Second Committee Draft (2CD) – Clean version

Project:	New OIML Recommendation (OIML R xxx-1)
Title:	Continuous totalizing automatic weighing instruments (CTAWIs) of the arched chute type Part 1: Metrological and technical requirements
Date:	29 November 2018
Document number:	TC9_SC2_P9_N027
Supersedes document:	TC9_SC2_P9_N020

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

☐ ☐ Comments by: 22nd February 2019

Contents - TO BE FINALISED ON PUBLICATION

Explanatory Note

The continuous totalizing automatic weighing instrument described in this Recommendation does not concern a beltweigher.

Functionally the instrument described is comparable to a beltweigher. The actual OIML R 50 is not applicable to such instruments while it only deals with the technical and metrological aspects of beltweighers. Such can be noticed from the title and scope of OIML R 50. From a historical point of view the focus of OIML R 50 on beltweighers is understandable while the instrument described in this new Recommendation concerns a rather new developed technique.

The same is true for the Continuous totalizing automatic weighing instruments as described in the European Measurement Instruments directive (MID) and such may be incorporated in the legislation in other regions or counties as well.

While the today tendency is to produce Recommendations being less dependent on the technology applied it would rather be expected that OIML R 50 would fit the purpose, however while OIML R 50 restricts to the beltweigher type and has been revised only a short time ago, for the time being it is expected to be more efficient to produce a Recommendation which merely concerns this new type of Continuous Totalizing Automatic Weighing Instruments (CTAWI).

In order to keep coherence with R 50 the contents and clauses of this new Recommendation have as much as possible been kept similar or the same.

FDR 50 has been applied as basis for the present draft. Only those clauses necessary to make the Recommendation applicable to the new type of CTAWI have been amended.
It is expected that in some later stage both Recommendations will be integrated to become one consolidated Recommendation and at the same time could be further aligned with the lay-out presented in OIML B 6-2

FOREWORD

STANDARD BIML FORWORD TO BE ADDED ON PUBLICATION

Continuous totalizing automatic weighing instruments of the arched chute type

Part 1 – Metrological and technical requirements

1 General

1.1 Scope

This International Recommendation specifies the metrological and technical requirements for continuous totalizing automatic weighing instruments of the type of which an arched chute transport support causes a force receptor to continuously measure the centripetal force effected by the flow of solid matter on this chute. Hereinafter referred to as “arched chute” (type) weighers”, that are subject to national metrological control.

1.2 Application

This Recommendation applies to:

arched chute weighers that determine the totalized mass value of a product in bulk by using the centripetal force caused by the action of gravity on the force receptor as a consequence of the mass flow of the product along the chute.

2 Terminology (terms and definitions)

The terminology used in this Recommendation conforms to the *International Vocabulary of Basic and General Terms in Metrology* (VIM) [1], the *International Vocabulary of Legal Metrology* (VIML) [2], OIML D 11 *General requirements for Measuring Instruments* [4] and to OIML D 31 *General requirements for software controlled measuring instruments* [23]. In addition, for the purposes of this Recommendation, the following definitions apply.

2.1 General definitions

2.1.1 weighing instrument

measuring instrument used to determine the mass of a body by using the action of gravity on this body

Note: In this Recommendation “mass” (or “weight value”) is preferably used in the sense of “conventional mass” or “conventional value of the result of weighing in air” according to OIML R 111 [5] and OIML D 28 [6], whereas “weight” is preferably used for an embodiment (or material measure) of mass that is regulated in regard to its physical and metrological characteristics.

The instrument may also be used to determine other quantities, magnitudes, parameters or characteristics related to the determined mass.

2.1.2 automatic weighing instrument

weighing instrument that weighs without the intervention of an operator and follows a predetermined program of automatic processes characteristic of the instrument

2.1.3 continuous totalizing automatic weighing instrument (CTAWI)

automatic weighing instrument for continuously totalizing the weight of the particles of a bulk product

2.1.4 arched chute type totalizing weighing instrument

CTAWI designed such that it causes a vertical flow of bulk product to effect a centripetal force proportionally to the mass of the product passing along the circular arched surface of the force receptor

(2.2.1).

2.1.5 true quantity value

quantity value consistent with the definition of a quantity *[VIM, 2.11]* [1]

2.1.6 control method

method used to determine the mass of the product used as the test load during product tests

Note: This will generally involve the use of a weighing instrument, referred to as the control instrument (see 2.1.10).

2.1.7 metrologically relevant

attribute of any device, instrument, function or software that may influence the measurement result or any other primary indication *[VIML 4.03]* [2]

2.1.8 legally relevant part

attribute of a part of a measuring instrument, a device or software subject to legal control *[VIML 4.08]*

2.1.9 audit trail

continuous data file containing a time stamped information record of events, e.g. changes in the values of the parameters of a device or software updates, or other activities that are legally relevant and which may influence the metrological characteristics *[VIML 6.05]*

2.1.10 control instrument

weighing instrument used to determine the conventional value of the mass of the test load(s) [VIML 5.08]

2.2 Construction

Note: In this Recommendation the term “device” is used for any means by which a specific function is performed irrespective of the physical realization e.g. by a mechanism or a key initiating an operation; the device may be a small part or a major portion of an instrument.

2.2.1 force receptor

part of the instrument intended to sense the force induced by the material flow

2.2.1.1 slide chute

part of the force receptor intended to bend and orient the material flow

2.2.2 conveyor

equipment for conveying the product to and from the weigher, (e.g. by means of a conveyor belt).

2.2.3 electronic measuring instrument

instrument intended to measure an electrical or non-electrical quantity using electronic means and/or equipped with electronic devices *[OIML D 11 3.1]* [4]

2.2.4 digital device

device that provides a digitized output or display

Examples: Printer, remote display, terminal, data storage device, personal computer.

2.2.5 totalization device

device that uses information supplied by the force receptor to integrate over time the mass of the product passing along the force receptor.

2.2.6 zero-setting device

device enabling the indication to be set to zero in absence of any material flow passing the force receptor

2.2.6.1 non-automatic zero-setting device

zero-setting device that requires observation and adjustment by the operator

2.2.6.2 semi-automatic zero-setting device

zero-setting device that operates automatically following a manual command or indicates the value of the adjustment required

2.2.6.3 automatic zero-setting device

zero-setting device that operates automatically without the intervention of the operator when no material flow on the force receptor is detected

2.2.7 printing device

device to produce a printout (see 2.4.3) of the weighing results

2.2.8 flowrate regulating device

device intended to ensure a programmed flowrate

2.2.9 module

identifiable part of an measuring instrument or of a family of measuring instruments that performs a specific function or functions, and that can be separately evaluated according to the prescribed metrological and technical performance requirements in this Recommendation *[VIML 4.04]* [3]

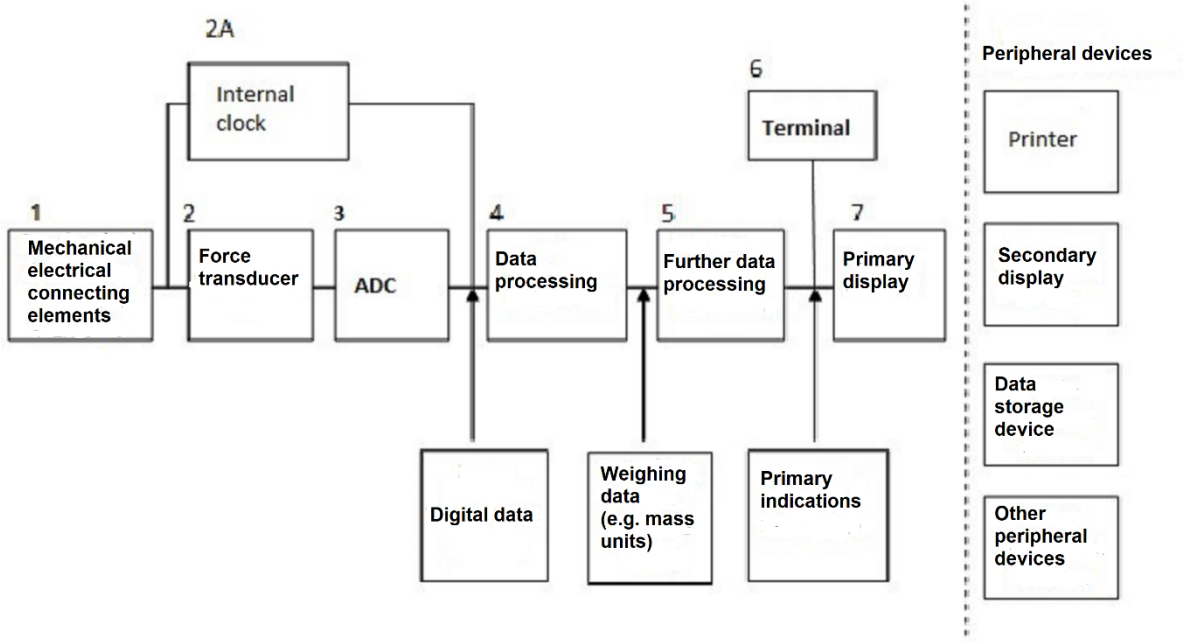
Note 1: The modules of a weighing instrument may be subject to specified partial error limits.

Note 2: Modules may be examined separately (subject to agreement with the metrological authority (see 6.1.6).

Typical modules of an automatic weighing instrument are: load cell (force receptor), indicator, analogue or digital processors, weighing module, remote display, software.

Figure 1 – Definition of typical modules according to 2.2.9 and 6.1.6

(other combinations are possible)



force transducer	(2.2.9.2)	2 + (3) + (4)*
internal clock	(2.2.9.3)	2A
analogue data processing device	(2.2.9.4)	3 + 4 + (5) + (6)
digital data processing device	(2.2.9.5)	(4) + 5 + (6)
indicator	(2.2.9.6)	(3) + 4 + (5) + (6) + 7
weighing module	(2.2.9.7)	1 + 2 + 3 + 4 + (5) + (6)
primary display	(2.2.9.6) (2.2.9.8)	7
terminal	(2.2.9.6)	(5) + 6 + 7

* Numbers in brackets indicate options

2.2.9.1 force receptor

part of the measuring instrument that converts an induced mechanical force into electronic information representing or containing a quantity value

2.2.9.2 force transducer

part of the force receptor, that converts the measured induced force into a different measurement quantity (output)

2.2.9.3 internal clock

device in the weighing instrument electronics providing the time base for calculation of the measurement result thus by combining the time information with corresponding measured induced force.

2.2.9.4 analogue data processing device (ADC)

electronic device that performs the analogue-to-digital conversion of the output signal of the force receptor, and further processes the data, and supplies the weighing result in a digital format via a digital interface without displaying it

2.2.9.5 digital data processing device

electronic device that processes digital data

2.2.9.6 indicator

electronic device that may perform the analogue-to-digital conversion of the output signal of the force receptor, and further processes the data, and displays the weighing result in units of mass

2.2.9.7 weighing module

part of an instrument providing information on the mass of the load to be measured. It may optionally have devices for further processing (digital) data and operating the instrument

2.2.9.8 digital display

output device visualizing actual information in volatile digital format

Note 1: A digital display may be a primary display or a secondary display.

Note 2: The terms “primary display” and “secondary display” should not be confused with the terms “primary indication” and “secondary indication” (see 2.4.1.1 and 2.4.1.2).

2.2.9.8.1 primary display

digital display, either incorporated in the indicator housing, or in the terminal housing or realized as a display in a separate housing (i.e. terminal without keys), e.g. for use in combination with a weighing module

2.2.9.8.2 secondary display

additional (optional) digital peripheral device, which repeats the weighing result and any other primary indication, or provides further, non-metrological information

2.2.9.9 terminal

digital device equipped with operator interface(s) such as a keypad, mouse, touch-screen, etc. used to monitor the operations of the instrument, often equipped with a display to provide feedback to the operator, such as weighing results, flow rate, etc. transmitted via the digital interface of a weighing module or an analogue data processing device

2.2.10 software

2.2.10.1 legally relevant software part

part of all software modules of a measuring instrument, electronic device, or sub-assembly that is legally relevant *[OIML D 31, 3.1.31]* [2]

Note: Examples of legally relevant software are software involved in determination of the final results of the measurement including the decimal sign and the unit, identification of the weighing range, software identification, and force receptor identification and configuration information.

2.2.10.2 legally relevant parameter

parameter of a measuring instrument (electronic) device, sub-assembly, software or a module subject to legal control

Note: The following types of legally relevant parameters can be distinguished: type-specific parameters and device-specific parameters. *[VIML, 4.10]* [2]

2.2.10.3 type-specific parameter

legally relevant parameter with a value that depends on the type of instrument only *[VIML, 4.11]* [2]

Note: Type-specific parameters are part of the legally relevant software.

Examples of type-specific parameters are: parameters used for weight value calculation, stability analysis or price calculation and rounding, software identification

2.2.10.4 device-specific parameter

legally relevant parameter with a value that depends on the individual instrument *[VIML, 4.12]* [2]

Note: Device specific parameters comprise adjustment parameters (e.g. span adjustments or other adjustments or corrections) and configuration parameters (e.g. maximum value, minimum value, units of measurement, etc.).

2.2.10.5 software identification

sequence of readable characters (e.g. version number, checksum) that is inextricably linked to the software or software module under consideration. It can be checked on an instrument whilst in use *[VIML, 6.01]* [2]

2.2.10.6 software separation

separation of the software in measuring instruments which can be divided into a legally relevant part and a legally non-relevant part *[VIML, 6.02]* [2]

Note: These parts communicate via a software interface.

2.2.11 data storage device

storage device used for keeping measurement data ready after completion of the measurement for later legally relevant purposes (e.g. the conclusion of a commercial transaction)

2.2.12 interface

shared boundary between two functional units, defined by various characteristics pertaining to the functions, physical interconnections, signal exchanges, and other characteristics of the units, as appropriate *[OIML D 31, 3.1.27]* [23]

2.2.12.1 user interface

interface that enables information to be interchanged between the operator and the measuring instrument or its hardware or software components, e.g. switches, keyboard, mouse, display, monitor, printer, touch-screen, software window on a screen including the software that generates it *[VIML, 6.08]* [2]

2.2.12.2 protective interface

interface (hardware and/or software) which will only allow the introduction into the instrument of data or instructions that cannot influence the metrological properties of the instrument

2.3 Metrological characteristics

2.3.1 scale intervals

2.3.1.1 totalization scale interval, *d*

difference between two consecutive indicated values, expressed in units of mass, with the instrument in its normal weighing mode

2.3.1.2 totalization scale interval for testing, *e*

difference between two consecutive indicated values, expressed in units of mass, with the instrument in a special mode for testing purposes. This scale interval for testing, *e*, is equal to the totalization scale interval, *d*, if the special mode is not available

2.3.2 weighing segment length (W_L)

length of the weighing part of the slide chute

2.3.3 maximum capacity, Max

maximum force that the force receptor is intended to withstand and able to determine the value of.

2.3.4 minimum capacity, Min

minimum force that the force receptor is intended to be able to accurately determine the value of.

2.3.5 mass flowrate, Q_m

2.3.5.1 maximum mass flowrate, Q_{mmax}

flowrate obtained at the maximum capacity of the force receptor

2.3.5.2 minimum mass flowrate, Q_{mmin}

flowrate above which the weighing results comply with the requirements of this Recommendation

2.3.5.3 feeding flowrate

flowrate of product from a preceding device onto the force receptor

2.3.6 minimum totalized quantity, Σ_{min}

totalized quantity, in units of mass, below which totalized values may be subject to errors exceeding the applicable MPE

2.3.7 control value

value, in units of mass, that is indicated by the totalization indicating device when a known additional force has been actually or by simulation introduced on the (empty) force receptor

2.3.8 warm-up time

time between the moment that power is applied to an instrument and the moment that the instrument is capable of complying with the requirements

2.3.9 measurement repeatability

measurement precision under a set of repeatability conditions of measurement [VIM, 2.21] [1]

2.3.10 durability

ability of an instrument to maintain its performance characteristics over a period of use *[VIML 5.15]* [2]

2.3.11 family of measuring instruments

identifiable group of measuring instruments belonging to the same manufactured type within the same category that have the same design features and metrological principles for measurement (for example the same type of indicator, the same type of design of force receptor and force transmitting device) but which may differ in some metrological and technical performance characteristics (e.g. Max, Min, *d*, accuracy class, etc.) *[VIML 4.02* [2]

Note: The concept of family primarily aims at reducing the test effort at type examination. It does not preclude the possibility of listing more than one family in one certificate.

2.4 Indications and errors

2.4.1 indication of a measuring instrument

quantity value provided by a measuring instrument or measuring system *[VIML, 0.03]* [2]

Note: "Indication", "indicate" or "indicating" includes both displaying, and/or printing.

2.4.1.1 primary indications

totalized quantity, signals and symbols that are subject to the requirements of this Recommendation

2.4.1.2 secondary indications

indications, signals and symbols that are not primary indications

2.4.2 types of indicating device

2.4.2.1 instantaneous force indicating device

device that indicates the actual force at a given time effected on the force receptor expressed as its quantity value or in percentage of the maximum capacity, Max, or alternatively in a quantity converted to mass values

2.4.2.2 flowrate indicating device

device that indicates the instantaneous flowrate either as the mass of the product conveyed in unit of time or as a percentage of the maximum mass flowrate

2.4.2.3 totalization indicating device

device that receives information from the totalization device and indicates the mass of the loads conveyed

2.4.2.4 general totalization indicating device

device that indicates the overall total of the mass of all the loads conveyed

2.4.2.5 partial totalization indicating device

device that indicates the mass of the loads conveyed over a limited period of time

2.4.2.6 supplementary totalization indicating device

indicating device with a scale interval greater than that of the general totalization indicating device and intended to indicate the mass of the loads conveyed over a fairly long period of operation

2.4.3 printout

hard copy of the measurement results produced by a printer

2.4.4 reading

2.4.4.1 reading by simple juxtaposition

reading of the weighing result by simple juxtaposition of consecutive figures giving the result, without the need of calculation

2.4.5 error of indication

indication minus a reference quantity value

Note: This reference value is sometimes referred to as a (conventional) true quantity value. *[VIML, 0.04]* [2]

2.4.5.1 intrinsic error

error of a measuring instrument determined under reference conditions *[VIML 0.06]* [2]

2.4.5.2 initial intrinsic error

intrinsic error of a measuring instrument as determined prior to performance tests and durability evaluations *[VIML 5.11]* [2]

2.4.5.3 fault

difference between the error of indication and the intrinsic error of a measuring instrument *[VIML 5.12]* [2]

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

2.4.5.4 fault limit

value specified (in this Recommendation) delimiting non-significant faults *[VIML 5.13]* [2]

2.4.5.5 significant fault

fault exceeding the applicable fault limit value *[VIML 5.14]* [2]

Note: A significant fault does not include

- faults arising from simultaneous and mutually independent causes ,
- faults implying the impossibility of performing any weighing,
- transitory faults, momentary variations in the indications which cannot be interpreted, memorized or transmitted as a weighing result,
- faults which are so serious they will inevitably be noticed by all those interested in the weighing result.

2.4.5.6 maximum permissible errors (MPE)

extreme values of an error permitted by specifications, regulations, etc. for a given instrument *[VIML 0.05]* [1]

2.4.5.7 durability error

difference between the intrinsic error after a period of use and the initial intrinsic error of a measuring instrument *[VIML 5.16]* [4]

2.5 Influences and reference conditions

2.5.1 influence quantity

quantity that, in a direct measurement, does not affect the quantity that is actually measured, but affects the relation between the indication and the measurement result *[VIM, 2.52]* [1]

2.5.1.1 influence factor

influence quantity having a value which ranges within the specified rated operating conditions of the measuring instrument *[VIML 5.18]* [4]

Note: The variation of an indication as a consequence of an influence factor is considered an error and not a fault.

2.5.1.2 disturbance

influence quantity having a value within the limits specified in this Recommendation but outside the rated operating conditions of the measuring instrument *[VIML 5.19]* [4]

2.5.2 rated operating condition

operating condition that must be fulfilled during measurement in order that a measuring instrument or measuring system perform as designed *[VIML, 0.08]* [1]

Note: Rated operating conditions generally specify intervals of values for a quantity being measured and for any influence quantity.

2.5.3 reference condition

operating condition prescribed for evaluating the performance of a measuring instrument or measuring system or for comparison of measurement results *[VIML, 0.09]* [1]

Note: Reference operating conditions specify intervals of values of the measurand and of the influence quantities.

2.6 Tests

2.6.1 product test

test carried out on a complete instrument using the type of product that it is intended to weigh

2.6.2 performance test

test intended to verify whether the EUT is able to accomplish its intended functions *[VIML 5.21]* [4]

2.6.3 durability test

test intended to verify whether the EUT is able to maintain its performance characteristics over a period of use *[VIML 5.22]* [4]

2.6.4 simulation test

test carried out on a complete instrument or part of an instrument in which any part of the instrument operation is simulated

2.7 Abbreviations and symbols

Symbol	Meaning
I	indication of the measuring instrument
I_n	nth indication
L	load
$\Sigma_{\min}$	minimum totalized quantity
Q_m	mass flowrate
Q_{mmax}	maximum mass flowrate
Q_{mmin}	minimum mass flowrate
B	length of conveyor
ΔL	additional load to next changeover point
P	indication prior to rounding (digital indication)
E_{r}	relative error
E%	relative error in percentage
E_0	error at zero load
d	totalization scale interval
W_{L}	weighing segment length
MPE	maximum permissible error
EUT	equipment under test
Fl	fault limit
Max	maximum capacity of the weighing instrument
Min	minimum capacity of the weighing instrument
U_{nom}	nominal voltage value marked on the instrument
U_{max}	highest value of a voltage range marked on the instrument
U_{min}	lowest value of a voltage range marked on the instrument

2.8 Basic relationships

2.8.1 indication prior to rounding (digital indication)

$P = I + 1/2\ e - \Delta L$

2.8.2 relative error

$E_r = (I - L) / L$

2.8.3 relative error prior to rounding

$E_{pr} = (P - L) / L$

2.8.4 relative error in percentage

$E_r\% = 100 \times E_r$

2.8.5 maximum mass flowrate

$Q_{mmax} = \text{max} \times v_{max}$

2.8.6 minimum mass flowrate

Q_{mmin} = normally 20 % of Q_{mmax}, but ≤ 35 % of Q_{mmax}

2.8.7 time per mass flow

minimum = B / v_{max}; or maximum = B / v_{min}

2.8.8 totalized mass for one flow at Q_{mmax}

$= \frac{Q_{max} \times B}{V_{max}}$

2.8.9 2 % of the load at Q_{mmax} for 1 hour

= 0.02 × load at Q_{mmax}

3 Metrological requirements

3.1 Accuracy classes

For an arched chute type weighing instrument one of the following four accuracy classes applies:

0.2 0.5 1 2

3.2 Maximum permissible errors

Maximum permissible errors apply to totalized quantities equal to or greater than the minimum totalized quantity, Σ_{min}.

3.2.1 Maximum permissible errors during automatic weighing

The maximum permissible errors for each accuracy class, positive or negative, are the applicable values in Table 1 rounded to the nearest totalization scale interval, *d*.

Table 1 – Maximum permissible errors for automatic weighing

Class	Percentage of the mass of the totalized quantity for	
	initial verification	in-service
0.2	0.10	0.20
0.5	0.25	0.50
1	0.50	1.0
2	1.0	2.0

3.2.2 Maximum permissible errors for influence factor tests

The maximum permissible errors for each accuracy class, positive or negative, are the applicable values in Table 2 rounded to the nearest totalization scale interval, *d*.

Table 2 – Maximum permissible errors for influence factor tests

Class	Percentage of the mass of the totalized quantity
0.2	0.07
0.5	0.175
1	0.35
2	0.70

Where modules of an instrument are evaluated separately, the maximum permissible error for a device under test shall be the applicable value specified in Table 2 above multiplied by the value of the fraction p_i applicable to this device (as described in 6.1.6.7).

However, when testing is performed on a module which directly influences the measurement value of the measurand, or an electronic device, the maximum permissible error for the device under test shall be 0.7 times the applicable value specified in Table 2 above.

3.3 Agreement between multiple indicating devices

For the same load, the difference between weighing results provided by any two devices having the same scale interval shall be zero for displaying and printing devices.

3.4 Lower limit for minimum totalized quantity, Σ_{min}

The minimum totalized quantity shall be not less than the largest of the following values:

a) 2 % of the totalized quantity during one hour at maximum mass flowrate;

b) the quantity corresponding to the appropriate number of totalization scale intervals in Table 3.

Table 3 – Minimum value of the minimum totalized quantity, Σ_{min}

Class	Number of totalization scale intervals
0.2	2000
0.5	800
1	400
2	200

3.5 Minimum mass flowrate, Q_{mmin}

The minimum mass flowrate shall be equal to 20 % of the maximum mass flowrate, unless the characteristics of a particular installation are such that the flowrate variation is less than a ratio of 5 to 1, exclusive of the flowrate gradient at the beginning and the end of the conveyance of the bulk load. In this case, the minimum flowrate shall not exceed 35 % of the maximum mass flowrate.

3.6 Units of measurement

The units of measurement applicable for weighing are those that concern mass and mass per unit of time expressed as mass flowrate

The units to be used

a) for mass are: gram (g), kilogram (kg) and tonne (t),

b) for mass flowrate are: gram per hour (g/h), kilogram per hour (kg/h), tonne per hour (t/h),

3.7 Further metrological requirements

3.7.1 Variation in inflow speed

A variation of ±10 % in the inflow speed shall not cause the errors to exceed the maximum permissible error (3.2.2, Table 2).

3.7.2 Eccentric inflow

Eccentric product flow shall not lead to a totalization error exceeding the maximum permissible error (as specified in 3.2.2 Table 2).

Note: Eccentric product flow may result from:

- non-uniform or eccentric distribution of product mass flowing from the product infeed;
- misaligned product flow, that is, misalignment between the product infeed and the slide chute.

3.7.3 Influence quantities

3.7.3.1 Temperature

The CTAWI shall comply with the appropriate metrological and technical requirements at ambient temperatures from –10 °C to +40 °C unless special temperature limits are specified in the descriptive markings of the instrument (in a form such as “-25 °C / +55 °C”).

The range within the temperature limits shall be at least equal to 30 °C.

The ambient temperature limits of the CTAWI shall be selected to be appropriate for the local environmental conditions of its use (this may be subject to national regulation).

3.7.3.2 Temperature effect at zero flowrate

The effect of ambient temperature on totalizations at zero flowrate shall not vary by more than

a) 0.007 % for class 0.2,

b) 0.0175 % for class 0.5,

c) 0.035 % for class 1,

d) 0.07 % for class 2.

per 5 °C of a quantity totalized at the maximum mass flowrate for the duration of the totalization.

3.7.3.3 Voltage variation

The CTAWI shall comply with the appropriate metrological and technical requirements, if the voltage varies from the nominal voltage, U_{nom} (if only one voltage is marked on the instrument), or from the upper and lower limits of the voltage range, U_{min}, U_{max}, marked on the instrument at

a) AC mains voltage:
   Lower limit is $0.85 \times U_{nom}$ or $0.85 \times U_{min}$, upper limit is $1.10 \times U_{nom}$ or $1.10 \times U_{max}$,

b) DC mains voltage:
   Lower limit is minimum operating voltage ($0.85\ U_{min}$) upper limit is $1.20 \times U_{nom}$ or $1.20 \times U_{max}$,

c) Battery voltage DC (not mains connected):
   Lower limit is minimum operating voltage; upper limit is U_{nom} or U_{min}.

Note: The minimum operating voltage is defined as the lowest possible operating voltage before the instrument is automatically switched off.

Battery-powered instruments and instruments with external or plug-in power supply device (AC or DC) shall either continue to function correctly or not indicate any weight values if the voltage is below the manufacturer's specified value, the latter being larger or equal to the minimum operating voltage.

3.7.3.4 Fault limit value

For a CTAWI the non-significant fault limiting value is the absolute value of the appropriate maximum permissible error for a totalized quantity of product equal to the minimum totalized quantity, Σ_{min}, for the designated class of the CTAWI.

3.7.4 Metrological characteristics

3.7.4.1 Repeatability (R xxx-2, 8.1)

The difference between any two results obtained for the same force applied under the same conditions to the force receptor shall not result in exceeding the absolute value of the maximum permissible errors (as specified in 3.2.2 Table 2).

3.7.4.2 Discrimination of the totalization indicating device (R xxx-2, 8.2)

At any flowrate between the minimum and maximum mass flowrates, the difference between the indications obtained for two totalized quantities, differing by a value equal to the maximum permissible error, shall be equal to at least one half of the calculated value from the difference between these totalized quantity.

3.8 In-situ requirements applying during type evaluation and verification (R xxx-2, 9)

3.8.1 Repeatability (R xxx-2, 9.1.1)

The difference between the relative errors for several results obtained at practically identical flowrates, for approximately the same quantities of product and under the same conditions, shall not exceed the absolute value of the maximum permissible error for automatic weighing in 3.2.1.

3.8.2 Zero-setting

Following any zero-setting within the range of the zero-setting device, the totalization error shall not exceed the maximum permissible errors (3.2.2, Table 2).

3.9 Durability

The durability error shall not be greater than the absolute value of the maximum permissible error for automatic weighing.

4 Technical requirements

4.1 Suitability for use

A CTAWI shall be designed to suit the method of operation, the product and the accuracy class for which it is intended.

4.2 Security of operation

4.2.1 Accidental breakdown and maladjustment

A CTAWI shall be constructed and installed such that an accidental breakdown or maladjustment likely to disturb its correct functioning can normally not take place without the effect being evident.

Adjustable components that potentially can disturb the metrological performance of a CTAWI shall be held securely and the position of the component shall be accurately and permanently defined.

4.2.2 Adjustments during operation

It shall not be possible for the general totalization indicating device to be reset to zero.

It shall not be possible to reset legally relevant indicating devices unless the flow rate is zero.

It shall not be possible to make adjustments which may affect the measurement result unless the flow rate is zero.

4.2.3 Fraudulent use

A CTAWI shall not have characteristics likely to facilitate its fraudulent use.

4.2.4 Operating devices

The design of the operating devices of a CTAWI shall ensure that the instrument cannot normally come to rest in a position other than that intended, without automatic disablement all indications and printing procedures.

4.2.5 Conveyor interlock

If the instrument is switched off or ceases to function, the product flow shall stop, or a visible or audible signal shall be given.

4.2.6 Out-of-range warning or alarm

The instrument shall produce a continuous, clearly audible and/or visible warning or alarm and a record of the warning or alarm with the date, time, duration and totalized value on the applicable partial or general totalized printout, or on any supplementary recording devices (flow rate chart recorder, etc.) if

a) the instantaneous force is above the maximum capacity of the weighing module,

b) the flowrate is above the maximum or below the minimum value,

c) a breakdown, maladjustment or fault has been detected (4.2.1), or

d) the MPE on checking of zero (3.8.2) has been exceeded (4.4.1).

Note: The indication is intended as a warning indication and its operation shall be obvious (e.g. an obvious continuously beeping or flashing warning light would be an acceptable solution). The warning or alarm shall be appropriate for the installation environment and the use of different indications for each cause is acceptable.

4.2.7 Securing and sealing of components and pre-set controls

Components, interfaces and pre-set controls subject to legal requirements that are not intended to be adjusted or removed by the user shall be fitted with a securing means or shall be enclosed. When enclosed, it shall be possible to seal the enclosure. The seals shall, in all cases, be easily accessible.

Adequate securing shall be provided on all parts of the measuring system which cannot be materially protected in any other way against operations liable to affect the measurement accuracy.

4.2.7.1 General

Securing and sealing measures on a CTAWI shall ensure that

a) access to functions liable to affect metrological properties is restricted by means such as: a switch protected by a physical seal, a password with audit trail, hard key or identification tag,

b) software functions are secured against intentional, unintentional and accidental changes in accordance with the requirements of 5.8,

c) transmission of metrological data via interfaces is secured against intentional, unintentional and accidental changes in accordance with the requirements of 5.6.1,

d) measurement data held on storage devices is secured against intentional, unintentional and accidental changes in accordance with the requirements of 5.7.

4.2.7.2 Components and pre-set controls

Means of securing and sealing components and pre-set controls to which access or adjustment is prohibited shall include the following:

a) Physical seals which must be broken to access the components or functions, and/or an audit trail system, if available, shall automatically memorise access to components or functions and it shall be possible to access and display this information; the records shall include the date and a means of identifying the authorised person making the intervention (a positive identification of the person may not be possible, however the audit trail should contain sufficient information to identify which password or identification tag was used to make the intervention);

b) The traceability of the interventions shall be assured (e.g. by means of a counter which is incremented whenever the components or functions are altered, and an associated record of the value of this counter at a particular time) for at least a period of time specified by national legislation (typically the period between periodical verifications if these apply). Records of interventions shall be retained. Records may not be overwritten, with the

exception that if the storage capacity for records is exhausted, new records may replace the oldest record provided that the owner of the data has given permission to overwrite the records;

c) The sealing measures provided shall be easily accessible.

4.3 Totalization indicating and printing devices

The CTAWI shall be equipped with a general totalization indicating device and may additionally be equipped with partial totalization indicating devices. Where a totalization is presented or indicated which is for indicative purposes only, this presentation shall be marked as such and not be applied for any transaction purposes.

4.3.1 Quality of indication

Totalization indicating and printing devices shall allow reliable, simple, and non-ambiguous reading of the primary indications (see 2.4.1.1) under rated operating conditions (see 2.5.2):

a) The figures forming the primary indications shall be of a size, shape and clarity for reading to be easy, the height of the figures shall be at least 9.5 mm;

b) The scales, numbering and printing shall permit the figures which form the results to be read by simple juxtaposition (see 2.4.4.1).

4.3.2 Format of the indication

4.3.2.1 Units of mass

Weighing results shall contain the names or symbols of the units of mass in which they are expressed.

For any one indication of mass, only one unit of mass may be used.

The units of mass shall be indicated only in the case as defined in the SI units (lower case letters for the unit symbols g and t as well for the prefix k) as shown in 3.6.

4.3.2.2 Digital indication

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

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

The unit of mass shall be chosen such that in the values indicated no more than one non-significant zero to the right is presented. For values with decimal sign, a non-significant zero is allowed only as the third digit to the right of the decimal sign.

A decimal fraction shall be separated from its integer by a decimal sign according to national legislation or convention (i.e. comma or dot), with the indication showing at least one figure to the left of the sign and all figures to the right.

The decimal sign shall be in line with the bottom of the figures (example: 0.305 kg).

Examples of suitable displays:

Scale interval	Suitable display	Unsuitable display
0.005 t, 5 kg	0.050 t, 50 kg	0.05 t, 0.0500 t
0.01 t, 10 kg	0.10 t, 0.100 t, 100 kg	0.1 t, 0.1000 t
0.02 t	0.20 t, 0.200 t	0.2 t, 0.2000 t
1 t	10 t	10.0 t, 10.00 t

4.3.3 Scale interval

4.3.3.1 General

The scale intervals of the indicating and printing devices shall be in the form1×10^k, 2×10^k, or 5×10^k, "*k*" being a positive or negative whole number or zero.

4.3.3.2 Scale interval of a partial totalization indicating device

The scale interval of a partial totalization indicating device shall be equal to the scale interval of the general totalization indicating device, *d*.

4.3.4 Range of the indication

At least one totalization indicating device on a CTAWI shall be capable of indicating a value being at least equal to the quantity of product totalized during 10 hours of operation at maximum mass flowrate.

Wider indication ranges may be required for installations where larger quantities of product are anticipated.

4.3.5 Totalization indicating devices

a) It shall not be possible to reset the general totalization indicating device to zero.

b) It shall not be possible to reset the partial totalization indicating device to zero unless the last total indicated before resetting to zero is printed or stored in memory with identification.

c) In automatic operation it shall not be possible to reset any totalization device to zero.

d) In the case of a multi-function display an automatic indication of the total shall be generated if the automatic operation is interrupted or during automatic operation at the latest 20 seconds after indication of another information.

4.3.6 Engagement of totalization indicating devices

a) Totalization indicating and printing devices (when printing devices are present) shall remain engaged at all times.

b) A means designed to disengage any totalization indicating and printing devices shall only come into operation when all product feed has stopped.

4.3.7 Printing device

Printing shall be clear and permanent for the intended use. Printed figures shall be at least 2 mm in height.

If printing takes place, the name or the symbol of the unit of measurement shall be either to the right of the value or above the column in which the applicable values are presented.

4.3.8 Scale interval of a supplementary totalization indicating device

The scale interval of a supplementary totalization indicating device shall be at least equal to ten times

the totalization scale interval.

Any supplementary totalization devices cannot be used for legal measurements.

4.4 Zero-setting device

Any deviation from zero indication during no load condition of the force receptor (slide chute) shall be compensated or corrected for by a zero-setting device of a type appropriate to the principle of operation of the CTAWI. The range of zero-setting shall not be more than 4 % of the maximum capacity.

4.4.1 Semi-automatic and automatic zero-setting devices

Semi-automatic and automatic zero-setting devices shall be constructed in such a manner that

a) the end of the zero-setting operation is indicated,

b) the zero-setting range shall not exceed 4 % of the maximum capacity, Max, and

c) a change in zero observed during a zero-load test that exceeds the MPE (3.8.2) shall be corrected by an automatic zero-setting device when present (see also 4.2.6).

For testing purposes, it shall be possible to disengage automatic zero-setting devices. A CTAWI may include an automatic zero-setting device with an interlock to prevent zero-setting when product is fed onto the force receptor.

4.5 Slide chute

4.5.1 Slide chute properties

4.5.1.1 Weighing segment length

The slide chute shall be installed in such a way that the length of the weighing segment and geometrical alignment remains unchanged while in service.

4.5.1.2 Slide chute shape (dimensions)

The curve of the slide chute shall fit the segment of a circle having a radius no less than half and no more than twice the slide chute length.

This circular shaped slide chute shall normally be installed in a fixed position.

If the slope angle of the force receptor, which is perpendicular to the product flow can change, either

a) the CTAWI shall be fitted with a device to compensate the effect of the change, or

b) the CTAWI shall not operate, delivery shall not be possible, and totalization shall be disabled during the period of time that the slope of the conveyor is in transition or when the limits to the slope angle set by the manufacturer are exceeded.

4.5.1.3 Slide chute surface

The slide chute surface shall suit the correct weighing of the applicable bulk product. Different bulk products may require different slide chute surfaces. For that specific documentation shall accompany each slide chute providing information on the ranges of bulk products for which the slide chute is designed.

4.5.2 Slide chute environmental conditions

4.5.2.1 Draught (air flow) prevention

Adequate measures shall be taken to prevent any disturbance of the flow of the bulk product caused by draught and potentially of influence on the measuring result.

4.6 Required descriptive markings

Instruments shall bear the following markings.

4.6.1 Identification markings

- identification mark of the manufacturer,
- serial number and type designation of the instrument,
- identification mark on each part of an instrument consisting of separate but associated units,
- type approval mark,

4.6.2 Marking of specifications

- mains power voltage V
- mains power frequency ..... Hz (if applicable)
- designation of type(s) of product to be weighed
- density the of product in kg/L or t/m^3
- particle size of the product in mm or in µm diameter
- maximum capacity, Max ..... N
- temperature range ..... °C / ..... °C, (if applicable, see 3.7.3.1)
- accuracy class = 0.2, 0.5, 1 or 2
- totalization scale interval, d = ... g, kg or t
- maximum mass flowrate, Q_{mmax} = ... g/h, kg/h or t/h
- minimum mass flowrate, Q_{mmin} = ... g/h, kg/h or t/h
- minimum totalized quantity, Σ_{min} = ... g, kg or t
- pneumatic/hydraulic pressure, (if applicable)

4.6.3 Supplementary markings

Depending on the particular use of the instrument, supplementary markings may be required on type approval by the metrological authority issuing the type approval certificate.

4.6.4 Presentation of descriptive markings

Descriptive markings shall be indelible and of a size, shape and clarity to enable legibility under rated operating conditions.

Descriptive markings may be either in the national language or a language which is allowed to be applied in the particular country or in form of adequate, internationally agreed and published pictograms or signs.

The markings shall be grouped together at a visible place on the instrument, either on a markings plate fixed or on a sticker fixed permanently near the general totalization indicating device or on a non-removable part of the indicating device itself. In case of a plate or sticker which will not be destructed in case it is removed, a means of securing shall be provided. (e.g. a non-removable control mark or a means for sealing the plate bearing the markings).

The markings mentioned above may also be shown on a software controlled display provided that

a) at least Max, Q_{mmax}, Q_{mmin}, Σ_{min} and d shall be displayed when the CTAWI is in switched on mode,

b) other markings will be displayed on manual command,

c) the user manual provides information on the manner in which the specifications can be observed, and

d) the markings are considered as device-specific parameters (see 2.2.10.4) and shall comply with the appropriate requirements for securing in 4.2.7 and 5.8.

The software controlled display markings need not be repeated on the hardware plate, if they are displayed on or indicated near the display of the weighing result, with the exception of the following markings which shall be shown on the data plate:

- Max, Q_{mmax}, Q_{mmin}, Σ_{min} and d shall be shown near the display,
- type approval mark (in accordance with national requirements),
- name or identification mark of the manufacturer,
- voltage supply,
- voltage supply frequency, (if applicable),
- pneumatic/hydraulic pressure, (if applicable).

4.7 Verification markings

4.7.1 Position

The hardware exterior of instruments shall comprise an area for applying the verification markings. This area shall

a) be such that the part on which it is located cannot be removed from the instrument without damaging the marks,

b) allow the easy applying of the mark without changing the metrological qualities of the instrument,

c) be visible without the instrument or its protective covers having to be moved when it is in service.

4.7.2 Mounting

Instruments which are required to bear verification markings shall have a verification mark support, at the location as described in 4.7.1, which shall ensure the conservation of the marks. When such marking is performed using a stamp, the support may consist of a strip of lead or any other product having similar quality, which is inserted into a plate fixed to the instrument, or into a cavity in the instrument. When the mark consists of an adhesive printed label, a space shall be prepared for this purpose.

5 Requirements for CTAWIs with respect to their environment

The type of CTAWI is presumed to comply with the requirements if it passes the examinations and tests specified in OIML R xxx-2..

5.1 General requirements

5.1.1 Performance under rated operating conditions

AGFIs shall be so designed and manufactured that they do not exceed the maximum permissible errors under rated operating conditions.

5.1.2 Disturbances

CTAWI containing electronics shall be designed and manufactured such that when exposed to disturbances, either

a) significant faults do not occur, or

b) significant faults are detected and acted upon.

5.1.3 Durability

The requirements in 3, 4, and 5.1.2 shall be met durably in accordance with the intended use of the instrument.

5.1.4 Evaluation for compliance

The instrument is presumed to comply with the requirements in 5 if an identical type passes the examination and tests specified in R xxx-2.

5.2 Application

The requirements in 5.1.2 may be applied separately to

a) each individual cause of significant fault, and/or

b) each part of the instrument.

The choice as to whether to apply 5.1.2 a) or b) is left to the manufacturer.

5.3 Acting upon a significant fault

When a significant fault has been detected, a visual or audible indication shall be provided and shall continue until such time as the user takes action or the fault disappears.

Means shall be provided to retain any totalized mass information contained in the instrument when a significant fault occurs.

5.4 Display failure detection

Upon switch-on (at switch-on of indication in the case of an electronic instrument permanently connected to the mains), a special sequence procedure shall be performed subsequently presenting all the relevant individual segments and signs in the display of the indicating devices, in their active and non-active states for a time period sufficient for the operator to easily observe. This requirement is not applicable for non-segmented displays, on which failures will become evident, for example screen-displays, matrix-displays, etc.

5.5 Functional requirements

5.5.1 Influence factors

Instruments shall comply with the requirements in 3.7.3.

5.5.2 Disturbances

Instruments shall comply with the requirements in 5.1.2.

5.5.3 Humidity

In addition to 3.7.3, instruments shall maintain their metrological and technical characteristics at a relative humidity of either 85 % (non-condensing) or at 93 % (condensing) at the upper limit of the temperature range of the instrument.

5.5.4 Warm-up time

During the warm-up time of an electronic instrument there shall be no indication or transmission of the weighing result and automatic operation shall be inhibited.

5.5.5 Mains electrical power supply failure

An instrument shall, in the event of a mains electrical power supply failure, retain the metrological information contained in the instrument at the time of failure for at least 24 hours, and shall be capable of indicating that information for at least 5 minutes following energisation during the 24-hour period. A switch-over to an emergency voltage supply shall not cause a significant fault.

5.5.6 Battery power supply failure

An instrument using a battery power supply shall, whenever the voltage drops below the manufacturer's specified minimum value, either continue to function correctly or automatically be put out of service. The instrument shall retain the metrological information contained in the instrument at the time of failure for at least 24 hours, and shall be capable during the 24-hour period to indicate this stored information at least for 5 minutes after power supply recovery.

5.6 Interfaces

Instruments may be equipped with interfaces (2.2.12) permitting the coupling of the instrument to external equipment and to user interfaces enabling the exchange of information between a human user and the instrument. When an interface is used, the instrument shall continue to function correctly and its metrological functions (including all metrology relevant parameters and software) shall not be influenced. Information on instrument interfaces shall be available, for example:

- list of all commands (e.g. menu items),
- description of the software interface,
- list of all commands together,
- brief description of their meaning and their effect on the functions and data of the instrument,
- other interface description.

5.6.1 Interface security

Interfaces shall not allow the legally relevant software and functions of the instrument and its measurement data to be inadmissibly influenced by other interconnected instruments, or by disturbances acting on the interface.

An interface through which the functions mentioned above cannot be performed or initiated, need not be protected. Other interfaces shall be secured as follows:

a) Data is protected e.g. with a protective interface (2.2.12.2), against accidental or intentional intervention,

b) Hardware and software functions shall comply with the appropriate requirements for securing in 4.2.7 and 5.8,

c) it shall be easily possible to verify the authenticity and integrity of data transmitted to and from the instrument,

d) Other devices required by national regulations to be connected to the interfaces of the instrument shall be secured to inhibit automatically the operation of the instrument for reasons of the non-presence or improper functioning of the required device.

5.7 Data storage device

If the instrument has a data storage device, its measurement data shall be stored, which may be in internal memory or on external storage for subsequent use (e.g. indication, printing, transfer, totalising, etc). In both cases, the stored data shall be adequately protected against intentional and unintentional changes during the data transmission and/or storage process and shall contain all relevant information necessary to reconstruct an earlier measurement.

5.7.1 Securing measures:

To ensure adequate security the following conditions apply:

a) The appropriate requirements of 4.2.7 for securing are applicable,

b) External storage devices identification and security attributes shall be automatically verified to ensure integrity and authenticity,

c) Exchangeable storage media for storing measurement data need not be sealed provided that the stored data is secured by a specific checksum or key code,

d) When storage capacity is exhausted, new data may replace the oldest data provided that overwriting the old data has been archived and/or authorized,

e) Instruments intended to be used in the absence of one trading party shall be equipped with a data storage device which records the measurement result accompanied by information to identify the particular transaction and reconstruct it later.

5.8 Software

The legally relevant software of the instrument shall be identified by the manufacturer, i.e., the software that is critical for measurement characteristics, measurement data and metrologically important parameters, stored or transmitted, and software programmed to detect system fault (software and hardware), is considered as an essential part of an instrument and shall meet the requirements for securing software specified below and shall be examined according to R xxx-2, A.2. Information on software controlled instruments shall be available, for example

- description of the legally relevant software,
- description of the accuracy of the measuring algorithms,
- description of the user interface, menus and dialogues,
- the unambiguous software identification,
- description of the embedded software,
- overview of the system hardware, e.g. topology block diagram, type of computer(s), source code for software functions, etc., if not described in the operating manual,
- means of securing software,
- operating manual, if appropriate.

Note: It shall be possible to check the software identification whilst the instrument is in use (it is acceptable if this checking can only occur whilst the material flow is stopped).

5.8.1 Security of legally relevant software

There shall be adequate security to ensure that

a) legally relevant software shall be adequately protected against accidental or intentional changes. The appropriate requirements for securing given in 4.2.7 and 5.7 apply,

b) the software shall be assigned with appropriate software identification (2.2.10.5). This software identification shall be adapted in the case of every software change that may affect the functions and accuracy of the instrument,

c) functions performed or initiated via connected interfaces, i.e., transmission of legally relevant software, shall comply with the securing requirements for interfaces in 5.6.

6 Metrological controls

The metrological controls of CTAWIs may, in agreement with national regulations, consist of

a) type evaluation,

b) initial verification,

c) subsequent verification,

d) in-service inspection.

Tests should be applied uniformly by the legal metrology services and should form a uniform program. Guidance for the conduct of type evaluation and initial verification is provided in International Documents OIML D 19 [9] and D 20 [10] respectively.

Measures to ensure durability, which shall include assessments under items a) to d) above shall be taken subject to national regulations.

Further information about durability testing is given in R xxx-2, Annex C.

6.1 Type evaluation

6.1.1 Documentation

The application for type evaluation shall include documentation comprising

a) metrological characteristics of the CTAWI (3),

b) a standard set of specifications for the CTAWI,

c) a functional description of the components and devices,

d) drawings, diagrams and photo of the instrument, explaining the construction and operation,

e) description and application of securing components, interlocks, adjustment devices, controls, etc. (4.2.7),

f) details of fractions p_i (modules tested separately) (6.1.6.7),

g) totalization indicating and printing devices (4.3),

h) data storage device (5.7),

i) zero-setting devices (4.4),

j) interfaces (types, intended use, immunity to external influences instructions, etc) (5.6),

k) for software controlled instruments detailed software information (5.8),

l) drawing or photo of the instrument showing the principle and the location of control marks, securing marks, descriptive and verification marks (4.7, 4.8),

m) operating instructions, operating manual,

n) information on the applications and ranges of bulk products for which the slide chute is designed (4.6)

o) any document or other evidence demonstrating that the design and construction of the instrument complies with the requirements of this Recommendation.

6.1.2 General requirements

Type evaluation shall be carried out on at least one and normally not more than three units that represent the definitive type. At least one of the units shall be completely installed at a typical site and at least one of the units shall be submitted in a form suitable for simulation testing of components in a laboratory. The evaluation shall consist of the tests specified in 6.1.3.

6.1.3 Examinations and tests

The CTAWI shall comply with

a) the metrological requirements in 3, particularly with reference to maximum permissible errors, when the instrument is operated in accordance with the manufacturer's specifications for range and product(s),

b) all the technical requirements in 4,

c) the requirements in 5.

The submitted documents shall be examined and tests carried out to verify that the instruments comply with the above requirements. Tests shall be conducted in a manner that prevents unnecessary commitment of resources, and when the same instrument is involved the result of these tests may be assessed for initial verification.

The metrological characteristics of the instrument in accordance with 3.7 and if applicable the specifications for the modular approach of the modules of the instrument in accordance with 6.1.6 shall be examined.

For software-controlled instruments, the additional requirements in 5.8 and in R xxx-2, Annex A shall apply.

6.1.3.1 In situ product tests

In-situ product tests shall be conducted in accordance with 7.1.

6.1.3.2 Provision for means of testing

For the purposes of testing, the applicant may be required to furnish the metrological authority with the quantity of product, handling equipment, qualified personnel, and a control instrument (see 7.1).

6.1.3.3 Place of testing

Instruments submitted for type evaluation may be tested at the following locations:

a) The premises of the metrological authority to which the application has been submitted,

b) Any other suitable location mutually agreed upon between the metrological authority and the applicant.

6.1.4 Classes stated in the type approval certificate

The type approval certificate shall state the applicable accuracy classes 0.2, 0.5, 1 or 2, as specified, to which the approved type has been verified to comply during type evaluation.

6.1.5 Influence tests

Test on performance of the EUT when exposed to the influence factor tests specified in R xxx-2, 7.2 shall be applied to the complete EUT or simulation as specified in 7.3 in a manner that will reveal a corruption of the weighing result of any weighing process for which the instrument could normally be applied, in accordance with:

a) 3.7 for all instruments, and;

b) 5 for electronic instruments.

6.1.6 Testing of a family of instruments or modules

Subject to agreement with the metrological authority, the manufacturer may define and submit a family of instruments or modules to be examined separately. This is particularly relevant in the following cases:

a) Where testing the instrument as a whole is difficult or impossible,

b) Where modules are manufactured and/or placed on the market as separate units to be incorporated in a complete instrument,

c) Where the applicant wants to have a variety of modules included in the approved type,

d) When a module is intended to be used for various kinds of instruments (in particular force transducers, indicators, data storage).

Where a family of instruments (2.3.11) or modules of various capacities and characteristics is presented for type examination, the following provisions apply for selecting the equipment under test (EUT).

6.1.6.1 Selection of EUTs

The selection of EUTs to be tested shall be such that their number is minimized but nevertheless sufficiently representative of the type. Further information is provided in R xxx-2, Annex B.

6.1.6.2 Accuracy class

If an EUT of a family has been tested completely for one accuracy class, it is sufficient for an EUT of a lower class if only partial tests are carried out that are not yet covered.

6.1.6.3 Other metrological features to be considered

All metrologically relevant features and functions have to be tested at least once in the EUT as far as applicable and as many as possible in the same EUT. Further information is provided in R xxx-2, Annex B.2.

6.1.6.4 Summary of relevant metrological characteristics

The specification of characteristics of the EUT shall include

a) lowest input signal (6.1.6.5),

b) all accuracy classes,

c) all temperature ranges,

d) dimensions of force receptor, where relevant,

e) dimensions and geometrical position (angles) of the slide chute,

f) metrological relevant features (see 6.1.6.3),

g) all possible instrument functions,

h) all possible indications,

i) all possible implemented digital devices,

j) all possible interfaces,

k) different types of force receptors, if connectable to the indicator

6.1.6.5 Minimum input voltage of electronics for maximum capacity

An analogue data processing device or indicator intended for force transducer(s) shall be tested at a minimum input voltage signal (specified by the manufacturer) for a load equal to maximum capacity. This is assumed to be the worst case for the performance tests and for the disturbance tests.

A complete instrument shall not be configured in such a way that its input voltage signal for a load equal to maximum capacity is below the value used at type testing.

6.1.6.6 Requirement for the minimum scale interval, v_{min}, of the used force transducer(s)

The minimum scale interval, v_{min}, of the force transducer shall fulfil the following equation:

$$v_{min} \leq \text{Max} / (S \times R / \sqrt{N})$$

Where

S = 15 000 for class 0.2,

S = 6 000 for class 0.5,

S = 3 000 for class 1,

S = 1 500 for class 2,

R is the reduction ratio of the force receptor,

N is the number of force transducers.

When digital force transducers are used, the above formula shall also be used, but since p_i= 1, the following S values shall be used:

S = 10 000 for class 0.2;

S = 4 000 for class 0.5;

S = 2 000 for class 1;

S = 1 000 for class 2.

6.1.6.7 Apportioning of errors

Where it is necessary to separately test modules of an instrument or system the following requirements apply.

The error limits applicable to a module which is examined separately are equal to a fraction p_i of the maximum permissible errors (3.2.2 Table 2) or the allowed variations of the indication of the complete instrument. The fractions for any module have to be taken for the same accuracy class as for the complete instrument incorporating the module.

The fractions p_i shall satisfy the following equation:

$$p_1^2 + p_2^2 + p_3^2 + ... \leq 1$$

The fraction p_i shall be chosen by the manufacturer of the module and shall be verified by an appropriate test, taking into account the following conditions:

a) For purely digital devices, p_i may be equal to 0;

b) For weighing modules, p_i may be equal to 1;

c) For all other modules (including digital force transducers) the fraction shall not exceed 0.8 and shall not be less than 0.3, when more than one module contributes to the effect in question.

For mechanical structures evidently designed and manufactured according to sound engineering practice, an overall fraction, $p_i = 0.5$, may be applied without any test, e.g. when levers are made of the same material and when the chain of levers has two planes of symmetry (longitudinal and transversal).

For instruments incorporating the typical modules (see 2.2.9), the fractions p_i may have the values given in Table 4, which takes into account the fact that the modules are affected in a different manner depending on the different performance criteria.

Table 4 – Values of p_i for different performance criteria

Performance criteria	Load cell	Electronic indicator	Connecting elements, etc.
Combined effect[1]	0.7	0.5	0.5
Temperature effect on no load indication	0.7	0.5	0.5
Power supply variation	-	1	-
Effect of creep	1	-	-
Damp heat	0.7[2]	0.5	0.5
Span stability	-	1	-

Note 1: Combined effects: non-linearity, hysteresis, temperature effect on span, repeatability, etc. After the warm-up time specified by the manufacturer, the combined effect error fractions apply to modules.

Note 2: According to OIML R 60 [6] valid for SH tested load cells ($p_{LC} = 0.7$).

Note 3: The sign "–" means "not applicable".

If the metrological characteristics of the force sensor or other major component have been evaluated in accordance with the requirements of OIML R 60 [7], that evaluation shall be used to aid type evaluation if so requested by the applicant.

6.2 Initial verification and in-service inspection

6.2.1 General requirements

Initial verification shall be carried out by the appropriate metrological authority to establish conformity of the instrument to the approved type and/or the requirements of this Recommendation.

CTAWI shall comply with the requirements in 3, excluding 3.7.1, and 4 for a given product or products for which the CTAWI is intended and when operated under rated operating conditions.

6.2.2 Tests

Tests are carried out by the appropriate metrological authority, in-situ, with the CTAWI fully assembled and fixed in the position in which it is intended to be used.

The installation of a CTAWI shall be designed so that an automatic weighing operation will be virtually the same for testing as it is for a transaction, and tests can be carried out in a reliable and easy manner without disrupting the weighing operation.

Tests shall be conducted in a manner that prevents an unnecessary commitment of resources.

In appropriate situations and to avoid duplicating tests previously performed on the CTAWI for type evaluation under 6.1.3, the metrological authority may use the results of observed tests for initial verification at that site.

6.2.2.1 In-situ product tests

In-situ product tests shall be conducted in accordance with 7.1 and R xxx-2, 9.

Before testing, the CTAWI shall operate (preferably loaded) for at least 30 minutes at nominal flowrate. A control instrument meeting the requirements of 7.2 shall be available at all times in the vicinity of the CTAWI(s) submitted for testing. Storage and transport shall be arranged so as to prevent any loss of the product. Checking of the mass of the product used may take place before or after its passage along the CTAWI.

The maximum permissible errors for automatic weighing shall be as specified in 3.2.1 Table 1, for initial verification, as appropriate for the class of the CTAWI.

6.2.3 Assessment of conformity

Assessment of conformity to the approved type and this Recommendation shall cover

a) compliance with the appropriate maximum permissible errors in 3.2.1 Table 1,

b) compliance of the instrument with the technical requirements in 4,

c) correct functioning of all devices, e.g. interlocks, indicating and recording devices,

d) construction material and design, as far as they are of metrological relevance.

6.2.4 Visual inspection

Before testing, the instrument shall be visually inspected for

a) metrological characteristics, i.e. scale interval, minimum capacity,

b) prescribed inscriptions and positions for verification and control marks,

c) Visual conformity with the approved type as described in the approval certificate.

6.2.5 Marking and securing

According to national legislation, initial verification may be testified by verification marks as specified in 4.8. National regulations may also require securing of devices whose dismantling or maladjustment might alter the metrological characteristics of the instrument without the alterations being clearly visible. The provisions of 4.2 and 4.8 shall be observed.

6.2.6 Application of accuracy class

Accuracy class requirements shall be applied in accordance with the appropriate parts of 3.2.1 for initial verification.

The accuracy class marking required in accordance with 3.1 shall show the same accuracy class(es) as for which the type was approved and which was laid down in the approval certificate.

Note: The accuracy class that was achieved at type approval stage may not be achieved at initial verification if the loads used are significantly less stable or of different dimensions. In this case a lower accuracy class shall be marked in accordance with 3.1 and 4.7.2. Marking of a higher accuracy class than was achieved at type approval stage is not permitted.

6.3 Subsequent metrological control

Subsequent metrological control may be performed according to national regulations.

Further information regarding durability testing as part of subsequent control is given in R xxx-2, Annex C.

6.3.1 Subsequent verification

Subsequent verification shall be carried out in accordance with the same provisions as in 6.2 for initial verification with the error limits being those on initial verification. Marking and securing may take place according to 6.2.5, the date being that of the subsequent verification.

6.3.2 In-service inspection

In-service inspection shall be carried out in accordance with the same provisions as in 6.2 for initial verification, with the exception that the in-service maximum permissible errors in 3.2.1 Table 1 shall be applied. Marking and securing may remain unchanged, or renewed according to 6.3.1.

7 Test methods

7.1 General test procedure

In-situ product tests shall be done as follows:

a) in accordance with the descriptive markings;

b) under the conditions of use for which the CTAWI is intended;

c) applying a quantity of product not less than the minimum totalized quantity, Σ_{min}, for initial verification and in-service verification (see Table 3);

d) using test load(s) that represents the range and type of products for which the CTAWI is likely to be used or product(s) for which the instrument is intended;

e) at mass flowrates between the maximum and minimum values;

f) in accordance with the test procedures in R xxx-2.

7.2 Verification standards

7.2.1 Control instruments and standard weights

A control instrument and standard weights meeting the appropriate requirements in 7 shall be available for determining the true quantity value of the mass of each test load.

The control instrument used for product testing shall enable the determination of the true quantity value of the mass of each test load to an accuracy of at least one-third of the appropriate maximum permissible error for automatic weighing in 3.2.1 Table 1.

If necessary, the control instrument shall be checked immediately following completion of the weighing to ascertain whether or not its performance has changed.

The standard weights used as reference for the type examination or verification of an instrument shall meet the metrological requirements of OIML R 111 [5].

7.3 Simulation tests (test with static load)

For testing the metrological characteristics of a CTAWI, standard weights may be used to simulate the mass flow. The EUT shall be fitted with:

a) a complete force receptor (including the slide chute) together with a platform which can be loaded with standard weights,

b) a platform which can be loaded with standard weights (excluding the slide chute),

c) a device enabling the comparison of integrations with a constant force over a time span predetermined by the operator and measured by means of the internal clock,

The test load, on the force receptor, is to be placed on the platform. The duration of each zero totalization shall be equal to the time needed to totalize the minimum totalized quantity at Q_{mmin}.

7.4 True quantity value of the mass of the test load

a) During the in-situ tests control method, the mass value of the test load shall be established using a control instrument and the control instrument indication (after application of any corrections which may be necessary) shall be considered as the true quantity value of the mass of the test load.

b) During simulation tests, the true quantity value of the mass of the test load shall be established through calculation of the totalised mass from the multiplication of the standard weight used as test load, the simulated totalization time span and the weighing element length dependent multiplication factor.

7.5 Indicated mass

a) When applying the in-situ tests control method, the known test load shall be used for an automatic bulk weighing operation and the indication of the totalized mass shall be observed and recorded.

b) During simulation tests, an automatic bulk weighing operation shall be conducted using standard weights placed on the load receptor. The indicated mass shall be observed and recorded, with flow of five times that at totalization of Σ_{min}. Alternatively, a supplementary totalization indicating device (2.4.2.6) with a higher resolution may be used to indicate the mass of the test load to at least ten times the resolution of the totalization scale interval.

