



**SLOVENSKI STANDARD**  
**SIST IEC 60359:1995**

**01-avgust-1995**

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**Expression of the performance of electrical and electronic measuring equipment**

Electrical and electronic measurement equipment - Expression of performance

Appareils de mesure électriques et électroniques - Expression des performances

**Ta slovenski standard je istoveten z: IEC 60359**

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**ICS:**

17.220.20	Merjenje električnih in magnetnih veličin	Measurement of electrical and magnetic quantities
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# NORME INTERNATIONALE INTERNATIONAL STANDARD

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Commission Electrotechnique Internationale  
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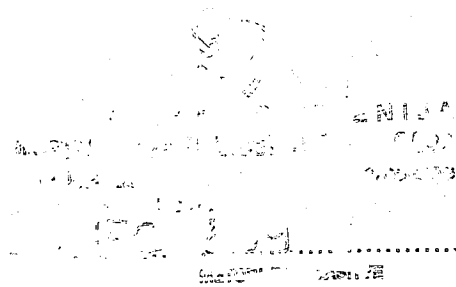
Expression des qualités de fonctionnement des équipements  
de mesure électriques et électroniques

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Expression of the performance of electrical and electronic  
measuring equipment



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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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**EXPRESSION OF THE PERFORMANCE OF ELECTRICAL  
AND ELECTRONIC MEASURING EQUIPMENT**

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## 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.

**iTeh STANDARD PREVIEW**

## PREFACE

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This standard has been prepared by IEC Technical Committee No. 66: Electrical and Electronic Test and Measuring Instruments, Systems and Accessories.

The text of this standard is based upon the following documents:

Six Months' Rule	Report on Voting
66(CO)43	66(CO)44

Full information on the voting for the approval of this standard can be found in the Voting Report indicated in the above table.

*The following IEC publications are quoted in this standard:*

Publications Nos.	50 (131) (1978): International Electrotechnical Vocabulary (IEV), Chapter 131: Electric and Magnetic Circuits.
	50 (151) (1978): Chapter 151: Electrical and Magnetic Devices.
50 (301, 302, 303) (1983):	Chapter 301: General Terms on Measurements in Electricity. Chapter 302: Electrical Measuring Instruments. Chapter 303: Electronic Measuring Instruments.

*Other publication quoted:*

CEE 10 (1964): Specification for Electric Motor-operated Appliances for Domestic and Similar Purposes, Part 1, General Specification.

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## EXPRESSION OF THE PERFORMANCE OF ELECTRICAL AND ELECTRONIC MEASURING EQUIPMENT

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### INTRODUCTION

#### *Relationship to existing methods of specification*

- 1) The two limits of error of the value of a performance characteristic appearing in a technical specification should not be exceeded in spite of all specified changes in the environment, in the supply source, and in any other performance characteristic, and these changes should simulate the probable working conditions. This is so that, knowing the permissible overall error of a process or system, a measuring instrument or system may be chosen having adequate accuracy.
  
- 2) In the field of electronic measuring equipment, the first edition of IEC Publication 359 (1971) recognized the concept of intrinsic error and influence errors, and used the system of specifying the operating error. This error is valid under the least favourable combination of values of influence quantities within their ranges, which are specified along with operating groups referring to severities of environment.  
 This system has been found useful for equipment which measures several parameters of one phenomenon. However, the determination of the most unfavourable combination of influence conditions and the production of combinations of conditions for testing are difficult and uneconomic.
  
- 3) In the field of electrical measuring instruments, IEC Publication 51, for example, recognizes the concept of intrinsic error and variations, and uses the system of specifying accuracy classes. These classes relate to ranges of influence quantities prescribed in IEC Publication 51, but not in relation to particular environments. This system has been found useful from the viewpoints of both manufacturers and users, particularly for economic reasons.

Intrinsic errors are moderately easy to determine and they are useful for acceptance testing and referee testing; however, they provide no information about any worsening of performance which may take place under the less favourable conditions of actual use. Nonetheless, the system provides some hints about the operating error by determining the change in error (the variation) produced by each influence quantity separately when it is changed from its reference value to one or the other of the limits of a range prescribed in the IEC product standard covering the particular kind of instrument. However, since all the other influence quantities are kept at their reference values, no information is determined about the effect of several influence quantities which simultaneously depart from their reference values.

- 4) In the field of analysing equipment, no fixed system prevails at present. In the field of process control equipment, the concept of intrinsic error and variations is basically adopted. Influence quantities other than those recognized for measuring equipment are of major importance.
  
- 5) It is impossible for a manufacturer to comply with conflicting requirements which the different disciplines of his various purchasers may have, and so it has become indispensable to introduce a single general concept of errors which is appropriate to the different applications in the extensive fields of measurement.

