IEC 62053-24

Edition 2.0 2020-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electricity metering equipment – Particular requirements –
Part 24: Static meters for fundamental component reactive energy
(classes 0,5S, 1S, 1, 2 and 3)

Équipement de comptage de l'électricité – Exigences particulières –
Partie 24: Compteurs statiques d'énergie réactive de composante fondamentale
(classes 0,5S, 1S, 1, 2 et 3)

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IEC 62053-24:2020-06(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICITY METERING EQUIPMENT – PARTICULAR REQUIREMENTS –

Part 24: Static meters for fundamental component reactive energy (classes 0,5 S, 1 S, 1, 2 and 3)

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

This second edition cancels and replaces the first edition published in 2014 and its amendment 1:2016. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition: see Annex E.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
13/1804/FDIS 13/1804(F)/FDIS	13/1811/RVD

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

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

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

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

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- withdrawn,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

NOTE The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC publication in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

It is the recommendation of the committee that the content of this publication be adopted for implementation nationally not earlier than 2 years from the date of publication.

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INTRODUCTION

This part of IEC 62053 is to be used with relevant parts of the IEC 62052, IEC 62058 and IEC 62059 series, *Electricity metering equipment*, and with the IEC 62055 series, *Electricity metering – Payment systems*:

IEC 62052-11:2020,	*Electricity metering equipment – General requirements, tests and test conditions – Part 11: Metering equipment*
IEC 62052-31:2015,	*Electricity metering equipment (AC) – General requirements, tests and test conditions – Part 31: Product safety requirements and tests*
IEC 62053-11:2003,	*Electricity metering equipment (AC) – Particular requirements – Part 11: Electromechanical meters for active energy (classes 0,5, 1 and 2)*
IEC 62053-21:2020	*Electricity metering equipment – Particular requirements – Part 21: Static meters for AC active energy (classes 0,5, 1 and 2)*
IEC 62053-22:2020,	*Electricity metering equipment – Particular requirements – Part 22: Static meters for AC active energy (classes 0,1 S, 0,2S and 0,5 S)*
IEC 62053-23:2020,	*Electricity metering equipment – Particular requirements – Part 23: Static meters for reactive energy (classes 2 and 3)*
IEC 62055-31:2005	*Electricity metering – Payment systems – Part 31: Particular requirements – Static payment meters for active energy (classes 1 and 2)*
IEC 62057-1: –	*Test equipment, techniques and procedures for electrical energy meters – Part 1: Stationary Meter Test Units (MTU)*
IEC 62058-11:2008,	*Electricity metering equipment (AC) – Acceptance inspection - –Part 11: General acceptance inspection methods*
IEC 62058-21:2008,	*Electricity metering equipment (AC) – Acceptance inspection – Part 21: Particular requirements for electromechanical meters for active energy (classes 0,5, 1 and 2)*
IEC 62058-31:2008,	*Electricity metering equipment (AC) – Acceptance inspection – Part 31: Particular requirements for static meters for active energy (classes 0,2 S, 0,5 S, 1 and 2)*
IEC 62059-11:2002,	*Electricity metering equipment – Dependability – Part 11: General concepts*
IEC 62059-21:2002,	*Electricity metering equipment – Dependability – Part 21: Collection of meter dependability data from the field*
IEC 62059-32-1:2011,	*Electricity metering equipment – Dependability – Part 32-1: Durability – Testing of the stability of metrological characteristics by applying elevated temperature*

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

This document is intended to be used in conjunction with IEC 62052-11:2020 and with IEC 62052-31:2015. When any requirement in this document concerns an item already covered in IEC 62052-11:2020 or in IEC 62052-31:2015, the requirements of this document take precedence over the requirements of IEC 62052-11:2020 or of IEC 62052-31:2015.

The test levels are regarded as minimum values that provide for the proper functioning of the meter under normal working conditions. For special applications, additional test levels might be necessary and are subject to an agreement between the manufacturer and the purchaser.

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ELECTRICITY METERING EQUIPMENT – PARTICULAR REQUIREMENTS –

Part 24: Static meters for fundamental component reactive energy (classes 0,5 S, 1 S, 1, 2 and 3)

1 Scope

This part of IEC 62053 applies only to static var-hour meters of accuracy classes 0,5 S, 1 S, 1, 2 and 3 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 document 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 IEC 62053-23, where reactive power and energy is only defined for sinusoidal signals. In this document 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.

NOTE 2 For other general requirements, such as safety, dependability, etc., see the relevant IEC 62052 or IEC 62059 standards.

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This document applies to electricity metering equipment designed to:

- measure and control electrical energy on electrical networks (mains) with voltage up to 1 000 V AC;

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NOTE 3 For AC electricity meters, the voltage mentioned above is the line-to-neutral voltage derived from nominal voltages. See IEC 62052-31:2015, Table 7;

- have all functional elements, including add-on modules, enclosed in, or forming a single meter case with exception of indicating displays;
- operate with integrated or detached indicating displays, or without an indicating display;
- be installed in a specified matching socket or rack;
- optionally, provide additional functions other than those for measurement of electrical energy.

Meters designed for operation with low power instrument transformers (LPITs as defined in the IEC 61869 series) may be considered as compliant with this document only if such meters and their LPITs are tested together and meet the requirements for directly connected meters.

NOTE 4 Modern electricity meters typically contain additional functions such as measurement of voltage magnitude, current magnitude, power, frequency, power factor, etc.; measurement of power quality parameters; load control functions; delivery, time, test, accounting, recording functions; data communication interfaces and associated data security functions. The relevant standards for these functions may apply in addition to the requirements of this document. However, the requirements for such functions are outside the scope of this document.

NOTE 5 Product requirements for power metering and monitoring devices (PMDs) and measurement functions such as voltage magnitude, current magnitude, power, frequency, etc., are covered in IEC 61557-12. However, devices compliant with IEC 61557-12 are not intended to be used as billing meters unless they are also compliant with the IEC 62052-11:2020 and one or more relevant IEC 62053-xx accuracy class standards.

NOTE 6 Product requirements for power quality instruments (PQIs) are covered in IEC 62586-1. Requirements for power quality measurement techniques (functions) are covered in IEC 61000-4-30. Requirements for testing of the power quality measurement functions are covered in IEC 62586-2.

This document does not apply to:

- meters for which the voltage line-to-neutral derived from nominal voltages exceeds 1 000 V AC;
- meters intended for connection with low power instrument transformers (LPITs as defined in the IEC 61869 series) when tested without such transformers;
- metering systems comprising multiple devices (except LPITs) physically remote from one another;
- portable meters;

NOTE 7 Portable meters are meters that are not permanently connected;

- meters used in rolling stock, vehicles, ships and airplanes;
- laboratory and meter test equipment;
- reference standard meters;
- data interfaces to the register of the meter;
- matching sockets or racks used for installation of electricity metering equipment;
- any additional functions provided in electrical energy meters.

This document does not cover measures for the detection and prevention of fraudulent attempts to compromise a meter's performance (tampering).

NOTE 8 Nevertheless, specific tampering detection and prevention requirements, and test methods, as relevant for a particular market are subject to the agreement between the manufacturer and the purchaser.

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NOTE 9 Specifying requirements and test methods for fraud detection and prevention would be counterproductive, as such specifications would provide guidance for potential fraudsters.

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NOTE 10 There are many methods of tampering with meters reported from various markets; designing meters to detect and prevent all kinds of tampering would lead to unjustified increase in costs of meter design, verification and validation.

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NOTE 11 Billing systems, such as, smart metering systems, are capable of detecting irregular consumption patterns and irregular network losses which enable discovery of suspected meter tampering.

NOTE 12 For transformer operated meters paired with current transformers (CTs) according to IEC 61869-2:

– the standard CT measuring range is specified from 0,05 I_n to I_{max} for accuracy classes 0,1, 0,2, 0,5 and 1 and these CTs are used for meters of class 1, 2 and 3 according to this document;
– the special CT measuring range is specified from 0,01 I_n to I_{max} for accuracy classes 0,2S and 0,5 S and these CTs are used for meters of class 0,5 S and 1 S according to this document;
– combinations of standard CTs and meters of class 0,5 S and 1 S are subject to an agreement between manufacturers and purchasers.

