COMMITTEE DRAFT OIML/1CD

Date: 7 February 2011

Reference number:
OIML TC 5/SC 1/002/1CD

Supersedes document:
OIML D11 (2004)

OIML TC 5 / SC 1

Title: Environmental conditions

Secretariat:
The Netherlands

Circulated to P- and O-members and liaison international bodies and external organisations for:

[X] discussion at (date and place of meeting):**27 - 28 June 2011** in **Utrecht;** The Netherlands

[X] comments by: **16 May 2011**

[ ] vote (P-members only) and comments by:

TITLE OF THE CD (English):
OIML D 11
Environmental requirements for measuring instruments

TITRE DU CD (French):
OIML D 11
Exigences environmentales pour les instruments de mesure

Original version in: English

Explanatory note to the 1 CD

(Temporary section to be removed after finalization of the Recommendation)

After publication of OIML D11: *General requirements for electronic measuring instruments* in 2004 the test methods and manner of presentation were implemented in many Recommendations and thus has been of great support in harmonization and speeding up the production processes for these Recommendations.

However soon after publication it appeared that many referred standards tend to be updated in quite short timeframes.

During the meeting of OIML TC 5/SC 1 (Electronic instruments) on 21–22 October 2002 in Delft this need for frequent regular updates of references to standards was already discussed and following a suggestion by participants the secretary of OIML TC 5/SC 1 produced an overview in OIML Bulletin Volume XLVI - Number 4 -October 2005 of the status at that time of the ISO and IEC Standards referred to in OIML D 11 (2004).

In a later stage it was concluded in discussion with the BIML Director on 22 September 2006, that publication as an Expert Report on the OIML web site would be more appropriate in which way a better availability and continuity in updating references would be supported. This resulted in the publication of Expert Report E 5:2006. A second update of this report: "*Overview of the present status of the Standards referred to in OIML D 11 - General requirements for electronic measuring instruments (2004)"* has been published in beginning 2010.

During the existence of OIML D11 it became more and more clear that it would be welcome when the title and scope of the document would be somewhat extended beyond the present restriction to electronic instruments only. In the published document scope and field of application some space for wider application was yet made, however the title is kept restricted.

In order to get to an adjusted title and scope a proposal for amendment was submitted by the secretariat of TC 5/SC 1 to CIML at its meeting in Sidney in 2008.

The CIML approved the proposal and accepted as the new document title*:*

"Environmental requirements for measuring instruments" (Exigences environnementales pour les instruments de mesure)

noting that:

"The present edition of D 11 gives OIML TCs/SCs the possibility to apply the relevant aspects of D 11 to non-electronic instruments, but on a strictly voluntary basis. Experience has shown that, reading the title of D 11, many people regard D 11 as dealing with electromagnetic compatibility only, and often insufficiently realize that it also covers for instance temperature, vibration and mechanical shock."

And a new project was proposed by the secretariat for revising OIML D11, which also was approved by CIML in its meeting in Sidney in 2008. This project was accepted having the following scope, purpose and justification:

"The primary aim of this revision of OIML D 11 is to update the standards referred to therein. This revision is also the ideal opportunity to clarify the scope of D 11 by changing its title from "General requirements for electronic measuring instruments" to "Environmental requirements for measuring instruments Furthermore, this revision might include other improvements like, for instance, a better separation between requirements and tests.

OIML D 11 was published in 2004, so the review period of 5 years has not yet expired. But clause 3.7.2 of the OIML Directives for the Technical Work provides for the possibility to propose an earlier review.
In the opinion of the Secretariat and others, so many standards referred to in D 11 have since been changed or replaced (See also OIML E 5), that the time has come to start a revision.
And now the generally accepted philosophy is that the requirements in the OIML Recommendations shall, as far as possible, be independent of technology.

A clarification of the scope/field of application of D 11 could be achieved by modifying the title."

In the time between this approval and the publication of this first draft several definitions used in D11 which were copied from the referred vocabulary (VIM) changed as a consequence of an extensive update of this vocabulary.

Furthermore some test methods needed to be amended and at least a few additional tests needed to be implemented to keep compliance with recent innovations and the changes in mainly electromagnetic environment and to mend detected leeks in coverage by the test methods included in OIML D11 (2004). Examples of such gaps are the lacking of methods for testing the immunity to disturbances caused by the increasing use of mobile and/or wireless communication means and instrumentation and distortions on mains power produced by e.g. power converters and adapters.

In the mean time also a personnel change at the Secretariat took place. By combining the input from collected notes of the former secretary and the gained information collected from TC 9/SC 2 and TC 12 meeting in 2009 as well as the TC1 (VIML) meeting in 2010 with the secretariats background knowledge on EMC the preparation of the present Committee Draft was taken up. Main attention concerned the producing of quite a number of proposals for amendments, which below are summarized in general terms:

- modification of terminology as to comply with the new (2010) edition of the "VIM";
- amending of definitions in order to harmonize with updated vocabularies (VIML(in revision) and VIM) and to converge terminology used such that it can be adapted in most Recommendations including those yet quite deviating;
- modification of terminology in such a way that redefining single words having a different meaning in every day English (US and UK) is as much as possible omitted ;
- removing the subjective term "severity" where "level" is more applicable and introduction of use of "index" where stepwise increasing indexing is concerned;
- removing mix up of wording "applicable" and "relevant";
- use of "electromagnetic" where applicable instead of "electrical";
- introduction of environmental class E3 non-mains local source of electrical power supply;
- more logical rearrangement of tables in Chapter 12-14. (On basis of EM frequency spectrum);
- updating of almost all referred references. (Since the publication of revised VIML and ref [26] is expected before or at about the same moment as the revised OIML D11, to be updated just before publication)
- attempts to reword vague formulated and grammatically incorrect clauses.

Some more comments of the secretary on specific clauses are included in this CD and a separate document in table format is added to with observations from the secretariat and presenting alternatives

All information can be downloaded from the OIML TC 5/SC 1 web pages following the link

http://workgroups.oiml.org/tcsc/tc-5/tc-5-sc-1

(Part of these web pages are password protected. Please approach the TC 5/SC 1 BIML contact or Secretariat in case of unknown or lost username and/or password)

Contents

Comment [GT1]: Note ! Contents table to be completed

Foreword

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.

The two main categories of OIML publications are:

• International Recommendations (OIML R), which are model regulations that establish the metrological characteristics required of certain measuring instruments and which specify methods and equipment for checking their conformity; the OIML Member States shall implement these Recommendations to the greatest possible extent;

• International Documents (OIML D), which are informative in nature and intended to improve the work of the metrological services.

OIML Draft Recommendations and Documents are developed by Technical Committees or Subcommittees which are formed by the Member States. Certain international and regional institutions also participate on a consultation basis.

Cooperative agreements are established between OIML and certain institutions, such as ISO and IEC, with the objective of avoiding contradictory requirements; consequently, manufacturers and users of measuring instruments, test laboratories, etc. may apply simultaneously OIML Publications and those of other institutions.

International Recommendations and International Documents are published in French (F) and English (E) and are subject to periodic revision.

This Publication - reference OIML D 11, edition 2011 (E) – was developed by the OIML Technical Subcommittee TC 5/SC 1 Environmental conditions **. It was approved for final publication by the International Committee of Legal Metrology in 20**11.

OIML publications may be downloaded from OIML web site in the form of PDF file.
Additional information on OIML publications may be obtained from the Organization's headquarters:

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1. Introduction

1.1 The primary aim of this International Document is to provide the OIML Technical Committees and Subcommittees with guidance for establishing appropriate metrological performance testing requirements for influence quantities that may affect the measuring instruments covered by International Recommendations. Furthermore, this International Document aims to provide guidance to especially OIML Member States in the implementation of OIML Recommendations in their national laws, in particular in their choice on the applicability and severity of the testing as far as not prescribed in the applicable Recommendation, but left to national legislation.

1.2 Based on information obtained from IEC and ISO standards and on the experience of experts who participated in its elaboration, this Document advises the OIML Technical Committees and Subcommittees on the selection of the appropriate tests for measuring instruments, while taking into account the operational and environmental factors governing their use.

1.3 The influence quantity tests' range and test level should be, when possible, selected from the levels proposed in this Document, taking into account the conditions of use of the instruments concerned, and the most recent IEC and ISO standards in the given field.

1.4 The OIML technical Committees and Subcommittees responsible for specific OIML Recommendations may:

- Establish test procedures and special test levels (higher or lower) in Recommendations, different from those specified in the Document, if that would be more appropriate for specific measuring instruments or environments.
- Utilize the expertise and knowledge of the OIML TCs and SCs or of other organizations to develop special test procedures and conditions not specified in OIML D 11.

2. Scope and field of application

2.1 This OIML Document specifies general metrological requirements applicable to measuring instruments and describes tests for verifying the compliance of an instrument with these requirements.

2.2 This Document shall be taken into consideration by the OIML Technical Committees and Subcommittees as a basis for establishing particular requirements and test to be performed on measuring instruments concerning their sensibility to influence quantities the of requirements and tests in the applicable OIML Recommendations.

2.3 The applicable Recommendation may either specify that requirements adopted from this Document apply only to electronic devices or also to other devices .

Notes:

(1) This Document does not cover those requirements for measuring instruments which are not related to external influence quantities and which are to be covered by the applicable Recommendation. For example: requirements on zero-setting devices, totalizers, etc.

(2) This Document does not address aspects such as safety or emissions of electromagnetic phenomena from measuring instruments. The requirements for these aspects are beyond the OIML scope and should be taken into account in accordance with the applicable international, regional or national regulations,

(3) This Document does not address aspects of influence by remote protocols such as software routines. For those aspects the OIML document D31 is applicable.

3. Terminology

The definitions used in this Document are in conformity with the International Vocabulary of Basic and General Terms in Metrology (VIM) [1] and the (draft)Vocabulary on Legal Metrology (VIML) [x]
For the purpose of this OIML Document, the definitions and abbreviations given below apply:

Comment [GT2]: To be completed before publication

3.1 electronic measuring instrument
instrument intended to measure an electrical or non-electrical quantity using electronic means and/or equipped with electronic devices.

Note: For the purpose of this Document, auxiliary equipment provided that it is subject to metrological control, is considered to be a part of the measuring instrument.

3.2 module
device performing a specific function or functions and (usually) manufactured and constructed such that it can be separately evaluated.

Notes:
(1) A module may be a complete measuring instrument (for example: counter scale, electricity meter) or a part of a measuring instrument (for example: printer, indicator).

(2) OIML B3 [2] contains the following definition for a "module":
Identifiable part of a measuring instrument or of a family of measuring instruments that performs a specific function or functions and that can be separately evaluated according to prescribed metrological and technical performance requirements in the applicable Recommendation.

3.3 device
identifiable instrument or part of an instrument or of a family of instruments having an identifiable function or functions

Notes:
(1) A device may be a stand-alone and complete measuring instrument (for example: counter scale, electricity meter) or a part of a measuring instrument (for example: printer, indicator).

3.4 (measurement) error

VIM:
2.16 (3.10)
measurement error
error of measurement
error

measured quantity value minus a reference quantity value

Note 1 The concept of 'measurement error' can be used both:

a) when there is a single reference quantity value to refer to, which occurs if a calibration is made by means of a measurement standard with a measured quantity value having a negligible measurement uncertainty or if a conventional quantity value is given, in which case the measurement error is known, and
b) if a measurand is supposed to be represented by a unique true quantity value or a set of true quantity values of negligible range, in which case the measurement error is not known.

Note 2 Measurement error should not be confused with production error or mistake.

It is suggested by the secretariat to copy this new VIM definition, excluding the notes.

Further comment:
The former as well as the present definition of (measurement) error is often considered to be the definition for the absolute error. Though when expressing the parameter in percentage or dB this definition could also be applied to a relative error. It shall be decided whether a separate definition for a relative error is needed. See also the note 2 on the definition of "fault"
In the case that an extra definition is needed the following addition is suggested:

3.4.1 relative error ($E_{\%}$)

ratio between the error (value) and the reference quantity value
(e.g. in a percentage or decibel)

3.5 error (of indication) [VIML x.x]
indicated quantity value of a measuring instrument minus a reference quantity value .

3.6 maximum permissible errors (of a measuring instrument) [VIM 5.21]
Extreme values of an error permitted by specifications, regulations, etc. for a given measuring instrument.

VIM:
4.26 (5.21)
maximum permissible measurement error
maximum permissible error
limit of error
extreme value of measurement error, with respect to a known reference quantity value, permitted by specifications or regulations for a given measurement, measuring instrument, or measuring system
Note 1 Usually the term “maximum permissible errors” or “limits of error” are used, where there are two extreme values.
Note 2 The term “tolerance” should not be used to designate ‘maximum permissible error’.

It is suggested by the secretariat to copy the new VIM text and leave out the notes.

3.7 intrinsic error Not any more defined in the new VIM
error of a measuring instrument, determined under reference conditions.

3.8 initial intrinsic error
intrinsic error of a measuring instrument as determined prior to performance tests and durability evaluations.

3.9 fault
difference between the error of indication and the intrinsic error of a measuring instrument .

Notes:

(1) Principally, a fault is the result of an undesired change of data contained in or flowing through an electronic measuring instrument.

(2) From the definition it follows that in this Document, a "fault" is a numerical value which is expressed either in a unit of measurement or as a relative value, for instance as a percentage.

Furthermore the following definition from the VIM is rather similar.

VIM 4.22
variation due to an influence quantity
difference in **indication** for a given **measured quantity value**, or in **quantity values** supplied by a **material measure**, when an **influence quantity** assumes successively two different quantity values

Since the term “fault” is in use within metrology for quite some time and implemented in many OIML Publications it is suggested to use for the time being both words : **Fault** or **Shift,** and similar amendment “significant fault”

3.9a fault limit
value specified in the applicable Recommendation delimiting non-significant faults

3.10 significant fault
fault exceeding the applicable fault limit value

Note:

The applicable Recommendation may specify that the following faults are not significant, even when they exceed the value defined in 3.9a

(a) faults arising from simultaneous and mutually independent causes (e.g. EM fields and discharges) originating in a measuring instrument or in its checking facilities,

(b) faults implying the impossibility to perform any measurement,

(c) transitory faults being momentary variations in the indication, which cannot be interpreted, memorized or transmitted as a measurement result,

(d) faults giving rise to variations in the measurement result that are serious enough to be noticed by all those interested in the measurement result; the applicable Recommendation may specify the nature of these variations.

Secr. Comment:
One should be aware that with the above definition a significant fault is a Boolean which also applies to significant durability error. (like "significant fault" is used in clause 4.2) These terms therefore implicitly have no numeric value. They are true or false . For fault "fault limit" is introduced as term for the numeric values established above which a fault is considered a significant fault. Similar defining "durability limit" could be taken into consideration.

3.11 durability error
difference between the intrinsic error after a period of use and the initial intrinsic error of a measuring instrument.

3.12 significant durability error
durability error exceeding the value specified in the applicable Recommendation.

Note: The applicable Recommendation may specify that durability errors are not significant, even when they exceed the value defined in 3.12, in the following cases:

(a) the indication cannot be interpreted, memorized or transmitted as a measurement result,

(b) the indication implies the impossibility to perform any measurement,

(c) the indication is so obviously wrong that it is bound to be noticed by all those interested in the result of the measurement, or

(d) a durability error cannot be detected and acted upon due to a breakdown of the appropriate durability securing facility.

3.13 influence quantity [VIM 2.7]
A quantity that is not the measurand but that affects the result of the measurement.

VIM 2.52 (2.7)
influence quantity
quantity that, in a direct measurement, does not affect the quantity that is actually measured, but affects the relation between the indication and the measurement result
EXAMPLES
a) Frequency in the direct measurement with an ammeter of the constant amplitude of an alternating current.
b) Amount-of-substance concentration of bilirubin in a direct measurement of haemoglobin amount-of-substance concentration in human blood plasma.
c) Temperature of a micrometer used for measurement of length of a rod, but not the temperature of the rod itself, which can enter into the definition of the measurand.
d) Background pressure in the ion source of a mass spectrometer during a measurement of amount-of-substance fraction.

Note 1 An indirect measurement involves a combination of direct measurements, each of which may be affected by influence quantities.

Note 2	In the GUM, the concept 'influence quantity' is defined as in the 2nd edition of the VIM, covering not only the quantities affecting the measuring system, as in the definition above, but also those quantities that affect the quantities actually measured. Also, in the GUM this concept is not restricted to direct measurements.

Secr. Comment:
Suggested to copy the definition from the VIM although the definition in the VIM can be interpreted in different ways while measurement result is not defined; therefore addition of the definition of the term "measurement result" is suggested (see definition in new VIM.)

3.13.1 influence factor
influence quantity having a value which ranges within the rated operating conditions of a measuring instrument.
Notes:
(1) The rated operating conditions shall be in conformity with the applicable requirements specified in the relevant Recommendation
(2) The variation of an indication as a consequence of an influence factor is considered an error and not a fault.

3.13.2 disturbance
influence quantity having a value exceeding the range specified in the rated operating conditions of the measuring instrument, but not exceeding certain limits set (and laid down in the applicable Recommendation).

Notes :
(1) The "certain limits" referred to concern quantity values established having an appreciable probability of occurrence within the specified environment of the measuring instrument.
(2) A disturbance typically is of stochastic nature

(3) In case the list of rated operating conditions of a measuring instrument does not include a range for the specific influence quantity the influence quantity is qualified as being a disturbance

3.14 rated operating conditions [Adapted from VIM 5.5]
conditions of use giving the range of values of influence quantities for which specified metrological characteristics of a measuring instrument are intended to lie within given limits.

VIM 4.9 (5.5)	**rated operating condition** operating condition that must be fulfilled during measurement in order that a measuring instrument or measuring system perform as designed
Note	Rated operating conditions generally specify intervals of values for a quantity being measured and for any influence quantity.

Secr. Comment:
Suggest to copy the new definition.

3.15 reference conditions [VIM 5.7]
conditions of use prescribed for testing the performance of a measuring instrument or for intercomparison of results of measurements.

Note:
The reference conditions generally include reference values or reference ranges for the influence quantities affecting the measuring instrument.

