SLOVENSKI STANDARD
SIST IEC 60145:1995

01-avgust-1995

Števci jalove energije

Var-hour (reactive energy) meters

Compteurs d'énergie réactive (varheuremètres)

Ta slovenski standard je istoveten z: **IEC 60145**

ICS:

17.220.20	Merjenje električnih in magnetnih veličin	Measurement of electrical and magnetic quantities
91.140.50	Sistemi za oskrbo z elektriko	Electricity supply systems

SIST IEC 60145:1995 **en**

NORME INTERNATIONALE
INTERNATIONAL STANDARD

CEI
IEC
145

Première édition
First edition
1963

Compteurs d'énergie réactive (varheuremètres)

Var-hour (reactive energy) meters

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

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CODE PRIX
PRICE CODE R

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

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

VAR-HOUR (REACTIVE ENERGY) METERS

FOREWORD

1) The formal decisions or agreements of the I.E.C. 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 this international unification, the I.E.C. expresses the wish that all National Committees having as yet no national rules, when preparing such rules, should use the I.E.C. recommendations as the fundamental basis for these rules in so far as national conditions will permit.
4) The desirability is recognized of extending international agreement on these matters through an endeavour to harmonize national standardization rules with these recommendations in so far as national conditions will permit. The National Committees pledge their influence toward that end.

PREFACE

These Recommendations were prepared by Sub-Committee 13A, Integrating meters, of Technical Committee No. 13, Measuring instruments.

Drafts were discussed at meetings held in Stockholm in 1958 and in Paris in 1960. The final draft was submitted to the National Committees for approval under the Six Months' Rule in April 1961.

The following countries voted explicitly in favour of publication:

Austria
Belgium
Czechoslovakia
Denmark
Finland
France
Germany
Hungary
Italy
Japan
Netherlands
Norway
Romania
Sweden
Switzerland
Turkey
Union of Soviet Socialist Republics
United Kingdom
Yugoslavia

VAR-HOUR (REACTIVE ENERGY) METERS

1. Scope

The present recommendations apply only to newly manufactured induction type var-hour meters for the measurement of reactive energy of frequency between 40 and 60 Hz (c/s), of an accuracy class of 3.0 for ordinary usage and to their type tests.

They do not apply to special types of var-hour meters except multi-rate meters.

They do not apply to instrument transformers, even when used in conjunction with the meters covered by these recommendations.

2. Units

The units employed in these recommendations are those adopted by the International Electrotechnical Commission.

3. Definitions

Some of the following terms have been taken from those given in the International Electrotechnical Vocabulary, Group 20 (Publication 50 (20) (1958)). In such cases the appropriate I.E.V. reference is given. Some other terms or their definitions have been added especially for these recommendations.

3.1 *Var-hour meter* (reactive energy meter)

An integrating instrument which measures reactive energy * in var-hours or in suitable multiples thereof.

3.2 *Induction meter*

A meter in which fixed coils carrying current act upon a conducting moving element, generally a disk, in which flow currents induced by the coils (I.E.V. 20-25-065).

---

* The term *reactive energy* is not available in the I.E.V., and general definitions for reactive power and energy do not exist for cases where the alternating quantities are not sinusoidal.

For these reasons the present recommendations are based on the following practical definitions, which are strictly correct only for sinusoidal voltages, but which are for practical purposes true where the voltages and currents are nearly sinusoidal.

Reactive energy in a single-phase circuit

Quantity measured by a perfect watt-hour meter which carries the current of a single-phase circuit and a voltage equal in magnitude to the voltage across the single-phase circuit but in quadrature therewith. The reactive energy of an inductive circuit is positive.

Reactive energy in a polyphase circuit

The algebraic sum of the reactive energies of the phases.

Because these practical definitions of reactive energy assume sinusoidal quantities, the inductive or capacitive state of a circuit in these recommendations is given by the factor " sin φ ".

3.3 *Multi-rate meter*

A meter provided with a number of registers each becoming operative at times corresponding to differing rates of charge (I.E.V. 20-25-110).

3.4 *Meter rotor*

The moving part of a meter upon which the fixed windings react.

3.5 *Driving element of an induction meter*

One of the working parts of the meter which produces a torque by its action on the moving element. It generally comprises an electro-magnet with its control devices (I.E.V. 20-35-185).

