SLOVENSKI STANDARD
SIST EN 60514:1995

01-avgust-1995

Prevzemna kontrola za števce električne delovne energije izmeničnega toka razreda 2

Acceptance inspection of Class 2 alternating-current watthour meters

Annahmeprüfung von Wechselstrom-Wirkverbrauchzählern der Klasse 2

Contrôle de réception des compteurs à courant alternatif de la classe 2

Ta slovenski standard je istoveten z: **EN 60514:1995**

ICS:

17.220.20	Merjenje električnih in magnetnih veličin	Measurement of electrical and magnetic quantities

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EUROPEAN STANDARD

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English version

Acceptance inspection of Class 2 alternating-current watthour meters (IEC 514:1975, modified)

Contrôle de réception des compteurs à courant alternatif de la classe 2 (CEI 514:1975, modifiée)

Annahmeprüfung von Wechselstrom-Wirkverbrauchzählern der Klasse 2 (IEC 514:1975, modifiziert)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of the International Standard IEC 514:1975, prepared by IEC TC 13, Equipment for electrical energy measurement and load control, together with common modifications prepared by the Technical Committee CENELEC TC 13, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 60514 on 1994-12-06.

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) 1995-07-15
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1995-07-15

For products which have complied with HD 309.2 S1:1979 before 1995-07-15, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2000-07-15.

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex A is normative and annex B is informative.

Endorsement notice

The text of the International Standard IEC 514:1975 was approved by CENELEC as a European Standard with agreed common modifications as given below.

COMMON MODIFICATIONS

Delete the introduction and replace "report" by "standard" throughout the text.

RAPPORT TECHNIQUE

TECHNICAL REPORT

CEI
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Contrôle de réception des compteurs à courant alternatif de la classe 2

Acceptance inspection of Class 2 alternating-current watthour meters

Bureau Central de la Commission Electrotechnique Internationale 3, rue de Varembé Genève, Suisse

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ACCEPTANCE INSPECTION OF CLASS 2 ALTERNATING-CURRENT WATTHOUR METERS

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 report has been prepared by Sub-Committee 13A, Integrating Meters, of IEC Technical Committee No. 13, Measuring Instruments.

Drafts were discussed at the meetings held in Budapest in 1970, in Stresa in 1971 and in Toronto in 1972. As a result of this latter meeting, a draft, document 13A(Central Office)35, was submitted to the National Committees for approval under the Six Months' Rule in July 1973.

The following countries voted explicitly in favour of publication:

Argentina
Austria
Belgium
Denmark
Egypt
France
Germany
Hungary
India
Israel
Italy
Netherlands
Poland
Portugal
South Africa (Republic of)
Sweden
Switzerland
Turkey
Yugoslavia

ACCEPTANCE INSPECTION OF CLASS 2 ALTERNATING-CURRENT WATTHOUR METERS

INTRODUCTION

1) It is emphasized that this publication is a report and does not constitute either a standard or a specification.

This report describes, in some detail, methods for acceptance inspection, and testing of newly manufactured watthour meters of Class 2 delivered in large quantities.

In this report wider error limits than those for type tests specified in the relevant publications have been allowed because:

– acceptance testing conditions have wider tolerances than those for type tests;

– displacing of the zero axis is not applicable for acceptance testing;
– the effects of handling of meters are taken into account.

2) This report has been issued with the object of enabling experience to be gained with meter acceptance testing methods (100% inspection and statistical sampling inspection). The intention is that the contents will be reviewed and the explanatory Appendix A deleted. In addition, the question of changing the status of this publication from a report to a standard will then be considered.

With these objects in view, the comments of National Committees are invited in three years' time.

1. Scope

The methods and procedures included in this report apply to newly manufactured direct connected induction type watthour meters of Class 2, covered by IEC Publication* 521, which are produced and delivered in large quantities.

They provide for 100% inspection or sampling inspection for acceptance by the purchaser.

