STANDARDS FOR ELECTRICITY METERS

INTRODUCTION

Electricity meters are being rolled out and installed in large quantities in numerous countries in the world. Many international IEC and European standards are applicable for these meters, containing the requirements for the meters basic construction, including electrical safety and their accuracy under various conditions. Considerable changes to these standards have recently been introduced, and there will be more to follow!

This white paper discusses the relevant standards for electricity meters as well as recent and upcoming changes in all those documents.

ACTUAL IEC STANDARDS

Essential IEC standards for static electricity meters for AC applications include:

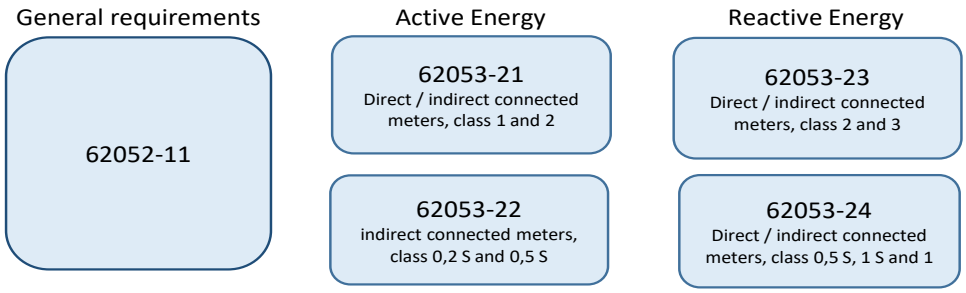


Figure 1: Applicable IEC standards for AC electricity meters

Figure 1 above outlines the Edition 2 version family of standards revised in 2020. The standards apply to the measurement of alternating current in 50 Hz or 60 Hz networks, up to voltages of 1.000 V AC.

The document 62052-11 contains general requirements, including mechanical aspects and tests for the construction of the meter. It also contains electrical requirements, type test conditions and climate conditions descriptions.

Standards 62053-21 and 62053-22 cover requirements for meters of various accuracy classes for active energy. They contain requirements for meter accuracy at reference conditions but also under various influence quantities and disturbances. These standards are always used in conjunction with the general standard 62052-11.

Standards 62053-23 and 62053-24 cover requirements for meters of various accuracy classes for reactive energy, similar to the standards for active energy. These standards are also always used in conjunction with the general standard 62052-11.

The IEC published the current Edition 2 versions of these standards in 2020. That version ushered in significant changes to the previous Edition 1 versions from 2003. Significant changes include:

- Address of export energy;
- Address of DC meters, in the form of new standard 62053-41, published in May 2021;
- Application of the standard is extended to networks with a voltage up to 1.000 V for AC meters and 1.500 V for DC meters;
- Expansion of EMC requirements, with radiated immunity up till 6 GHz, a new ring wave test, increased surge levels and 2-150 kHz disturbances in accordance with 61000-4-19;

- Addition of new aspects such as:
  - a test with fast load changes,
  - a durability test in conformity with 62059-32-1,
  - tests with stronger magnets and
  - the application of the phase-fired waveform test at extra phase angles;
- Coverage of meters with multiple voltage ranges;
- Addition of multi-branch meters in a specific Annex;
- Addition of accuracy requirements of the clock;
- Additions of meters with detached indicating display (powered by the meter);
- Addition of a new accuracy class 0,1 S (62053-22) and 0,5 (62053-21);
- Removal of various safety-related aspects while referencing the safety standard 62052-31 (see below).

As a result, type testing conforming to Edition 2 standards is far more comprehensive than Edition 1 standards type testing.

CURRENT EUROPEAN STANDARDS

In 2006 the Measuring Instruments Directive (MID) came into force. This European directive contains the essential requirements for several measuring instruments, including active electrical energy meters. While some European countries have specific requirements for reactive energy, reactive energy is not included in the MID.

CENELEC published the EN 50470 series to reflect specific European requirements. Based on the 2003 IEC 62052 / 62053, the EN 50470 series adds specific aspects required by the MID. Additions include:

- different accuracy classes,
- different terminology,
- some specific accuracy requirements and
- requirements for data protection and software.