VIM 4.11 (5.7)	**reference operating condition** **reference condition** operating condition prescribed for evaluating the performance of a measuring instrument or measuring system or for comparison of measurement results.

Note 1	Reference operating conditions specify intervals of values of the measurand and of the influence quantities.
Note 2	In IEC 60050-300, item 311-06-02, the term “reference condition” refers to an operating condition under which the specified instrumental measurement uncertainty is the smallest possible.

Secr. Comment:
Suggest to copy the new definition and deleting note 2

3.16

Secr. Comment:
Suggested to delete the definition 3.16 (performance) while e.g. substitution 3.17 results in nonsense and when used in the further document the general meaning in English language is applicable.

3.17 durability
ability of the measuring instrument to maintain its performance characteristics over a period of use.

3.18 checking facility
facility that is incorporated in a measuring instrument and which enables:

- significant faults
- incorrect functioning of a specific device of the measuring instrument; and/or
- disturbed communication between specific devices of the measuring instrument

to be detected and acted upon.

Note:
"Acted upon" refers to any adequate response by the measuring instrument (luminous signal, acoustic signal, prevention of the measurement process, etc.).

Comment [GT3]: alternative: Facility that is incorporated in the meter and which enables faults that would otherwise be significant faults to be detected and acted upon in such a way that incorrect registration is prohibited or recorded separately. (used in draft R46)

Comment [GT4]: See remark 1.2

Secr. Comment:
The addition of the two last bullets is based on the need for extending the definition to prevent confusion with the use of a similar definition particularly in flow measurement

3.18.1 automatic checking facility
checking facility that operates without the intervention of an operator.

3.18.1.1 permanent automatic checking facility (type P)
automatic checking facility that operates at each measurement cycle.

3.18.1.2 intermittent automatic checking facility (type I)
automatic checking facility that operates at certain time intervals or per fixed number of measurement cycles.

3.18.2 non-automatic checking facility (type N)
checking facility that requires the intervention of an operator.

3.19 durability protection facility
facility that is incorporated in a measuring instrument and which enables significant durability errors to be detected and acted upon .

3.20 test
series of operations intended to verify the compliance of the equipment under test (EUT) with specified requirements.

3.20.1 test procedure
detailed description of the test operations.

3.20.2 test program
description of a series of tests for certain types of equipment.

3.20.3 performance test
test intended to verify whether the EUT is able to accomplish its intended functions.

3.20.4 durability test
A test intended to verify whether the EUT is able to maintain its performance characteristics over a period of use.

3.21 mains power
mains
primary external source of electrical power for an instrument, including all sub-assemblies.
(Examples: public power (AC or DC), generator, external battery or other DC supply systems)

3.22 power converter (power supply device)
sub assembly converting the voltage from the mains power to a voltage suitable for other sub-assemblies.

3.23 auxiliary battery
battery that is:
- mounted in, or connected to, an instrument that can be powered by the mains power as well, and
- capable to supply power for the complete instrument for a reasonable period of time.

3.24 back-up battery
battery that is intended to maintain power supply for specific functions of an instrument in the absence of the primary power supply.
(For example: to preserve stored data)

3.25 Abbreviations

AC	Alternating Current
AM	Amplitude Modulation
ASD	Acceleration Spectral Density
DC	Direct Current
DIS	Draft International Standard (ISO)
EM	Electromagnetic
EMC	ElectroMagnetic Compatibility
e.m.f.	electromotive force
ESD	Electrostatic Discharge
EUT	Equipment Under Test
GSM	Global System for Mobile communication
IEC	International Electrotechnical Committee
I/O	Input / Output (refers to ports)
ISO	International Organization for Standardization
MPE	Maximum Permissible Error
N.A.	Not Applicable
RF	Radio Frequency
RH	Relative Humidity
RMS	Root Mean Square
WHO	World Health Organisation

4. Instructions for use of this Document in drafting OIML Recommendations

4.1 The applicable Recommendation shall specify, for each category or subcategory of measuring instruments:
(a) expected influence factors, during operating and reference conditions,
(b) expected disturbances and associated expected maximum intensity (limit of disturbance) ,
(c) maximum permissible errors on type evaluation, on initial verification, in service, and on subsequent verification, as well as significant fault level, and significant durability error level (wherever applicable).

4.2 The applicable Recommendation may specify additional requirements or adapt the requirements in this Document with a view to limiting the occurrence of the significant faults defined in 3.10.

Note:
These requirements may depend on the nature of the measurement (repeatable, non-repeatable, non-interruptible, etc.) or the intended use (trade, direct selling to the public, health, law enforcement, etc.).

4.3 The applicable Recommendation may specify requirements concerning the occurrence of durability errors defined in 3.11 (see note clause 4.2).

4.4 Some of the test described in this Document may be relevant only for specific kinds of instruments. Therefore, a test for a particular kind of instrument should be included only if that instrument is likely to be significantly influenced by the test, under the instruments´ specified operating conditions.

4.5 Chapter 8 of this Document contains guidelines for the determination of the test levels to be applied in the evaluation of compliance with the requirements specified in the applicable Recommendation

4.6 All referenced standards and normative documents are subject to revision, and the users of this Document are encouraged to investigate the possibility of applying the most recent editions of these documents.

Note:
The applicable Recommendation shall specify the rated operating conditions, reference conditions and limits of disturbances for the category of instruments concerned. However, the applicable Recommendation may indicate that individual subcategories of measuring instruments may have different rated operating conditions, reference conditions and limits of disturbances.
Rated operating conditions are generally specified as a range (for example: - 10 °C to + 40 °C); reference conditions are generally specified as a single value with a range of variation (for example: 23 °C ± 2 °C).
The reference conditions shall preferably be specified in accordance with IEC 60068-1 (1988-6), Appendix B (including Amendment 1, 1992-4), Environmental testing. Part 1: General and guidance [3]

5. Requirements for measuring instruments with respect to their environment

Comment [GT5]: Not restricted to electronics only but restricted to environmental conditions

Measuring instruments shall comply with the following requirements, notwithstanding all other technical and metrological requirements of the applicable Recommendations, when installed and used in accordance with the manufacturers' specifications.

5.1. General requirements

5.1.1 Measuring instruments shall be designed and manufactured such that their errors do not exceed the maximum permissible errors under rated operating conditions.

5.1.2 Measuring instruments shall be designed and manufactured such that when they are exposed to disturbances, either:
(a) significant faults do not occur, or
(b) significant faults are detected and acted upon by means of a checking facility.

Note:
A fault equal to or smaller than the value fixed (fault limit) in the applicable Recommendation as defined in 3.10 is allowed irrespective of the value of the error of indication.

5.1.3 The provisions in 5.1.1 and 5.1.2 shall be durably met. Measuring instruments shall be designed and manufactured such that either:
(a) significant durability errors do not occur, or
(b) significant durability errors are detected and acted upon by means of a durability protection facility.

5.1.4 The type of a measuring instrument is presumed to comply with the provisions in 5.1.1, 5.1.2 and 5.1.3 if it passes the examination and tests specified in 6.2.

5.2. Application

5.2.1 The provisions in 5.1.2 (a) and 5.1.2 (b) may be applied separately to:
(a) each individual cause of significant fault, and/or
(b) each part of the measuring instrument.

5.2.2 The choice of whether 5.1.2 (a) or 5.1.2 (b) is applied is left to the manufacturer, unless the applicable Recommendation specifies otherwise in view of the intended use of the measuring instrument or the nature of measurement (see note clause 4.2).

5.2.3 The provisions in 5.1.3 (a) and 5.1.3 (b) may be applied separately to each part of the measuring instrument (for example: analogue and digital parts).

5.2.4 The choice of whether 5.1.3 (a) or 5.1.3 (b) is applied is left to the manufacturer, unless the applicable Recommendation specifies otherwise.

5.3. Measuring instruments equipped with checking facilities

5.3.1 For each function of measuring instrument the applicable Recommendation may specify:
(a) the kind of checking facility (P, I or N), as defined in 3.18,
(b) the checking frequency, if appropriate,
(c) the method of acting upon a significant fault.

5.3.2 The applicable Recommendation may specify that it shall be possible to determine the presence and correct functioning of these facilities.

5.3.3 The requirements in 5.3.1 and 5.3.2 do not apply to measuring instruments or parts of measuring instruments for which the manufacturer claims compliance with the provisions in 5.1.2 (a) and which are nevertheless equipped with checking facilities.

5.4. Measuring instruments equipped with durability protection facilities

5.4.1 The applicable Recommendation may specify:
(a) details concerning the operation of the durability protection facilities, and/or
(b) the method of acting upon the detection of significant durability errors.

5.4.2 The applicable Recommendation may specify that it shall be possible to determine the presence and correct operation of these facilities.

5.4.3 The requirements in 5.4.1 and 5.4.2 do not apply to measuring instruments or parts of measuring instruments for which the manufacturer claims compliance with the provision in 5.1.3 (a) and which are nevertheless equipped with durability protection facilities.

5.5 Requirements for battery powered instruments (local power supply)

5.5.1 Specification of batteries

Type(-s) and capacity(-ies) of the batteries allowed to be used in the applicable measuring instruments shall be specified by the manufacturer. Instruments not equipped with allowed batteries are considered not of the same type.

5.5.2 Stand-alone batteries

Instruments powered by non-rechargeable batteries or by rechargeable batteries that cannot be (re)charged during the operation of the measuring instrument, shall comply with the following requirements:
(a) Instrument provided with new and fully charged batteries shall comply with the metrological requirements;

(b) As soon as the battery voltage has dropped to the level specified by the manufacturer as the minimum voltage at which the instrument still complies the metrological requirements, this shall be detected and acted upon by the instrument. The Recommendation may prescribe this manner of response.

For such instruments, the exposure tests related to influence quantities associated with the "mains" power variations and interferences need not to be performed.

In the criteria for (categories of) instruments, a minimum period of time shall be stated during which the instrument shall function properly without changing or recharging the batteries and (in particular for continuous totalizing measuring equipment) provisions may be prescribed that prevent the loss of stored data.

5.5.3 Rechargeable auxiliary batteries

Instruments powered by rechargeable auxiliary batteries that are intended to be (re)charged during the operation of the measuring instrument shall both:

(a) comply with the requirements of 5.5.2 with the mains power switched off, and
(b) comply with the requirements for mains powered instruments with the mains power switched on.

5.5.4 Back-up batteries

Instruments powered by the mains power and provided with a back-up battery for data-storage only, shall comply with the requirements for mains powered instruments.
In the criteria for (categories of) instruments, a minimum period of time shall be stated during which the applicable function of the instrument shall function properly without renewing or recharging the batteries.
The provisions of 5.5.2(b) and 5.5.3 do not apply for back-up batteries.

6. Type evaluation

6.1. Documentation

Comment [GT6]: Is a description of required documentation needed within the D11 scope

6.1.1 The applicable Recommendation may specify that the documentation submitted with the application for type approval shall include:
(a) a list of the devices and modules with their essential characteristics,
(b) a description of the devices with drawings, diagrams and general software information explaining their characteristics and operation,
(c) mechanical drawings,
(d) installation and security sealing plan,
(e) panel layout,
(f) operating instructions, and
(g) test outputs, their use, and their relationships to the parameters being measured.

6.1.2 Furthermore, the application for type evaluation shall be accompanied by a document or other evidence that supports the assumption that the design and characteristics of the measuring instrument comply with the requirements of the applicable Recommendation, in which the general requirements of this Document have been incorporated.

6.2. General requirements

The applicable Recommendation shall include the following examinations and tests to verify compliance with the general requirements for measuring instruments:

(a) examination to verify whether the measuring instrument complies with the provisions in 5.1,

(b) performance tests to verify compliance with the provisions in 5.1.1 and 5.1.2, regarding influence quantities; during which tests the EUT shall be operational (i.e. the power shall be switched on), except in case the test procedure in this Document or in the applicable Recommendation specifies otherwise;

(c) durability evaluation (i.e. tests and/or other means) to verify compliance with the provisions in 5.1.3,

Note:
Compliance with the durability requirements may be met by:
- passing durability tests,
- incorporating durability securing facilities,
- incorporating self-calibrating devices,
- granting provisional type approval and, after a sufficient number of measuring instruments have been functioning for a sufficiently long period of time, granting final type approval,
- no additional requirements if evidence for sufficient durability is gained by other means.

(The applicable Recommendation may specify details according to the intended use of the instrument.)

(d) examination and tests to verify compliance of the electronic measuring instrument with the provisions in 5.3, 5.4, and 5.5 if applicable.

All measuring instruments of the same category whether or not equipped with checking facilities and whether or not equipped with durability securing facilities, are subject to the same test program, unless the applicable Recommendation specifies otherwise. The test program shall be specified in the applicable Recommendation, according to the operating conditions of the category of measuring instruments.

6.3. Instrument performance tests

During performance tests the measuring instrument shall comply with:
(a) the provisions in 5.1.1, the maximum permissible error being the maximum permissible error on type evaluation, and
(b) the provisions in 5.1.2.

6.4. Instrument durability tests

In case a durability test is to be performed, the performance tests shall be carried out before the durability test. The Recommendation shall further specify which specific performance test(-s) shall be repeated after the durability test.

During performance tests carried out after each durability test, the measuring instrument shall comply with the provisions in 5.1.3.

Note: After each durability test, only performance tests that are relevant to the durability test concerned shall be carried out.

6.5. Test program

The applicable Recommendation may specify details concerning the test program, including:
(a) which tests shall be performed,
(b) the order in which the tests are to be performed (if necessary, taken into account the technology),
(c) determination of the performance characteristics (initial intrinsic error), prior to all other performance and durability tests,
(d) determination of the intrinsic error, prior to those performance tests for which the EUT shall comply with the provisions in 5.1.2, and
(e) evaluation of test results.

6.6. Test procedures

6.6.1 The test procedures of the most common performance tests are specified in Chapters 9 - 14.
Annex A provides a general approach to the durability concept.

6.6.2 The applicable Recommendation shall specify:
(a) necessary details concerning the tests, including those already stated in Chapters 9 - 14,
Note: As a rule, only one influence quantity may be varied during a test, while all others shall be kept at their reference values.
(b) test levels in accordance with the classification laid down in chapter 8, where applicable, and
(c) allowed deviations from the described tests, if necessary. (For example, a limited temperature range for a measuring instrument may lead to modification of the static temperature performance test.)

6.7. Number of specimens to be submitted to tests

The test shall be performed on the number of specimens as specified in the applicable Recommendation.

6.8. Test arrangement (Equipment under test (EUT))

As a rule, tests shall be carried out on the complete measuring instrument. If the size or configuration of the measuring instrument does not allow for testing the complete EUT or if only a separate device (module) of the measuring instrument is concerned, the applicable Recommendation may indicate that the tests, or certain tests, can be performed on the devices separately while making use of an EUT simulating set-up, sufficiently representing its normal operation. In such cases the device(s) need(s) to be in operation.

Note: It is not intended to dismantle the measuring instruments or devices for the cause of testing.

7. Initial verification

Measuring instruments stated to be produced in conformance with the approved type shall not deviate in construction, lay-out and performance from the evaluated specimen(s).

Initial verification of a measuring instrument may include a procedure to verify and ensure that the individual measuring instruments conform to the approved type.

8. Determination of test levels

8.1. Introduction

8.1.1 This chapter is intended as a guideline for TC´s and SC´s for determination of the test levels as to verify the sustainable compliance of measuring instruments with their metrological requirements in their applicable operating and storage environment.

This determination is not intended as a classification with strict boundaries leading to special requirements as in the case of an accuracy classification.

Moreover, this guideline does not interfere with the liberty of the Technical Committees and Subcommittees to provide for test levels that differ from those resulting from the other guidelines set forth in this Document. Different test levels may be used in accordance with special limitations prescribed in the applicable Recommendations.

8.1.2 The environment determining parameters of interest being most common to measuring instruments could be subdivided into three main groups, which are generally considered mutually independent:
(a) those establishing the climatic environment,
(b) those establishing the mechanical environment , and
(c) those establishing the electric, magnetic and electromagnetic environment.

All measuring instruments will encounter variations in the environment as a consequence of normal changes in magnitude of one or more of the parameters mentioned.
Since the presented environment determining parameters generally are mutual independent, an overall single classification on basis of increasing severity level is not possible.
For each of these three main groups therefore a separate classification is made.
The classification subsequently will serve in choosing the adequate test level.

Notes:
(1) The applicable Recommendation may require that the classification be indicated on the instrument.

8.1.3 When selecting the level of immunity needed for environmental phenomena and the associated test levels for a particular category of instruments, the following aspects are to be taken into account:
(a) the (typical) climatic, mechanical and electro-magnetic environment,
(b) the consequence and the social and societal impact ,
(c) the value of goods to be measured,
(d) the practical possibilities for the industry to comply with the prescribed level, and
(e) the possibility to repeat a measurement.

8.2. Classification and test level for the climatic tests [22], [23]

Different environmental classes covering most climatic conditions of locations where measuring instruments are used have been defined as described below.
The preferred test levels based on this classification are presented in the table.
Extreme conditions are not included; since the probability of occurrence of such conditions is considered low.
An incidental occurrence of such an extreme situation is to be interpreted as being a disturbance.

8.2.1 Temperature

The environmental temperature of a measuring instrument in use, may vary considerably. This is highly dependent not only on the place on earth, ranging from arctic to tropical regions, but also considerably on indoor or outdoor use. Instruments typically being used indoors in the one country may typically be in use outdoors in another country (for instance gas meters and electricity meters in residential environment). Therefore, no classification based on temperature ranges has been described in this Document.

In general, the choice on the lower and the upper temperature limits should preferably be left to national (or regional) legislation. When applying tests in order to verify the compliance with the required temperature range, the test levels should be in conformity with those like specified in the tables 10.1.1 and 10.1.2.

