STANDARDS IN MOTION

Standards for electricity meters in motion

INTRODUCTION

Electricity meters are being rolled out and installed in large quantities in many countries in the world. A number of international IEC and European standards are applicable for these meters, containing the requirements for the meters basic construction including electrical safety, as well as their accuracy under various conditions. However… these standards for electricity meters are in motion!
A new standard for electrical safety has been published, while the basic IEC and EN standards are currently being heavily revised. This white paper discusses the changes in all those documents and their impact, for meter manufacturers and others involved in the rollout of meters.

CURRENT IEC STANDARDS

For static electricity meters, mainly the following IEC standards are important:

General requirements	Active energy	Reactive energy
62052-11	62053-21 direct / indirect connected meters, class 1 and 2	62053-23 direct / indirect connected meters, class 2 and 3
	62053-22 indirect connected meters, class 0,2 S and 0,5 S	62053-24 direct / indirect connected meters, class 0,5 S, 1 S and 1

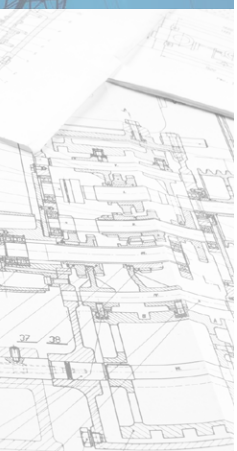
Figure 1: current IEC standards

All the standards as shown in Figure 1 have been published in 2003, apart from the 62053-24, which has been added to the scheme in 2014. They are applicable for the measurement of alternating current in 50 Hz or 60 Hz networks, up till voltages of 600 V.

The 62052-11 contains the general requirements. This includes mechanical requirements and tests for the construction of the meter and several requirements for electrical safety. In addition, climate conditions are described, as well as electrical requirements and type test conditions.

Furthermore, the 62053-21 and 62053-22 contain requirements for meters of various accuracy classes, for active energy. They contain requirements for the meters 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.

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



CURRENT EUROPEAN STANDARDS

In 2006 the Measuring Instruments Directive (MID) came into force. This European directive contains the essential requirements for a number of measuring instruments, including active electrical energy meters. Although a limited number of European countries has specific requirements for reactive energy as well, this aspect is not included in the MID.

In order to reflect those specific European requirements, CENELEC has published the EN 50470 series. These documents are constructed on the IEC 62052 / 62053 series as a basis, while adding some specific aspects as required by the MID (like 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:

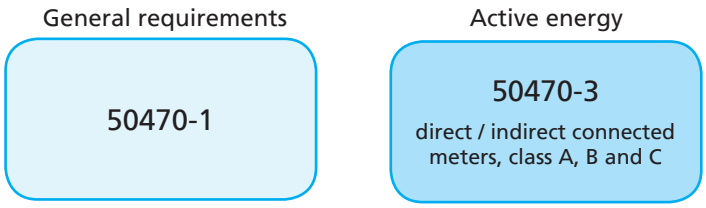


Figure 2: current EN standards

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

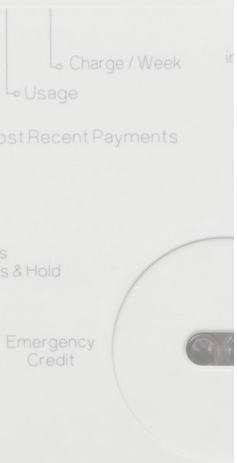
EN 50470 series are harmonised documents under the MID. Presumption of conformity with the MID is assumed, if a meter meets the requirements laid down in those documents, under the extra condition that the meter fulfils the essential requirements when being exposed to 2-150 kHz disturbances. The latter requirement has been added in 2012, when it was noticed this important frequency range was not covered by the EN 50470 series. In order to fill this gap the TR 50579 document has been developed by CENELEC TC 13, later followed by the basic EMC standard 61000-4-19, being published by IEC SC77A.

A NEW STANDARD FOR ELECTRICAL SAFETY

In 2015, IEC TC 13 has 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 61010-1:2010 established by TC 66. The purpose of the requirements of this standard is to 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 the protection against mechanical hazards, but also insulation requirements are covered, as well as clearance and creepage distances. Impulse voltage tests, AC or DC voltage tests and resistance to heat or protection against spread of fire are included. Depending on the design of the meter, the standard also contains specific tests for supply control switches or load control switches. This includes exposure to short-circuit currents, testing with a number of 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 safety of the meter is also examined under single fault conditions. This may happen in case a certain protection component is damaged, which can be simulated by short-circuiting or disconnection of that part.