For static electricity meters, the following EN documents are important:

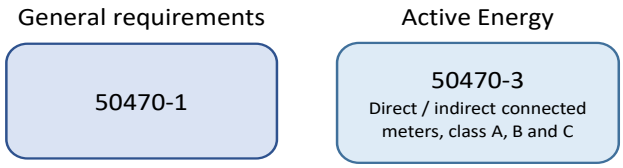


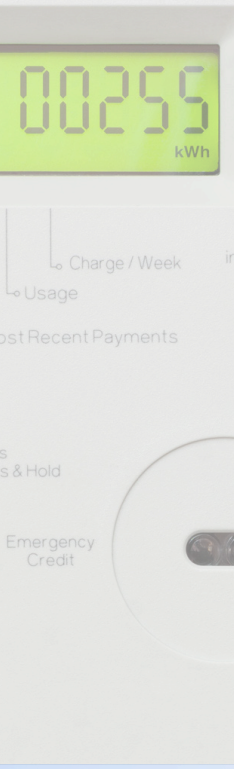
Figure 2: Applicable EN documents

The 50470-1 contains the general requirements comparable with the IEC 62052-11 document. The EN 50470-3 includes provisions for meters of various accuracy classes for active energy. The EN 50470-3 standard is always used in conjunction with the general document 50470-1.

The EN 50470 series are harmonised standards under the MID. When a meter meets the requirements prescribed by the EN 50470 series, conformity with the MID is assumed, under the extra condition that the meter fulfils the essential requirements when exposed to 2-150 kHz disturbances. CENELEC TC 13 added the latter requirement under TR 50579 in 2012 when it became evident that the EN 50470 series did not cover this critical frequency range. The CL/TR 50579 document was later followed by the basic EMC standard IEC 61000-4-19, published by IEC SC 77A in 2014.

A NEW STANDARD FOR ELECTRICAL SAFETY

In 2015, IEC TC 13 developed a new standard for electrical safety of electricity meters and load control equipment: 62052-31. It applies to newly manufactured metering equipment. This product safety standard is based on, among others, the group safety standard IEC 61010-1:2010 established by TC 66. The requirements of standard IEC 61010-1:2010 ensure that hazards to the user and the surrounding area are reduced to a tolerable level.



The document contains specific requirements for the design of the metering equipment related to its application. It includes:

- protection against mechanical hazards,
- insulation requirements,
- clearance and creepage distances,
- impulse voltage tests,
- AC or DC voltage tests, and
- resistance to heat or protection against the spread of fire.

Depending on the meter's design, the standard also contains specific tests for supply control switches or load control switches. Tests include exposure to short-circuit currents, testing with several operating cycles, dielectric strength tests and others.

Furthermore, the document contains requirements for maximum surface temperatures, in case the device is exposed to the specified maximum overload current. The temperature of terminals and internal parts are included in the investigation, which are dependent on the type of material.

The standard also prescribes examination of meter safety under single fault conditions. This may happen if a specific protection component is damaged, which can be simulated by short-circuiting or disconnecting that part.

Given the safety standard referenced from the 62052-11:2020 standard, this safety standard is also mandatory under the IEC scheme.

In Europe, the safety standard has been published as EN 62052-31. In December 2018, CENELEC TC 13 published amendments to the EN 50470 standards, replacing the specific safety clauses and referencing the new safety standard instead.

At the moment, these amendments are not yet published in the Official Journal in order to be used for conformity assessments with the MID. However, as indicated in the foreword of the amendments, the latest date by which national standards conflicting with these documents must be withdrawn is 27 August 2021. As a result, it can be concluded that the EN 62052-31 is now effective in the European setting.

DC METERS

In June 2021 IEC has published also a dedicated standard for DC electricity meters: 62053-41. This standard is used in conjunction with the general standard 62052-11, as indicated in Figure 3.

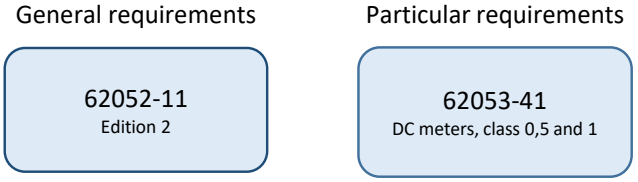
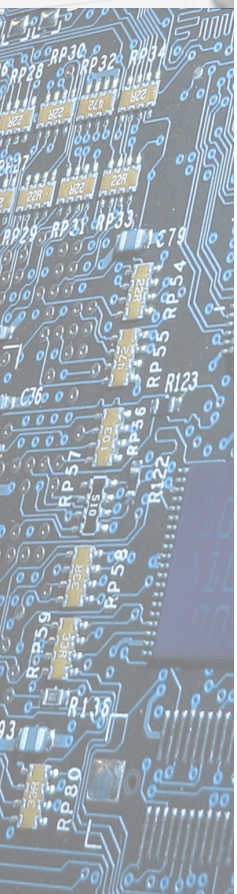


Figure 3: Applicable IEC standards for DC electricity meters

This set of standards can be used for meters with accuracy class 0,5 and 1, for applications up to 1.500 V DC. Being referenced in the 62052-11, the safety standard 62052-31 is also applicable for DC meters. Although the actual version of standard is not fully suitable for DC applications yet, IEC started a project to improve the document to deal with these aspects in a better way.

