SLOVENSKI STANDARD
SIST IEC 60528:1995

01-avgust-1995

Expression of performance of air quality infra red analyzers

Expression of performance of air quality infra-red analyzers

Expression des qualités de fonctionnement des analyseurs infrarouges de contrôle de la qualité de l'air

Ta slovenski standard je istoveten z: **IEC 60528**

ICS:

07.060	Geologija. Meteorologija. Hidrologija	Geology. Meteorology. Hydrology

SIST IEC 60528:1995 **en**

NORME INTERNATIONALE

INTERNATIONAL STANDARD

CEI
IEC
60528

Première édition
First edition
1975-01

Expression des qualités de fonctionnement des analyseurs infrarouges de contrôle de la qualité de l'air

Expression of performance of air quality infra-red analyzers

International Electrotechnical Commission 3, rue de Varembé Geneva, Switzerland
Telefax: +41 22 919 0300 e-mail: inmail@iec.ch IEC web site http: //www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CODE PRIX
PRICE CODE Q

Pour prix, voir catalogue en vigueur
For price, see current catalogue

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPRESSION OF PERFORMANCE OF AIR QUALITY INFRA-RED ANALYZERS

FOREWORD

1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.

2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.

3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

This publication has been prepared by IEC Technical Committee No. 66, Electronic Measuring Equipment.

A first draft was discussed at the meeting held in The Hague in 1973. The draft, Document 66(Central Office)17, was submitted to the National Committees for approval under the Six Months' Rule in May 1974.

The following countries voted explicitly in favour of publication:

Australia	Japan
Belgium	Netherlands
Brazil	Poland
Denmark	Portugal
Germany	Switzerland
Hungary	Turkey
Israel	United Kingdom
Italy	United States of America

Other IEC publications quoted in this publication:

Publications Nos. 348: Safety Requirements for Electronic Measuring Apparatus.
359: Expression of the Functional Performance of Electronic Measuring Equipment.
381: Analogue D.C. Current Signals for Process Control Systems.

EXPRESSION OF PERFORMANCE OF AIR QUALITY INFRA-RED ANALYZERS

1. General

1.1 *Scope*

1.1.1 This standard applies to non-dispersive infra-red analyzers used for the continuous determination of certain aspects of air quality by measuring gaseous constituents either in ambient or confined atmospheres or in gaseous streams entering the ambient air.

1.1.2 It applies to infra-red analyzers specified for installation either indoors or outdoors.

1.1.3 It applies to the complete analyzer as an integral analytical unit, including all optical, mechanical, electrical and electronic portions.
For the purpose of this standard, any regulated power supply, provided with the analyzer or specified by the manufacturer, is considered part of the analyzer whether it is integral with the analyzer or housed separately.

1.1.4 It does not apply to the required sample handling systems or other accessories such as recorders, analogue-to-digital converters or data acquisition systems, used in conjunction with the analyzer.

1.1.5 Safety requirements are dealt with in IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus.

1.1.6 This standard is in accordance with the general principles set out in IEC Publication 359, Expression of the Functional Performance of Electronic Measuring Equipment.

1.2 *Object*

This standard is intended:

- to specify the terminology and definitions related to the functional performance of non-dispersive infra-red analyzers used for the continuous determination of certain aspects of air quality by measuring gaseous constituents either in ambient or confined atmospheres or in gaseous streams entering the ambient air;
- to unify methods used in making and verifying statements on the functional performance of such analyzers;
- to specify what tests should be performed to determine the functional performance and how such tests should be carried out.

2. Definitions

The following definitions apply for the purpose of this standard:

2.1 *Non-dispersive infra-red analyzer*

An electro-optical spectrophotometric instrument with no spectral dispersion component, consisting of a single or double source of infra-red radiation and one or more infra-red detectors separated by an optical cell or cells through one or more of which the sample flows, whereby the specific spectral absorption of the component of interest is determined.