2. General remarks

2.1 Two methods of acceptance inspection are proposed, namely:
– 100% inspection, and
– sampling inspection.

2.2 The 100% inspection consists of testing all the meters of a batch.

2.3 The sampling inspection is based upon the principles of mathematical statistics and as a consequence certain specified risks are undertaken both by the manufacturer and the purchaser. However, sampling inspection generally is more economical than 100% inspection.

In this report sampling inspection has been planned so that, in practice, the quality of the meter batches can be judged with nearly the same accuracy as with 100% inspection.

2.4 Two methods of sampling inspection are described:
– inspection by attributes;
– inspection by variables.

These two methods have been chosen so that the judgement of quality is virtually the same for both methods.

2.5 Inspection by *attributes* gives results indicating conformity or non-conformity.

It *shall* be applied when the characteristic under inspection cannot be measured.

It *shall* also be applied when a characteristic can be measured but the values are not of normal distribution (Laplace-Gauss).

It *may* be applied, when the distribution is approximately normal, in place of inspection by variables.

The advantage of inspection by attributes is its simplicity of application.

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* Class 0.5, 1 and 2 alternating-current watthour meters (being printed).

2.6 Inspection by *variables* gives additional information but it is applicable only when the values of a characteristic are measurable and when those values are approximately normally distributed. In these circumstances, inspection by variables is the recommended method.
The advantage of inspection by variables is a smaller sample size than by attributes for the same risk of decision. However, it requires more calculation.
The test results are represented by:
$\bar{x}$ = the sample mean as an estimation of the batch mean;
s = the standard deviation
$\bar{w}$ = the average range
} as an estimation of the dispersion of the characteristic x in the batch.

Note. – The average range is easier to calculate than the standard deviation. However, when suitable calculating means are available for making a decision and for preparing additional information, the use of the standard deviation enables the efficiency of the method to be increased for the same sample size.

3. Units

The units employed in this report are those used by the IEC.

4. Definitions

For definitions concerning meters, reference is made to IEC Publication 521. The majority of the definitions of sampling techniques are generally in accordance with the Glossary (1972) of the European Organization for Quality Control (E.O.Q.C.) and with ISO/R 645 (1967) and ISO/R 1786 (1970)*, Statistical Vocabulary and Symbols.

4.1 *Batch*

A definite quantity of meters of the same type, of the same voltage and current rating and the same register, delivered by one supplier, manufactured or produced under conditions which are presumed uniform.

4.2 *Batch size*

The number N of meters in a batch (ISO).

4.3 *Sample*

Meters taken at random for inspection from a batch.

4.4 *Sample size*

The number n of meters in the sample (ISO).

4.5 *100% inspection*

Inspection of every meter in a batch.

4.6 *Sampling inspection*

The inspection of a limited number of meters, taken at random from the batch, according to a prescribed sampling plan (ISO mod.).

4.7 *Sampling plan*

A plan according to which one or more samples are taken to obtain information and possibly to reach a decision (ISO).

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* It is intended to take the corresponding definitions of IEC Publication 410 (1973), Sampling Plans and Procedures for Inspection by Attributes, into consideration in the future.

4.8 *Characteristic (quality characteristic)*

A property (e.g. dielectric strength, starting, accuracy at one test point) of a meter which contributes to the quality and which helps to differentiate between the meters of a given batch. The differentiation may be either quantitative (by variables) or qualitative (by attributes).

If it is measurable, its value for a given meter i is indicated by x_i (ISO mod.).

4.9 *Defect*

A failure of a meter to meet a standard with respect to a characteristic (ISO mod.).

4.10 *Defective meter*

A meter having one or more defects (ISO mod.).

4.11 *Operating characteristic curve*

A curve showing, for a given sampling plan, the probability of acceptance of a batch as a function of its actual quality for a given characteristic (ISO mod.).

4.12 *Inspection by attributes*

Inspection whereby certain characteristics of the sample meters are evaluated, classified as conforming or not conforming to the requirements, the number of defective meters counted and used as the basis for judgement of the batch (E.O.Q.C.).