Although the 62052-11:2003 standard already contained several safety related requirements, 62052-31:2015 standard presents a more comprehensive and complete set of requirements for meters, including possible add-on modules.
Therefore, in November 2016 IEC TC 13 published specific amendments to the 62052 / 62053 standards, where the specific safety clauses were replaced, referencing the new safety standard instead. As a result, 62052-31 has become effective, being part of the group of 62052 / 62053 standards, while applying a transitional period of 2 years, later extended by another period of 2 years.

As a result, 62052-31:2015 will become effective in November 2020. As said earlier, this effects all newly manufactured electricity meters and equipment for load control.

In Europe, the safety standard has been published as EN 62052-31. In December 2018 CENELEC TC 13 published specific 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 published in the Official Journal yet, 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 have to be withdrawn is 27 August 2021. As a result, it can be concluded the EN 62052-31 will become effective in Q3 2021 at the latest.

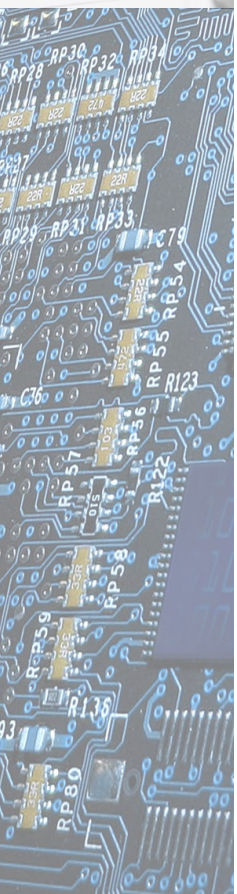
NEXT DEVELOPMENT: UPCOMING REVISION OF IEC STANDARDS

Recently, another project has been started within IEC TC13, with the objective to revise the 62052 / 62053 series of standards. Several drivers caused this initiative:

- those standards should already have been re-evaluated in 2013;
- a number of aspects of modern smart meters were necessary to be included, like communication technologies, new functionalities, the modular approach and software aspects;
- new requirements were necessary to be included, like 2-150 kHz disturbances;
- the introduction of the safety standard, requiring a new structure of the documents.

This has resulted in new draft versions of the 62052-11 and 62053-21/22/23/24 standards (Edition 2). The major changes are the following ones:

- Export energy is clearly addressed;
- DC meters are covered, with a reference to a new standard 62053-41, which is expected to be published in May 2021;
- The application of the standard is extended to networks with a voltage up to 1.000 V for AC meters and to 1.500 V for DC meters;
- The EMC requirements have been broadened, 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;
- New items are included, like a test with fast load changes, a durability test conform IEC 62059-32-1, tests with stronger magnets and the application of the phase-fired waveform test at extra phase angles;
- Meters with multiple voltage ranges are covered;
- Multi-branch meters are covered in a specific Annex;



- Requirements for the accuracy of the clock are included;
- Meters with a detached indicating display (powered by the meter) are included;
- The addition of new accuracy classes 0,1 S (62053-22) and 0,5 (62053-21);
- The removal of safety related aspects, while referencing safety standard 62052-31.

Apart from these major changes, a number of other aspects have been updated, in order to achieve a brand new set of documents, containing state-of-the-art requirements. The official publication of 62052 / 62053 Edition 2 documents will take place in Q2 2020. The documents will have a transitional period of 2 years.

OTHER LONG TERM DEVELOPMENTS WITHIN IEC

Several other developments have been started within IEC TC 13, where the documents can be expected in the near future:

- Safety standard 62052-31 – a new edition with improvements, official publication is expected in December 2021;
- DC standard 62053-41 – a new standard for DC meters for active energy (class 0.5 and 1), official publication is expected in May 2021;
- Prepayment standard 62055-31 – a new edition, for static payment meters for active energy (classes 1 and 2), official publication is expected in May 2021;
- Test equipment 62057-1 – a new document, for stationary meter test units, official publication expected in December 2020.

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

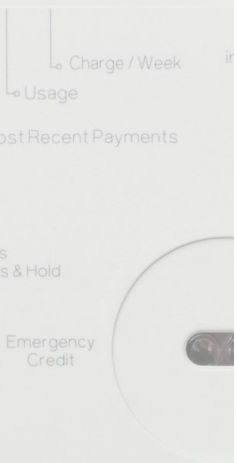
- embedded software applied in metering equipment;
- multi-energy and multi-function metering equipment;
- metering equipment processing digital information derived by Low Power Instrument Transformers (LPIT);
- control switches contained with and/or controlled by metering equipment.