NOTE 13 This document does not specify emission requirements, these are specified in IEC 62052-11:2020, 9.3.14.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60375:2018, *Conventions concerning electric circuits*

IEC 62052-11:2020, *Electricity metering equipment – 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 62052-11:2020 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia website: http://www.electropedia.org
- ISO Online Browsing Platform website: http://www.iso.org/obp

NOTE 1 For direction of flow and sign of reactive power, see Annex B.

NOTE 2 The actual algorithm used for the calculation of reactive power is not of importance as long as the meter meets requirements of this document. See also Annex D.

NOTE 3 While meters for active energy measure active energy including harmonic components, reactive energy meters according to this document measure fundamental component reactive energy, with minimum influence from harmonics.

4 Standard electrical values

4.1 Voltages

The values given in IEC 62052-11:2020 apply.

4.2 Currents

4.2.1 General

The values given in IEC 62052-11:2020 apply.

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4.2.2 Starting current (see Table 1)

Table 1 – Starting current

Meters for	Starting current I_{st}				sin φ
	class 0,5 S	classes 1 S, 1	class 2	class 3	(inductive or capacitive)
Direct connection	-	0,004 I_n	0,005 I_n	0,01 I_n	1
Connection through current transformers	0,001 I_n	0,002 I_n	0,003 I_n	0,005 I_n	1

4.2.3 Minimum current (see Table 2)

Table 2 – Minimum current

Meters for	Minimum current I_{min}	
	class 0,5 S, 1 S	class 1, 2 and 3
Direct connection	---	0,05 I_n
Connection through current transformers	0,01 I_n	0,02 I_n

4.2.4 Maximum current

The requirements given in IEC 62052-11:2020 apply.

4.3 Frequencies

The values given in IEC 62052-11:2020 apply.

4.4 Power consumption

The values given in IEC 62052-11:2020 apply.

5 Construction requirements

The requirements of IEC 62052-11:2020 apply.

6 Meter marking and documentation

The requirements of IEC 62052-11:2020 apply.

7 Accuracy requirements

7.1 General test conditions

Tests and test conditions given in IEC 62052-11:2020 apply.

7.2 Methods of accuracy verification

Tests and test conditions given in IEC 62052-11:2020 apply.

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7.3 Measurement uncertainty

The measurement uncertainty estimation methods given in IEC 62052-11:2020 apply.

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7.4 Meter constant

The requirements of IEC 62052-11:2020 apply.

7.5 Initial start-up of the meter

The requirements of IEC 62052-11:2020 apply.

7.6 Test of no-load condition

Tests and test conditions given in IEC 62052-11:2020 apply.

7.7 Starting current test

Tests and test conditions given in IEC 62052-11:2020 apply.

7.8 Repeatability test

Tests and test conditions given in IEC 62052-11:2020 apply.

7.9 Limits of error due to variation of the current

When the meter is operated under the reference conditions given in 7.1, the percentage errors shall not exceed the limits for the relevant accuracy class given in Table 3.

If the meter is designed for the measurement of energy in both directions, the values in Table 3 shall apply for each direction.

If the meter is rated for multiple connection modes, the accuracy testing results are valid only for the connection modes tested and cannot be used to claim accuracy for other, untested connection modes.

Table 3 – Acceptable percentage error limits (single-phase meters and poly-phase meters with balanced loads or single-phase loads)

Value of current		sin φ (inductive or capacitive)	Acceptable percentage error limits for meters of class				
for directly connected meters	for transformer operated meters[a,b]		0,5 S[a]	1 S[a]	1	2	3
$I_{min} \le I < 0{,}1\ I_n$	$I_{min} \le I < 0{,}05\ I_n$	1	±1,0	±1,5	±1,5	±2,5	±4,0
$0{,}1\ I_n \le I \le I_{max}$	$0{,}05\ I_n \le I \le I_{max}$	1	±0,5	±1,0	±1,0	±2,0	±3,0
$0{,}1\ I_n \le I < 0{,}2\ I_n$	$0{,}05\ I_n \le I < 0{,}1\ I_n$	0,5	±1,0	±1,5	±1,5	±2,5	±4,0
$0{,}2\ I_n \le I \le I_{max}$	$0{,}1\ I_n \le I \le I_{max}$	0,5	±0,5	±1,0	±1,0	±2,0	±3,0
$0{,}2\ I_n \le I \le I_{max}$	$0{,}1\ I_n \le I \le I_{max}$	0,25	±1,0	±2,0	±2,0	±2,5	±4,0

[a] It is recommended that current transformers of accuracy class 0,2S / 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. See also Annex C.