8.2.2 Humidity and water

The following table presents the classification concerning exposure to humidity and water and indicates the applicable test method and test level:

Classification based on environmental humidity conditions

Class	Test level			Description
	Damp Heat		Water	
	Steady state (test 10.2.1)	Cyclic (test 10.2.2)	(test 10.3)	
H1	-	-	-	This class applies to those instruments or parts of instruments typically being used in more or less temperature-controlled closed (weather protected) locations. The local humidity is not controlled. Where necessary heating, cooling or humidification is used to maintain the required environmental conditions, Measuring instruments are not exposed to condensed water, precipitation, or ice formations. These environmental conditions may apply in living rooms, continuously staffed offices, certain workshops, and other rooms for special applications.
H2	1	1	-	This class applies to those instruments or parts of instruments typically being used in closed (weather protected) locations where the local climate is not controlled. Measuring instruments present may be subjected to condensed water, water from sources other than rain and to ice formations. These environmental conditions may apply in some public available areas in buildings, in garages, cellars, certain workshops, factories and industrial plants, ordinary storage rooms for frost-resistant products, farm buildings, etc.
H3	1	2	2	This class applies to instruments or parts of instruments used in open air locations excluding those in extreme climate zones like polar and desert environments.

Note: A comparison between steady-state and cyclic tests is presented in IEC 60068-3-4 [15].

Test 10.3 (“Water”) is mainly applicable to those instruments or parts of instruments typically being used in the open air and that, in their normal use, could be directly exposed to spraying water (rain, etc.). Examples are platforms of weighbridges or automatic radar speed measuring instruments.

It is advised to therefore only require this class of water protection and implement the performance test 10.3 in those Recommendations that are applicable to measuring instruments which typically will be used in an environment where this kind of exposure to water can be expected (see 4.4).

8.2.3 Atmospheric pressure (Test 10.4)

Considering the ranges and variations in global terrestrial atmospheric pressure, only a few categories of measuring instruments due to their physical principles are likely to be influenced by these changes. This influence could either be on the zero-indication of the instrument (offset), on the span (curve) or on both.
It is advised to therefore only require the evaluation of performance on atmospheric pressure variation in those Recommendations that are applicable to measuring instruments which typically, due to their physical measuring principle, are expected to be sensitive to variations in atmospheric pressure (see 4.4).

8.2.4 Sand and dust (Test 10.5)

Referred test is mainly applicable to those instruments or parts of instruments typically being used in dusty warehouses and building industry (for instance production of concrete) or, in some climatic regions, in the open air.
It is advised to therefore only require a measure of protection to withstand this influence and consequently implement the performance test 10.5 in those Recommendations that are applicable to measuring instruments that can be expected to be typically used under sandy/dusty conditions (see 4.4).

8.2.5 Salt mist (Test 10.6)
Referred test is mainly applicable to those instruments or parts of instruments that are typically used in a salty environment. Examples are measuring instruments on board of sea-going vessels or in cheese-industry. It is advised to therefore only require a measure of protection to withstand this influence and consequently implement the performance test 10.6 in those Recommendations that are applicable to measuring instruments that can be expected to be typically used in a humid and salt environment (see 4.4).

8.3. Classification and test levels for mechanical tests (Tests 11.1 and 11.2)

The following table presents the classification concerning exposure to vibration and shocks and indicates the applicable test method and test level:

Classification based on expected environmental vibrations			
Class	Test level		Description
	Vibration (test 11.1)	Shock (test 11.2)	
M1	-	-	This class applies to locations with vibration and shocks of low significance, e.g. for instruments fastened to light supporting structures subject to negligible vibrations and shocks transmitted from local blasting or pile-driving activities, slamming doors, etc.
M2	1	1	This class applies to locations with significant or high levels of vibration and shock, e.g. transmitted from machines and passing vehicles in the vicinity or adjacent to heavy machines, conveyor belts, etc.
M3	2	2	This class applies to locations where the level of vibration and shock is high or very high, e.g. where measuring instruments are directly mounted on machines, conveyor belts etc.

In 11.1, two vibration tests (random and sinusoidal) have been described. In general, it should be avoided to prescribe both tests in OIML Recommendations.

Since vibration of a random nature is real life practice , it is expected that a performance test on the sensitivity of measuring instruments to random vibration covers the requirement for withstanding influences by environmental vibrations and should be the most commonly prescribed performance test in OIML Recommendations The sinusoidal test shall be prescribed and applied only in those cases were the measuring instrument is expected to be typically subjected to sinusoidal vibrations.

For the selection of the appropriate test (random or sinusoidal) refer to IEC 60068-3-8 [16]; in particular to (sub)clauses 4.2, 7, 8.3, and 8.4 of that standard.

It is strongly recommended not to try to convert sine vibration to random vibration or vice versa. There is no simple physical relationship between the two. The impact on the specimen will therefore be different.

8.4. Classification and test levels for electro-magnetic tests [26]

For adequate type evaluation concerning electro-magnetic influences and interferences a selection needs to be made of the test to be performed and test levels to apply.
As far as electro-magnetic related tests are concerned this choice will need to depend on the expected electro-magnetic environmental conditions of the measuring instrument and on its application. (see sub-clause 8.1.3)

These conditions depend on the environment where the instrument is expected to be installed (residential, general public, commercial, industrial etc.), the concept of the measurement system and the use of the measurement system.

A discrimination in electro-magnetic environment could be made on basis of differences in:

(a1) the kind of potential electro-magnetic influence quantity in the environment and their intensity
(a2) the available potential entering paths of the influence quantity, which in turn are defined by the concept of measuring instrument or system. Furthermore one could distinguish between concepts with a closed (isolated) structure and those with a more open electromagnetic architecture. In the latter case cabling lay-out of the instrument or system can be quite of influence to the sensitivity for influence quantities.

For feasibility reasons and while for most instruments the above discrimination is not trivial, a discrimination will be made only between 3 (electro-magnetic) classes and the associated requirements and test methods are presented for only a limited number of potential sources of influence (which are considered to be the main potential electrical influence quantities)

The following groups of influence quantities are to be considered:
(1) those caused by conducted EM phenomena (transmitted through power or data lines),
(2) those caused by radiation of EM phenomena (non-guided transmission)

(Both these influences could origin from all kind of sources, for example: remote instrumentation, some action of personnel or atmospheric disturbances)

The following table presents a classification for selection of tests related to the electro-magnetic environment:

Classification based on electro-magnetic environment	
Class	Description
E1	This class applies to measuring instruments used in locations where electromagnetic disturbances correspond to those likely to be found in residential, commercial and light industrial environment .
E2	This class applies to instruments used in locations where electromagnetic disturbances correspond to those likely to be found in industrial buildings.
E3	This class applies to mobile measuring instruments powered by any non-mains (local) source and exposed to electromagnetic disturbances which correspond to those likely to be found in any environment not considered hazardous for general public.

The following table presents the references to the test method and test level to be applied taking into account the classification of the electro-magnetic environment.

Test method selection based on classification of electro-magnetic environment				
Test level index for class			Test	
E1	E2	E3	Table	Description
			12.1.1	DC mains voltage variation
-	1	1	12.1.2	Ripple on DC mains power
1	1		12.2.1	AC mains voltage variation
1	1		12.2.2	AC mains frequency variation
-	1	-	12.3.1	DC mains voltage dips, short interruptions and (short term) voltage variations
1	2	-	12.3.2	AC mains voltage dips, short interruptions and reductions
2 or 3	3	3	12.3.3	AC mains harmonics
1	1	1	12.3.4	VLF and LF disturbances on AC and DC mains
2	3	-	12.3.5	Bursts (transients) on AC and DC mains
3	3	-	12.3.6	Surges on AC and DC mains power lines
2	3	2	12.4.1	Bursts (transients) on signal, data and control lines
3	3	2	12.4.2	Surges on signal, data and control lines
4	5	-	13.1	AC mains power frequency electromagnetic field

Comment [GT7]: See remark 1.3

2	3	3	13.2	Conducted (common mode) currents generated by RF EM fields
2	3	3	13.3.1	RF EM fields (general origin)
3 or 4 (*)	3 or 4 (*)	4	13.3.2	RF EM fields (digital radio telephones)
3	3	3	13.3.1	Electrostatic discharges
-	-	C or F	14.2.1	Voltage variations of a road vehicle battery
-	-	IV	14.2.2	Electrical transient conduction along supply lines of external 12 V and 24 V batteries
-	-	IV	14.2.3	Electrical transient conduction via lines other than supply lines for external 12 V and 24 V batteries

(*) See sub-clause 8.4.1

The conditions have been adapted from the basic Publication IEC 61000-2-5 [26]

Guidance to test level choice

Some extra guidance for choosing the test level for some specific tests concerning electro-magnetic environment is presented in the following sub-clauses 8.4.1 - 8.5.2.

8.4.1 Radiated RF electromagnetic fields and resulting induced RF currents

(Test 13.2.1 and 13.2.2**)**

The frequency range presented in table 13.2.2.1 is typically in use by broadcast transmitters. The maximum level of field strength which can be expected near to these transmitters may in the general public area exceed the level of 10 V/m, but may be expected not to exceed the maximum exposure levels for human beings (general public) as advised by the WHO and implemented in the national legislation of quite some nations. Up to 400 MHz this maximum level is 27.5 V/m, linear increasing with frequency from 400 MHz to about 45 V/m at 1000 MHz.

Though such high field strength levels may be expected in the neighbourhood of fences around transmitter sites one should be aware of the following risk reducing factors.

- the field strength near to a transmitter will reduce about with the square of the distance to the transmitter.
- the optimum coupling (influence) only occurs when polarization of source and sensitive part or element of the exposed object (acting as receiver) are in parallel and the transmission direction of the transmitter (perpendicular to the polarization) is in line with that of the receiver.

The unforeseen incidental exposure to the above mentioned levels probably may apply in case a mobile measuring instrument in operation, passes such a powerful broadcast transmitter.

The frequency ranges in table 13.2.2.2 typically apply for digital mobile phones.

To get some impression on applicable field strength levels one should be aware that:

- a 2 W GSM phone typically produces a field strength of 10 V/m (modulated wave) at a distance of 1 m from the transmitter. For an 8 W GSM this distance will be 2 m.
- a 200 W GSM base station typically produces a field strength of 10 V/m (modulated wave) at a distance of 10 m.

For more details, please consult table G.1 in IEC 61000-4-3 [29].

So the maximum level of field strength which can be expected near to these radiating sources may in the general public area exceed the level of 10 V/m, but may be expected not to exceed the maximum exposure levels for human beings (general public) as advised by the WHO. This maximum level of 27.5 V/m up to 400 MHz is linear increasing with frequency from 400 MHz to 61 V/m at 2 GHz and is limited to 61 V/m level in the frequency range above 2 GHz. Therefore the tests to be applied and specified in the applicable Recommendation cannot be related to only one specific environment. So in order to verify compliance with the electromagnetic environment of use, the tests shall extend to a frequency range and an intensity level that merely depend on:

- the possibility of a mobile telephone being used in close vicinity of the instrument or
- the location of a base station relative to the instrument,
- the risk of fraud by using a mobile phone as source of disturbance, and
- the consequences of an error or disturbance.

In the frequency band between 3 and 6 GHz the following should be taken into consideration:
The larger radiating sources in this frequency band mainly concern amateur radio stations creating field strengths in the bands 3.3-3.5 GHz and 5.65-5.93 GHz up to 30 V/m at 10 m distance. (see IEC/TR 61000-2-5 Table 25 [26]) This however concerns transmission using narrow beam antennas such as dish antennas in use for dish to dish beam connections including satellite uplinks. Only in the main beam if the antenna this level of field strength may be measured. For this reasons a rationale will be needed for implementing tests in this frequency band.

8.4.2 Electrostatic discharge (Test 14)
Since the human body may be charged to a maximum value of 15 kV in extreme conditions (very low relative humidity combined with synthetic fabrics and use of synthetic footwear), ESD tests of test level 4 will only be necessary for instruments to be used under circumstances where such conditions are likely to exist. Measurement instruments that will be used in areas where the relative humidity exceeds 50 % should be tested by exposure up to and including the test level 3.

8.4.3 Mains frequency (electro)magnetic fields (Test 13.1)
This test shall only be prescribed as required in those OIML Recommendations where a significant influence from external power frequency magnetic fields on the measurement results may be expected, as a consequence of the physical principle of the measuring instruments concerned. This includes instrumentation using equipped with touch switches, (also refer to 4.4)
This test does not cover the frequency spectrum of harmonics of the power frequency, which fields normally are more common and intense.
Notes:

1) The WHO advises a protection level for whole body human exposure (general public) of 80 A/m (50Hz) and of 400 A/m for occupational exposure (workers).
2) Small sources like many types of the adapters used to power or load battery powered equipment tend to create electromagnetic fields exceeding the 80 A/m level, but these power frequency EM fields tend to diminish very rapidly with distance and only a few centimetres from the source could be reduced to 1 % of the original level.

Typical environments where relative high level mains electromagnetic field strength can be expected are:

- high and medium voltage mains power lines
- heavy industry
- static power converters (transformers)
- induction cooking

8.4.4 AC Mains frequency harmonics (Test 12.3.3**)**

Through the increasing use of small transformers and semiconductor switching devices in power converters, lighting systems, AC/DC converters, UPS systems and rectifiers the distortion of public power supply networks has increased. Power supply companies are obliged for several reasons to keep the level of disturbance beneath certain limits.
For harmonisation reasons for each harmonic an environment dependent compatibility level has been established. Immunity test levels require a certain margin. In IEC 61000-4-13 a facto 1.5 was used to create this margin.
This test shall be implemented in OIML Recommendations for measuring instruments which tend to be connected to a to a AC mains network.
In the standard a further subdivision is made in the class E1 environment. Only in pure residential environment the test level index 2 is yet considered applicable.

Typical environments where relative high level mains electromagnetic mains power harmonics can be expected are:

- heavy industry (chloride production plants)
- high capacity rectifier stations

8.4.5. VLF and LF disturbances on mains power lines (Test under consideration)

Through the increasing use of power line communication (PLC) and switching semiconductors in power supply systems VLF and LF differential mode disturbances tend to interfere with the mains power supply sine wave. Moreover PLC and semiconductor switching devices tend to interfere with each other.
Especially in those cases where the waveform of the mains power line could be directly of influence to measuring instruments (like electrical energy meters) these tests should be applied.

8.4.6 Bursts (transients) (Tests 12.3.5 and 12.4.1)

The selection of the applicable test level shall be based on the expected use of the measuring instrument and presented in the applicable Recommendation.

Test level 1 applies to instruments operating in environments well-protected against electro-magnetic interferences (e.g. computer rooms); test level 2 applies to instruments operating in areas with a normal level of protection (class E1); and test level 3 applies to instruments operating in areas without special protection measures (e.g. industrial plants, class E2).

8.4.7 Surges (Tests 12.3.6 and 12.4.2)
This test is only applicable in those cases where, based on typical situations of installation, the risk of a significant influence of surges can be expected.
This especially concerns outdoors installations and/or indoor installations connected to long data, signal or power lines (lines longer than 30 m or those lines partially or fully installed outside the buildings regardless of their length).
Therefore, the test for the influence of surges should only be prescribed in the applicable Recommendation for measuring instruments that are connected to a network.
The test is applicable to the AC and DC mains power lines, the communication lines (internet, dial up modem, etc.), and other leads for control, data or signal mentioned above (leads for temperature sensors gas or liquid flow sensors, etc) (see clause 4.4)

8.4.8 AC mains frequency variation (Test 12.2.2)
In general the public AC mains supply networks are coupled resulting in negligible variations in the frequency. Only in remote areas and in case of local generators, the frequency changes can be of significance.
Therefore it is advised to only prescribe this test in OIML Recommendations in those cases where as a result of the physical principle of the measuring instruments, the frequency of the AC mains supply can have a significant influence on the performance of the instrument, for instance in the case where an internal time-base of the instrument is derived from the mains power frequency.
(also refer to 4.4).

8.4.9 AC mains voltage dips, short interruptions and voltage variations (Test matrix 12.3.2)
Occurrence of voltage dips in AC mains power supply networks is rather standard. Moreover interruptions for half a cycle or less are characteristic. A measuring instrument shall need withstand and be more or less immune to such dips and interruptions in order to comply with the provisions of 5.1.1 .
To evaluate the compliance of performance with these provisions the presented level 2 is the minimum test level required.

The occurrence of voltage dips and short supply interruptions in general cannot be predicted. Especially in the industrial environments, these may occur and persist for a relative long period of time.
It is reasonable to require instruments, intended to be used in an industrial environment, to withstand such dips and interruptions and consequently require them to be submitted to performance tests up to a test level 3 in order to avoid the risk on frequent interruption of instrument performance.

When, on basis of the classification of the environment, test level 2 applies three tests are to be performed and in case test level 3 applies five tests are to be performed All 3 or 5 tests presented in the applicable test level column need to be implemented in the applicable Recommendation since the response or failing of the EUT on one of the tests cannot be predicted from the responses on the other tests.

8.4.10 Voltage dips, short interruptions and (short term) voltage variations on DC mains (Test 12.3.1)
Since DC power is not commonly in use in mains Low Voltage networks and almost exclusively applicable to industrial environments, no test level for class E1 has been proposed in the selection table.

8.4.11 Ripple on DC mains power (Test 13.7)
This test only applies to DC mains power networks which are almost exclusively applicable in industrial environments, therefore no such test is suggested in the selection table for E1 classified instruments.

8.5. Additional guidance for battery powered instruments

For selecting tests for battery powered measuring instruments a distinction is to be made on basis of kind of battery applied.
These different types are:
(a) disposable batteries,
(b) general rechargeable batteries, and
(c) batteries of road vehicles.

8.5.1 In case of disposable and rechargeable batteries of a general nature, at present no standards can be referred to. The requirements are described in brief in clause 5.5 and the applicable tests in table 14.1.

8.5.2 For instruments powered by the on board battery of a road vehicle (environmental class E3), a series of special tests simulating disturbances associated with the road vehicle power supply is presented in the clause 14.2 of this Document. These tests are based on the standards series ISO 7637 [41-43].
According to clause 4 of ISO 7637-1 [41], this series of standards "provides a basis for mutual agreement between vehicle manufacturers and component suppliers, intended to assist rather than restrict them."
Measuring instruments that are designed to be mounted on board a road vehicle in generally could be mounted on any kind of vehicle. Therefore, in the tables 14.2.2 and 14.2.3 of this Document, only the most severe level of testing specified in the standard is indicated as being the preferred level.