IMPACT ON EUROPEAN STANDARDS

The above-mentioned changes in the IEC documents will have an impact on the European documents as well. What is to be expected?

At the moment the EN 50470:2006 documents are still harmonised under the MID. However, after publication of the IEC 62052-11 edition 2 document in Q2 2020, the European version will be issued as EN 62052-11, most likely as an identical copy. As a result, all improvements on IEC level will be available on European level as well.

Furthermore, CENELEC TC 13 will publish a new version of the EN 50470-3 as well, containing the specific European requirements as laid down in the MID. This document is expected in Q3 2020.



As a consequence, in the near future the following documents will be used as harmonised standards, after being published in the Official Journal, as indicated in figure 3:

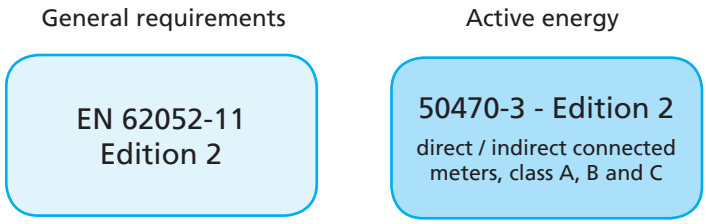


Figure 3: Upcoming harmonised standards under the MID

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

LOW VOLTAGE DIRECTIVE (LVD)

In Europe the Low Voltage Directive (2014/35/EU) plays an important role to ensure that electrical equipment provides a high level of protection. In general, it applies to all electrical equipment designed to be used at voltages from 50 to 1.000V AC and 75 to 1.500V DC. However, from the beginning electricity meters are excluded from the scope of the LVD. The main reason for that was that the old EEC regulations for electricity meters already contained a number of electrical safety tests. The MID, which came into force in 2006, is mainly intended for legal metrology and therefore it contains hardly specific safety requirements. Although the existing harmonised standards EN 50470 do include several safety tests, in general, for electricity meters electrical safety is not clearly addressed.

However, as soon as electricity meters contain a radio module, the Radio Equipment Directive (RED) becomes applicable. In the RED electrical safety is addressed, while referencing the LVD. As a consequence, there is no level playing field for meters with and without radio modules.

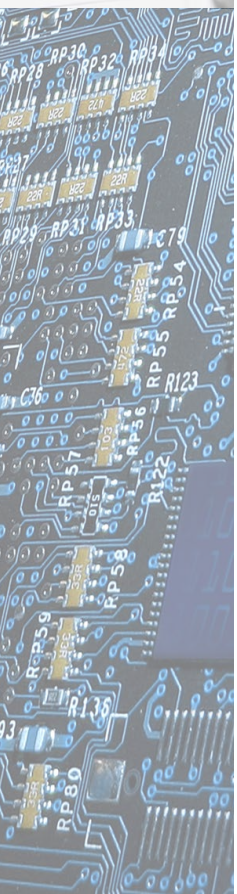
The introduction of the safety standard 62052-31, as discussed above, could be a help to change this situation. CENELEC TC 13 has proposed to remove the exclusion from electricity meters in the LVD and to apply the EN 62052-31 as harmonised standard for presumption of conformity with the safety requirements. At the moment this proposal is under consideration by the European Commission.

DEVELOPMENTS IN OIML

The International Organization of Legal Metrology (OIML) is a worldwide, intergovernmental organization whose primary aim is to harmonize the regulations and metrological controls applied by the national metrological services, or related organizations, of its Member States. They publish International Recommendations, which are model regulations that establish the metrological characteristics required for certain measuring instruments and which specify methods and equipment for checking their conformity. The member states have the 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 the R 46 has been used as a basis for their legislation in several countries. The document is also included in the OIML Certification System.



At the moment the R 46 is being revised. The main objective is to address also new technologies and applications (smart meters) and to develop a more adaptable standard, being more broadly accepted and applied. In the new version several new aspects will be added, like:

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

Possible barriers between OIML and other standardisation organizations like IEC and ANSI will be avoided as much as possible. This is done by including an Annex how to deal 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.

The official publication of the revised R 46 is expected in 2022.

TIMELINE

The time line on the next page gives an overview at which moment the above mentioned documents can be expected, as presented in Figure 4.