[b] The current transformers under IEC 61869-2 have a lowest load point at 0,05 I_n for class 0,1 to class 1, and 0,01 In for class 0,2S and 0,5 S.

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When testing poly-phase meters for compliance with Table 3 requirements for single phase loads, the test current shall be applied to each measuring element in sequence, while all the phase voltages shall remain balanced.

7.10 Limits of error due to influence quantities

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Tests and test conditions given in IEC 62052-11:2020, 7.1 apply.

If the meter is rated for multiple connection modes, the accuracy requirements apply for each of the connection modes. All tests of effects of influence quantities shall be performed in one connection mode selected to exercise the complete metrological capability of the meter.

When the current and the phase displacement (sinφ) are held constant as specified in Table 4, and any single influence quantity is applied one at a time, with the meter otherwise operated at reference conditions as specified in IEC 62052-11:2020, 7.1, the variation in percentage error relative to the intrinsic error shall not exceed the limits specified for the relevant class indexes given in Table 4.

The variation in percentage error induced by the influence quantities may vary depending on the value of the test current. The variation in percentage error in Table 4 is given for the specified values or ranges of the test current, but the testing should be performed at the recommended values of test current given in Table 4.

Table 4 – Acceptable limits of variation in percentage error due to influence quantities

Influence quantity	Test clause in IEC 62052-11:2020	Specified range or value and recommended value of test current (balanced unless otherwise stated)		sin φ[c]	Acceptable limits of variation in percentage error for meters of class				
		for directly connected meters	for transformer-operated meters		0,5 S	1 S	1	2	3
Radiated, radio-frequency, electromagnetic field immunity test – test with current	9.3.5	I_n		1	2,0	2,0	2,0	3,0	3,0
Electrical fast transient/burst immunity test	9.3.6	I		1	2,0	4,0	4,0	6,0	6,0
Immunity to conducted disturbances, induced by radio-frequency fields	9.3.7	I_n		1	2,0	2,0	2,0	3,0	3,0
Test for immunity to conducted, differential mode disturbances and signalling in the frequency range 2 kHz to 150 kHz at AC power ports	9.3.8	I_n		1	2,0	4,0	4,0	6,0	6,0
Damped oscillatory wave immunity test[d]	9.3.11	---	I_n	1	2,0	2,0	*n/a*	3,0	4,0
External static magnetic fields	9.3.12	I_n		1	2,0	2,0	2,0	3,0	3,0
Power frequency magnetic field immunity test	9.3.13	I_n		1	1,0	2,0	2,0	3,0	3,0
Harmonics in the current and voltage circuits – 5th harmonic test	9.4.2.2	0,5 I_{max}		1	0,5	0,8	0,8	1,0	1,5
Interharmonics in the AC current circuit – burst fired waveform test	9.4.2.3	0,5 I_n		1	1,5	3,0	3,0	6,0	6,0
Odd harmonics in the AC current circuit	9.4.2.4	0,5 I_n		1	1,5	3,0	3,0	6,0	6,0
DC and even harmonics – half-wave rectified waveform test[f]	9.4.2.5	$\frac{I_{max}}{\sqrt{2}}$	---	1 0,5	n/a	n/a	3,0	6,0	6,0
Voltage variation	9.4.3	$I_{min} \leq I \leq I_{max}$ (I_n)		1	0,25	0,5	0,5	1,0	2,0
		0,1 $I_n \leq I \leq I_{max}$ (I_n)	0,05 $I_n \leq I \leq I_{max}$ (I_n)	0,5	0,5	1,0	1,0	1,5	3,0

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