3.6 *Meter braking element*

That part of a meter which is intended to produce a braking torque by its action on the moving element. It comprises one or more magnets and their setting device (I.E.V. 20-35-190).

3.7 *Register of a meter (counting mechanism)*

That part of a meter which registers the energy, or more generally the value of the quantity measured by the meter (I.E.V. 20-35-180).

3.8 *Meter base*

The back of the meter by which it is fixed and to which are attached the frame, the terminal block and the cover (I.E.V. 20-35-160).

3.9 *Meter cover*

The enclosure on the front of the meter, made sometimes of transparent material, but generally including transparent parts through which the movement of the disk can be seen, and the counting mechanism read (I.E.V. 20-35-170).

3.10 *Meter case*

This comprises the base and the cover (I.E.V. 20-35-175).

3,11 *Meter frame*

That part to which are affixed the driving element, the counting mechanism, usually the braking element, and sometimes the adjusting devices (I.E.V. 20-35-165).

3.12 *Terminal block*

A support made of insulating material on which all terminals of an instrument, or part of them, are grouped together (I.E.V. 20-35-135).

3.13 *Terminal cover*

Auxiliary cover which covers the meter terminals and the ends of the wires or the cables from the apparatus connected to these terminals (I.E.V. 20-35-195 modified).

3.14 *Current circuit*

That part of a meter through which flows the current in the circuit which it measures, or a proportional current supplied by a current transformer (I.E.V. 20-35-205 modified).

3.15 *Voltage circuit*

That part of a meter supplied by the voltage of the circuit it is to measure or by a proportional voltage supplied by a transformer or voltage divider (I.E.V. 20-35-210 modified).

3.16 *Auxiliary circuit(s)*

Circuit(s) within the meter case and connected to an auxiliary device, for example, an hour meter, a clock, a trip coil, a relay.

3.17 *Basic current*

The value of the current which serves as a basis for these recommendations.

3.18 *Rated maximum current*

The value of current up to which the meter purports to meet the highest accuracy requirements of these recommendations.

3.19 *Reference voltage*

The value of voltage which forms the basis of these recommendations, if the meter is marked for one voltage only.

If the meter is marked for a range of voltages of which the ratio between the upper and lower limits does not exceed 1.3*, the reference voltage is the arithmetic mean of the extreme values of the range, for all tests except those prescribed in Sub-Clauses 8.2.1 and 8.2.5.

If the meter is marked for two voltages of which the ratio between the higher one and lower one exceeds 1.3, these two voltages are to be considered as reference voltages and all the tests are to be made for both.

In var-hour meters for 3-phase circuits, the reference voltage will be the voltage applied to the voltage circuit(s), which may include external devices.

3.20 *Reference frequency*

The frequency which forms the basis of these recommendations.

3.21 *Reference speed*

The number of revolutions per minute of the rotor when the meter carries reference voltage, and basic current, $\sin \varphi = 1$.

3.22 *Reference torque*

The torque of the rotor when at rest, when the meter carries reference voltage and basic current, $\sin \varphi = 1$.

---

* $\frac{U_{\text{upper}}}{U_{\text{lower}}} \leq 1.3$

3.23 *Constant of a var-hour meter*

Coefficient giving the relation between the reactive energy nominally measured by a meter and the corresponding angular movement of the rotor.

It is usually expressed as var-hours per revolution (varh/rev) or in revolutions per kilovar-hour (rev/kvarh).

3.24 *Reference temperature*

The ambient temperature for which the meter is intended.

3.25 *Type tests*

Qualifying tests which are made on a meter, or on a small number of meters of the same type.

3.26 *Routine tests*

Tests carried out on every meter in a consignment.

3.27 *Sampling tests*

Tests carried out on a sample of a consignment.

3.28 *Errors*

a) Absolute error

The indicated value of reactive energy minus its true value expressed algebraically (I.E.V. 20-40-085 modified).

b) Relative error

The ratio of the absolute error to the true value of the reactive energy (I.E.V. 20-40-090 modified).

c) Percentage error

Relative error × 100.

3.29 *Distortion factor*

The ratio between the r.m.s. value of the harmonic content obtained by subtracting the fundamental wave from a non-sinusoidal periodic quantity and the r.m.s. value of the non-sinusoidal quantity. It is usually expressed as a percentage.