In Germany, the association VDE published in November 2020 a new document for EV Charging Systems "Elektromobilität – Messsysteme für Ladeeinrichtungen", VDE-AR-E 2418-3-100. This product standard provides requirements for EV Charging Systems and also contains a dedicated Annex A for DC meters. This Annex is to some extent quite similar as the 62053-41, although it is based on older versions of IEC documents.



OTHER LONG-TERM DEVELOPMENTS WITHIN IEC

NMi anticipates the impending introduction of the following new documents resulting from current developments in play within IEC TC 13.

- Safety standard 62052-31 – a new edition with improvements. Official publication expected in 2023.
- Prepayment standard 62055-31 – a new edition for static payment meters for active energy (classes 1 and 2). Official publication expected in 07/2022.
- A new standard for Energy registration methods and requirements for multi-energy and multi-rate meters, 62052-41. Official publication is expected end of 2022.
- Test equipment 62057-1 – a new document for stationary meter test units. Official publication expected end of 2022.
- The IEC created a dedicated taskforce to find a more practical approach for the IEC 62059-31-1, related to accelerated reliability testing. Taskforce output is expected in Q2 2022.

Furthermore, within IEC TC 13, decisions have been made to develop the following documents for the requirements and conformity assessment methods for:

- embedded software applied in metering equipment;
- metering equipment processing digital information derived by Low Power Instrument Transformers (LPIT);
- control switches contained with and/or controlled by metering equipment.

IMPACT ON THE EUROPEAN STANDARDS

The changes mentioned above in the IEC documents will also have an impact on the European documents as. What can we expect?

For now, the EN 50470:2006 documents remain harmonised under the MID. However, CENELEC TC 13 is currently working on a new version of the EN 50470-3. This standard will be applied in conjunction with the EN 62052-11, an identical copy of the IEC 62052-11:2020. This document is expected middle of 2022.

Consequently, after publication in the Official Journal, the documents identified in figure 4 will be used as harmonised standards in the near future.

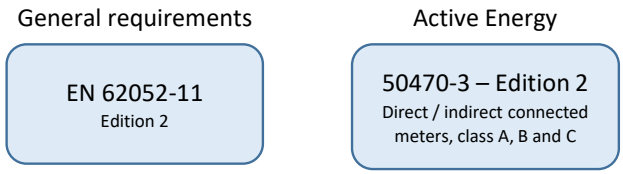


Figure 4: Upcoming harmonized standards under MID

As previously indicated, this includes all improvements and modifications implemented in the IEC 62052 / 62053 series, with the enclosure of the application of the safety standard EN 62052-31.

THE MID AND DC METERS

Since a few years DC meters become more popular, especially for charging applications with Electric Vehicles (EV). Up till now it was not possible to issue MID approvals for these meters, due to the fact these meters are not really covered by the MID and due to the lack of harmonised standards. However, this situation is about to change.

When looking to the MID a bit closer, DC meters are not excluded principally. The MID uses the expression "active electrical energy meters", both in the MID text itself as well in the instrument specific Annex V, which is applicable to both AC and DC meters. Furthermore, although Annex V mentions aspects like frequency or power factor, which are only applicable for AC electricity meters, it doesn't exclude DC meters principally. It seems to be more a matter of interpretation to use the MID for DC meters as well.

Within CENELEC TC 13 a harmonised standard EN 50470-4 is being developed. This document will be based on the IEC 62053-41, adopted with typical elements as mentioned in the MID, like other accuracy classes A/B/C, different terminology and the application of the composite error. This document is expected to be published in 2023.

As a result the following will be applicable:

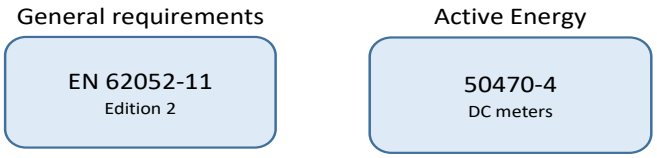


Figure 5: Upcoming harmonized standards for DC under MID

DEVELOPMENTS IN OIML

The International Organization of Legal Metrology (OIML) is a worldwide intergovernmental organisation whose primary aim is to harmonise the regulations and metrological controls applied by the national metrological services, or related organisations, of its Member States. The OIML publishes International Recommendations, which are model regulations that establish the metrological characteristics required for certain measuring instruments which specify methods and equipment for checking their conformity. The member states have an obligation to implement those recommendations into their national legislation.

However, for electricity meters, the vast majority of the countries in the world implemented the IEC standards in their legislation, mainly due to a lack of a good up-to-date OIML Recommendation.

