

Acceptance inspection for direct connected alternating current static watt-hour meters for active energy (classes 1 and 2)

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British Standard

ICS 17.220.20

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- Building Automation and Mains Signalling Association (BAMSA)
- BEAMA Metering Association (BMA)
- Department of Trade and Industry
- Electricity Association
- Electricity Pool of England and Wales
- Energy Systems Trade Association
- Flag Association
- Institution of Electrical Engineers
- Office of Electricity Regulations (OFFER)
- United Kingdom Automatic Meter Reading Association

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National foreword

This British Standard has been prepared by Technical Committee PEL/13 and is the English Language version of EN 61358:1996 *Acceptance inspection for direct connected alternating current static watt-hour meters for active energy (classes 1 and 2)* published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 1368:1996 published by International Electrotechnical Commission (IEC).

Cross-references

Publication referred to	Corresponding British Standard
EN 60514:1995 (IEC 514:1975)	BS EN 60514 <i>Acceptance inspection of class 2 alternating-current watt-hour meters</i>
EN 61036:1992 (IEC:1990)	BS EN 61036:1993 <i>Alternating current static watt-hour meters for active energy (classes 1 and 2)</i>
	BS ISO 3534: <i>Statistics. Vocabulary and symbols</i>
ISO 3534-1:1993	BS ISO 3534-1:1993 <i>Probability and general statistical terms</i>
ISO 3534-2:1993	BS ISO 3534-2:1993 <i>Statistical quality control</i>

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 26, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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English version

Acceptance inspection for direct connected alternating current static watt-hour meters for active energy (classes 1 and 2)

(IEC 1358:1996)

Contrôle de réception des compteurs statiques d'énergie active pour courant alternatif et à branchement direct (classes 1 et 2)
(CEI 1358:1996)

Annahmeprüfung von elektronischen Wechselstrom-Wirkverbrauchszählern für direkten Anschluß (Klassen 1 und 2)
(IEC 1358:1996)

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European Committee for Electrotechnical Standardization
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Foreword

The text of document 13/1093/FDIS, future edition 1 of IEC 1358, prepared by IEC TC 13, Equipment for electrical energy measurement and load control, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61358 on 1996-03-05.

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) 1997-01-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1997-01-01

Annexes designated “normative” are part of the body of the standard.

Annexes designated “informative” are given for information only.

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

Annex ZA has been added by CENELEC.

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Introduction

This International Standard describes, in some detail, methods for acceptance inspection, and testing of newly manufactured static watt-hour meters delivered in quantities of 50 and above. IEC 514 serves as a reference document and annex A of that standard should be consulted for explanatory notes concerning sampling procedures. In this standard, 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.

1 Scope

The methods and procedures included in this International Standard apply to newly manufactured direct connected alternating current static watt-hour meters of classes 1 and 2, covered by IEC 1036, which are produced and delivered in quantities of 50 and above.

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 standard, sampling inspection has been planned so that, in practice, the quality of the meter batches can be judged with nearly the same confidence 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 characteristics 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.

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:

$\bar{x}$	= sample mean as an estimation of the batch mean;	
s	= standard deviation	} as an estimation of the dispersion of the characteristics x in the batch.
$\bar{w}$	= average range	

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.

2.7 Inspection by variables is based on normally distributed values. It is recommended to test whether the sample is normally distributed, using e.g.:

- The “w/s” test of David, Hartley and Pearson. For details of the test procedures see [1]¹⁾ For this test only the figures $w(x_{\max} - x_{\min})$ and s are needed.
- The Wilk-Shapiro test. For details of the test procedures see [2].
- The Pearson chi-square test.

¹⁾ Figures in square brackets refer to the bibliography given in annex B.

3 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards. IEC 410:1973, *Sampling plans and procedures for inspection by attributes*.

IEC 514:1975, *Acceptance inspection of Class 2 alternating-current watt-hour meters*.

IEC 1036:1990, *Alternating current static watt-hour meters for active energy (classes 1 and 2)*.

ISO 3534-1:1993, *Statistics — Vocabulary and symbols — Part 1: Probability and general statistical terms*.

