboratory test data to produce the individual performance characteristic measurement uncertainties, u, and the combined performance characteristic measurement uncertainty, U_C. They are based on the ISO Guide to the Expression of Uncertainty in Measurement (GUM). The procedure for calculating the combined performance characteristic measurement uncertainty involves converting the individual performance characteristic uncertainties to standard uncertainties. This takes account of the probable distribution of errors. In the GUM, standard uncertainties are combined using a root sum of squares with due account taken of the contribution of each component through the use of sensitivity co-efficients. To determine sensitivity co-efficients, it is necessary to know the analytical functions by which each component contributes to