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OIML TC 9/SC 2 *Automatic weighing instruments*

Secretariat: United Kingdom (National Measurement Office)

BIML Contact

Mr. Ian Dunmill

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FOREWORD

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0 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 B 3 Basic Certificate System for OIML Type Evaluation of Measuring Instruments* [3], the *OIML D 11 General requirements for Electronic Measuring Instruments* [4], the OIML R 76 *Non-automatic weighing instruments* [7], and to the *OIML D 31 General requirements for software controlled measuring instruments* [23]. In addition, for the purposes of this Recommendation, the following definitions apply.

0.1 general definitions

0.1.1 mass

physical quantity, which can be ascribed to any material object and which gives a measure of its quantity of matter~~quantity of matter in any solid object or in any volume of liquid or gas.~~ OIML D 28, 2 [28]

0.1.2 load

amount of material (or object) that can be carried at any one time by specified means

0.1.3 fill *(F)*

one load, or more loads combined, that make up the predetermined mass.

0.1.4 weight

quantity representing the force resulting from the effect of gravity on a load.

0.1.5 weighing

process of determining the mass of a load using the effect of gravity on that load.

0.1.6 weighing instrument

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

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

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

0.1.7 measurement result
result of measurement

set of quantity values being attributed to a meas-urand together with any other available relevant information

NOTE 1: A measurement result generally contains “relevant information” about the set of quantity values, such that some may be more representative of the measurand than others. This may be expressed in the form of a probability density function (PDF).

NOTE 2: A measurement result is generally expressed as a single measured quantity value and a measure-ment uncertainty. If the measurement uncertainty is considered to be negligible for some purpose, the measurement result may be expressed as a single measured quantity value. In many fields, this is the common way of expressing a measurement result.

NOTE 3: In the traditional literature and in the previous edition of the VIM, measurement result was defined as a value attributed to a measurand and explained to mean an indication, or an uncorrected result, or a corrected result, according to the context.

0.1.8 metrologically relevant

any device, module, part, component or function of a weighing instrument that may influence the weighing result or any other primary indication is considered as metrologically relevant.

0.2 categories of instruments

0.2.1 automatic weighing instrument

weighing instrument operating without the intervention of an operator and /or follows a predetermined program of automatic process characteristic of the instrument.

0.2.2 automatic gravimetric filling instrument

automatic weighing instrument intended to fill containers with a predetermined and virtually constant mass of product from bulk by automatic weighing, and which comprises essentially automatic feeding device(s)associated with weighing unit(s) and the appropritae control and discharge devices.

0.2.2.1 associative (selective combination) weigher

automatic gravimetric filling instrument comprising one or more weighing units and which computes an appropriate combination of the loads and combines themto a fill.

0.2.2.2 cumulative weigher

automatic gravimetric filling instrument comprising one weighing unit with the facility to apply more than one weighing cycle for the composition of the desired fill.

0.2.2.3 subtractive weigher

automatic gravimetric filling instrument for which the fill is determined by controlling the output feed from the weigh hopper.

0.2.2.4 control instrument

weighing instrument used to determine the mass of the test fill(s) delivered by the filling instrument.

The control instrument used during testing may be:

a) separate, from the instrument being tested

b) integral, the instrument being tested is used as the control instrument

0.3 construction

~~Note~~NOTE: In this Recommendation the term “device” is applied to any part of a filling instrument which uses any means to perform one or more specific functions irrespective of the physical realisation e.g. by a mechanism or a key initiating an operation; the device may be a small part or a major portion of a filling instrument.

0.3.1 principal parts

0.3.1.1 weighing unit

device which provides information on the mass of the load to be measured. This device may consist of all or part of a non-automatic weighing instrument.

0.3.1.2 load receptor

part of the instrument intended to receive the load.

0.3.1.3 feeding device

device which provides a supply of product from bulk to the weighing unit. It may operate in one or more stages.

0.3.1.4 control device

device that control the operation of the feeding process. The devices may incorporate software functions.

0.3.1.4.1 feed control device

device which regulates the rate of feed of the feeding device.

0.3.1.4.2 fill setting device

device which allows the setting of the preset value of the fill.

0.3.1.4.3 final feed cut-off device

device which controls the cut-off of the final feed so that the average mass of the fills corresponds to the preset value. This device may include an adjustable compensation for the material in flight.

0.3.1.4.4 correction device

device which automatically corrects the setting of the filling instrument.

0.3.2 electronic parts

0.3.2.1 electronic instrument

instrument equipped with electronic devices

0.3.2.2 electronic device

device ~~comprising~~ employing electronic sub-assemblies and performing a specific function. Electronic devices are usually manufactured as separate units and are capable of being independently tested. OIML D 11, 3.2 [4]

NOTES:

(1) An electronic device may be a complete measuring instrument (for example: counter scale, electricity meter) or a part of a measuring instrument (for example: printer, indicator).

(2) An electronic device can be a module in the sense that this term is used in OIML Publication B 3 "The OIML Certificate System for Measuring Instruments" [3].

0.3.2.3 electronic sub-assembly

part of an electronic device, employing electronic components and having a recognisable function of its own. OIML D 11, 3.3 [4]

0.3.2.4 electronic component

smallest physical in an electronic device used to affect electrons and/or their associated fields in their movement through a medium or vacuum" (see OIML R137-1 &-2 (2012) 3.5.3)~~entity that uses electron or hole conduction in semi-conductors, gases or in a vacuum.~~ OIML D 11, 3.4 [4]

0.3.3 indicating device (of a weighing instrument)

~~Part~~ part of the load measuring device that displays the value of a weighing result in units of mass and may additionally display:

~~The~~ the difference between mass of a load and a reference value

~~The~~ the value of the fill(s) and /or related quantities or parameters of a number of consecutive weighings.

0.3.4 zero-setting device

~~Device~~ device for setting the indication to zero when there is no load on the load receptor. OIML R76, T.2.7.2 [7]

0.3.4.1 non-automatic zero-setting device

device for setting the indication to zero by an operator.
OIML R76, T.2.7.2.1 [7]

0.3.4.2 semi-automatic zero-setting device

~~Device~~ device for setting the indication to zero automatically following a manual command. OIML R76, T.2.7.2.2 [7]

0.3.4.3 automatic zero-setting device

device for setting the indication to zero automatically without the intervention of an operator. OIML R76, T.2.7.2.3 [7]

0.3.4.4 initial zero-setting device

device ~~for~~ which automatically at switch-on, preceding the ´ready-for-use´ mode, sets the indication of the instrument to zero~~setting the indication to zero automatically at the time the filling instrument is switched on and before it is ready for use~~.

0.3.4.5 zero-tracking device

device for maintaining the zero indication within certain limits automatically.
OIML R76, T.2.7.3 [7]

0.3.5 tare device

device for setting the indication to zero when a load is on the load receptor:~~device for taring~~:

a) aithout altering the weighing range for net loads (additive tare device), or

b) ~~aeducing~~ reducing the weighing range for net loads (subtractive tare device).

The tare device may function as:

a) a non-automatic device (load balanced by operator or preset tare by operator),
b) a semi-automatic device (load balanced automatically following a single manual command),
c) an automatic device (load balanced automatically without the intervention of an operator).

OIML R76, T.2.7.4 [7]

0.3.6 software

0.3.6.1 legally relevant software part

part of all software modules of a measuring instrument, electronic device, or sub-assembly that is legally relevant. VIML, 6.10 [2]

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

~~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(s).~~

0.3.6.2 legally relevant parameter

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

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

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

0.3.6.3 type-specific parameter

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

NOTE: Type-specific parameters are part of the legally relevant software.
Examples of type-specific parameters are: parameters used for weight value calculation, stability analysis or price calculation and rounding, software identification

~~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.~~

0.3.6.4 device-specific parameter

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

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

~~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.~~

0.3.6.5 software identification

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

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

0.3.6.6 software separation

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

~~unambiguous separation of software into legally relevant software and non-legally relevant software.~~

NOTE: These parts communicate via a software interface.
~~if no software separation exists, the whole software is to be considered as legally relevant.~~

0.3.7 data storage device

storage device used for keeping weighing data ready after completion of the measurement for subsequent indication, data transfer, totalizing, etc.

0.3.8 interface

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

0.3.9 user interface

interface that enables information to be interchanged between the operator and the measuring instrument or its hardware or software components, e.g. switches, keyboard, mouse, display, monitor, printer, touch-screen, software window on a screen including the software that generates it. VIML 6.15 [2]

0.3.10 protective interface

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

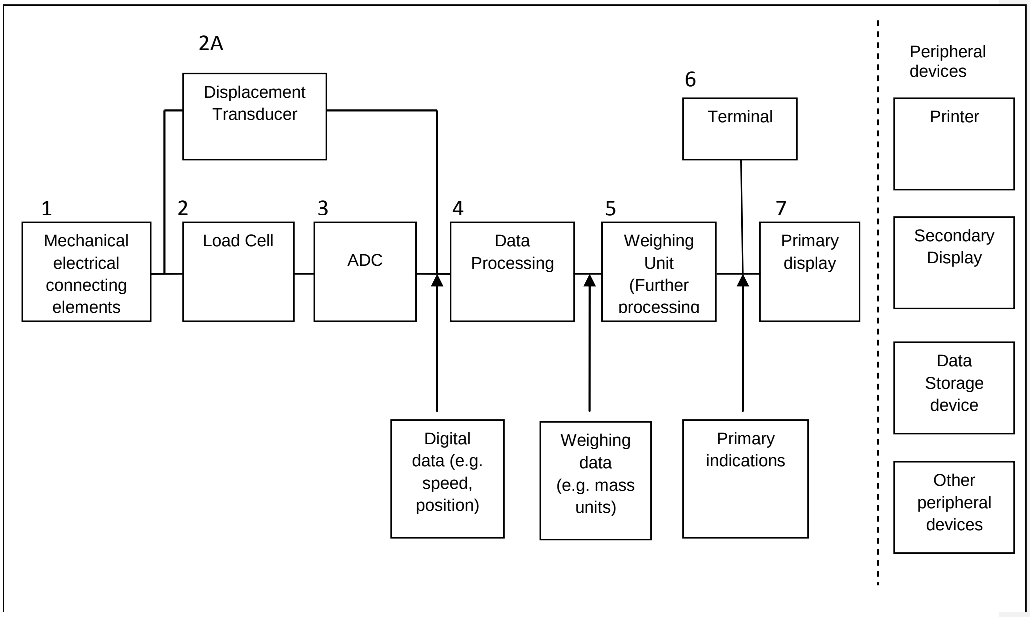
0.3.11 module

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 this Recommendation. OIML B 3, 3.4 [3]

NOTE: The modules of a weighing instrument are subject to specified partial error limits.

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

Figure 1
Definition of typical modules according to 0.2.11 and 5.1.6
(other combinations are possible)



load cell	(0.3.12)	2 + 3 + (4)*)
displacement transducer	(0.2.11.2)	2A
indicator	(0.5.1.1)	(3) + 4 + (5) + (6) + 7
analogue data processing device	(0.5.1.4)	3 + 4 + (5) + (6)
digital data processing device	(0.5.1.5)	(4) + 5 + (6)
primary display	(0.5.1.9) (0.2.11.9)	7
weighing module	(0.5.1.7)	1 + 2 + 3 + 4 + (5) + (6)
Terminal	(0.5.1.6)	(5) + 6 + 7

*) Numbers in brackets indicate options

0.3.12 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). OIML R 60 [7].

NOTE: Load cells equipped with electronics including amplifier, analogue-to-digital converter (ADC), and data processing device (optionally) are called digital load cells (see Figure 1).

0.4 metrological characteristics

0.4.1 scale interval (d)

value, expressed in units of the measured quantity ~~mass,~~ of the difference between:

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

VIML, 5.01 [2]

0.4.2 reference particle mass of a product

mass equal to the mean of ten of the largest particles or pieces of the product taken from one or more fills.

0.4.3 preset value

value, expressed in units of mass, preset by the operator by means of the fill setting device, in order to define the nominal value of the fills.

0.4.4 static set point

value of the test weights or masses which, in static tests, balance the value selected on the indication of the fill setting device.

0.4.5 weighing cycle

the combination of operations including:

a) delivery of material to the load receptor,

b) a weighing operation, and

c) the discharge of a single discrete load

after the completion of which the weighing instrument is in its initial state.

0.4.6 final feed time

time taken to complete the last stage of delivery of the product to a load receptor.

0.4.7 minimum capacity (Min)

smallest discrete load that can be weighed automatically on a load receptor of the filling instrument.

~~Note~~NOTE: For filling instruments which effect the fill by one weighing cycle Min is equal to the rated minimum fill (Minfill).

0.4.8 maximum capacity (Max)

largest discrete load that can be weighed automatically on a load receptor of the filling instrument.

0.4.9 rated minimum fill (Minfill)

rated value of the fill below which the weighing results may be subject to errors outside the limits specified in this Recommendation.

~~Note~~NOTE: For filling instruments which effect the fill by more than one weighing cycle Minfill is larger than the minimum capacity (Min).

0.4.10 average number of loads per fill

half the sum of the maximum and minimum number of loads per fill that can be set by the operator or, in cases where the number of loads per fill is not directly determined by the operator, either the mean of the actual number of loads per fill (if known) in a period of normal operation, or the optimum number of loads per fill as may be specified by the manufacturer for the type of product which is to be weighed.

0.4.11 static test load

~~TLoad~~ load that is used in static tests only.

0.4.12 minimum discharge

smallest load that can be discharged from a subtractive weigher.

0.4.13 warm-up time

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

0.5 indications and errors

0.5.1 methods of indication

0.5.1.1 indicator

electronic device 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.

0.5.1.2 analogue indication

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

0.5.1.3 digital indication

indication in which the scale marks comprise a sequence of aligned figures that do not permit interpolation to fractions of a scale interval.

0.5.1.4 analogue data processing device

electronic device 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.

0.5.1.5 digital data processing device

electronic device that processes digital data.

0.5.1.6 terminal

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

0.5.1.7 weighing unit

~~The~~ part of a belt weigher providing information on the mass of the load to be measured.

0.5.1.8 digital display

~~A~~ digital display (device) is an output device visualizing actual information in volatile digital format.

NOTES:
1) A digital display may concern a primary display or a secondary display.
2) The terms “primary display” and “secondary display” should not be confused with the terms “primary indication” and “secondary indication” (0.4.1.1 and 0.4.1.2).

0.5.1.9 primary display

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

0.5.1.10 secondary display

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

0.5.2 errors

0.5.2.1 ~~error of indication (E)~~ measurement error
error of measurement
error

measured quantity value minus a reference quantity value

NOTE 1 The concept of ‘measurement error’ can be used both:
a) when there is a single reference quantity value to refer to, which occurs if a calibration is made by means of a measurement standard with a measured quantity value having a negligible measurement uncertainty or if a conventional quantity value is given, in which case the meas-urement error is known, and
b) if a measurand is supposed to be represented by a unique true quantity value or a set of true quantity values of negligible range, in which case the meas-urement error is not known.

NOTE 2 Measurement error should not be confused with production error or mistake.Indication of a weighing instrument minus the (conventional) true value of the mass. [VIM 5.20] VIM 2.16 [1]

0.5.2.2 intrinsic error

error of a weighing measuring instrument, determined under reference conditions.[VIM 5.24] VIML, 0.06 [2]

0.5.2.3 initial intrinsic error

intrinsic error of a measuring instrument as determined prior to performance tests and durability evaluations intrinsic error of a weighing instrument as determined prior to performance and span stability tests. VIML 5.10 [2]

0.5.2.4 maximum permissible measurement error
maximum permissible error
limit of error

extreme value of measurement error, with respect to a known reference quantity value, permitted by specifications or regulations for a given meas-urement, measuring instrument, or measuring system

NOTE 1: usually, the term "maximum permissible errors" or "limits of error" is used where there are two extreme values.

NOTE 2: the term "tolerance" should not be used to designate 'maximum permissible error'.maximum permissible errors (MPE) VIM 4.26 [1]

extreme values of an error permitted by specifications or regulations between the indication of a weighing instrument and the corresponding true value, as determined by reference standard masses, at zero or no load, in the reference position. [VIM 5.21]

0.5.2.4.1 maximum permissible deviation of each fill (MPD)

maximum permissible deviation of each fill from the average value of all the fills of a test sequence.

0.5.2.4.2 maximum permissible preset value error (MPSE)

maximum permissible setting error for each preset value of the fill.

0.5.2.4.3 maximum permissible error for influence factor tests

maximum permissible error for influence quantity values.

0.5.2.5 fault

difference between the error of indication and instrinsic error of a measuring instrument. OIML D11, 3.9 [4]

NOTE 1: Principally, a fault is the result of an undesired change of data contained in or flowing through an electronic measuring instrument. 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 a "fault" is a numerical value which is expressed either in a unit of measurement or as a relative value, for instance as a percentage.

0.5.2.6 significant fault

fault greater than 0.25 of the maximum permissible deviation of each fill for in-service inspection as specified in 4.2.2, for a fill equal to the Minimum capacity or rated minimum fill respectively of the filling instrument.

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

- faults arising from simultaneous and mutually independent causes in the instrument,
- faults that imply it is impossibile to perform a measurement
- faults that are so serious that they will inevitably be noticed by those interested in the measurement,
- transitory faults that are momentary variations in the indications or operation that can not be interpreted, memorized or transmitted as a measurement result.

