IEC 62053-24

Edition 1.0 2014-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electricity metering equipment (a.c.) – Particular requirements – Part 24: Static meters for reactive energy at fundamental frequency (classes 0,5 S, 1 S and 1)

Équipement de comptage de l'électricité (c.a.) – Exigences particulières – Partie 24: Compteurs statiques d'énergie réactive à la fréquence fondamentale (classes 0,5 S, 1 S et 1)

IEC 62053-24:2014-06(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX U

ICS 17.220.20; 91.140.50

ISBN 978-2-8322-1560-9

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FOREWORD

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International Standard IEC 62053-24 has been prepared by IEC technical committee 13: Electrical energy measurement and control.

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

FDIS	Report on voting
13/1569/FDIS	13/1578/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC series 62053, under the general title *Electricity metering equipment (a.c.) – Particular requirements*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This part of IEC 62053 is to be used with the following relevant parts of the IEC 62052, IEC 62053 and IEC 62059 series, *Electricity metering equipment*:

IEC 62052-11:2003, *Electricity metering equipment (a.c.) – General requirements, tests and test conditions – Part 11: Metering equipment*

IEC 62053-21:2003, *Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2)*

IEC 62053-22:2003, *Electricity metering equipment (a.c.) – Particular requirements – Part 22: Static meters for active energy (classes 0,2 S and 0,5 S)*

IEC 62053-31:1998, *Electricity metering equipment (a.c.) – Particular requirements – Part 31: Pulse output devices for electromechanical and electronic meters (two wires only)*

IEC 62053-52:2005, *Electricity metering equipment (a.c.) – Particular requirements – Part 52: Symbols*

IEC 62053-61:1998, *Electricity metering equipment (a.c.) – Particular requirements – Part 61: Power consumption and voltage requirements*

IEC 62059-11:2002, *Electricity metering equipment (a.c.) – Dependability – Part 11: General concepts*

IEC 62059-21:2002, *Electricity metering equipment (a.c.) – Dependability – Part 21: Collection of meter dependability data from the field*

IEC 62059-31-1:2008, *Electricity metering equipment – Dependability –Part 31-1: Accelerated reliability testing – Elevated temperature and humidity*

IEC 62059-32-1:2011, *Electricity metering equipment – Dependability – Part 32-1: Durability – Testing of the stability of metrological characteristics by applying elevated temperature*

IEC 62059-41:2006, *Electricity metering equipment – Dependability – Part 41: Reliability prediction*

This part is a standard for type testing electricity meters. It covers the particular requirements for meters, used indoors and outdoors. It does not deal with special implementations (such as metering-part and/or displays in separate housings).

This standard is intended to be used in conjunction with IEC 62052-11. When any requirement in this standard concerns an item already covered in IEC 62052-11, the requirements of this standard take precedence over the requirements of IEC 62052-11.

This standard distinguishes:

- between transformer operated meters of accuracy class index 0,5 S and 1 S and direct connected meters of accuracy class index 1;
- between protective class I and protective class II meters;
- between meters for use in networks equipped with or without earth fault neutralizers.

The test levels are regarded as minimum values that provide for the proper functioning of the meter under normal working conditions. For special application, other test levels might be necessary and should be agreed on between the user and the manufacturer.

ELECTRICITY METERING EQUIPMENT (a.c.) – PARTICULAR REQUIREMENTS –

Part 24: Static meters for reactive energy at fundamental frequency (classes 0,5 S, 1 S and 1)

1 Scope

This part of IEC 62053 applies only to newly manufactured transformer operated static var-hour meters of accuracy classes 0,5 S, and 1 S as well as direct connected static var-hour meters of accuracy class 1, for the measurement of alternating current electrical reactive energy in 50 Hz or 60 Hz networks and it applies to their type tests only.

This standard uses a conventional definition of reactive energy where the reactive power and energy is calculated from the fundamental frequency components of the currents and voltages only. See Clause 3.

NOTE 1 This differs from the approach of IEC 62053-23, where reactive power and energy is defined only for sinusoidal signals. In this standard reactive power and energy is defined for all periodic signals. Reactive power and energy is defined in this way to achieve proper reproducibility of measurements with meters of different designs. With this definition, reactive power and energy reflects the generally unnecessary current possible to compensate with capacitors rather than the total unnecessary current.

It applies only to static var-hour meters for indoor and outdoor application consisting of a measuring element and register(s) enclosed together in a meter case. It also applies to operation indicator(s) and test output(s). If the meter has a measuring element for more than one type of energy (multi-energy meters), or when other functional elements, like maximum demand indicators, electronic tariff registers, time switches, ripple control receivers, data communication interfaces, etc., are enclosed in the meter case, then the relevant standards for these elements also apply.