Notes 1. – For the purpose of this standard, the analyzer is adjusted by the manufacturer to select only the spectral band(s) at which the component to be determined has its characteristic absorption, and the sample cell length is appropriate for the rated range of concentration.

2. – Specific spectral sensitivity is obtained by a selective component such as a selective source, selective detector or selective filter, or any combination of these components.

2.2 *Calibration gas*

A mixture of known concentration of the component to be determined or a suitable simulant for the component to be determined in air or another suitable carrier gas, used for periodic calibration of the infra-red analyzer, and for various performance tests.

Notes 1. – For the purpose of this standard, concentration means the mass or the volume of the component to be determined in a given volume of calibration gas. Different units may be used, but the manufacturer shall state exactly what is meant.

2. – For the purpose of this standard, the concentrations of these gases represent the conventionally true values* (see Sub-clause 2.6.2.1) against which indicated values are compared. Therefore, the values of the calibration gases should be traceable to standards agreed upon by the manufacturer and the user or to national standards, and the uncertainty of the conventionally true values shall be stated.

2.3 *Performance characteristic*

One of the quantities assigned to an apparatus in order to define by values, tolerances, ranges, etc., the performance of the apparatus.

2.4 *Influence quantity*

Any quantity, generally external to an apparatus, which may affect the performance of the apparatus.

2.5 *Values related to quantities*

2.5.1 *Rated value*

The value (or one of the values) of a quantity to be measured, observed, supplied or set, which the manufacturer has assigned to the apparatus.

2.5.2 *Rated range*

The range of a quantity to be measured, observed, supplied or set, which the manufacturer has assigned to the apparatus.

2.5.3 *Effective range*

That part of the rated range where measurements can be made within the stated limits of error.

2.6 *Terms related to the specification of performance*

2.6.1 *Performance*

The degree to which the intended functions of an apparatus are accomplished.

2.6.2 *Error*

2.6.2.1 *Absolute error*

The error expressed algebraically, in the unit of the measured quantity.

For measuring apparatus, the error is the indicated value of the measured quantity minus its true value.

Note. – The true value of a quantity is the value that would be measured by a measuring process having no error.

In practice, since this true value cannot be determined by measurement, a conventionally true value, approaching the true value as closely as necessary (having regard to the error to be determined), is used in place of the true value. This value should be traced to standards agreed upon by the manufacturer and the user, or to national standards. In both cases, the uncertainty of the conventionally true value shall be stated.

2.6.2.2 *Relative error*

The ratio of the absolute error to a stated value.

---

* This definition and related terms are given in IEC Publication 359.

2.6.2.3 *Percentage error*

The relative error expressed as a percentage, such as percent of full scale (the maximum value of the effective range), percent of the indicated or preset value or of the rated value.

2.6.2.4 *Fiducial value*

A value to which reference is made in order to specify the percentage error, e.g. the upper limit of the effective range, or another clearly stated value.

2.6.3 *Intrinsic error*

The error determined under reference conditions.

2.6.4 *Operating error*

The error determined under rated operating conditions.

2.6.5 *Influence error*

The error determined when one influence quantity assumes any value within its rated range of use (or an influencing characteristic assumes any value within its effective range), all others being at reference conditions.

2.6.6 *Linearity error*

The maximum deviation between actual analyzer readings and the readings predicted by a linear function of the measured quantity which includes the indicated values at the upper and lower limits of the effective range.

2.6.7 *Interference error*

The error caused by interfering gases and vapours being present in the sample.

Note. – This is an influence error and other influence errors are dealt with below.

2.6.8 *Limits of error*

The maximum values of error assigned by the manufacturer to a measured quantity of an apparatus operating under specified conditions.

2.6.9 *Repeatability*

The deviation between repeated measurements made in rapid succession at the same concentration of the component to be determined, under constant environmental conditions and rated sample conditions.

2.6.10 *Zero drift*

The shift in reading for zero calibration gas (see Sub-clause 5.2) over a stated period of time.

2.6.11 *Span drift (drift of the limits of the effective range)*

The shift in span over a stated period of time.

2.6.12 *Operating period*

The maximum time interval within which the limits of operating error are not exceeded, without adjustment by external means.

2.6.13 *Output fluctuation*

Deviations from a mean output not caused by variation in the concentration of the component to be determined or by a change in any influence quantity.

2.6.14 *Minimum detectable concentration*

The concentration which corresponds to twice the output fluctuation level when the concentration of the component to be determined is zero.

2.6.15 *Delay time*

The time interval from the instant a step change occurs in the concentration of the component to be determined at the analyzer inlet, to the instant when the change in the indicated value passes 10% of its steady-state amplitude, with the sample flow kept at its rated value.

2.6.16 *Rise (fall) time*

The time interval within which the indicated value passes from 10% to 90% (from 90% to 10%) of its steady-state amplitude after a step increase (decrease) in the concentration of the component to be determined at the analyzer inlet, with the sample flow kept at its rated value.

2.6.17 *Warm-up time*

The time interval after switching on the analyzer under specified conditions, until the zero and span drifts are within specifications.

2.7 *Terms related to conditions of operation, transport and storage*

2.7.1 *Reference conditions*

A set of values with tolerances, or of restricted ranges of influence quantities, specified for making comparison and calibration tests.

2.7.2 *Rated range of use (of influence quantities)*

The range of values for an influence quantity within which the requirements concerning operating error are satisfied.

2.7.3 *Rated operating conditions*

The whole of the effective ranges for performance characteristics, and rated ranges of use for influence quantities, within which the performance of the apparatus is specified.

2.7.4 *Limit conditions of operation*

The whole of the ranges of values for influence quantities and performance characteristics (beyond the rated ranges of use and effective ranges respectively) within which an apparatus can function without resulting in damage or degradation of performance when it is afterwards operated under rated operating conditions (see Sub-clause 3.2.3).

2.7.5 *Conditions of storage and transport*

The whole of the conditions of temperature, humidity, air pressure, vibration, shock, etc., within which the apparatus may be stored or transported in an inoperative condition, without resulting in damage or degradation of performance when it is afterwards operated under rated operating conditions.

3. Procedure for statement

3.1 The manufacturer shall provide statements on the following:

3.1.1 The rated values for the performance characteristics listed in Sub-clause 3.3. The rated values for these performance characteristics shall be equal to their effective ranges.

3.1.2 The limits of errors listed in Sub-clause 3.4.

3.1.3 The limits of drifts listed in Sub-clause 3.5.

3.1.4 The performance characteristics listed in Sub-clause 3.6.

3.1.5 The reference values or ranges, the rated ranges of use and the limit ranges of operation, storage and transport, for all influence quantities shall be stated and shall be selected from only one of the usage Groups I, II or III in Clause 4. Any exceptions to the values given there shall be explicitly and clearly stated by the manufacturer with an indication that they are exceptions.

Note. – Analyzers may correspond to one group of the rated ranges of use for environmental conditions and to another group for mains supply conditions, but this must be clearly stated by the manufacturer.

3.2 Statements on rated operating conditions and limit conditions shall be made in such a way that the following requirements are met unless otherwise specified.

3.2.1 The analyzer, while functioning, shall show no damage or degradation of performance when any number of performance characteristics and/or influence quantities assume any value within the limit conditions of operation during a specified time or, if no time is specified, for an unlimited time.

3.2.2 The analyzer shall show no permanent damage or degradation of performance when, being inoperative, it has been subjected to conditions where any number of influence quantities assume any value within their storage or transport conditions during a specified time or, if no time is specified, for an unlimited time.

3.2.3 Absence of damage or degradation of performance means that after re-establishing reference conditions or rated operating conditions the analyzer again meets the requirements concerning its performance.