NOTE: For filling instruments where the fill may be greater than one load, the value of the significant fault applicable for a test on one statica static load shall be calculated in accordance with the test procedures in A.6.1.3.

Adapted from OIML D11, 3.10 [4]

0.5.2.7 span stability

Capability capability of an instrument to maintain the difference between the indication of weight at maximum capacity and the indication at zero within specified limits over a period of use. Adapted from OIML D11, 3.5.9 [4]

0.5.3 reference value for accuracy class (Ref(x))

Value value for accuracy class determined by static testing of the weighing unit during influence quantity testing at patterntype approval stage. Ref(x) is equal to the best accuracy class for which the instrument may be verified for operational use.

0.6 influences and reference conditions

0.6.1 influence quantity

quantity that, in a direct measurement, does not affect the quantity that is actually measured, but affects the relation between the indication and the measurement result Quantity that is not the subject of the measurement but which influences the value of the measurand or the indication of the filling instrument. [VIM 2.7]VIM 2.52[1]

0.6.1.1 influence factor

Influence influence quantity having a value within the specified rated operating conditions of the filling instrumenta measuring instrument specified in this recommendation. VIML, 5.15 [2].

0.6.1.2 disturbance

Influence influence quantity having a value within the limits specified in this Recommendation but outside the rated operating conditions of the filling measuring instrument. VIML, 5.16 [2]

0.6.2 rated operating conditions

operating condition that must be fulfilled during measurement in order that a measuring instrument or measuring system perform as designed. VIM, 2.52 [1]

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

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 deviations specified in this Recommendation. [VIM 5.5]

0.6.3 reference conditions

operating condition prescribed for evaluating the performance of a measuring instrument or measuring system or for comparison of measurement results. VIM 4.11 [1]

NOTE 1: Reference operating conditions specify intervals of values of the measurand and of the influence quantities.

NOTE 2: In IEC 60050-300, item 311-06-02, the term “reference condition” refers to an operating condition under which the specified instrumental measurement uncertainty is the smallest possible.

Set of specified values of influence factors fixed to ensure valid intercomparison of the results of measurements. [VIM 5.7]

0.7 tests

0.7.1 material test

Test test carried out on a complete filling instrument using the type of material which it is intended to weigh.

0.7.2 simulation test

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

0.7.3 performance test

test to verify whether the equipment under test (EUT) is able to accomplish its intended functions. VIML, 5.18 [2]

0.7.4 span stability test

test to verify that the EUT is capable of maintaining its span stability.

0.8 Abbreviations and Symbols

- *I* = Indication
- *I*n = *n*th indication
- *L* = Load
- *ΔL* = Additional load to next changeover point
- $P = I + ½ d – ΔL$ = Indication prior to rounding (digital indication)
- $E = I – L$ or $P – L$ = Error
- *F* = Mass of fill
- F_P = Preset value of fill
- *P*i = Fraction of the MPE(1) applicable to one part of the instrument which is examined separately
- (x) = Class designation factor
- MPE = Maximum permissible error (absolute value)
- EUT = Equipment under test
- MPE(1) = Maximum permissible error for influence factor tests for class X(1)
- se = Preset value error (setting error)
- MPSE(1) = Maximum permissible preset value error for class X(1)
- *md*max = Maximum of the actual deviations of each fill from the average of all fills
- MPD(1) = Maximum permissible deviation of each fill from the average for class X(1)
- *mpΔz*(1) = Maximum permissible zero change per 5 °C for class X(1)

PART 1 – METROLOGICAL AND TECHNICAL REQUIREMENTS

1 Introduction

This OIML Recommendation consists of 3 parts:

Part 1: Metrological and Technical Requirements;
Part 2: Metrological Controls and Performance Tests;
Part 3: Report Format for Type Evaluation.

Parts 1 and 2 are a combined publication and Part 3 is a separate ~~one~~publication

2 Scope

This International Recommendation specifies the metrological and technical requirements, metrological controls and performance tests for automatic gravimetric filling instruments which ~~produces~~ produce predetermined mass of individual fills of products from one or more loads by automatic weighing.

~~Notes~~NOTES:

1) This Recommendation places no constraint on the maximum or minimum capacities of the filling instruments for which this Recommendation is applicable.

2) Filling instruments may also be required to comply with certain requirements of other OIML Recommendations, e.g. automatic filling instruments which, in normal use, could be operated in non-automatic mode will need to comply with OIML R 76 [7] ~~"~~*~~Non-automatic weighing instruments~~*, and fills less than or equal to 25 kg will need to comply with OIML R 87 [24] ~~"~~*~~Quantity products in prepackages~~*.

~~**3**~~

~~The terminology used in this Recommendation conforms to the *International Vocabulary of Metrology - Basic and General Concepts and Associated Terms* (VIM) [1], the *International Vocabulary of Legal Metrology* (VIML) [2], the *OIML Certificate System for Measuring Instruments* [3], and to OIML d 11 *General requirements for Electronic Measuring Instruments* [4]. In addition, for the purposes of this Recommendation, the following definitions apply.~~

~~**3.1 General definitions**~~

~~**3.1.1 Mass**~~

~~Quantity of matter in any solid object or in any volume of liquid or gas.~~

~~**3.1.2 Load**~~

~~Amount of material (or object) that can be carried at any one time by specified means~~

~~**3.1.3 Fill**~~

~~One load, or more loads combined, that make up the predetermined mass.~~

~~**3.1.4 Weight**~~

~~Quantity representing the force resulting from the effect of gravity on a load.~~

~~**3.1.5 Weighing**~~

~~Process of determining the mass of a load from the effect of gravity on that load.~~

~~**3.1.6 Weighing instrument**~~

~~Measuring instrument that serves to determine the mass of a load by using the action of gravity on that load.~~

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

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

3.2 Categories of instruments

3.2.1 Automatic weighing instrument

Instrument which weighs without the intervention of an operator and /or follows a predetermined program of automatic process characteristic of the instrument.

3.2.2 Automatic gravimetric filling instrument

Instrument which fills containers with predetermined and virtually constant mass of product from bulk by automatic weighing, and which comprises essentially automatic feeding device(s)associated with weighing unit(s) and the appropritae control and discharge devices.

3.2.2.1 Associative (selective combination) weigher

Automatic gravimetric filling instrument comprising one or more weighing units and which computes an appropriate combination of the loads and combines themto a fill.

3.2.2.2 Cumulative weigher

Automatic gravimetric filling instrument with one weighing unit with the facility to effect the fill by more than one weighing cycle.

3.2.2.3 Subtractive weigher

Automatic gravimetric filling instrument for which the fill is determined by controlling the output feed from the weigh hopper.

3.3 Control instrument

Weighing instrument used to determine the mass of the test fill(s) delivered by the filling instrument.

The control instrument used during testing may be:

c) separate, from the instrument being tested
d) integral, the instrument being tested is used as the control instrument

3.3 Construction

Note: In this Recommendation the term “device” is applied to any part of a filling instrument which uses any means to perform one or more specific functions irrespective of the physical realisation e.g. by a mechanism or a key initiating an operation; the device may be a small part or a major portion of a filling instrument.

3.3.1 Principal parts

3.3.1.1 Weighing unit

Device which provides information on the mass of the load to be measured. This device may consist of all or part of a non-automatic weighing instrument.

3.3.1.2 Load receptor

Part of the instrument intended to receive the load.

3.3.1.3 Feeding device

Device which provides a supply of product from bulk to the weighing unit. It may operate in one or more stages.

3.3.1.4 Control devices

Device that control the operation of the feeding process. The devices may incorporate software functions.

3.3.1.4.1 Feed control device

Device which regulates the rate of feed of the feeding device.

3.3.1.4.2 Fill setting device

Device which allows the setting of the preset value of the fill.

3.3.1.4.3 Final feed cut-off device

Device which controls the cut-off of the final feed so that the average mass of the fills corresponds to the preset value. This device may include an adjustable compensation for the material in flight.

3.3.1.4.4 Correction device
Device which automatically corrects the setting of the filling instrument.

3.3.2 Electronic parts

3.3.2.1 Electronic instrument

Instrument equipped with electronic devices

3.3.2.2 Electronic device

Device comprising electronic sub-assemblies and performing a specific function. Electronic devices are usually manufactured as separate units and are capable of being independently tested.

3.3.2.3 Electronic sub-assembly

Part of an electronic device, employing electronic components and having a recognisable function of its own.

3.3.2.4 Electronic component

Smallest physical entity that uses electron or hole conduction in semi-conductors, gases or in a vacuum.

3.3.3 Indicating device (of a weighing instrument)

Part of the load measuring device that displays the value of a weighing result in units of mass and may additionally display:

The difference between mass of a load and a reference value

The value of the fill(s) and /or related quantities or parameters of a number of consecutive weighings.

3.3.4 Zero-setting device

Device for setting the indication to zero when there is no load on the load receptor.

3.3.4.1 Non-automatic zero-setting device

Device for setting the indication to zero by an operator.

3.3.4.2 Semi-automatic zero-setting device

Device for setting the indication to zero automatically following a manual command.

3.3.4.3 Automatic zero-setting device

Device for setting the indication to zero automatically without the intervention of an operator.

3.3.4.4 Initial zero-setting device

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

3.3.4.5 Zero-tracking device
Device for maintaining the zero indication within certain limits automatically.

3.3.5 Tare device
Device for taring:

c) Without altering the weighing range for net loads (additive tare device), or

d) Reducing the weighing range for net loads (subtractive tare device).

The tare device may function as:

d) A non-automatic device (load balanced by operator or preset tare by operator),

e) A semi-automatic device (load balanced automatically following a single manual command),

f) An automatic device (load balanced automatically without the intervention of an operator).

3.3.6 Software

3.3.6.1 Legally relevant software

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

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(s).

3.3.6.2 Legally relevant parameter

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

3.3.6.3 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.

3.3.6.4 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.

3.3.6.5 Software identification

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

3.3.6.6 Software separation

Unambiguous separation of software into legally relevant software and non-legally relevant software.

If no software separation exists, the whole software is to be considered as legally relevant.

3.3.7 Data storage device

Storage device used for keeping weighing data ready after completion of the measurement for subsequent indication, data transfer, totalizing, etc.

3.4 Metrological characteristics

3.4.1 Scale interval (d)

Value, expressed in units of mass, of the difference between:

c) The values corresponding to two consecutive scale marks for analogue indication, or
d) Two consecutive indicated values for digital indication.

3.4.2 Reference particle mass of a product

Mass equal to the mean of ten of the largest particles or pieces of the product taken from one or more fills.

3.4.3 Preset value

Value, expressed in units of mass, preset by the operator by means of the fill setting device, in order to define the nominal value of the fills.

3.4.4 Static set point

Value of the test weights or masses which, in static tests, balance the value selected on the indication of the fill setting device.

3.4.5 Weighing cycle

The combination of operations including:

d) Delivery of material to the load receptor,

e) A weighing operation, and

f) The discharge of a single discrete load;

after the completion of which the weighing instrument is in its initial state.

3.4.6 Final feed time

Time taken to complete the last stage of delivery of the product to a load receptor.

3.4.7 Minimum capacity (Min)

Smallest discrete load that can be weighed automatically on a load receptor filling instrument.

Note: For filling instruments which effect the fill by one weighing cycle Min is equal to the rated minimum fill (Minfill).

3.4.8 Maximum capacity (Max)

Largest discrete load that can be weighed automatically on a load receptor of the filling instrument.

3.4.9 Rated minimum fill (Minfill)

Rated value of the fill below which the weighing results may be subject to errors outside the limits specified in this Recommendation.

Note: For filling instruments which effect the fill by more than one weighing cycle Minfill is larger than the minimum capacity (Min).

3.4.10 Average number of loads per fill

Half the sum of the maximum and minimum number of loads per fill that can be set by the operator or, in cases where the number of loads per fill is not directly determined by the operator, either the mean of the actual number of loads per fill (if known) in a period of normal operation, or the optimum number of loads per fill as may be specified by the manufacturer for the type of product which is to be weighed.

3.4.11 Static test load

TLoad that is used in static tests only.

3.4.12 Minimum discharge

Smallest load that can be discharged from a subtractive weigher.

3.4.13 Warm-up time

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

3.5 Indications and errors

3.5.1 Methods of indication

3.5.1.1 Analogue indication

Indication allowing the evaluation of an equilibrium position to a fraction of the scale interval.

3.5.1.2 Digital indication

Indication in which the scale marks comprise a sequence of aligned figures that do not permit interpolation to fractions of a scale interval.

3.5.2 Errors

3.5.2.1 Error of indication (E)

Indication of a weighing instrument minus the (conventional) true value of the mass. [VIM 5.20]

3.5.2.2 Intrinsic error

Error of a weighing instrument, determined under reference conditions.[VIM 5.24]

3.5.2.3 Initial intrinsic error

Intrinsic error of a weighing instrument as determined prior to performance and span stability tests.

3.5.2.4 Maximum permissible errors (MPE)

Extreme values of an error permitted by specifications or regulations between the indication of a weighing instrument and the corresponding true value, as determined by reference standard masses, at zero or no load, in the reference position. [VIM 5.21]

3.5.2.4.1 Maximum permissible deviation of each fill (MPD)

Maximum permissible deviation of each fill from the average value of all the fills of a test sequence.

3.5.2.4.2 Maximum permissible preset value error (MPSE)

Maximum permissible setting error for each preset value of the fill.

3.5.2.4.3 Maximum permissible error for influence factor tests

Maximum permissible error for influence quantity values.

3.5.2.5 Fault

Difference between the error of indication and instrinsic error of a measuring instrument.

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

3.5.2.6 Significant fault

Fault greater than 0.25 of the maximum permissible deviation of each fill for in-service inspection as specified in sub-clause 2.2.2, for a fill equal to the Minimum capacity or rated minimum fill respectively of the filling instrument.

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

- Faults arising from simultaneous and mutually independent causes in the instrument,
- Faults that imply it is impossibile to perform a measurement
- Faults that are so serious that they will inevitably be noticed by those interested in the measurement,
- Transitory faults that are momentary variations in the indications or operation that can not be interpreted, memorized or transmitted as a measurement result.

Note: For filling instruments where the fill may be greater than one load, the value of the significant fault applicable for a test on one static load shall be calculated in accordance with the test procedures in A.6.1.3.

3.5.2.7 Span stability

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

3.5.3 Reference value for accuracy class (Ref(x))

Value for accuracy class determined by static testing of the weighing unit during influence quantity testing at pattern approval stage. Ref(x) is equal to the best accuracy class for which the instrument may be verified for operational use.

3.6 Influences and reference conditions

3.6.1 Influence quantity

Quantity that is not the subject of the measurement but which influences the value of the measurand or the indication of the filling instrument. [VIM 2.7]

3.6.1.1 Influence factor

Influence quantity having a value within the specified rated operating conditions of the filling instrument.

3.6.1.2 Disturbance

Influence quantity having a value within the limits specified in this Recommendation but outside the rated operating conditions of the filling instrument.

3.6.2 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 deviations specified in this Recommendation. [VIM 5.5]

3.6.3 Reference conditions

Set of specified values of influence factors fixed to ensure valid intercomparison of the results of measurements. [VIM 5.7]

3.7 Tests

3.7.1 Material test

Test carried out on a complete filling instrument using the type of material which it is intended to weigh.

3.7.2 Simulation test

Test carried out on a complete filling instrument or part of a filling instrument in which any part of the weighing operation is simulated.

3.7.3 Performance test

Test to verify whether the equipment under test (EUT) is able to accomplish its intended functions.

3.7.4 Span stability test

Test to verify that the EUT is capable of maintaining its span stability.

~~4~~3 Units of measurement

The units of mass ~~are the~~include:

- ~~Metric carat (ct)~~
- Milligram (mg),
- Gram (g),
- Kilogram (kg), and
- Tonne (t).

~~5~~ 4 Metrological requirements

~~5.1~~ 4.1 Accuracy classes

The manufactuerer shall specify the accuracy class, X(x) and reference value for accuracy class, Ref(x) ~~shall be specified~~ in accordance with the ~~limits of error~~error limitation given in ~~2.2~~ 4.2 and marked on the filling instrument in accordance with the descriptive markings given in ~~6.12~~5.12.

Accuracy classes for filling instruments shall be specified for intended usage, i.e. nature of the product(s) to be weighed, type of installation and operating environment, value of the fill (9.2.1), and operating rate ~~in accordance with 5.2 and 5.3~~(9.2.3).

NOTE: The use of accuracy classes for certain applications may be determined by national prescription.

~~5.2~~4.2 ~~Limits of error~~Error limitation

~~5.2~~4.2.1 Maximum permissible error (MPE) for static tests

The filling instrument shall have a reference value for accuracy class, Ref(x), applicable for static testing at ~~pattern~~type approval stage, for which the MPE for influence factor tests shall be as specified in ~~5.5~~4.5.

~~5.2~~4.2.2 Maximum permissible deviation (MPD) of each fill

The filling instrument shall have a specified accuracy class X(x), determined at initial verification, for which the MPD of each fill from the average of all fills in a test shall be equal to the limits specified in Table 1, multiplied by the class designation factor (x).