NOTE 2 IEC 61869-2:2012 describes transformers having a measuring range of 0,05 I_n to I_{max} for accuracy classes 0,2, 0,5, 1 and 2, and transformers having a measuring range of 0,01 I_n to I_{max} for accuracy classes 0,2 S and 0,5 S. As the measuring range of a meter and its associated transformers have to be matched and as only transformers of classes 0,2 S / 0,5 S have the current error and phase displacement characteristics suitable to operate a class 0,5 S / 1 S meter respectively as specified in this standard, the measuring range of the transformer operated meters will be 0,01 I_n to I_{max}. Reactive meters intended to be used together with non-S transformers are, therefore, not covered by this standard.

It does not apply to:

- var-hour meters where the voltage across the connection terminals exceeds 600 V (line-to-line voltage for meters for polyphase systems);
- portable meters;
- data interfaces to the register of the meter;
- reference meters.

The dependability aspect is covered by the standards of the IEC 62059 series.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62052-11:2003, *Electricity metering equipment (a.c.) – General requirements, tests and test conditions – Part 11: Metering equipment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62052-11 apply with the following exception:

3.1
reactive power
Q
reactive power Q in a single phase system is defined for steady-state and periodic signals as

$$Q = U_1 * I_1 * \sin\varphi_1$$

where U_1 and I_1 are the r.m.s. values of the fundamental frequency components of the voltage and the current respectively, and

φ_1 is the phase angle between them. The reactive power in poly-phase system is the algebraic sum of the per-phase reactive powers:

$$Q = U_{L1} * I_{L1} * \sin\varphi_{L1} + U_{L2} * I_{L2} * \sin\varphi_{L2} + ...$$

where

L1 and L2 are the first and second phase of the system.

Note 1 to entry: For direction of flow and sign of reactive power, see Annex C.

Note 2 to entry: The actual algorithm used for the calculation of reactive power is not of importance as long as the meter meets requirements of this standard. See also Annex E.

Note 3 to entry: While meters for active energy have to measure active energy including harmonic components, reactive energy meters according to this standard have to measure fundamental component reactive energy, with minimum influence from harmonics.

4 Standard electrical values

The values given in IEC 62052-11 apply.

5 Mechanical requirements

The requirements of IEC 62052-11 apply.

6 Climatic conditions

The conditions given in IEC 62052-11 apply.

7 Electrical requirements

7.1 General

In addition to the electrical requirements in IEC 62052-11, meters shall fulfil the following requirements.

7.2 Power consumption

7.2.1 General

The power consumption in the voltage and current circuit shall be determined at reference values of the influence quantities given in 8.6 by any suitable method. The overall uncertainty of the measurement of the power consumption shall not exceed 5 %.

7.2.2 Voltage circuits

The active and apparent power consumption in each voltage circuit of a meter at reference voltage, reference temperature and reference frequency shall not exceed the values shown in Table 1.

Table 1 – Power consumption in voltage circuits for single-phase and polyphase meters including the power supply

Meters	Power supply connected to the voltage circuits	Power supply not connected to the voltage circuits
Voltage circuit	2 W and 10 VA	0,5 VA
Auxiliary power supply	–	10 VA

NOTE 1 In order to match voltage transformers to meters, the meter manufacturer should state whether the burden is inductive or capacitive (for transformer operated meters only).

NOTE 2 The above figures are mean values. Switching power supplies with peak values in excess of these specified values are permitted, but it should be ensured that the rating of associated voltage transformers is adequate.

NOTE 3 For multifunctional meters, see IEC 62053-61.

7.2.3 Current circuits

The apparent power taken by each current circuit of a direct connected meter at basic current, reference frequency and reference temperature shall not exceed the values shown in Table 2.

The apparent power taken by each current circuit of a meter connected through a current transformer shall not exceed the value shown in Table 2, at a current value that equals the rated secondary current of the corresponding transformer, at reference temperature and reference frequency of the meter.

Table 2 – Power consumption in current circuits

Meters	Class of meter		
	0,5 S	1 S	1
Single-phase and polyphase direct connected meter	–	–	4,0 VA
Single-phase and polyphase transformer operated meters	1,0 VA	1,0 VA	–

NOTE 1 The rated secondary current is the value of the secondary current indicated on the current transformer, on which the performance of the transformer is based. Standard values of maximum secondary current are 120 %, 150 % and 200 % of the rated secondary current.

