COMMITTEE DRAFT 3CD OIML R 85

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Title: Third Committee Draft
Revision OIML International Recommendation R85

Secretariat:
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[X] discussion at 8 and 9 March 2007 in Wien

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

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
Part 2: Metrological Control and tests
Part 3: Test report format

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
Partie 2: Contrôles métrologiques et essais
Partie 3: Format du rapport d'essai

Original version in: English

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.

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 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 R 85, 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. It supersedes the previous edition dated 1998.

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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) includes also requirements concerning the tank. This new revision is dealing only with the level gauge itself.
- The format of Recommendation R85 (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: General requirements for electronic measuring instruments.
- The previous Part 1 has been split in Part 1 "Metrological and technical requirements" and Part 2 "Metrological Control and tests"

With respect to the OIML Certificate system, this has the following consequences:
The Certificates of Conformity according the Recommendation R85 (200x) will be covering a more precise defined measuring instrument, being a Electronic Level Gauge. In practice the ALG will be installed on a tank according Recommendation R71

2 Scope

This Recommendation specifies the metrological and technical requirements and test procedures for automatic level gauges for storage tanks. The storage tanks include 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.***During the meeting in Hamburg, the US delegation offered to draft a proposal for changes in this chapter to clarify the application in atmospheric and/or pressurized tanks. This has not yet been received.***

3 Terminology

The terminology used in this Recommendation 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 measuring device(s) 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 larger than the general OIML meaning (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 Non-automatic checking facility (type N)

Checking facility that requires the intervention of an operator.

3.14 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.

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

3.16 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).

3.17 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.

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

Note: The term “innage” is synonymous.

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

Note: The term “outage” is synonymous.

3.20 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.

3.21 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.

3.22 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 .

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

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

3.25 Performance
The ability of the ALG to accomplish the intended functions.

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

3.27 Error (of indication)
The indication of an ALG minus a true value of the corresponding input quantity

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

3.29 Intrinsic error
The error of an ALG determined under reference conditions

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

3.31 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.

3.32 Significant fault
A fault greater than the maximum permissible error specified in Table 1 (see 6.2.1).

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.

3.33 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

3.34 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
T.	Number of the test (in Part 3)

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:

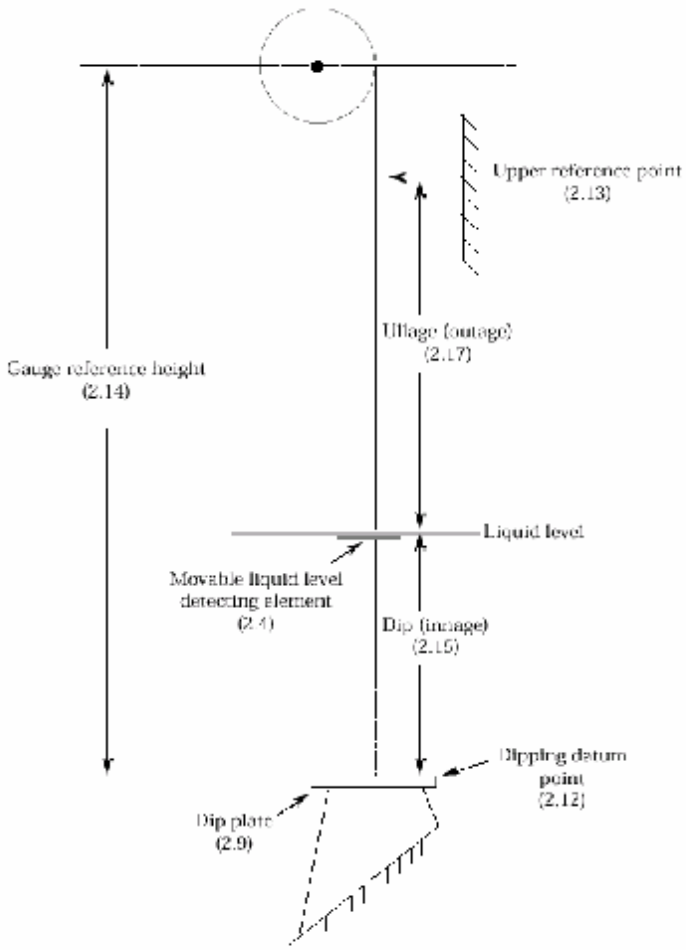

Figure 1

Some of the principal elements of an ALG, shown here with a movable liquid level detecting element

Temporary note:
The numbers in this figure, referring to the definitions, will be reviewed in a later stage.