The class designation factor (x) shall be ≤ 2 and in the form ~~Value of (x) shall be~~ 1×10^k, 2×10^k, 5×10^k, k being a positive or negative whole number or zero.

Table 1- Maximum permissible deviation (MPD) of each fill

Value of the mass of the fills F (g)	MPD of each fill from the average of the fills for class X(1) (as percentage of F or in grams)	
	Initial verification	In-service inspection

F ≤ 50	7.2 %	9 %
50 < F ≤ 100	3.6 g	4.5 g
100 < F ≤ 200	3.6 %	4.5 %
200 < F ≤ 300	7.2 g	9 g
300 < F ≤ 500	2.4 %	3 %
500 < F ≤ 1000	12 g	15 g
1000 < F ≤ 10000	1.2 %	1.5 %
10000 < F ≤ 15000	120 g	150 g
15000 < F	0.8 %	1 %

(See ~~6.3~~9.3 for the number of fills required to find the average value).

~~5.3~~4.3 Particle mass correction (see ~~3.4~~0.4.2)

For material tests, when the reference particle mass exceeds 0.1 of the maximum permissible in-service deviation, the values derived from Table 1 shall be increased by 1.5 times the value of the reference particle mass. However, the maximum value of the MPD shall not exceed the value from the multiplication of the class designation factor (x) by 9 %.

~~Note~~NOTES:

1) Particle mass correction is not applicable to limits which are derived from Table 1, e.g. influence quantity tests, zero setting etc.

2) Instruments which are verified with particle mass correction are not suitable for fills which need to comply with OIML R87 ~~*Quantity product in prepackages*~~[24]. In the case of high particle mass of the product, associative (selective combination) weighers (see ~~3.2~~0.2.2.1) should be used.

~~5.4~~4.4 Maximum permissible preset value error (MPSE)

For filling instruments where it is possible to preset a fill value the maximum difference between the preset value (as defined in ~~6.6~~5.6) and the average mass of all the fills in a test sequence (as defined in ~~6.7~~9.7) shall not exceed 0.25 of the MPD of each fill from the average of the fills, as specified for in-service inspection in ~~5.2~~4.2.2. These limits will apply for Initial verification and in-service inspection tests.

~~5.5~~4.5 Maximum permissible error (MPE) for influence factor tests

The MPE for any static test load during influence factor tests shall be 0.25 of the MPD for in-service inspection as specified in ~~5.2~~4.2.2 for a fill equal to the static test load.

~~Note~~NOTE: For filling instruments where the fill may not be equal to one load, the MPE applicable for a test on ~~one static~~a static load shall be calculated in accordance with the test procedures in A.6.

~~5.6~~4.6 Minimum capacity (Min)

The Min is the smallest load value specified by the manufacturer which can be automatically weighed on a load receptor within the error limits and requirements for filling instruments given in this Recommendation.

The Min shall be marked on the instrument in accordance with the descriptive markings in ~~6.12~~5.12.

~~Note~~NOTE: For filling instruments which effect the fill by ~~-~~one weighing cycle Min is equal to the Minfill.

~~5.7~~4.7 Rated Minimum Fill (Minfill)

The Minfill is the rated minimum fill from automatic weighing below which the weighing results may be subject to errors outside the limits and requirements specified in this Recommendation.

~~Note: For filling instruments which effect the fill by more than one weighing cycle Minfill is larger than the Min.~~

The Minfill shall be subjected to the following requirements:

a) ~~6.8~~5.8.2 capability of zero-setting related to Minfill~~(*)~~
b) A.5.2 warm-up error related to Minfill
c) A.6.2.2 temperature effect on no-load indication related to Minfill
d) A.6.3 significant fault for disturbance tests related to Minfill

The Minfill value shall be marked on the instrument in accordance with the descriptive markings in ~~6.12~~5.12.

NOTE 1: For filling instruments which effect the fill by more than one weighing cycle Minfill is larger than the Min.

~~(*) With a resolution in scale interval (d) and the equilibrium device the filling instrument is able to meet the requirement of 3.85.8.2 with an error (E) = 0.25d. Since 3.85.8.2 require that 0.25d ≤ 0.25 MPD in-service . Minfill, then you have the condition: Minfill ≥ d/MPD in-service (with MPD as relative value).~~
~~For class X(x) instruments the minimum permissible values of Minfill for d values are tabled below :~~

~~Dd (g)~~	~~Minimum permissible value of Minfill (g)~~			
	~~X(0.2)~~	~~X(0.5)~~	~~X(1)~~	~~X(2)~~
~~0.5~~	~~28~~	~~11~~	~~6~~	~~3~~
~~1~~	~~111~~	~~22~~	~~11~~	~~6~~
~~2~~	~~334~~	~~44~~	~~22~~	~~12~~
~~5~~	~~1665~~	~~335~~	~~110~~	~~30~~
~~10~~	~~3330~~	~~1330~~	~~330~~	~~110~~
~~20~~	~~6660~~	~~2660~~	~~1340~~	~~340~~
~~50~~	~~25000~~	~~6650~~	~~3350~~	~~1650~~
~~100~~	~~50000~~	~~20000~~	~~6700~~	~~3300~~
~~200~~	~~100000~~	~~40000~~	~~20000~~	~~6600~~
~~≥500~~	~~500 d~~	~~200 d~~	~~100d~~	~~50 d~~

~~(The gramme values are rounded to the d-values which can be indicated)~~

~~For calculating the Minfill value for class X(x) instruments the MPD and F values in Table 1R61-1 are used.~~

~~For example: Class X(0.2) instrument with d = 20 g and estimated MPD of 3% * 0.2 = 0.6%.~~
~~Calculated Minfill : 20 g / 0.006 = 3330 g. This value belongs to the F range with MPD of 1.5% * 0.2 = 0.3% therefore further calculation is necessary as follows; Calculated Minfill: 20 g / 0.003 = 6660 g, this is the correct value because the F range and MPD are coherent.~~

~~Minfill cannot be obtained for any constant MPD value. Only the relative MPD values can be used for the calculation of the Minfill and the calculated Minfill shall be in the same (F) range as the MPD in the calculation.~~

~~For example: Class X(1) instrument with d = 10 g and constant MPD of 9 g = 3.6% for an estimated Minfill of 250 g.~~
~~Calculated Minfill : 10 g / 0.036 = 280 g: but for 280 g the MPD = 3.2% therefore further calculation is necessary;~~
~~Calculated Minfill: 10 g / 0.032 = 310 g; but for 310 g the MPD = 3.0% therefore further calculation is necessary; Calculated Minfill: 10 g / 0.03 = 330 g; this value is correct because the F range and MPD are coherent.~~

NOTE 2: These values are given as a theoretical basis and for a given instrument on a site are dependent on the products, conditions of use and whether operational tests have demonstrated that the tolerances have been met for this value

NOTE 3: With a resolution in scale interval (d) and the equilibrium device the filling instrument is able to meet the requirement of 5.8.2 with an error (E) = 0.25d. Since 5.8.2 require that 0.25d ≤ 0.25 MPD in-service * Minfill, then you have the condition: Minfill ≥ d / MPD in-service (with MPD as relative value).

For class X(x) instruments the minimum permissible values of Minfill for d values are given in Table 2 below:

Table 2 Minimum permissible value of Minfill (g)

d (g) ~~(g)~~	X(0.2)	X(0.5)	X(1)	X(2)
0.5	28	11	6	3
1	111	22	11	6
2	334	44	22	12
5	1665	335	110	30
10	3330	1330	330	110
20	6660	2660	1340	340
50	25000	6650	3350	1650
100	50000	20000	6700	3300
200	100000	40000	20000	6600
≥500	500 d	200 d	100d	50 d

(The gramme values are rounded to the d-values which can be indicated)

For calculating the Minfill value for class X(x) instruments the MPD and F values (value of the mass of the fills) in Table 1 are used.

For example:
Class X(0.2) instrument with d = 20 g and estimated MPD of 3% * 0.2 = 0.6%.
Calculated Minfill: 20 g / 0.006 = 3330 g. This value belongs to the F range with MPD of 1.5% * 0.2 = 0.3%, therefore further calculation is necessary as follows;
Calculated Minfill: 20 g / 0.003 = 6660 g, this is the correct value because the F range and MPD are coherent.

Minfill cannot be obtained for any constant MPD value. Only the relative MPD values can be used for the calculation of the Minfill and the calculated Minfill shall be in the same (F) range as the MPD in the calculation.

For example:
Class X(1) instrument with d = 10 g and constant MPD of 9 g = 3.6% for an estimated Minfill of 250 g.
Calculated Minfill: 10 g / 0.036 = 280 g: but for 280 g the MPD = 3.2% therefore further calculation is necessary;
Calculated Minfill: 10 g / 0.032 = 310 g; but for 310 g the MPD = 3.0% therefore further calculation is necessary;
Calculated Minfill: 10 g / 0.03 = 330 g; this value is correct because the F range and MPD are coherent.

~~5.8~~4.8 Influence factors

The permissible effects of influence factors on instruments under simulated conditions are specified for each case below.

Refer to Annex A for test conditions.

~~5.8~~4.8.1 Temperature

~~5.8~~4.8.1.1 Prescribed temperature limits

If no particular working temperature is stated in the descriptive markings of the filling instrument, then the instrument shall comply with the appropriate metrological and technical requirements at temperatures from:

-10 °C to + 40 °C.

The temperature limits shall be marked on the instrument in accordance with the descriptive markings in ~~6.12~~5.12.

~~5.8~~4.8.1.2 Special temperature limits

For special applications the limits of the temperature range may differ from those given above but such a range shall not be less than 30 °C and shall be specified in the descriptive markings.

~~5.8~~4.8.1.3 Temperature effect on no load indication

At specified temperatures the indication at zero shall not vary by more than the MPE for influence factor tests specified in ~~5.5~~4.5 for a load equal to the Minfill for a difference in ambient temperature of 5 °C.

~~5.8~~4.8.2 Supply voltage

An electronic instrument shall comply with the appropriate metrological and technical requirements, if the supply voltage varies from the nominal voltage, U_{nom} (if only one voltage is marked on the instrument), or from the voltage range, U_{min} (lowest value), U_{max} (highest value), marked on the instrument at:

- AC mains power supply:
  - lower limit = 0.85 *U*nom or 0.85 U_{min}
  - upper limit = 1.10 *U*nom or 1.10 U_{max}

- External or plug-in power supply device (AC or DC), including rechargeable battery if the battery can be fully (re)charged during the operation of the instrument:

  - In case of an external or plug-in power supply device, the instrument (including this power supply device) shall "simply" comply with the requirements for AC mains power supply.
  - In case of a rechargeable battery, the upper limit for the battery shall be a fully charged battery.
  - ~~lower limit = minimum operating voltage~~
  - ~~upper limit = 1.20 *U*nom or 1.20 *U*max~~

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- Non-rechargeable battery power supply (DC), including rechargeable battery power supply 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}.

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

Battery-operated and DC mains powered instruments shall either continue to function correctly or not indicate any weight values if the voltage is below the manufacturer's specified value, the latter being larger or equal to the minimum operating voltage.

~~5.8~~4.8.3 Tilting

A filling instrument liable to be tilted ~~which is not intended for installation in a fixed position~~ and which do not have a level indicator shall comply with the appropriate metrological and technical requirements when tilted (longitudinally and transversely) by up to 5 %.

a) Where a ~~level~~levelling device and a level indicator is present the limiting value of tilting shall be defined by a marking (e.g. a ring) on the level indicator which shows that the maximum permissible tilt has been exceeded when the bubble is displaced from a central position and the edge touches the marking. The limiting value of the level indicator shall be obvious, so that tilting is easily noticed. The level indicator shall be fixed firmly on the instrument in a place clearly visible to the user and representative for the tilt sensitive part.~~it shall enable the filling instrument to be set to a tilt of 1 % or less~~.

b) If the instrument is fitted with an automatic tilt sensor the limiting value of tilting is defined by the manufacturer. The tilt sensor shall release a display switch-off or other appropriate alarm signal (e.g. error signal) and shall inhibit the printout and data transmission if the limiting value of tilting has been exceeded The automatic tilt sensor may also compensate the effect of tilting.

~~b)~~c) Mobile instruments intended to be used outside in open locations (e.g. on roads) shall either be fitted with an automatic tilt sensor or a Cardanic (gimbal type) suspension of the tilt sensitive part(s). In case of an automatic tilt sensor, b) applies, whereas in the case of a Cardanic suspension, c) applies

~~6~~ 5 Technical requirements

~~6.1~~5.1 Suitability for use

A filling instrument shall be designed to suit the method of operation and the products for which it is intended. It shall be of adequately robust construction so that it maintain it metrological characteristics when properly installed and used in an environment for which it is intended.

~~6.2~~5.2 Security of operation

~~6.2~~5.2.1 Fraudulent use

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

~~6.2~~5.2.2 Accidental maladjustment

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

~~6.2~~5.2.3 Security

Means shall be provided for securing components, interfaces, software devices and pre-set controls of a filling instrument, to which unauthorised access is prohibited or is detected and made evident by an audit trail or similair.

National prescription may specify the security or sealing that is required.

~~6.2~~5.2.4 Modifications and identification

Any modifications to the filling instrument or devices or software parts shall be such that they do not affect their correct functioning and their metrological characteristics. Modifications shall be identifiable and capable of being confirmed at verification.

~~6.3~~5.3 Indication of weighing results

~~6.3~~5.3.1 Quality of reading

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

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

~~6.3~~5.3.2 Form of the indication

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

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

All indicating, printing and tare weighing devices of filling instruments shall, within any one weighing range, have the same scale interval for any given load.

Digital indication shall display at least one figure beginning at the extreme right.

~~6.3~~5.3.3 Use of a printer

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

If printing takes place, the name or the symbol of the unit of measurement shall be either to the right of the value or above a column of values.

~~Any printout is for information purposes only and not for use in any commercial transaction, except preset values and number of weighings.~~

~~6.3~~5.3.4 Scale interval (d)

Scale intervals of all indicating devices associated with a weighing unit shall be the same.

The scale interval for a measured value shall be in the form $1x10^n$, $2x10^n$, or $5x10^n$, where n is any integer or zero.

~~6.4~~5.4 Fill setting device

If fill setting is by means of a scale, it shall be graduated in units of mass.

If fill setting is by means of weights, they shall be either weights in accordance with OIML R 111 [5] requirements or purpose-designed of any nominal value, distinguishable by shape and identified with the filling instrument.

~~6.5~~5.5 Final feed cut-off device

The final feed cut-off device shall be clearly differentiated from any other device. The direction of movement corresponding to the sense of the desired result shall be shown, where applicable.

For automatic mechanical scales the final feed cut-off device may include an adjustable compensation beam for the material in flight.

~~6.6~~5.6 Feeding device

The feeding device shall be designed to provide sufficient and regular flowrate(s).

An adjustable feeding device shall be fitted with an indication of the direction of movement corresponding to the sense of the adjustment of the feed where applicable.

~~6.7~~5.7 Load receptor

The load receptor, and feed and discharge devices as appropriate, shall be designed to ensure that residual material retained after each discharge is negligible.

A filling instrument using the subtractive weighing principle shall be designed to ensure that residual material retained at feed from the discharge gate is negligible.

The load receptor shall provide access and facilities so that where necessary test weights or masses up to the maximum capacity can be placed in position, in a safe and secure manner. If these facilities are not a permanent fixture of the instrument, they must be kept in the vicinity of the filling instrument.

Manual discharge of the load receptor shall not be possible during automatic operation.

~~6.8~~5.8 Zero-setting and tare devices

A filling instrument shall be provided with zero-setting and/or tare devices and it may be provided with additional zero tracking tracking devices. Tare devices (except preset tare devices) may also be used for zeroing. The devices may be:

- Non-automatic (tare balancing and/or preset tare), or
- Semi-automatic, or
- Automatic

~~6.8~~5.8.1 Range of adjustment

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

The range of adjustment of zero-setting devices shall not exceed 4%, and of the initial zero-setting device not more than 20%, of the Max of the filling instrument.

~~6.8~~5.8.2 Accuracy of zero-setting and tare devices

Zero-setting and tare devices (except the preset tare function) shall be capable of setting to less than or equal to 0.25 of the MPD for in-service inspection as specified in ~~2.2.2~~4.2.2 for a fill equal to the Min or Minfill respectively of the filling instrument.

~~6.8~~5.8.3 Control of the zero-setting and tare devices

5.8.3.1 Non-automatic and semi-automatic devices

Non-automatic or semi-automatic zero-setting and tare devices must be locked during automatic operation.

The weighing unit shall be in stable equilibrium when the zero-setting and tare devices are operating.

~~6.8~~5.8.3.2 Automatic devices

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) should be included in the ~~pattern~~type approval certificate.

The automatic zero-setting device shall operate sufficiently often to ensure that zero is maintained within twice the given MPE in ~~6.8~~5.8.2.

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 programmable time interval. The maximum programmable time interval shall not be greater than the value calculated according to the method in A.5.3.5, or shall be reduced depending on prevailing operating conditions.

The maximum programmable time interval for automatic zero-setting required above and specified in A.5.3.5 may start again after taring or zero tracking has taken place.

The automatic zero-setting device shall generate suitable information to draw attention to overdue zero setting.

~~6.8~~5.8.4 Zero-tracking device

A zero-tracking device shall operate only when:

a) the indication is at zero, or at a negative net value equivalent to gross zero, and

b) the corrections are not more than 0.25 MPD in-service inspection for a fill equal to the Min or Minfill respectively of the filling instrument.

When zero is indicated after a tare operation, the zero-tracking device may operate within a range of 4% of Max of the filling instrument around the actual zero value.

NOTE: Zero-tracking is functionally similar to automatic zero setting. The differences are important in applying the requirements of ~~6.8~~5.8. Automatic zero-setting and zero-tracking are defined in ~~3.3~~0.3.4.3 and ~~3.3~~0.3.4.5. Specifically:

a) Automatic zero setting is activated by an event, such as part of every automatic weighing cycle or after a programmed interval.
b) Zero-tracking may operate continuously when the above conditions are fulfilled and must therefore be subject to a maximum rate of correction of 0.5 MPD in-service inspection to prevent interaction with the normal weighing process.

~~6.8~~5.8.5 Tare device

~~6.8~~5.8.5.1 Accuracy and control of tare devices

Accuracy and operation of the tare device shall be as specified in ~~6.8~~5.8.2 and ~~6.8~~5.8.3.

~~6.8~~5.8.5.2 Subtractive tare device

When the use of a subtractive tare device does not allow the value of the residual weighing range to be known, a device shall prevent the use of the instrument above its maximum capacity or indicate that this capacity has been reached.

~~6.8~~5.8.5.3 Combined zero-setting and tare devices

If the same key operates the semi-automatic zero-setting device and the semi-automatic tare device, the accuracy requirements specified in ~~6.8~~5.8.2 and in ~~6.8~~5.8.4 apply at any load

~~6.8~~5.8.6 **Preset tare device**

~~6.8~~5.8.6.1 Scale interval

The scale interval of a preset tare device shall be equal or automatically rounded to the scale interval of the instrument.

~~6.8~~5.8.6.2 Modes of operation

A preset tare device may be operated together with one or more tare devices provided that a preset tare operation cannot be modified or cancelled as long as any tare device operated after the preset tare operation is still in use.

Preset tare devices may operate automatically only if the preset tare value is clearly identified with the load to be measured (e.g. by bar code identification on the container).

~~6.9~~5.9 **Data storage**

~~The measuring instrument shall record by a durable means the measurement result accompanied by information to identify the particular transaction. And a durable proof of the~~

~~measurement result and the information to identify the transaction shall be available on request at the time the measurement is concluded.~~

~~Metrologically relevant m~~Measurement ~~data~~ result ~~may~~ shall be stored, which may be in ~~a~~ internal memory of the instrument or on external storage for subsequent use (e.g. indication, printing, transfer, totalising, etc.). In this case, the stored data shall be adequately protected against intentional and unintentional changes during the data transmission and/or storage process and shall contain all relevant information necessary to reconstruct an earlier measurement.

The storage of primary indications for subsequent indication, data transfer, totalizing, etc. shall be inhibited when the equilibrium is not stable.

To ensure adequate security the following conditions apply~~There shall be adequate security to ensure that~~:

a) the requirements for security of software given in ~~6.10~~5.10 are applied as appropriate;

b) if software realizing short or long term data storage can be transmitted to or downloaded into the instrument these processes shall be secured in accordance with requirements of ~~6.2~~5.2.3;

c) external storage devices identification and security attributes shall be automatically verified to ensure integrity and authenticity;

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

e) when storage capacity is exhausted, new data may replace oldest data provided that that overwriting the old data has been archived and/or authorized~~the owner of the old data has given authority to overwrite the old data~~.

Further information is provided in Annex B.

~~6.10~~5.10 Software

~~There shall be a distinct separation between the legally relevant and non-relevant software (6.3.6.6) in an instrument.~~ The legally relevant software of an instrument shall be identified by the manufacturer, i.e. the software that is critical for measurement characteristics, measurement data and metrologically important parameters, stored or transmitted, and software programmed to detect system fault (software and hardware), is considered as an essential part of gravimetric filling instrument and shall meet the requirements for securing software specified in ~~6.10~~5.10.2. Further information is provided in Annex B.

~~6.10~~5.10.1 Software documentation

The software documentation submitted by the manufacturer may include:

a) description of the legally relevant software;

b) description of the accuracy of the measuring algorithms;

c) description of the user interface, menus and dialogues;

d) the unambiguous software identification;

e) description of the embedded software;

f) overview of the system hardware, e.g. topology block diagram, type of computer(s), types of software functions, etc. if not described in the operating manual;

g) means of securing software;

h) operating manual.

~~6.10~~5.10.2 Means of securing

There shall be adequate security and tests conducted to ensure that:

a) legally relevant software shall be adequately protected against accidental or intentional changes. The requirements for securing given in ~~6.2~~5.2.3 apply;

b) the software shall be assigned with appropriate software identification (see ~~6.3~~5.3.6.5). This software identification shall be adapted in the case of every software change that may affect the functions and accuracy of the instrument;

c) functions performed or initiated via connected interfaces, i.e. transmission of legally relevant software, shall comply with the securing requirements for interfaces of ~~4.2.5~~7.9.

~~6.11~~5.11 Equilibrium mechanism

The equilibrium mechanism may be provided with detachable masses which shall be either weights in accordance with OIML R 111 [5] requirements or purpose designed masses of any nominal value, distinguishable by shape and identified with the filling instrument.

~~6.12~~5.12 Descriptive markings

A filling instrument shall bear the following markings.

~~6.12~~5.12.1 Markings shown in full

- Name or identification mark of the manufacturer
- Name or identification mark of the importer (if applicable)
- Date of manufacture of the instrument
- Serial number and type designation of the instrument
- Product(s) designation (i.e. materials that may be weighed)
- Temperature range (if applicable, see ~~2.5.1~~4.8.1) in the form: ....°C / ....°C
- Electrical supply voltage in the form: V
- Electrical supply frequency in the form: .... Hz
- Pneumatic/hydraulic pressure (if applicable) in the form: .... kPa or bar
- Average number of loads/fill (if applicable) ....
- Maximum fill (if applicable) in the form Maxfill.......
- Rated minimum fill (if applicable) in the form Minfill ....
- Maximum rate of operation (if applicable) in the form: .... loads per minute

~~6.12~~5.12.2 Markings shown in code

- ~~Pattern~~Type approval sign
- Indication of the accuracy class in the form X(x) =…….
- Reference value for accuracy class in the form Ref(x) =…….
- Scale interval (if applicable) in the form: d = ...
- Maximum capacity in the form: Max ....
- Minimum capacity (or minimum discharge where applicable) in the form: Min ....
- Maximum additive tare in the form: T = + ...

- Maximum subtractive tare in the form: T = - ....

~~6.12~~5.12.3 Supplementry markings

Depending upon the particular use of the filling instrument, supplementary markings may be required on ~~pattern~~type approval by the metrological authority issuing the ~~pattern~~type approval certificate, for example: filling instruments may be verified for different materials for which different classes apply or which require different operating parameters to maintain ~~limits of error~~error limitation.

Marking shall be such that the materials and alternative class or operating parameters are clearly associated with the appropriate material designation.

In the case of subtractive weighers the minimum load to be discharged shall be specified.

~~6.12~~5.12.4 Presentation of descriptive markings

The descriptive markings shall be indelible and of a size, shape and clarity to enable legibility under normal conditions of use of the filling instrument.

They shall be grouped together in a clearly visible place on the filling instrument, either on a descriptive plate or on the filling instrument itself.

Where the markings are placed on a descriptive plate, it shall be possible to seal the plate bearing the markings. Where they are marked on the filling instrument itself, it shall not be possible to remove them without destroying them.

The descriptive markings may be shown on a programmable display which is controlled by software. In this case, 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 event logger providing information record of the changes or event counter providing non-resettable counter of changes.

When a programmable display is used, the descriptive plate on the instrument shall bear at least the following markings:

- Type and designation of the instrument,
- Name or identification mark of the manufacturer,
- Serial number
- Temperature range
- ~~Pattern~~Type approval number,
- Electrical supply voltage,
- Electrical supply frequency,
- Pneumatic/hydraulic pressure.

~~6.13~~5.13 Verification marks

~~6.13~~5.13.1 Position

The filling instrument shall have a place for the application of verification marks. This place shall:

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

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

c) be visible without the filling instrument or its protective covers having to be removed.

~~6.1~~3~~3~~5.13.2 Mounting

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Afilling instrument 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.

~~7~~ 6 Control instruments

Control instruments may be separate from, or an integral part of, the filling instrument.

Control instruments may incorporate other devices including software which allows them to determine the mass of the fill(s). Where other devices and software are incorporated into control instruments they shall continue to function correctly and their metrological functions shall not be influenced.

~~8~~ 7 Requirements for electronic instruments

The ~~pattern~~type of an electronic instrument is presumed to comply with the following general requirements if it passes the examination and tests specified in Annex A,~~ in addition to the applicable requirements of all other clauses of this Recommendation~~.

~~8.1~~7.1 Rated operating conditions

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

~~8.2~~7.2 Disturbances

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

(a) Significant faults do not occur, i.e. the difference between the weight indication due to the disturbance and the indication without the disturbance (intrinsic error) shall not exceed the value of the significant fault specified in ~~3.5~~0.5.2.6 , or

(b) Significant faults are detected and acted upon.

NOTE: A fault equal to or less than the value specified in ~~3.5~~0.5.2.6 is allowed irrespective of the value of the error of indication.

~~8.3~~7.3 Durability

The requirements in ~~8.1~~7.1, ~~8.2~~7.2 and ~~8.2.1~~ 7.5 shall be met durably in accordance with the intended use of the instrument.

~~8.4~~7.4 Application

The requirements in ~~8.2~~7.2 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

~~8.2~~7.2 (a), Electronic instruments designed to withstand disturbances or

~~8.2~~7.2 (b), Electronic instruments designed to detect and act on significant faults

The choice as to whether to apply 7.2(a) or 7.2(b) is applied ~~is left~~ to the manufacturer of the filling instrument.

~~8.5~~7.5 Influence factors

An electronic instrument shall comply with the influence factors requirements of ~~2.8~~4.8 and shall also comply with appropriate metrological and technical requirements at a relative humidity of 85 % at the upper limit of the temperature range of the instrument.

~~8.6~~7.6 Indicator display test

If the failure of an indicator display element can cause a false weight indication then the instrument may have a display test facility which is automatically initiated at switch-on of indication, e.g. indication of all the relevant signs of the indicator in their active and non-active states for a sufficient time to be easily observed by the operator.

~~8.7~~7.7 Acting upon a significant fault

When a significant fault has been detected, the instrument shall either be automatically made inoperative or a visual or audible indication shall be provided automatically and shall continue until such time when the user takes action or the fault disappears.

~~8.8~~7.8 Warm-up time

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

~~8.9~~7.9 Interfaces

A filling instrument may be equipped with interfaces which allows it to be coupled to external equipment and software devices.

An interface comprises all mechanical, electrical and software devices at the communication point between instruments, peripheral and software devices.

When an interface is used, the filling instrument shall continue to function correctly and its metrological functions shall not be influenced by the attached external equipment or software devices or by disturbances acting on the interface.

Functions that are performed or initiated via an interface shall meet the relevant requirements and conditions of ~~clause 3~~6.

It shall not be possible to introduce into a filling instrument, through an interface, functions, program modules or data structures intended or suitable to:

- Display unclear data,
- Falsify displayed, processed or stored weighing results,
- Unauthorised adjustment of the instrument.

Other interfaces shall be secured in accordance with ~~3.2.3~~5.2.3.

~~**8.10** DC mains or rechargeable battery supply voltage~~

~~An instrument that operates from a DC mains supply or rechargeable battery supply shall, whenever the voltage drops below the manufacturer's specified minimum value (2.8.2), either continue to function correctly or automatically be put out of service.~~

~~8.11~~7.10 Examination and tests

Examination and testing of electronic instruments is intended to verify compliance with the applicable requirements of this Recommendation and with the requirements of ~~clause~~ 8.

~~8.11~~7.10.1 Examinations

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

~~8.11~~7.10.2 Performance tests

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

Tests are to be carried out 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 electronic devices shall be tested, where possible as a simulated instrument including all electronic elements of a system which can affect the weighing result. In addition, an examination shall be carried out on the fully operational instrument.

Susceptibility that would result from the use of electronic interfaces to other equipment shall be simulated in the tests.

~~8.11~~7.10.3 Span stability

When an electronic instrument is subjected to the span stability test specified in A.7, the absolute value of the difference between the errors obtained for any two measurements shall not exceed half the maximum permissible error for influence factor tests for a near maximum capacity load.

PART 2 – METROLOGICAL CONTROLS AND PERFORMANCE TESTS

~~9~~ 8 METROLOGICAL CONTROLS

~~9.1~~8.1 General

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

a) ~~Pattern~~type approval,

b) ~~Initial~~ initial verification,

c) ~~Subsequent~~ subsequent verification

d) ~~In~~in-service inspection.

Tests should be applied uniformly by the metrological authority and should form a uniform program. Guidance for the conduct of ~~pattern~~type approval and initial verification is provided in OIML International Documents D 19 [8] ~~*Pattern evaluation and pattern approval*~~ and D 20 [20] ~~*Initial and subsequent verification of measuring instruments and processes*~~ respectively.

For the purposes of testing, the metrological authority may require from the applicant the product (i.e. the material to be weighed), the handling equipment, the control instrument (as defined in ~~3.12~~ 5.14 and A.3.6) and the personnel to assist in performing the tests.

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

Further information about durability testing is given in Annex D.

~~9.2~~8.2 ~~Pattern~~Type Approval

~~9.2~~8.2.1 Documentation

The application for ~~pattern~~type approval shall include documentation comprising:

NOTE: The numbers in parentheses in the table below refer to clauses in this Recommendation.

Item	Documentation required
1	General description of the instrument, description of the function, intended purpose of use, kind of instrument.
2	General characteristics (manufacturer; Class, Max, Min, X(x), Ref(x), temperature range, voltage, etc.).
3	List of descriptions and characteristic data of all devices and modules of the instrument.
4	Drawings of general arrangement and details of metrological interest including details of any interlocks, safeguards, restrictions, limits, etc.

4.1	Securing components, adjustment devices, controls, etc. (5.2.2), protected access to set-up and adjustment operations (5.2.3).
4.2	Place for application of control marks, securing elements, descriptive markings, identification, conformity and/or approval marks (5.12.4, 5.13.2).
5	Devices of the instrument.
5.1	Auxiliary, or extended indicating devices (9.5.2).
5.2	Multiple use of indicating devices (5.2, 5.3.9).
5.3	Printing devices (5.5.3).
5.4	Memory storage devices (5.9).
5.5	Zero-setting, zero-tracking devices (5.8).
5.6	Tare devices and preset tare devices (5.8.5).
5.7	Leveling device and level indicator, tilt sensor, upper limit of tilting (4.8.3).
5.8	Locking devices and auxiliary verification devices.
5.9	Connection of different load receptors (5.7, A.8.1.2).
5.10	Interfaces (types, intended use, immunity to external influences instructions (7.9)).
5.11	Peripheral devices, e.g. printers, secondary displays, for including in the type approval certificate and for connection for the disturbance tests (7.10.2, 8.2.2).
5.12	Functions of price-computing instruments (e.g. for direct sales to the public), self-service, price labeling.
5.13	Other devices or functions, e.g. for purposes other than determination of mass (not subject to conformity assessment).
5.14	Detailed description of the stable equilibrium function (5.11) of the instrument.
6	Information concerning special cases.
6.1	Subdivision of the instrument in modules - e.g. load cells, mechanical system, indicator, display - indicating the functions of each module and the fractions *p*i. For modules that have already been approved, reference to test certificates or type approval certificates (8.3.3), reference to evaluation to R 60 for load cells.
6.2	Special operating conditions (5.12.3).
6.3	Reaction of the instrument to significant faults (7.3, 7.4, 7.7).
6.4	Functioning of the display after switch-on (7.6).
7	Technical description, drawings and plans of devices, sub-assemblies, etc. particularly those in 5.12 – 5.13.
7.1	Load receptor, (5.7) force transmitting devices.
7.2	Load cells, if not presented as modules.
7.3	Electrical connection elements, e.g. for connecting load cells to the indicator, including length of signal lines.
7.4	Indicator: block diagram, schematic diagrams, internal processing and data exchange via interface, keyboard with function assigned to any key.
7.5	Declarations of the manufacturer, e.g. for interfaces (5.10.11, 7.9), for protected access to set-up and adjustment (5.2.3), for other software based operations.
7.6	Samples of all intended printouts.
8	Results of tests performed by the manufacturer or from other laboratories, on protocols from R 76-2, including proof of competence.
9	Certificates of other type approvals or separate tests, relating to modules or other parts mentioned in the documentation, together with test protocols.

10	For software controlled instruments or modules, additional documents according to 5.10 and Annex B).
11	Drawing or photo of the instrument showing the principle and the location of verification and securing marks are to be applied, which is necessary to be included in the OIML Certificate or Test Report.

All documents of the weighing instrument shall be kept confidential by the approving authority, except to the extent agreed with the manufacturer.

- ~~Metrological characteristics of the instrument,~~
- ~~A 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, including interlocks,~~
- ~~Any document or other evidence that the design and construction of the instrumentcomplieswith the requirements of this Recommendation.~~

~~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 specified in 8.9, and for password protected access to prevent unauthorized access in accordance with 3.2.3.~~

~~9.2~~8.2.2 General requirements

~~Pattern~~Type evaluation shall be carried out on one or more and normally not more than three instruments that represent the definitive ~~pattern~~type. At least one of the instruments shall be submitted in a form suitable for simulation testing in a laboratory and shall include the whole of the electronics which affect the weighing result except in the case of an associative weigher where only one representative weighing unit may be included.

The evaluation shall consist of the tests specified in ~~9.2~~8.2.3.

MPE for static tests shall be apportioned in accordance with ~~9.2~~8.2.3.3 to parts of the filling instrument that are tested seperately.

~~9.2~~8.2.3 ~~Pattern~~Type evaluation

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

- The requirements specified for static tests in ~~clause 2~~ 5,
- The technical requirements in ~~clause 3~~ 6,
- The requirements in ~~clause 4~~8 for electronic instruments, where applicable.

The metrological authority shall:

- Conduct the tests in a manner which prevents an unnecessary commitment of resources,
- Permit the results of these tests to be assessed for initial verification

~~Note~~NOTE: The metrological ~~-~~authority is advised to accept, with the consent of the applicant, equivalent test data obtained from other metrological authorities without repeating the tests.

~~9.2~~8.2.3.1 Operational tests for ~~pattern~~type evaluatiuon

Tests for ~~pattern~~type evaluation shall be conducted:

a) In accordance with the appropriate parts of ~~clause 3~~6.

b) Under the normal conditions of use for which the instrument is intended, and

c) In accordance with the material test methods given in ~~clause~~ 6, using material that is representative of a product for which the filling instrument is designed to assess compliance with the technical requirements of ~~clause 3~~6.

For software-controlled instruments, the additional requirements in 5.10 and in Annex B apply.

~~9.2~~8.2.3.2 Influence factor tests

Influence factors shall be applied to the instrument or simulator during simulation tests in a manner that will reveal a corruption of the weighing result of any weighing process to which the instrument could be applied, in accordance with:

a) ~~Subclause 2.8~~4.8 for all instruments,

b) ~~Clause~~ 4 for electronic instruments.

~~9.2~~8.2.3.3 Apportioning of errors

Where parts of a filling instrument are examined separately in the process of ~~pattern~~type approval, the following requirements apply:

The error limits applicable to a part 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 part have to be taken for the same accuracy class as for the complete instrument incorporating the part.

The fractions ~~P_i~~pi shall satisfy the following equation:

(~~P_1^2~~ p_1^2 + ~~P_2^2~~ p_2^2 + ~~P_3^2~~ p_3^2 + ...) ≤ 1

The fraction ~~P_i~~pi shall be chosen by the manufacturer of the part and shall be verified by an appropriate test. However, the fraction shall not exceed 0.8 and shall not be less than 0.3, when more than one part contributes to the effect in question.

If the metrological characteristics of the load cell or other major component has been evaluated in accordance with the requirements of any OIML International Recommendation (e.g. OIML R 60 [6] for load cells), that evaluation shall be used to aid in the ~~pattern~~type evaluation if so requested by the applicant.

NoteNOTE: As the requirements of this subclause clause only apply to the instrument submitted for patterntype evaluation and not to those subsequently submitted for verification, the means by which it will be possible to determine whether the appropriate maximum permissible error or maximum allowable variation has been exceeded will be decided mutually between the metrological authority and the applicant. The means may be for example:

- The provision or adaptation of the indicating device to give the required resolution or appropriate increment or scale interval, or
- The use of change point weights, or
- Any other means mutually agreed.

Acceptable solution

For instruments incorporating the typical modules (see **0.3.11**) the fractions p_i may have the values given in Table 3, which takes into account the fact that the modules are affected in a different manner depending on the different performance criteria.

Table 3

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

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

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

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

NOTE 4: See OIML R 76-1(3.9.4) [7] for information on the effects of time.

NOTE 5: The compatibility check of the weighing instrument and the modules shall be considered in accordance with OIML R 76-1 (Annex F) [7].

9.28.2.4 Place of testing for patterntype approval

Instruments submitted for ~~pattern~~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.

~~9.2~~8.2.5 ~~Pattern~~Type approval certificate and determination of classes (~~2.2.1~~ 4.1and A.5)

The ~~pattern~~type approval certificate shall state the reference value for the accuracy class Ref(x) as determined by the static tests in A.5, and shall state that the actual class (equal to or higher than the reference value) shall be determined by compliance with the metrological requirements at initial verification.

~~9.3~~8.3 Initial verification

~~9.3~~8.3.1 General requirements

A filling instrument shall be examined for conformity with the approved ~~pattern~~type where applicable and shall be tested for compliance with ~~clause 2~~5 (excluding ~~2.2.1~~4.2.1 and ~~2.5~~4.5) for the intended products and corresponding accuracy classes and when operated under normal conditions of use.

Tests shall be carried out by the metrological authority, in-situ, with the filling instrument fully assembled and fixed in the position in which it is intended to be used. The requirement of 4.8.3 applies if the instrument is liable to be tiled.

The installation of a filling instrument shall be so designed that an automatic weighing operation will be the same whether for the purposes of testing or for use for a transaction.

~~9.3~~8.3.2 Material tests for initial verification

In-situ material tests shall be done:

a) In accordance with the descriptive markings given in ~~3.12~~5.12,

b) Under the normal conditions and with the products for which the filling instrument is intended.

c) In accordance with the test method in ~~clause~~ 6 and the material tests procedure given in A.8.2.

Accuracy requirements shall be applied in accordance with the appropriate parts of ~~clause 2~~5.

8.3.3 Conduct of the tests

The metrological authority:

a) Shall conduct the tests in a manner which prevents an unnecessary commitment of resources,

b) May, where appropriate and to avoid duplicating tests previously done on the instrument for ~~pattern~~type evaluation under ~~9.2~~8.2, use the test results from ~~pattern~~type evaluation for initial verification.

9.38.3.4 Determination of accuracy class X(x)

For class X(x) filling instruments the metrological authority shall:

a) Determine the accuracy class for the materials used in the tests in accordance with 9.28.2.5 by reference to the material test results from A.8 and the limits of errorerror limitation specified in 2.2.24.2.2 and 2.44.4 for initial verification,

b) Verify that accuracy classes marked in accordance with descriptive markings in 3.125.12 are equal to or greater than the accuracy classes determined as above. The accuracy class marking required in accordance with 5.12 shall show the same accuracy class as for which the type was approved and which was laid down in the approval certificate.

8.3.5 Appropriate material designation

Marking shall be such that the materials and alternative class or operating parameters are clearly associated with the appropriate material designation in accordance with 5.12.

9.48.4 Subsequent verification

Subsequent verifcation shall be carried out in accordance with the same provisions as in 9.38.3 for initial verification.

Further information regarding durability testing as part of subsequent control is given in Annex D.

9.58.5 In-service inspection

In-service Inspection shall be carried out in accordance with the same provisions as in 8.3.1 and 8.3.2In-service inspection shall be as specified in:

a) 9.3.1, general requirements for initial verification and,

b) 9.3.2 for materials tests.

The maximum permissible errors shall be as specified in 2.2.2 for in-service inspection.

10 9 TEST METHODS

10.19.1 Determination of the mass of individual fills

The mass of individual fills is determined using either the separate verification method given in 10.59.5.1 or the integral verification method given in 10.59.5.2.

10.29.2 Conduct of material tests

10.29.2.1 Values of the mass of the fills

a) The tests shall be carried out on fills using loads at, or near to, the Max and also at, or near to, the Minfill of the filling instrument.

b) Cumulative weighers shall be tested as in (a) with the maximum practical number of loads per fill and also with the minimum number of loads per fill, and associative weighers as in (a) with the average (or optimum) number of loads per fill (see ~~3.4~~0.4.10).

c) If the Minfill is less than one third of the Maxfill then tests shall also be carried out near the centre of the load weighing range preferably at a value close to, but not above, 100 g, 300 g, 1 000 g or 15 000 g, as appropriate.

~~10.2~~9.2.2 Types of test loads

For ~~pattern~~type evaluation, the materials used for test loads shall be as specified in ~~9.2~~8.2.3.1 and for initial verification and in-service inspection material used for test loads shall be as specified in ~~9.3~~8.3.2.

~~10.2~~9.2.3 Condition of tests

All tests shall be conducted with any adjustable parameter critical to metrological integrity, e.g. final feed time or rate, set to the most onerous condition allowed by the manufacturer's printed instructions and incorporated in the descriptive markings.

Prior to the start of a new test the filling instrument shall be operated for a time period under normal operating conditions to enable stability, i.e until all the principal parts, devices and parameters such as warm-up, temperature, indications, etc, critical to metrological integrity have stabilized according to the manufacturer's printed instructions. During this stabilization period the fills shall not be included in the test.

Any correction device, e.g. in-flight correction and/or automatic zero-setting fitted to an instrument shall be operated during the tests according to the manufacturer's printed instructions.

The initial fills after the change between Max and Min shall be included in the test unless the instrument bears a clear warning to discard the stated number of fills after a change to the instrument settings.

~~10.3~~9.3 Number of fills

The minimum number of individual test fills depends upon the preset value (F_P) as specified in ~~Table 2~~Table 4.

~~Table 2~~Table 4 – Number of test fills

Preset value of the fills F_P (kg)	Minimum number of test fills (n)
$F_P \leq 1$ kg	60 fills
1 kg < $F_P \leq 10$ kg	30 fills
10 kg < $F_P \leq 25$ kg	20 fills
25 kg < F_P	10 fills

~~10.4~~9.4 Accuracy of standards

a) The control instrument and standard weights used in testing shall ensure the checking of the test fills to an error not greater than either: One one third of the MPD and MPSE (as appropriate) for automatic weighing (details as given in 2.2 4.5and 2.44.4 respectively). if the control instrument or the device used for control purposes is verified immediately prior to the material test, or,

b)

c)One third of the MPD and MPSE (as appropriate) for automatic weighing (details as given in 2.2 and 2.4 respectively) in all other cases.

10.59.5 Material test methods

10.59.5.1 Separate verification method

The separate verification method requires the use of a (separate) control instrument (details as given in 3.125.14 and A.3.6) to find the conventional true value of the mass of the test fill.

10.59.5.2 Integral verification method

With this method the filling instrument being tested is used to determine the conventional true value of the mass of the test fill. The integral verification method shall be conducted using either:

(a) An appropriately designed indicating device, or

(b) An indicating device with standard weights to assess the rounding error.

The total uncertainty of the test method (separate or integral verification) shall be not greater than one third of the maximum permissible error for the filling instrument.

NOTE1: The integral verification method depends on determining the masses of the loads. Limits of errorError limitation as specified in 2.2 4.2 are for the mass of the fill. If it is not possible to ensure that in normal operation all of the load is discharged at each cycle of operation, i.e. that the sum of the loads is equal to the fill, then the separate verification method (details as given in 10.59.5.1) must be used.

NOTE 2: When using the integral verification method for a cumulative weighing instrument a sub-division of the test fill is unavoidable. When calculating the conventional true value of the mass of the test fill, it is necessary to consider the increased uncertainty due to the division of the test fill.

10.59.5.2.1 Interruption of automatic operation

An automatic filling operation of a test fill shall be initiated as for normal operation. However the automatic operation shall be interrupted twice during each filling cycle in the following conditions:

(A) on a filling instrument where the fill is weighed in the load receptor

- After filling the load receptor (a)
- After discharge of the load receptor (b)

(B) on a filling instrument where the load is weighed in a container on the load receptor

- After tare balancing the empty container (b)

- After filling the container (a)

(C) on a subtractive weigher

- After tare balancing the filled load receptor (a)
- After discharge of the fill from the load receptor (b)

An automatic operation shall not be interrupted during consecutive weighing cycles if the interruption would significantly affect the mass of the fill. In this case, one or two fills shall be discharged in automatic operation without being checked, between the fills that are checked.

(a) Pre-discharge (full) interrupt

The automatic operation shall be interrupted immediately after the feed of material has ceased and the load receptor(s), or the container on the load receptor has been filled, or on a subtractive weigher the filled load receptor has been tare balanced.

When the load receptor(s) has (have) stabilized, the net weight of the fill indicated or determined by balancing with standard weights shall be recorded and the instrument switched back to automatic operation.

(b) Post-discharge (empty) interrupt

The automatic operation shall be interrupted after the load(s) has (have) been discharged, or a new container has been placed on the load receptor and its weight has been tare balanced, and the load receptor(s) is (are) ready to receive a further load. When the load receptor(s) has (have) stabilized, the empty load receptor weight indicated or determined by balancing with standard weights shall be recorded and the instrument switched back to automatic operation.

~~10.6~~9.6 Preset value

The indicated preset value of the fill shall be noted where applicable.

~~10.7~~9.7 Mass and average value of the test fills

The test fill shall be weighed on a control instrument and the result shall be considered as being the conventional true value of the test fill. The average value of all the fills in the test shall be calculated and noted.

~~10.8~~9.8 Deviation for automatic weighing

The deviation for automatic weighing used to determine compliance of each fill with the maximum permissible deviation for automatic weighing (specified in ~~2.2.2~~4.2.2) shall be the difference between the conventional true value of the mass of the test fill (as defined in ~~10.7~~9.7) and the average value of all the fills in the test.

~~10.9~~9.9 Preset value error for automatic weighing

The preset value error for automatic weighing used to determine compliance with ~~2.4~~4.4 shall be the difference between the average value of the conventional true value of the mass of the test fills (as defined in ~~10.7~~9.7) and the preset value of the fills.

ANNEX A

~~TESTING~~ PROCEDURES FOR TESTS ON AUTOMATIC GRAVIMETRIC FILLING INSTRUMENTS
(Mandatory)

~~Meaning of symbols:~~

~~I~~	~~=~~	~~Indication~~
~~I_n~~	~~=~~	~~n^{th} indication~~
~~L~~	~~=~~	~~Load~~
~~ΔL~~	~~=~~	~~Additional load to next changeover point~~
~~P~~	~~=~~	~~I + 1/2 d - ΔL = Indication prior to rounding (digital indication)~~
~~E~~	~~=~~	~~I - L or P - L = Error~~
~~MPE~~	~~=~~	~~Maximum permissible error~~
~~MPD~~	~~=~~	~~Maximum permissible deviation of each fill from the average~~
~~EUT~~	~~=~~	~~Equipment under test~~
~~se~~	~~=~~	~~Preset value error (setting error)~~
~~MPSE~~	~~=~~	~~Maximum permissible setting error~~
~~F~~	~~=~~	~~Conventional true value of the mass of the fill~~
~~F_p~~	~~=~~	~~Preset value of fill~~
~~md_{max}~~	~~=~~	~~Maximum of the absolute values of the actual deviations of the~~

A.1 Examination for ~~pattern~~type approval

A.1.1 Documentation

Review the documentation that is submitted to determine if it is adequate and correct. For ~~pattern~~type approval the documentation shall be as specified in ~~9.2~~8.2.1.

A.1.2 Compare construction with documentation

Examine the various devices of the instrument to ensure compliance with the documentation in accordance with ~~8.3~~7.3.

A.1.3 Metrological requirements

Note the metrological characteristics using the checklist in the test report format in OIML ~~R61-2~~R 61-3

A.1.4 Technical requirements

Examine the instrument for conformity with the technical requirements of ~~clause 3~~5 and 8, using the checklist given in the test report format in OIML ~~R61-2~~R 61-3.

A.1.5 Functional requirements

Examine the instrument for conformity with functional requirements according to details given in ~~8.2 and 8.3 respectively~~8, using the checklist given in OIML ~~R61-2~~R 61-3 *Test report format*.

A.2 Examination for initial verification

A.2.1 Compare construction with documentation

Examine the instrument for conformity with the approved ~~pattern~~type in accordance with the requirements in ~~9.3~~8.3.1.

A.2.2 Descriptive markings

Check the descriptive markings in accordance with ~~3.12~~5.12 and use the checklist given in OIML ~~R61-2~~R 61-3.

A.3 General test requirements

A.3.1 Power supply (in accordance with ~~2.8.2~~4.8.2)

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 energised for the duration of each test.

A.3.2 Zero-setting (in accordance with ~~3.8~~5.8)

Using the manual or semi-automatic zero-setting facility, adjust the EUT as closely as practicable to zero prior to each test, and do not readjust it at any time during the test, except to reset if a significant fault has been indicated.

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

A.3.3 Temperature (in accordance with ~~2.8.1~~4.8.1)

The tests shall be performed at a steady ambient temperature, usually normal ambient temperature unless otherwise specified. The temperature is deemed to be steady when the difference between the extreme temperatures noted during the test does not exceed one-fifth of the temperature range of the instrument without being greater than 5 °C, and the rate of change does not exceed 5 °C per hour.

The handling of the instrument shall not result in condensation of water on the instrument.

A.3.4 Recovery

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

A.3.5 Pre-loading

Before each weighing test the filling instrument shall be pre-loaded to Max, except for the tests in A.5.2 and A.6.2.2.