3.30 *Mean temperature coefficient*

The ratio between the relative variation of a quantity and the change of temperature which produces it.

4. Classification

4.1 Var-hour meters may be classified according to:

— *Class of accuracy*, each class being denoted by a number corresponding to the percentage accuracy limit at basic current and sin $\varphi = 1$ under the conditions of Sub-Clause 8.2.1.

In this edition of the recommendations the meters concerned are classified as 3.0.

— *Degree of phase displacement*, each class of single driving element * of a var-hour meter which is characterized by the nominal phase displacement between the voltage and current magnetic fluxes in the principal air gaps when the voltage and current applied to this single driving element are in phase.

Var-hour meters which are the subject of these recommendations usually fall into one of three classes: 0, 90 and 60.

5. Mechanical requirements

5.1 General

All insulating materials used in the construction of meters shall be substantially non-hygroscopic.

All parts which are subject to corrosion under normal working conditions shall be effectively protected against corrosion due to atmospheric causes. Any protective coating shall not be liable to damage by ordinary handling nor injuriously affected by exposure to air, under ordinary conditions of service.

5.2 Case

The meter shall have a reasonably dust-proof case, which can be sealed such that the mechanism of the meter is only accessible after breaking the seals.

Metal cases of meters for use on a voltage exceeding 250 V to earth shall be provided with means for the effective connection of an adequate earthing conductor.

5.3 Windows

If the meter case is not transparent, one or more windows shall be provided for reading the register and the observation of the rotor. These windows shall be covered by plates of transparent material, which cannot be removed without breaking the seals.

5.4 Terminals — Terminal block

The terminals shall be grouped in a terminal block of adequate mechanical strength. They shall permit the connection of both solid and stranded conductors. It shall be possible easily to disconnect the voltage terminals from the current terminals.

The manner of fixing the conductors to the terminals shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. The holes in the insulating material which form a prolongation of the terminal holes shall be of sufficient size to accommodate the insulation of the conductors.

5.5 Terminal cover

The terminals of a meter shall have a separate cover which can be sealed independently of the meter cover. The terminal cover shall enclose the actual terminals, their fixing screws, and if required a suitable length of the external conductors, and their insulation.

---

* Driving element here includes any necessary accessory resistors, inductors and shunts.

When the meter is fixed, no access to the terminals shall be possible without breaking the seals of the terminal cover.

5.6 Register (counting mechanism)

The register may be of the pointer or of the drum type.

The principal terms in which the register records shall be the kilovar-hour (kvarh) or the megavar-hour (Mvarh).

In drum type registers, the terms in which the register records shall be marked adjacent to the assembly of drums.

In pointer type registers, the terms in which the register records shall be marked adjacent to the units dial in the form " 1 kvarh/div " or " 1 Mvarh/div ", and adjacent to the other dials shall be marked the number of kilovarhours or megavarhours respectively corresponding to one division of each dial. For example, in a meter registering in terms of kilovarhours, the units dial shall be marked " kvarh/div " and adjacent to the other dials to the left of the units dial shall be marked 10 — 100 — 1 000 — etc.

Decimal dials or drums shall be coloured, or encircled in colour, the fastest moving being graduated and numbered.

The register shall be able to record, starting from zero, for a minimum of 2 500 hours for meters marked " 2 500 hours " and a minimum of 1 500 hours for those marked " 1 500 hours ", the reactive energy corresponding to rated maximum current at reference voltage and $\sin \varphi = 1$.

Register markings shall be indelible and easily readable.

5.7 Meter rotor, direction of rotation

The edge of the rotor near to an observer viewing a meter from the front shall move from left to right on inductive or capacitive load, according to the intended use of the meter. The direction of rotation shall be marked by a clearly visible, indelible arrow.

The edge and upper surface of the disk shall carry a visible mark to facilitate revolution counting. Other marks may be added for stroboscopic or other tests, but such marks shall be so placed as not to interfere with the use of the main visible mark for photo-electric revolution-counting.

5.8 Iron cores

The iron cores of current and voltage windings shall not be relied upon for stiffening the frame structure.

6. Electrical requirements

6.1 Standard basic currents

Standard basic currents are:

1 — 2 — 5 — 10 — 20 — 30 — 50 and 100 A.