The choice of the test level to be applied is not related to a specific environment, but merely by the impact of a disturbance and, where relevant, to the electromagnetic properties of the specific type of vehicle in which the instrument is used.

9. Instrument performance tests (general)

9.1. Preliminary remarks

The brief descriptions of test procedures in this document are intended only for information. It will be necessary to consult the referenced IEC and ISO Publications before conducting a test.

Terminology used in the applicable IEC and ISO Publications was copied in this Document to the widest possible extend.
Sometimes in the IEC and ISO Publications, the term "specimen" may be found instead of "EUT" which is used in chapter 10 - 14 of this Document

Most of the standards, referred to in the following chapters of this Document, concern "basic" standards not specifically linked to a product. This implies that for many tests a choice may be made between more than one test levels. In order to optimize harmonization between those standards and the OIML Recommendations, all these test levels were copied from these standards into this Document, but only a limited number of these are actually recommended for implementing in OIML Recommendations. To be able to recognize the preferred test levels, these have been presented in **bold face**.

9.1.1. Measurement uncertainty considerations

Every measurement result is subjected to measurement uncertainty. Every test comprises measurements using harmonized test setups and comparison with requirements (verification). In testing the test procedure and set-up contribute to the uncertainty in the result and often even are the mayor contributors.
Moreover a test is just an instant observation of the response of one or a few specimen(-s) on that test and sometimes for practical reasons even reduced to only a selection of the different manifestations of influencing phenomena.

The argument for evaluation of the uncertainty of a test result is obtaining with sufficient high probability the assurance that a clear decision on compliance to the requirements can be made by taking into account this uncertainty on the result

Summarizing the contributors to the overall "test" uncertainty are:

a) measuring instrumentation uncertainty
b) test set up introduced uncertainty
c) test procedure introduced uncertainty
d) sample introduced uncertainty

Examples of the above mentioned contributors are:

a) thermometer in climate room and pulse waveform of ESD generator
b) homogeneity of temperature in climate room position of EUT above conducting cable
c) curve of climate change; location for the discharge

In recommendations the uncertainty contribution:

a) can be stated a maximum value and
b) is to be estimated on basis of the test method
c) is to be obtained by the reproducibility of test results

The acceptable overall measurement uncertainty can be presented by stating a maximum test uncertainty ratio (TUR) being the relation between overall uncertainty and MPE.

The following text should be included in all OIML Recommendations that are based on OIML D11:

> *"Every test is subject to uncertainty.*
> *The uncertainty of a measurement is defined as: "parameter, associated with the result of a measurement, which characterizes the dispersion of the values that could reasonably be attributed to the measurand" [VIM 3.9].*

The uncertainty of the test method shall be taken into account in the decision on the applicability of the test method."
The maximum test uncertainty ratio (TUR) of each test method shall be specified in the Recommendation.
Some additional explanation still required

9.2. Test considerations

9.2.1. General

In principal, all tests, shall be performed meeting the conditions concerning installation as stipulated by the manufacturer and the corresponding rated operating conditions unless it is obvious that these will not be relevant to the result of the test.

The applicable OIML Recommendation shall in all cases describe the manner in which the instrument shall be tested as well as the allowed changes in the performance of the instrument.
Simulation of any part of the instrument tested should be avoided. In case such simulation cannot be omitted all parts of the instrument that could be affected by the test shall play their intended role in the measurements.

The following table is a general guideline showing the advised method of evaluation of the test results in relation to the several tests presented in this Document (the applicable Recommendation may divert in evaluation method).

Evaluation method applicable to each test			
Evaluation		**Sub clause**	**Exposure**
I	MPE	10.1.1	Dry heat
I	MPE	10.1.2	Cold
I	MPE	10.2.1	Damp heat, steady-state (non condensing)
D	NSFa	10.2.2	Damp heat, cyclic (condensing)
D	NSFa	10.3	Water
I	MPE	10.4	Atmospheric pressure
D	NSFa	10.5	Sand and Dust
D	NSFa	10.6	Salt mist
I	MPE	11.1	Vibration
D	NSFa	11.2	Mechanical shock
I	MPE	12.1.1	DC mains voltage variation
D	NSFd	12.1.2	Ripple on DC mains power
I	MPE	12.2.1	AC mains voltage variation
I	MPE	12.2.2	AC mains frequency variation
D	NSFa (1) NSFd (2)	12.3.1	DC mains voltage dips, short interruptions and reductions
D	NSFd	12.3.2	AC mains voltage dips, short interruptions and voltage variations
D	NSFd	12.3.3	AC mains harmonics
D	NSFd	12.3.4	VLF and LF disturbances on AC and DC mains
D	NSFd	12.3.5	Bursts (transients) on AC and DC mains
D	NSFa	12.3.6	Surges on AC and DC mains power
D	NSFd	12.4.1	Bursts (transients) on signal, data and control lines
D	NSFa (1) NSFd (2)	12.5.2	Surges on signal, data and control lines
D	NSFd	13.1	Mains power frequency magnetic field
D	NSFd	13.2.1	Conducted (common mode) currents generated by RF EM fields
D	NSFd	13.2.2	RF electromagnetic fields
D	NSFa (1) NSFd (2)	14	Electrostatic discharge
I	MPE	14.1	Low voltage of internal battery
I	MPE	14.2.1	Voltage variations of a road vehicle battery
D	NSFd	14.2.2	Electrical transient conduction along supply lines of external 12 V and 24 V batteries pulses 2a, 3a, 3b and 4
D	NSFa	14.2.2	Electrical transient conduction along supply lines of external 12 V and 24 V batteries pulse 2b
D	NSFd	14.2.3	Electrical transient conduction via lines other than supply lines for external 12 V and 24 V batteries

I	Influence factor
D	Disturbance
MPE	Maximum permissible error according to 3.6
NSFa	No significant fault shall occur after the disturbance.
NSFd	No significant fault shall occur during the disturbance.
(1)	For integrating instruments
(2)	For non-integrating instruments

9.2.2 Integrating instruments

As a consequence of the operating principle of integrating instruments the evaluation approach has to be different from that of non-integrating instruments This implies more attention to the evaluation sequence is needed and shall therefore be taken into account when prescribing tests and evaluation for such instruments.
. Examples of integrating instruments are: water, gas, electricity and heat meters as well as belt weighers. For evaluation of these instruments testing and observation over a certain established period of time of operation is needed.

9.2.2.1 Sequence of test when NSFa evaluation is applicable

The following test and evaluation sequence is recommended:

(a) Determine the intrinsic error,

(b) Stop the measurements but keep the instruments switched on. [1)]

(c) Record all indicated and registered values of interest.

(d) Activate the disturbance generator ,

(e) Record all indicated and registered values of interest. The change in the display reading and registers may only alter by one unit or by the significant fault (to be prescribed in the relevant Recommendation),

(f) Perform a second measurement and determine the error,

(g) Calculate the difference between the error of the second measurement and the intrinsic error. This difference shall not exceed the fault limit specified in the applicable Recommendation.

Notes:

(1) In case of the damp heat – cyclic test the position “switched on” or “switched off” is specified in the Recommendation; the position “switched off” facilitating condensing.

(2) For step b, it is possible that the test procedure prescribes the EUT being switched off (for instance the damp heat, cyclic test that has been classified as a disturbance).

(3) For step e, it is sometimes impossible for the instrument to indicate the same result after the application of the disturbance as before (in particular when switched off ; also for instance mechanical shocks of clinical thermometers that indicate only in a narrow range).

9.2.2.2 Tests using NSFd for evaluation

The following test sequence is recommended:

(a) Determine intrinsic error,

(b) Start measurements and apply the test.

(c) Stop applying the disturbance and stop the measurement. Determine the error,

(d) Calculate the difference between the error of the second measurement and the intrinsic error. This difference shall not be greater than the significant fault specified in the applicable Recommendation.

For the test 10.2.2 (damp heat, cyclic) the recommended sequence is:

(a) Determine the intrinsic error

(b) Continue the measurements

(c) Apply the test

(d) Carry out the measurements during the last cycle, starting 1 h after initiation of the increase of the temperature from the lower to the upper temperature and determine the error

(e) Stop the test after the last cycle

Comment [GT8]: This sequence is not very logical.

(f) After the recovery, carry out a measurements and determine the error

(g) Calculate the difference between the error of the second measurement and the intrinsic error. This difference shall not be greater than the significant fault specified in the applicable recommendation

(h) Calculate the difference between the error of the third measurement and the intrinsic error this difference shall not be greater than the significant fault specified in the applicable recommendation

10. Climate related performance tests

10.1. Static temperatures

10.1.1 Dry heat						
Applicable standards	IEC 60068-2-2 [5], IEC 60068-3-1 [14]					
Test method	Exposure to dry heat (non condensing)					
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of high temperature					
Test procedure in brief	The test comprises exposure to the specified high temperature under "free air" conditions during the period of time specified (the period specified is the period succeeding the moment at which the EUT has reached temperature stability). The change in temperature shall not exceed 1 °C/min during heating up and cooling down. The absolute humidity of the test atmosphere shall not exceed 20 g/m^3. When tests are performed at temperatures below 35 °C, the relative humidity shall not exceed 50 %.					
	One of the following test levels may be specified:					
Test level index[1)]	**1**	**2**	**3**	4	5	unit
Temperature	**30**	**40**	**55**	70	85	°C
Duration	**2**	**2**	**2**	2	2	h
Note	[(1)] For each OIML Recommendation the choice on applicable level is to be made. The levels assumed most applicable and preferred to implement are presented in **bold face.**					
Information to be presented in the applicable Recommendation, where relevant	a) preconditioning b) details of mounting or supports c) state of the EUT including cooling system during conditioning d) test level to be applied: temperature and duration of exposure e) measurements and/or loading during conditioning f) recovery (if non-standard)					

10.1.2 Cold					
Applicable standards	IEC 60068-2-1 [4], IEC 60068-3-1 [14]				
Test method	Exposure to low temperature				
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of low temperature				
Test procedure in brief	The test comprises exposure to the specified low temperature under "free air" conditions during the period of time specified (the period specified is the period succeeding the moment at which the EUT has reached temperature stability). The change of temperature shall not exceed 1 °C/min during heating up and cooling down. IEC specifies that the power to the EUT shall be switched off before the temperature is raised.				
	One of the following test levels may be specified:				
Test level index [(1)]	**1**	**2**[(1)]	**3**[(1)]	4	unit
Temperature	**+5**	**-10**	**-25**	-40	°C
Duration	**2**	**2**	**2**	2	h
Note	[(1)] For each OIML Recommendation the choice on applicable level is to be made. The levels assumed most applicable and preferred to implement are presented in **bold face.**				

Information to be presented in the applicable Recommendation, where relevant	a) preconditioning b) details of mounting supports c) state of the EUT including cooling system during conditioning d) extend: temperature and duration of exposure e) measurements and/or loading during conditioning f) recovery (if non-standard)

10.2. Damp heat

10.2.1 Damp heat, steady-state (non condensing)			
Applicable standards	IEC 60068-2-78 [13], IEC 60068-3-4 [15]		
Test method	Exposure to damp heat in steady-state		
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of high humidity and constant temperature. The steady-state test should always be used where adsorption or absorption play the main part. When diffusion but not breathing is involved, either the steady-state or the cyclic test shall be prescribed depending on the type of EUT and its application.		
Test procedure in brief	The test comprises exposure to the specified high level temperature and the specified constant relative humidity for a certain fixed period of time as defined by the test level chosen. The EUT shall be handled such that no condensation of water occurs on it.		
	One of the following test levels may be specified:		
Test level index (1)	**1**	2	unit
Temperature	**30**	40	°C
Relative humidity (RH)	**85**	93	%
Duration	**2**	4	days
Note	(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.**		
Information to be presented in the applicable Recommendation, where relevant	a) preconditioning procedure b) electrical and mechanical measurements to be made prior to the test c) state of the EUT as introduced into the chamber d) extend and tolerance: temperature, relative humidity and duration e) loading during conditioning f) electrical and mechanical measurements to be made during conditioning and the period(s) after which they shall be performed g) special precautions to be taken regarding removal of surface moisture h) recovery conditions (if other than standard) i) electrical and mechanical measurements to be made at the end of the test, the parameters to be measured first, and the maximum period allowed for the measurement of these parameters		

10.2.2 Damp heat, cyclic (condensing)			
Applicable standards	IEC 60068-2-30 [9], IEC 60068-3-4 [15]		
Test method	Exposure to damp heat with cyclic temperature variation		
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of high humidity combined with cyclic temperature changes Cyclic tests shall be applied in all the cases where condensation is concerned and potentially of influence or when the penetration of vapour will be accelerated by the breathing effect.		
Test procedure in brief	The test comprises exposure to cyclic temperature variation between 25 °C and the appropriate upper temperature while maintaining the relative humidity above 95 % during the temperature change and the low temperature phases and at or above 93 % RH at the upper temperature phases. Condensation is expected to occur on the EUT during the temperature rise. The 24 h cycle comprises: 1) temperature rise during 3 hours 2) temperature maintained at upper value until 12 hours from the start of the cycle 3) temperature lowered to lower temperature level within a period of 3 to 6 hours, the rate of fall during the first hour and a half being such that the lower temperature level would be reached in a 3 hours period. 4) temperature maintained at the lower level until the 24 h period is completed. The stabilizing period before and recovery period after the cyclic exposure shall be such that the temperature of all parts of the EUT is within 3 °C of its final value. Special electrical conditions and recovery conditions may need to be specified. For integrating measuring instrument see sub clause 9.2.2 for the appropriate sequence of the test		
	One of the following test levels may be specified:		
Level index(1)	**1**	**2**	unit
Upper temperature:	**40**	**55**	°C
Duration	**2**	**2**	cycles
Note	(1)For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.**		
Information to be presented in the applicable Recommendation, where relevant	a) extend: temperature and number of cycles b) state of the EUT during conditioning c) details of mounting or support d) need for intermediate measurements e) instrument recovery conditions f) special precautions to be taken regarding surface moisture elimination g) measurements to be made at the end of the test, sequence of parameters to be measured , and the maximum time period allowed for and between the measurement of these parameters		

Comment [TG(,M9]: What is meant ?

10.3. Water			
Applicable standards	IEC 60068-2-18 [8], IEC 60512-14-7 [18], IEC 60529 [19]		
Test method	Exposure to water falling in drops and impacting (colliding) water		
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 when the EUT is subjected to spraying and splashing water		
Test procedure in brief	The EUT is mounted on an appropriate fixture and is subjected to impacting water generated from either an oscillating tube or a spray nozzle used to simulate spraying or splashing water. The stabilizing period before and recovery after the exposure shall be specified in the applicable Recommendation.		
	One of the following test levels may be specified:		
Test level index (1)	1	**2**	unit
Flow rate (per nozzle)	0.07	**0.07**	L/min
Duration	10	**10**	min
Angle of inclination	± 60	**± 180**	°
Note	(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.**		
Information to be presented in the applicable Recommendation, where relevant	a) extend: angle of inclination b) state of the EUT during conditioning c) details of mounting or support d) intermediate measurements e) recovery conditions f) special precautions to be taken regarding removal of surface moisture g) electrical and mechanical measurements to be made at the end of the test, the parameters to be measured first, and the maximum period allowed for the measurement of these parameters		

10.4. Atmospheric pressure

In the following two sub clauses, two tests for determining the influence of atmospheric influence on measuring instruments have been described. In general, it should be avoided to prescribe both tests in OIML Recommendations. Either of these tests shall only be prescribed in OIML Recommendations in those cases where, as a result of the physical principle of the measuring instruments, a significant influence of changes in atmospheric pressure can be expected (also refer to 4.4).
The choice on either the test 10.4.1 or 10.4.2 and on the test level to be prescribed in the applicable Recommendation, is to be made by the responsible OIML Technical Committee or Subcommittee.

10.4.1 Static atmospheric pressure				
Applicable standard		There are no applicable standards (refer to Annex B)		
Test method		Exposure to low and high atmospheric pressure		
Object of the test		Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of static atmospheric pressure changes to upper and lower limit		
Test procedure in brief		The test comprises the installing an EUT such that it can be exposed to the applicable higher and lower atmospheric pressures limits.		
		One of the following test levels may be specified:		
Test level index		**1**	**2**	unit
Atmospheric pressure	Lower limit	**Ambient pressure - 2.5 kPa (± 0,15)**	**86 (± 1)**	kPa
	Upper limit	**Ambient pressure + 2.5 kPa (± 0,15)**	**106 (± 1)**	
Uncertainty of the recorded		**0.15**	**0.15**	

pressure			
Information to be presented in the applicable Recommendation, where relevant	a) extend: pressure range b) acceptable influence on the EUT		

10.4.2 Variation of atmospheric pressure			
Applicable standard	There are no applicable standards (refer to Annex B)		
Test method	Exposure to variable atmospheric pressure		
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of and during changes in atmospheric pressure		
Test procedure in brief	The test comprises the installing an EUT such that it can be exposed to changes in atmospheric pressure and performing measurement during these changes.		
	One of the following test levels may be specified:		
Test level index	**1**	**2**	unit
Change of atmospheric pressure, relative to ambient pressure	**1 (± 0.1)**	**10 (± 1)**	kPa
Information to be presented in the applicable Recommendation, where relevant	a) extend : pressure change b) acceptable influence on the EUT		

10.5. Sand and dust		
Applicable standards	IEC 60512-11-8 [17], IEC 60529 [19], IEC 60721-2-5 [21]	
Test method	Exposure to sand and dust	
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under dust-laden atmosphere.	
Test procedure in brief	The test comprises exposure to cyclic temperature variation between 30 °C and 65 °C, maintaining the following conditions: ▪ relative humidity: less than 25 % ▪ air velocity: 3 m/s ▪ particles concentration: 5 g/m^3 ▪ composition of the particles: as specified in 3.2.1 of IEC 60512-11-8 [17]	
	One of the following test levels may be specified:	
Test level index	**1** (1)	2
Number of cycles	**1**	2
Note	(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.**	
Information to be presented in the appropriate Recommendation, where relevant	a) extend : number of cycles b) state of the EUT during conditioning c) intermediate measurements d) recovery conditions e) electrical and mechanical measurements to be made at the end of the test, the parameters to be measured first, and the maximum period allowed for the measurement of these parameters	

10.6. Salt mist					
Applicable standards	IEC 60068-2-11 [7], IEC 60721-2-5 [21]				
Test method	Exposure to salt mist				
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under salt mist atmosphere.				
Test procedure in brief	The test comprises exposure to salt mist atmosphere at 35 °C.				
	One of the following test levels may be specified:				
Test level index	1	**2 (1)**	3	4	unit
Duration	16	**24**	48	96	h
Note	(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.**				
Information to be presented in the applicable Recommendation, where relevant	a) extend: (duration) b) state of the EUT during conditioning c) intermediate measurements d) recovery conditions e) electrical and mechanical measurements to be made at the end of the test f) the parameters to be measured first g) the maximum period allowed for the measurement of these parameters.				

11. Mechanics related performance tests

11.1. Vibration

In the following two sub clauses, two vibration tests (random and sinus) have been described. In general, it should be avoided to require both tests in OIML Recommendations.
Implementation of the random vibration test is preferred in OIML Recommendations.
The sinusoidal vibration test shall be applied only in those cases where the measuring instrument is expected to be typically subjected to sinusoidal vibrations.
For the selection guidance on both tests can be found in IEC 60068-3-8 [16]

11.1.1 Vibration (random)				
Applicable standard	IEC 60068-2-47 [11], IEC 60068-2-64 [12], IEC 60068-3-8 [16]			
Test method	Exposure to random vibration			
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of random vibration			
Test procedure in brief	The test comprises exposure to the vibration for a time sufficient for testing the various functions of the EUT during the exposure. The EUT shall subsequently be tested in three, mutually perpendicular axes mounted on a rigid fixture by its normal mounting means. The EUT shall normally be mounted in such a way that the gravity vector points in the same direction as it would in normal use. Where on basis of the measurement principle the direction the effect can be assumed negligible the EUT may be mounted in any position.			
	One of the following test levels may be specified:			
Test level index	**1**(1)	**2**(1)	3	unit
Total frequency range	**10 - 150**	**10 – 150**	10 - 150	Hz
Total RMS level	**1.6**	**7**	16	$m \cdot s^{-2}$
ASD level 10-20 Hz	**0.05**	**1**	5	$m^2 \cdot s^{-3}$
ASD level 20-150 Hz	**-3**	**-3**	-3	dB/octave
Duration per axis	For each of the orthogonal directions the vibration exposure time shall be 2 minutes in each functional mode as defined in the applicable Recommendation or for a longer period if necessary for performing the measurement			
Note	(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.**			
Information to be presented in the applicable Recommendation, where relevant	Extend: - total frequency range, - total RMS level, - ASD (acceleration spectral density) level, - number of axes, - duration per axis			

11.1.2 Vibration (sinusoidal)				
Applicable standards	IEC 60068-2-6 [6], IEC 60068-2-47 [11] , IEC 60068-3-8 [16]			
Test method	Exposure to sinusoidal vibration			
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of sinusoidal vibration			
Test procedure in brief	The test comprises exposure to the vibration for a time sufficient for testing the various functions of the EUT during the exposure The EUT shall be tested exposing it to the specified acceleration level and sweeping the vibration frequency in the specified frequency range , at 1 octave/min, for the specified number of sweep cycles per axis. The EUT shall be tested in three, mutually perpendicular main axes while mounted on a rigid fixture by its normal mounting means. It shall normally be mounted in such a way that the gravity vector points in the same direction as it would in normal use Where on basis of the measurement principle the direction the effect can be assumed negligible the EUT may be mounted in any position.			
	One of the following test levels may be specified:			
Test level index(1)	**1**	**2**	3	unit
Frequency range	**10 - 150**	**10 – 150**	10 - 150	Hz
Max. acceleration level	**2**	**10**	20	ms^{-2}
Number of sweep cycles per axis	**20**	**20**	20	-
Note	(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.**			
Information to be presented in the applicable Recommendation, where relevant	a) extend b) mounting of the EUT c) pre-conditioning			

11.2. Mechanical shock			
Applicable standard	IEC 60068-2-31 [10]		
Test method	Dropping the EUT on after tilting		
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of mechanical shocks		
Test procedure in brief	The EUT, standing in its normal position of use on a rigid surface, is tilted along one bottom edge and subsequently is allowed to fall freely back on to the test surface. The height of fall is the distance between the opposite bottom edge and the test surface. However, the angle between the bottom and the test surface shall not exceed 30°.		
	One of the following test levels may be specified:		
Test level index	**1**	**2**	unit
Height of fall	**25**	**50**	mm
Number of falls (on each bottom edge)	**1**	**1**	-
Information to be presented in the applicable Recommendation, where relevant	a) conditioning procedure b) fitting of cables, covers, etc. c) way of execution of the test in case the bottom is not a rectangle d) extend: height of drop on to a face		

Comment [TG(,M10]: seems not correctly translated from French language

12. External wiring and mains power supply related performance tests

Methods for determining the degradation of performance of mains supplied EUT during electrical mains power and external wiring conducted variations and disturbances.

12.1. DC mains variations (within network specification)

12. 1.1 DC mains voltage variation	
Applicable standard	IEC 60654-2 [20]
Test method	Applying low and high level DC mains power voltage
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of DC mains power voltage changes between upper and lower limit
Test procedure in brief	The test comprises exposure to the specified power supply condition for a period sufficient for achieving temperature stability and subsequently performing the required measurements.
Test level	The upper voltage limit is the DC level at which the EUT is claimed and proven to has been manufactured to automatically detect high-level conditions. The lower limit will be the DC level at which the EUT has been manufactured to automatically detect low-level conditions. The EUT shall comply with the specified maximum permissible errors at voltage levels between the two levels.

12.1.2 Ripple on DC mains power						
Applicable standard	IEC 61000-4-17 [35]					
Test method	Introducing a ripple voltage on the DC input power port.					
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of the introduction of a ripple on the DC mains voltage. This test is not applicable for instruments connected to battery charger systems with incorporated switch mode converters.					
Test procedure in brief	A test generator as defined in the referred standard shall be used. Before starting the tests, the performance of the generator shall be verified. The test comprises subjecting the EUT to ripple voltages such as those generated by traditional rectifier systems and/or auxiliary service battery chargers overlaying on DC power supply sources. The frequency of the ripple voltage is the applicable power frequency or a multiple (2, 3 or 6) dependant on the rectifier system used for the mains . The waveform of the ripple, at the output of the test generator, has a sinusoid-linear character. The test shall be applied for at least 10 min or for the period time necessary to allow a complete verification of the EUT's operating performance.					
	One of the following test levels may be specified:					
Test level index	**1** (1)	2	3	4	x(2)	unit
Percentage of the nominal DC voltage (3)	**2**	5	10	15	special	%
Notes	(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.** (industrial environments only, see sub-clause 8.4.9) (2) "x" indicates that an alternative test level may be specified in the applicable Recommendation. (3) The values presented are the peak-to-peak voltages expressed as a percentage of the nominal DC voltage.					

Information to be presented in the applicable Recommendation, where relevant	a) test level to be applied b) waveform of the ripple voltage c) frequency of the ripple d) duration of the test e) climatic conditions f) etc.

12.2. AC mains variations (within network specification)

12.2.1 AC mains voltage variation		
Applicable standards	IEC/TR3 61000-2-1 [24], IEC 61000-4-1 [27]	
Test method	Applying low and high level AC mains power voltage (single phase)	
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of AC mains network voltage changes between upper and lower limit	
Test procedure in brief	The test comprises exposure to the specified power supply condition for a period sufficient for achieving temperature stability and subsequently performing the required measurements.	
	The following test levels are preferred for OIML Recommendations	
Test level index		**1**
Mains voltage (1), (2)	Upper limit	$\boldsymbol{U_{nom1}}$ **+ 10 %**
	Lower limit	$\boldsymbol{U_{nom2}}$ **- 15 %**
Notes	(1) For three phase mains power supplies, the voltage variation is applicable for each of the phases successively. (2) The values of U_{nom} are those as inscripted on the measuring instrument. $\boldsymbol{U_{nom1}}$ concerns the highest and U_{nom2} concerns the lowest value in the case a range is specified. If only one nominal mains voltage value ($\boldsymbol{U_{nom}}$) is presented then $\boldsymbol{U_{nom1} = U_{nom2} = U_{nom}}$.	

12.2.2 AC mains frequency variation		
Applicable standards	IEC/TR3 61000-2-1 [24], IEC 61000-2-2 [25], IEC 61000-4-1 [27]	
Test method	Variation in AC mains power frequency	
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of AC mains network power frequency changes between upper and lower limit	
Test procedure in brief	The test consists of exposure to the specified power condition for a period sufficient for achieving temperature stability and for performing the required measurements.	
	The following test levels are preferred for OIML Recommendations	
Test level index		**1**
Mains frequency (1), (2)	Upper limit	$\boldsymbol{f_{nom1}}$ **+ 2 %**
	Lower limit	$\boldsymbol{f_{nom2}}$ **- 2 %**
Notes	(1) The values of f_{nom} are those as inscripted on the measuring instrument. $\boldsymbol{f_{nom1}}$ concerns the highest and f_{nom2} concerns the lowest value in the case a range is specified. If only one nominal mains voltage value ($\boldsymbol{f_{nom}}$) is presented then $\boldsymbol{f_{nom1} = f_{nom2} = f_{nom}}$. (2) As the power frequency in interconnected networks varies only in a narrow frequency band around the rated frequency (50 Hz or 60 Hz), this test applies only to special cases, for example: • EUT's to be operated at large power frequency variations • EUT's to be installed in small networks that are isolated from a large interconnected system.	

12.3. Mains power disturbances

12.3.1 DC mains voltage dips, short interruptions and (short term) variations					
Applicable standard		IEC 61000-4-29 [36]			
Test method		Introducting voltage dips, short interruptions and voltage variations on DC mains power lines using the test set-up defined in the applicable standard			
Object of the test		Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of voltage dips, voltage variations and short interruptions on DC mains.			
Test procedure in brief		A test generator as defined in the referred standard shall be used. Before starting the tests, the performance of the generator shall be verified. The EUT shall be exposed to voltage dips, short interruptions, for each of the selected combinations of amplitude and duration, using a sequence of tree dips/interruptions and intervals of at least 10 s between each test event. The most representative operating modes of the EUT shall be tested three times at 10 s intervals for each of the specified voltage variations If the EUT is an integrating instrument, the test pulses shall be continuously applied during the measurement time.			
		One of the following test levels may be specified: **(1)**			
Voltage dips	Test level index	**1**	i **(2)**		unit
	Amplitude	**40 and 70**	x_i		% of the rated voltage
	Duration **(3)**	**0.01; 0.03; 0.1; 0.3; 1**; t			s
Short interrup-tions	Test condition	High impedance and/or low impedance			
	Amplitude	**0**			% of the rated voltage
	Duration **(3)**	**0.001; 0.003; 0.01; 0.03; 0.1; 0.3; 1**; x			s
Voltage variations	Test level index	**1**	2	i	
	Amplitude	**85 and 120**	80 and 120	x_i	% of the rated voltage
	Duration **(3)**	**0.1; 0.3; 1; 3; 10**; t			s
Notes		**(1)** For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.** (industrial environments only, see sub-clause 8.4.8) **(2)** "i, x and t" are variables and indicate that alternative test level with alternative characteristics may be specified in the applicable Recommendation if accompanied with a rational for such choice. **(3)** One or more values of the presented amplitude and duration may be specified in the applicable OIML Recommendation. The shortest duration in the table should at least be included. **(4)**			
Information to be presented in the applicable Recommendation, where relevant		a) Amplitude and duration of the simulated disturbances b) climatic conditions c) performance level d) if the EUT is an integrating instrument: an exact description of the sequence of the test pulses e) etc.			

Comment [TG(,M11]: ???? suggest to delete while this cannot be detected before testing

12.3.2 AC mains voltage dips, short interruptions and reductions						
Applicable standards	IEC 61000-4-11 [34], IEC 61000-6-1 [37], IEC 61000-6-2 [38]					
Test method	Introduction short-time reductions of mains voltage using the test set-up defined in the applicable standard					
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of short time mains voltage reductions					
Test procedure in brief	A test generator is to be used which is suitable to reduce the amplitude of the AC mains voltage for the required period of time. The performance of the test generator shall be verified before connecting the EUT. The mains voltage reduction tests shall be repeated 10 times with intervals of at least 10 s between the tests. If the EUT is an integrating instrument, the tests shall be applied continuously during the measurement time.					
	One of the following test levels may be specified: (1),					
Test level index			**1**	**2** ,	i (3)	unit
Voltage dips (2)	Test a	Reduction to	**0**	**0**	x_a	%
		Duration	**0.5**	**0.5**	n_a	cycles
	Test b	Reduction to	**0**	**0**	x_b	%
		Duration	**1**	**1**	n_b	cycles
	Test c	Reduction to	**70**	**40**	x_c	%
		Duration	**25/30** (5)	**10/12** (4)	n_c	cycles
	Test d	Reduction to	N.A.	**70**	x_d	%
		Duration	N.A.	**25/30** (4)	n_d	cycles
	Test e	Reduction to	N.A.	**80**	x_e	%
		Duration	N.A.	**250/300** (4)	n_e	cycles
Short interruptions	Reduction to		**0**		x	%
	Duration		**250/300** (4)		n	cycles
Notes	(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.** (2) For the voltage dips, all tests within the test level may be applicable (see sub-clause 8.4.7). (3) "i", "x" and "n" are variables and indicate that alternative test levels with alternative characteristics may be specified in the applicable Recommendation if accompanied with a rational for such choice. For equipment connected directly or indirectly to the public network, the levels shall not be less severe than level 2. (4) Values applicable for 50 Hz / 60 Hz respectively					
Information to be presented in the applicable Recommendation, where relevant	a) amplitude and duration of the simulated disturbances b) performance of the instrument at each of the tests c) climatic conditions d) if the EUT is an integrating instrument: an exact description of the sequence of the test pulses e) etc					

12.3.3 AC mains harmonics						
Applicable standards	IEC 61000-2-5 [], IEC 61000-4-13 []					
Test method	Introducing harmonics on the AC mains power lines					
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 during conditions where the mains voltage is disturbed by harmonics of its fundamental frequency					
Test procedure in brief	A test generator as defined in the referred standard shall be used. The characteristics of the generator shall be verified before connecting the EUT. The test comprises exposure to mains harmonic distortions as defined in the referred standard. Harmonic voltages at test levels from 3% and higher, up to the 9th harmonic, shall be applied using a phase shift of both 0° and 180° with respect to the positive zero-crossing of the fundamental. Test shall be performed up to the 40th harmonic If the EUT is an integrating instrument, the harmonics shall be continuously applied during the measurement time.					
	Harmonic order n	One of the following test levels (3) may be specified:				
Test level index (1)		1	**2**	**3**	i(2)	unit
Odd Harmonics non multiples of 3	5	4.5	**9**	**12**	x_n	% of rated voltage
	7	4.5	**7.5**	**10**	x_n	
	11	4.5	**5**	**7**	x_n	
	13	4.5	**4,5**	**7**	x_n	
	17	3	**3**	**6**	x_n	
	19;23;25	2	**2**	**6**	x_n	
	29	1.5	**1.5**	**5**	x_n	
	31;35;37	1.5	**1.5**	**3**	x_n	
Odd Harmonics multiples of 3	3	4.5	**8**	**9**	x_n	
	9	2	**2.5**	**4**	x_n	
	15	-	**-**	**3**	x_n	
	21	-	**-**	**2**	x_n	
	27;33;39	-	**-**	**2**	x_n	
Even Harmonics	2	3	**3**	**5**	x_n	
	4	1.5	**1.5**	**2**	x_n	
	6	-	**-**	**1.5**	x_n	
	8 – 40	-	**-**	**1.5**	x_n	
Notes	(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.** (2) "i" and "x_n" are variables and indicate that an alternative test level may be specified. in the applicable Recommendation if accompanied with a rational for such choice. (3) For the calculation of the test levels from compatibility levels as specified in IEC/TR 61000-2-5 and IEC 61000-2-2 the IEC 61000-4-13 suggested multiplication factor k=1.5 has been applied.					
Information to be presented in the applicable Recommendation, where relevant	a) test level to be applied b) climatic conditions c) if the EUT is an integrating instrument: an exact description of the sequence of testing d) etc.					

12.3.5 Bursts (transients) on AC and DC mains						
Applicable standards	IEC 61000-4-1 [27], IEC 61000-4-4 [30]					
Test method	Introducing transients on the mains power lines					
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 during conditions where electrical bursts are superimposed on the mains voltage					
Test procedure in brief	A burst generator as defined in the referred standard shall be used. The characteristics of the generator shall be verified before connecting the EUT. The test comprises exposure to bursts of voltage spikes for which the output voltage on 50 Ω and 1000 Ω load are defined in the referred standard. Both positive and negative polarity of the bursts shall be applied. The duration of the test shall not be less than 1 min for each amplitude and polarity. The injection network on the mains shall contain blocking filters to prevent the burst energy being dissipated in the mains. If the EUT is an integrating instrument, the test pulses shall be continuously applied during the measurement time.					
	One of the following test levels may be specified:					
Test level index	1	**2** (1)	**3** (1)	4	i(2)	unit
Amplitude (peak value)	0.5	**1**	**2**	4	U	kV
Repetition rate	**5**					kHz
Notes	(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.** (2) "i" and "U" are variables and indicate that an alternative amplitude may be specified. in the applicable Recommendation if accompanied with a rational for such choice.					
Information to be presented in the applicable Recommendation, where relevant	a) test level to be applied b) climatic conditions c) if the EUT is an integrating instrument: an exact description of the sequence of testing d) etc.					