NOTE 2 In order to match current transformers to meters, the meter manufacturer should state whether the burden is inductive or capacitive (for transformer operated meters only).

7.3 Influence of short-time overcurrents

Short-time overcurrents shall not damage the meter. The meter shall perform correctly when back to its initial working condition and the variation of error shall not exceed the values shown in Table 3.

The test circuit shall be practically non-inductive and the test shall be performed for polyphase meters phase-by-phase.

After the application of the short-time overcurrent with the voltage maintained at the terminals, the meter shall be allowed to return to the initial temperature with the voltage circuit(s) energized (about 1 h).

a) Meter for direct connection

   The meter shall be able to carry a short-time overcurrent of 30 I_{max} (r.m.s.) with a relative tolerance of +0 % to –10 % for one half-cycle of a sinusoidal waveforms starting at zero volt, at rated frequency.

b) Meter for connection through current transformer

   The meter shall be able to carry for 0,5 s a sinusoidal current at rated frequency equal to 20 I_{max} with a relative tolerance of +0 % to –10 %.

This requirement does not apply to meters having a switch in the current circuits. For this case, see appropriate standards.

Table 3 – Variations due to short-time overcurrents

Meters for	Value of current	sin φ (inductive or capacitive)	Limits of variations in percentage error for meters of class		
			0,5 S	1 S	1
Direct connection	I_b	1	–	–	1,5
Connection through current transformers	I_n	1	0,1	0,1	–

7.4 Influence of self-heating

The variation of error due to self-heating shall not exceed the values given in Table 4.

Table 4 – Variations due to self-heating

Value of current	sin φ (inductive or capacitive)	Limits of variations in percentage error for meters of class	
		0,5 S	1 S or 1
I_{max}	1	0,2	0,7
	0,5	0,2	1,0

The test shall be carried out as follows: After the voltage circuits have been energized at reference voltage for at least 1 h, without any current in the current circuits, the maximum current shall be applied to the current circuits. The meter error shall be measured at sin φ = 1 immediately after the current is applied and then at intervals short enough to allow a correct drawing to be made of the curve of error variation as a function of time. The test shall be carried out for at least 1 h, and in any event until the variation of error during 20 min does not exceed 0,1 % for class 1 S and class 1 meters and 0,05 % for a class 0,5 S meter.

For this test, the percentage error of the meter shall be measured at sin φ = 1 and sin φ = 0,5 inductive or capacitive with minimum interruptions for changing the measurement point.

The cable to be used for energizing the meter shall have a length of 1 m. For meters with I_{max} > 6 A, the cable cross-section shall ensure that the current density is between 3,2 A/mm^2 and 4 A/mm^2. For meters with an $I_{max} \leq 6$ A, a cross-section in accordance with the meter specification shall be used.

7.5 AC voltage test

The a.c. voltage test shall be carried out in accordance with Table 5.

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

All these tests shall be carried out with the case closed and the cover and terminal covers in place.

During this test, no flashover, disruptive discharge or puncture shall occur.

Table 5 – AC voltage tests

Test	Applicable to	Test voltage r.m.s	Points of application of the test voltage
A	Protective class I meters	2 kV	a) Between, on the one hand, all the current and voltage circuits as well as the auxiliary circuits whose reference voltage is over 40 V, connected together, and, on the other hand, earth
		2 kV	b) Between circuits not intended to be connected together in service
B	Protective class II meters	4 kV	a) Between, on the one hand, all the current and voltage circuits as well as the auxiliary circuits whose reference voltage is over 40 V, connected together, and, on the other hand, earth
		2 kV	b) Between circuits not intended to be connected together in service
		–	c) A visual inspection for compliance with the conditions of 5.7 of IEC 62052-11:2003.

8 Accuracy requirements

8.1 General

The tests and test conditions given in IEC 62052-11 apply.

8.2 Limits of error due to variation of the current

When the meter is under the reference conditions given in 8.6, the percentage errors shall not exceed the limits for the relevant accuracy class given in Table 6 and Table 7.