## 6) Reference documents:

a) *The following IEC publications dealing in detail with subjects related to performance and errors:*

- 50: International Electrotechnical Vocabulary, (IEV).  
 51: Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories.  
 68: Basic Environmental Testing Procedures.  
 160 (1963): Standard Atmospheric Conditions for Test Purposes.  
 258 (1968): Direct Acting Recording Electrical Measuring Instruments and their Accessories.  
 484 (1974): Indirect Acting Electrical Measuring Instruments.  
 529 (1976): Classification of Degrees of Protection Provided by Enclosures.  
 654: Operating Conditions for Industrial-process Measurement and Control Equipment.  
 688: Electrical Measuring Transducers for Converting A.C. Electrical Quantities into D.C. Electrical Quantities.  
 721-3 (1984): Classification of Environmental Conditions, Part 3: Classification of Groups of Environmental Parameters and their Severities.

b) *IEC publications dealing with disturbances on supply networks:*

- 555: Disturbances in supply systems caused by household appliances and similar electrical equipment.  
 555-1 (1982): Part 1: Definitions.  
 555-2 (1982): Part 2: Harmonics.  
 555-3 (1982): Part 3: Voltage fluctuations.  
 725 (1981): Considerations on reference impedances for use in determining the disturbance characteristics of household appliances and similar electrical equipment.  
 816 (1984): Guide on methods of measurement of short duration transients on low voltage power and signal lines.

## SECTION ONE — GENERAL PRINCIPLES

## 1. Scope

This standard applies to the specification of the performance of the following kinds of electrical and electronic equipment and instruments and the accessories used with them:

- a) Those which measure electrical quantities (indicating and recording instruments).
- b) Those which supply measured electrical quantities (supply instruments), such as signal generators and some power supplies.
- c) Those which measure non-electrical quantities using electrical means, excluding any parts, such as transducers, which provide an electrical analogue of the non-electrical quantity; and provided that there exists no IEC product standard relating to the equipment or its electrical or electronic parts which has requirements that contradict this standard. The expression of performance covers only the electrical or electronic part.

## 2. Object

This standard provides methods for ensuring uniformity in the specification and measurement of errors of equipment within its scope. All other necessary requirements have been reserved for

dependent IEC product standards pertaining to particular types of equipment which fall within the scope of this standard.

For example: the selection of performance characteristics and their measuring ranges, and influence quantities and their specified operating ranges, is reserved for IEC product standards.

### 3. Quantities, values and ranges to be stated and measured

3.1 In the manufacturer's technical specification for measuring equipment, the quality of performance is defined by statements on the limits of error of the performance characteristics.

A specification of limits of error provides one of the following kinds of information:

- a) Limits of intrinsic error and variations.
- b) Limits of operating error, calculated from a) above, using statistical methods.
- c) Worst-case error, calculated from a) above.

3.2 A reference value or reference range and an operating range are defined for each influence quantity which the manufacturer takes into account. It is also useful to specify the limiting conditions and storage and transport conditions of each influence quantity.

3.3 Determination of limits of error is based on the measurement of intrinsic errors and variations, followed by any necessary calculations.

3.4 Where limits of operating error are specified, the recommended method of measurement and calculation provides a probability of 95% that the error will remain within the limits during use within the rated operating conditions. See Appendix A.

3.5 The manufacturer's responsibility relates to the correction of excessive operating errors and worst-case errors, which are calculated from intrinsic errors and variations inside their stated limits, but he is not responsible for injury or defects resulting from these excesses.

## SECTION TWO — DEFINITIONS

### 4. Definitions

The following definitions apply for the purposes of this standard.

4.1 *True value* (IEV 301-08-01 and VIM\* 1.18)

The value which characterizes a quantity perfectly defined, in the conditions which exist when that quantity is considered.

*Note.* — The true value of a quantity is an ideal concept and, in general, cannot be known exactly.

4.2 *Conventional true value* (IEV 301-08-02 modified)

A value approximating to the true value of a quantity such that, for the purpose for which that value is used, the difference between the two values can be neglected.

*Notes 1.* — The conventional true value of a quantity is generally determined by means of methods and by the use of instruments of an accuracy suitable for each particular case.

2. — Since the true value cannot be known exactly, for the sake of simplicity and where no ambiguity exists, the term "true value" may be used when "conventional true value" is meant.

\* International Vocabulary of Basic and General Terms in Metrology (1984).



#### 4.3 *Fiducial value* (IEV 301-08-03 modified)

A clearly specified value to which reference is made in order to define the fiducial error.

*Note.* — This value can be, for example, the measured value, the upper limit of the measuring range, the scale range, a preset value or another clearly stated value.

#### 4.4 *Rated value* (IEV 151-04-03 modified)

A quantity value assigned by a manufacturer for a specified operating condition of the equipment or instrument.

#### 4.5 *Range*

Domain between limits expressed by stating the values of the lower and upper limits of the quantity under consideration.

*Note.* — The term “range” is usually used with a modifier. It may apply to a performance characteristic, to an influence quantity, etc.

#### 4.6 *Performance* (IEV 303-08-01)

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

#### 4.7 *Performance characteristic*

One of the quantities (described by values, tolerances, ranges) assigned to an equipment in order to define its performance.

*Notes 1.* — Depending on its application, one and the same quantity may be referred to in this standard as a “performance characteristic” and as a “measured or supplied quantity”, and also may act as an “influence quantity”.

