IEC 62057-1

Edition 1.0 2023-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electrical energy meters – Test equipment, techniques and procedures – Part 1: Stationary meter test units (MTUs)

Compteurs d'énergie électrique – Équipements, techniques et procédures d'essai – Partie 1: Bancs d'essai stationnaires des compteurs d'énergie électrique (MTU)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTRICAL ENERGY METERS – TEST EQUIPMENT, TECHNIQUES AND PROCEDURES –

Part 1: Stationary meter test units (MTUs)

FOREWORD

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

Draft	Report on voting
13/1879/FDIS	13/1886/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62057 series, published under the general title *Electrical energy meters – Test equipment, techniques and procedures*, 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 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- withdrawn,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.

ELECTRICAL ENERGY METERS – TEST EQUIPMENT, TECHNIQUES AND PROCEDURES –

Part 1: Stationary meter test units (MTUs)

1 Scope

This part of IEC 62057 applies to stationary meter test units (MTUs) permanently installed in laboratories, used for testing and calibration of electricity meters, in particular for their type test, acceptance test and verification test. It covers the requirements for automatic MTUs for indoor laboratory application and applies to newly manufactured MTUs to test electricity meters on 50 Hz or 60 Hz networks with an AC voltage up to 600 V (phase to neutral).

If meters are intended for system voltages not specified in this document, special requirements are agreed between the manufacturer and the purchaser.

This document also defines the kind of tests to perform as type tests / routine tests / acceptance tests and commissioning tests for MTUs.

It does not apply to:

- portable reference meters and portable sources;
- electricity meters;
- data interfaces to the meter and test procedures of data interface;
- transformer operated MTUs;
- personal computers supplied together with the MTU.

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 60417, *Graphical symbols for use on equipment* (available at http://www.graphical-symbols.info/equipment)

IEC 60617, *Graphical symbols for diagrams* (available at http://std.iec.ch/iec60617)

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60721-3-2:2018, *Classification of environmental conditions – Part 3-2: Classification of groups of environmental parameters and their severities – Transportation and handling*

IEC 60721-3-3:2019, *Classification of environmental conditions – Part 3-3: Classification of groups of environmental parameters and their severities – Stationary use at weatherprotected locations*

IEC 61010-031:2015, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 031: Safety requirements for hand-held probe assemblies for electrical measurement and test*
IEC 61010-031:2015/AMD1:2018

IEC 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*
IEC 61010-1:2010/AMD1:2016

IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61326-1:2020, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

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 (all parts), *Electricity metering equipment*

CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
CISPR 11:2015/AMD1:2016
CISPR 11:2015/AMD2:2019

EN 50160, *Voltage characteristics of electricity supplied by public electricity networks*

EN 50470 (all parts), *Electricity metering equipment (a.c.)*

ISO 3864-1:2011, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs and safety markings*

ISO 7000, *Graphical symbols for use on equipment – Registered symbols* (available at http://www.graphical-symbols.info/equipment)

ISO 13732-1:2006, *Ergonomics of the thermal environment – Methods for the assessment of human responses to contact with surfaces – Part 1: Hot surfaces*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Definitions related to the elements of the MTU

3.1.1
device under test
DUT
meter intended to measure active and/or reactive energy by integrating active and/or reactive power with respect to time

Note 1 to entry: For the definition of various types of energy meters and their elements, see IEC 62052-11:2020, IEC 62053-21:2020, IEC 62053-22:2020, IEC 62053-23:2020, and IEC 62053-24:2020.

3.1.2
meter test unit
MTU
assembly of sources, frequency generator, reference or working standard, and error calculation and indication system to supply the required test signals to the DUT and to measure, calculate and display the error of the DUT

3.1.3
automatic meter test unit
AMTU
MTU which conducts, controls and monitors the desired function(s) or activity(ies) of meter testing through computer-controlled software

3.1.4
source
part of the MTU that generates test voltage signals and current signals with the appropriate frequency, magnitude, and with the appropriate phase angles between currents and voltages

Note 1 to entry: These test signals shall be independent from the mains input in the specified operating range.

Note 2 to entry: The test signals are based on the command(s) received from the test software or controller.

3.1.5
reference standard meter
reference standard
meter used to measure the unit of electrical energy and power

Note 1 to entry: The reference standard meter is designed and operated to obtain the highest accuracy and stability in a controlled laboratory environment.

Note 2 to entry: A reference standard meter shall be traceable to national or international primary standards.

3.1.6
working standard meter
working standard
meter used to measure the unit of electrical energy and power, for use in MTUs

Note 1 to entry: The working standard meter shall be calibrated against the reference standard (meter).

Note 2 to entry: An MTU can also be fitted with a reference standard used for day to day calibration of DUTs of high accuracy (reference standard used as the working standard).