A.3.6 Control instruments (~~3.3~~0.3 and ~~3.12~~5.14)

A.3.6.1 Accuracy of test system (in accordance with~~10.4~~9.4)

The control instrument and standard weights used in testing shall ensure the determination of the weight of test loads and fills to an error not greater than one third of the MPE of the filling instrument in accordance with ~~10.4~~9.4 (a) or ~~-~~(b) for material tests

~~Note~~NOTE: Accuracy requirements for the test system depend on the ~~limits of error~~error limitation which depend on the accuracy class. However the class is determined from the results of the tests. It is therefore necessary that the metrological authority responsible for testing should be informed of the best accuracy class that may be achieved, prior to commencement of testing.

A.3.6.2 Use of standard weights to assess rounding error of indication

A.3.6.2.1 General method to assess error of indication prior to rounding

For instruments with digital indication having a 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 say 0.1 d are successively added until the indication of the instrument is increased unambiguously by one scale interval (I + d). The additional load ΔL 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 prior to rounding is: $E = P - L = I + 0.5\ d - \Delta L - L$

Example: A weighing instrument with a scale interval, d, of 5 g is loaded with 1 kg and thereby indicates 1 000 g. After adding successive weights of 0.5 g, the indication changes from 1 000 g to 1 005 g at an additional load of 1.5 g. Inserted in the above formula these observations give:

$$P = (1\,000 + 2.5 - 1.5)\ g = 1\,001\ g$$

Thus the true indication prior to rounding is 1 001 g, and the error of indication prior to rounding is:

$$E = (1\,001 - 1\,000)\ g = +1\ g$$

A.3.6.2.2 Correction for error at zero

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

Evaluate 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: $E_0 = +0.5$ g,

the corrected error is: $E_c = +1 - (+0.5) = +0.5$

A.4 Test program

A.4.1 ~~Pattern~~Type evaluation (in accordance with ~~9.2~~8.2.2 and ~~9.2~~8.2.3)

The following tests shall normally be applied for ~~pattern~~type evaluation:

Examination for ~~pattern~~type approval in A.1,

a) Static tests in A.5,

b) Influence factor and disturbance tests given in A.6,

c) Span stability test in A.7, and

d) Material tests in A.8.1

A.4.2 Non-automatic weighing instruments (in accordance with ~~1.1~~2)

For instruments in which the weighing function is provided by a non-automatic weighing instrument that has been approved in respect of conformity with OIML R 76 [7], the tests specified in A.4.1 may be omitted where equivalent test results specified in OIML R 76 [7] prove conformity with the relevant parts of OIML R 61. Use of OIML R 76 [7] test results shall be recorded in the test report checklist and summary in OIML R 61-~~2~~3.

A.4.3 Initial verification (in accordance with ~~9.3~~8.3)

The following tests shall normally be applied for initial verification:

a) Examination for initial verification in A.2, and

b) Material tests at initial verification in A.8.2.

Static weighing test method (as detailed in A.5.4) may also be used if necessary to verify the indicator for the integral verification method of material tests.

A.5 Static tests (~~pattern~~type approval stage)

A.5.1 General (in accordance with ~~9.2~~8.2.2 and ~~9.2~~8.2.3.2)

Electronic instruments or instrument simulators are required to have a load indicator, or an interface allowing access to a quantity that can be calibrated to provide an indication of load so that the effect of influence quantities may be tested and the reference accuracy class determined. This facility also enables testing of warm-up time and zero-setting and tare devices where applicable. The static weighing tests are normally done as part of influence quantity testing.

Limits for warm-up time tests and for accuracy of zero- and tare-setting tests are derived from ~~2.2~~4.2, and are therefore dependent on the reference accuracy class Ref(x). Therefore the results of these tests must be evaluated after Ref(x) has been determined as specified in ~~9.2~~8.2.5.

A.5.2 Warm-up time (in accordance with ~~8.8~~7.8)

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 the zero variation and the errors at Max comply with the specified requirements during the first 30 minutes of operation. If the zero is set as part of the normal automatic weighing cycle then this function shall be enabled or simulated as part of the test.

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

1) Disconnect instrument from the power supply for a period of at least 8 hours prior to the test.

2) Reconnect 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) 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 A.3.4.2.1, 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) From (5) verify that E_{0I} is not greater than the MPE specified in ~~3.8.2~~5.8.2.

7) Apply a static load close to Max. Determine the error by the method of A.3.4.2.1 and A.3.4.2.2.

8) Repeat steps (5), (6) and (7) (~~6) after 5, 15 and 30 minutes.~~every minute within the first 5 minutes, between 5 and 15 minutes every two minutes, after 15 minutes take the readings every five minutes. Observe whether the drift has stopped after 30 minutes. If not, continue taking the readings until warm-up process has completely finished and the indication both at zero and Max remain stable (show no further drift).

9) From (7) and (8) verify that:

   a) The error (corrected for zero error) for a static load close to Max is not greater than the MPE specified in ~~2.5~~4.5,

   b) After each time interval the zero-variation error (E_0 - E_{0I}) is not greater than the MPE specified in ~~3.8.2~~5.8.2.

A.5.3 Zero-setting and tare devices (in accordance with ~~3.8~~5.8)

A.5.3.1 General

Unless it is clear that zero and tare functions are performed by the same process then both functions shall be tested separately.

Zero-setting and taring may be by more than one mode, for example:

a) Nonautomatic or semi-automatic,
b) Automatic at switch-on,
c) Automatic at start of automatic operation,
d) Automatic at programmable time intervals,
e) Automatic as part of weighing cycle.

It is normally only necessary to test the accuracy of zero-setting and taring in one mode if it is clear that the same process is used for each mode. If zero-setting or taring is set as part of the automatic weighing cycle then this mode shall be tested. To test automatic zero-setting or taring it is necessary to allow the filling 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.5.3.2 Range of zero-setting

A.5.3.2.1 Initial zero-setting

(a) Positive range

With the load receptor empty, set the instrument to zero. Place a test load on the load receptor and set the instrument to zero again. Continue this process until 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

(1) Remove any load from the load receptor and set the instrument to zero. Then, if possible, remove any non-essential components of the load receptor. If, at this point, the instrument can be reset to zero with the zero setting device, the mass of the non-essential components is used as the negative portion of the initial zero-setting range.

(2) If the instrument cannot be reset to zero with the non-essential components removed, add loads to any live part of the scale until the instrument indicates zero again.

(3) Then remove the loads and, after each load is removed, use the zero setting device. The maximum load that can be removed while the instrument can still be reset to zero by the zero-setting device is the negative portion of the initial zero-setting range.

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

(5) Alternatively, if it is not possible to test the negative range of initial zero setting by removing parts of the instrument, the instrument may be temporarily re-calibrated with a test load applied before step (3) above. (The test load applied for the temporary re-calibration should be greater than the permissible negative portion of the initial zero setting range which can be calculated from the result of the positive range test).

(6) If it is not possible to test the negative portion of the initial zero-setting range by these methods then only the positive part of the zero-setting range need be considered.

(7) Reassemble or recalibrate the instrument for normal use after the above tests.

A.5.3.2.2 Automatic zero-setting range

Remove the non-essential parts of the load receptor or re-calibrate the instrument as described in A.5.3.2.1 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.

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

A.5.3.3 Accuracy of zero-setting

1) When the load receptor is empty, zero the filling instrument in a mode as determined by A.5.3.1.

2) Add load(s) to the load receptor to determine the additional load at which the indication changes from zero to one scale interval above zero.

3) Calculate the error at zero according to the method described in A.3.6.2.1.

4) Verify that the zero-setting error is within the limit specified in ~~3.8.2~~5.8.2

A.5.3.4 Accuracy of taring

Accuracy of the tare device shall be tested at the maximum tare as specified by the manufacturer.

(1) Place the maximum tare load on the load receptor, operate the tare function key immediately in a mode as determined by A.5.3.1 to enable the equilibrium device to release the tare function.

(2) Add load(s) to the load receptor to determine the additional load at which the indication changes from zero to one scale interval above zero.

(3) Calculate the error according to the method described in A.3.6.2.1.

(4) Verify that the zero-setting error is within the limit specified in ~~3.8.2~~5.8.2

A.5.3.5 Frequency of automatic zero-setting and taring

This test does not need to be performed for filling instruments that have automatic zero-setting as part of every automatic weighing cycle.

If the zero-setting device is not part of the automatic weighing cycle but operates with a programmable time interval, the value for maximum permissible time interval for automatic zero-setting shall be determied as follows:

a) The maximum allowable rate of change of a steady ambient temperature is 5 °C per hour as specified in ~~sub-clause~~ A.3.3.

b) ~~Sub-clause 3.8.2~~5.8.2 requires that maximum zero-setting error:

$(Ezse_{max}) \leq 0.25$ MPD in-service $\times$ Minfill $\times$ Ref(x) (1)

c) For the maximum zero-checking error, ~~3.8.3~~5.8.3.2 requires that:

$(Ezc_{max}) \leq 0.5$ MPD in-service $\times$ Minfill $\times$ Ref(x) (2)

so the maximum zero-variation (Δz_{max}) is:

$(Ezc_{max} - Ezse_{max}) = 0.25$ MPD in-service $\times$ Minfill $\times$ Ref(x) (3)

d) A.6.2.2 requires that the maximum zero-variation (Δz_{max}) per 5°C is less than or equal to 0.25 MPD in-service:

Δz_{max} per 5 °C ≤ 0.25 MPD in-service x Minfill x Ref(x) (4)

e) Substituting the 5 °C per hour steady ambient temperature from paragraph (a)

For Δz_{max} per 5 °C in equation (4) gives:

Δz_{max} per hour ≤ 0.25 MPD in-service x Minfill x Ref(x) (5)

Since equations (5) and (4) are identical, a filling instrument which needs the maximum allowable variation given in A.6.2.2 has a maximum programmable time interval of automatic zero-setting or taring 1 hour. If the filling instrument needs less or more of the maximum zero-variation given in A.6.2.2, the maximum programmable time interval of automatic zero-setting or taring may be increased or decreased proportionally.

In exceptional situations the effects of external factors such as operating temperatures, environmental conditions, stickiness of the product being handled, etc, may determine the maximum programmable time interval of automatic zero setting or taring, which shall be no greater than 2 hours.

A.5.4 Static weighing test method for ~~pattern~~type evaluation (in accordance with ~~9.2~~8.2.3)

Apply test loads from zero up to and including Max, and similarly remove the test loads back to zero. The test loads selected shall include values close to Max and Min and other critical loads as specified in ~~10.2~~9.2.1(c), subject to requirements of this Annex.

Determine the error at each test load, using the standard weights assessment procedure of A.3.6.2, if necessary, to obtain the accuracy of the test system as specified in A.3.6.1.

It should be noted that when loading or unloading, the load shall be progressively increased or progressively decreased.

A.5.5 Determination of reference accuracy class, Ref(x) (in accordance with ~~9.2~~8.2.5)

The static weighing tests during application of influence factors (as appropriate) shall be used at ~~pattern~~type approval stage to establish the reference value for accuracy class, i.e. Ref(x), as follows:

a) Perform static weighing tests for influence factors and loads as specified in this Annex.

b) Determine the MPE for influence factor tests for class X(1), $MPE_{(1)}$ for each load as follows:

$MPE_{(1)} = 0.25\ MPD_{(1)}$ * (~~P_i~~pi, if applicable) in-service inspection for the fill value equal to the load.

For example, with a load of 10kg, the MPE for influence factor tests as specified in ~~2.5~~4.5 will be calculated thus:

$$MPE_{(1)} = ~~P_i~~ pi \times (0.25 \times 1.5\% \times 10{,}000g)$$

where

~~P_i~~pi (as specified in ~~9.2~~8.2.3.3) is a fraction of the MPE applied to a part of the filling instrument which is examined seperately

$MPE_{(1)}$ is error limit specified in ~~2.2~~ 4.2 and given in Table 1 for mass of fill.

(3) Calculate [│Error│ / $MPE_{(1)}$] for each load

where

Error is the corrected error calculated at zero load, in units of mass, as specified in A.3.6.2.2.

(4) From (3) determine the maximum value of [│Error│ / $MPE_{(1)}$] for all the influence factor tests,

i.e. [│Error│ / $MPE_{(1)}$]$_{Max}$ for all influence factor tests

(5) Determine Ref(x) from [│Error│ / $MPE_{(1)}$]$_{Max}$ such that:

Ref(x) $\geq$ [│Error│ / $MPE_{(1)}$]$_{Max}$ and

Ref(x) = 1×10^k, 2×10^k, or 5×10^k,

the index k being a positive or negative whole number or zero. Values for significant fault shall then be calculated from the MPD for the reference class.

A.6 Influence factor and disturbance tests

A.6.1 Test conditions

A.6.1.1 General requirements

Prior to a test, the error at zero shall be assessed and corrected by the methods given in A.3.6.2 and in A.3.6.2.2.

Influence factor and disturbance tests specified in ~~8.2~~7.2 and ~~8.2.1~~ 7.5 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.

It is generally not possible to apply the influence factors or disturbances to a filling instrument which are processing material automatically. The instrument shall therefore be subjected to the influence factors or disturbances under static conditions or simulated operation as defined herein. 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 filling instrument shall be allowed to recover sufficiently before the following test.

Where parts of the filling instrument are examined separately, errors shall be apportioned in accordance with details given in ~~9.2~~8.2.3.3.

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

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

A.6.1.2 Simulator requirements

A.6.1.2.1 General

The simulator for influence factor and disturbance tests should include all electronic devices of the weighing system.

A.6.1.2.2 Load cell

The simulator 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.

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.6.1.2.3 Interfaces (details as given in ~~8.9~~7.9)

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 3m of interface cable terminated to simulate the interface impedance of the other equipment.

A.6.1.2.4 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.

This information shall be attached to, or be traceable from the test report.

A.6.1.3 Test limits for multi-load instruments

For filling instruments where the fill may consist of more than one load, the value of a significant fault and the limit of error for influence factor tests must be determined by the metrological authority or manufacturer after considering the design of the instrument and the method of test, such that the effect on the fill is not greater than the significant fault value specified in ~~3.5~~0.5.2.6 and the MPE specified in ~~2.5~~4.5.

A.6.1.3.1 Significant fault for multi-load instruments

The following examples show how to determine the value of a significant fault on selective combination weighers and cumulative weighers when testing.

a) Significant fault for selective combination weighers:

A fault greater than 0.25 MPD of each fill (as given in Table 1) for in-service inspection divided by the square root of the average (or optimum) number of loads in a fill, for a fill equal to the Min multiplied by the average (or optimum) number of loads in a fill.

Example: For a class X(1) filling instrument with Min = 200 g designed for an average of 8 loads per fill, fill = 1 600 g, the MPD of each fill from the average fill (as specified in Table 1) for in-service inspection is 1.5 % = 24 g. Hence the value of significant fault is:

$$0.25 \times (24 / \sqrt{8}) = 2.12 \text{ g}$$

b) Significant fault for cumulative weighers:

A fault greater than 0.25 MPD of each fill (as given in Table 1) for in-service inspection, for a fill equal to the Minfill, divided by the square root of the minimum number of loads per fill.

Example: For a class X(1) filling instrument with Max = 1 200 g and Minfill of 8 kg: 8 kg/1.2 kg = 6.67; therefore the minimum number of loads per fill is 7. The MPD (as given in in Table 1) for the Minfill of 8 kg is 1.5 % or 120 g. Hence the value of significant fault is:

$$0.25 \times (120 / \sqrt{7}) = 11.34 \text{ g}$$

~~Note~~NOTE: This definition of significant fault for cumulative weighers does not include Min. A cumulative weigher would normally be used at or near to Max.

A.6.1.3.2 ~~Limits of error~~Error limitation for influence factor tests for multi-load instruments

The following examples show how to determine the limit of error for influence factor testing for selective combination weighers and cumulative weighers when testing.This method determines the maximum permissible error for influence factor testing for a fill consisting of more than one static test load.

a) For selective combination weighers the MPE for any static test load during influence factor tests shall be 0.25 MPD for in-service inspection for the appropriate mass of the fill divided by the square root of the average (or optimum) number of loads per fill.

Example: Class X(1) selective combination weigher, where the average number of loads per fill is equal to 4. For a static test load = 100 g the appropriate mass of the fill will be 400 g for which the MPD for in-service inspection is 3 %, i.e. 12 g. Hence the MPE for influence factor tests is:

$$0.25 \times (12 \text{ g} / \sqrt{4}) = 1.5 \text{ g}$$

b) For cumulative weighers the MPE for any static test load during influence factor tests shall be 0.25 MPD for in-service inspection for the Minfill divided by the square root of the minimum number of loads per fill.

Example: For a class X(1) filling instrument with Max = 1 200 g and Minfill of 8 kg: 8 kg/1.2 kg = 6.67; therefore the minimum number of loads per fill = 7. The MPD (as specified in Table 1) for the Minfill of 8 kg is 1.5 %, i.e. 120 g. Hence the MPE for influence factor tests is:

$$0.25 \times (120 / \sqrt{7}) = 11.34 \text{ g}$$

~~Note~~NOTE: For cumulative weighers the average number of loads per fill is not known. Therefore it is not possible to define the limit of error for influence factors in terms of average loads per fill and appropriate mass of the fill. The above definition is based on Max load and Minfill.