3.3 *Performance characteristics requiring statements of rated values*

3.3.1 *Minimum and maximum rated values for the concentration of the component to be determined (range or ranges)*

The lower value is specified first, then the upper value (e.g. 0 to 1 cm^3/m^3 or 10 to 20 mg/m^3).

3.3.2 *Minimum and maximum rated values for output signals corresponding to the concentrations as given in Sub-clause 3.3.1*

These signals shall be stated in units of either voltage or current, and if multiple outputs are provided they shall be stated. If stated in units of voltage, the minimum allowable load, in ohms, shall be stated also. If stated in units of current, the maximum allowable load, in ohms, shall be stated also.

If capacitive or inductive load will influence the output signal, this shall be specified.

Note. – If the analyzer output signal is electrical current and more than one output range is supplied, the minimum and maximum rated values of one output range should be 4 mA and 20 mA (see IEC Publication 381, Analogue D.C. Current Signals for Process Control Systems).

3.3.3 *Rated ranges for sample conditions at the analyzer inlet, including flow rate, pressure and temperature*

3.4 *Error limits to be stated*

3.4.1 Operating error for the indicated concentration, expressed as concentration of the component to be determined (e.g. ± 2 mg/m^3 or ± 1 cm^3/m^3), or as percent of full scale.

Note. – For the purpose of this standard, the stated operating error will not include effects of interference errors or effects of variation in barometric pressure. They are stated separately and must be considered as additive to the operating error as stated by the manufacturer (see Sub-clauses 3.4.3, 3.4.3.1, 3.4.3.2, 5.7.2, 5.7.2.1, 5.7.2.2 and 5.7.8.1 relative to interference errors; see Sub-clauses 3.6.8 and 5.7.8.1 relative to the effect of barometric pressure variation).

3.4.1.1 Intrinsic error (which applies under reference conditions) may be stated in addition, for comparison and calibration purposes.

3.4.2 Linearity error for each specified range, expressed as percentage values in terms of the rated range of concentration (e.g. +2% of full scale or −2% of full scale).

Note. – Deviation from linearity is strictly considered as an error only if a linear output signal is claimed for the analyzer. However, as a performance characteristic it should be included for comparison purposes and is referred to as an error in all cases for simplicity.

3.4.3 Interference errors for each specified range:

3.4.3.1 Interference errors shall be stated in terms of the equivalent concentration of the component to be determined for at least two concentration levels of the interfering component. Depending on the design and adjustment of the analyzer, the interference error may be either positive or negative; therefore, the sign shall be included in the statement.

3.4.3.2 The manufacturer should indicate which components are known to have interference in the particular application under consideration. The specification of all interfering components for which interference errors are to be stated, and their concentration levels, shall be made by agreement between the manufacturer and the user.

3.4.4 Repeatability error for each specified range, in terms of two standard deviations in the concentration of the component to be determined.

3.5 Zero drift and span drift, expressed as percentage values in terms of the rated range of concentration (e.g. 2% of full scale) over a specified time interval.

The time interval for which the drift limits are stated should be chosen appropriately for the specific application (e.g. 1, 3 or 7 h for automobile exhaust analyzers; 24 h, 7 days or 30 days for ambient air monitors). They should be chosen from the following:

15 min	7 days
1 h	30 days
3 h	3 months
7 h	6 months
24 h	1 year

These values are to be stated on the basis that no adjustments will be made on the analyzer by external means during the stated time intervals. The warm-up time is always excluded from the time interval.

3.6 Although no statements of error limits are required for the performance characteristics listed below, the manufacturer shall state their values or ranges.

3.6.1 Output fluctuation expressed as a percentage value in terms of the rated range of concentration for the peak-to-peak deviation (e.g. 0.25% of full scale).

3.6.1.1 In the case of analyzers having variable time constants in the output circuit, the output fluctuation shall be stated for the same time constant as used for the statement of delay time, rise time and fall time.

3.6.2 *Minimum detectable concentration*

3.6.3 *Delay time*

3.6.4 *Rise time*

3.6.5 *Fall time*