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Testing equipment for electrical energy meters

Equipement d'étalonnage de compteurs d'énergie électrique

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Testing equipment for electrical energy meters

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

TESTING EQUIPMENT FOR ELECTRICAL ENERGY 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: Electric Energy Measuring Equipment, of IEC Technical Committee No. 13: Electrical Measuring Equipment.

Drafts were discussed at the meetings held in Warsaw in 1976 and in Florence in 1978. As a result of this meeting, a draft, Document 13A(Central Office)43, was submitted to the National Committees for approval under the Six Months' Rule in June 1979. Amendments, Document 13A(Central Office)49, were submitted to the National Committees for approval under the Two Months' Procedure in October 1980.

The National Committees of the following countries voted explicitly in favour of publication:

Austria	Ireland
Belgium	Israel
Brazil	Italy
Bulgaria	Japan
China	Netherlands
Czechoslovakia	Poland
Denmark	Romania
Egypt	South Africa (Republic of)
Finland	Sweden
France	Switzerland
Germany	Turkey
Hungary	

In view of the fact that this is the first IEC publication on meter testing equipment (MTE) and that, in various countries, there are very different ways of constructing and using an MTE, explanatory notes, additional notes and guidance to which attention should be given will be found in Appendices A, B and C.

TESTING EQUIPMENT FOR ELECTRICAL ENERGY METERS

1. Scope

This report is applicable to three-phase and/or single-phase equipment used for type and acceptance testing of electrical energy meters of Classes 0.5, 1 and 2.

2. Units and definitions

The units used in this report are those used by the International Electrotechnical Commission (IEC).

2.1 *Testing equipment for electrical energy meters; meter testing equipment (MTE)*

An assembly of apparatus to supply energy to meters under test and to measure this energy.

2.2 *Power × time measurement method (wattmeter method)*

A method by which the energy supplied to the meter(s) under test is determined by the product of a known constant power and a known interval of time.

2.3 *Energy comparison method (standard meter method)*

A method by which a known amount of energy is supplied to the meter(s) under test.

2.4 *Reference standard*

A standard with which standards of lower accuracy are compared.

2.5 *Working standard*

A standard which, calibrated against a reference standard, is intended to verify working measuring instruments of lower accuracy.

2.6 *MTE test standard*

A measuring device for the determination of the accuracy of an MTE. It always includes a reference standard. It may include other elements, for example precision instrument transformers, precision time interval generator, etc.

2.7 *Output terminals of an MTE*

The terminals from which the power, corresponding to the separate application of voltages and currents, is supplied to the terminal block(s) of the meter(s) under test.

2.8 *Maximum output of an MTE*

The output, in voltamperes, corresponding to the highest loading applied at the output terminals of an MTE, for which the limits of permissible errors (Table I) under reference conditions (Sub-clause 3.3) are not exceeded.

The output shall be defined separately for the voltage and current circuits.

3. Accuracy

3.1 *General remarks*

An MTE shall allow the user to adjust and measure the necessary quantities, voltage, current, power-factor, time, power and energy within the permissible tolerances for the relevant class of meters which will be tested with this MTE.

The error *E* of an MTE is the overall error of all its components under normal service conditions.

3.2 *Methods for the determination of the overall error of an MTE*

The determination of the overall error of an MTE is made according to the following methods:

— comparison of the *energy* delivered at the output terminals of the MTE indicated by the MTE test standard with the energy indicated by the working standard(s) of the MTE;

— comparison of the *power* at the output terminals of the MTE, indicated by the MTE test standard, with the power indicated by the working standard(s) of the MTE. The influence of the accuracy of the time measurement on the error of the energy shall be specified.

3.3 *Reference conditions*

The reference conditions at the input of the MTE shall be specified by the manufacturer and shall be such that, at its output, the reference conditions for the meter(s) under test are fulfilled.

Sub-clause 3.4 gives the particular requirements for the magnetic field produced by the MTE.

3.4 *Magnetic field of the MTE*

It is recommended that the magnetic flux density produced by the MTE at the position of the meter(s) under test should not exceed the following values:

for $I \leqq 10$ A $\quad B \leqq 0.0025$ mT

for $I = 200$ A $\quad B \leqq 0.05$ mT

The limiting values of magnetic flux density for *I*, between 10 A and 200 A, shall be evaluated by interpolation.

I = output current of the MTE.

B = magnetic flux density in air due to the magnetic field.

Note. – $B = \mu_0 H$, H in amperes per metre.
$\mu_0 = 4\pi \cdot 10^{-7}$ H/m (henrys per metre).

3.5 *Error determination of an MTE*

The error of a newly manufactured MTE at a certain test point shall be lower than the error E_{max} in Table I (see Clause B1 of Appendix B for the error definition).

If the result of a single measurement gives an error in excess of the permissible limits, then two additional measurements at this particular test point can be taken. The results of these two additional measurements shall be within the permissible limits of E_{max}.

An MTE is capable of being used at least for meters of the relevant class (type test or acceptance inspection) according to Table I, if the results of all test points (Table III) are within the limits of the permissible errors.