12.3.6 Surges on AC and DC mains power lines	
Applicable standard	IEC 61000-4-5 [31]
Test method	Introducing electrical surges on the mains power lines
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 during conditions where electrical surges are superimposed on the mains voltage
Test procedure in brief	A surge generator as defined in the referred standard shall be used The characteristics of the generator shall be verified before connecting the EUT. The test comprises exposure to electrical surges for which the rise time, pulse width, peak values of the output voltage/current on high/low impedance load and the minimum time interval between two successive pulses are defined in the referred standard. At least 3 positive and 3 negative surges shall be applied. On AC mains supply lines the surges shall be synchronised with AC supply frequency and shall be repeated such that injection of surges on all the 4 phase shifts: 0°, 90°, 180° and 270° with the mains frequency is covered. The injection network circuit depends on the applicable conductor and is defined in the referred standard. If the EUT is an integrating instrument, the test pulses shall be continuously applied during

	the measurement time.						
	One of the following test levels may be specified: (1)						
Test level index (installation class)	1	2	**3**	4	5	i (2)	unit
AC Line to line	N.A.	0.5	**1.0**	2.0	(3)	U_1	kV
AC Line to ground	0.5	1.0	**2.0**	4.0	(3)	U_2	kV
DC Line to line	N.A.	N.A.	**1.0**				
DC Line to ground	N.A.	N.A.	**2.0**				
Notes	(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.** (installation class) for OIML Recommendations: level 3 (2) "i","U_1" and"U_2" indicate that a alternative voltage levels may be specified in the applicable Recommendation if accompanied with a rational for such choice. (3) Depends on the class of the local power supply system						
Information to be presented in the Recommendation, where relevant	a) test level to be applied (installation class according to IEC 61000-4-5 [31]) b) climatic conditions c) coupling method d) set-up of the EUT for this test e) permissible changes in the performance of the EUT as a result of this test f) if the EUT is an integrating instrument: an exact description of the sequence of the test pulses g) etc						

12.4. Other disturbances introduced through conduction by connected external wiring

12.4.1 Bursts (transients) on signal, data and control lines						
Applicable standards	IEC 61000-4-1 [27], IEC 61000-4-4 [30]					
Test method	Electrical bursts					
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 during conditions where electrical bursts are superimposed on I/O and communication ports					
Test procedure in brief	A burst generator as defined in the referred standard shall be used The characteristics of the generator shall be verified before connecting the EUT. The test comprises exposure to bursts of voltage spikes for which the output voltage on 50 Ω and 1000 Ω load are defined in the referred standard. Both positive and negative polarity of the bursts shall be applied. The duration of the test shall not be less than 1 min for each amplitude and polarity. A capacitive coupling clamp as defined in the standard shall be used for the coupling of the bursts into the I/O and communication lines, If the EUT is an integrating instrument, the test pulses shall be continuously applied during the measurement time.					
	One of the following test levels may be specified:					
Test level index	1	**2** (1)	**3** (1)	4	i(2)	unit
Amplitude (peak value)	0.25	**0.5**	**1**	2	U(2)	kV
Repetition rate	**5**					kHz
Notes	(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.** (2) "i" and "U" are variables and indicate that an alternative amplitude may be specified in the applicable Recommendation if accompanied with a rational for					

	such choice.
Information to be presented in the applicable Recommendation, where relevant	a) test level to be applied b) climatic conditions c) signal cables to be exposed to bursts d) if the EUT is an integrating instrument: an exact description of the sequence of the test pulses e) etc.

12.4.2 Surges on signal, data and control lines									
Applicable standard		IEC 61000-4-5 [31]							
Test method		Introducing electrical surges on signal, data and control lines							
Object of the test		Verification of compliance with the provisions in 5.1.1 or 5.1.2 during conditions where electrical surges are superimposed on I/O and communication ports							
Test procedure in brief		A surge generator as defined in the referred standard shall be used. The characteristics of the generator shall be verified before connecting the EUT. The test comprises exposure to electrical surges for which the rise time, pulse width, peak values of the output voltage/current on high/low impedance load and the minimum time interval between two successive pulses are defined in the referred standard. At least 3 positive and 3 negative surges shall be applied. The applicable injection network depends on the kind of wiring the surge is coupled into and is defined in the referred standard. If the EUT is an integrating instrument, the test pulses shall be continuously applied during the measurement time.							
		One of the following test levels may be specified:							
Test level index (Installation class)		0	1	2	**3**[(1)]	4	5	i [(2)]	unit
Unsymmetrical lines	Line to line	N.A.	N.A.	0.5	**1.0**	2.0	2.0	U_1	kV
	Line to ground	N.A.	0.5	1.0	**2.0**	4.0	4.0	U_2	kV
		N.A.	0.5	1.0	**2.0**	2.0	4.0	U_3	kV
Shielded I/O and communication lines		N.A.	N.A.	0.5	**2.0**	4.0	4.0	U_4	kV
Notes		[(1)] For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.** (installation class) for OIML Recommendations [(2)] "i" and U_n indicate that an alternative voltage levels may be specified in the applicable Recommendation if accompanied with a rationale for such choice.							
Information to be presented in the applicable Recommendation, where relevant		a) test level to be applied (installation class according to IEC 61000-4-5 [31]) b) climatic conditions c) coupling method d) set-up of the EUT for this test e) permissible changes in the performance of the EUT as a result of this test. f) if the EUT is an integrating instrument: an exact description of the sequence of the test pulses							

13. Electromagnetic environment related disturbances

Methods for determining the degradation of performance of general EUT when exposed to electromagnetic fields,)

13.1. Mains power frequency (electro) magnetic field

See 8.4.3. for applicability (also refer to 4.4)

Applicable standard		IEC 61000-4-8 [33]						
Test method		Exposure to power frequency electromagnetic fields (50 Hz or 60 Hz)						
Object of the test		Verification of compliance with the provisions in 5.1.1 or 5.1.2 while exposed to power frequency electromagnetic fields (50 Hz or 60 Hz)						
Test procedure in brief		The test comprises the exposure to a power frequency magnetic field (50 Hz or 60 Hz)						
		One of the following test levels may be specified:						
Test level index		1	2	3	**4** (1)	**5** (1)	i(2)	unit (3)
Magnetic field strength	Continuous field	1	3	10	**30**	**100**	H_{1i}	A/m
	Short duration (1 s to 3 s)	N.A.	N.A.	N.A.	**300**	**1000**	H_{2i}	A/m
Notes		(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.** (2) "i" and H_{xi} are variables indicating that alternative field strength levels may be specified in the applicable Recommendation if accompanied with a rational for such choice. (3) The magnetic field strength is expressed in A/m. 1 A/m corresponds to a free space magnetic flux density of 1.26 μT.						
Information to be presented in the applicable Recommendation, where relevant		a) test level to be applied b) the direction of the magnetic field related to the position(s) of the instrument c) the phase of the magnetic field related to the phase of the power supply of the instrument, d) the duration of the short duration test						

13.2. Immunity to RF Electromagnetic fields

13.2.1 Conducted (common mode) currents generated by RF EM fields					
Applicable standard	IEC 61000-4-6 [32]				
Test method	Injection of RF currents representing exposure to RF electromagnetic fields				
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 while exposed to electromagnetic fields				
Test procedure in brief	Radio frequency EM current, simulating the influence of EM fields shall be coupled or injected into the power ports and I/O ports of the EUT using coupling/decoupling devices as defined in the referred standard. The characteristics of the test equipment consisting of an RF generator, (de-)coupling devices, attenuators, etc. shall be verified before connecting the EUT.				
	One of the following test levels may be specified:				
Test level index	1	**2** (1)	**3** (1)	i (2)	unit
RF amplitude (50 Ω)	1	**3**	**10**	U_i	V (e.m.f.)
Frequency range (5)	0.15 – 80				MHz
Modulation	80 % AM, 1 kHz sine wave				
Notes	(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.** (2) "i" and "U_i" indicate that an alternative amplitude may be specified in the applicable Recommendation if accompanied with a rational for such choice. (3) This test is not applicable for EUT without mains power supply or other input port. (4) If the EUT comprises several devices the tests shall be performed at each extremity of the cable if both of the elements are part of the EUT. (5) For the frequency range 26 ÷ 80 MHz, the testing laboratory can either carry out the test according to 12.1.1 or according to 12.1.2. In case of a dispute, the result of the test according to 12.1.2 prevails.				
Information to be presented in the applicable Recommendation, where relevant	a) test level to be applied b) climatic conditions c) wiring to and from EUT d) etc.				

13.2.2 Radiated RF electromagnetic fields	
Applicable standard	IEC 61000-4-3 [29]
Test method	Exposure to radiated radio frequency electromagnetic fields
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of exposure to electromagnetic fields
Test procedure in brief	The EUT is exposed to electromagnetic fields with the required field strength and the field uniformity like defined in the referred standard. The level of field strength specified refers to the field generated by the unmodulated carrier wave. The EUT shall be exposed to the modulated wave field. The frequency sweep shall be made only pausing to adjust the RF signal level or to switch RF-generators, amplifiers and antennas if necessary. Where the frequency range is swept incrementally, the step size shall not exceed 1 % of the preceding frequency value. The dwell time of the amplitude modulated carrier at each frequency shall not be less

	than the time necessary for the EUT to be exercised and to respond, but shall in no case be less than 0.5 s. Adequate EM fields can be generated in facilities of different type and set-up the use of which is limited by the dimensions of the EUT and the frequency range of the facility. The expected most critical frequencies (e.g. clock frequencies) shall be analyzed separately. (1)
Test levels	Test levels may be specified according to Tables 12.1.1/1 and 12.1.2/2
Note	(1) These frequencies can be expected to correspond the EUT emitted EM field frequencies
Information to be presented in the applicable Recommendation, where relevant	a) test level to be applied b) climatic conditions c) wiring to and from EUT d) duration of the test e) etc.

13.2.2.1 Electromagnetic fields of general origin							
Test level index		1	**2** (3)	**3** (3)	4	i(4)	unit
Frequency Range	80 - 1000 MHz (1) 26 - 1000 MHz (2), (5)	1	**3**	**10**	30	E_i	V/m
Modulation		80 % AM, 1 kHz, sine wave					
Notes		(1) IEC 61000-4-3 [29] only specifies test levels above 80 MHz. For the lower frequency range the test methods for conducted radio frequency disturbances are recommended (test). (2) For EUT lacking any cabling as is needed for applying the test specified in 12.1.2 the lower frequency limit shall be 26 MHz (refer to Annex H of IEC 61000-4-3 [29]). In all other cases both 12.1.1. and 12.1.2 shall apply. (3) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.** (4) "i" and E_i indicate that a alternative field strength level may be specified in the applicable Recommendation if accompanied with a rational for such choice. (5) For the frequency range 26 to 80 MHz, the testing laboratory can either carry out the test according to 13.2.1 or according to 13.2.2. But in case of a dispute, the results according to 13.2.2 shall prevail.					

13.2.2.2 Electromagnetic fields specifically caused by wireless communication networks							
Test level index		1	2	**3** (1)	**4** (1)	i(2)	unit
Frequency Range	800 - 960 MHz	1	3	**10**	**30**	E_i	V/m
	1.4 – 3 GHz (3)	1	3	**10**	**30**		
	3 – 6 GHz (3) (4)	1	3	10	30		
Modulation		80 % AM, 1 kHz, sine wave					
Notes		(1) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.** 2) "i" and E_i indicate that a alternative field strength level may be specified in the applicable Recommendation if accompanied with a rational for such choice. 3)The main test level selection criteria should be the consequences of failure of an					

	instrument located at the expected minimum distance from a radiating source for wireless communication . (see 8.4.1 and Annex G of the referred applicable standard) and the possibility of fraud by using such radiating source (like a mobile phone).[4)] The most intensive or the frequency ranges 3.3-3.5 GHz. A rationale is required when specifying the need for testing in this frequency band. (see 8.4.1 and IEC /TR 61000-5-2)

13.3. Immunity to electrostatic discharges

Test to determining the degradation of performance of EUT when exposed to electrostatic discharges

13.3.1 Electrostatic discharge							
Applicable standard		IEC 61000-4-2 [28]					
Test method		Exposure to electrostatic discharge (ESD)					
Object of the test		Verification of compliance with the provisions in 5.1.1 or 5.1.2 in case of direct exposure to electrostatic discharges or such discharges in the neighbourhood of the EUT					
Test procedure in brief		The test comprises exposure of the EUT to electrical discharges An ESD generator as defined in the referred standard shall be used and the test set-up shall comply the dimensions, materials used and conditions as specified in the referred standard. Before starting the tests, the performance of the generator shall be verified. At least 10 discharges per preselected discharge location shall be applied. The time interval between successive discharges shall be at least 1 second. For EUT not equipped with a ground terminal, the EUT shall be fully discharged between discharges. If the EUT is an integrating instrument, the test pulses shall be applied continuously during the measurement time. Contact discharge is the preferred test method. Air discharge is far less defined and reproducible and therefore shall be used only where contact discharge cannot be applied. Direct application: In the contact discharge mode to be carried out on conductive surfaces, the electrode shall be in contact with the EUT before activation of the discharge. In such case the discharge spark occurs in the vacuum relays of the contact discharge tip. On insulated surfaces only the air discharge mode can be applied. The EUT is approached by the charged electrode until a spark discharge occurs Indirect application: The discharges are applied in the contact mode only on coupling planes mounted in the vicinity of the EUT.					
		One of the following test levels may be specified:					
Test level index (1)		1	2	**3** (2)	4	i(3)	unit
Test voltage	Contact discharge	2	4	**6**	8	U_{1i}	kV
	Air discharge	2	4	**8**	15	U_{2i}	kV
Notes		(1) In this case “level” means: “up to and including” the specified level (i.e. the test shall also be performed at the specified lower levels in the standard). (2) For each OIML Recommendation the choice on applicable level is to be made. The level assumed most applicable and preferred to implement is presented in **bold face.** (3) “i” and U_{ni} indicate that an alternative test voltages may be specified in the applicable Recommendation if accompanied with a rational for such choice. (4) Contact discharges shall be applied on conductive surfaces. Air discharges shall be applied on non-conductive surfaces.					
Information to be presented in the applicable Recommendation, where relevant		a) test level to be applied b) climatic conditions c) for non-earthed EUT’s, procedure for discharging the EUT between two successive electrostatic discharges					

Comment [GT12]: as in the standard

	d) the number of discharges at each point e) if the EUT is an integrating instrument: an exact description of the sequence of the test pulses

14. Battery and non-mains power supply related performance tests

Tests to determine the degradation of performance of battery powered EUT as a consequence of specific electrical influence quantities

14.1. Low voltage of internal battery (not connected to the mains power)

Applicable standards	No standard is available
Test method	Applying minimum supply voltage
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 during low battery voltage
Test procedure	The test comprises exposure of the EUT to the specific low battery level condition during a period sufficient for achieving temperature stability and for performing the required measurements. The maximum internal impedance of the battery and the minimum battery supply voltage level (U_{bmin}) are to be specified by the manufacturer of the instrument. In case of simulating the battery by using an alternative power supply source like in bench testing, the internal impedance of the specified type of battery shall also to be simulated. The alternative power supply shall be capable to deliver sufficient current at the applicable supply voltage. The test sequence is as follows: - Let the power supply stabilize at a voltage as defined within the rated operating conditions and apply the measurement and/or loading condition. - Record: a) the data defining the actual measurement conditions including date, time and environmental conditions, b) the actual power supply voltage. - Perform measurements and record the error (-s) and other relevant performance parameters. - Verify compliance with clauses 5.1.1. and 5.1.2 - Repeat the above procedure with actual supply voltage at U_{bmin} and again at 0,9 U_{bmin} Verify compliance with the requirements stated in the sub clauses of clause 5.5.
	The following test be specified:
Test level index	1
Lower limit of the voltage	The lowest voltage at which the EUT functions properly according to the specifications
Number of test cycles	At least one test cycle for each functional mode
Information to be presented in the applicable Recommendation, where relevant	a) preconditioning of the EUT b) measurements and/or loading during conditioning and test c) number of test cycles d) maximum allowable variations e) response of the EUT to low supply voltage; for instance indication or switch off

14.2. Power from external 12V and 24 V road vehicle batteries

Note:
The nominal voltage U_{nom} of the electrical system in road vehicles is usually 12 V or 24 V.
But the practical voltage at the battery-terminals of a road vehicle can vary considerably.
ISO 7637-2 [42], clauses 4.2 and 5, specify reference levels of 13.5 V and 27 V respectively.

It is likely that the future will bring 42 V systems too, but these are not yet included in the ISO 7637-series of standards, nor in ISO 16750-2:2003 [40]. Therefore, no attempt is made to include them in this version of OIML D 11.

14.2.1 Voltage variations								
Applicable standard	ISO 16750-2 [40]							
Test method	Variation in supply voltage							
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of high while charging) and low battery voltage							
Test procedure in brief	The test comprises exposure to the specified maximum and minimum power supply voltage conditions for a period sufficient for achieving temperature stability and performing the required measurements at these conditions.							
	One of the following test levels may be specified:							
Nominal battery voltage	U_{nom} = 12 V				U_{nom} = 24 V			Unit
Test level index (1)	A	B	**C (2)**	D	E	**F (2)**	G	
Lower limit	6	8	**9**	10.5	10	**16**	22	V
Upper limit	16	16	**16**	16	32	**32**	32	V
Notes	1) In ISO 16750-2 [40] called “Code” 2) Preferred test level for OIML Recommendations: Code C for 12 V batteries and Code F for 24 V batteries. 3) Other tests from ISO 16750-2 [40] are not adopted in this Document.							
Information to be presented in the applicable Recommendation, where relevant	a) preconditioning of the instrument b) measurements and/or loading during conditioning and test c) number of test cycles d) maximum allowable variations e) reaction of the EUT to low supply voltage; for instance indication or switch off.							

