COMMITTEE DRAFT 4CD OIML R 85-1

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OIML TC8 / SC1

Title: 4th Committee Draft
Revision OIML International Recommendation R85

Secretariat:
TC8/SC1: Austria/Germany

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

☐ discussion at (date and place of meeting):

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☒ **vote (P-members only) and comments by 15 November 2007**

TITLE OF THE CD (English):
Revision OIML R 85
Automatic level gauges for measuring the level of liquid in stationary storage tanks
Part 1: Metrological and technical requirements

TITLE OFTHE CD (French):
Révision OIML R 85
Jaugeurs automatiques pour le mesurage des niveaux de liquide dans les réservoirs de stockage fixes
Partie 1: Exigences métrologiques et techniques

Original version in: English

Part 1
Clean version

Explanatory note

[Will be deleted in the final text]

As part of an inquiry from 4th July 2000 the secretariat of OIML TC8/SC1 (Austria) investigated the need for revision of OIML Recommendation R71, Edition 1985.

From this inquiry it could be concluded that a majority of the voters was in favour for the confirmation of this Recommendation. A revision should not to be necessary. However, further action should be taken considering the inclusion of OIML R71 in the OIML Certificate System.

To submit a category of measuring instruments to the OIML Certificate System, the Recommendation concerned must contain the following elements: metrological requirements, test procedures and a format for the test report. The metrological requirements should already be fixed in the existing Recommendation R71. A working group should be established to develop the test procedures and the test report format.

To establish the working group a TC8/SC1 meeting was held on 30 and 31 October 2003 in Vienna. 6 P-Member countries and 1 O-Member country attended this meeting.

Contrary to the outcome of the inquiry in 2000 the delegates attending the meeting in Vienna advised the P-Members to re-consider there voting and to agree with the terms of reference of a new working group OIML TC8/SC1/WG2, convened by the Netherlands (Mr. Aart Kooiman), i.e.

Revision of OIML R71, in connection with R85;

Revision of OIML R85, and the implementation of automatic calculation of volume and/or converted volume and/or mass.

With respect to R71 the development of test procedures and a test report format would be not necessary. So, only the first verification shall be performed.

On 19 January 2004 the secretariat OIML TC8/SC1 sent out an enquiry to P-, O- and liaison Members of TC8/SC1, as well as BIML, for agreement of the decisions made in Vienna.

On 22 March 2004 the secretariat OIML TC8/SC1 informed the P-, O- and liaison Members of TC8/SC1, as well as BIML, about the outcome of this enquiry. It was agreed by 11 out of 12 votes to accept the terms of reference of OIML TC8/SC1/WG2 “Revision of OIML R71 and R85” and the working group could start work.

The first meeting took place from 14 – 17 June 2004 in Delft (The Netherlands). During this meeting the work program was presented. The first task would be to prepare revised documents for OIML R71 and R85, fully in accordance with the terms of reference of the working group.

Because there is a need for developing provisions for automatic calculation of volume and/or converted volume and/or mass based on an automatic level measurement and the tank table the working group proposes to develop a new OIML Recommendation “Measuring systems for the volume of liquids in fixed storage tanks”.

Moreover there is a need for an OIML Recommendation concerning Hybrid Tank Measuring Systems. The working group proposes the development of a new OIML Recommendation “Hybrid Tank Measuring Systems for determination of volume, density and mass of liquid and liquefied hydrocarbons and liquid chemicals in vertical cylindrical fixed storage tanks”.

During the OIML TC8/SC1 meeting in Vienna to be held on 21 and 22 April 2005 the working group will ask for permission to develop these two new Recommendations.

End of September 2004 the second working draft for revision of OIML R 85 was sent for comments by 1 November 2004 to the working group members. This working draft contains the decisions made on the first working draft during the WG meeting in Delft.

A first Committee Draft on OIML R 85 has been distributed to P-, O- and liaison Members on 13 January 2005. These Members being requested to send their comments and urgent matters for discussion during the TC8/SC1 meeting in Vienna not later than 15 April 2005.

The chairman of the working group, together with the secretariat TC8/SC1, made a selection of these urgent matters. And these were discussed on 21 and 22 April 2005 in Vienna.

During that meeting in Vienna, it was also discussed to start the work on 2 other projects:

* Measuring Systems for the volume of liquids in fixed storage tanks
* Hybrid Tank Measuring Systems for determination of volume, density and mass of liquefied hydrocarbons in vertical cylindrical fixed storage tanks.

These projects could either been regarded as a logical extension of the revision of R 71 and R 85 (within the scope of these existing projects) or as 2 new projects of TC8/SC1.

Further communication with the BIML resulted in the decision that these are to be considered as 2 new projects. So, in accordance with the Directives for the Technical Work - Part 1, the Subcommittee first has to make a proposal to the CIML. After being accepted by CIML, the Subcommittee (or its Working Group) can formally start this work.

The comments made in that meeting are implemented in the second Committee Draft, and superfluous definitions have been deleted. The consistency between the definitions and the text has been improved.

Furthermore, this draft has been brought in better compliance with the OIML Directives for the Technical Work, Part 2, in particular clause 3 and 4, and with the horizontal document OIML D 11. Doing so, the secretary of TC8/SC1/WG2 observed that there were many more changes to make in Part 2 (in particular with respect to the proper implementation of OIML D 11).

In particular, both the concepts of “Checking Facilities” (the checking facilities as mentioned in OIML D 11, as well as the facilities checking the integrity of data storage and data communication) have been combined. See definition 3.9 and sub clause 7.8.

In this respect, it should be emphasized that the application of the checking facilities intended to prevent significant faults are not mandatory: the choice to apply these is clearly left to the manufacturer (see 7.8.2.3).

The extensive rearrangement of the chapters made it not practical to distribute a marked version of the draft. Some aspects to be discussed in particular, are marked in yellow.

In this stage, the authors mainly focused on the requirements for ALG’s (Part 1) as these should be agreed on before going into detail about the Parts 2 and 3.

In December 2005, the 2nd Committee Draft has been distributed. This 2CD and the remarks have been discussed in the meeting of OIML TC8/SC1, 11-12 May in Hamburg (Germany).

Based on the written comments and the outcome of the discussions during the meeting, a 3CD has been drafted and distributed.

The severity levels for all tests have been assessed and in general the levels for “industrial environment” have been applied for the tests.

During the meeting of TC8/SC1 in March 2007 in Vienna, the draft was discussed and several changes were agreed. These changes have been effected in the next version..