If the results of some test points are not within the limits of the permissible errors, the use of this MTE may be restricted to certain ranges, for certain classes of meters. Such a restriction shall be indicated in a suitable visible place on this MTE.

TABLE I

Limits of permissible errors in percentage

Meter class	0.5			1			2		
Power-factor	1	0.5 lagging	0.5 leading	1	0.5 lagging	0.5 leading	1	0.5 lagging	0,5 leading
E_{max}	±0.10	±0.15	±0.20	±0.20	±0.30	±0.40	±0.30	±0.45	±0.60

3.6 *Correction of the error E of an MTE*

If the error E of an MTE in service is outside the limits of Table I but within twice the relevant values of Table I then a correction for the error of the MTE shall be applied to the results of the tests on the meter(s) under test. In these cases, it is recommended that an effort should be made to reduce the error of the MTE in order to bring it within the permissible limits.

3.7 *Repeatability of the measurements (see Clause B5 of Appendix B)*

A sequence of repeated measurements is recommended for the "control point" U_c, I_c, at power-factor 1 (reference No. 1 of Table III). Not less than five measurements for each phase shall be made. Between successive measurements the controlling switches and controlling devices shall be operated.

The results of these repeated measurements are used to calculate the value s, which is the estimation of the standard deviation:

$$s = + \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} (E_i - \bar{E})^2}$$

where:

E_i = error of the MTE determined by one individual measurement of a sequence of repeated measurements at a certain test point

$\bar{E}$ = mean value of the errors E_i

n = total number of individual measurements

For newly manufactured MTEs, the values of s at the control point U_c, I_c, power-factor 1 shall be within the limits of s_{max} given in Table II.

If additional measurements are made at power-factor 0.5 lagging, the corresponding values for s_{max}, given in Table II, are recommended.

For MTEs in service, twice the values of Table II are permitted.

TABLE II

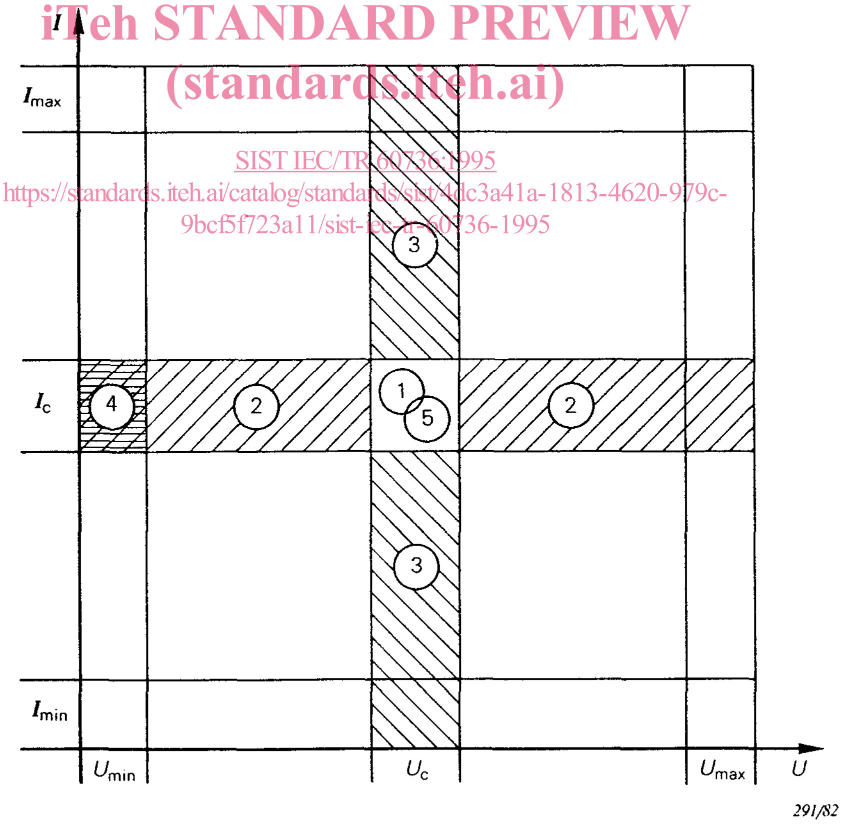
Limits of permissible values s in percentage

Meter class	0.5		1		2	
Power-factor	1	0.5 lagging	1	0.5 lagging	1	0.5 lagging
s_{max}	0.01	0.02	0.02	0.03	0.03	0.05

4. Testing procedure

4.1 *Selection of voltage and current ranges*

Of all the possible combinations of voltage and current, only those should be chosen for testing which are particularly important in practice or with which certain sources of error show up with the most effect. Figure 1 shows by means of a graph the way in which the measuring points given in Table III have been chosen.



The values U_{max}, U_{min}, I_{max}, I_{min}, U_c, and I_c correspond to the rated values of the relevant ranges.

① ② ③ ④ ⑤ are the reference numbers of test points in Table III.

FIGURE 1