3.1.7
standard meter
common term for the reference standard according to 3.1.5 or the working standard in accordance with 3.1.6

3.1.8
error calculation system
device or a group of devices to count pulses, or read energy values and to compare, calculate and indicate the relative error of the DUTs

Note 1 to entry: The default error calculation system receives pulses from the scanning heads or from the pulse outputs of the DUTs and compares these with pulses received from the standard meter.

3.1.9
output terminal
<of an MTU> terminal from which the test voltages and currents are applied to the DUTs

3.1.10
maximum output power of the source
output power corresponding to the highest load applied at the output terminals of a source

Note 1 to entry: It shall be expressed in VA and shall be defined separately for the test voltage and test current sources.

3.1.11
S
output stability of source
value or relative error of the output quantity of the source indicating that the output quantity may likely vary within this number when all other parameters such as supply voltage, etc., are in accordance with reference conditions (Annex B)

Note 1 to entry: The output stability (S) for voltage, current, power and frequency test output shall be separately defined in % and is given in Formula (1).

$$S = \frac{\max\{m_1(T), m_2(T), ... m_N(T)\} - \min\{m_1(T), m_2(T), ... m_N(T)\}}{\frac{1}{N} \cdot \sum_{k=1}^{N} m_k(T)} \cdot 100\ \% \quad (1)$$

where:

S is the stability of the test output;

$m_N(T)$ is the N^{th} measured value with integration period T inside a successive sequence of measurements;

$m_k(T)$ is the k^{th} value, k = 1…N inside this sequence;

N is the number of values inside this sequence;

T is the integration period;

max is the largest value in a sequence of elements {$m_1(T)$, $m_2(T)$, …. $m_N(T)$};

min is the smallest value in a sequence of elements {$m_1(T)$, $m_2(T)$, …. $m_N(T)$}.

The output stability (S_{abs}) of the phase angle between output values shall be separately defined in ° (degrees) and is given in Formula (2).

$$S_{abs} = \max\{m_1(T), m_2(T), ... m_N(T)\} - \min\{m_1(T), m_2(T), ... m_N(T)\} \quad (2)$$

Note 2 to entry: The purchaser and the manufacturuer may mutually agree for the integration period T and the values N of the measuring sequence.

3.2 Definitions of active, reactive and apparent power

3.2.1
active power
active power at any single sinusoidal frequency component of a periodic signal in a single-phase circuit is defined as the product of the RMS values of current and voltage and the cosine of the phase angle between them, where the phase angle is the angle of the voltage signal vector with respect to the current signal vector

Note 1 to entry: Under sinusoidal conditions, the active power is the real part of the complex power.

Note 2 to entry: The active power of the periodic signal is the algebraic sum of the active power of the sinusoidal frequency components.

Note 3 to entry: The coherent SI unit for active power is the watt W.

Note 4 to entry: Time domain calculation under general conditions:

$$P = \frac{1}{T} \cdot \int_0^T u(t) \cdot i(t) \cdot dt \tag{3}$$

where:

P is the active power;

$u(t)$ is the instantaneous value of the voltage;

$i(t)$ is the instantaneous value of the current;

T is the integration time of the measurement cycle.

Fourier summation for frequency domain calculations with equal time periods for U and I up to nth harmonic:

$$P = \sum_{k=1}^{n} U_k \cdot I_k \cdot \cos\left(\varphi_{uk} - \varphi_{ik}\right) = P_1 + P_2 + P_3 + ... + P_n = P_1 + P_H \tag{4}$$

where:

P_1 is the fundamental active power;

P_H is the harmonic active power;

U_k is the RMS value of the voltage component of order k;

I_k is the RMS value of the current component of order k;

φ_{uk} is the phase shift between the voltage component of order k and the fundamental voltage component;

φ_{ik} is the phase shift between the current component of order k and the fundamental voltage component.

[SOURCE: IEC 62052-11:2020, 3.1.14, modified – Note 2 to entry has been replaced by a new Note 2 and Note 4 to entry has been added.]

3.2.2
apparent power
product of the RMS voltage U between the terminals of a two-terminal element or two-terminal circuit and the RMS electric current I in the element or circuit

Note 1 to entry: The coherent SI unit for apparent power is voltampere, VA.

Note 2 to entry: There are no IEC TC 13 standards available for meters measuring apparent power/energy.

Note 3 to entry: Time domain calculation under general conditions:

$$S = U \cdot I = \frac{1}{T} \cdot \sqrt{\int_0^T i^2(t)dt \cdot \int_0^T u^2(t)dt} \tag{5}$$

where:

S is the apparent power;

U is the RMS value of the voltage;

I is the RMS value of the current;

$u(t)$ is the instantaneous value of the voltage;

$i(t)$ is the instantaneous value of the current;

T is the integration time of the measurement cycle.

Note 4 to entry: Power triangle method to calculate the absolute value of apparent power for sinusoidal conditions.