In May 2007 the next draft was circulated among the members of TC8/SC1/WG2 and the convener of WG2 only received remarks from Messrs Hagg and Sochor, and he also had some remarks himself.

This resulted in this 4 CD. In the marked version, the changes compared to the 3 CD are indicated.

For practical reasons, this 4CD has been split in 3 separate drafts: a separate draft for each of the Parts. This has an extra advantage that each of these 3 Parts can be voted on as soon as

this is appropriate.
Annex A has been moved to Part 1 (this change is not marked).
As a reference to draft R 71 has been added, all references are reviewed and updated.
For ease of reading, the lay-out is somewhat improved; these changes are not marked.
For Figure 1, a new drawing has been made, with updated terminology and references.

In this stage, Parts 2 and 3 do not have a separate numbering of their own, as the way this shall be solved will depend on the final way of publication: in one ”booklet” (file), or split in 2 or 3. This is an editorial / lay-out item to be decided by BIML together with the secretary at the last moment.

In all the previous versions of the draft, a first start for Part 3 (Test Report Format) was included with a remark *“To be completed after Part 2 is (almost) ready.”* So up to now, there were neither remarks nor discussions concerning this Part 3.

In the opinion of the convener, the time has come now to proceed with Part 3. And a fully revised version is included in a separate file. As from now on, Part 3 will be under discussion, this is called “1 CD R-85-3”.

Contents

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 in the field of legal metrology;

§ **International Guides (OIML G),** which are also informative in nature and which are intended to give guidelines for the application of certain requirements to legal metrology; and

§ **International Basic Publications (OIML B),** which define the operating rules of the various OIML structures and systems.

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

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

International Recommendations, Documents, Guides, and Basic Publications are published in English (E) and translated into French (F) and are subject to periodic revision.

Additionally, the OIML publishes or participates in the publication of **Vocabularies (OIML V)** and periodically commissions legal metrology experts to write **Expert Reports (OIML E)**. Expert Reports are intended to provide information and advice, and are written solely from the viewpoint of their author, without the involvement of a Technical Committee or Subcommittee, nor that of the CIML. Thus, they do not necessarily represent the views of the OIML.

This publication – reference OIML R 85-1, edition XXXX (E) – was developed by the OIML Technical Subcommittee TC 8/SC 1 *Static volume measurement*. It was approved for final publication by the International Committee of Legal Metrology in XXXX and will be submitted to the International Conference of Legal Metrology in XXXX for formal sanction. Together with R 85-2 and R 85-3, it supersedes the previous edition of R85 dated 1998.

OIML Publications may be downloaded from the OIML WEB site in the form of PDF files. Additional information on OIML Publications may be obtained from the Organization's headquarters:

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PART 1 Metrological and technical requirements

1 Introduction

After the need for a revision of OIML Recommendation R 85 (1998) "Automatic level gauges for measuring the level of liquid in fixed storage tanks" was identified, the project for this revision was initiated.

The most important changes of this edition (200x) of R 85 compared to the previous edition (1998) are:

- The Recommendation R85 (1998) included also requirements concerning the tank. This new revision is dealing only with the level gauge itself.
- The format of Recommendation R85-1 and R 85-2 (200x) is in line with the OIML publication B 6-2: Directives of the technical work Part 2: Guide to the drafting and presentation of OIML International Recommendations and Documents.
- The performance tests are updated according the OIML Document D 11(edition 2004) General requirements for electronic measuring instruments. But the latest editions (as per 19-7-2007) of the referred IEC standards have been applied.
- The Recommendations has been split in Part 1 "Metrological and technical requirements", Part 2 "Metrological Control and tests", and Part 3 "Test Report Format".

With respect to the OIML Certificate system, this has the following consequences:

The Certificates of Conformity according this edition of Recommendation R85 (200x) will be covering a more precise defined measuring instrument, being an Electronic Level Gauge. In practice the ALG will be installed on a tank according Recommendation R 71.

The differences between the previous Recommendation and the present one are thus far-reaching that ALG's complying with the edition 1998, can not be supposed to comply with this new edition, unless the compliance is confirmed by new tests.

2 Scope

This Recommendation specifies the metrological and technical requirements and test procedures for automatic level gauges for storage tanks. The storage tanks include all the shapes corresponding with OIML R 71 [5] e.g.vertical, cylindrical storage tanks and pressurized storage tanks (spheres, spheroid, bullets).

The storage tank may be refrigerated or heated.

The metrological purpose of tank level measurements is the application in conjunction with tank calibration tables for the determination of liquid volume received from, delivered to or contained in stationary storage tanks.

3 Terminology

The terminology used in this Recommendation is applicable to all parts 1, 2 and 3 of OIML R 85.

It conforms to the *International Vocabulary of Basic and General Terms in Metrology* (VIM) [1], to the *International Vocabulary of Terms in Legal Metrology* (VIML) [2], and to OIML D 11 *General Requirements for electronic measuring instruments* [3].

In addition, for the purposes of this Recommendation, the following definitions apply:

3.1 Automatic level gauge (ALG)

An instrument intended to measure automatically and display the level of the liquid contained in a tank with respect to a fixed reference (see Figure 1).

An automatic level gauge includes at least a liquid level sensor, a transducer, and an indicating device (see Figure 1 in clause 4).

3.2 Electronic automatic level gauge

An automatic level gauge using electronic means and/or equipped with electronic devices.

3.3 Ancillary device

A device intended to perform a particular function, directly involved in elaborating, transmitting or displaying measurement results.

Examples:

- repeating indicating device,
- printing device,
- memory device,
- conversion device.

Note: For the purpose of this Recommendation ancillary equipment, in so far as it is subject to metrological control, is considered to be part of the ALG.

3.4 Liquid level sensor

An element that senses the presence of the liquid surface and gives information on its level.

3.5 Transducer

A device that provides an output quantity, having a determined relationship to the input quantity.

3.6 Correction sensor

A sensor that measures a relevant property of the liquid and/or the medium above the liquid level for the purpose of applying a correction to the liquid level measurement.

3.7 Calculator

A part of the ALG that receives the output signals from the transducer) and, if applicable, from ancillary devices and/or other devices, processes them and, if appropriate, stores in memory the results until they are used. In addition, the calculator may be capable of communicating both ways with other devices.

3.8 Indicating device

A part of the ALG that displays or prints the measuring result.

Note: For the application of this Recommendation the meaning of “indicating device” is broader than the general meaning in other OIML Recommendations (a printing device is considered as such).

3.9 Checking facility

A facility incorporated in an electronic automatic level gauge that enables:
- significant faults and/or

- incorrect functioning of a specific device of the ALG and/or
- disturbed communication between specific devices of the ALG

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.).