14.2.2 Electrical transient conduction along supply lines					
Applicable standard	ISO 7637–2 [42]	§ 5.6.2: Test pulse 2a + 2b § 5.6.3: Test pulse 3a + 3b		§ 5.6.4: Test pulse 4	
Test method	Electrical transient conduction along supply lines.				
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under the following conditions [(4)]: - transients due to a sudden interruption of currents in a device connected in parallel with the device under test due to the inductance of the wiring harness (pulse 2a); - transients from DC motors acting as generators after the ignition is switched off (pulse 2b)[(5)]; - transients on the supply lines , which occur as a result of the switching processes (pulses 3a and 3b); - voltage reductions caused by energizing the starter-motor circuits of internal combustion engines (pulse 4).				
Test procedure in brief	The test comprises exposure to disturbances on the power voltage by direct coupling into the supply lines.				
	One of the following test levels may be specified:				
Test level index [(1)] [(2)]	III		**IV [(3)]**		unit
Test pulse	Pulse voltage U_s		**Pulse voltage U_s**		
	U_{nom} = 12 V	U_{nom} = 24 V	**U_{nom} = 12 V**	**U_{nom} = 24 V**	
2a	+ 37	+ 37	**+ 50**	**+ 50**	V
2b[(5)]	+ 10	+ 20	**+ 10**	**+ 20**	V
3a	- 112	- 150	**- 150**	**- 200**	V
3b	+ 75	+ 150	**+ 100**	**+ 200**	V
4	-6	- 12	**- 7**	**- 16**	V
Notes:	(1) In ISO 7637-2 [42], so called “test levels”. (2) In ISO 7637-2 [42], the former levels I and II were deleted because concerning transients in road vehicles these do not ensure a sufficient level of immunity. (3) The text of this standard indicates that this standard is primarily intended as a basis for contracts between manufacturers of motor vehicles and electronic sub-assemblies As instruments shall comply with the provisions in 5.1.1 or 5.1.2 in any type of car, test level IV is advised to incorporate in OIML Recommendations. (4) Test pulses 1, 5a and 5b, mentioned in the standard are considered not applicable (5) Test pulse 2b is only applicable in case the measuring instrument may be connected to the battery via the main switch of the car, so if the manufacturer of the measuring instrument has **not** specified that the instrument is to be connected directly to the battery.				
Information to be presented in the applicable Recommendation, where relevant	a) test pulses to be applied b) test level to be applied c) minimum number of pulses or test time d) performance of the EUT during and after the test pulses				

14.2.3 Electrical transient conduction via lines other than supply lines							
Applicable standard	ISO 7637-3 [43], § 4.5: Test pulses a and b						
Test method	Electrical transient conduction along lines other than supply lines						
Object of the test	Verification of compliance with the provisions in 5.1.1 or 5.1.2 under conditions of transients which occur on other lines as a result of the switching processes (pulses a and b)						
Test procedure in brief	The test consists of exposure to bursts of voltage spikes by capacitive and inductive coupling via lines other than supply lines.						
	The following test level may be specified:						
Test level index			I	II	III	**IV** (1)	unit
U_{nom} = 12 V	pulse a	U_s	- 10	- 20	- 40	**- 60**	V
	pulse b	U_s	+ 10	+ 20	+ 30	**+ 40**	V
U_{nom} = 24 V	pulse a	U_s	- 14	- 28	- 56	**- 80**	V
	pulse b	U_s	+ 14	+ 28	+ 56	**+ 80**	V
Notes:	(1) The text of the standard indicates that this standard is primarily intended as a basis for contracts between manufacturers of motor vehicles and electronic sub-assemblies As instruments must comply with the provisions in 5.1.1 or 5.1.2 in any type of car, test level IV is advised for application in OIML Recommendations.						
Information to be presented in the applicable Recommendation, where relevant	a) test level to be applied b) performance of the EUT during and after the test pulses						

ANNEX A
DURABILITY ASSESSMENT
(Informative)

A.1 Introduction

A.1.1 Objective

The objective of durability assessment is to verify the instruments' capability to operate correctly within the performance criteria over the required period of time.
Since deterioration of an instrument may occur (i) due to the failure of one of its components, which may happen at an unpredictable moment during its lifetime, or (ii) due to the gradually wear and tear the durability assessment comprises determination of the capability of the instrument to:

- act adequately upon the failure of a component;
- collect information on the possible occurrence of defects during its complete lifetime .

A.1.2 Verification of the instrument capability to act adequately upon failure of a part or component

Tests may be carried out to verify the correct performance of durability protection facilities and checking facilities by creating situations where that these facilities meant to act upon, provided that the integrity of the instrument is maintained. Study of the documentation on circuitry may give guidance. The applicable Recommendation may specify the parts that are to be tested. Special attention should be paid to parts (electronic or mechanic) which may be expected to gradually change in properties during the lifetime of the instrument.

A.1.3 Assessment of the possible occurrence of defects during the lifetime of the complete measuring system

Information concerning this subject can only be collected by performance of an actual endurance tests simulating the complete lifetime by accelerating in time the instruments´ wear and tear The manufacturer may have carried out such tests in order to ameliorate the overall quality of the instrument by reinforcing certain parts, to elaborate other solutions for certain problems, or to set up an adequate maintenance system.

It is recommended that the testing authority requests documentation concerning these tests.

The applicable Recommendation may specify certain endurance tests.

A.2 Characteristics of durability protection

Durability protection in its basic form provides the operator with information concerning the status of the instrument. He may be warned that a certain operation time has elapsed or that the instrument itself has detected a significant durability error and is consequently invited to take corrective actions; alternatively, he may be recommended to carry out certain checking operations.

A proper intake for protection may be the time factor itself, in which case an obvious moment for checking operations is the switching-on of the instrument, or for example the switching on of a display or an additional device. Another approach may be the use of timers or operation cycle counters, which would determine other checking times based on the known or estimated frequency of the occurrence of durability errors.

In these cases, the operator may be given a certain lapse of time to carry out his checking operations at a suitable moment; after that time, however, the instrument shall discontinue its operation if the checks have not been done.

In more sophisticated forms of durability protection, the instrument may automatically compare the result of checking operations with stored result values and automatically conclude whether it is still in good condition or not. If the self-checking involves the application of physical reference standards (for example in weighing instruments) monitoring of the durability of analogue input transducers will also be possible.

Within the instrument, the circuits warranting durability protection shall represent a logical function with self-checking properties. Since significant durability errors normally need a certain time interval to develop, this self-checking action may be intermittent, and very often an interlock with the switch-on procedure may be sufficient.

Durability protection should not be confused with protection against disturbances and influence factors, although checking facilities sometimes also monitor durability aspects, for example by detecting a significant fault that occurs

due to the wearing of a component in the measuring chain. The objective of both requirements 5.1.2 and 5.1.3 is to safeguard the routine measurement operations of the instrument against failures.

The applicable Recommendation may contain prescriptions concerning the means for securing digital signal handling in the case of a self-checking ability. The difference in self-checking frequency (automatic and permanent for some routine operations; intermittent for durability effects) is to be seen as a consequence of speed: a slow evolution of durability errors opposed to the transmission of typically one million information-carrying pulses every second in the digital signal processing.

Where transmission and storage of digital data has been sufficiently protected, the internal function of a typical microprocessor (which processes program instructions as well as arithmetical operations through the same function blocks) may be considered as self-checked by its normal operation.

ANNEX B
FACILITY FOR TESTS ON BAROMETRIC PRESSURE
(Informative)

B.1 Introduction

At publication date of this document no publication is available on a standard method describing a test facility for the evaluation of the influence of minor changes in the barometric pressure on the performance of measuring instruments.
As the performance of certain measuring instruments can be influenced by changes in atmospheric pressure, exposing these to such test makes sense. Typical example is the influence on the zero-output of certain designs of load cells, having a low excitation voltage.
This Annex presents a brief description for a simple test set-up, primarily designed and designated for testing load cells, but also applicable for other relatively small EUTs with a safe low excitation voltage.
For this test, it should be emphasized that the changes in pressure introduced are very small: the difference in atmospheric pressure between the test chamber and the outer atmosphere will never exceed 20 kPa. So no special precautions need to be taken with respect to pressure related safety measures.
Furthermore, there is no need to control the exact pressure; it will be sufficient to control the difference between the pressure in the pressure chamber and the atmospheric pressure in the laboratory.
When using a small pressure-chamber for the testing of electronic measuring instruments a practical problem is making the connection for the cable(s) between the pressure-room and the outer atmosphere airtight using simple means and without a need to dismantle the connection plug(s).

B.2 Facility for barometric pressure test

It must be clearly emphasized that the facility described below is just one possible solution. Other solutions may be equally acceptable.
In the described facility, the problem of getting an airtight feed-through for the cables is solved by creating a water-slot and using it to generate the changes in pressure as well.

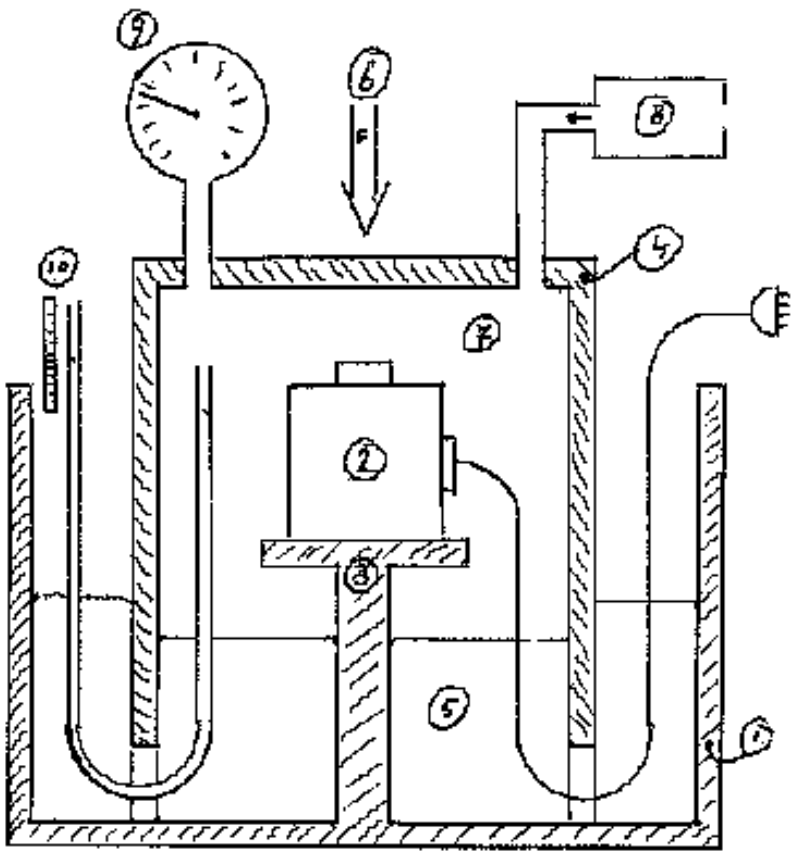
The principle of the test facility is depicted in Figure 1 and a practical set-up is shown in Figure 2.
The vessel (1) is partly filled with water.
The EUT (2) is placed on a table (3) and prevents the EUT getting wet.
A transparent vessel (4), having a smaller diameter than the one mentioned before, is placed upside down within the first vessel (1) to form a water seal (5) between the two vessels. Furthermore, there should be a means (6) that prevents the vessel from floating. This could be either a bar like shown in Figure 2 or some heavy object.
The pressure above the water level in the second vessel (7) can be set by means of a manually operated pump (8) and its level read on a pressure gauge (9).
The water seal (5) between the two vessels solves the problem of an airtight feed-through for the cables.

The vessel (1) shown in Figure 2 a has a diameter of about 50 cm.

The pressure in the chamber can be increased by either a small hand-pump or by adding a small amount of water.

As an alternative for the pressure gauge (9), a water manometer (10) consisting of a water-filled plastic tube and a ruler could be used.

Warning:
Due to the presence of water and a metal housing, this facility can only be of use for situations were only safe low voltages occur, or no electric power at all.



(1) Vessel
(2) EUT
(3) Table
(4) Transparent vessel
(5) Water
(6) Prevention against floating up
(7) Pressure chamber
(8) Pump
(9) Pressure gauge
(10) Water-manometer

Figure B-1 The basic principle

Figure B-2 The practical set-up

ANNEX C
BIBLIOGRAPHY and NOTES

At the time of Publication, the editions indicated were valid. All normative documents are subject to revision, and the users of this Document are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.
The actual status of the standards referred to can also be found on the Internet:
IEC Publications: http://www.iec.ch/searchpub/cur_fut.htm
ISO Publications: http://www.iso.org/iso/en/CatalogueListPage.CatalogueList
OIML Publications: http://www.oiml.org/publications/ (with free download option of PDF files)
In order to prevent any misunderstanding, it is highly recommended that all references to standards in OIML Recommendations and International Documents shall be followed by the version referred to (mostly year or date).

Ref.	Standards and reference documents	Description
[1]	International Vocabulary of Metrology – Basic and General (2010) Concepts and Associated Terms (VIM). 3rd Edition OIML V 2-200 (2007) □ncluding erratum 2010	Vocabulary, prepared by a joint working group consisting of experts appointed by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, and OIML
[n]	VIML	
[2]	OIML B 3 (2003) + Amendment (2006) OIML Certificate System for Measuring	This basic OIML Publication provides the rules for issuing, registering and using OIML basic certificates of conformity
[3]	IEC 60068-1 Ed. 6.0 (1988-6), Appendix B (including Amendment 1, 1992-4) Environmental testing. Part 1: General and guidance	Enumerates a series of environmental tests and appropriate severities, and prescribes various atmospheric conditions for measurements for the ability of specimens to perform under normal conditions of transportation, storage and operational use
[4]	IEC 60068-2-1 Ed. 6.0 (2007-03) Environmental testing Part 2-1: Tests - Test A: Cold	Concerns exposure to low temperatures (cold) tests on both non-heat-dissipating and heat-dissipating specimens
[5]	IEC 60068-2-2 Ed 5.0 (2007-07) Environmental testing Part 2-2: Tests - Test B: Dry heat	Concerns exposure to high temperatures and low humidity (dry heath) tests on both non-heat-dissipating and heat-dissipating specimens and contains the following tests with gradual change of temperature: Bb: for non heat-dissipating specimens; Bd: for heat-dissipating specimens and Be: for heat-dissipating specimens powered throughout the test.,
[6]	IEC 60068-2-6 Ed 7.0 (2007-12) with Corr. 1 (1995-03) Environmental testing Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	Concerns a method of test which provides a standard procedure to determine the ability of components, equipment and other articles to withstand specified severities of sinusoidal vibration. Publication
[7]	IEC 60068-2-11 Ed. 3.0 (1981-01) Environmental testing Part 2-11: Tests - Test Ka: Salt mist + Correction 1 (1999-12)	Compares resistance to deterioration from salt mist between specimens of similar construction. May be used to evaluate the quality and the uniformity of protective coatings.

Comment [GT13]: To be completed on basis of status of VIML at publication

[8]	IEC 60068-2-18 Ed. 2.0 (2000-10) Environmental testing - Part 2-18: Tests - Test R and guidance: Water	Provides methods of test applicable to products which, during transportation, storage or in service, may be subjected to falling drops, impacting water or immersion. The primary purpose of water tests is to verify the ability of enclosures covers and seals to maintain components and equipment in good working order after and, when necessary, under a standardized drop field or immersion in water. These tests are not corrosion tests and should not be considered and used as such. The effects of a large temperature difference between the water and the specimen, such as increased water ingress resulting from pressure changes, as well as thermal shock, are not simulated. Established water tests in other standards are not intended to simulate natural rainfall and their quoted intensities are too high to be adopted for that purpose. Therefore, in addition to the high-intensity severities, Test R includes an artificial rain test based upon natural conditions but not taking into account high wind speeds generally associated with natural rain. Guidance is given on the applicability of the tests and the severities to be selected.
[9]	IEC 60068-2-30 Ed 3.0 (2005-08) Environmental testing Part 2-30: Tests Test Db : Damp heat, cyclic (12 + 12-hour cycle)	Determines the suitability of components, equipment or other articles for use, transportation and storage under conditions of high humidity - combined with cyclic temperature changes and, in general, producing condensation on the surface of the specimen
[10]	IEC 60068-2-31 Ed 2.0 (2008-05) Environmental testing Part 2-31: Tests Test Ec: Rough handling shocks, primarily for equipment-type specimens	Provides a test procedure for simulating the effects of rough handling shocks, primarily in equipment-type specimens, the effects of knocks, jolts and falls which may be received during repair work or rough handling in operational use. This procedure does not simulate the effects of impacts received during transportation as loosely constrained cargo
[11]	IEC 60068-2-47 Ed 3.0 (2005-4) Environmental testing Part 2-47: Tests Mounting of specimens for vibration, impact and similar dynamic tests	Provides methods of mounting components, and mounting requirements for equipment and other articles, for the families of dynamic tests in IEC 60068-2, that is impact (Test E), vibration (Test F) and acceleration, steady-state (Test G).
[12]	IEC 60068-2-64 Ed 2.0 (2008-04) Environmental testing - Part 2-64: Test methods, Test Fh: Vibration, broad-band random and guidance	Determines the adequacy of specimens to resist dynamic loads without unacceptable degradation of its functional and/or structural integrity when subjected to the specified random vibration test requirements. Broadband random vibration may be used to identify accumulated stress effects and the resulting mechanical weakness and degradation in the specified performance. This standard is applicable to specimens which may be subjected to vibration of a stochastic nature resulting from transportation or operational environments, for example in aircraft, space vehicles and land vehicles. It is primarily intended for unpackaged specimens, and for items in their transportation container when the latter may be considered as part of the specimen itself. Publication
[13]	IEC 60068-2-78 Ed. 1.0 (2001-08) Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state	Provides a test method for determining the suitability of electro technical products, components or equipment for transportation, storage and use under conditions of high humidity. The test is primarily intended to permit the observation of the effect of high humidity at constant