ISO 3534-2:1993, *Statistics — Vocabulary and symbols — Part 2: Statistical quality control*.

4 Definitions

For the purpose of this International Standard, the following definitions apply.

For definitions concerning meters, reference is made to IEC 1036. The majority of the definitions of sampling techniques are generally in accordance with [3] and with ISO 3534-1 and ISO 3534-2.

4.1 batch

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

number N of meters in a batch [ISO]

4.3 sample

meters taken at random for inspection from a batch

4.4 sample size

number n of meters in the sample [ISO]

4.5 100 % inspection

inspection of every meter in a batch

4.6 sampling inspection

inspection of a limited number of meters, taken at random from the batch, according to a prescribed sampling plan [ISO, modified]

4.7 sampling plan

plan according to which one or more samples are taken to obtain information and possibly to reach a decision [ISO, modified]

4.8 characteristic (quality characteristic)

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 variable) or qualitative (by attributes)

if it is measurable, its value for a given meter i is indicated by x_i . [ISO, modified]

4.9 defect

failure of a meter to meet a standard with respect to a characteristic [ISO] modified]

4.10 defective meter

meter having one or more defects [ISO, modified]

4.11 operating characteristic curve

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, modified]

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 (EOQC)

4.13 acceptance number

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 $\bar{x}$**

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

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

4.16**range w_j**

difference between the maximum and minimum observed values of a given characteristic in a subgroup:

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

for subgroup j

NOTE For the purpose of this standard, the size m of a subgroup j is 5 and there are r subgroups in a sample.

4.17**average range $\bar{w}$**

arithmetic mean of the r ranges w_j of the r subgroups in a sample

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

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

4.18**standard deviation of the sample**

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

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

4.19**acceptance trapezium**

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 given characteristic, maximum percentage of defective meters in a batch that, for the purpose of sampling inspection, can be considered satisfactory (EOQC)

5 Acceptance conditions for batches

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

5.1 100 % inspection

The tests shall be made according to clause 8.

The number of meters failing the test shall not exceed the acceptance number given in Table 6.

5.2 Sampling inspection

In the case 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 given in Table 8;
- 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 (see 9.2.3).

NOTE The risk of a wrong interpretation of the results can be read off from the operating characteristic curves of Table 12a, Table 12b and Table 12c.

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 1.

Table 1 — Reference conditions

Influence quantity	Reference value	Permissible tolerances
Ambient temperature ^a	Reference temperature or, in its absence, 23 °C	± 2 °C
Voltage	Reference voltage	± 1,5 %
Frequency	Reference frequency	± 0,5 %
Waveform	Sinusoidal voltages and currents	Distortion factor less than 5 %
Magnetic induction of external origin at the reference frequency	Magnetic induction equal to zero	Induction value which causes a variation of error not greater than ± 0,3 % but should in any case be smaller than 0,05 mT ^b

^a 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.

^b The test consists of:

a) for a single-phase meter, determining the errors first with the meter normally connected to the mains and then after inverting the connections to the current circuits as well as to the voltage circuits. 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 should 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:

Table 2 — Uncertainty of measurement

Class of meter		Power factor
1	2	
0,2 %	0,4 %	1
0,3 %	0,6 %	0,5 inductive

7.3 Cover and seal

The meters shall be inspected and tested with their covers on and manufacturer's seal unbroken.

The base and cover shall show no signs of damage.

For sampling procedure damaged meters shall be replaced.

8 Inspection and test procedure

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

NOTE If mechanical aspects have to be tested, the conditions should be agreed on between the parties.

8.1 Preheating

Before any test is made, the circuits shall have been energized for a time sufficient to reach thermal stability (see 3.6.13 of IEC 1036).

8.2 Test no. 1: AC voltage test

The a.c. voltage test shall be carried out in accordance with Table 3.

The test voltage shall be substantially sinusoidal, having a frequency between 45 Hz and 65 Hz, and applied for 1 min. The power source shall be capable of supplying at least 500 VA. During this test no flashover, disruptive discharge or puncture shall occur.

During the tests relative to earth, the auxiliary circuits with reference voltage equal to or below 40 V shall be connected to earth.