A.6.2 Influence factor tests

Summary of tests

§	Test	Characteristic under test	Conditions applied
A.6.2.1	Temperature test with static loadPrescribed (static) temperatures	Influence factor	MPE
A.6.2.2	Temperature effect on no-load indication	Influence factor	MPE
A.6.2.3	Damp heat, steady state	Influence factor	MPE
A.6.2.4	Power voltage variation	Influence factor	MPE
A.6.2.5	DC mains voltage variations	Influence factor	MPE
A.6.2.6	Battery voltage variations (DC)	Influence factor	MPE
A.6.2.7	Tilting	Influence factor	MPE

NOTE: Although IEC Standards are mentioned, the requirements of OIML R61 have to be fulfilled. Differences should be taken into account.

A.6.2.1 Prescribed temperatures (in accordance with 2.8.14.8.1.1)

Prescribed temperatures for static tests are carried out according to basic standard IEC Publication 60068-2-1[10], IEC Publication 60068-2-2[11](**), and and IEC 60068-3-1[12],and according toTable 3Table 5.

Table 3Table 5 – Static temperature tests

Environmental Phenomena	Test specification	Test set-up
Temperature	Reference of 20 °C	
	Specified high for 2 hours	IEC 60068-2-2
	Specified low for 2 hours	IEC 60068-2-1
	Temperature of 5 °C, if the specified low temperature is ≤ 0 °C	IEC 60068-2-1
	Reference of 20 °C	
NoteNOTE 1: Use IEC 60068-3-1[12] for background information. *NoteNOTE 2:* The static temperatures test is considered as one test.		

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions given in ~~2.8.1~~4.8.1.1 under conditions of dry heat (non condensing) and cold. The test A.6.2.2 may be combined with~~conducted during~~ this test.
Test procedures in brief.	
~~Precondition:~~	~~16 hours~~
Condition of the EUT:	16 hours switched on at reference environmental conditions The EUT is ~~connected to the mains power supply and~~ switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. 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.“” ~~The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off.~~
Stabilization:	Minimum of 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 ~~2.8.1~~4.8.1.1.
Temperature sequence:	Reference temperature of 20 °C Specified high temperature Specified low temperature Temperature of 5 °C Reference temperature of 20 °C
Number of test cycles:	At least one cycle.
Weighing test:	After stabilization at the reference temperature and again at each specified temperature conduct the following: Adjust the EUT as close to zero indication as practicable. It is important to ensure that the test result is unaffected by the automatic zero-setting function which should therefore be disabled. The EUT shall be tested with at least five different static test loads (or simulated loads) including Max and Min capacities. When loading or unloading weights the load must be respectively increased or decreased monotonically. Record the following data: a) Date and time b) Temperature c) Relative humidity d) Test load e) Indications

f) Errors
g) Functional performance

Maximum allowable variations: All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in ~~2.5~~4.5.

A.6.2.2 Temperature effect on no-load indication (in accordance with ~~2.8.1~~4.8.1.3)

NOTE: This test should not be performed for instruments that have automatic zero- setting as part of every automatic weighing cycle.

Object of the test: To verify compliance with the provisions given in 4.8.1.3 under conditions of dry heat (non condensing) and cold. This test may be combined with the test in A.6.2.1.

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

~~This test may be performed during the temperature test procedure given in A.6.2.1.~~ 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.

Maximum allowable variations: The change in zero indication shall not vary by more than the MPE for influence factor tests as specified in ~~2.5~~4.5 for the Minfill of the filling instrument, for a temperature difference of 5 °C.

Condition of EUT: The EUT is ~~connected to the mains power supply and~~ switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Power is to be on for the duration of the test.

A.6.2.3 Damp heat, steady state (in accordance with ~~8.2~~7.2)

Damp heat, steady state test are carried out according to basic standard IEC Publication 60068-2-78[13] and IEC Publication 60068-3-4[14]~~(**)~~,and according to ~~Table 4~~Table 6.

~~Table 4~~Table 6 – Damp heat, steady state

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
Use IEC 60068-3-4 for guidance for damp heat tests and refer to Bibliography [XXX] for		

specific parts of the IEC test.

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions given in 8.27.2 under conditions of high humidity and constant temperature.
Precondition:	None required.
Test load:	A complete weighing test in accordance with A.5.4 and 10.2.1.
Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. The zero-setting and zero-tracking facilities shall be enabled as for normal operation. Adjust the EUT as close to zero indication as is practicable, prior to the test. The handling of the EUT shall be such that no condensation of water occurs on the EUT.
Test load:	A complete weighing test in accordance with A.5.4 and 9.2.1.
Stabilization:	3 hours at reference temperature and 50 % humidity. Exposure for 48 hours at the upper limit temperature as specified in 2.8.14.8.1.1.
Temperature:	Reference temperature and at the upper limit as specified in 2.8.14.8.1.1.

Temperature/ humidity 48 hour sequence: The reference temperature at 50 % relative humidity.

The upper limit temperature at 85 % humidity.

The reference temperature at 50 % relative humidity.

Number of test cycles:	At least one cycle.
Weighing test and test sequence:	After stabilisation of the EUT at reference temperature and 50 % humidity apply the test load. Record the following data: a) Date and time b) Temperature c) Relative humidity

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d) Test load
e) Indications
f) Errors

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 static test load and record the data as indicated above. Allow full recovery of the EUT before any other tests are performed.

Maximum allowable variations: All errors shall be within the maximum permissible errors specified in 2.54.5.

A.6.2.4 AC mains voltage supply voltage (in accordance with 2.8.24.8.2)

AC mains voltage supply variation tests are carried out according to basic standard IEC/TR Publication 61000-2-1 [15] and IEC Publication 61000-4-1[16],and according to Table 5Table 7.

Table 5Table 7 - AC mains voltage supply variation tests

Environmental Phenomena	Test specification	Test set-up
Voltage variation	U_{nom}	IEC 61000-2-1 IEC 61000-4-1
	Upper limit: 110 % of U_{nom} or U_{max}	
	Lower limit: 85 % of U_{nom} or U_{min}	
	U_{nom}	
NoteNOTE: 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 given in 2.8.24.8.2 under conditions of voltage variations.

Test procedures in brief.

Precondition: None required.

Condition of the EUT: The EUT is connected to the mains power voltage supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off.

Adjust the EUT as close to zero indication as practicable, prior to the test. If it has an automatic zero-setting function then the instrument should be set to zero after applying each level of voltage.

Number of test cycles: At least one cycle.

Weighing test: The EUT shall be tested with a test load approximately equal to the minimum capacity, and one load between ½

	Max and Max. Zero-setting function shall be in operation.
Test sequence:	Stabilize the ~~power~~ voltage supply at the nominal voltage within the defined limits and apply the test load. Record the following data: a) Date and time b) Temperature c) ~~Power~~ Voltage supply ~~voltage~~ d) Test load e) Indications (as applicable) f) Errors g) Functional performance Repeat the test weighing for each of the voltages defined in IEC 61000-4-1[16] in section 5 (noting the need in certain cases to repeat the test weighing at both ends of the voltage range) and record the indications.
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in ~~2.5~~4.5.

A.6.2.5 DC mains voltage supply ~~voltage~~ (~~2.8.2~~4.8.2~~, 8.10~~)

Instruments operating from DC mains ~~power~~ voltage supply shall fulfil the tests in A.6.2, with the exception of A.6.2.4 which is to be replaced by the test according to basic standard IEC Publication 60654-2 [17] and according to ~~Table 10~~Table 8.

~~Table 6~~ Table 8 – DC voltage supply variations test

Environmental phenomena	Test specification	Test set-up
DC mains voltage variations	U_{nom}	IEC 60654-2
	Upper limit: ~~120~~ 110 % of U_{nom} or U_{max}	
	Lower limit: Minimum operating voltage (see ~~2.8.2~~4.8.2)	
	U_{nom}	
~~Note~~NOTE: If a voltage-range is marked, use the average value as the nominal voltage, U_{nom}.		

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in ~~2.8.2~~4.8.2 under conditions of DC voltage supply variations.
~~Pre-condition:~~	~~None.~~
Condition of the EUT	The EUT is connected to the DC mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to

the EUT shall not be switched off.

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

Number of test cycles: At least one cycle.

Test information: Stabilize the EUT at the nominal voltage, U_{nom}, and record the following data at no load and with ~~one~~ a small test load:

a) Date and time;
b) Temperature;
c) Relative humidity;
d) ~~Supply v~~Voltage supply;
e) Test load;
f) Indications (as applicable);
g) Errors;
h) Functional performance.

~~Repeat the test for each of the voltages defined in IEC 60654-2 and record the indications.~~

Maximum allowable variations: All functions shall operate as designed.

All errors shall be within the maximum permissible errors specified in ~~2.2.2~~4.2.2 for initial verification.

A.6.2.6 Battery ~~power~~ voltage supply (DC), not mains connected (~~2.8.2~~4.8.2 ~~and 8.2.7~~)

Battery-powered instruments shall fulfil the tests in A.6.2, in accordance with ~~Table 11~~Table 9.

~~Table 7~~ Table 9 – Battery voltage supply variations test		
Environmental phenomena	Test specification	Test set-up
Battery voltage variations	U_{nom}	No reference to standards for this test
	Upper limit: U_{nom} or U_{max} (voltage of a new, fully charged, battery of the type specified by the manufacturer of the instrument)	
	Lower limit: Minimum operating voltage (see ~~2.8.2~~4.8.2)	
	U_{nom}	

Supplementary test information:

Object of the test: To verify compliance with the provisions in ~~2.8.2~~4.8.2 under conditions of battery voltage variations.

Test procedure in brief:

~~Preconditioning:~~ ~~None.~~

Condition of the EUT: The EUT is connected to the battery ~~power~~ voltage supply, fully charged or at the maximum voltage as specified by the manufacturer and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off.

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

Number of test cycles: At least one cycle.

Test information: Stabilize the EUT at the nominal voltage, U_{nom}, and record the following data at no load and with ~~one~~ a small test load:

a) Date and time;
b) Temperature;
c) Relative humidity;
d) ~~Supply v~~Voltage supply;
e) Test load;
f) Indications (as applicable);
g) Errors;
h) Functional performance.

Reduce the voltage ~~to the EUT~~of the battery until the instrument:

- automatically resumes normal operation producing a clear warning
- ceases to function properly

and record the indications and response of the instrument just before and after it responds to the low voltage condition~~according to the specifications and metrological requirements, and record the indications~~.

Maximum allowable variations: For voltages above the lower limit, all functions shall operate as designed; for voltages below the lower limit, the instrument shall automatically resume normal operation without loss of any previous measurement data.

~~All functions shall operate as designed~~.

All errors shall be within the maximum permissible errors specified in ~~2.2.2~~4.2.2 for initial verification.

A.6.2.7 Tilting (4.8.3)

~~Note~~NOTE: This test only applies to filling instruments ~~that will not be permanently installed~~liable to be tilted. This test is not required for filling~~mobile~~ instruments fitted with:

a) a level indicator which shows clearly the limiting value of the level indicator and if the maximum permissible tilt has been exceeded ;~~if it can be established that the tilt can be adjusted to 1 % or less as specified in 2.8.4~~

~~a)~~b) an automatic tilt sensor which clearly indicates (e.g. error signal) and inhibits the printout and data transmission if the limiting value of the tilt has been exceeded.

Test method:	Static tests whilst the EUT is tilted.
Object of the test:	To verify compliance with the provisions given in ~~2.8.4~~4.8.3.
Test procedure in brief:	The test consist of tilting the EUT both forwards and backwards, longitudinally and from side to side (transversely), while observing the weight indications for a static test load.
Test severity:	Two test loads at Min and Max at a tilt of 5%
Maximum allowable variations:	All indications shall be within maximum permissible errors specified in ~~2.5~~4.5.
Condition of EUT:	The EUT is ~~connected to the mains power supply and~~ switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT in its reference position (not tilted) as close to zero indication as practicable. If the instrument is provided with automatic zero-setting it shall not be in operation.
Test sequence:	Record the zero indication. Apply the test load approximately equal to the Max and record the indication. Remove the test load. Tilt the EUT longitudinally to the appropriate extent and record the zero indication. Apply the test load approximately equal to the Max and record the indication. Remove the test load. Without further adjustment to any control affecting metrological performance tilt the EUT to the appropriate extent in the opposite direction and repeat the static weighing tests as above. Tilt the EUT in the transverse direction to the appropriate extent and repeat the above tests. Tilt the EUT in the opposite direction and repeat the above tests.

Record the following data for each of the test set-ups as prescribed above:

a) Date and time
b) Test load
c) Indications at each tilt
d) Errors
e) Functional performance

In order to determine the influence of tilting on the loaded instrument, the indication obtained at each tilt shall be corrected for the deviation from zero which the instrument had prior to loading.

A.6.3 Disturbance tests (in accordance with ~~8.2~~7.2)

Summary of disturbance tests

§	Test	Condition applied
A.6.3.1	AC mains voltage dips and short interruptions	Significant fault
A.6.3.2	Fast transients / burst immunity on mains power supply lines and on the I/O circuits and communication lines	Significant fault
A.6.3.3	Electrostaic discharge	Significant fault
A.6.3.4	Electromagnetic susceptibility	Significant fault
A.6.3.5	Surges on mains power supply lines and on signal and communication lines	Significant fault

(NOTE 1: Tests shall be conducted to the appropriate classification for electrical and mechanical tests. The severity level stated in the tests A.6.3.1 to A.6.3.5 apply to instruments installed and used in locations with significant or high levels of vibration and shock, and electromagnetic disturbances corresponding to those likely to be found in industrial environments.

NOTE 2: 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.6.3.1 AC mains voltage dips and short interruptions

AC mains voltage dips and short interruptions tests are carried out according to basic standard IEC Publication 61000-4-11[18],and according to ~~Table 6~~Table 10.

~~Table 6~~ Table 10 - AC mains voltage dips and short interruptions

Environmental phenomena	Test specification			Test set-up
	Test	Reduction of amplitude to	Duration / Number of	IEC 61000-4-11

			cycles	
Voltage dips and short interruptions	Test a	0 %	0.5	
	Test b	0 %	1	
	Test c	40 %	10/12[2]	
	Test d	70 %	25/30[2]	
	Test e	80 %	250/300[2]	
	Short interruption	0 %	250/300[2]	
NOTE 1: 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 ten times with an interval of at least ten seconds.				
NOTE 2: These values are for 50 Hz /60 Hz respectively				

Supplementary information to the IEC test procedures:

Object of the test: To verify compliance with the provisions given in ~~8.2~~7.2 under conditions of short mains voltage interruptions and reductions while observing the weight indication for a small static load.

Test procedures in brief:

~~Precondition:~~ ~~None required.~~

Condition of the EUT: The EUT is connected to the mains ~~power~~ voltage supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off.

Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation. Not to be adjusted or readjusted at any time during the test except the reset if a significant fault has been indicated.

Number of test cycles: At least one cycle.

Weighing test~~ and test sequence~~: The EUT shall be tested with ~~one~~ a small static test load.

Stabilize all factors at nominal reference conditions. Apply the test load and record the following data:

a) Date and time
b) Temperature
c) ~~Power supply v~~Voltage supply
d) Test load
e) Indications
f) Errors

g) Functional performance

Interrupt the ~~power~~ voltage supply to zero voltage for a period equal to one half cycle and conduct the test as detailed in IEC 61000-4-11[18] section 8.2.1. During interruption observe the effect on the EUT and record as appropriate.

Reduce the ~~power~~ voltge supply to 50 % of nominal voltage for a period equal to two half cycles and conduct the test as detailed in IEC 61000-4-11 section 8.2.1 during reductions observe the effect on the EUT and record, as appropriate.

Maximum allowable variations: The difference between the weight indication due to the disturbance and the indication without the disturbance either shall not exceed the significant fault value specified in ~~3.5~~0.5.2.6, or the EUT shall detect and act upon a significant fault.

A.6.3.2 Fast transients / burst immunity on mains ~~power~~ voltage supply lines and on the I/O circuits and communication lines

Electrical bursts tests (fast transient tests) are carried out according to basic standard IEC 61000-4-4[19], for 2 minutes with a positive polarity and for 2 minutes with a negative polarity, and according to ~~Tables 7.1~~Table 11.1 ~~,~~ and ~~7.2~~Table 11.2 ~~and 7.3~~.

~~Table 7.1~~Table 11.1: Bursts (transients) on signal lines and communication lines

Environmental phenomena	Test specification	Test set-up
Fast transient common mode	1.0 kV (peak) 5/50 ns T_1 / T_h 5 kHz rep. Frequency	IEC 61000-4-4
~~Note~~NOTE: Applicable only to ports or interfacing with cables whose total length may exceed 3 maccording to the manufacturer's functional specification.		

~~Table 7.2~~Table 11.2: Bursts (transients) on AC and DC mains ~~power~~ voltage supply lines

Environmental phenomena	Test specification	Test set-up
Fast transient common mode	2.0 kV (peak) 5/50 ns T_1 / T_h 5 kHz rep. Frequency	IEC 61000-4-4
~~Note~~NOTE: ~~-~~Not applicable to battery operated appliances that cannot be connected to the mains ~~-~~while in use.		

A coupling/decoupling network shall be applied for testing AC power ports.

