

Expression of performance of electrochemical analyzers —

Part 2: pH value

The European Standard EN 60746-2:2003 has the status of a
British Standard

ICS 71.040; 19.040

National foreword

This British Standard is the official English language version of EN 60746-2:2003. It is identical with IEC 60746-2:2003, including Corrigendum July 2003. It supersedes BS 6438-2:1984 which is withdrawn.

This Part 2 of EN 60746 should be used in conjunction with EN 60746-1.

The UK participation in its preparation was entrusted by Technical Committee GEL/65, Industrial — Process measurement and control, to Subcommittee GEL/65/4, Process instruments for gas and liquid analysis, which has the responsibility to:

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English version

**Expression of performance of electrochemical analyzers —
Part 2: pH value
(IEC 60746-2:2003)**

Expression des qualités
de fonctionnement des analyseurs
électrochimiques —
Partie 2: Mesure du pH
(CEI 60746-2:2003)

Angabe zum Betriebsverhalten
von elektrochemischen Analysatoren
Teil 2: pH-Wert —
(IEC 60746-2:2003)

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European Committee for Electrotechnical Standardization
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Foreword

The text of document 65D/90A/FDIS, future edition 2 of IEC 60746-2, prepared by SC 65D, Analysing equipment, of IEC TC 65, Industrial-process measurement and control, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60746-2 on 2003-02-01.

This Part 2 of EN 60746 shall be used in conjunction with EN 60746-1.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2003-11-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2006-02-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes C and ZA are normative and annexes A and B are informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60746-2:2003 was approved by CENELEC as a European Standard without any modification.

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EXPRESSION OF PERFORMANCE OF ELECTROCHEMICAL ANALYZERS –

Part 2: pH value

1 Scope

This International Standard is intended:

- to specify terminology, definitions and requirements for statements by manufacturers for analyzers, sensor units and electronic units used for the determination of the pH of aqueous solutions;
- to establish performance tests for such analyzers, sensor units and electronic units;
- to provide basic documents to support the applications of quality assurance standards ISO 9001, ISO 9002 and ISO 9003.

2 Normative reference

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.

IEC 60746-1:2002, *Expression of performance of electrochemical analyzers – Part 1: General*

ISO 9001, *Quality management systems – Requirements*

ISO 9002, *Quality systems – Model for quality assurance in production, installation and servicing*

ISO 9003, *Quality systems – Model for quality assurance in final inspection and test*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this part of IEC 60746, the definitions given in Clause 3 of IEC 60746-1, as well as the following apply.

3.1.1

pH value

A measure of the conventional hydrogen ion activity a_{H^+} (see equation (1)), in an aqueous solution given by the expression:

$$pH = -\log a_{H^+}$$

It is measured with respect to pH values assigned to certain reference pH buffer solutions. The measurement is performed by determining the e.m.f., E , between a pair of electrodes immersed in the sample to be measured, according to the cell scheme:

Reference electrode | Sample | pH electrode E

and a measurement with the same electrode pair at the same temperature in a reference buffer solution of pH (S_1) according to

Reference electrode | Buffer (S_1) | pH electrode $E(S_1)$

The e.m.f.s $E(S_1)$, etc. are defined as the difference of the potential of the right-hand (pH) electrode minus the potential of the left-hand (reference) electrode.

The pH of the sample is then given ideally by:

$$\text{pH} = \text{pH}(S_1) - \frac{E - E(S_1)}{k} \quad (1)$$

where $k = 2,3026 R \cdot T/F$, the theoretical, Nernstian, slope (see 3.1.2) .

Numerical values for k , the theoretical slope factor, at temperatures from 0 °C to 95 °C, are given in Annex A.

NOTE Measurements in non or partially aqueous media are beyond the scope of this document; the reader should refer to specialist texts.

3.1.2

practical slope factor and percentage theoretical slope

PTS

performance of the electrode pair may fall below the theoretical slope k exhibiting the practical slope k' which may be determined by replacing the sample with a second reference buffer solution of pH value pH (S_2) with an e.m.f. $E(S_2)$, then:

$$k' = \frac{E(S_2) - E(S_1)}{\text{pH}(S_1) - \text{pH}(S_2)} \quad (2)$$

NOTE The difference in pH value between the two reference buffer solutions should be as large as possible, however, solutions above pH 10 and below pH 3 should not generally be used (see Annex B).

The percentage theoretical slope (PTS) is given by:

$$\text{PTS} = \frac{100 k'}{k}$$

Equations (1) and (2) can be combined by substituting k' for k in equation (1) where:

$$\text{pH} = \text{pH}(S_1) - \frac{[E - E(S_1)] \cdot [\text{pH}(S_1) - \text{pH}(S_2)]}{E(S_2) - E(S_1)} \quad (3)$$

and the two reference buffers are usually chosen to bracket the pH of the sample.

3.1.3

pH sensor

the most commonly used pH sensor is the glass electrode, other potentiometric sensors, for example, the antimony electrode only being adopted when its use is precluded. The pH isfet (ion selective field effect transistor) sensor is an alternative to potentiometric sensors, necessitating manufacturer-specific instrumentation.