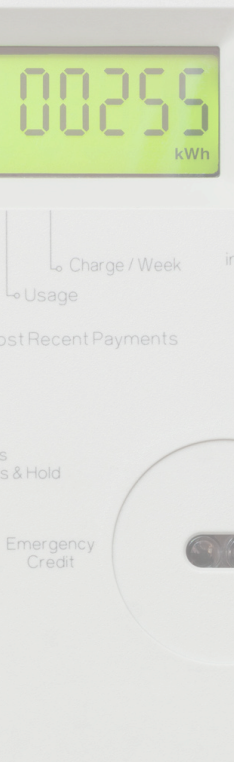
In 2012 OIML published the R 46, prepared by technical committee TC 12. This document covers active electrical energy meters. Since that time, several countries have used the R 46 as a basis for their national legislation. The R 46 is also included in the OIML Certification System.

At the moment, the R 46 is under revision. The main objective of the revision is to address new technologies and applications such as smart meters and to develop a more adaptable standard to promote universal acceptance and use. In the updated version, several new aspects will be added, such as:

- reactive energy meters
- prepayment meters
- meters with modular components, like remote indicators and sensors
- branch circuit meters
- electric vehicle charging stations
- street lighting

The OIML also recently decided to add DC meters.

The goal is to avoid possible barriers between OIML and other standardisation organisations like IEC and ANSI. To do so, the OIML will include an Annex on dealing with the differences in accuracy classes and load points by referring to several IEC standards, like the safety standard 62052-31, the durability standard 62059-32-1 as well as the standard for 2-150 kHz disturbances 61000-4-19.



NMi expects the official publication of the revised R 46 in 2023.

HOW TO DEAL WITH THOSE STANDARDS?

All these new documents and modifications to the already published standards may have a significant impact. How to deal with all those standards? NMi notes the following:

1. EN 50470 documents
   EN 50470 and the added requirements for immunity against 2-150 kHz disturbances currently remains harmonised under the MID. This route stays valid for MID approvals until the newer versions (EN 62052-11 with EN 50470-3 - edition 2) are published in the Official Journal as harmonised standards.

2. Safety standard IEC 62052-31 and IEC 62052 / 62053 Edition 2
   The safety standard is now effective within the IEC system. Testing in accordance with the safety standard is included in the assessment of electricity meters according to the 62052 / 62053 series.

3. IEC 62053-41 – DC meters
   DC meters can be examined according to the 62052-11 and 62053-41 and the German VDE Anwendungsregel VDE-AR-E 2418-3-100, Annex A. As soon as CENELEC TC 13 publishes the EN 50470-4, it can be applied as well.

4. Other documents
   After their publication, as indicated above, the documents can be used.

On top of this, NMi fields questions on how to apply standards during their transitional period in case an already certified product changes.

In general, a newer version of the standard remains voluntary as long as the transitional period is still valid. During that period, where an already certified meter changes and retesting is necessary, a manufacturer can indicate which standard to apply. However, a Certificate of Conformity for the new version of the standard is only possible after the device passes the examination in accordance with the new standard. As soon as the transitional period is over, the more recent version of the standard becomes mandatory.

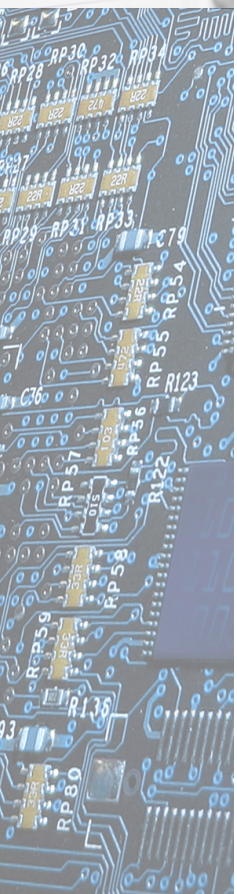
In Europe, MID approvals have a validity period of 10 years. Meters previously approved before the introduction of a new harmonised standard can still be placed on the market until the validity period of the approval ends.

If a manufacturer requests revision of an existing approval in case (a part of) such a meter is modified, the type approval examination will focus only on the modification itself. For example, if a manufacturer changes the software, only this change is examined while applying the new harmonised standard. No other aspects, e.g., EMC- or magnetic field testing, will be taken into account, under the condition that the change is not related to these aspects.

Once the validity period ends, an approval renewal can be issued for another 10-years after the product has passed the examination with the latest actual version of the harmonised standard as a whole.

CONCLUSION

Several standards are essential for electricity meters. Many of them were revised recently or will shortly be changed. These changes will significantly impact the construction of the meters and the testing and approval process. Publication of the safety standard 62052-31



will have considerable repercussions on the construction of the meters. NMi recommends that manufacturers and others involved in the rollout meters take these developments into account. The correct use of forthcoming standards will enable state-of-the-art meters designs prepared for the future.

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