*2.* — In addition, the term “performance characteristic” includes quotients of quantities, such as voltage per unit of length.

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#### 4.8 *Influence quantity* (VIM 2.10 modified)

A quantity which is not the subject of the measurement but which influences the value of the measured quantity or the indication of the measuring equipment.

*Notes 1.* — An influence quantity may be external or internal with reference to the equipment.

*2.* — When the value of one performance characteristic changes within its measuring range, it may affect the error due to another.

*3.* — The measured quantity or a parameter of it may itself act as an influence quantity. For example, for a voltmeter, the value of the measured voltage may produce an additional error due to non-linearity or its frequency may also cause an additional error.

#### 4.9 *Reference conditions* (IEV 301-08-10 modified)

The appropriate set of influence quantities and performance characteristics, with reference values with their tolerances and reference ranges, with respect to which the intrinsic error is specified.

#### 4.10 *Reference value* (IEV 302-08-01 modified)

A specified value of one of a set of reference conditions.

*Note.* — A tolerance is specified for a reference value.

#### 4.11 *Reference range* (IEV 302-08-02 modified)

A specified range of values of one of a set of reference conditions.

#### 4.12 *Rated operating conditions*

A set of specified measuring ranges for performance characteristics and specified operating ranges for influence quantities, within which the variations or operating errors of an instrument are specified and determined.

#### 4.13 *Specified operating range*

A range of values of a single influence quantity which forms a part of the rated operating conditions.

*Note.* — The operating range is a concept similar to the “nominal range” of use (IEV 302-08-04) “and rated range of use” (Publication 359 (1971), Sub-clause 2.6.2).

#### 4.14 *Specified measuring range* (VIM 5.04 modified)

The set of values of a measured quantity for which the error of a measuring instrument is intended to lie within specified limits.

*Notes 1.* — An instrument can have several specified measuring ranges.

2. — The specified measuring range may be smaller than the range of values indicated.

3. — This term used to be known as “effective range”.

#### 4.15 *Limiting conditions* (VIM 5.06 modified)

The extreme conditions which an operating measuring instrument can withstand without damage and without degradation of its metrological characteristics when it is subsequently operated under its rated operating conditions.

#### 4.16 *Storage and transport conditions*

The extreme conditions which a non-operating measuring instrument can withstand without damage and without degradation of its metrological characteristics when it is subsequently operated under its rated operating conditions.

#### 4.17 *(Absolute) error (of a measuring instrument)*

The indication of a measuring instrument minus the (conventional) true value of the measured quantity.

*Note.* — For a supplied quantity, the indication is its nominal or marked value.

#### 4.18 *Relative error* (IEV 301-08-07 modified)

The ratio of the error (expressed in the units of the measured or supplied quantity) to the conventional true value.

#### 4.19 *Fiducial error*

The error of a measuring instrument divided by the fiducial value specified for the instrument.

#### 4.20 *Intrinsic error* (IEV 301-08-11 modified)

The error of a measuring instrument or supply instrument when used under reference conditions.

*Note.* — Error caused by friction is a part of the intrinsic error.

#### 4.21 *Variation* (IEV 302-08-03 modified)

The difference between the indicated values for the same value of the measured quantity of an indicating or recording instrument, or the (conventional) true values of a supply instrument, when a single influence quantity assumes successively two different values.

#### 4.22 *Operating error*

The error of a performance characteristic which is obtained at any point within the rated operating conditions.

*Note.* — The operating error will have an extreme value (without regard to sign) at some combination of values of influence quantities within their operating ranges.

#### 4.23 *Limits of error*

The two extreme values (positive and negative) of error assigned by the manufacturer to equipment operating under specified conditions.

### SECTION THREE — PROCEDURE FOR SPECIFICATION

#### 5. Specification of values and ranges

5.1 The manufacturer shall state rated values or specified measuring ranges for all quantities which he considers to be performance characteristics applicable to the particular equipment.

5.2 The manufacturer shall state a reference value or a reference range and/or a specified operating range for each influence quantity which he takes into account when specifying limits of error of performance characteristics. The specified operating range shall include the whole of the reference range and usually exceeds it in at least one direction.

If any performance characteristic acts as an influence quantity, its measuring range is its specified operating range.

If any performance characteristic appears as an influence quantity, its reference value or reference range shall also be stated unless this is the same as its specified measuring range.

For any influence quantity not specified, its reference value or reference range is considered to be its specified operating range.

Clause 15 provides information on reference values and reference ranges for some common influence quantities for use in compliance testing. The inclusion of these values or ranges in a technical specification is not mandatory.

*Note.* — A variation may exceed its specified limit if the conditions under which the instrument is used include more than one stated influence quantity lying outside their reference values or ranges.

5.3 The manufacturer should specify limiting conditions and storage and transport conditions for each specified influence quantity. If no ranges are specified, the rated operating conditions are considered to be the limiting conditions and to include the storage and transport conditions.

#### 6. Requirements for IEC product standards

6.1 Authors of IEC product standards covering all kinds of equipment falling within the scope of this standard shall observe the rules laid down herein, and especially the following points: