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International Organisation for Legal Metrology (OIML)

INTERNATIONAL RECOMMENDATION

Second committee draft revision

OIML R 107-1

Discontinuous totalizing automatic weighing instruments (totalizing hopper weighers)

Part 1: Metrological and technical requirements - Tests

May 2006

EXPLANATORY NOTE

This second committee draft revision of OIML R 107-1 developed by the OIML subcommittee TC 9/ SC 2 *Automatic weighing instruments,* following consultations in 2005 to the first committee draft revision.

OIML TC 9/ SC 2 “Automatic Weighing instruments”
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Supprimé : for electronic instruments under test

FOREWORD

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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], the *OIML Certificate System for Measuring* Instruments [3], and to the *OIML International Document for General requirements for Electronic Measuring Instruments* [4]. In addition, for the purposes of this Recommendation, the following definitions apply.

T.1 GENERAL DEFINITIONS

T.1.1 Mass

The physical property of an amount of material that causes it to have a weight value in a gravitational field (see OIML R 111) [5].

Supprimé : a body

T.1.2 Load

The quantity representing the material measure of mass due only to the vertically-downward force of gravity as applied on the weighing instrument.

Supprimé : Weight to be borne or conveyed at any one time

T.1.3 Weight

Material measure of mass that is regulated in regard to its physical and metrological characteristics and maximum permissible error (OIML R 111) [5]. It is used (as standard weights or mass) for the type examination or verification of an instrument.

T.1.4 Weighing

The process of determining the mass of an amount of material by using the action of gravity on this material.

Supprimé : body

T.1.5 Weighing instrument

Measuring instrument used to determine the mass of an amount of material by using the action of gravity on this material.

Supprimé : that serves

Supprimé : a body

Supprimé : body

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

According to its method of operation, a weighing instrument is classified as automatic or nonautomatic.

T.1.6 Automatic weighing instrument

An instrument that weighs and follows a predetermined program of automatic processes characteristic of the instrument.

Supprimé : without the intervention of an operator and follows

T.1.7 Non-automatic weighing instrument

Instrument that requires the intervention of an operator during the weighing process to decide that the weighing result is acceptable.

Supprimé : it

Note: Deciding that the weighing result is acceptable includes any intelligent action of the operator that affects the result, such as taking an action when an indication is stable or adjusting the mass of the weighed load, and to make a decision regarding the acceptance of each weighing result on observing the indication or releasing a print out. A non-automatic weighing process allows the operator to take an action (i.e. adjust the load, adjust the unit price, determine that the load is acceptable, etc.) which influences the weighing result in the case where the weighing result is not acceptable.

T.1.8 Discontinuous totalizing automatic weighing instrument (totalizing hopper weigher)

An automatic weighing instrument that weighs a bulk product by dividing it into discrete loads, determining the mass of each discrete load in sequence, summing the weighing results and delivering the discrete loads to bulk.

T.1.9 Control instrument

Weighing instrument used to determine the conventional true value of the mass of the test loads during material tests.

Control instruments used for testing may be:

- separate from the instrument being tested, or
- integral, when a nonautomatic (static) weighing mode is provided by the instrument being tested, which allows the weighing cycle to be interrupted as described in 6.2.1.2.1.

T.1.10 Conventional true value (of a quantity)

A value attributed to a particular quantity and accepted, by convention, as having an uncertainty appropriate for a given purpose. [VIM 1.20]

T.1.11 Metrological authority

A legal entity, designated or formally accepted by the government to be responsible for ascertaining that the automatic weighing instrument satisfies all or some specific requirements of this Recommendation.

Supprimé : An authorized representative of the legal metrology authority or accredited organisations, issuing, testing, approving organisations; with responsibility for ascertaining and confirming that the instrument satisfies all or some of the requirements of this Recommendation.

T.1.13 Accuracy of the instrument The ability of the instrument to give responses close to a true value [VIM 5.18]. Note: Accuracy is a qualitative concept.

T.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.

T.2.1 Main devices

T.2.1.1 Load receptor

The part of the instrument intended to receive the load.

T.2.1.2 Load-transmitting device

Part of the instrument for transmitting the force produced by the load acting on the load receptor to the load-measuring device.

T.2.1.3 Load-measuring device

Part of the instrument for measuring the mass of the load, with a device which indicates and records the measurement result in units of mass.

T.2.2 Electronic instrument

An instrument equipped with electronic devices.

T.2.2.1 Electronic device

A device comprised of electronic sub-assemblies and performing one or more specific functions. An electronic device is usually manufactured as a separate unit and may be capable of being independently tested.

T.2.2.2 Electronic component

The smallest physical entity that uses electron or hole conduction in semiconductors, gases, or in a vacuum.

T.2.2.3 Digital device

Electronic device that only performs digital functions and provides a digitized output or display.

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

T.2.3 Totalisation device

The device that calculates the sum of consecutive loads weighed and discharged to bulk.

T.2.4 Control indicating device

An indicating device that enables the use of the instrument as a control instrument to weigh discrete loads for control purposes.

T.2.5 Ancillary devices

T.2.5.1 Zero-setting device

The means used to set the mass indicating device to zero when the load receptor is empty.

Supprimé : weight

T.2.5.2 Nonautomatic zero-setting device

A zero-setting device that must be operated manually.

T.2.5.3 Semi-automatic zero-setting device

A zero-setting device that operates automatically following a manual command.

T.2.5.4 Automatic zero-setting device

A zero-setting device that operates automatically and without the intervention of an operator.

T.2.5.5 Initial zero-setting device

Device for setting the indication to zero automatically at the time the instrument is switched on and before it is ready for use.

T.2.5.6 Zero-tracking device

Device for maintaining the zero indication within certain limits automatically.

T.2.6 Printing device

The device to produce hardcopies of the weighing results, i.e., the value of each discrete load weighed in the load receptor, and/or the sum of consecutive loads weighed and discharged to bulk.

Supprimé : print

T.2.7 Air-enclosed integrated system

An automatic weighing instrument fitted with the appropriate safety and dust control features.

T.2.8 Recording device

The means to record the weighing results to a printer or data storage (e.g. computer).

T.2.9 Module

Identifiable part of an instrument or device that performs a specific function or functions, and that can be separately evaluated according to the metrological and technical performance requirements in the relevant Recommendation. The modules of a weighing instrument are subject to specified partial error limits.

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

Supprimé : terminal,

T.2.9.1 Load cell

Force transducer which, after taking into account the effects of the acceleration of gravity and air buoyancy at the location of its use, measures mass by converting the measured quantity (mass) into another measured quantity (output). See OIML R 60 [6].

T.2.9.2 Indicator

Electronic instrument that may perform the analogue-to-digital conversion of the output signal of the load cell, and further processes the data, and displays the weighing result in units of mass.

T.2.9.3 Analogue data processors

Electronic instrument that performs the analogue-to-digital conversion of the output signal of the load cell, and further processes the data, and supplies the weighing result in a digital format via a digital interface without displaying it. It may optionally have one more keys to operate the instrument.

T.2.9.4 Digital data processor

Electronic instrument that further processes the data, and supplies the weighing result in a digital format via a digital interface without displaying it. It may optionally have one or more keys to operate the instrument.

T.2.9.5 Weighing module

That part of the weighing instrument that comprises all mechanical and electronic devices (i.e. load receptor, load-transmitting device, load cell, and analogue or digital data processing device) but not having the means to display the weighing result. It may optionally have devices for further processing data and operating the instrument.

T.2.9.6 Remote display

Terminal without keys that can be used for the primary indications or for their repetition.

T.2.9.7 Software

T.2.9.7.1 Legally relevant software

Supprimé : Metrologically

Programs, data and device-specific parameters that belong to the measuring instrument or device, and define or fulfil functions which are subject to legal control.

Supprimé : type

Examples of legally relevant software are: final results of the measurement including the decimal sign and the unit, identification of the weighing range and the load receptor (if several load receptors have been used).

T.2.9.7.2 Legally relevant parameter

Parameter of a measuring instrument or a module subject to legal control. The following types of legally relevant software can be distinguished: type-specific parameter and device-specific parameter.

T.2.9.7.3 Type-specific parameter

Legally relevant parameter with a value that depends on the type of instrument only. They are fixed at type approval of the instrument.

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

Supprimé : weight

T.2.9.7.3 Device-specific parameter

Legally relevant parameter with a value that depends on the individual instrument. Such parameters comprise calibration parameters (e.g. span adjustments or corrections) and configuration parameters (e.g. maximum capacity, minimum capacity, units of measurement, etc). They are adjustable or selectable only in a special operational mode of the instrument and may be classified as those that should be secured (unalterable) and those that may be accessed (settable parameters) by an authorised person.

T.2.9.7.4 Software identification

A sequence of readable characters of software, and that is inextricably linked to the software (e.g. version number, checksum).

Supprimé : T.2...5 Metrological software version A designation that specifically defines the metrological software version used in a measuring instrument, system, or peripheral/auxiliary device with field programmable or downloadable metrological software. ¶

T.2.10 Measurement data storage

Storage used for keeping measurement data ready after completion of the measurement for later legally relevant purposes

Storage may be integrated with the instrument (e.g. non-removable data storage such as a hard disk, or removable storage, e.g. diskettes, rewritable compact disks). Storage may also be on a universal computer system (multitasking operating system where storage can be moved within the universal system), or a remote system, e.g. file server located anywhere, e.g. in the same building or even in a different country. Thus the communications link to storage devices may be direct, or indirect, whereby there might be an intermediate storage phase not under the control of the user, e.g. dial-up on Internet.

T.2.11 Communication interface

An electronic, optical, radio or other hardware and software interface that enables information to be automatically passed between instruments and modules.

T.2.12 User interface

An interface that enables information to be passed between a human user and the instrument or its hardware or software components, as, e.g. switch, keyboard, mouse, display, monitor, printer, touchscreen.

T.2.13 Protective interface

Interface which allows the introduction of only such data into the data processing device of the

instrument, which cannot:

- display data, that are not clearly defined and could be taken for a measurement result,
- falsify displayed, processed or stored measurement results or primary indications,
- adjust the instrument or change any adjustment factor.

T.3 METROLOGICAL CHARACTERISTICS

T.3.1 Scale interval

A value expressed in units of mass that is the difference between:

- the values corresponding to two consecutive scale marks for analogue indication, or
- two consecutive indicated values for digital indication.

T.3.1.1 Totalisation scale interval (d_t)

The scale interval of a principal totalisation indicating device.

T.3.1.2 Control scale interval (d)

The scale interval on a control indicating device.

T.3.2 Weighing cycle

The sequence of weighing operations that includes the following:

- one delivery of a load to the load receptor,
- a single weighing operation,
- the discharge to bulk of a single discrete load.

T.3.3 Automatic weighing range

The range from minimum capacity to maximum capacity.

T.3.3.1 Maximum capacity (Max)

The largest discrete load that can be weighed automatically.

T.3.3.2 Minimum capacity (Min)

The smallest discrete load that can be weighed automatically.

T.3.3.3 Overload

A load on the load receptor of more than Max plus 9 d_t.

T.3.4 Final mass value

Weighing value that is achieved when an automatic operation is ended and the instrument is completely at rest.

Supprimé : and there are no disturbances taking effect on the indication

Note: This definition is only applicable to static weighing and not to weighing-in-motion.

T.3.5 Stable equilibrium

The condition of the instrument such that the printed or stored weighing values of each separate weighing test show no more than two adjacent values; with one of them being the final mass value.

T.3.6 Minimum totalized load ($\sum_{min}$)

The value of the smallest bulk load that can be totalized without exceeding the maximum permissible error when the automatic operation is comprised of discrete loads, each within the automatic weighing range.

T.3.7 Warm-up time

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

T.3.8 Nonautomatic (static) operation

A static weighing mode for test purposes.

Supprimé : T.3.7 Sensitivity¶
¶
For a given value of the measured mass, the quotient of the change of the observed variable and the corresponding change of the measured mass M:¶
¶
$k = \Delta l / \Delta M$¶

T.3.9 Discrimination

Ability of an instrument to react to small variations of load.

T.3.10 Discrimination

The discrimination level, for a given load, is the value of the smallest additional load that, when gently deposited on or removed from the load receptor, causes a detectable change in the indication.

Supprimé : threshold

T.3.11 Repeatability

Ability of an instrument to provide results that agree one with the other when the same load is deposited several times and in a practically identical way on the load receptor under reasonably constant test conditions.

T.3.12 Durability

Ability of an instrument to maintain its performance characteristics over a period of use.

T.4 INDICATIONS AND ERRORS

T.4.1 Indication of a measuring instrument

Value of a quantity provided by a measuring instrument [VIM 3.2].

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

T.4.1.1 Primary indications

Indications, signals and symbols that are subject to requirements of this Recommendation.

T.4.1.2 Secondary indications

Indications, signals and symbols that are not primary indications.

T.4.2 Methods of indication

T.4.2.1 Analogue indication

An indication allowing the determination of an equilibrium position to a fraction of the scale interval.

T.4.2.2 Digital indication

The measurement results are displayed by a digital measuring instrument in a digitized form [Adapted from VIM 4.11].

T.4.3 Totalisation indicating devices

The device that indicates the sum of consecutive loads weighed and discharged to bulk.

T.4.3.1 Principal totalisation indicating device

The device that indicates the sum of consecutive loads weighed and discharged to bulk. This indicating device is not ressetable to zero during automatic operations by the user.

T.4.3.2 Partial totalisation indicating device

An optional device used during static weighing to indicate the sum of a limited number of consecutive loads delivered to bulk.

T.4.3.3 Supplementary totalisation indicating device

An indicating device with a scale interval greater than that of the principal totalisation indicating device and indicating the sum of consecutive loads weighed over a long period of time.

T.4.4 Reading

T.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.

T.4.4.2 Overall inaccuracy of reading

The overall inaccuracy of reading of an instrument with analogue indication is equal to the standard deviation of the same indication, the reading of which is carried out under normal conditions of use by several observers.

T.4.5 Errors

Supprimé : An indication in which the scale marks are a sequence of aligned figures that do not permit interpolation to a fraction of a scale interval.¶ ¶

T.4.5.1 Error (of indication)

The indication of an instrument minus the (conventional) true value of the mass.

T.4.5.2 Rounding error of digital indication

Difference between the indication and the result the instrument would give with analogue indication.

T.4.5.3 Intrinsic error

The error of an instrument under reference conditions.

T.4.5.4 Initial intrinsic error

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

T.4.5.5 Fault

The difference between the error of indication and the intrinsic error of a weighing instrument.

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

Note 2: From the definition it follows that in this Recommendation a “fault” is a numerical value.

T.4.5.6 Significant fault

A fault greater than 1 d_t.

The following are not considered to be significant faults:

- faults that result from simultaneous and mutually independent cause in the instrument or in its checking facility,
- faults that imply the impossibility of performing any measurement,
- transitory faults that are momentary variations in the indications which cannot be interpreted, memorized or transmitted as a measurement result,
- faults that are so serious that they will inevitably be noticed by those interested in the

measurement.

T.4.5.7 Span stability

The capability of an instrument to maintain the difference between the indication of mass at maximum capacity and the indication at zero within specified limits over a period of use.

Supprimé : weight

T.4.5.8 Maximum permissible errors (MPE)

Supprimé : T.4.2.8
Maximum span stability error¶
¶
A span stability error greater than one half of the absolute value of the maximum permissible error applicable to the load.¶
¶

Extreme values of an error permitted by specifications, regulations, etc. for a given instrument. [VIM 5.21]

T.5 INFLUENCES AND REFERENCE CONDITIONS

T.5.1 Influence quantity

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

T.5.1.1 Influence factor

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

T.5.1.2 Disturbance

An influence quantity having a value that falls within the limits specified in this International Recommendation but that falls outside the rated operating conditions of the instrument.

T.5.2 Rated operating conditions

Conditions of use, giving the ranges of the measurand and of the influence quantities for which the metrological characteristics are intended to lie within the maximum permissible errors specified in this Recommendation. [VIM 5.5]

T.5.3 Reference conditions

A set of specified values of influence factors fixed to ensure valid inter-comparison of the results of measurements. [VIM 5.7]

T.6 TESTS

T.6.1 Material test

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

T.6.2 Simulation test

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

T.6.3 Performance test

A test to verify that the equipment under test (EUT) is capable of accomplishing its intended functions.

T.6.4 Span stability test

A test to verify that the EUT is capable of maintaining its performance characteristics over a period of use.

T.7 ABBREVIATIONS AND SYMBOLS

Symbols	Meaning
I	Indication
I_n	n^{th} indication
L	Load
ΔL	Additional load to next changeover point
P	I + 1/2 e – ΔL = Indication prior to rounding (digital indication)
E	I – L or P – L = Error
E%	(P - L)/L %
E_0	Error at zero load
d	Actual scale interval
p_i	Fraction of the MPE applicable to a module of the instrument which is examined separately.
MPE	Maximum permissible error
EUT	Equipment under test
sf	Significant fault
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
v_{min}	Minimum operating speed
v_{max}	Maximum operating speed
DC	direct current
AC	alternating current

DISCONTINUOUS TOTALIZING AUTOMATIC WEIGHING INSTRUMENTS (TOTALIZING HOPPER WEIGHERS)

1 GENERAL

1.1 Scope

This International Recommendation specifies the requirements and test methods for discontinuous totalizing automatic weighing instruments (totalizing hopper weighers), hereafter referred to as "instruments".

It is intended to provide standardized requirements and test procedures to evaluate the metrological and technical characteristics of an instrument in a uniform and traceable way. A standardized test report format is given as Part 2 of this Recommendation, OIML R 107-2.

1.2 Application

This Recommendation applies to discontinuous totalizing automatic weighing instruments having a load receptor in the form of a hopper.

This Recommendation does not apply to the following types of instruments:

– "weighing-in-motion" instruments;
– instruments that totalize the bulk load by multiplying the mass of a preset constant load by the number of weighing cycles.

Supprimé : weight

In this Recommendation, instruments which in normal use, could be operated in a nonautomatic weighing mode shall also comply with the requirements of 3.2.6.

1.3 Terminology

The terminology given in the terminology section shall be considered as a part of this Recommendation.

2 METROLOGICAL REQUIREMENTS

2.1 Accuracy classes

Instruments are divided into four accuracy classes as follows:

0.2 0.5 1 2

The accuracy classes shall be specified in accordance with the maximum permissible errors in 2.2 and marked on the instrument in accordance with the descriptive markings in 3.9.

Accuracy classes shall be specified for intended usage, i.e. nature of the product(s) to be weighed, type of installation and other specified operating conditions in accordance with 5.1 and 5.2.

Notes:

1) The use of accuracy classes for certain applications may be determined by national prescription.
2) For operational inspection when weighing the same amount of material using instruments with different accuracy classes the accuracy class of the weighing instrument shall be printed along with the weighing result.

2.2 Maximum permissible errors

2.2.1 Automatic weighing

The maximum permissible errors for each accuracy class shall be the appropriate values in Table 1 rounded to the nearest totalisation scale interval (d_t). Maximum permissible errors apply to loads not less than the minimum totalized load ($\sum_{min}$). (See the example in 2.5).

Table 1

Accuracy class	Percentage of the mass of the totalised load	
	Initial verification	In-service
0.2	± 0.10 %	± 0.2 %
0.5	± 0.25 %	± 0.5 %
1	± 0.50 %	± 1.0 %
2	± 1.00 %	± 2.0 %

2.2.2 Influence quantities

The maximum permissible errors applied in tests to assess the effect of influence quantities shall be as specified in Table 2.

Table 2

Maximum permissible errors	Load (m) expressed in totalisation scale intervals
±0.5 d_t	0 ≤ m ≤ 500
±1.0 d_t	500 < m ≤ 2 000
±1.5 d_t	2 000 < m ≤ 10 000

Digital indications and printed results shall be corrected for the rounding error, and the error shall be determined with an accuracy of at least 0.2 d_t.

2.3 Form of the scale interval

The scale intervals of the indicating and printing devices shall be in the form of 1×10^k, 2×10^k, or 5×10^k, "k" being a positive or negative whole number or zero.

2.4 Totalisation scale interval (d_t)

The totalisation scale interval shall be:

a) not less than 0.01 % of the maximum capacity, and
b) not greater than 0.2 % of maximum capacity.

2.5 Value of minimum totalized load, $\sum_{min}$

The minimum totalized load ($\sum_{min}$) shall:

a) not be less than the value of the load at which the maximum permissible error for automatic weighing on initial verification is equal to the totalisation scale interval (d_t), and
b) not less than the minimum capacity (Min).

Therefore, using Table 1:

Accuracy class	$\sum_{min}$ shall not be less than either of:
0.2	1 000 x d_t, and Min
0.5	400 x d_t, and Min
1	200 x d_t, and Min
2	100 x d_t, and Min

For example*:

Instrument: Accuracy class = 0.5,
Maximum capacity (Max) = 1000 kg,
Minimum capacity (Min) = 200 kg;
d_t = 0.2 kg (see 2.4);

To comply with 2.5 (a): $\sum_{min} \geq 400 \times d_t = 400 \times 0.2$ kg = 80 kg, and
to comply with 2.5 (b): $\sum_{min} \geq$ Min = 200 kg.

Therefore, in this example, the value of minimum totalized load, $\sum_{min}$ is 200 kg

Supprimé : 100

2.6 Agreement between indicating and printing devices

For the same load, the difference between the weighing results provided by any two devices having the same scale interval shall be as follows:

- zero for digital indicating or printing devices;
- not greater than the absolute value of the maximum permissible error for automatic weighing for analogue devices.

2.7 Influence factors

2.7.1 Temperature

2.7.1.1 Temperature limits

Instruments shall comply with the appropriate metrological and technical requirements at temperatures limits from – 10 °C to + 40 °C.

Depending on local environmental conditions, however, the limits of the temperature range may differ from the above provided that they are specified in the descriptive markings the ranges within those limits shall be at least equal to 30°C:

Temperature limits:					Unit
lower temperature limit	+ 5	-10	-25	-40	°C
higher temperature	+ 30	40	55	70	

2.7.1.2 Temperature effect on no-load indication

The indication at zero or near zero shall not vary by more than one totalisation scale interval (d_t) for a difference in ambient temperature of 5 °C.

2.7.2 Power supply

Supprimé : Electrical p

An electronic instrument shall comply with the appropriate metrological and technical requirements, if the voltage supply 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:

- AC mains power: lower limit is 0.85 x U_{nom} or 0.85 x U_{min}, upper limit is 1.10 x U_{nom} or 1.10 x U_{max};
- External or plug-in power (AC or DC), including rechargeable battery power supply if (re)charge of batteries during the operation of the instrument is possible: lower limit is

minimum operating voltage, upper limit is 1.20 x U_{nom} or 1.20 x U_{max}

- Battery power (not mains connected), including rechargeable auxiliary battery power if (re)charge of batteries during the operation of the instrument is not possible: lower limit is the minimum operating voltage, upper limit is U_{nom} or U_{max};
- 12 V or 24 V road vehicle battery power: lower limit is minimum operating voltage, upper limit is 16 V (12 V battery) or 32 V (24 V battery)

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

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

Supprimé : weight

2.8 Units of measurement

The units of mass to be used on an instrument are the:

- gram (g),
- kilogram (kg)
- tonne (t).

3 TECHNICAL REQUIREMENTS

3.1 Suitability for use

An instrument shall be designed to suit the method of operation and the loads for which it is intended. It shall be of adequately robust construction in order that it maintains its metrological characteristics.

3.2 Security of operation

3.2.1 Fraudulent use

An instrument shall have no characteristics likely to facilitate its fraudulent use.

3.2.2 Accidental breakdown and maladjustment

An instrument shall be so constructed that an accidental breakdown or maladjustment of control elements likely to disturb its correct functioning cannot take place without its effect being evident.

3.2.3 Purging of load receptor

The design of the load receptor and the operation of the instrument shall be such that the weighing results are not adversely affected by any variation in the quantity of the load remaining

in the load receptor after discharge during a weighing cycle.

3.2.4 Overload (T.3.3.3)

The design of the load receptor and the operation of the instrument shall be such that the weighing results are not adversely affected by any variation in the quantity of the load resulting in overload due to inconstant or abruptly increasing mass flow during a weighing cycle. The overload limit shall be specified by the manufacturer.

3.2.5 Automatic weighing conditions

An automatic operation shall be interrupted, printing shall be prevented or marked with a clear warning and a warning signal shall be given in the following cases:

a) overload, if the maximum capacity (Max) in each weighing range has been exceeded by more than 9 d_t,
b) if the value of the load to be weighed and discharged to bulk is less than minimum capacity (Min), unless processed as the last discrete load of the transaction.

3.2.6 Use as a non-automatic weighing instrument

An instrument to be used as a non-automatic weighing instrument shall

- comply with the requirements of OIML R76-1 [7] for class (III) or class (IIII) non-automatic weighing instruments;
- be equipped with an enabling device for non-automatic operation that prevents both automatic operation and in-motion weighing.

3.2.7 Operational adjustments

It shall not be possible to make operating adjustments nor to reset the indicating devices during an automatic weighing operation, with the exception of the possibility to interrupt the weighing cycle in the case of 3.2.5 (a) and during testing as described in 6.2.1.2.1.

3.2.8 Controls

Controls shall be so designed that they cannot normally come to rest in positions other than those intended by design, unless during the manoeuvre all indications are made impossible. Keys shall be marked unambiguously.

3.2.9 Dust extraction

The operation of a dust extractor shall not affect the result of the measurement.

3.2.10 Adjustment

An instrument may be fitted with a span adjustment device. This device shall be incorporated inside the instrument. External influence upon this device shall be practically impossible after securing.

3.3 Securing of components, interfaces and pre-set controls

3.3.1 General

Components, interfaces, software devices 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. However, other national prescribed types of securing are permitted which provide sufficient integrity.

Any device for changing the parameters of legally relevant measurement results, particularly for correction and calibration, shall be sealed in a manner that requires the security seal to be broken before an adjustment can be made to any component affecting the performance of an instrument.

The seals should, in all cases, be easily accessible. Securing should 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.

3.3.2 Means of securing

Securing shall be provided by hardware, passwords or similar software means provided that:

a) Access shall only be allowed to authorised people, e.g. by means of a code (key-word) or of a special device (hard key, etc); the code must be changeable;
b) It shall be possible for at least the last intervention to be memorised and it must be possible to access and display this information; the record shall include at least the ten most recent access or changes, the date and a means of identifying the authorised person making the intervention (see (a) above); 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 memorise more than one intervention, and if deletion of a previous intervention must occur to permit a new record, the oldest record shall be deleted.
c) Software functions shall be secured against intentional, unintentional and accidental changes in accordance with the requirements of 3.6;
d) Transmission of legally relevant data via interfaces shall be secured against intentional, unintentional and accidental changes in accordance with the requirements of 4.3.6.2;
e) The securing possibilities available in an instrument shall be such that separate securing of the settings is possible;
f) Stored data shall be secured against intentional, unintentional and accidental changes in accordance with the requirements of 3.4.

3.4 Data storage device

The primary indications and device-specific parameters may be stored in a memory of the instrument (hard drive), or on a universal computer storage, or on external storage for subsequent indication, printing, data transfer, totalising, etc. In all cases, the stored data shall be adequately protected against intentional and unintentional changes during the transfer process and stored data shall contain all relevant information necessary to reconstruct an earlier measurement.

For securing stored measurement data, the following apply:

a) Software transmission and downloading process shall be secured in accordance with the requirements in 3.6;
b) External storage devices identification and security attributes shall be verified to ensure integrity and authenticity;
c) Device-specific parameters stored in exchangeable storage media are secured and the exchangeable media is sealed against removing in accordance with 3.3;
d) When storage capacity is exhausted, new data shall replace oldest data.

National regulation may specify other requirements for securing stored data which provide sufficient integrity.

3.5 Indication and printing of weighing results

Instruments shall include a principal totalisation indicating device, printing device and may include a supplementary totalisation indicating device, partial totalisation indicating device and data storage device.

3.5.1 Quality of indication

Reading of the primary indications (see T.4.1.1) shall be reliable, easy and unambiguous under conditions of normal use:

- the overall inaccuracy of reading of an analogue indicating device shall not exceed 0.2 d_t,
- the figures forming the primary indications shall be of a size, shape and clarity for reading to be easy.

The indication shall be the self-indicating type and the scales, numbering and printing shall permit the figures which form the results to be read by simple juxtaposition (see T.4.4.1).

3.5.2 Form of the indication

3.5.2.1 Unit 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.

Supprimé : weight

The unit of mass shall be chosen so that the mass 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.

Supprimé : weight

The units of mass shall be indicated in small letters (lower case) as shown in 2.8.

3.5.2.2 Scale interval

Except for a supplementary totalisation indicating device, the scale intervals of all totalisation indicating devices shall be the same.

The form of the scale interval shall be as specified in 2.3.

Where the scale interval is changed automatically the decimal sign shall maintain its position in the display.

3.5.2.3 Digital indication

A digital zero indication shall include the display of a zero for all places that are displayed to the right of a decimal sign and at least one place to the left. When no decimal values are displayed, a zero shall be displayed for each place of the displayed division, (i.e. at least one active decade plus any fixed zeros must be displayed).

Examples of the number of zeros required:

Capacity	Minimum Zero Indication (kg)
25 x 0.01	0.00
5000 x 1	0
100 000 x 20	00

Supprimé : 0

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

3.5.3 Totalisation indicating and printing devices

The following shall apply:

a) A totalisation indicating and printing device shall allow reliable, clear and unambiguous reading of the results by simple juxtaposition and shall bear the symbol of the appropriate unit of mass;
b) Printing shall be clear and permanent for the intended use. Printed figures shall be at least 2 mm high.
c) In automatic operation it shall not be possible to reset the principle totalisation device to zero;
d) In static weighing conditions it shall not be possible to reset the partial totalisation indicating device to zero unless the last total indicated before resetting to zero is automatically recorded or printed;
e) An automatic recording or printing of the last total indicated shall be generated if the automatic operation is interrupted and operating adjustments can be made;
f) The control indicating device (T.2.4) shall allow indication to a higher resolution to than that of the principal totalisation indicating device.
g) In static operations, printing shall be inhibited if the stability criteria in 3.5.6 are not fulfilled.

3.5.5 Combined indicating devices

Two or more types of indicating devices may be combined so that the indication required can be displayed on demand provided that it is clearly identified.

3.5.6 Stable equilibrium for static weighing

For static weighing, equilibrium is deemed to be stable when in case of indications and printing, the indicated and printed weighing values show no more than two adjacent values; with one of them being the final mass value.

Stable equilibrium requirement does not apply to weighing-in-motion.

3.6 Software

The legally relevant software used in an instrument must be present in such a form in the instrument that alteration of the software is not possible without breaking a seal, or any change in the software can be signalled automatically by means of an identification code. The software shall be assigned with a fixed software identification. This software identification shall be adapted in the case of every software change that may affect the functions and accuracy of the instrument.

The securing requirements in 3.3 apply. National regulation may specify other requirements for securing software which provide sufficient integrity.

The software documentation provided by the manufacturer shall include:

a) A description of the legally relevant software;
b) A description of the accuracy of the measuring algorithms (e.g. programming modes);
c) A description of the user interface, menus and dialogues;
d) The unambiguous software identification;
e) A description of the embedded software;
f) An 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;
g) Means of securing software;
h) The operating manual.

The following means of securing legally relevant software apply:

a) Access shall only be allowed to authorised people, e.g. by means of a code (key-word) or of a special device (hard key, etc); the code must be changeable;
b) It shall be possible for at least the last intervention to be memorised and it must be possible to access and display this information; the record shall include at least the ten most recent access or changes, the date and a means of identifying the authorised person making the intervention (see (a) above); 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 memorise more than one intervention, and if deletion of a previous intervention must occur to permit a new record, the oldest record shall be deleted.
c) Downloading of legally relevant software shall be through appropriate protective interface (T.2.13) connected to the instrument;
d) The software shall be assigned with appropriate software identification (T.2.9.7.4). This software identification shall be adapted in the case of every software change that may affect the functions and accuracy of the instrument.

e) Functions that are performed or initiated via a software interface shall meet the relevant requirements and conditions for interfaces of 4.2.6.

3.7 Instruments with control indicating devices

For instruments with control indicating devices, the load receptor shall have the facility to support a quantity of standard weights in accordance with Table 3.

Table 3

Maximum capacity (Max)	Minimum quantity of standard weights
Max ≤ 5 *t* 5 t < Max ≤ 25 *t* 25 *t* < Max ≤ 50 *t* 50 t < Max	Max 5 *t* 20 % Max 10 *t*

3.8 Ancillary devices

Ancillary devices shall not affect the indicated totalisation(s) representing a bulk load for a transaction.

3.8.1 Zero-setting

Instruments that do not tare-weigh after each discharge shall exclusively be used for well non-caking materials and materials not tending to adhesion and shall be provided with a zero-setting device which may be:

- non-automatic, or
- semi-automatic, or
- automatic, or

3.8.1.1 Accuracy of zero-setting device

After zero-setting the effect of zero deviation on the result of the weighing shall be not more than 0.25 d_t.

3.8.1.2 Maximum effect

The effect of any zero-setting device shall not alter the maximum weighing capacity of the instrument.

The overall effect of zero-setting devices shall not be more than 4 %, and of the initial zero-setting device not more than 20 %, of the maximum capacity. This does not affect an instrument of class  , except if it is used for commercial transactions.

A wider range is possible for the initial zero-setting device if tests show that the instrument complies with 2.2 for any load compensated by this device within the specified range.

3.8.1.3 Control of zero-setting devices

An interlock shall be provided to stop an automatic operation if the zero indication varies by or more than:

a) 1 d_t on instruments with an automatic zero-setting device, or
b) 0.5 d_t on instruments with a semi-automatic or non-automatic zero-setting device.

3.8.1.4 Zero indicating device on an instrument with digital indication

An instrument with digital indication shall have a device that displays a special signal when the deviation from zero is not more than 0.25 d_t.

A non-automatic or semi-automatic zero-setting device shall not be operable during automatic operation.

Supprimé : ¶
A semi-automatic zero-setting device shall function only when the instrument is in stable equilibrium (3.3.7),¶
¶

3.8.1.5 Stability of automatic zero-setting device

An automatic zero-setting device may operate at the start of automatic operation, as part of every automatic weighing cycle, or after a programmable time interval. A description of the operation of the automatic zero-setting device (e.g. the maximum programmable time interval) shall be included in the test report.

The automatic zero-setting device shall operate sufficiently often to ensure that zero is maintained within 0.5 d_t.

Where the automatic zero-setting device operates as part of every automatic weighing cycle, it shall not be possible to disable this device or to set this device to operate at time intervals.

Where the automatic zero-setting device operates after a programmable time interval, the manufacturer shall specify the maximum time interval. The maximum programmable time interval:

- shall not be greater than the value necessary to ensure that the zero error is not greater than 0.5 d_t.
- may start again after zero tracking has taken place.

The actual maximum programmable time interval for automatic zero-setting shall be specified considering the actual operating conditions of the instrument. The automatic zero-setting device shall either automatically set to zero after the allocated time or should stop the instrument so that a zero-setting operation can occur or be capable of generating information to draw attention to overdue zero setting.

3.9 Descriptive markings

Instruments and associated modules shall bear the following basic markings at each location having a mass indicating and printing device.

3.9.1 Markings shown in full

- identification mark or name of the manufacturer
- identification mark or name of the importer (if applicable)
- serial number and type designation of the instrument
- product description
- control scale interval (if applicable) ... g or kg or t
- electrical supply voltage ... V
- electrical supply frequency ... Hz
- pneumatic/hydraulic pressure (if applicable) ... kPa or bar
- software identification

Supprimé : <#>Product density …kg/dm^3¶ <#>Load receptor volume … dm^3¶

Supprimé : working fluid pressure or air

3.9.2 Markings shown in code

- type approval sign in accordance with national requirements
- accuracy class 0.2, 0.5, 1 or 2
- maximum capacity Max = ... g or kg or t
- minimum capacity Min = ... g or kg or t
- minimum totalized load $\sum_{min}$ = ... g or kg or t
- totalisation scale interval d_t = ... g or kg or t

Supprimé : maximum safe load in the form Lim = …¶ (if the manufacturer has provided for a maximum safe load of more than Max + 9 d)¶

3.9.3 Supplementary markings

Depending upon the particular use of the instrument, supplementary markings may be required on type approval by the metrological authority issuing the type approval certificate (for example: securing code, date of manufacture).

Additional markings may be required on initial verification to specify types of products and related weighing conditions (for example: overload limit, product density, load receptor (hopper) volume.

3.9.4 Presentation of descriptive markings

Descriptive markings shall be indelible and of a size, shape and clarity that permit legibility under normal conditions of use.

Descriptive markings shall be shown in accordance with national legislation.

They shall be grouped together in a clearly visible place on the instrument, either on a descriptive plate or sticker fixed permanently near the indicating device, or on a non removable part of the instrument itself. In case of a plate or sticker which is not destroyed when removed, a means of securing shall be provided, e.g. a non removable control mark that can be applied.

It shall be possible to seal the plate bearing the markings, unless it cannot be removed without being destroyed.

As an alternative all applicable markings above may be shown on a programmable display which is controlled by software provided that:

- At least Max, Min and d_t shall be displayed as long as the instrument is switched on.
- The other marking may be shown on manual commend.
- It must be described in the type approval (OIML) certificate

For programmable display, means shall be provided for any access to reprogramming of the markings to be automatically and non-erasably recorded and made evident by an audit trail, e.g. by traceable access software such as an event logger providing a record of the changes or an event counter providing non-resettable counter of any changes.

These programmable display markings need not be repeated on the data plate, if they are shown 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, Min and d_t shall be shown near the display if not already located there,
- type and designation of the instrument,
- name or identification mark of the manufacturer,
- type approval number,
- electrical supply voltage,
- electrical supply frequency,
- pneumatic/hydraulic pressure, (if applicable).

3.10 Verification marks

3.10.1 Position

Instruments shall have a place for the application of verification marks. This place shall:

- be such that the part on which it is located cannot be removed from the instrument without damaging the marks,
- allow easy application of the mark without changing the metrological qualities of the instrument,
- be visible without the instrument or its protective covers having to be moved when it is in service.

3.10.2 Mounting

Instruments required to bear verification marks shall have a verification mark support, at the place provided for above, which shall ensure the conservation of the marks. The type and method of sealing shall be determined by national prescription.

4 REQUIREMENTS FOR ELECTRONIC INSTRUMENTS

4.1 General requirements

Electronic instruments shall comply with the following requirements, in addition to the applicable requirements of all other clauses of this Recommendation.

4.1.1 Rated operating conditions

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

4.1.2 Disturbances

Electronic instruments shall be so designed and manufactured that when they are exposed to disturbances, either

a) significant faults do not occur, or
b) significant faults are detected and acted upon.

Note: A fault equal to or less than the value specified in T.4.5.6 (1 d_t) is allowed irrespective of the value of the error of indication.

4.1.3 Durability

The requirements in 4.1.1 and 4.1.2 shall be met durably in accordance with the intended use of the instrument.

4.1.4 Evaluation for compliance

A type of an electronic instrument is presumed to comply with the requirements in 4.1.1, 4.1.2, and 4.1.3 if it passes the examination and tests specified in Annex A.

4.1.5 Application of requirements for disturbances

The requirements in 4.1.2 may be applied separately to:

a) each individual cause of significant fault, and/or
b) each part of the electronic instrument.

The choice of whether 4.1.2 a) or b) is applied is left to the manufacturer.

4.2 Functional requirements

4.2.1 Acting upon a significant fault

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

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

4.2.2 Indicator display test

Upon switch-on (switch-on of indication), a special procedure shall be performed that shows all relevant signs of the indicator in their active and non-active state sufficiently long to be checked by the operator. This is not applicable for displays, on which failures become evident, for example a display where failure of 1 or 2 elements do not lead to a wrong result

4.2.3 Influence quantities

An electronic instrument shall comply with the requirements of 2.7 and shall also comply with appropriate metrological and technical requirements at a relative humidity of 85 % at the upper limit of the temperature range.

4.2.4 Disturbances

When an electronic instrument is subjected to the disturbances specified in Annex A, either of the following shall apply:

a) the difference between the mass indication due to the disturbance and the indication without the disturbance (intrinsic error) shall not exceed the value specified in T.4.5.6 (1 d_t);
b) the instrument shall detect and act upon a significant fault.

4.2.5 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.

4.2.6 Interfaces

An instrument may be equipped with communication interfaces (T.2.11) permitting the coupling of the instrument to external equipment and user interfaces (T.2.12) permitting the exchange of information exchange between a human user and the instrument. When an interface is used, the instrument shall continue to function correctly and its metrological functions shall not be influenced.

4.2.6.1 Interface documentation

The manufacturer shall provide documentation on all interfaces comprising of at least:

a) A list of all commands (e.g. menu items);
b) Description of the software interface;
c) A list of all commands together;
d) A brief description of their meaning and their effect on the functions and data of the instrument.

4.2.6.2 Securing of interfaces

Supprimé : This is not applicable for non-segmented displays, on which failures become evident, for example screen-displays, matrix-displays, etc.

Supprimé : , or ¶ under conditions of high humidity of between 93 to 95 % when combined with cyclic temperature changesNote: The requirement in (b) is applicable to cases where condensation is likely to occur or when the instrument is to be installed in high cyclic temperature environments.

Supprimé : weight

Communication and user interfaces shall not allow the legally relevant software and functions of the instrument and its and 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 secured. Other interfaces shall be secured as follows:

a) Data is protected (e.g. with a protective interface as defined in T.2.13) against accidental or deliberate interference during the transfer;
b) All functions in the software interface shall be subject to the requirements for securing software in 3.6;
c) All functions in the hardware interface shall be subject to the requirements for securing hardware in 3.3;
d) Legally relevant parts of the target instrument shall be included in the initial verification (or equivalent conformity assessment procedures);
e) it shall be easily possible to verify the authenticity and integrity of data transmitted to and from the instrument;
f) Functions performed or initiated by other connected instruments through the interfaces shall meet the appropriate requirements of this OIML Recommendation.

Other instruments required by national regulation to be connected to the interfaces of an 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.

4.2.7 AC mains supply failure

An instrument that operates from the AC mains shall, in the event of a supply failure, retain the metrological information contained in the instrument at the time of failure for at least 24 hours. A switch-over to an emergency power supply shall not cause a significant fault.

4.2.8 Voltage variations of external or plug-in (AC or DC)supply, or battery power supply

Instrument with external or plug-in (AC or DC) voltage supply, or battery power supply shall, whenever the voltage drops out of the specified operating voltage range (see 2.7.2), either continue to function correctly or show an error message or is automatically put out of service.

4.3 Examination and tests

The examination and testing of an electronic weighing instrument is intended to verify compliance with the applicable requirements of this Recommendation and especially with the requirements in Clause 4.

4.3.1 Examination

An electronic weighing instrument shall be examined to obtain a general appraisal of the design and construction.

4.3.2 Performance tests

An electronic weighing instrument or electronic device, as appropriate, shall be tested as specified in Annex A to determine its correct functioning.

Tests are to be conducted on the whole instrument except when the size and/or configuration of the instrument does not lend itself to testing as a unit. In such cases, the separate electronic devices shall be subjected to testing. It is not intended that electronic devices be further dismantled for separate testing of components. In addition, an examination shall be carried out on the fully operational weighing instrument or, if necessary, on the electronic devices in a simulated set-up that sufficiently represents the weighing instrument. The equipment shall continue to function correctly as specified in Annex A.

4.3.3 Span stability tests

The instrument shall be subjected to span stability tests at various intervals, i.e. before, during and after being subjected to performance tests.

When the instrument is subjected to span stability test specified in Annex A.8:

- the maximum allowable variation in the errors of indication shall not exceed half the absolute value of the maximum permissible error in 2.2.2 Table 2 for the test load applied on any of the n measurements;
- where the differences of the results indicate a trend more than half the allowable variation specified above, the test shall be continued until the trend comes to rest or reverses itself, or until the error exceeds the maximum allowable variation.

5 METROLOGICAL CONTROLS

The metrological controls of instruments shall, in agreement with national legislation, consist of the following:

- type evaluation;
- initial verification;
- subsequent verification;
- 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 OIML International Documents D 19 [8] and D 20 [9], respectively.

5.1 Type approval

5.1.1 Documentation

The application for type evaluation shall include documentation comprising:

- metrological characteristics of the instrument;
- a standard set of specifications for the instrument;
- a functional description of the components and devices;
- drawings, diagrams and general software information (if applicable), explaining the construction and operation;
- detailed software information (if applicable) for software-controlled operation;
- any document or other evidence demonstrating that the design and construction of the instrument complies with the requirements of this Recommendation;
- operating manual.

Note: Adherence to requirements for which no test is available, such as software-based operations, may be demonstrated by a specific declaration of the manufacturer (e.g. for interfaces as per 4.2.6, and for password protected access to set-up and adjustment operations as per 3.2.7.

5.1.2 General requirements

Type evaluation shall be carried out on at least one and normally, not more than three instruments that represent the definitive type. At least one of the instruments shall be completely installed at a typical site and at least one of the instruments or the major component of an instrument shall be submitted in a form suitable for simulation testing in a laboratory. The evaluation shall consist of the tests specified in 5.1.3.

5.1.3 Type evaluation

The submitted documents shall be examined and tests carried out to verify that the instruments comply with:

- the metrological requirements in Clause 2, particularly with reference to maximum permissible errors, when the instrument is operated in accordance with the manufacturer's specifications for range and product(s);
- the technical requirements in Clause 3 including the requirement for security of operation in 3.2. Additionally electronic instruments shall comply with the requirements in Clause 4.

The appropriate metrological authority:

- shall conduct the tests in a manner that prevents unnecessary commitment of resources;
- shall permit, when the same instrument is involved, the result of these tests to be assessed for initial verification;
- is advised to accept, with the consent of the applicant, test data obtained from other metrological authorities without repeating the tests;
- ensure that an instrument used in static weighing in accordance with the integral verification method as specified in A.5.3, comply with the requirements of 3.2.6.

5.1.4 Operational tests

In-situ material tests shall be conducted in accordance with either the separate verification method as specified in A.5.2 or the integral verification method as specified in A.5.3.

For the purposes of testing, the applicant may be required to furnish the metrological authority with the material, handling equipment, qualified personnel, and a control instrument.

5.1.5 Simulation tests

Influence factors shall be applied during simulation as specified in Annex A.7, in accordance with Clauses:

- 2.7 for all instruments,
- 4 for electronic instruments.

5.1.5.1 Modules

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

- where testing the instrument as a whole is difficult or impossible;
- where modules are manufactured and/or placed on the market as separate units to be incorporated in a complete instrument;
- where the applicant wants to have a variety of modules included in the approved type;
- when a module is intended to be used for various kinds of weighing instruments (in particular load cells, indicators, data storage).

5.1.5.1.1 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 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:

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

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:

- For purely digital devices p_i may be equal to 0.
- For weighing modules p_i may be equal to 1.
- For all other modules (including digital load sensors) 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).

If the metrological characteristics of the load sensor or other major component have been evaluated in accordance with the requirements of OIML R 60 [6], or any other applicable OIML Recommendation, that evaluation shall be used to aid type evaluation if so requested by the applicant.

5.1.6 Place of testing

Instruments submitted for type approval may be tested either:

- on the premises of the metrological authority to which the application has been submitted, or
- in any other suitable place agreed between the metrological authority concerned and the applicant.

5.1.7 Type approval certificate and determination of classes

The type approval certificate shall state the accuracy class, as specified at type approval stage and be determined by compliance with the metrological requirements at initial verification of each instrument.

5.2 Initial verification

5.2.1 General requirements

Instruments shall be tested to verify that they comply with the requirements in Clause 2 (except 2.7) and Clause 3 for any product(s) for which they are intended and when operated under normal conditions of use.

Tests shall be carried out by the metrological authority, in-situ, with the instrument fully assembled and fixed in the position in which it is intended to be used. The installation of an instrument shall be so designed that the weighing operation will be the same whether for the purposes of testing or for normal operation.

5.2.2 Operational tests

Instruments shall be tested in their normal mode of automatic operation and in accordance with either the separate verification method as specified in A.5.2 or the integral verification method as specified in A.5.3.

The appropriate metrological authority shall conduct the tests in a manner that prevents an unnecessary commitment of resources. In appropriate situations and to avoid duplicating tests previously performed on the instrument for type evaluation under 5.1.3, the authority may use the results of observed tests for initial verification.

The metrological authority may require the applicant to supply the material, equipment, qualified personnel, and a control instrument to perform the tests.

5.2.3 Determination of accuracy class

The metrological authority shall:

(a) apply the accuracy class requirements in accordance with the appropriate parts in 2.2.1 for initial verification.
(b) verify that the accuracy classes marked in accordance with 3.9 are equal to the accuracy class determined as above.

Supprimé : 3.7

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 2.2.1 and 3.9. Marking of a higher accuracy class than was achieved at type approval stage is not permitted.

5.2.4 Nonautomatic weighing instruments

When an instrument can be operated as a nonautomatic weighing instrument in accordance with the integral verification method as specified in A.5.3, it shall meet the requirements of 3.2.6.

5.3 Subsequent metrological control

Subsequent metrological control may be performed according to national regulations.

5.3.1 Subsequent verification

Subsequent verification shall be carried out in accordance with the same provisions as in 5.2 for initial verification.

5.3.2 In-service inspection

In-service inspection shall be carried out in accordance with the same provisions as in 5.2 for initial verification, with the exception that the in-service maximum permissible errors in 2.2.1 Table 1 shall be applied.

6 TEST METHODS

6.1 General test procedure

In-situ material tests shall be carried out as follows:

(a) In accordance with the descriptive markings;
(b) Under the rated operating conditions for the instrument;
(c) Tests shall be conducted in accordance with either the separate verification method in A.5.2, or the integral verification method in A.5.3 using the materials test procedure in A.5.4.

(d) Not less than three material tests shall be conducted, one at maximum capacity (Max), one at minimum capacity (Min), and one close to the minimum totalized load ($\sum_{min}$) marked on the instrument;
(e) With test load(s) that is representative of the range and type of products for which the instrument is likely to be used or product(s) for which the instrument is intended;
(f) Each test shall be conducted at the maximum rate of weighing cycles per hour;
(g) A minimum of five cycles per test shall be conducted.
(h) Equipment near the instrument, including conveyors, dust collection systems etc. that are in use when the instrument is in normal operation, shall be in use during the tests;
(i) If the instrument can divert weighed material through alternative discharge facilities the test program shall be performed for each alternative unless it can be established that the weigh hopper is not affected for example by different air flow.

6.2 Control instruments and test standards

A control instrument and standard weights for determining the conventional true value of the mass of each test load shall be available for testing. The control instrument may either be separate or integral.

6.2.1 Accuracy of control instruments and test weights

The control instrument (separate or integral) and standard weights used for material tests shall ensure the checking of the test load to an error not greater than 1/3 of the maximum permissible errors for automatic weighing in 2.2.1 if the control instrument is verified immediately prior to the material, or to an error not greater than 1/5 if the control instrument is verified at any other time.

6.2.1.1 Separate control instrument (A.5.2)

An instrument other than the instrument being verified is used to determine the conventional true value of the mass of the test load.

6.2.1.2 Integral control instrument (A.5.3)

The instrument being verified is used as the control instrument in nonautomatic (static) operation to determine the conventional true value of the mass of the test load.

6.2.1.2.1 Interruption of the automatic operation (A.5.3.3)

The integral control instrument uses a special facility (e.g. a test-stop program) to automatically interrupt automatic weighing operation twice as specified in A.5.3.3 during each weighing cycle in order to weigh and discharge a subdivision of the test load.

If the integral control instrument is installed as an air-enclosed system (T.2.7) interruption of the automatic operation during consecutive weighing cycles may not be possible and tests shall be conducted as specified in A.5.3.8.

6.2.3 Conventional true value of the mass of the test load

Supprimé : with the separate or integral verification method

(a) With the separate verification method, the test load shall be weighed on a control instrument and the result shall be considered as the conventional true value of the mass of the test load.

(b) With the integral verification method, for each discharge, the tare value subtracted from the gross value is the net value of the material discharged. A summation of the net values of all the discharges in the test load shall be the conventional true value of the mass of the test load.

Note: When using the integral control verification method, a subdivision of the test load is unavoidable and this may also be true when using the separate control verification method. When calculating the conventional true value of the mass of the test load, it is necessary to consider the increased uncertainty due to subdividing the test load.

6.2.4 Indicated mass

Supprimé : weight

Supprimé : with the separate or integral verification method

(a) With the separate verification method, a test load shall be weighed as an automatic bulk to bulk weighing operation and the indicated mass on the principal totalisation indicating device shall be observed and recorded.

Supprimé : weight

(b) With the integral verification method, a partial totalisation indicating device with standard weights increments shall be used to assess the rounding error. Alternatively, an appropriately designed control indicating device (T.2.4) with a higher resolution shall be use to indicate the mass of the test load to at least ten times the resolution of the totalisation scale interval (d_t).

6.2.5 Error for automatic weighing

Supprimé : with the separate or integral verification method

The error for automatic weighing shall be the difference between the conventional true value of the mass of the test load as specified in 6.2.3 as appropriate for the separate or the integral verification method, and the indicated mass observed and recorded as specified in 6.2.4 as appropriate for the separate or the integral verification method.

Supprimé : weight

The maximum permissible error for automatic weighing shall be as specified in 2.2.1 Table 1 for initial verification and as appropriate for the class of instrument.

6.2.6 Use of an appropriately designed control instrument

When a load receptor cannot be loaded with sufficient standard weights to verify and determine the rounding error of the control instrument indicating device or partial totalisation indicating device, then the instrument shall be subjected to material tests by the separate verification method. For this method an appropriately designed control instrument shall be available so that the material tests can be effectively and efficiently conducted.

6.3 Mode of operation for performance testing

6.3.1 Span stability testing

For span stability testing the instrument shall be tested in nonautomatic (static) operation. A single static test load near maximum capacity shall be used.

6.3.2 Disturbance testing

For disturbance testing the instrument shall be tested in nonautomatic (static) operation. Each test shall be performed with one small static test load.

6.3.3 Warm-up test

The warm-up test shall be performed in nonautomatic (static) operation. A single static test load near maximum capacity shall be used.

ANNEX A (MANDATORY)

TEST PROCEDURES FOR DISCONTINUOUS TOTALIZING AUTOMATIC WEIGHING INSTRUMENTS

A.1 EXAMINATION FOR TYPE APPROVAL

Supprimé : Meaning of symbols:¶
¶
I = Indication¶
L = Load¶
ΔL = Additional load to next changeover point¶
P = I + 0.5 *d* – ΔL = Indication prior to rounding¶
E = P – L = error¶
E_0 = Error calculated at zero¶
E_c = Corrected error¶
MPE = Maximum permissible error¶
EUT = Equipment under test¶
¶

A.1.1 Documentation (5.1.1)

Review the documentation that is submitted, including necessary photographs, drawings, diagrams, general software information, relevant technical and functional description of main components, devices, operational manual, etc. to determine if it is adequate and correct.

A.1.2 Comparing construction with documentation (5.1.1)

Examine the various devices of the instrument to ensure compliance with the documentation.

A.1.3 Metrological characteristics

Note metrological characteristics according to the checklist given in the test report format, OIML R 107-2.

A.1.4 Technical requirements

Check for conformity with the technical requirements according to the checklist given in the test report format, OIML R 107-2.

A.1.5 Functional requirements

Check for conformity with the functional requirements according to the checklist given in the test report format, OIML R 107-2.

A.2 EXAMINATION FOR INITIAL VERIFICATION

A.2.1 Compare construction with documentation

Examine the instrument for conformity with the approved type.

A.2.2 Descriptive markings (3.9)

Check the descriptive markings according to the requirements 3.9 and if applicable of the type approval.

A.2.3 Securing and verification marks (3.3 and 3.10)

Check the arrangements for securing and for verification marks according to the requirements of the type approval.

A.3 GENERAL TEST REQUIREMENTS

Supprimé : FOR ELECTRONIC INSTRUMENTS UNDER TEST

A.3.1 Power supply

Unless otherwise specified for each test power-up the equipment under test (EUT) for a time-period equal to or greater than the warm-up time specified by the manufacturer and maintain the EUT energized for the duration of the test.

A.3.2 Zero-setting

Adjust the EUT as closely as practicable to zero prior to each test and do not readjust at any time during the test, except to reset if a significant fault has occurred.

Status of automatic zero facilities shall be as specified for each test.

A.3.3 Temperature

Except for the temperature test (A.7.3.1) and the humidity test (A.7.3.3), the test shall be performed at a steady ambient temperature, usually normal room temperature unless otherwise specified. The temperature is deemed to be steady when the differences between the extreme temperatures noted during the test does not exceed one-fifth of the temperature range of the instrument and the rate of change does not exceed 5 °C per hour.

The handling of the instrument shall be such that no condensation of water occurs on the instrument.

A.3.4 Recovery

After each test, allow the instrument to recover sufficiently before the following test.

A.3.5 Preloading

Before each weighing test the instrument shall be pre-loaded to Max, except for the tests in A.5.4 (warm-up) and A.7.3.2 (temperature effect on no-load).

A.3.6 Test standards (6.2)

A.3.6.1 Control instruments

A control instrument meeting the requirements of 6.2.1 shall be used to perform the material tests. Where necessary, standard weights meeting the requirements of 6.2.1 may be used to

assess the rounding error.

A.3.6.2 Use of standard weights to assess rounding error

A.3.6.2.1 General method to assess error prior to rounding

For instruments with digital indication having scale interval *d*, changeover points may be used to interpolate between scale intervals i.e. to determine the indication of the instrument, prior to rounding, as follows.

At a certain load, L, the indicated value, I, is noted. Additional weights of for example 0.1 d are successively added until the indication of the instrument is increased unambiguously by one scale interval (I + *d*). The additional load ∆L added to the load receptor gives the indication, P, prior to rounding by using the following formula:

$$P = I + 0.5\,d - \Delta L$$

The error E prior to rounding is:

$$E = P - L = I + 0.5\,d - \Delta L - L$$

Example: an instrument with a scale interval, *d*, of 1 kg is loaded with 100 kg and thereby indicates 100 kg. After adding successive weights of 0.1 kg, the indication changes from 100 kg to 101 kg at an additional load of 0.3 kg. Inserted in the above formula these observations give:

$$P = (100 + 0.5 - 0.3)\ kg = 100.2\ kg$$

Thus, the true indication prior to rounding is 100.2 kg, and the error is:

$$E = (100.2 - 100)\ kg = 0.2\ kg$$

A.3.6.2.2 Correction for error at zero

Evaluate the error at zero load, (E_0) and the error at load *L*, (*E*), by the method of A.3.6.2.1.

The corrected error prior to rounding, (E_c) is:

$$E_c = E - E_0$$

Example: if, for the example in A.3.6.2.1, the error calculated at zero load was:

$$E_0 = +0.4\ kg,$$

The corrected error is:

$$E_c = 0.2\ kg - (+0.4\ kg) = -0.2\ kg$$

A.4 TEST PROGRAM

A.4.1 Type evaluation (5.1)

All tests in A.5 to A.8 shall normally be applied for type evaluation, using the test methods in Clause 6.

Sub-clause A.5.3 may be omitted if the instrument under test is not an integral control instrument.

A.4.2 Initial verification (5.2)

Tests in A.2 and A.5 shall be applied for initial verification. The types of test loads used shall comply with 6.1 (e).

Supprimé : Tests in A.5.4 (warm-up) may be omitted if the integral instrument is not to be used as the control indicating device for material testing.¶
¶

Supprimé : , except for A.5.4 (warm-up)

A.5 METROLOGICAL TESTS

A.5.1 Material test requirements

Material tests shall be conducted with the material, test load, requirements and methods in:

(a) 5.1.4 for type approval;
(b) 5.2.2 for initial verification;
(c) A.5.2 or A.5.3 (using the materials test procedure in A.5.4).

A.5.2 Separate verification method (6.2.1.1 and A.9.2.3)

The separate control instrument is used to weigh the material either before or after it is weighed on the discontinuous totalising automatic weighing instrument.

A.5.2.1 Calculation of error (6.2.5)

When calculating the error, it is necessary to consider the scale interval of the control indicating device and the number of subdivisions of the test load.

The mass values on the separate control instrument are observed and recorded. The error for automatic weighing shall be the difference between the conventional true value of the mass of the test load determined on the separate control instrument (6.2.3 (a)) and the values obtained from the principal totalisation indication (6.2.4 (a)).

Supprimé : weight

This is the value that shall be used for comparison with the appropriate maximum permissible error for automatic weighing in 2.2.1.

A.5.3 Integral verification method (6.2.1.2 and A.9.2.1)

The integral control instrument is used for static weighing of material tests loads by use of a special facility (e.g. a test-stop program) to interrupt automatic weighing operation during the automatic process.

A.5.3.1 Integral verification weighing test performance

The integral verification weighing performance may be determined as follows, prior to the material tests, for determining the errors in material testing.

Apply test loads from zero up to and including Max, and similarly remove the test loads back to zero. When determining the initial intrinsic error, at least 10 different test loads shall be selected, and for other weighing tests at least 5 shall be selected. The test loads selected shall include Max and Min so that the errors may be determined for the nominal hopper loads that will be used in the material tests.

Determine the error at each test load using the procedure in A.3.6.2 if necessary to obtain the accuracy requirements of A.3.6.1.

When loading or unloading weights the load shall be progressively increased or decreased.

Errors of indication shall be recorded and taken into account when determining the errors in material testing.

A.5.3.2 Substitution material

Apply test loads from zero up to and including the maximum portion of standard weights.

Determine the error (A.3.6.2) and then remove the weights so that the no-load indication is reached.

Substitute the previous weights with substitution material until the same changeover point as used for the determination of the error is reached. Repeat the above procedure until Max of the instrument is reached.

Unload in reverse order to zero, i.e. unload the weights and determine the changeover point. Load the weights back on and remove the substitution material until the same changeover point is reached. Repeat this procedure until no-load indication is reached.

Similar equivalent procedures may be applied.

A.5.3.3 Interruption of automatic weighing during operational tests

(a) Interruption before emptying (automatic gross weighing), the gross mass indication of the loaded receptor is observed and recorded after interruption of automatic operation and completion of the automatic gross weighing but before discharge of the receptor.

(b) The static control weighing indication of the loaded receptor is observed and recorded after complete stabilisation of the instrument and auxiliary equipment following stage (a) above. If necessary, standard weights may be used to interpolate between scale intervals. The static control indication shall be corrected for the errors determined in A.5.3.1 (for increasing loads).

(c) Interruption after emptying (automatic tare weighing), the tare load indication of the empty receptor is observed and recorded after interruption of automatic operation following the discharge of the receptor and completion of the automatic tare weighing but

Supprimé : A.5.3.3.1 Interruption before emptying (automatic gross weighing)¶ ¶

Supprimé : weight

Supprimé : weight

before the receptor is loaded again.

(d) The static control weighing indication of the empty receptor is observed and recorded after complete stabilisation of the instrument following (a). The static indication shall be corrected for the errors determined in A.5.3.1 (for decreasing loads).

A.5.3.5 Calculation of error (6.2.5)

When calculating the error, it is necessary to consider the scale interval of the control indicating device and the number of subdivisions of the test load.

The error for automatic weighing shall be the difference between the conventional true value of the mass of the test load in A.5.3.6 and the values obtained from the totalisation indication in A.5.3.6

This is the value that shall be used for comparison with the appropriate maximum permissible error for automatic weighing in 2.2.1.

A.5.3.7 Conventional true value of the mass of the test load (6.2.3 (b))

The mass values obtained under static conditions on the control indicating device or those values obtained by balancing with standard weights are noted and totalized. For each weighing cycle, the net value is the difference between the values obtained in A.5.3.3.1 (b) and in A.5.3.3.2 (d). The conventional true value of the mass of the total test load is determined by summation of the net mass obtained at each cycle.

Supprimé : weight

Supprimé : weights

A.5.3.8 Indicated totalised mass (6.2.4 (b))

Supprimé : weight

The mass values obtained automatically on the principal totalisation indicating device are noted and totalized. For each weighing cycle, the net value is the difference between the values obtained in A.5.3.3.1 (a) and in A.5.3.3.2 (c).

Supprimé : weight

A.5.3.9 Air-enclosed integrated instruments (6.2.1.2.1, A.9.2.2)

If the instrument is installed in an air-enclosed system, the moving mass of material causes air turbulence that can affect the weighing results. To ensure that such an instrument is tested in normal conditions of use, the automatic operation shall not be interrupted during consecutive weighing cycles so that at least one receptor shall be discharged in automatic mode. In this case it is necessary to observe and record the indications according to A.5.3.3.1 (a) or A.5.3.3.2 (c) or the net mass indicated by the instrument during automatic weighings shall be used to determine the discharged mass which corresponds to the value of the test mass.

Supprimé : weight

Supprimé : weight

A.5.4 Materials test procedure (6.1, A.9)

The test procedure shall be as follows.

(1) Start up the automatic weighing system, including the surrounding equipment which is normally in use when the instrument is itself in use.
(2) Run the system for five weigh cycles (or more if necessary) to ensure normal working conditions.
(3) Halt the automatic weighing system and record the indication of totalized mass.

(4) Run the weighing system for a number of weighing cycles as specified for each test in 6.1, ensuring that the processed material can be weighed on the control instrument (integral or separate) in accordance with one of the alternative verification methods of A.5.2 or A.5.3.
(5) Halt the weighing system, and record the final indication of totalized mass.
(6) Determine the indicated totalized mass for the test from the difference between the indications at start (3) and finish (5).
(7) Repeat the above procedure for further tests as specified in 6.1.
(8) Determine the material test error from the difference between the indicated totalized mass as determined in (6) and the total mass of material determined using the control instrument as in (4).

A.5.5 Warm-up (4.2.5)

This test is to verify that metrological performance is maintained in the period immediately after switch on. The method is to check that automatic operation is inhibited until a stable indication is obtained and to verify that zero and span errors comply with the requirements during the first 30 minutes of operation. Zero-tracking and automatic zero-setting shall be disabled, unless if the zero operates as part of every automatic weighing cycle then this function shall be enabled or simulated as part of the test.

Note: For instruments that do not tare weigh after each discharge it is not necessary to calculate the zero variation error.

Other test methods which verify that metrological performance is maintained during the first 30 minutes of operation may be used.

(1) Disconnect the instrument from the supply for a period of at least 8 hours prior to the test.
(2) Reconnect the instrument and switch on while observing the load indicator.
(3) Check that it is not possible to initiate automatic weighing until the indicator has stabilized (4.2.2).
(4) As soon as the indication has stabilized, set the instrument to zero if this is not done automatically.
(5) Determine the error at zero by the method of Annex A.3.6.2.1, and specify this error as E_{0I} (error of initial zero-setting) at first and as E_0 (zero-setting error) when repeating this step.
(6) Apply a static load close to Max. Determine the error by the method of A.3.6.2.1 and A.3.6.2.2.
(7) Verify that:
- zero indication error (E_{0I}) is not greater than 0.25 d_t (3.8.1.1),
- span error is not greater than the maximum permissible error specified in 2.2.2 Table 2 for initial verification.

(8) Repeat steps (5) and (6) after 5, 15 and 30 minutes.
(9) After each time interval verify that:
- zero variation error ($E_0 - E_{0I}$) is not greater than 0.25 $d_t * P_i$,
- span error is not greater than the maximum permissible error specified in 2.2.2 Table 2 for initial verification

Supprimé : 3.6.1

A.5.6 Zero-setting (3.8.1)

Supprimé : 3.6.1

A.5.6.1 Modes of zero-setting

It is normally only necessary to test the range and accuracy of zero-setting in one mode. If zero is set as part of the automatic weighing cycle then this mode shall be tested. To test automatic zero it is necessary to allow the instrument to operate through the appropriate part of the automatic cycle and then to halt the instrument before testing.

The range and accuracy of zero-setting shall be tested by applying loads as specified below in nonautomatic (static) operation to the load receptor after the instrument is halted.

A.5.6.2 Range of zero-setting

A.5.6.2.1 Initial zero-setting

The initial zero-setting range is the sum of the positive and negative portions of the initial zero-setting range.

(a) *Positive range*

With the load receptor empty, set the instrument to zero. Place a test load on the load receptor and switch the instrument off and then back on. Continue this process until, after placing a load on the load receptor and switching the instrument off and on, it does not reset to zero. The maximum load that can be re-zeroed is the positive portion of the initial zero-setting range.

(b) *Negative range*

Remove any weights from the load receptor and set the instrument to zero. Then remove the load receptor (platform) from the instrument. If, at this point, the instrument can be reset to zero by switching it off and back on, the mass of the load receptor is used as the negative portion of the initial zero-setting range.

If the instrument cannot be reset to zero with the load receptor removed, add weights to any live part of the scale (e.g. on the parts where the load receptor rests) until the instrument indicates zero again.

Then remove weights and, after each weight is removed, switch the instrument off and back on. The maximum load that can be removed while the instrument can still be reset to zero by switching it off and on is the negative portion of the initial zero-setting range.

The zero-setting range is the sum of the positive and negative portions.

A.5.6.2.2 Nonautomatic and semi-automatic zero-setting

This test is conducted in the same manner as described in A.5.5.2.1, except that the zero-setting device is used rather than switching the instrument on and off.

A.5.6.2.3 Automatic zero-setting

This test shall not be carried out during the span stability test.

Remove the non-essential parts of the load receptor or re-calibrate the instrument as described in A.5.6.2.1 and place weights on the live part of the scale until it indicates zero.

Remove weights in small amounts and after each weight is removed allow the instrument to operate through the appropriate part of the automatic cycle so as to see if the instrument is reset to zero automatically. Repeat this procedure until the instrument will not reset to zero automatically.

The maximum load that can be removed so the instrument can still be reset to zero is the zero-setting range.

A.5.6.3 Accuracy of zero-setting

(1) Set the instrument to zero.
(2) Add weights to the load receptor to determine the additional load at which the indication changes from zero to one totalisation scale interval above zero.
(3) Calculate the error at zero according to the description in A.3.6.2.1.

A.5.6.4 Stability of zero and frequency of automatic zero-setting (3.8.1.5)

This test is applicable for instruments with programmable automatic zero-setting and does not need to be performed for instruments that have automatic zero-setting as part of every automatic weighing cycle or instruments that do tare weigh after each discharge.

To verify that an automatic zero-setting facility will operate sufficiently often to ensure that zero error is not greater than 0.5 d_t, apply the following method:

(1) Determine the maximum permissible time interval as specified by the manufacturer in accordance with 3.8.1.5,
(2) Allow the instrument to be reset to zero automatically.
(3) After an interval close to the maximum permissible zero-setting interval established in (1) but before a further automatic zero-setting, carry out the test of A.5.6.3, but without zero-setting.
(4) Steps (2) and (3) shall also be carried out as soon the instrument is operable after switch-on, i.e. immediately after the normal warm-up time.

A.6 ADDITIONAL FUNCTIONALITY

A.6.1 Test for the stability of equilibrium (3.5.6)

Check the documentation of the manufacturer; whether the following stable equilibrium functions are described in detail and sufficiently:

- The basic principle, the function and the criteria for stable equilibrium.
- All adjustable and not adjustable parameters of the stable equilibrium function (time interval, number of measuring cycles, etc.).

- Securing of these parameters.
- Definition of the most critical adjustment of the stable equilibrium.

Test of the stable equilibrium by manually disturbing the equilibrium by one single action (e.g. by operation of a test switch) and initiate the command for printing, recording to data storage or other function, as soon as possible. In the case of printing or data storage, read the indicated value 5 seconds after printing. Stable equilibrium is considered to be achieved when no more than two adjacent values are indicated, one of which being the printed value. In the case of zero-setting check the accuracy as per A.5.5.3. Perform the test 5 times.

Check whether under continuous disturbance of the equilibrium no functions can be performed that require stable equilibrium, e.g. printing, storing, or zero operations.

A.6.2 Agreement between indicating and printing devices (2.4)

During the tests verify that for the same load, the difference between any two indicating devices having the same scale interval is as follows:

- zero for digital indicating or printing devices;
- not greater than the maximum permissible error for analogue devices.

A.6.3 Adjustments in automatic operating mode (3.2.5)

Verify that it is not possible to make operating adjustments nor to reset the indicating devices during an automatic weighing operation.

A.6.4 Securing of components and pre-set controls (3.3)

Verify that it is not possible to make unauthorised adjustments or resetting of components, interfaces, software devices and pre-set controls without any access becoming automatically evident.

A.6.5 Indication and printing of weighing results (3.5)

For indication and printing of weighing results, verify that:

- in automatic operation the principle totalisation device cannot be reset to zero;
- in static weighing conditions the partial totalisation device cannot be reset to zero unless the total is automatically recorded. Test by disabling the printing device and attempting to reset the partial totalisation device;
- an automatic printing of the total is generated if the automatic operation is interrupted;
- printing is inhibited if the stability criteria (3.4) are not fulfilled.

A.6.6 Retention of total after power failure (4.2.7)

Switch off power to the instrument while the principle totalisation device is indicating a total of not less than $\sum_{min}$. Verify that this total is retained for at least 24 hours.

A.6.7 Voltage variations in external or plug-in (AC or DC) mains power, including on-line rechargeable battery power supply (4.2.8)

Reduce supply voltage until the instrument ceases to operate or ceases to give a mass indication. Verify that no malfunction or significant fault occurs before the instrument is thus put out of service. Measure and record the voltage value when the instrument ceases to operate or ceases to give a mass indication and compare this measured value with the manufacturer's specified value.

Supprimé : weight

Supprimé : weight

A.6.8 Zero offset interlock (3.8.1.3)

A.6.8.1 Positive offset

Set the instrument to zero by the method used for the tests in A.5.5.2. Add a load to the load receptor of > d_t, for instruments with an automatic zero-setting device, or > 0.5 d_t, for instruments without an automatic zero-setting device. Confirm that automatic operation is no longer possible.

A.6.8.2 Negative offset

Add a load to the load receptor of > d_t, for instruments with an automatic zero-setting device, or > 0.5 d_t, for instruments without an automatic zero-setting device.

Set the instrument to zero by the method used for the tests in A.5.5.2. Remove the test weights and confirm that automatic operation is no longer possible.

A.7 INFLUENCE FACTOR AND DISTURBANCE TESTS

A.7.1 General

Influence factor and disturbance tests are intended to verify that electronic instruments can perform and function as intended in the environment and under the conditions specified. Each test indicates, where appropriate, the reference condition under which the intrinsic error is determined.

The influence factors or disturbances tests shall be applied to a complete instrument under normal operation. Where it is not possible to apply the influence factors or disturbances to an instrument under normal operation, the instrument shall be subjected to the influence factors or disturbances under static conditions or simulated operation as defined herein. The minimum requirements for simulators are listed under the test equipment heading for each test. The permissible effects of the influence factors or disturbances, under these conditions, are specified for each case.

When the effect of one influence factor is being evaluated, all other factors are to be held relatively constant, at a value close to normal. After each test the instrument shall be allowed to recover sufficiently before the following test.

Where modules of the instrument are examined separately, errors shall be apportioned in accordance with 5.1.3.3.

Supprimé : parts

After each test the instrument shall be allowed to recover sufficiently before the following test.

The operational status of the instrument or simulator shall be recorded for each test.

When an instrument is connected in other than a normal configuration, the procedure shall be mutually agreed on by the metrological authority and the applicant.

A.7.2 Simulator requirements

A.7.2.1 General

Simulators shall be designed to enable verification of the accuracy of the weighing function and the integrity of the totalisation storage and indicating function. The automatic process control and data processing functions should be verified where possible.

Where possible the simulator should include all electronic devices of the weighing processing system. It should also include the load cell and a means to apply standard test loads. Where this is not possible, e.g. for high capacity instruments, then a load cell simulator may be used or alternatively the load cell interface may be modified to incorporate a scaling factor to give the design output for a small test load.

Supprimé : and weight

Repeatability and stability of a load cell simulator should make it possible to determine the performance of the instrument with at least the same accuracy as when the instrument is tested with weights.

A.7.2.2 Interface (4.2.6)

Susceptibility that would result from the use of electronic interfaces to other equipment shall be simulated in the tests. For this purpose it is sufficient to connect 3 m of interface cable terminated to simulate the interface impedance of the other equipment.

A.7.2.3 Documentation

Simulators shall be defined in terms of hardware and functionality by reference to the instrument under test, and by any other documentation necessary to ensure reproducible test conditions and this information shall be attached to or traceable from the test report.

A.7.2.4 Weighing function

The weighing function may be verified by observation of the control indicating device, if available, during application of the influence factors or disturbances.

Alternatively the totalisation indicator may be observed while the total is being incremented by continually adding the result of weighing a static load during application of the influence factors or disturbances. This may be achieved by special test software or by manual intervention or combinations thereof. Other methods which enable the weighing function to be verified may be used as appropriate. The maximum permissible errors, in terms of mass, will be the same regardless of the method used.

A.7.2.5 Totalisation storage and indication function

The simulator must display a recorded total of not less than the minimum totalized load, $\sum_{min}$. It must be verified that the recorded total is retained during and after application of influence factors or disturbances. Transient errors that are not possible to record and temporary failure of indication when disturbances are applied are acceptable.

In case of purely digital totalisation device(s), the totalisation device(s) need not be tested during influence factor testing. The operation of the totalisation device(s) shall be checked at least once during normal operating conditions

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A.7.3 Influence factor tests

Summary of tests

Test	Criteria	§
Static temperatures	MPE(*)	A.7.3.1
Temperature effect on no load indication	MPE	A.7.3.2
Damp heat test steady-state	MPE	A.7.3.3
AC mains power voltage variation	MPE	A.7.3.4
External or plug-in power (AC or DC), including rechargeable battery power supply	MPE	A.7.3.5
Battery power (DC), non-rechargeable and including rechargeable battery if (re)charge of battery during the operation of the instrument is not possible	MPE	A.7.3.6
Voltage variations in 12 V and 24 V road vehicle battery power	MPE	A.7.3.7

(*) maximum permissible errors as specified in 2.2.2

A.7.3.1 Static temperature tests (2.7.1.1)

Static temperature tests are carried out according to basic standard IEC Publication 60068-2-1 [10], IEC Publication 60068-2-2 [11] and IEC 60068-3-1 [12], and according to Table 4.

Table 4 -Static temperature test

Environmental Phenomena	Test specification	Test set-up
Temperature	Reference temperature of 20 °C	IEC 60068-2-2 IEC 60068-2-1 IEC 60068-3-1
	Specified high temperature for 2 hours	
	Specified low temperature for 2 hours	
	Temperature of 5 °C, if the specified low temperature is ≤ 0 °C	
	Reference temperature of 20 °C	
Note: Use IEC 60068-3-1 for background information.		

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in 2.7.1.1 under conditions of dry heat (non-condensing) and cold. The test in A.7.2.2 may be conducted during this test.
Test procedure in brief:	The test consists of exposure of the EUT to a steady ambient temperature within the range stated in 2.7.1.1.
Preconditioning:	16 hours
Condition of the EUT:	EUT is connected to the voltage supply and «on» for a time period equal to or greater than the warm-up time specified by the manufacturer. Voltage supply is to be «on» for the duration of the test. The zero-setting and zero-tracking facilities shall be enabled as for normal operation. If the test is performed together with A.7.2.2 automatic zero-setting and zero tracking shall not be in operation.
Stabilisation:	2 hours at each temperature under «free air» conditions. «Free air» conditions mean a minimum air circulation to keep the temperature at a stable level.
Temperature:	As specified in 2.7.1.1
Temperature sequence:	a) at the reference temperature of 20 °C b) at the specified high temperature, c) at the specified low temperature, d) at a temperature of 5 °C, if the specified low temperature is below 10 °C, and e) at the reference temperature
Barometric pressure	Changes in barometric pressure shall be taken into account.
Number of test cycles:	At least one cycle.
Test information:	Adjust the EUT as close to zero indication as practicable prior to the test (if an automatic zero-tracking device is connected, adjust it to a value near zero). The EUT shall not be readjusted at any time during the test. After stabilisation at the reference temperature and again at each specified temperature, apply at least five different test loads or simulated loads and record: a) date and time; b) temperature; c) relative humidity; d) test load; e) indications (as applicable); f) errors; g) functional performance. The EUT shall display a recorded total not less than the minimum totalized load, $\sum_{min}$, but observe A.7.2.5.

Maximum allowable variations: All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 2.2.2 Table 2.

A.7.3.2 Temperature effect on the no-load indication (2.7.1.2)

No reference to international standards can be given at the present time. This test should therefore be conducted as described below.

This test does not need to be performed for instruments that have automatic zero setting as part of every automatic weighing cycle or that do tare weigh after each discharge.

The instrument is set to zero, the temperature is then changed from 20 °C to the prescribed highest and lowest temperature, to 5 °C and to reference 20 °C. After stabilization the error of the zero indication is determined at each temperature level. The change in zero indication per 5 °C is calculated. The changes of these errors are calculated for any two consecutive temperatures of this test.

This test shall be performed together with the temperature test (A.7.3.1). The errors at zero shall then be additionally determined immediately before changing to the next temperature and after the 2-hour period after the instrument has reached stability at this temperature.

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Note: Pre-loading is not allowed before these measurements.

Automatic zero-setting or zero-tracking if available shall not be in operation.

Maximum allowable variations: The change in zero indication shall not vary by more than one totalisation scale interval for a temperature difference of 5 °C.

Condition of EUT: Normal power «on» for a time period equal to or greater than the warm-up time specified by the manufacturer. Power is to be «on» for the duration of the test.

A.7.3.3 Damp heat, steady-state (4.2.3)

Damp heat, steady state tests are carried out according to basic standard IEC Publication 60068-2-78 [13] and IEC Publication 60068-3-4 [14], and according to Table 5.

Table 5 - Damp heat, steady state test

Environmental phenomena	Test specification	Test set-up
Damp heat, Steady state.	Upper limit temperature and relative humidity of 85% for 48 hours.	IEC 60068-2-78 IEC 60068-3-4
Note: Use IEC 60068-3-4 for guidance for damp heat tests.		

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in 4.1.1 under conditions of high humidity and constant temperature.
Test procedure in brief:	
Preconditioning:	None required.
Condition of the EUT:	EUT is connected to the voltage supply and «on» for a time period equal to or greater than the warm-up time specified by the manufacturer. The zero-setting and zero-tracking facilities shall be enabled as for normal operation. The handling of the EUT shall be such that no condensation of water occurs on the EUT.
Stabilisation:	3 hours at reference temperature and 50 % humidity. 2 days at the upper limit temperature as specified in 2.7.1.1.
Temperature:	Reference temperature (20 °C or the mean value of the temperature range whenever 20 °C is outside this range) and at the upper limit as specified in 2.7.1.1.
Temperature-humidity 48 hour sequence:	a) Reference temperature of 20 °C at 50 % humidity; b) Upper limit temperature at 85 % humidity; c) Reference temperature of 20 °C at 50 % humidity.
Barometric pressure:	Changes in barometric pressure shall be taken into account.
Number of test cycles:	At least one cycle.
Test information:	After stabilisation of the EUT at reference temperature and 50 % humidity, apply at least five different test loads or simulated loads and record: a) date and time; b) temperature; c) relative humidity; d) test load; e) indications (as applicable); f) errors; g) functional performance. Increase the temperature in the chamber to the upper limit and increase the relative humidity to 85 %. Maintain the EUT at no load for a period of 48 hours. Following the 48 hours, apply the same test loads or simulated loads and record the data as indicated above. Decrease the relative humidity to 50 % and decrease the temperature in the chamber to the reference temperature. After stabilisation of the EUT, apply the same test loads or simulated loads and record the data as indicated above. The EUT shall display a recorded total not less than the minimum totalized load, $\sum_{min}$, but observe A.7.2.5.

Allow full recovery of the EUT before any other tests are performed.

Maximum allowable variations: All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 2.2.2 Table 2.

A.7.3.4 AC mains power voltage variation (2.7.2, 4.2.7)

AC mains power voltage variation tests are carried out according to basic standard IEC Publication 61000-2-1 [15] and IEC Publication 61000-4-1 [16], and according to Table 6.

Table 6 - AC mains power voltage

Environmental phenomena	Test specification		Test set-up
AC mains power voltage supply variation	U_{nom}		IEC 61000-2-1 IEC 61000-4-1 IEC 61000-4-11
	Upper limit:	1.10 x U_{nom} or 1.10 x U_{max}	
	Lower limit:	0.85 x U_{nom} or 0.85 x U_{min}	
	U_{nom}		
Note. Where an instrument is powered by a three phase supply, the voltage variations shall apply for each phase successively			

Supplementary information to the IEC test procedures:

Object of the test: To verify compliance with the provisions in 2.7.2 under conditions of AC mains voltage variations.

Test procedure in brief:

Preconditioning: None required.

Condition of the EUT: EUT is connected to the AC mains voltage and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable prior to the test and do not readjust at anytime during the test except to reset if a significant fault has occurred.

Number of test cycles: At least one cycle.

Test information: The EUT shall be tested with a test or simulated load at or near Min and with one test load or simulated load between 50 % and the maximum capacity of the EUT.

Stabilize the EUT at the nominal voltage and record the following data:

a) date and time;
b) temperature;
c) relative humidity;
d) AC voltage supply;

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A.7.3.3.2 Damp heat, cyclic (condensing)¶
¶
Damp heat, cyclic tests are carried out according to basic standard IEC Publication 60068-3-4 [13] and IEC Publication 60068-2-30 [14], and according to Table 6.¶
¶
Note: This test applies to cases where condensation is likely to occur or when the instrument is to be installed in high cyclic temperature environments.¶
¶
Table 6 - Damp heat, cyc ... [1]

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e) test loads;
f) indications (as applicable);
g) errors;
h) functional performance.

Repeat the test for each of the voltages defined in IEC 61000-4-1, section 5 (noting the need in certain cases that the weighing test will be repeated at both ends of the voltage range) and record the indications.

The EUT shall display a recorded total not less than the minimum totalized load, $\sum_{min}$, but observe A.7.2.5.

Maximum allowable variations: All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 2.2.2 Table 2.

A.7.3.5 External or plug-in power (AC or DC), including on-line rechargeable battery power supply (2.7.2, 4.2.8)

Tests of instruments with external or plug-in mains power (AC or DC), including on-line rechargeable battery power shall be conducted in accordance with A.7.3, with the exception of A.7.3.4, which is to be replaced by the test according to basic standard IEC Publication 60654-2 [17] and according to Table 7.

Table 7 – External or plug-in power (AC or DC), including rechargeable battery power supply if (re)charge of batteries during the operation of the instrument is possible

Environmental phenomena	Test specification		Test set-up
Voltage variations in external or plug-in power (AC or DC), including off-line rechargeable battery power supply	U_{nom}		I EC 60654-2
	Upper limit	1.20 x U_{nom} or 1.20 x U_{max}	
	Lower limit	minimum operating voltage (see 2.7.2)	
	U_{nom}		
Note: In case a voltage-range is marked, use the average value as nominal U_{nom}			

Supplementary information to the IEC test procedures:

Object of the test: To verify compliance with the provisions in 2.7.2 under conditions of voltage variations in external or plug-in power (AC or DC), including on-line rechargeable battery power.

Test procedure in brief: The test consists of exposure to the specified power condition when operating under normal atmospheric conditions with one test load or simulated load.

Preconditioning: None

Condition of the EUT	Normal power supplied and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test.
Number of test cycles:	At least one cycle.
Weighing test :	Stabilize the power at the reference voltage within the defined limits and record the following data at no load and with one load or simulated load: a) date and time; b) temperature; c) relative humidity; d) power supply; e) test load; f) indications (as applicable); g) errors; h) functional performance Reduce the voltage to the EUT until the instrument ceases to function properly according to the specifications and metrological requirements, and record the indications. The EUT shall display a recorded total not less than the minimum totalized load, $\sum_{min}$, but observe A.7.2.5.
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 2.2.2 Table 2.

A.7.3.6 Battery power (not mains connected), non-rechargeable and also including rechargeable battery power supply if (re)charge of battery during the operation of the instrument is not possible (2.7.2, 4.2.8)

Battery-powered instruments shall fulfil the tests in A.7.3, with the exception of A.7.3.4, A. 7.3.5 and A. 7.3.7 which are to be replaced by the test in Table 8.

Table 8 - Battery power (not mains connected), including rechargeable auxiliary battery

Environmental phenomena	Test specification		Test set-up
Low voltage of fully charged battery voltage (DC)	U_{nom}		No reference to standards for this test.
	Upper limit	U_{nom} or x U_{max}	
	Lower limit	minimum operating voltage (see 2.9.2)	
	U_{nom}		

Note:	In case a voltage-range is marked, use the average value as nominal U_{nom}

Supplementary test information:

Object of the test:	To verify compliance with the provisions in 2.7.2 under conditions of low voltage variations in battery power, including non-rechargeable battery supply if (re)charge of battery during the operation of the instrument is not possible.
Test procedure in brief:	The test consists of exposure to the specified condition of the battery for a period sufficient for achieving temperature stability and for performing the required measurements.
Pre-condition:	None
Condition of the EUT:	EUT is connected to the battery and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test.
Number of test cycles:	At least one cycle.
Test information:	Stabilize the power at the reference voltage within the defined limits and record the following data at no load and with one load or simulated load: a) date and time; b) temperature; c) relative humidity; d) power supply; e) test load; f) indications (as applicable); g) errors; h) functional performance Reduce the voltage to the EUT until the instrument ceases to function properly according to the specifications and metrological requirements, and record the indications. The EUT shall display a recorded total not less than the minimum totalized load, $\sum_{min}$, but observe A.7.2.5.
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 2.2.2 Table 2.

A.7.3.7 Voltage variation of 12 V and 24 V road vehicle batteries (2.7.2)

Instruments operated form 12 V and 24 V road vehicle battery power shall fulfil the tests in A.7.3, with the exception of A.7.3.4 and A.7.3.5 which is to be replaced by the following test according to ISO 16750-2 [18] and according to Table 9.

Table 9

Environmental phenomena	Test specification			Test set-up
	U_{nom}	Upper limit	Lower limit	
Voltage variation of 12 V and 24 V road vehicle batteries	12 V	16 V	minimum operating voltage (see 2.9.2)	ISO 16750-2
	24 V	32 V		
Note: The nominal voltage (U_{nom}) of the electrical system in road vehicles is usually 12 V or 24 V. But the practical voltage at the battery-terminal points can vary considerably.				

Supplementary information to the ISO test procedures:

Object of the test:	To verify compliance with the provisions in 2.7.2 under conditions of voltage variation in 12 V and 24 V road vehicle batteries.
Test procedure in brief:	The test consists of exposure to the specified condition of the battery when the former is operating under normal atmospheric conditions with one test load or simulated load.
Preconditioning:	None
Condition of the EUT	Normal power supplied and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test.
Number of test cycles:	At least one cycle.
Weighing test:	Stabilize the power supply at nominal battery voltage and record the following data at no load and with one load or simulated load: a) date and time; b) temperature; c) relative humidity; d) power supply voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance. Reduce the power voltage to the EUT until the instrument ceases to function properly according to the specifications and metrological requirements, and record the indications. The EUT shall display a recorded total not less than the minimum totalized load, $\sum_{min}$, but observe A.7.2.5.

Maximum allowable variations: All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 2.2.2 Table 2.

A.7.4 Disturbance tests (4.1.2)

Summary of tests		
Test	Criteria	§
AC mains short time power reduction	sf (*)	A.7.4.1
Electrical bursts (fast transients) on mains power lines and on signal and communication lines	sf	A.7.4.2
Electrical surges on mains power lines and on signal and communication lines	sf	A.7.4.3
Electrostatic discharge	sf	A.7.4.4
Immunity to electromagnetic fields	sf	A.7.4.5
Electrical transient conduction for 12 V and 24 V batteries	sf	A.7.4.6

(*) value of the significant fault (see T.4.5.6)

Prior to any test, the rounding error shall be set as close as possible to zero.

If there are interfaces on the instrument (or simulator), the use of these interfaces to other equipment shall be simulated in the tests. For this purpose, either an appropriate peripheral device or 3 m of interface cable to simulate the interface impedance of the other equipment, shall be connected to each different type of interface.

A.7.4.1 AC mains short time power reductions

Short time power reduction (voltage dips and short interruptions) tests are carried out according to basic standard IEC Publication 61000-4-11 [19] and according to Table 10.

Table 10- Short time power reductions

Environmental phenomena	Test specification			Test set-up
	Test	Reduction of amplitude to	Duration / Number of cycles	
Voltage dips and short interruptions	Test a	0 %	0.5	IEC 61000-4-11
	Test b	0 %	1	
	Test c	40 %	10	
	Test d	70 %	25	
	Test e	80 %	250	
	Short	0 %	250	

	interruption			
Notes:	A test generator suitable to reduce for a defined period of time the amplitude of one or more half cycles (at zero crossings) of the AC mains voltage shall be used. The test generator shall be adjusted before connecting the EUT. The mains voltage reductions shall be repeated 10 times with an interval of at least 10 seconds.			

Supplementary information to the IEC test procedures

Object of the test:	To verify compliance with the provisions in 4.1.2 under conditions of short time mains voltage interruptions and reductions while observing the indication of a single static load.
Test procedure in brief:	
Preconditioning:	None required.
Condition of the EUT:	EUT is connected to the voltage supply and «on» for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to re-set if a significant fault has occurred.
Number of test cycles:	At least one cycle.
Test information:	The EUT shall be tested with one small static test load. Stabilize all factors at nominal reference conditions. Apply one load or simulated load and record: a) date and time; b) temperature; c) relative humidity; d) voltage supply; e) test load; f) indications (as applicable); g) errors; h) functional performance In accordance with the test specification in Table 10, interrupt the voltages to the corresponding durations / number of cycles and conduct the test as detailed in IEC 61000-4-11 section 8.2.1. During interruption observe the effect on the EUT and record as appropriate.
Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed 1 d_t, or the EUT shall detect and act upon a significant fault.

A.7.4.2 Electrical bursts (Fast transient tests) on mains power lines and on signal and communication lines

Electrical bursts tests (fast transients) are carried out at the positive and the negative polarity for at least 1 minute at each polarity in accordance with the basic standard IEC 61000-4-4 [20] and according to Tables 11.1 and 11.2.

Table 11.1: Ports for signal and communication lines

Environmental phenomena	Test specification	Test set-up
Fast transient common mode	0.5 kV (peak) 5/50 ns T_1/T_h 5 kHz rep. frequency	IEC 61000-4-4
Note: Applicable only to ports or interfacing with cables whose total length exceed 3 m according to the manufacturer's functional specification.		

Table 11.2: Input and output AC and DC power ports

Environmental phenomena	Test specification	Test set-up
Fast transient common mode	1 kV (peak) 5/50 ns T_1/T_h 5 kHz rep. frequency	IEC 61000-4-4
Note: DC power ports, not applicable to battery-operated appliance that cannot be connected to the mains while in use.		

Supplementary information to the IEC test procedures

Object of the test: To verify compliance with the provisions in 4.1.2 under conditions where fast transients are superimposed separately on the mains voltage, and on the signal and communication lines (if any), while observing the indications for one static test load.

Test procedure in brief: The duration of the test shall not be less than one minute for each amplitude and polarity. The injection network on the mains shall contain blocking filters to prevent the burst energy being dissipated in the mains. For the coupling of the bursts into the input/output and communication lines, a capacitive coupling clamp as defined in the reference standard shall be used.

Preconditioning: None required.

Condition of the EUT: EUT is connected to the power supply source and «on» for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to re-set if a significant fault has occurred.

Number of test cycles: At least one cycle.

Weighing test: The EUT shall be tested with one small static test load.

Before any test stabilize the EUT under constant environmental conditions. Apply one load or simulated load and record:

a) date and time;
b) temperature;
c) relative humidity;
d) supply voltage;
e) test load;
f) indications (as applicable);
g) errors;
h) functional performance

Maximum allowable variations: The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed 1 d_t, or the EUT shall detect and act upon a significant fault.

A.7.4.3 Electrical surges on mains power lines and on signal and communication lines

Electrical surge tests are carried out according to IEC 61000-4-5 [21] and according to Table 12.

Table 12 - Electrical surges

Environmental phenomena	Test specification	Test set-up
Surges on mains power lines and on I/O circuits and communication lines	0.5 kV line to line 1.0 kV line to earth a) 3 positive and 3 negative surges applied synchronously with AC supply voltage in angles 0°, 90°, 180° and 270°. b) 3 positive and 3 negative surges applied on DC power lines and on communication lines.	IEC 61000-4-5
Note:	This test is only applicable in those cases where, based on typical situations of installation, the risk of a significant influence of surges can be expected. This is especially relevant in cases of outdoors installations and/or indoor installations connected to long signal lines (lines longer than 30 m or those lines partially or fully installed outside the buildings regardless of their length). The test is applicable to the power lines and other lines for signal and communication. It is also applicable to DC powered instruments if the power supply comes from a DC network.	

Supplementary information to the IEC test procedures

Object of the test: To verify compliance with the provisions in 4.1.2 under conditions where electrical surges are applied separately to the mains power lines, and to the signal and communication lines (if any), while observing the indications for one static test load.

Test procedure in brief: The test consists of exposure to surges for which the rise time, pulse width, peak values of the output voltage/current on high/low

impendence load and minimum time interval between two successive pulses are defined in IEC 61000-4-5.

The injection network depends on the lines the surge is coupled to and is defined in IEC 61000-4-5.

Preconditioning: None required.

Condition of the EUT: EUT connected to the power supply source and «on» for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to re-set if a significant fault has occurred.

Number of test cycles: At least one cycle.

Weighing test: The EUT shall be tested with one small static test load.

Before any test stabilize the EUT under constant environmental conditions. Apply one load or simulated load and record:

a) date and time;
b) temperature;
c) relative humidity;
d) supply voltage;
e) test load;
f) indications (as applicable);
g) errors;
h) functional performance

Maximum allowable variations: The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed 1 d_t, or the EUT shall detect and act upon a significant fault.

A.7.4.4 Electrostatic discharge test

Electrostatic discharge tests are carried out according to basic standard IEC 61000-4-2 [22], with test signals and conditions as given in Table 13.

Table 13 - Electrostatic discharge test

Environmental phenomena	Test specification		Test set-up
Electrostatic discharge	Test voltage	Levels(1)	IEC 61000-4-2
	contact discharge	6 kV	
	air discharge	8 kV	
Notes: 1) Tests shall be performed at the specified lower levels, starting with 2 kV and proceeding with 2 kV steps up to and including the level specified above in			

accordance with IEC 61000-4-2.

2) The 6 kV contact discharge shall be applied to conductive accessible parts. Metallic contacts, e.g. in battery compartments or in socket outlets are excluded from this requirement.

Contact discharge is the preferred test method. 20 discharges (10 with positive and 10 with negative polarity) shall be applied on each accessible metal part of the enclosure. The time interval between successive discharges shall be at least 10 seconds. In the case of a non-conductive enclosure, discharges shall be applied on the horizontal or vertical coupling planes as specified in IEC 61000-4-2. Air discharges shall be used where contact discharges cannot be applied.

Supplementary information to the IEC test procedures

Object of the test:	To verify compliance with the provisions in 4.1.2 under conditions where electrostatic discharges are applied while observing the indication for one small static test load.
Test procedure in brief:	
Preconditioning:	None required.
Condition of the EUT:	EUT is connected to the power supply source and «on» for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to re-set if a significant fault has occurred.
Number of test cycles:	At least one cycle.
Weighing test:	The EUT shall be tested with one small static test load. Before any test stabilize the EUT under constant environmental conditions. Apply one load or simulated load and record the following with and without electrostatic discharge: a) date and time; b) temperature; c) relative humidity; d) supply voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance
Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed 1 d_t, or the EUT shall detect and act upon a significant fault.

A.7.4.5 Immunity to electromagnetic fields

A.7.4.5.1 Immunity to radiated electromagnetic fields

Radiated, radio frequency, electromagnetic field immunity tests are carried out in accordance to IEC 61000-4-3 [23] and according to Table 14.

The unmodulated carrier of the test signal is adjusted to the indicated test value. To perform the test the carrier is in addition modulated as specified.

Table 14 - Immunity to radiated electromagnetic fields

Test specification			
Environmental phenomena	Frequency ranges MHz	Field strength (V/m)	Test set-up
Immunity to radiated electromagnetic fields	80 to 2000(1)	10	IEC 61000-4-3
	26 to 80(2)		
	1400 to 2000		
Modulation	80 % AM, 1 kHz sine wave		

Notes:
1) IEC 61000-4-3 only specifies test levels above 80 MHz. For frequencies in the lower range the test methods for conducted radio frequency disturbances are recommended (A.6.3.5.2).
2) For EUTs having no mains or other I/O ports available so that the test according to A.6.3.5.2 cannot be applied, the lower limit of the radiation test is 26 MHz.

Supplementary information to the IEC test procedures

Object of the test: To verify compliance with the provisions in 4.1.2 under conditions of specified radiated electromagnetic fields applied while observing the indication for one small static test load.

Supprimé : weight

Test procedure in brief:

Preconditioning: None required.

Condition of the EUT: EUT is connected to the power supply source and «on» for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to re-set if a significant fault has occurred.

Number of test cycles: At least one cycle.

Weighing test: The EUT shall be tested with one small static test load.

Before any test stabilize the EUT under constant environmental conditions. Apply one load or simulated load and record:

a) date and time;
b) temperature;
c) relative humidity;
d) supply voltage;
e) test load;
f) indications (as applicable);
g) errors;
h) functional performance

Maximum allowable variations: The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed 1 d_t, or the EUT shall detect and act upon a significant fault.

A.7.4.5.2 Immunity to conducted electromagnetic fields

Conducted, radio-frequency, electromagnetic field immunity tests are carried out in accordance to IEC 61000-4-6 [24] and according to Table 15.

The unmodulated carrier of the test signal is adjusted to the indicated test value. To perform the test the carrier is in addition modulated as specified.

Table 15 - Immunity to conducted electromagnetic fields

Test specification			
Environmental phenomena	Frequency range MHz	RF amplitude (50 ohms) V (e.m.f)	Test set-up
Immunity to conducted electromagnetic fields	0.15 to 80	10	IEC 61000-4-6
Modulation	80 % AM, 1 kHz sine wave		
Note: 1) This test is not applicable when the EUT has no mains or other input port. 2) Coupling and decoupling devices shall be used for appropriate coupling of the disturbing signal (over the entire frequency range, with a defined common-mode impedance at the EUT port) to the various conducting cables connected to the EUT.			

Supplementary information to the IEC test procedures

Object of the test: To verify compliance with the provisions in 4.1.2 under conditions of specified conducted electromagnetic fields applied while observing the indication for one small static test load.

Supprimé : weight

Test procedure in brief:

Preconditioning: None required.

Condition of the EUT: EUT is connected to the power supply source and «on» for a time

period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to re-set if a significant fault has occurred.

Number of test cycles: At least one cycle.

Weighing test: The EUT shall be tested with one small static test load.

Before any test stabilize the EUT under constant environmental conditions. Apply one load or simulated load and record:

a) date and time;
b) temperature;
c) relative humidity;
d) supply voltage;
e) test load;
f) indications (as applicable);
g) errors;
h) functional performance

Maximum allowable variations: The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed 1 d_t, or the EUT shall detect and act upon a significant fault.

A.7.4.6 Electrical transient conduction for instruments powered from a road vehicle battery

A.7.4.6.1 Conduction along supply lines of 12 V and 24 V batteries

For this test refer to ISO 7637-2 [25] and according to Table 16.

Table 16 - Conduction along 12 V and 24 V supply lines

Environmental phenomena	Test specification			Test set-up
Conduction along 12 V and 24 V supply lines	Test pulse	Pulse voltage U_s		ISO 7637-2
		U_{nom} = 12 V	U_{nom} = 24 V	
	2a	+50 V	+50 V	
	2b(1)	+10 V	+20 V	
	3a	-150 V	-200 V	
	3b	+100 V	+200 V	
	4	-7 V	-16 V	
Note:	Test pulse 2b is only applicable if the instrument is connected to the battery via the main (ignition) switch of the car, i.e. if the manufacturer has not specified that the instrument is to be connected directly (or by its own main switch) to the battery.			

Supplementary information to the ISO test procedures

Applicable standards	ISO 7637-2	§ 5.6.2: Test pulse 2a + b, § 5.6.3: Test pulse 3a + 3b, § 5.6.4: Test pulse 4
Object of the test	To verify compliance with the provisions in 4.1.2 under the following conditions while observing the indication for one small static test load :	

Supprimé : weight

– transients due to a sudden interruption of currents in a device connected in parallel with the device under test due to the inductance of the wiring harness (pulse 2a);
– transients from DC motors acting as generators after the ignition is switched off (pulse 2b);
– transients on the supply lines, which occur as a result of the switching processes (pulses 3a and 3b);
– voltage reductions caused by energizing the starter-motor circuits of internal combustion engines (pulse 4).

Test Procedures in brief:

Preconditioning:	None
Condition of the EUT	Normal power supplied and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable prior to the test. Zero-setting functions shall not be in operation and are not be adjusted at any time during the test except to re-set if a significant fault has occurred.
Stabilisation	Before any test, stabilize the EUT under constant environmental conditions.
Weighing test:	The test consists of exposure of the EUT to conducted disturbances (on the power voltage by direct brief coupling on supply lines) of the strength and character as specified in Table 16. With the static load in place record:

a) date and time;
b) temperature;
c) relative humidity;
d) supply voltage;
e) test load;
f) indications (as applicable);
g) errors;
h) functional performance.

Repeat the test weighing for the defined voltages and record the indications.

Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed 1 d_t, or the EUT shall detect and act upon a significant fault.

A.7.4.6.2 Electrical transient conduction via lines other than supply lines

For this test refer to ISO 7637-3 Bibliography [26] and according to Table 17.

Table 17 – Electrical transient conduction via lines other than supply lines

Environmental phenomena	Test specification			Test set-up
Electrical transient conduction via lines other than supply lines	Test pulse	Pulse voltage U_s		ISO 7637-3
		U_{nom} = 12 V	U_{nom} = 24 V	
	a	-60 V	-80 V	
	b	+40 V	+80 V	

Supplementary information to the ISO test procedures:

Applicable standards	ISO 7637-3, § 4.5: Test pulses a and b
Object of the test	To verify compliance with the provisions in 4.1.2 under conditions of transients which occur on other lines as a result of the switching processes (pulses a and b). The test shall be performed with one small test load only.
Test procedure in brief:	
Preconditioning:	None
Condition of the EUT	Normal power "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to re-set if a significant fault has occurred.
Stabilization	Before any test stabilize the EUT under constant environmental conditions

Weighing test:	The test consists of exposure of the EUT to conducted disturbances (bursts of voltage spikes by capacitive and inductive coupling via lines other than supply lines) of the strength and character as specified in Table 17. Record: a) date and time; b) temperature; c) relative humidity; d) test load; e) indications (as applicable); f) errors; g) functional performance. Repeat the test weighing for the defined voltages and record the indications.
Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance either shall not exceed 1 e or the instrument shall detect and act upon a significant fault.
Note:	An instrument must comply with the provisions in 4.1.3 in any type of vehicle.

Supprimé : weight

A.8 SPAN STABILITY TEST (4.3.3)

Summary of test

Test	Characteristic under test	Condition applied
Span stability	Stability	1/2 absolute MPE(*)

(*) MPE: maximum permissible error on initial verification in 2.2.2 Table 2.

Note: the maximum permissible error for the zero point shall also be taken into consideration.

Test method:	Span stability.
Object of the test:	To verify compliance with the provisions in 4.3.3 after the EUT has been subjected to the performance tests.
Reference to standard:	No reference to international standards can be given at the present time.
Test procedures in brief:	The test consists of observing the variations of the error of the EUT or simulator under sufficiently constant ambient conditions (reasonable constant conditions in a normal laboratory environment) at various intervals: before, during, and after the EUT has been subjected to performance tests.

	The performance tests shall include the temperature test and, if applicable, the damp heat test; an endurance test shall not be included. Other performance tests listed in this Annex may be performed. The EUT shall be disconnected twice from the mains power supply (or battery supply where fitted) for at least 8 hours during the period of the test. The number of disconnections may be increased if so specified by the manufacturer or at the discretion of the approval authority in the absence of any specification. In the conduct of this test, the operating instructions for the instrument as supplied by the manufacturer shall be considered. The EUT shall be stabilized at sufficiently constant ambient conditions after switch-on for at least five hours, and at least 16 hours after the temperature and damp heat tests have been performed.
Test severities:	Test duration: 28 days or the time period necessary to conduct the performance tests, whichever is less. Time (t) between tests (days): $0.5 < t < 10$.
Test load:	near maximum capacity (Max); the same test weights shall be used throughout the test.
Maximum allowable variations:	The variation in the errors of indication shall not exceed half the absolute value of the maximum permissible error in 2.2.2 Table 2 for the test load applied on any of the n measurements.
Number of tests (n):	At least 8 except where the difference of the results indicates a trend more than half the allowable variation specified, the measurements shall be continued until the trend comes to rest or reverses itself, or until the error exceeds the maximum allowable variation.
Precondition:	None required.
Test equipment:	Verified mass standards or simulated load.
Condition of the EUT:	Normal power supplied and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer.
Test sequence:	Stabilize all factors at nominal reference conditions.

Adjust the EUT as close to zero as possible.
Automatic zero-tracking shall be made inoperative and automatic built-in span adjustment device shall be made operative.

• Initial measurement

Determine the span error using the following method:

(1) Determine the initial zero error (E_o)

If necessary disable any automatic zero-setting or zero-tracking devices by placing a “zero weight” of for example 10 times the scale interval resolution on the load receptor. Note the indication at zero (I_0).

Either by use of an indicator with a suitable higher resolution scale interval or using the change point weight method in A.3.6.2 (noting the total addition change point weight ΔL_0), determine and record the initial zero error (E_0).

(2) Determine the error at near Max capacity (E_L)

Carefully remove the change point weights (if used) and apply the test load (or simulated load) and note the indication (I_L). Either by use of an indicator with a suitable higher resolution scale interval or using the change point weight method in A.3.6.2 (noting the total addition change point weight ΔL), determine and record the error at near Max capacity (E_L).

Record:

a) date and time;
b) temperature;
c) barometric pressure;
d) relative humidity;
e) value of 0.1 d_t;
f) test load;
g) total of added change point weights at zero load ΔL_0;
h) total of added change point weights at test load ΔL;
i) the following indications:
   - indication at zero (I_0);
   - indication of test load (I_L);

j) calculate:
   - initial zero error E_0;
   - error at test load (E_L);

k) change in location and apply all necessary corrections resulting from variations of temperature, pressure, etc. between the various measurements.

Immediately repeat steps (1) and (2) four more times and determine and record the average value of the error for the five tests.

- Subsequent measurements

After observing the time between measurements requirement repeat the test sequence (1) to (2) once recording the data above unless:

- either the result is outside the maximum allowable variation, or
- the range of the five readings of the initial measurement is more than 0.1 d_t, in which case continue four more times repeating steps (1) and (2) recording the data above and determine and record the average value of the error of the five tests.

The measurements shall continue until there are at least eight measurements except where the difference of the results indicates a trend more than half the allowable variation specified, the measurements shall be continued until the trend comes to rest or reverses itself, or until the error exceeds the maximum allowable variation.

A.9 PROCEDURE FOR IN-SITU TESTS

Meaning of symbols:

A_N	Net test load in automatic mode
S_N	Net test load in nonautomatic (static) mode
A_G	Gross mass in automatic operation or alternatively discharged mass in discharged mode
A_T	Tare value in automatic operation, or in discharge mode the indication of the instrument after subtractive tare of the filled receptor
S_G	Gross load in nonautomatic (static) mode
S_T	Tare load in nonautomatic (static) mode

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E Error for automatic weighing
E_{CI} Deviation of measurement of control instrument

A.9.1 General

For type approval, tests shall be carried out in accordance with the requirements of this Recommendation, and especially the requirements in 2.2 for limits of error, and in 5.1 for type approval.

For initial verification, tests shall be carried out corresponding to the normal site operation of the instrument. In this case, limits of error in 2.2.1 for initial verification and the requirements in 5.2 for initial verification apply.

A.9.2 Control instrument

A.9.2.1 Integral control instrument (A.5.3)

Establish whether or not the instrument is to be used as an integral control instrument. If it is an integral control instrument then it shall comply with 6.2.1 and be tested in accordance with 6.2.1.2 and A.5.3.

The test procedure consists of five (or more if necessary) automatic weighing cycles, with each cycle conducted as follows:

(a) Interruption of automatic weighing cycle before emptying load receptor to determine the automatic gross mass value, A_G of the loaded receptor. Initiate automatic operation of the instrument and all essential auxiliary equipment. After the load receptor has been filled with material or test weights and completion of automatic gross weighing, the automatic operation shall be interrupted. However, before discharge of the load receptor, record the gross mass indication, A_G.

(b) When the filled load receptor has stabilized to conditions comparable to those for nonautomatic testing, the static gross mass indication, S_G shall be recorded. The static indication of the control instrument shall be corrected by the previously determined error of the control instrument in A.5.3.1 (at increasing loading).

(c) Interruption of automatic weighing cycle after emptying load receptor to determine the automatic tare value, A_T of the empty load receptor. Following on from stage (b) above, initiate automatic operation of the instrument and all essential auxiliary equipment, and interrupt the automatic operation after discharge of the filled load receptor and completion of automatic tare weighing. However, before re-filling of the load receptor, the tare indication, A_T shall be recorded.

(d) Determination of static tare value, S_T of the empty load receptor. Switch off the instrument and all auxiliary equipment. When the empty load receptor has stabilized to conditions comparable to those for nonautomatic testing, the static tare indication, S_T of the empty load receptor shall be recorded. The indication of the control instrument shall be corrected by the previously determined error of the control instrument A.5.3.1 (at decreasing loading).

Steps (a) to (d) shall be repeated for the specified number of weighing cycles and the required test mass.

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A.9.2.2 Determination of the net mass value and calculation of the error for automatic weighing:

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(a) For automatic mode:

$$A_N = \sum_{i=1}^{n} (A_{G_i} - A_{T_i})$$

(b) For the nonautomatic mode (test instrument):

$$S_N = \sum_{i=1}^{n} ((S_{G_i} - E_{CI}) - (S_{T_i} - E_{CI}))$$

Taking into account the error of the control instrument at A_N or S_N, the error E of the weighing instrument at the corresponding test mass accumulated over a specified number of weighing cycles is:

$$E = A_N - S_N$$

A.9.2.2 Air-enclosed integrated instruments (A.5.3.5)

Air-enclosed discontinuous automatic weighing instruments produce air turbulence that can affect the weighing results. To ensure that such an instrument is tested in normal conditions of use, at least one receptor shall be dispensed in automatic mode, i.e., the automatic operation shall not be interrupted in (a) or (c) during consecutive weighing cycles. In this case the uninterrupted automatic weighing results according to (a) or (c) or the net mass registered by the instrument shall be displayed and recorded, in order to correctly calculate the discharged mass which corresponds to the value of the test mass.

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In the case of discharge weighing the test is to be performed as mentioned above, while the indications have a different sign, i.e. the indication is zero for a loaded receptor, and the indication is positive after discharging the receptor.

Example:

Evaluation with the instrument using re-weighing (of the emptied receptor) and using discharge weighing, assuming:

- Error of control instrument is zero.
- A_T = indication of the weighing results of the single load in automatic mode
- S_T = indication of the weighing results of the single load in nonautomatic mode

Weighing instrument kg		Weighing instrument with discharge weighing kg	
A_G	400.0	A_T	0

S_G	400.05	P_T	-0.05
A_T	0	A_G	400.0
S_T	0.1	S_G	400.1
E	400.0 – 400.15 = -0.15	E	400.0 – 400.15 = -0.15

A.9.2.3 Separate control instrument (A.5.2)

If the control instrument is separate from the instrument being verified then it shall comply with 6.2.1 and be tested, using the test methods in 6.2.1.1 and A.5.2, for the specified number of weighing cycles as follows:

(a) Start of the test

Initiate automatic operation of the instrument and all essential auxiliary equipment. After the load receptor has been filled with material and a minimum of five weighing cycles has been reached record the mass indication.

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(b) End of the test

With the weighing instrument in automatic operation, conduct the necessary number of weighing cycles to obtain the required test mass, making sure that the test mass can be weighed using a separate control instrument.

Supprimé : Interrupt the automatic operation again and record the new indicated weight.¶

(c) Determination of the value of the test mass and calculation of the error for automatic weighing

Supprimé : weight

The mass indication from the weighing instrument is the difference between the indication at the start of the test in (a) and the indication at the end of the test in (b). The conventional true value of the test mass is determined by weighing the test mass on a separate control instrument.

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The error for automatic weighing is the difference between mass indication from the instrument and the mass indication from the separate control instrument.

Supprimé : weight

BIBLIOGRAPHY

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

Ref.	Standards and reference documents	Description
[1]	International Vocabulary of Basic and General Terms in Metrology (VIM) (1993)	Vocabulary, prepared by a joint working group consisting of experts appointed by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML
[2]	International Vocabulary of Terms in Legal Metrology, BIML, Paris (2000)	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. Also included in this Vocabulary are certain concepts of a general character which have been drawn from the VIM.
[3]	OIML B 3 (2003) OIML Certificate System for Measuring Instruments (formerly OIML P1)	Provides rules for issuing, registering and using OIML Certificates of conformity
[4]	OIML D11 (2004) General requirements for electronic	Contains general requirements for electronic measuring instruments

	measuring instruments	
[5]	OIML R111 (2004) Weights of classes E1, E2, F1, F2, M1, M1–2, M2, M2–3 and M3	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 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
[7]	OIML R 76 -1 – Non-automatic weighing instruments. Second Committee draft revision (2005)	Provides the principal physical characteristics and metrological requirements for the verification of non-automatic weighing instruments
[8]	OIML D 19 (1988) Pattern evaluation and pattern approval	Provides advice, procedures and influencing factors on pattern evaluation and pattern approval
[9]	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

Ref.	Standards and reference documents	Description
[10]	IEC 60068-2-1 (1990-05) with amendments 1 (1993-02) and 2 1994-06)	Basic environmental testing procedures - Part 2: Tests, Test Ad: Cold, for heat dissipating equipment under test (EUT), with gradual change of temperature.
[11]	IEC 60068-2-2 (1974-01) with amendments 1 (1993-02) and 2 (1994-05)	Basic environmental testing procedures, Part 2: Tests, Test Bd: Dry heat, for heat dissipating equipment under test (EUT) with gradual change of temperature.
[12]	IEC 60068-3-1 (1974)	Part 3: Background information, section 1: Cold and dry heat tests.
[13]	IEC 60068-2-78 (2001-08)	Environmental testing, Part 2: Tests, Test Cb: Damp heat, steady state. Primarily for equipment.
[14]	IEC 60068-3-4 (2001-08)	Environmental testing – Part 3-4: Guidance for damp heat tests.
[15]	IEC 61000-2-1 (1990-05)	Electromagnetic compatibility (EMC) Part 2: Environment Section 1: Description of the environment- Electromagnetic environment for low-frequency conducted disturbances and signalling in public power supply systems
[16]	IEC 61000-4-1 (2004):	Basic EMC Publication Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 1: Overview of IEC 61000-4 series
[17]	IEC 60654-2 (1979-01), with amendment 1 (1992-09)	Operating conditions for industrial-process measurement and control equipment - Part 2: Power.
[18]	ISO 16750-2 (2003)	Road vehicles - Environmental conditions and testing for electrical and electronic equipment – Part 2: Electrical loads
[19]	IEC 61000-4-11 (2004-03)	Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 11: Voltage dips, short interruptions and voltage variations immunity tests.
[20]	IEC 61000-4-4 (2004-07)	Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test. Basic EMC publication.

Ref.	Standards and reference documents	Description
[21]	IEC 61000-4-5 (2001-04) consolidated Edition 1.1 (including amendment 1 and Correction 1)	Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques Section 5: Surge immunity test.
[22]	IEC 61000-4-2 (1995-01) with amendment 1 (1998-01) and amendment 2 (2000-11) -04) Ed. 1.2.	Basic EMC Publication. Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test. Basic EMC Publication.
[23]	IEC 61000-4-3 Consolidated Edition 2.1 (including amendment 1) (2002-09)	Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test.
[24]	IEC 61000-4-6 Consolidated Edition 2.1 (including amendment 1) (2004-11)	Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 6: Immunity to conducted disturbances, induced by radio-frequency fields.
[25]	ISO 7637-2 (2004)	Road vehicles - Electrical disturbance by conduction and coupling - Part 2: Electrical transient conduction along supply lines only.
[26]	ISO 7637-3 (1995) with correction 1 (1995)	Road vehicles - Electrical disturbance by conduction and coupling - Part 3: Passenger cars and light commercial vehicles with nominal 12 V supply voltage and commercial vehicles with 24 V supply voltage - electrical transient transmission by capacitive and inductive coupling via lines other than supply lines.

A.7.3.3.2 Damp heat, cyclic (condensing)

Damp heat, cyclic tests are carried out according to basic standard IEC Publication 60068-3-4 [13] and IEC Publication 60068-2-30 [14], and according to Table 6.

Note: This test applies to cases where condensation is likely to occur or when the instrument is to be installed in high cyclic temperature environments.

Table 6 - Damp heat, cyclic test

Environmental phenomena	Test specification	Test set-up
Damp heat, cyclic	Temperature variations for 24 hours. Maintaining relative humidity at 93 % during temperature changes from lower limit of 25 °C to upper limit temperature of 40 °C, and at relative humidity of 93 % at the upper temperature phrases.	IEC 60068-2-30 IEC 60068-3-4

Supplementary information to the IEC test procedures:

Object of the test: To verify compliance with the provisions in 4.1.1 under conditions of high humidity and cyclic temperature changes.

Test procedures in brief:

Precondition: None required.

Condition of the EUT: Normal power "off" for the duration of the test unless otherwise specified.

The EUT shall display a recorded total not less than the minimum totalized load, $\sum_{min}$, but observe A.7.2.5.

The handling of the EUT shall be such that condensation should occur on the EUT during the temperature rise.

Stabilisation: All parts of the EUT are within 3 °C of their final temperature.

Temperature-humidity
24 hour cycle sequence: (a) Temperature rise from 25 ° at 93 % humidity C during the first 3 hours.

(b)Temperature maintained at the upper limit of 40 °C and 93 % humidity until 12 hours from start of the cycle.
(c)Temperature lowered to 25 °C at 93 % humidity within 3-6 hours.
(d)Temperature maintained at 25 °C at 93 % humidity until the 24-hour cycle is completed.

Number of test cycles: At least one cycle.

Test information: After stabilisation of the EUT at reference temperature, apply at least five different test loads or simulated loads (A.5.1.1) and record:

a)date and time;
b)temperature;
c)relative humidity;
d)power supply voltage;
e)test loads;
f)indications (as applicable);
g)errors;
h)functional performance.

Allow full recovery of the EUT before any other tests are performed.

Maximum allowable variations: All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 2.2.2 Table 2.