3.10 Automatic checking facility

Checking facility that operates without the intervention of an operator.

3.11 Permanent automatic checking facility (type P)

Automatic checking facility that operates at each measurement cycle.

3.12 Intermittent automatic checking facility (type I)

Automatic checking facility that operates at certain time intervals or per fixed number of measurement cycles.

3.13 Dip plate

A horizontal plate located along the vertical axis descending from the upper reference point, providing a fixed contact surface from which manual liquid depth measurements are made.

Note: The term “datum plate” is synonymous.

3.14 Principal gauge hatch

The gauge hatch which has been designated for the principal measurements and is situated at a convenient, accessible and stable position.

3.15 Dipping datum point

The intersection of the vertical measurement axis with the upper surface of the dip plate, or with the bottom surface of the tank if a dip plate is not provided. It constitutes the origin for the measurement of liquid levels (zero reference or dipping reference point).

3.16 Upper reference point

A point clearly marked on the principal gauge hatch located along the vertical axis ascending from the dip-ping datum point to indicate the reference position to which ullage is measured.

3.17 Dip

The vertical distance between the dipping datum point and the liquid level.

Note: The term “innage” is synonymous.

3.18 Ullage

The distance between the liquid level and the upper reference point, measured along the vertical measurement axis.

Note: The term “outage” is synonymous.

3.19 Rated operating conditions

The conditions of use, giving the range of values of influence quantities for which the metrological characteristics are intended to lie within the specified permissible errors

Note: The rated operating conditions generally specify intervals of values for the quantity being measured and for any influence quantity.

3.20 Reference conditions

A set of specified values of influence factors fixed to ensure valid inter comparisons of the results of measurements.

Note: Reference conditions generally specify intervals of values for any influence quantity.

3.21 Influence quantity

A quantity which is not the subject of the measurement but which influences the value of the measurand or the indication of the ALG .

3.22 Influence factor

An influence quantity having a value within the specified rated operating conditions of the ALG.

3.23 Disturbance

An influence quantity having a value within specified limits, but outside the specified rated operating conditions of the ALG.

3.24 Performance

The ability of the ALG to accomplish the intended functions.

3.25 Durability

The ability of the ALG to maintain its performance characteristics over a period of use.

3.26 Error (of indication)

The indication of an ALG minus a true value of the corresponding input quantity.

3.27 Maximum permissible error

The extreme permitted value by the present Recommendation for the error of indication.

3.28 Intrinsic error

The error of an ALG determined under reference conditions.

3.29 Initial intrinsic error

The intrinsic error of an ALG as determined prior to performance tests and durability evaluations.

3.30 Fault

The difference between the error of indication and the intrinsic error of an ALG.

Note: Principally a fault is the result of an undesired change of data contained in or flowing through an ALG.

3.31 Significant fault

A fault greater than the maximum permissible error specified in Table 2 (see 6.2.2).

The following faults are considered not to be significant, even when they exceed the value defined above:

(a) faults arising from simultaneous and mutually independent causes in the ALG itself 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 results so serious that they are bound to be noticed by all those interested in the result of the measurement.

3.32 Discrimination

The largest change in a stimulus that produces no detectable change in the response of a measuring instrument, the change in the stimulus taking place slowly and monotonically

3.33 Abbreviations

AC Alternating Current

ALG Automatic Level Gauge

AM Amplitude Modulation

ASD Acceleration Spectral Density

DC Direct Current

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

OIML International Organization of Legal Metrology

RH Relative Humidity

RMS Root Mean Square

4 Description of the category of instrument

An automatic level gauge (ALG) comprises at least a liquid-level sensor, a transducer, and an indicating device.

The general configuration of an automatic level gauge is given in Figure 1:

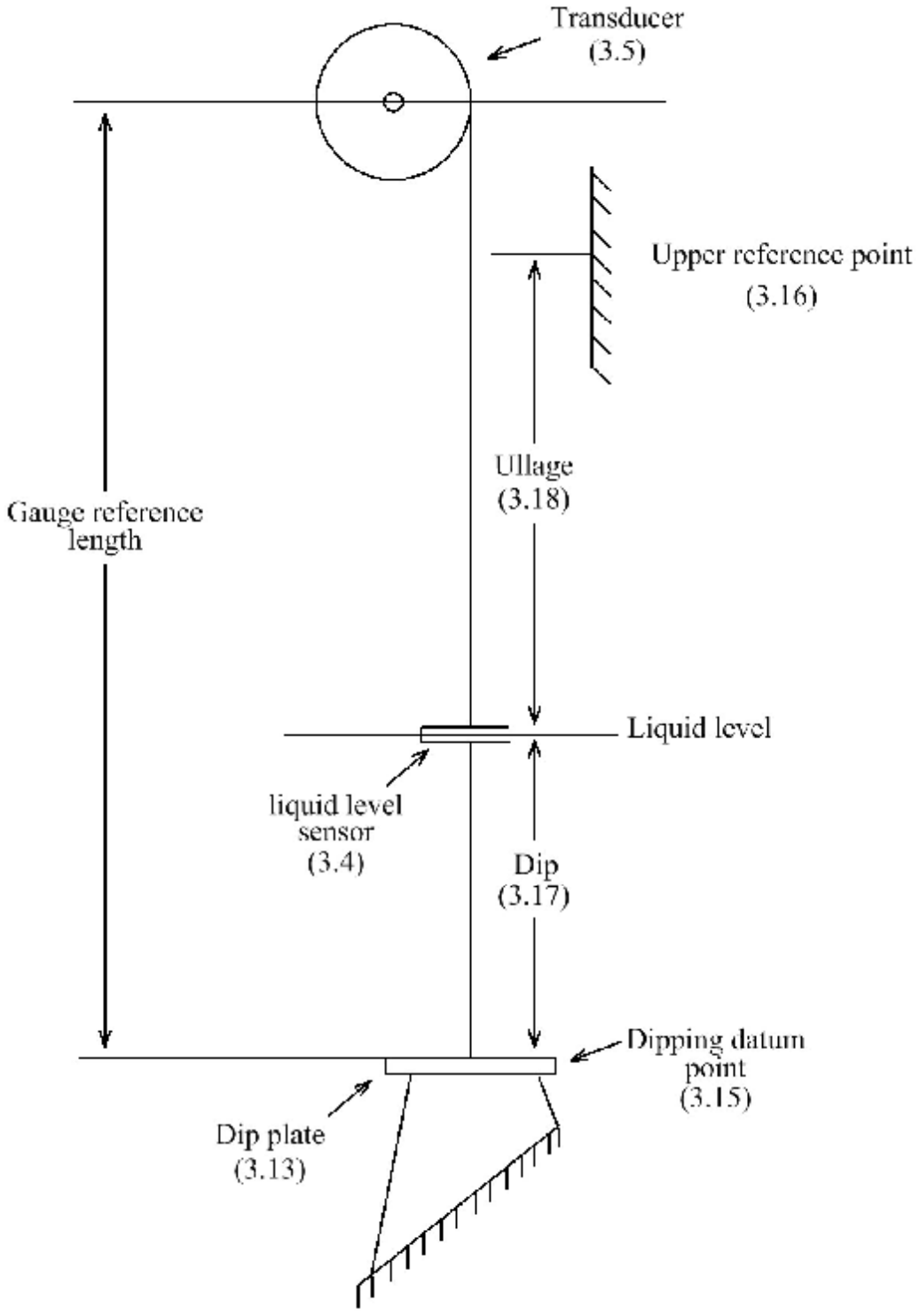

Figure 1

Some of the principal elements of an ALG, with reference to their definitions

5 Units of measurement

The authorized units of measurement are those of the International System of Units (SI).

If, in any country, units of measurement outside the SI are authorized, the legal units of measurement of that country may be used. In international trade, the officially agreed equivalents between these units of measurement and those of the SI shall be applied.

Indications of the dip or, if applicable, the ullage shall be in legal units of length and shall be accompanied by the name or symbol of the unit.

Indication of information that is not subject to metrological control is allowed, provided that it cannot be confused with metrological information.

6 Metrological requirements

6.1 Rated operating conditions

Automatic level gauges shall be designed and manufactured such that their errors do not exceed the maximum permissible errors under the following rated operating conditions:

Table 1

<table>
<tr><td rowspan="2">a)</td><td rowspan="2">Ambient temperature</td><td>low</td><td>+ 5 °C, - 10 °C, -25 or - 40 ° C (**)</td></tr>
<tr><td>high</td><td>+ 30 °C, + 40 °C, + 55 or + 70 °C (**)</td></tr>
<tr><td>b)</td><td>Relative humidity</td><td colspan="2">up to 93%</td></tr>
<tr><td>c)</td><td>DC mains voltage (*)</td><td colspan="2">As specified by the manufacturer</td></tr>
<tr><td>d)</td><td>AC mains voltage (*)</td><td colspan="2">U_{nom} - 15 % to U_{nom} + 10 %</td></tr>
<tr><td>e)</td><td colspan="2">The minimum and maximum temperatures of the liquid and the medium above the liquid</td><td rowspan="4">As specified by the manufacturer</td></tr>
<tr><td>f)</td><td colspan="2">The minimum and maximum pressures in the tank</td></tr>
<tr><td>g)</td><td colspan="2">The characteristics of the liquid and of the medium above the liquid</td></tr>
<tr><td>h)</td><td colspan="2">The minimum and maximum densities of the liquid and of the medium above the liquid</td></tr>
<tr><td colspan="4">(*) Whatever is applicable
(**) This value is to be decided by the national authority as it depends on the climatic conditions and the expected conditions of application (indoors, outdoors, etc.) that are different in different countries.</td></tr>
</table>

If national regulations allow the use of an ALG under conditions outside the rated operating conditions, the manufacturer of the ALG shall supply the user with all necessary information to make the required corrections.

6.2 Maximum permissible errors

6.2.1 General
The maximum permissible error (MPE) of an ALG before installation is determined by testing under controlled conditions. The MPE of an ALG after installation is verified by comparing the ALG readings to the manual reference level measurement.

6.2.2 The maximum permissible errors, positive and negative, under rated operating conditions to be applied for the relevant indications are specified in Table 2.

Table 2

Description	Maximum Permissible Error
Prior to installation	1 mm
After installation	4 mm

The maximum permissible errors of Table 2 apply to the indication of a dip or an ullage according to the measuring principle of the ALG.

Note: The volume in the tank, calculated from the level measured and the tank calibration table could be adversely affected by various factors. These factors include: tank bottom deformation, roof stability, and tank shell bulging that cannot be compensated.

6.2.3 The hysteresis error when changing the direction of the movement of the level shall not exceed 1 mm (see 8.1.5.4 in Part 2).

6.2.4 The MPE for the ALG prior to installation applies to the ALG itself, before being installed on the tank, for type approval and for initial verification.

The MPE “after installation” applies to the ALG after installation on the storage tank, for initial and subsequent verification.

6.2.5 The discrimination of the ALG itself shall be such that level measurements are in all cases within 1 mm.

6.3 Presumption of compliance

An automatic level gauge is presumed to comply with the provisions in 6.1 and 6.2 if it passes the relevant tests specified in Part 2 of this Recommendation.

7 Technical requirements

7.1 Indicating device

7.1.1 For an analogue indication, the distance between successive marks on the scale shall be not less than 1 mm.

7.1.2 An ALG may have more than one indicating device. In this situation each indication shall comply with the applicable maximum permissible error specified in 6.2.2. In addition,

the difference between any two of them shall not be greater than 1 mm resp. 1 scale interval* under stable level conditions. **** in case the scale intervals differ: the greater one***

A second indicating device is mainly used for observation of the ALG indication on a easy accessible location (e.g. control room).

The indicating and repeating indicating device shall give an alarm when the operational limits of the level gauge are reached (maximum and minimum heights).
Other indicating devices, not subjected to legal metrological control, may be connected, provided these are clearly marked as such and have no interaction with the electronics of the ALG.

7.1.3 An additional indicating device may be common when connected to more than one ALG.

7.1.4 A remote indication on an indicating device shall be unambiguously identified with respect to the ALG it belongs to.

7.1.5 An ALG shall indicate the innage (dip). Other measured values, as ullage, may be indicated on the same display but these indications shall be replaced by the innage within 10 s.
For metrological purposes, an indication of the ullage shall either be permanently available or be available on demand, together with the indication that the ullage is presented and, if applicable, which ALG is presented.

7.1.6 Reading of the results shall be reliable, easy and unambiguous under conditions of normal use.

The figures forming the results shall be of a size, shape and clarity for reading to be easy.

The scales, numbering and printing shall permit the figures which form the results to be read by simple juxtaposition.

7.1.7 The presentation of the measuring results shall contain the names or symbols of the units of length in which they are expressed.

The scale interval of each display or print must be in the form 1×10^n,2×10^n, or 5×10^n units of length, n being a whole positive or negative number, or zero.

7.1.8 A digital indication shall display at least one figure beginning at the extreme right.

A decimal fraction shall be separated from its integer by a decimal sign (in general a comma or in English speaking countries a dot on the line), with the indication showing at least one figure to the left of the sign and all figures to the right.

Zero may be indicated by one zero to the extreme right, without a decimal sign.

The unit shall be chosen so that the displayed or printed values have not more than one non-significant zero to the right. For values with decimal sign, the non-significant zero is allowed only in the third position after the decimal sign.

7.1.9 Sub clauses 7.1.2 through 7.1.8 are also applicable to printing devices, as appropriate.

7.2 Additional technical requirements for ALG's with movable sensor

7.2.1 Suspension mechanism

In order to facilitate checks on the mechanism of the gauge, where applicable, the ALG shall be provided with means allowing to impart on request a movement to the working parts of the gauge.

Note: An example of a situation where this is applicable, is a dipstick having a movable part (the float) but the gauge does not have the possibility to force a movement.

7.2.2 Static position

If the level sensor can be statically positioned above or below the liquid level, it shall be made unambiguously clear that the indication is not presenting an actual measurement.

7.3 Installation requirements

7.3.1 General

7.3.1.1 ALG's shall be installed in such a way that the requirements of 7.3 through 7.7 are fulfilled.
The indication shall be easily accessible and legible.

7.3.1.2 If possible, ALG's shall be equipped and installed in such a way that they can be verified when mounted on the tank and with the tank in service.

7.3.1.3 The liquid level sensor shall be in close proximity to the official gauge hatch if present.

The ALG shall be installed in such a way that the operation of the liquid level sensor, or the measurement by the ALG shall not be obstructed by obstacles.

7.3.1.4 If the procedure during verification, sampling, etc. affects the ALG measurement so a significant fault occurs, this shall be clearly indicated..

7.3.1.5 The ALG shall be installed in such a way that the influence of eddies, currents, turbulence, foam, condensation, variation of process conditions, asymmetrical heating, wind and other effects have negligible effect on the performance of the ALG.

If applicable, adequate protection shall be provided.

7.3.1.6 The ALG shall be installed on the tank in such a way that the deviation of the gauge reference length plus level due to movement of the tank shell, tank bottom, tank roof or stilling well remains within the MPE after installation (4 mm).
For construction details refer to applicable standards, which are listed in the Bibliography (Annex A).

Note: This may imply that influences must be compensated for, using correction devices.

7.3.1.7 If provided, the correction sensor shall be situated in such a way that a reliable value is obtained of the properties intended to be measured. If necessary, more than one sensor shall be installed in order to obtain a correct average value.

7.3.1.8 The thermal expansion of the tank shell or, if applicable, the support pipe, shall be such that the total deviation for temperature changes will fall within the maximum permissible errors for the installed ALG, or if necessary compensated for.

Note: this requirement may be verified by calculation.

7.4 Ancillary devices

Ancillary devices shall not affect the measurement and shall have no characteristics that facilitate fraudulent use.

7.5 Markings

7.5.1 ALG's shall be legibly and clearly marked with the following information:

- name of the manufacturer or trademark;
- type designation
- serial number and year of manufacture;
- type approval mark;
- any information required by national legislation.

7.5.2 The repeating indication device(s) shall be marked with the following information:

- type approval number
- identifications of the tanks

7.5.3 The descriptive markings shall be indelible and of a size, shape and clarity allowing easy reading under operating conditions of the ALG. They shall be grouped together in a clearly visible place on the ALG itself or on a data plate fixed to it.

7.6 Verification marks

ALG's shall have a place for the verification marks which is visible and allows easy application of the marks. It shall be impossible to remove the marks without damaging them.

Note: This requirement is only applicable in those countries having mandatory verification marks for ALG's.

7.7 Sealing

It shall be possible to seal the data plate mentioned in 7.5.3 bearing the markings unless this plate cannot be removed without being destroyed.

Sealing means shall be provided for those parts that can affect the accuracy of the measurement and which are not intended to be accessible by the user.

Sealing may be carried out with metal, plastic or other suitable material as long as it is sufficiently durable and provides evidence of tampering.

When access to parameters that participate in the determination of results of measurements is not protected by mechanical sealing devices, a electronic sealing can be applied. The software sealing shall fulfil the following provisions:

a) Access shall only be allowed to authorized persons, e.g. by using a “password” and, after changing parameters, the ALG may be put into use “in sealed condition” again without any restriction,
or
Access is allowed without restrictions (similar with the classical sealing) but, after changing parameters, the measuring system shall only be put into use “in sealed condition” again by authorized persons, e.g. by using a “password”

b) The “password” must be changeable.

c) The device shall either clearly indicate when it is in the configuration mode (not under legal metrological control). Or it shall not operate while in this mode. This status shall remain until the ALG has been put into use “in sealed condition”

d) For identification, data concerning the latest intervention shall be recorded into an event logger. The record shall include at least:
- an event counter,
- the date the parameter was changed,
- the new value of the parameter, and
- an identification of the person that implemented the intervention

e) The traceability of the last intervention shall be assured for at least two years, if it is not over-written on the occasion of a further intervention.

If it is possible to store more than one intervention, and if deletion of a previous intervention must occur to permit a new record, the oldest record shall be deleted.

7.8 Safeguarding the integrity of the measurement

7.8.1 General requirements

ALG’s shall be designed and manufactured such that their metrological functions are safeguarded and their errors do not exceed the limits of the maximum permissible errors under rated operating conditions.

It shall be possible to determine the presence and correct functioning of the checking facilities.

The checking facilities shall be of type I or P.

7.8.2 Prevention or signalling of significant faults

7.8.2.1 ALG’s shall be designed and manufactured such that when they are exposed to the following disturbances, either:

(a) Significant faults do not occur, or

(b) Significant faults are detected and acted upon by means of a checking facility:

***** during the following disturbances:

(1) Radiated, radio-frequency, electromagnetic fields;

(2) Conducted radio-frequency fields;

(3) Electrostatic discharge;

(4) Bursts (transients) on signal, data and control lines;

(5) Surges on signal, data and control lines;

(6) AC mains voltage dips, short interruptions and voltage variations;

(7) Bursts (transients) on AC and DC mains;

(8) Voltage dips, short interruptions and voltage variations on DC mains power;

(9) Ripple on DC mains power,

* and after the following disturbances:

(10) Damp heat cyclic (condensing);

(11) Surges on AC and DC mains power.

Note: A fault equal to or smaller than the significant fault according to definition 3.31 is allowed irrespective of the value of the error of indication.

7.8.2.2 The provisions in 7.8.2.1 (a) and 7.8.2.1 (b) may be applied separately to:

(a) Each individual cause of significant fault; and/or

(b) Each part of the measuring instrument.

Note: In case of a disturbance, a fault equal to or smaller than the MPE as specified in Table 1 is allowed irrespective of the value of the error of indication.

7.8.2.3 The provisions in 7.8.1 and 7.8.2 shall be met durably.

ALG's 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.

7.8.2.4 The choice of whether 7.8.2.1 (a) or (b) and whether 7.8.3 (a) or (b) is applied, is left to the manufacturer.

7.8.2.5 If a significant fault is detected by a checking facility, a visual and/or audible indication shall automatically occur and shall continue until the user takes action or the fault is corrected.

7.8.2.6 The type of an ALG is presumed to comply with the provisions in 7.8.2.1 and 7.8.2.2 if it passes the relevant examination and tests specified in Part 2 of this Recommendation.

7.8.3 Signalling the loss or distortion of data

7.8.3.1

The loss or distortion of data shall be signalled by one or more checking facilities enabling:

(a) incorrect functioning of a specific device of the ALG and

(b) disturbed communication between specific devices of the ALG

to be detected and acted upon.

If a risk of loss or distortion of data is detected by a checking facility, a visual and/or audible indication shall automatically occur and shall continue until the user takes action or the fault is corrected.

7.8.3.2

The design of the instrument shall prevent that the values of permanently memorized instructions are incorrect [1].

7.8.3.3

All relevant measurement data shall be checked for correct value whenever they are transferred or stored internally or transmitted to peripheral equipment by interface, by such means as: parity bit, check sum, independent double storage or other handshake-routine with retransmission.

7.8.3.4 Checking facilities of the calculator

The objective of the checking of the functioning of the calculator is to verify that the values of all permanently memorized instructions and data are correct, and all procedures of internal transfer and storage of data relevant to the measurement result are performed correctly.

The objective of the checking the correct value of all data related to the measurement whenever these data are internally stored or transmitted to an ancillary device through an interface. In addition, the calculation system shall be provided with a means of controlling the continuity of the calculation program ("watch-dog").

7.8.3.5 Checking facilities of the indicating device

The instrument shall automatically check the data transmitted to the indicating device and the electronic circuits used for the indicating device, except the driving circuits of the display itself.
The display may be checked either automatically or manually.

If the failure of an indicator display element can cause a false indication then the instrument shall have a display test facility which on demand will show all relevant signs of the indicator display in their active and non-active states for a sufficient time to be easily observed by the operator.

If a PC is used as a common indication device, and the communication with the transducer is digital, it is assumed that the device meets the requirements for the checking facilities.

7.8.3.6 Checking facilities of ancillary devices

Devices intended to perform a particular function, involved in elaborating and transmitting measurement results for custody transfer purposes shall be checked on presence and correct operation.

Devices intended to perform a particular function, involved in transmitting or displaying measurement results for custody transfer purposes shall also comply with 7.8.3.

The object of this checking facility is to verify the presence of the ancillary device, and to verify the correct transmission of data from the calculator to the ancillary device

Note: The use of parity bit alone is not sufficient in case of storing or reading metrological data for an electronic ALG.

[1] Acceptable solution:
- summing up of all instruction and data codes and comparing the sum with a fixed value;
- line and column parity bits;
- cyclic redundancy check;
- multiple storage of data, both in the same code;
- multiple storage of data, second in inverse or shifted coding; or
- storage of data in "safe coding", for example protected by check sum, line and parity bits.

Annex A Bibliography

(These references apply to all 3 Parts of OIML R 85)

Ref.	ISO / IEC Standard	Abstract
[1]	**ISO Guide 99** **ISO/IEC VIM** **OIML V1** International vocabulary of basic and general terms in metrology (1993)	An international agreement on terminology, prepared as a collaborative work of experts appointed by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML. This vocabulary covers subjects relating to measurement and includes information on the determination of physical constants and other fundamental properties of materials and substances.
[2]	**OIML V2** (2000) International Vocabulary of Terms in Legal Metrology (**VIML**)	No abstract available
[3]	**OIML D 11** (2004) General requirements for electronic measuring instruments	The primary aim of this International Document is to provide 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.
[4]	**OIML B 3** (2003) OIML Certificate System for Measuring Instruments (formerly OIML P1) Including Amendment 2006	No abstract available
[5]	**OIML R 71** 3CD (2007) Fixed Storage Tanks - General Requirements	This recommendation specifies the general requirements all stationary storage tanks onshore with fixed or floating roofs including pressured, non-pressured, refrigerated and non refrigerated. Additional information for the different types of tanks are stated in chapter 9.
[6]	**IEC 60068-1** (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 nfor measurements for the ability of specimens to perform under normal conditions of transportation, storage and operational use
[7]	**IEC 60068-2-1** (2007) Environmental testing, Part 2: Tests, Test A: Cold	Deals with cold tests applicable to both non heat-dissipating and heat-dissipating specimens. For non heat-dissipating specimens, Tests Ab and Ad do not deviate essentially from earlier issues. Test Ae has been added primarily for testing equipment that requires being operational throughout the test, including the conditioning periods. The object of the cold test is limited to the determination of the ability of components, equipment or other articles to be used, transported or stored at low temperature. Cold tests cover by this standard do not enable the ability of specimens to withstand or operate during the temperature variations to be assessed. In this case, it would be necessary to use IEC 60068-2-14. The cold tests are subdivided as follows: - Cold tests for non heat-dissipating specimens * with gradual change of temperature, Ab; - Cold test for heat-dissipating specimens * with gradual change of temperature, Ad, * with gradual change of temperature, specimen powered throughout, Ae.

		The procedures given in this standard are normally intended for specimens that achieve temperature stability during the performance of the test procedure. Temperature chamber(s) are constructed and verified in accordance with specifications IEC 60068-3-5 and IEC 60068-3-7. Further guidance for dry heat and cold tests can be found in IEC 60068-3-1 and general guidance in IEC 60068-1. This sixth edition deals with cold tests applicable both to non heat-dissipating and heat-dissipating specimens. For non heat-dissipating specimens, Tests Ab and Ad do not deviate essentially from earlier issues. Test Ae has been added primary for testing equipment that requires being operational throughout the test including the conditioning periods.
[8]	**IEC 60068-2-2** (1974-01), with amendments 1 (1993-02) and 2 (1994-05) Environmental testing, Part 2: Test, test B: Dry heat	Contains Test Ba: Dry heat for non-heat-dissipating specimen with sudden change of temperature; Test Bb: Dry heat for non-heat-dissipating specimen with gradual change of temperature; Test Bc: Dry heat for heat-dissipating specimen with sudden change of temperature; Test Bd: Dry heat for heat-dissipating specimen with gradual change of temperature. The 1987 reprint includes IEC No. 62-2-2A
[9]	**IEC 60068-2-30** (2005-08) Environmental testing Part 2-30: Tests, test Db a 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. If the test is being used to verify the performance of a specimen whilst it is being transported or stored in packaging then the packaging will normally be fitted when the test conditions are being applied. For small, low mass specimens, it may be difficult to produce condensation on the surface of the specimen using this procedure; users should consider the use of an alternative procedure such as that given to IEC 60068-2-38. The main changes with respect to the previous edition are listed below: - editorial changes, - addition of normative references, - addition of guidance for temperature tolerances, - period for recovery has been extended.
[10]	**IEC 60068-3-1** (1974-01) + Supplement A (1978-01) Environmental testing Part 3: Background information, Section 1: 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.
[11]	**IEC 60068-3-4** (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.
[12]	**IEC 60654-2** (1979-01), with amendment 1 (1992-09) 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.
[13]	**IEC/TR3 61000-2-1** (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 - d.c. components.
[14]	**IEC 61000-4-1** (2006-10) Electromagnetic compatibility (EMC), Part 4-1: Testing and measurement techniques - Overview of IEC 61000-4 series	The object of this part of IEC 61000 is to give applicability assistance to the technical committees of IEC or other bodies, users and manufacturers of electrical and electronic equipment on EMC standards within the IEC 61000-4 series on testing and measurement techniques and to provide general recommendations concerning the choice of relevant tests. This standard has the status of a basic EMC publication in accordance with IEC Guide 107.
[15]	**IEC 61000-4-2** (1995-01) with amendment 1 (1998-01), Basic EMC Publication Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques, Section 2: Electrostatic discharge immunity test. Consolidated Edition: IEC 61000-4-2 (2001-04) Ed. 1.2	This publication is based on IEC 60801-2 (second edition: 1991). It relates to the immunity requirements and test methods for electrical and electronic equipment subjected to static electricity discharges, from operators directly, and to adjacent objects. It additionally defines ranges of test levels which relate to different environmental and installation conditions and establishes test procedures. The object of this standard is to establish a common and reproducible basis for evaluating the performance of electrical and electronic equipment when subjected to electrostatic discharges. In addition, it includes electrostatic discharges which may occur from personnel to objects near vital equipment.
[16]	**IEC 61000-4-3** (2006-02) Electromagnetic compatibility (EMC) Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.	Is applicable to the immunity requirements of electrical and electronic equipment to radiated electromagnetic energy. It establishes test levels and the required test procedures. The object of this standard is to establish a common reference for evaluating the immunity of electrical and electronic equipment when subjected to radiated, radio-frequency electromagnetic fields. The test method documented in this part of IEC 61000 describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon. This part deals with immunity tests related to the protection against RF electromagnetic fields from any source. Particular considerations are devoted to the protection

		against radio-frequency emissions from digital radiotelephones and other RF emitting devices. It has the status of a basic EMC publication.
[17]	**IEC 61000-4-4** (2004-07), plus Corr.1 (2006-08) Electromagnetic compatibility (EMC) – Part 4-4: Testing and Measurement techniques - Electrical fast transient/burst immunity test. Basic EMC Publication.	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. This second edition cancels and replaces the first edition published in 1995 and its amendments 1 (2000) and 2 (2001) and constitutes a technical revision.
[18]	**IEC 61000-4-5** (2005-11) Electromagnetic compatibility (EMC) – Part 4-5: Testing and Measurement techniques – Surge immunity test	Relates to the immunity requirements, test methods, and range of recommended test levels for 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. These requirements are developed for and are applicable to electrical and electronic equipment. The object of this standard is to establish a common reference for evaluating the immunity of electrical and electronic equipment when subjected to surges. The test method documented in this part of IEC 61000 describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon. This standard defines: - a range of test levels; - test equipment; - test setups; - test procedures. The task of the described laboratory test is to find the reaction of the EUT under specified operational conditions, to surge voltages caused by switching and lightning effects at certain threat levels. It is not intended to test the capability of the EUT's insulation to withstand high-voltage stress. Direct injections of lightning currents, i.e, direct lightning strikes, are not considered in this standard. It has the status of a basic EMC publication in accordance with IEC Guide 107.
[19]	**IEC 61000-4-6** (2003-05) with Amendment 1 (2004-10) and Amendment 2 (2006-03) Electromagnetic compatibility (EMC) Part	This part of IEC 61000-4 relates to the conducted immunity requirements of electrical and electronic equipment to electromagnetic disturbances coming 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)

	4-6 Testing and measurement techniques - Immunity to conducted disturbances, induced by radio frequency fields. Consolidated edition 2006-05	which can couple the equipment to the disturbing RF fields is excluded. The object of this standard is to establish a common reference for evaluating the functional immunity of electrical and electronic equipment when subjected to conducted disturbances induced by radio-frequency fields. The test method documented in this part of IEC 61000 describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon.
[20]	**IEC 61000-4-11** (2004-03) Electromagnetic compatibility (EMC) - Part.4-11: Testing and Measuring techniques – Voltage dips, short interruptions and voltage variations immunity tests.	This part of IEC 61000 defines 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. This standard applies to electrical and electronic equipment having a rated input current not exceeding 16 A per phase, for connection to 50 Hz or 60 Hz a.c. networks. It does not apply to electrical and electronic equipment for connection to 400 Hz a.c. networks. Tests for these networks will be covered by future IEC standards. 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. This second edition cancels and replaces the first edition published in 1994 and its amendment 1 (2000). This second edition constitutes a technical revision in which 1) preferred test values and durations have been added for the different environment classes; 2) the tests for the three-phase systems have been specified. It has the status of a Basic EMC Publication in accordance with IEC Guide 107.
[21]	**IEC 61000-4-17** (1999-06), Am. 1 (2001-07) Electromagnetic compatibility (EMC) – Part 4-17: Testing and measurement techniques – Ripple on DC input power port immunity test. Consolidated edition (2002-07) Ed. 1.1	Defines test methods for immunity to ripple at the d.c. input power port of electrical or electronic equipment. Applies to low-voltage d.c. 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.
[22]	**IEC 61000-4-29** (2000-08) Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on DC input power port immunity tests	Establishes a common and reproducible basis for testing electrical and electronic equipment when subjected to voltage dips, short interruptions or voltage variations on d.c. power ports. This standard defines: - the range of test levels; - the test generator; - the test set-up; - the test procedure.
[23]	**IEC 61000-6-1** (2005-03) Electromagnetic compatibility (EMC) - Part 6-1: Generic	Applies to electrical and electronic apparatus intended for use in residential, commercial and light-industrial environments. Immunity requirements in the frequency range 0 Hz to 400 GHz are covered. No tests need to be

	standards - Immunity for residential, commercial and light-industrial environments	performed at frequencies where no requirements are specified. This generic EMC immunity standard is applicable if no relevant dedicated product or product-family EMC immunity standard exists. 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 applies also to apparatus which is battery operated or is powered by a non-public, but non-industrial, low-voltage power distribution system if this apparatus is intended to be used in the locations described below. The environments encompassed by this standard are residential, commercial and light-industrial locations, both indoor and outdoor. The following list, although not comprehensive, gives an indication of locations which are included: - residential properties, for example houses, apartments; - retail outlets, for example shops, supermarkets; - business premises, for example offices, banks; - areas of public entertainment, for example cinemas, public bars, dance halls; - outdoor locations, for example petrol stations, car parks, amusement and sports centres; - light-industrial locations, for example workshops, laboratories, service centres. Locations which are characterised by being supplied directly at low voltage from the public mains network are considered to be residential, commercial or light-industrial. The immunity requirements have been selected to ensure an adequate level of immunity for apparatus at residential, commercial and light-industrial locations. The levels do not, however, cover extreme cases, which may occur at any location, but with an extremely low probability of occurrence. Not all disturbance phenomena have been included for testing purposes in this standard but only those considered as relevant for the equipment covered by this standard. These test requirements represent essential electromagnetic compatibility immunity requirements. Test requirements are specified for each port considered.
[24]	**IEC 61000-6-2** (2005-01) Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments	applies to electrical and electronic apparatus intended for use in industrial environments, as described below. Immunity requirements in the frequency range 0 Hz to 400 GHz are covered. No tests need to be performed at frequencies where no requirements are specified. This generic EMC immunity standard is applicable if no relevant dedicated product or product-family EMC immunity standard exists. 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 applies also to apparatus which is battery operated and intended to be used in industrial locations.

		The environments encompassed by this standard are industrial, both indoor and outdoor. The immunity requirements have been selected to ensure an adequate level of immunity for apparatus at industrial locations. The levels do not, however, cover extreme cases, which may occur at any location, but with an extremely low probability of occurrence. Not all disturbance phenomena have been included for testing purposes in this standard, but only those considered as relevant for the equipment covered by this standard. These test requirements represent essential electromagnetic compatibility immunity requirements.
[25]	**ISO 4266-1 (**2002) Petroleum and liquid petroleum products -- Measurement of level and temperature in storage tanks by automatic methods -- Part 1: Measurement of level in atmospheric tanks	ISO 4266-1 gives guidance on the accuracy, installation, commissioning, calibration and verification of automatic level gauges (ALGs), of both intrusive and non-intrusive types, for measuring the level of petroleum and petroleum products having a Reid vapour pressure less than 100 kPa, stored in atmospheric storage tanks. This part of ISO 4266 is not applicable to the measurement of level in refrigerated storage tanks with ALG equipment.
[26]	**ISO 4266-2** (2002) Petroleum and liquid petroleum products -- Measurement of level and temperature in storage tanks by automatic methods -- Part 2: Measurement of level in marine vessels	ISO 4266-2 gives guidance on the accuracy, installation, calibration and verification of automatic level gauges (ALGs), both intrusive and non-intrusive, for measuring the level of petroleum and liquid petroleum products having a Reid vapour pressure less than 100 kPa, transported aboard marine vessels (i.e. tankers and barges). ISO 4266-2 gives guidance for buyers and sellers who mutually agree to use marine ALGs for either fiscal and/or custody transfer applications. ISO 4266-2 is not applicable to the measurement of level in refrigerated cargo tanks.
[27]	**ISO 4266-3** (2002) Petroleum and liquid petroleum products -- Measurement of level and temperature in storage tanks by automatic methods -- Part 3: Measurement of level in pressurized storage tanks (non-refrigerated)	ISO 4266-3 gives guidance on the accuracy, installation, commissioning, calibration and verification of automatic level gauges (ALGs) both intrusive and non-intrusive, for measuring the level of petroleum and petroleum products having a vapour pressure less than 4 MPa, stored in pressurized storage tanks. ISO 4266-3 gives guidance on the use of ALGs in custody transfer application. ISO 4266-3 is not applicable to the measurement of level in caverns and refrigerated storage tanks with ALG equipment.
[28]	**ISO 4266-4** (2002) Petroleum and liquid petroleum products -- Measurement of level and temperature in storage tanks by automatic methods -- Part 4: Measurement of temperature in atmospheric tanks	ISO 4266-4 gives guidance on the selection, accuracy, installation, commissioning, calibration and verification of automatic tank thermometers (ATTs) in fiscal/custody transfer applications in which the ATT is used for measuring the temperature of petroleum and liquid petroleum products having a Reid vapour pressure less than 100 kPa, stored in atmospheric storage tanks. ISO 4266-4 is not applicable to the measurement of temperature in caverns or in refrigerated storage tanks.

[29]	**ISO 4266-5** (2002) Petroleum and liquid petroleum products -- Measurement of level and temperature in storage tanks by automatic methods -- Part 5: Measurement of temperature in marine vessels	ISO 4266-5 gives guidance on the selection, accuracy, installation, commissioning, calibration and verification of automatic tank thermometers (ATTs) in fiscal/custody transfer applications in which the ATT is used for measuring the temperature of petroleum and liquid petroleum products having a Reid vapour pressure less than 100 kPa, stored in cargo tanks on board marine vessels. ISO 4266-5 is not applicable to the measurement of temperature in refrigerated storage tanks, or pressurized cargo tanks on board marine vessels.
[30]	**ISO 4266-6** (2002) Petroleum and liquid petroleum products -- Measurement of level and temperature in storage tanks by automatic methods -- Part 6: Measurement of temperature in pressurized storage tanks (non-refrigerated	ISO 4266-6 gives guidance on the selection, accuracy, installation, commissioning, calibration and verification of automatic tank thermometers (ATTs) in fiscal/custody transfer applications in which the ATT is used for measuring the temperature of petroleum and liquid petroleum products stored in pressurized storage tanks. ISO 4266-6 is not applicable to the measurement of temperature in caverns or in refrigerated storage tanks.