HOW TO DEAL WITH ALL THOSE STANDARDS?

All these new documents and modifications to the already published standards may have a big impact. How to deal with all those standards? Several statements can be made:

1. **EN 50470 documents**
   At the moment the EN 50470 documents are still harmonised under the MID, together with the added requirements for immunity against 2-150 kHz disturbances. This route remains valid for MID approvals, until the moment the newer versions (EN 62052-11 with EN 50470-3 - Edition 2) will be published in the Official Journal as harmonised standards.

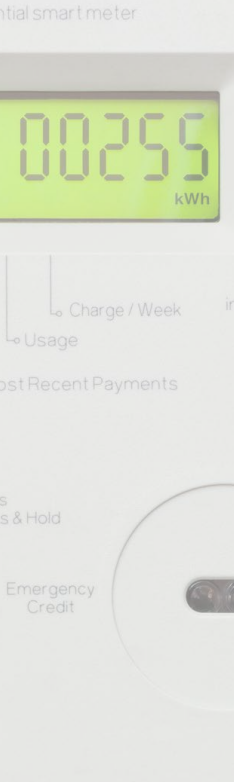
2. **Safety standard IEC 62052-31**
   Testing in accordance with the safety standard is already possible, but still voluntary. From November 2020 onwards the document becomes effective in the IEC system, at that time the transitional period ends (Amendment 1 on IEC 62052-11).

3. **IEC 62052 / 62053 – Edition 2**
   Testing in accordance with the draft versions is already possible, but still voluntary. While calculating with a transitional period of 2 years, this edition becomes effective in 2022.

4. **IEC 62053-41 – DC meters**
   DC meters will be addressed already in the IEC 62052 / 62053 – Edition 2 documents. However, testing is only possible after publication of the (draft) IEC 62053-41.

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

   On top of this, it can be questioned how to apply the standards during their transitional period in case an already certified product is changed.



2015

IEC: 62062-31 Safety standard

2016

IEC: Amendment of 62052-11, reference to Safety standard

2017

2018

CLC: Amendment of EN 50470, reference to Safety standard

2019

2020

IEC: 62052 / 62053 Edition 2

CLC: EN 62052-11 / EN 50470-3 Edition 2
IEC: Safety standard effective
IEC: 62057-1 for stationairy meter test units

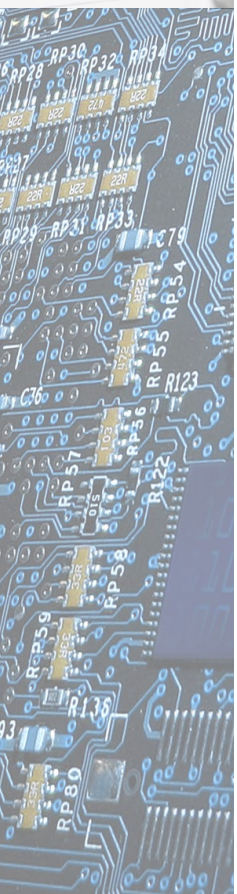
2021

IEC: 62053-41 for DC meters ; 62055-31 Edition 2
CLC: Safety standard effective
IEC: 62052-31 Edition 2

2022

IEC: 62052 / 62053 Edition 2 effective
OIML: R46 Edition 2

Figure 4: Time line upcoming standards



In general it can be said that a newer version of the standard remains voluntary as long as the transitional period is still valid. During that period of time, in case an already certified meter is changed 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 passed the examination in accordance with the new standard as a whole. As soon as the transitional period is over, the newer version of the standard becomes mandatory.

In Europe, MID approvals have a validity period of 10 years. Meters, which have been 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 revision of an existing approval is requested 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 change is made to the software, only this change is examined, while applying the new harmonised standard as a basis. No other aspects, like e.g. EMC- or magnetic field testing, will be taken into account, under the condition that the change is not related to these aspects.

As soon as the validity period ends, a renewal of the approval 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

A number of standards is important for electricity meters. Many of them will be revised in the near future. That has a big impact on the construction of the meters, as well as the testing and approval process. Also, the publication of the safety standard 62052-31 has a big impact on the construction of the meters. It is recommended for meter manufacturers and others who are involved in the rollout to take these developments into account. The correct use of the upcoming standards will lead to state-of-the-art meters designs, being prepared for the future.

Henri Schouten is Senior Approvals Expert at testing- and certification institute NMi and member of several international committees for smart meters, like OIML, IEC /CENELEC TC13 and WELMEC 11.

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