Where possible, the procedures in R xxx-2, 3.7 shall be used to eliminate rounding errors included in any digital indication.

7.6 Calculation of relative errors (R xxx-2, 3.7)

The relative error, E_r, is given as:

$$E_r(\%) = \frac{I - L}{L} \times 100 = \frac{(\text{Result of measurement} - \text{True quantity value})}{\text{True quantity value}} \times 100$$

Note: This only is true for non-rounded indications.

For the in-situ tests –control method:

$$E_r(\%) = \frac{(\text{CTAWI indication} - \text{Control instrument indication})}{\text{Control instrument indication}} \times 100$$

For the simulation tests:

$$E_r(\%) = \frac{(\text{Totalised weight displayed} - \text{Totalised weight calculated})}{\text{Totalised weight calculated}} \times 100$$

The true quantity value is as specified in 7.4 and the indicated (or displayed) mass is as specified in 7.5.

The relative error value expressed as a percentage (%) shall be used for comparison with the appropriate maximum permissible errors for automatic weighing in 3.2.1.

7.7 Examination and tests

7.7.1 Examinations

A CTAWI shall be examined to obtain a general appraisal of the design and construction.

7.7.2 Performance tests

The measuring instrument shall be tested as defined in Part 2 of this Recommendation to determine its correct operation. Tests are to be conducted on the whole instrument except when its size and/or configuration does not allow for testing the complete instrument. In such cases, the separate devices shall be subjected to testing. It is not intended that devices be further dismantled for separate testing of components.

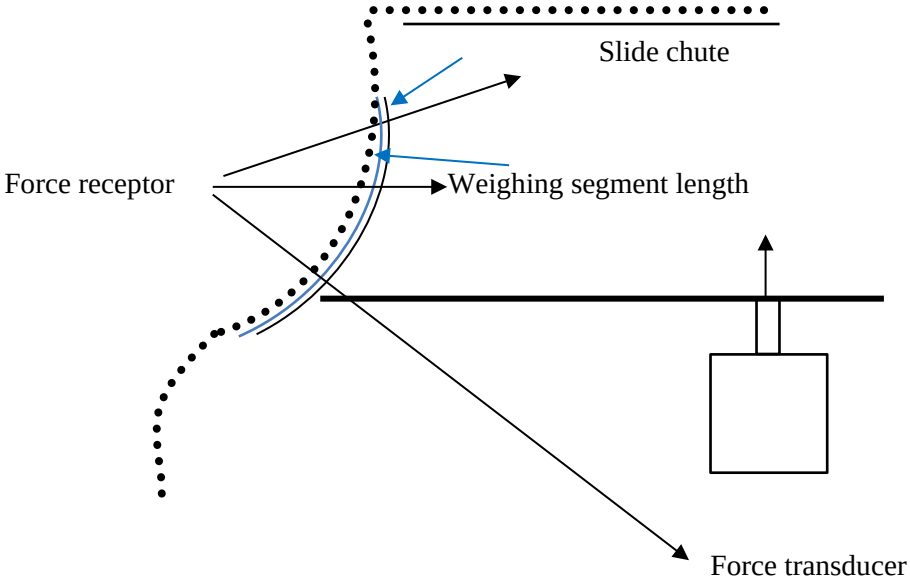
In addition, an examination shall be carried out on the fully operational instrument or, if necessary for practical reasons, on the electronic devices in a simulated set-up sufficiently representing the CTAWI. The instrument shall continue to function correctly as specified in Part 2 of this Recommendation.

Modules may be examined separately (subject to agreement with the metrological authority, see 6.1.6).

Annex A

Illustration of 2.2.1 and 2.2.2 in a typical weighing instrument of the arched chute type

(Informative)



Annex B

(Informative)

Bibliography

Below are references to Publications of the International Electrotechnical Commission (IEC), the International Organisation for Standardization (ISO) and the OIML, which are mentioned in this Recommendation.

Ref.	Standards and references	Description
[1]	International Vocabulary of Basic and General Terms in Metrology (VIM:2010)	Vocabulary, prepared by a joint working group consisting of experts appointed by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML.
[2]	International Vocabulary of Legal Metrology, BIML, Paris (2012)	Vocabulary including only the concepts used in the field of legal metrology. These concepts concern the activities of the legal metrology service, the relevant documents as well as other problems linked with this activity.
[4]	OIML D 11 (2013) General requirements for electronic measuring instruments	Contains general requirements for electronic measuring instruments.
[5]	OIML R 111 (2004) Weights of classes E_1, E_2, F_1, F_2, M_1, M_{1-2}, M_2, M_{2-3} and M_3	Provides the principal physical characteristics and metrological requirements for weights used with and for the verification of weighing instruments and weights of a lower class.
[6]	OIML D 28 Conventional value of the result of weighing in air	Provides the definition of the quantity "conventional mass" (conventional value of the result of weighing in air) as it is used for the characterization of weights and its relation to the physical quantities mass and density and the evaluation of its uncertainty.
[7]	OIML R 60 (2000) Metrological regulation for load cells	Provides the principal static characteristics and static evaluation procedures for load cells used in the evaluation of mass.
[8]	OIML R 76-1(2006) Non-automatic weighing instruments	Provides the principal physical characteristics and metrological requirements for the verification of non-automatic weighing instruments.
[9]	OIML D 19 (1988) Pattern evaluation and pattern approval	Provides advice, procedures and influencing factors on pattern evaluation and pattern approval.
[10]	OIML D 20 (1988) Initial and subsequent verification of measuring instruments and processes	Provides advice, procedures and influencing factors on the choice between alternative approaches to verification and the procedures to be followed in the course of verification.
[11]	IEC 60068-2-1 Ed. 6.0 (2007-03)	Basic environmental testing procedures - Part 2: Tests, Test Ad: Cold, for heat dissipating equipment under test (EUT), with gradual change of temperature.

Ref.	Standards and references	Description
[12]	IEC 60068-2-2 (2007-07). Environmental testing Part 2: Tests, 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; tests 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.
[13]	IEC 60068-3-1 Environmental testing Part 3 Background information, Section 1: Cold and dry heat tests revised 2011	Gives background information for Tests A: Cold (IEC 68-2-1), and Tests B: Dry heat (IEC 68-2-2). Includes appendices on the effect of: chamber size on the surface temperature of a specimen when no forced air circulation is used; airflow on chamber conditions and on surface temperatures of test specimens; wire termination dimensions and material on surface temperature of a component; measurements of temperature, air velocity and emission coefficient. Supplement A - Gives additional information for cases where temperature stability is not achieved during the test.
[14]	IEC 60068-2-78 Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state revised 2012	Provides a test method for determining the suitability of electro-technical products, components or equipment for transportation, storage and use under conditions of high humidity. The test is primarily intended to permit the observation of the effect of high humidity at constant temperature without condensation on the specimen over a prescribed period. This test provides a number of preferred severities of high temperature, high humidity and test duration. The test can be applied to both heat-dissipating and non-heat dissipating specimens. The test is applicable to small equipment or components as well as large equipment having complex interconnections with test equipment external to the chamber, requiring a set-up time which prevents the use of preheating and the maintenance of specified conditions during the installation period.
[15]	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.

Ref.	Standards and references	Description
[16]	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.
[17]	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	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 AC networks. It does not apply to electrical and electronic equipment for connection to 400 Hz AC 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. It has the status of a Basic EMC Publication in accordance with IEC Guide 107.
[18]	IEC 61000-4-4 Electromagnetic compatibility (EMC). Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test revised 2012	Establishes a common and reproducible reference for evaluating the immunity of electrical and electronic equipment when subjected to electrical fast transient/burst 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; and ▪ test procedure. The standard gives specifications for laboratory and post-installation tests.
[19]	IEC 61000-4-5 Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test revised 2014.	Relates to the immunity requirements, test methods, and range of recommended test levels for equipment to unidirectional surges caused by over-voltages 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. Establishes a common reference for evaluating the performance of equipment when subjected to high-energy disturbances on the power and inter-connection lines.

Ref.	Standards and references	Description
[20]	IEC 61000-4-2 Ed. 2.0 (2009) Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test.	Basic EMC Publication. Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test. Basic EMC Publication.
[21]	IEC 61000-4-3 (2008-04) Ed. 3.1. Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.	Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test.
[22]	IEC 61000-4-6Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fieldsrevised 2013	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), which can couple the equipment to the disturbing RF fields is excluded. This standard does not intend to specify the tests to be applied to particular apparatus or systems. Its main aim is to give a general basic reference to all concerned product committees of the IEC. The product committees (or users and manufacturers of equipment) remain responsible for the appropriate choice of the test and the severity level to be applied to their equipment.
[23]	OIML D 31 General requirements for software controlled measuring instruments	Contains general requirements for software controlled measuring instruments.
[24]	OIML R xxx-3 (not yet published)	Test report format.
[25]	ILAC-G24/OIML D 10 (2007) Guidelines for the determination of calibration intervals of measuring instruments	
[26]	IEC 60068-2-30 (1980-01) with amendment 1 (1985-08) Environmental testing Part 2: Tests Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)	Determines the suitability of components, equipment and other articles for use and/or storage under conditions of high humidity when combined with cyclic temperature changes. Amendment 1 replaces the third paragraph of clause 8, Recovery.