Table 6 – Percentage error limits (single-phase meters and polyphase meters with balanced loads)

Value of current		sin φ (inductive or capacitive)	Percentage error limits for meters of class		
for direct connected meters	for transformer operated (S) meters [a]		0,5 S [a]	1 S [a]	1
$0{,}05\ I_b \le I < 0{,}1\ I_b$	$0{,}01\ I_n \le I < 0{,}05\ I_n$	1	±1,0	±1,5	±1,5
$0{,}1\ I_b \le I \le I_{max}$	$0{,}05\ I_n \le I \le I_{max}$	1	±0,5	±1,0	±1,0
$0{,}1\ I_b \le I < 0{,}2\ I_b$	$0{,}05\ I_n \le I < 0{,}1\ I_n$	0,5	±1,0	±1,5	±1,5
$0{,}2\ I_b \le I \le I_{max}$	$0{,}1\ I_n \le I \le I_{max}$	0,5	±0,5	±1,0	±1,0
$0{,}2\ I_b \le I \le I_{max}$	$0{,}1\ I_n \le I \le I_{max}$	0,25	±1,0	±2,0	±2,0

[a] It is recommended that current transformers of accuracy class 0,2 S / 0,5 S are used with meters of accuracy class 0,5 S / 1 S respectively in order to keep the overall system error – due to the phase displacement – on a low level.

Table 7 – Percentage error limits (polyphase meters carrying a single-phase load, but with balanced polyphase voltages applied to voltage circuits)

Value of current		sin φ (inductive or capacitive)	Percentage error limits for meters of class	
for direct connected meters	for transformer operated (S) meters [a]		0,5 S [a]	1 or 1 S [a]
$0{,}1\ I_b \le I \le I_{max}$	$0{,}05\ I_n \le I \le I_{max}$	1	± 0,7	± 1,5
$0{,}2\ I_b \le I \le I_{max}$	$0{,}1\ I_n \le I \le I_{max}$	0,5	± 1,0	± 2,0
$0{,}2\ I_b \le I \le I_{max}$	$0{,}1\ I_n \le I \le I_{max}$	0,25	± 1,5	± 3,0

[a] It is recommended that current transformers of accuracy class 0,2 S / 0,5 S are used with meters of accuracy class 0,5 S / 1 S respectively in order to keep the overall system error – due to the phase displacement – on a low level.

The difference between the percentage error when the meter is carrying a single-phase load and a balanced polyphase load at basic current I_b and sin φ = 1 for direct connected meters, shall not exceed 1,5 % for meters of class 1. At rated current I_n and sin φ = 1 for transformer operated meters, the difference shall not exceed 0,7 % and 1,5 % for meters of classes 0,5 S and 1 S respectively.

When testing for compliance with Table 7, the test current should be applied to each measuring element in sequence.

8.3 Limits of error due to influence quantities

8.3.1 General

The additional percentage error due to the change of influence quantities with respect to reference conditions, as given in 8.6, shall not exceed the limits for the relevant accuracy class given in Table 8.

Table 8 – Influence quantities

Influence quantity	Value of current (balanced unless otherwise stated)		sin φ (inductive or capacitive)	Mean temperature coefficient %/K for meters of class	
	for direct connected meters	for transformer-operated meters		0,5 S	1 or 1 S
Ambient temperature variation 7)	$0,1\ I_b \le I \le I_{max}$	$0,05\ I_n \le I \le I_{max}$	1	0,03	0,05
	$0,2\ I_b \le I \le I_{max}$	$0,1\ I_n \le I \le I_{max}$	0,5	0,05	0,10
				Limits of variation in percentage error for meters of class	
				0,5 S	1 or 1 S
Voltage variation ±10 % 1) 2)	$0,05\ I_b \le I \le I_{max}$	$0,02\ I_n \le I \le I_{max}$	1	0,25	0,5
	$0,1\ I_b \le I \le I_{max}$	$0,05\ I_n \le I \le I_{max}$	0,5	0,5	1,0
Frequency variation±2 % 2)	$0,05\ I_b \le I \le I_{max}$	$0,02\ I_n \le I \le I_{max}$	1	0,5	1,0
	$0,1\ I_b \le I \le I_{max}$	$0,05\ I_n \le I \le I_{max}$	0,5	0,5	1,0
Harmonic components in the current and voltage circuits 9)	I_b	$I_{max}/2$	1	2,5	2,5
DC and even harmonics in the current circuit 3)	$\frac{I_{max}}{\sqrt{2}}$	–	1	–	6,0
Continuous magnetic induction of external origin 4)	I_b	I_n	1	2,0	2,0
Magnetic induction of external origin 0,5 mT 5)	I_b	I_n	1	1,0	2,0
Electromagnetic RF fields	I_b	I_n	1	2,0	2,0
Operation of accessories 6)	$0,05\ I_b$	$0,05\ I_n$	1	0,5	0,5
Conducted disturbances, induced by radio-frequency fields	I_b	I_n	1	1,5	2,5
Fast transient burst	I_b	I_n	1	2,0	3,0
Damped oscillatory waves immunity 8)	–	I_n	1	2,0	3,0