	(IEC 60068-2-78 replaces the following withdrawn standards: *IEC 60068-2-3, test Ca and* *IEC 60068-2-56, test Cb)*	temperature without condensation on the specimen over a prescribed period. This test provides a number of preferred severities of high temperature, high humidity and test duration. The test can be applied to both heat-dissipating and non-heat dissipating specimens. The test is applicable to small equipment or components as well as large equipment having complex interconnections with test equipment external to the chamber, requiring a set-up time which prevents the use of preheating and the maintenance of specified conditions during the installation period.
[14]	IEC 60068-3-1 Ed. 1.0 (1974-01) + Supplement A (1978-01) Environmental testing Part 3-1: Background information,- Cold and dry heat tests	Gives background information for Tests A: Cold (IEC 68-2-1), and Tests B: Dry heat (IEC 68-2-2). Includes appendices on the effect of: chamber size on the surface temperature of a specimen when no forced air circulation is used; airflow on chamber conditions and on surface temperatures of test specimens; wire termination dimensions and material on surface temperature of a component; measurements of temperature, air velocity and emission coefficient. Supplement A gives additional information for cases where temperature stability is not achieved during the test.
[15]	IEC 60068-3-4 Ed. 1.0 (2001-08) Environmental testing - Part 3-4: Supporting documentation and guidance - Damp heat tests	Provides the necessary information to assist in preparing relevant specifications, such as standards for components or equipment, in order to select appropriate tests and test severities for specific products and, in some cases, specific types of application. The object of damp heat tests is to determine the ability of products to withstand the stresses occurring in a high relative humidity environment, with or without condensation, and with special regard to variations of electrical and mechanical characteristics. Damp heat tests may also be utilized to check the resistance of a specimen to some forms of corrosion attack.
[16]	IEC 60068-3-8 Ed. 1.0 (2003-08) Environmental testing - Part 3-8: Supporting documentation and guidance - Selecting amongst vibration tests	Provides guidance for selecting amongst the IEC 60068-2 stationary vibration test methods Fc sinusoidal, Fh random and F(x) Mixed mode vibration. The different steady-state test methods and their aims are briefly described in Clause 4. Transient test methods are not included. For vibration testing, the environmental conditions, especially the dynamic conditions for the specimen, should be known. This standard helps to collect information about the environmental conditions (Clause 5), to estimate or measure the dynamic conditions (Clause 6) and gives examples to enable decisions to be made on the most applicable environmental vibration test method. Starting from the condition, the method of selecting the appropriate test is given. Since real life vibration conditions are dominated by vibration of a random nature, random testing should be the commonly used method, see Table 1, Clause 7. The methods included hereafter may be used to examine the vibration response of a specimen under test before, during and after vibration testing. The selection for the appropriate excitation method is described in Clause 8 and tabulated in Table 2. In this standard specification, writers will find information concerning vibration test methods and guidance for their selection.
[17]	IEC 60512-11-8 Ed. 1.0 (1995-11) Electromechanical components for	Defines a standard test method to assess the ability of a connector to withstand driving fine sand and dust.

	electronic equipment - Basic testing procedures and measuring methods - Part 11: Climatic tests - Section 8: Test 11h - Sand and dust	
[18]	IEC 60512-14-7 Ed. 1.0 (1997-10) Electromechanical components for electronic equipment - Basic testing procedures and measuring methods - Part 14: Sealing tests - Section 7: Test 14g: Impacting water	Defines a standard test method to assess the effects of impacting water or specified fluid on electrical connecting devices.
[19]	IEC 60529 Ed. 2.1 (2001-02) Degrees of protection provided by enclosures (IP Code) Corr.1 (2003-01) Ed. 2.1 Corr.2 (2007-10) Ed. 2.1	Applies to the classification of degrees of protection provided by enclosures for electrical equipment with a rated voltage not exceeding 72.5 kV.
[20]	IEC 60654-2 Ed. 1.0 (1979-01), with amendment 1 (1992-09) on Ed. 1.0 Operating conditions for industrial-process measurement and control equipment Part 2: Power	Gives the limiting values for power received by land-based and offshore industrial-process measurement and control systems or parts of systems during operation. Maintenance and repair conditions are not considered
[21]	IEC 60721-2-5 Ed. 1.0 (1991-07) Classification of environmental conditions - Part 2-5: Environmental conditions appearing in nature - Dust, sand, salt mist	Presents characteristics of dust, sand and salt mist appearing in nature, and describes the influences from these environmental factors to which products are liable to be exposed during storage, transportation and use.
[22]	IEC 60721-3-3 Consolidated Ed. 2.2 (2002-10) with correction1 (2008-06) on Ed. 2.2 Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use at weather-protected locations	Classifies groups of environmental parameters and their severities to which products are subjected when mounted for stationary use at weather-protected locations.
[23]	IEC 60721-3-4 Ed. 2.0 (1995-01) with Amendment 1 (1996-11) Part 3-4: Classification of groups of environmental parameters and their severities - Stationary use at non-weather protected locations.	Classifies groups of environmental parameters and the severities to which a product may be exposed under use conditions, including periods of erection work, downtime, maintenance and repair, when mounted for stationary use at locations which are non-weather protected.
[24]	IEC/TR 61000-2-1 Ed. 1.0 (1990-05) Electromagnetic compatibility (EMC) Part 2: Environment Section 1: Description of the environment - Electromagnetic environment for low-frequency conducted disturbances and signalling in public power supply systems	Has the status of a technical report, and gives information on the various types of disturbances that can be expected on public power supply systems. The following disturbance phenomena are considered: - harmonics - inter-harmonics - voltage fluctuations - voltage dips and short supply interruptions - voltage unbalance - mains signalling - power frequency variation - DC components
[25]	IEC 61000-2-2 Ed. 2.0 (2002-03) Electromagnetic compatibility (EMC) Part 2 Environment Section 2: Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems	This standard is concerned with conducted disturbances in the frequency range from 0 kHz to 9 kHz, with an extension up to 148.5 kHz specifically for mains signalling systems. It gives compatibility levels for public low voltage AC distribution systems having a nominal voltage up to 420 V, single-phase or 690 V, three-phase and a nominal frequency of 50 Hz or 60 Hz. Compatibility levels are specified for electromagnetic disturbances of the types which can be expected in public low voltage power supply systems, for guidance in: - the limits to be set for disturbance emission into public power supply systems;

		- the immunity limits to be set by product committees and others for the equipment exposed to the conducted disturbances present in public power supply systems.
[26]	~~(?)Conditions have been adapted from basic IEC Publication~~ IEC/TR 61000-2-5 To be published Electromagnetic compatibility (EMC) – Environment - Classification of electromagnetic environments.	This publication is a technical report intended for guidance, not as a specification, for those who are in charge of writing immunity standards for an equipment or system. Its purpose is to classify electromagnetic environments and help improve the specification of the immunity requirements of an item containing electrical or electronic parts, and consequently obtain electromagnetic compatibility. It also gives basic guidance for the selection of immunity levels. The data are applicable to any equipment, subsystem or system making use of electromagnetic energy and operating in a specific location as defined by this report.
[27]	IEC 61000-4-1 Ed.3.0 (2006-10) Basic EMC Publication Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 1: Overview of IEC 61000-4 series	Provides applicability assistance to the users and manufacturers of electrical and electronic equipment on EMC standards within the IEC 61000-4 series on testing and measurement techniques. Provides general recommendations concerning the choice of relevant tests.
[28]	IEC 61000-4-2 Ed. 2.0 (2008-12) Basic EMC Publication Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 2: Electrostatic discharge immunity test.	Provides the immunity requirements and test methods for electrical and electronic equipment subjected to static electricity discharges, from operators directly, and from any person to adjacent objects. It additionally defines ranges of test levels which relate to different environmental and installation conditions and establishes test procedures.
[29]	IEC 61000-4-3 consolidated Ed. 3.1 (2008-04) Basic EMC Publication ISH-1 (2008-08) (Interpretation sheet 1) to Ed. 3.1 Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 3: Radiated, radio-frequency, electromagnetic field immunity test	Provides the immunity requirements of electrical and electronic equipment to radiated electromagnetic energy. It establishes test levels and the required test procedures. Establishes a common reference for evaluating the performance of electrical and electronic equipment when subjected to radio-frequency electromagnetic fields.
[30]	IEC 61000-4-4 Ed. 2.0 (2004-07) and correction 1 on Ed. 2.0 (2006-08) correction 2 on Ed. 2.0 (2007-06) and amendment1 to Ed. 2.0 (2010-01) Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 4: Electrical fast transient/burst immunity test	Establishes a common and reproducible reference for evaluating the immunity of electrical and electronic equipment when subjected to electrical fast transient/bursts on supply, signal, control and earth ports. The test method documented in this part of IEC 61000-4 describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon. The standard defines: - test voltage waveform; - range of test levels; - test equipment; - verification procedures of test equipment; - test set-up; - test procedure. The standard gives specifications for laboratory and post-installation tests.
[31]	IEC 61000-4-5 Ed. 2.0 (2005-11) correction 1 on Ed. 2.0 (2009-10)	Provides the immunity requirements, test methods, and range of recommended test levels for electrical and

Comment [GT14]: To be completed on basis of status of standard at publication

	Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 5: Surge immunity test	electronic equipment to unidirectional surges caused by overvoltages from switching and lightning transients. Several test levels are defined which relate to different environment and installation conditions. It establishes a common reference for evaluating the performance of equipment when subjected to high-energy disturbances on the power and inter-connection lines.
[32]	IEC 61000-4-6 Ed 3.0 (2008-10) Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 6: Immunity to conducted disturbances, induced by radio-frequency fields	Provides the immunity requirements of electrical and electronic equipment to conducted electromagnetic disturbances originating from intended radio-frequency (RF) transmitters in the frequency range 9 kHz up to 80 MHz. Equipment not having at least one conducting cable (such as mains supply, signal line or earth connection), which can couple the equipment to the disturbing RF fields is excluded.
[33]	IEC 61000-4-8 Ed. 2.0 (2009-09) Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 8: Power frequency magnetic field immunity test	Provides the immunity requirements of equipment, only under operational conditions, to magnetic disturbances at power frequency related to: - residential and commercial locations - industrial installations and power plants - medium voltage and high voltage sub-stations.
[34]	IEC 61000-4-11 Ed.2.0 (2004-03) Electromagnetic compatibility (EMC) Part 4: Testing and measuring techniques Section 11:Voltage dips, short interruptions and voltage variations immunity tests	Provides the immunity test methods and range of preferred test levels for electrical and electronic equipment connected to low-voltage power supply networks for voltage dips, short interruptions, and voltage variations. It applies to equipment having a rated input current not exceeding 16 A per phase, for connection to 50 Hz or 60 Hz AC networks. It does not apply equipment for connection to 400 Hz AC networks. The object of this standard is to establish a common reference for evaluating the immunity of electrical and electronic equipment when subjected to voltage dips, short interruptions and voltage variations.
[35]	IEC 61000-4-17 Consolidated Ed. 1.2 (2009-01) (incl. am1+am2) Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques Section 17: Ripple on DC input power port immunity test.	Provides test methods for immunity to ripple at the DC input power port of electrical or electronic equipment. This standard is applicable to low-voltage DC power ports of equipment supplied by external rectifier systems, or batteries which are being charged This standard defines: - test voltage waveform - range of test levels - test generator - test set-up - test procedure. This test does not apply to equipment connected to battery charger systems incorporating switch mode converters.

[36]	IEC 61000-4-29 Ed. 1.0 (2000-08) Electromagnetic compatibility (EMC) – Part 4-29: Testing and measuring techniques- Voltage dips, short interruptions and voltage variations on DC input power port immunity tests.	Provides test methods for immunity to voltage dips, short interruptions and voltage variations at the DC input power ports of electrical or electronic equipment. This standard is applicable to low voltage DC power ports of equipment supplied by external DC networks. This standard defines: - the range of test levels - the test generator - the test set-up - the test procedure
[37]	IEC 61000-6-1 Ed. 2.0 (2005-3) Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 1: Immunity for residential, commercial and light-industrial environments	Defines the immunity performance requirements for electrical and electronic apparatus intended for use in residential, commercial and light-industrial environment, both indoor and outdoor and for which no dedicated product or product-family standard exists. Immunity requirements in the frequency range 0 kHz to 400 GHz are covered in relation to continuous and transient conducted and radiated disturbances, including electrostatic discharges and are specified for each port considered. This standard applies to apparatus intended to be directly connected to a low-voltage public mains network or connected to a dedicated DC source which is intended to interface between the apparatus and the low-voltage public mains network. This Standard also applies to apparatus which are battery operated or powered by a non-public, but non-industrial, low voltage power distribution system if they are intended to be used in the environments described above.
[38]	IEC 61000-6-2 Ed. 2.0 (2005-01) Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments	Defines the immunity performance requirements for electrical and electronic apparatus intended for use in industrial environments, both indoor and outdoor and for which no dedicated product or product-family immunity standard exists. Immunity requirements in the frequency range 0 Hz to 400 GHz are covered, in relation to continuous and transient, conducted and radiated disturbances, including electrostatic discharges. and are specified for each port considered. This Standard applies to apparatus intended to be connected to a power network supplied from a high or medium voltage transformer dedicated to the supply of an installation feeding manufacturing or similar plant, and intended to operate in or in proximity to industrial locations, as described below. This Standard also applies to apparatus which are battery operated and intended to be used in industrial locations Industrial locations are in addition characterised by the existence of one or more of the following: - industrial, scientific and medical (ISM) apparatus (as defined in CISPR 11); - heavy inductive or capacitive loads are frequently switched; - currents and associated magnetic fields are high.
[39]	IEC 61326-1 Ed. 1.0 (2005-12) and corrigendum 1 on Ed. 1.0 (2008-02) Electrical equipment for measurement, control and laboratory use-EMC requirements – Part 1: General	Specifies minimum requirements for immunity and emissions regarding electromagnetic compatibility (EMC) for electrical equipment, operating from a supply or battery of less than 1000 V AC or 1500 V DC, or from the circuit being measured, intended for professional,

	requirements	industrial process industrial-manufacturing and educational use, including equipment and computing devices.
	IEC 61326-2-1 Ed. 1.0 (2005-12) Electrical equipment for measurement, control and laboratory use – EMC requirements - Part 2: Particular requirements; Section 1: Test configurations, operational conditions and performance criteria for sensitive test and measurement equipment for EMC unprotected applications.	Specifies more detailed test configurations, operational conditions and performance criteria for equipment with test and measurement circuits (both internal and/or external to the equipment) that are not EMC protected for operational and/or functional reasons, as specified by the manufacturer.
	IEC 61326-2-2 Ed. 1.0 (2005-12) and corrigendum 1 on Ed. 1.0 (2007-11) Electrical equipment for measurement, control and laboratory use – EMC requirements - Part 2: Particular requirements Section 2: Test configurations, operational conditions and performance criteria for portable test, measuring and monitoring equipment used in low-voltage distribution systems.	Specifies more detailed test configurations, operational conditions and performance criteria for equipment which is used for testing, measuring or monitoring of protective measures in low-voltage distribution systems, and powered by battery and/or from the circuit measured, and portable.
	IEC 61326-2-6 Ed. 1.0 (2005-12) and corrigendum 1 on Ed. 1.0 (2007-09) Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 2: Particular requirements – Section 6: In vitro diagnostic (IVD) medical equipment.	specifies minimum requirements for immunity and emissions regarding electromagnetic compatibility for in vitro diagnostic medical equipment, taking into account the particularities and specific aspects of this electrical equipment and their electromagnetic environment
	IEC 61326-3-1 Ed. 1.0 (2008-01) Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 3: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) - Section 1: General industrial applications	Applies to systems and equipment for industrial applications intended to perform safety functions as defined in IEC 61508 with SIL 1-3. The electromagnetic environments encompassed by this product family standard are industrial, both, indoor and outdoor, as described for industrial locations in IEC 61000-6-2 or defined in 3.7 of IEC 61326-1. Equipment and systems intended for use in other electromagnetic environments, for example, in the process industry or in environments with potentially explosive atmospheres, are excluded from the scope of this product family standard.
	IEC 61326-3-2 Ed. 1.0 (2008-01) Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 3: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) - Section 2: Industrial applications with specified electromagnetic environment	Applies to systems and equipment for industrial applications within a specified electromagnetic environment and intended to perform safety functions as defined in IEC 61508 with SIL 1-3. The electromagnetic environments encompassed by this product family standard are industrial, both indoor and outdoor, as they can be found in industrial applications with an electromagnetic environment having specified characteristics (for example, process industry). The difference between the electromagnetic environment covered by this standard compared to the general industrial environment (see IEC 61326-3-1) is due to the mitigation measures employed against electromagnetic phenomena leading to a specified electromagnetic environment.

Comment [GT15]: ref [39] missing in D11 (2004) reconsider deleting

[40]	ISO 16750-2:2006 Road vehicles - Environmental conditions and testing for electrical and electronic equipment Part 2: Electrical loads	Specifies electrical loads and corresponding tests and requirements for the mounting of electric and electronic systems and components on road vehicles. It is applicable to environmental conditions and tests affecting electrical and electronic equipment mounted directly on or in the vehicle. It does not cover electromagnetic compatibility (EMC).
[41]	ISO 7637-1 (2002) and Amd. 1 (2008) Road vehicles - Electrical disturbance from conducting and coupling - Part 1: Definitions and general considerations	Defines basic terms used in the various parts for electrical disturbance by conduction and coupling. Gives also general information relating to the whole International Standard and common to all parts.
[42]	ISO 7637-2 (2004) and Amd. 1 (2008) Road vehicles - electrical disturbance from conducting and coupling – Part 2: Electrical transient conduction along supply lines only	Specifies bench tests for testing the compatibility to conducted electrical transients of equipment installed on passenger cars and light commercial vehicles fitted with a 12 V electrical system or commercial vehicles fitted with a 24 V electrical system~~ – for both injection and the measurement of transients (?)~~. Failure mode severity classification for immunity to transients is also given. It is applicable to these types of road vehicle, independent of the propulsion system (e.g. spark ignition or diesel engine, or electric motor).
[43]	ISO 7637-3 (2007) Road vehicles - Electrical disturbance by conducting and coupling - Part 3: Passenger cars and light commercial vehicles with nominal 12 V supply voltage and commercial vehicles with 24 V supply voltage - Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines	Establishes a common basis for the evaluation of the EMC of electronic instruments, devices and equipment in vehicles against transient transmission by coupling via lines other than supply lines. The test intention is the demonstration of the immunity of the instrument, device or equipment when subjected to coupled fast transient disturbances, such as those caused by switching (switching of inductive loads, relay contact bounce, etc.)