4.13 *Acceptance number*

The maximum permitted number of defects in a sample for inspection by attributes.

4.14 *Inspection by variables*

Inspection whereby certain characteristics of the sample meters (e.g. a meter error for a particular current) are measured with respect to a continuous scale (e.g. in per cent), and their mean value, the standard deviation or the average range calculated and used as the basis for judgement of the batch.

4.15 *Sample mean* $\overline{x}$

The arithmetic mean of values x_i for a characteristic (e.g. a meter error for a particular current) in the sample:

$$\overline{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

4.16 *Range* w_j

The difference between the maximum and minimum observed values of a given characteristic in a sub-group:*

$$w_j = | x_{max} - x_{min} |$$

for sub-group j.

4.17 *Average range* $\overline{w}$ **

The arithmetic mean of the r ranges w_j of the r sub-groups in a sample:

$$\overline{w} = \frac{\sum_{j=1}^{r} w_j}{r}$$

* For the purpose of this report, the size m of a sub-group j is 5 and there are r sub-groups in a sample.

** This is an estimation of the dispersion of the characteristic x in a batch.

4.18 *Standard deviation of the sample*

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

This is an estimation of the dispersion of the characteristic x in a batch.

4.19 *Acceptance trapezium*

A graph, with control limits, on which are plotted two corresponding statistical values (i.e. sample mean $\bar{x}$ and either standard deviation s or average range $\bar{w}$), for each sample.

4.20 *Acceptable quality level (AQL)*

For a given characteristic, the maximum percentage of defective meters in a batch that, for the purpose of sampling inspection, can be considered satisfactory (E.O.Q.C.).

5. Acceptance conditions for batches

A batch is deemed to comply with the requirements of this report and shall be accepted if for each inspected characteristic the proportion of defective meters does not exceed the following specified values:

– no meter shall be accepted with a false constant or faulty insulation (for sampling inspection, see Sub-clauses 9.2.1.1 and 9.2.1.4).

Under test conditions in Clause 7:

– not more than 1% of the meters shall complete one revolution of the rotor with a current of $0.001 I_b$;
– not more than 1% of the meters shall fail to complete one revolution of the rotor with a current of $0.006\ I_b$;
– not more than 1% of the meters shall have errors exceeding the prescribed limits for each test point (Nos. 4 to 9 in Table II).

In the event of sampling inspection, the above conditions shall be considered satisfied* when for each characteristic of the meters in the batch:

– for inspection by attributes the number of defective meters in the sample is smaller than or equal to the acceptance number;
– for inspection by variables the graphically presented test result is within the acceptance trapezium or the calculated test result does not exceed the specified limits.

6. Place of inspection

The inspection shall be carried out by mutual agreement:

– on the manufacturer's premises, but on test benches other than those on which the adjustments were made;
– or on the purchaser's test benches;
– or on other agreed test benches.

7. Test conditions

7.1 *Reference conditions*

Tests shall be carried out under conditions given in Table I.

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* The risk of a wrong interpretation of the results can be read off from the operating characteristic curves of Tables IXa, b and c.

TABLE I
Reference conditions

Influence quantity	Reference value	Tolerances on reference value
Ambient temperature [1]	23 °C	± 2 °C
Position [2]	Vertical	± 1 °
Voltage [3]	Reference voltage	± 1.5%
Frequency	Reference frequency	± 0.5%
Voltage and current waveform	Sinusoidal	Distortion factor ≤ 5%
Magnetic induction of external origin at reference frequency [4]	Zero	Induction not producing an error variation greater than ± 0.3%

[1] For any ambient temperature outside the range 21°C to 25°C, but within the range 15°C to 30°C, it is permissible to apply a correction for the reference temperature of 23°C, using the mean temperature coefficient of the meter type as declared by the manufacturer.

[2] The construction and assembly of the meter shall be such that the correct vertical position is ensured (in both the "front-to-back" and "left-to-right" vertical planes) when:
a) the base of the meter is supported against a vertical wall, and
b) a reference edge (such as the lower edge of the terminal block) or a reference line marked on the meter case is horizontal.