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:

a)	Ambient temperature	low	+ 5 °C, - 10 °C, or - 25 ° C (**)
		high	+ 30 °C, + 40 °C, or + 55 °C (**)
b)	Humidity	up to 93% RH	
c)	DC mains voltage (*)	As specified by the manufacturer	
d)	AC mains voltage (*)	U_{nom} - 15 % to U_{nom} + 10 %	
e)	The minimum and maximum temperatures of the liquid and the medium above the liquid		As specified by the manufacturer
f)	The minimum and maximum pressures in the tank		
g)	The characteristics of the liquid and of the medium above the liquid		
h)	The minimum and maximum densities of the liquid and of the medium above the liquid		
(*) 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.			

6.2 Maximum permissible errors

6.2.1 The maximum permissible errors, positive and negative, under rated operating conditions to be applied for the relevant indications are specified inTable 1.

Table 1

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

The maximum permissible errors of Table 1 apply to the indication of a dip or an ullage according to the measuring principle of the ALG;

Note: In case the volume is displayed, this is calculated from the measured height (dip or ullage) and the properties of the tank (calibration table and deformation). So any fault in the calibration table or unexpected deformation of the tank will lead to undetected faults in the measurement of volume.

6.2.2 The hysteresis error when changing the direction of the movement of the level shall not exceed 1 mm.

6.2.3 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.

6.2.4 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 tests 8.1.5.1 to 8.1/5/5 and 8.1.4.1 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 of 6.2.1. 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).
Other indicating devices, notsubjected 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 at least after 10 s be replaced by the innage.
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 7.1.1 through 7.1.8 are 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 sub clauses 7.4 through 7.7 are fulfilled.
The indication shall be easily accessible and legible.

7.3.1.2 ALG's must be equipped and installed in such a way that they can be verified when mounted on the tank and with the tank in servive.

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 ALGmeasurement so a significant fault occurs, then it 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.
For construction details refer to applicable standards, which are listed at the end of the document.
Remark: This may imply that influences must be compensated for, using correction devices.

7.3.1.7 If provided, the correction detector 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 detector 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 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.

7.7 Sealing

It shall be possible to seal the data plate mentioned in 7.5.2 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 measuring system 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 measuring system 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.

[There was a suggestion from Sweden with regard to various signal condition modes. However, this was not clear for the secretary of the Working Group. So more clarification will be necessary. To be discussed.]

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 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

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:
  a) Radiated, radio-frequency, electromagnetic fields;
  b) Conducted radio-frequency fields;
  c) Electrostatic discharge;
  d) Bursts (transients) on signal, data and control lines;
  e) Surges on signal, data and control lines;
  f) AC mains voltage dips, short interruptions and voltage variations;
  g) Bursts (transients) on AC and DC mains;
  h) Voltage dips, short interruptions and voltage variations on DC mains power;
  i) Ripple on DC mains power,

- after the following disturbances:
  a) Damp heat cyclic (condensing);
  b) Surges on AC and DC mains power.

Note: A fault equal to or smaller than the significant fault according to 3.32 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.

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

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.
[In a later stage, the word "relevant" is to be replaced by an exact reference to these "relevant" tests in Part 2.]

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].
[The secretary suggests to move this footer in a later stage to an informative annex]

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.

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1 Acceptable solution:
• summing up of all instruction and data codes and comparing the sum with a fixed value;
• line and column parity bits (LRC and VRC, ISO 2111, [3]);
• cyclic redundancy check (CRC 16, ISO 2111);
• 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.

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 paragraph 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.