[3] In respect to polyphase meters:
The phase sequence shall be as marked on the diagram of connections.
Each phase or line voltage shall not differ from the mean corresponding voltage by more than 1%.
The current in each phase or line respectively shall not differ from the mean current by more than 2%.
The phase displacements of each of these currents with respect to the corresponding line-to-neutral voltage irrespective of the power factor, shall not differ from one another by more than 3°.

[4] The test consists of:
a) for a *single-phase* meter, determining the errors at first with the meter normally connected to the mains and then after inverting the connections to the current circuit as well as to the voltage circuits: The half of the difference between the two errors is the value of the variation of error. Because of the unknown phase of the external field, the test has to be made at 0.1 I_b at unity power-factor and 0.2 I_b at 0.5 power-factor;
b) for a *three-phase* meter, making three measurements, at 0.1 I_b at unity power-factor, after each of which the connections to the current circuits and to the voltage circuits are changed over 120°, while the phase sequence is not altered. The greatest difference between each of the errors so determined and their average value is the value of the variation of error.

7.2 *Uncertainty of measurement*

The measuring instruments and other apparatus used for the tests shall be such that the overall uncertainty of measurement does not exceed the following values:

±0.4% at unity power-factor
±0.6% at 0.5 power-factor.

7.3 *Cover and seal*

The meters shall be tested with their covers on and manufacturer's seal unbroken, except when verifying certain mechanical characteristics.

8. **Inspection and test procedure**

The quality of the batch of meters shall be checked by adopting the inspection and test procedure detailed in this clause.

8.1 *Preliminary tests and pre-conditioning*

The meters to be tested shall be visually examined in order to verify that none shows signs of damage and that their specified markings are correct.

The meters shall be energized at reference voltage and 0.1 I_b at unity power-factor for at least 30 min to verify that the rotors turn and to pre-condition the meters.

For 100% inspections, any replacements which may be required shall be subject to agreement between manufacturer and purchaser.

For sampling inspection, it is permissible to replace one meter in a sample of 30 and two meters in a sample of 40.

All meters which satisfy the foregoing requirements shall be subjected to the tests in the order given below, unless otherwise agreed upon between manufacturer and purchaser, except for test No. 11, which is always the last test.

8.2 *Test No. 1: dielectric properties*

The test voltage of 2 kV (r.m.s.), which shall be substantially sinusoidal and having a frequency between 45 Hz and 65 Hz, shall be applied for 1 min between all terminals interconnected and the case or a flat metal base on which the meter is placed, when insulated cases are used.

8.3 *Test No. 2: running with no-load* *

With the meter energized at reference voltage, at unity power-factor and with a current of 0.001 I_b and connected as shown in the diagram of connections, the rotor shall not make a complete revolution.

8.4 *Test No. 3: starting* *

With the meter energized at reference voltage, at unity power-factor and with a current of 0.006 I_b and connected as shown in the diagram of connections, the rotor shall start and make more than one revolution.

8.5 *Tests Nos. 4 to 9: accuracy*

The accuracy tests for single-phase and polyphase meters shall be carried out at the current values and power-factor values given in Table II, without waiting for the thermal equilibrium to be attained.

TABLE II

Test points and limits of errors

Test No.	Current	Power factor	Number of phases of the meter	For polyphase, whether balanced or unbalanced	Limits of errors in percent
4	0.05 I_b	1	Single and polyphase	Balanced	± 3.5
5	I_b	1	Single and polyphase	Balanced	± 2.5
6	I_b	0.5	Single and polyphase	Balanced	± 3.0
7	I_b	1	Polyphase	1 phase loaded	± 3.5
8	I_b	1	Polyphase	1 phase loaded (different phase from test No. 7)	± 3.5
9	I_{max}	1	Single and polyphase	Balanced	± 2.5

* For tests Nos. 2 and 3 for cyclometer type registers, only the most rapidly moving drum shall be engaged.