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions given in ~~8.2~~7.2 under conditions where electrical bursts (fast transients) are superimposed on the mains voltage while observing the weight indication for ~~one small~~a small static test load.
Test procedures in brief:	
~~Precondition:~~	~~None required.~~
Condition of the EUT:	The EUT is ~~connected to the mains power supply and~~ switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Reset the EUT if a significant fault has been indicated.
Stabilization:	Before any test stabilize the EUT under constant environmental conditions.
Weighing test:	With the single static load in place record the following with and without the transients: a) Date and time b) Temperature c) Test load d) Indications (as applicable)
Maximum allowable variations:	The difference between the weight indication due to the disturbance and the indication without the disturbance either shall not exceed the significant fault value specified in ~~3.5~~0.5.2.6, or the instrument shall detect and act upon a significant fault.

A.6.3.3 Electrostatic discharge

Electrostatic discharge tests are carried out according to basic standard IEC 61000-4-2 [21], with test signals and conditions as given in ~~Table 8~~Table 12.

~~Table 8~~ Table 12 – Electrostatic discharge tests

Environmental phenomena	Test specification	Test set-up
Electrostatic discharge	8 kV air discharge 6 kV contact discharge	IEC 61000-4-2
~~Note~~NOTE 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.		
~~Note~~NOTE 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 s. 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[21]. Air discharges shall be used where contact discharges cannot be applied. Tests with other (lower) voltages than those given in Table ~~8~~ 11 are not required.

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions given in ~~8.2~~7.2 under conditions where electrostatic discharges are applied while observing the weight indication for ~~one small~~a small static test load.
Test procedures in brief:	
~~Precondition:~~	~~None required.~~
Condition of the EUT:	The EUT is connected to the ~~mains power~~ voltage supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Reset the EUT if a significant fault has been indicated.
Stabilization:	Before any test stabilize the EUT under constant environmental conditions.
Weighing test:	With the single static load in place, record the following with and without electrostatic discharge: a) Date and time b) Temperature c) Test load d) Indications (as applicable)
Maximum allowable variations:	The difference between the weight indication due to the disturbance and the indication without the disturbance either shall not exceed the significant fault value specified in ~~3.5~~0.5.2.6, or the instrument shall detect and act upon a significant fault.

A.6.3.4 Electromagnetic susceptibility

A.6.3.4.1 Radiated electromagnetic immunity tests

Radiated, radio frequency electromagnetic susceptibility tests are carried out to IEC 61000-4-3 [22],and according to ~~Table 9~~Table 13.

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 9~~ Table 13 - Radiated electromagnetic immunity tests

Test specification			
Environmental phenomena	Frequency ranges (MHz)	Field strength (V/m)	Test set-up
Radiated electromagnetic immunity tests	26 to 80(1)	10	IEC 61000-4-3
	80 to ~~2000~~2700(2)		

Modulation	80 % AM, 1 kHz sine wave
NoteNOTE 1: For EUTs having no mains or other I/O ports available so that the test according to A.7.3.5.2 cannot be applied, the lower limit of the test is 26 MHz. *NoteNOTE 2:* 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 according to A.7.3.5.2A.6.3.4.2 is recommended.	

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions given in 8.27.2 under conditions of specified electromagnetic fields applied while observing the weight indication for one smalla small static test load.
Test procedures in brief:	
Precondition:	None required.
Condition of the EUT:	The EUT is connected to the mains powervoltage supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Reset the EUT if a significant fault has been indicated.
Stabilization:	Before any test stabilize the EUT under constant environmental conditions.
Weighing test:	With the single static load in place record the following with and without electromagnetic fields: a) Date and time b) Temperature c) Test load d) Indications (as applicable)
Maximum allowable variations:	The difference between the weight indication due to the disturbance and the indication without the disturbance either shall not exceed the significant fault value in 3.50.5.2.6, or the instrument shall detect and act upon a significant fault.

A.6.3.4.2 Conducted electromagnetic immunity tests

Conducted, radio frequency, electromagnetic field immunity tests are carried out in accordance to IEC 61000-4-6[23],] and according to Table 16Table 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 10 Table 14 – Conducted electromagnetic immunity tests

Test specification			
Environmental phenomena	Frequency range	RF amplitude (50 ohms) (emf)	Test set-up
Conducted electromagnetic immunity tests	0.15 MHz to 80 MHz	10 V	IEC 61000-4-6
Modulation	80 % AM, 1 kHz sine wave		
~~Note~~NOTE: This test is not applicable when the EUT has no mains or other input port.			

Coupling and decoupling devices shall be used for appropriate coupling of the disturbing signal (over the entire frequency range, with 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 given in ~~8.2~~7.2 under conditions of specified conducted electromagnetic fields while observing the weight indication for ~~one static~~a static test load.

Test procedures in brief:

~~Precondition: None required.~~

Condition of the EUT:

The EUT is connected to the ~~mains power~~voltage supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off.

Reset the EUT if a significant fault has been indicated.

Stabilisation: Before any test, stabilise the EUT under constant environmental conditions.

Weighing test: With the single static load in place record the following with and without electromagnetic fields:

a) Date and time,
b) Temperature,
c) Test load,
d) Indications (as applicable).

Maximum allowable variations: The difference between the weight indication due to the disturbance and the indication without the disturbance either shall not exceed the significant fault value specified in ~~3.5~~0.5.2.6

or the instrument shall detect and act upon a significant fault.

A.6.3.5 Electrical surges on mains voltage lines and on signal and communication lines

Electrical surge tests are carried out according to IEC 61000-4-5 [20] and according to Table 15.

Table 15 - Electrical surges

Environmental phenomena	Test specification	Test set-up
Surges on mains power lines and on signal and communication lines	a) 1.0 kV line to line b) 2.0 kV line to earth c) 3 positive and 3 negative surges applied synchronously with AC supply voltage in angles 0°, 90°, 180° and 270°. d) 3 positive and 3 negative surges applied on DC voltage lines and on signal and communication lines.	IEC 61000-4-5

Supplementary information to the IEC test procedures:

Object of the test: To verify compliance with the provisions in 7.2 under conditions where electrical surges are applied separately to the mains voltage lines and to the signal and communication lines (if any), while totalizing – at maximum flowrate - at least $\sum_{min}$ (or a time sufficient to complete the test).

Condition of the EUT: The characteristics of the test generator shall be verified before connecting the EUT.

The EUT is connected to the power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off.
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 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.

Before any test stabilize the EUT under constant environmental conditions. Changes in barometric pressure shall be taken into account. While totalizing - at maximum flowrate - at least $\sum_{min}$ (or a time sufficient to complete the test) record the following with and without the surges:

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

Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed the fault specified in 0.5.2.6, or the EUT shall detect and react to a significant fault.

A.7 Span stability test (in accordance with 8.3.37.11.3)

Test method:	Span stability.
Object of the test:	To verify compliance with the provisions given in 8.3.37.11.3 after the EUT has been subjected to the performance tests.
Reference to standard:	No reference to international standards are given.
Test procedure in brief:	The test consists of observing the variations of error of the EUT under sufficiently constant ambient conditions (reasonably 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. Other performance tests listed in this Annex may be performed. The EUT shall be disconnected from the mains power supply, or battery supply where fitted, two times for at least 8 hours during the period of the test. The number of disconnections may be increased if the manufacturer of

	the instrument specifies so or at the discretion of the approved authority in the absence of any such 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 5 hours, and at least 16 hours after the temperature and damp heat tests have been performed.
Test severities:	Test duration: 28 days or over the period necessary for the conduct of the performance tests, whichever is less.
Time t (days) between tests:	$0.5 \leq t \leq 10$
Test load:	A static test load near Max; the same test weights shall be used throughout the test.
Maximum allowable variations:	The variation in the indication of the test load shall not exceed half of the absolute value of the MPE for influence factor tests (~~2.5~~4.5) for the test load applied on any of the (n) tests conducted.
Number of tests (n):	$n \geq 8$. If the test results indicate a trend more than half the permissible variation specified above, conduct additional tests until the trend comes to rest or reverses itself, or until the error exceeds the maximum permissible variation.
Precondition:	None required.
Test equipment:	Verified mass standards.
Condition of the EUT:	Adjust the EUT as close to zero indication as practicable before each test.
Test sequence:	Stabilize all factors at nominal reference conditions. If the instrument is provided with automatic zero-setting it shall not be in operation. Apply the test load (or simulated load) and record the following data: a) Date and time b) Temperature c) Barometric pressure d) Relative humidity e) Test load f) Indication g) Errors h) Changes in test location and apply all necessary corrections resulting from variations of temperature, pressure, etc. between the various measurements. At the first measurement immediately repeat zeroing and

loading four times to determine the average value of error. For the next measurements perform only one, unless either the result is outside the specified tolerance or the range of the five readings of the initial measurement was more than 1/10 of the maximum permissible variation.

Repeat this test at periodic intervals during and after the conduct of the various performance tests.

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

A.8 Procedure for material tests

A.8.1 Material tests at ~~pattern~~type evaluation (in accordance with ~~9.2~~8.2.3.1)

Operational tests with material shall be done on a complete instrument to assess compliance with the requirements of ~~clause 3~~ 6 with material for the test load as specified in ~~9.2~~8.2.3.1.

A.8.1.1 Feeding device (details as given in ~~3.6~~5.6)

Check that the feeding device provides sufficient and regular flow rate.

Check that any adjustable feed device has an indication of the direction of movement corresponding to the sense of the adjustment of the feed (where applicable).

For instruments using the subtractive weighing principle check that residual material retained at the feeding device after each load is delivered, is negligible relative to ~~limits of error~~error limitation.

A.8.1.2 Load receptor (details as given in ~~3.7~~5.7)

For instruments that weigh material in a separate load receptor prior to discharge to a container,

Check that the residual material retained at the load receptor after each discharge is negligible relative to ~~limits of error~~error limitation.

Check that manual discharge of the load receptor is not possible during automatic operation.

A.8.2 Material tests at initial verification (in accordance with ~~9.3~~8.3.2)

Metrological tests with material shall be done on a complete filling instrument, fully assembled and fixed in the position in which it is intended to be used and as specified in ~~9.3~~8.3.2.

The accuracy class X(x) (or classes) shall be determined from the results.

A.8.2.1 Requirements for metrological material tests:

a) Types of loads shall be as specified in ~~6.2.2~~9.2.2.

b) Mass of test loads and fills shall be as specified in ~~6.2.1~~9.2.1 a, b and c.

c) Condition of material tests shall be as specified in ~~6.2.3~~9.2.3~~:~~

d) Number of fills shall be as specified in ~~6.3~~9.3.

A.8.2.2 Methods for metrological material tests (as given in ~~6.5~~9.5)

One of the following verifications methods shall be used:

a) Separate verification method: the separate verification method is as defined in ~~6.5~~9.5.1.

b) Integral verification method: the integral verification method is as defined in ~~6.5~~9.5.2.

A.8.2.3 Procedure for metrological material tests

1) Set up the instrument in accordance with the conditions of test given in ~~6.2.3~~9.2.3.

2) Select a preset value for the fill and set the load value if different from the fill, in accordance with values of the mass of the fills as specified in ~~6.2.1~~9.2.1. Record the indicated preset value.

3) Run the instrument to produce a number of fills as specified in ~~6.3~~9.3 using types of test loads specified in ~~6.2.2~~9.2.2.

4) Weigh all the fills by either:

   a) Separate verification method specified in ~~6.5~~9.5.1 or

   b) The integral verification method specified in ~~6.5~~9.5.2

to determine the mass of fill in accordance with ~~6.7~~9.7 so that the result of weighing the test fill on the control instrument shall be considered as the conventional true value of the test fill.

(5) In accordance with ~~6.7~~9.7 calculate the average value of all the fills in the test as follows:

$$\Sigma F/n$$

where

F is the mass of the fill (conventional true value), in units of mass

n is the number of fills in the test

(6) In accordance with ~~6.8~~9.8 calculate the deviation of each fill from the average of all the fills in the test as follows:

$$|md| = F - (\Sigma F/n)$$

where

md is the deviation from average, in units of mass

(7) Repeat stages (2) to (6) for other loads as specified for values of the mass of the fills in ~~6.2.1~~9.2.1.

A.8.2.4 Determination of accuracy class, X(x) (in accordance with ~~9.2~~8.2.5)

(1) For each preset value of the test fill (F_P):

a) Calculate the preset value error specified in ~~2.4~~4.4 in accordance with ~~6.9~~9.9 as follows:

$$[|se| = \left(\Sigma F/n\right) - F_p]$$

where

se is the preset value error.

b) Determine the maximum permissible preset value error for class X(1), $MPSE_{(1)}$ as follows:

$MPSE_{(1)}$ = 0.25 $MPD_{(1)}$ for in-service inspection, corresponding to the value of a fill equal to F_P

c) Then calculate: $[|se| / MPSE_{(1)}]$.

(2) For each preset value of the test fill (F_P):

a) Determine the maximum (largest) of the absolute values of the actual deviation from the average i.e. md_{max}

b) Determine the maximum permissible deviation from the average for class X(1), $MPD_{(1)}$.

c) Then calculate: $[md_{max} / MPD_{(1)}]$.

(3) From (1) determine the maximum (largest) value of $[|se| / MPSE_{(1)}]$,

i.e. $[|se| / MPSE_{(1)}]_{max}$ from all the preset test fills

(4) From (2) determine the maximum (largest) value of $[md_{max} / MPD_{(1)}]$,

i.e. $[md_{max} / MPD_{(1)}]_{max}$ from all the preset test fills

(5) Determine the accuracy class (x) such that

$(x) \geq [|se| / MPSE_{(1)}]_{max}$

and $(x) \geq [md_{max} / MPD_{(1)}]_{max}$

and $(x) = 1 \times 10^k$, 2×10^k, or 5×10^k,

the index k being a positive or negative whole number or zero.

Annex B (Informative)

Additional examinations and tests for software-controlled digital devices and instruments

B.1 Devices and instruments with embedded software

Review the descriptive documents according to 5.10.1 and check whether the manufacturer has described or declared that the software is embedded, i.e. that it is used in a fixed hardware and software environment and cannot be modified or uploaded via any interface or by other means after securing or sealing.

Check whether the securing means are described and provide evidence of an intervention.

Check whether there is a software identification that is clearly assigned to the legally relevant software and the legally relevant functions it performs as described in the documentation submitted by the manufacturer.

Check whether the software identification is easily provided by the instrument.

B.2 Computers and other devices with programmable or loadable software

B.2.1 Software documentation (5.10.1)

Check that the manufacturer has supplied software documentation according to 5.10.1 containing all relevant information to examine the legally relevant software.

B.2.2 Software protection (5.10.2)

B.2.2.1 Software with closed shell (no access to the operating system and/or programs possible for the user)

Check whether there is a complete set of commands (e.g. function keys or commands via external interfaces) supplied and accompanied by short descriptions.

Check whether the manufacturer has submitted a written declaration of the completeness of the set of commands.

B.2.2.2 Operating system and / or program(s) accessible for the user

Check whether a checksum or equivalent signature is generated over the machine code of the legally relevant software (program module(s) subject to legal control and type-specific parameters).

Check whether the legally relevant software cannot be started if the code is falsified using a text editor.

B.2.2.3 In addition to the cases in B.2.2.1 or B.2.2.2

Check whether all device-specific parameters are sufficiently protected, e.g. by a checksum.

Check whether there is an audit trail for the protection of the device-specific parameters and a description of the audit trail.

Perform some practical spot checks to test whether the documented protections and functions work as described.

B.2.3 Software interface(s)

Check whether the program modules of the legally relevant software are defined and separated from the modules of the associated software by a defined protective software interface.

Check whether the protective software interface itself is part of the legally relevant software.

Check whether the functions of the legally relevant software that can be released via the protective software interface are defined and described.

Check whether the parameters that may be exchanged via the protective software interface are defined and described.

Check whether the description of the functions and parameters are conclusive and complete.

Check whether each documented function and parameter does not contradict the requirements of this Recommendation.

Check whether there are appropriate instructions for the application programmer (e.g. in the software documentation) concerning the protectiveness of the software interface.

B.2.4 Software identification

Check whether there is an appropriate software identification generated over the program module(s) of the legally relevant software and the type-specific parameters at runtime of the instrument.

Check whether the software identification is indicated on manual command and can be compared with the reference identification fixed at type approval.

Check whether all relevant program module(s) and type-specific parameters of the legally relevant software are included in the software identification.

Check also by some practical spot checks whether the checksums (or other signatures) are generated and work as documented.

Check whether an effective audit trail exists.

B.3 Data storage devices (5.9)

Review the documentation submitted and check whether the manufacturer has foreseen a device - whether incorporated in the instrument or connected externally - that is intended to be used for long-term storage of legally relevant data. If so:

Check whether the software used for data storage is realized on a device with embedded software (B.1) or with programmable/ loadable software (B.2). Apply either B.1 or B.2 to examine the software used for data storage.

Check whether the data are stored and retrieved correctly.

Check whether the storage capacity and the measures to prevent inadmissible data loss are described by the manufacturer and are sufficient.

Check whether the data stored contain all relevant information necessary to reconstruct an earlier weighing (relevant information is: gross or net values and tare values (if applicable, together with a distinction of tare and preset tare), the decimal signs, the units (e.g. kg may be encoded), the identification of the data set, the identification number of the instrument or load receptor if several instruments or load receptors are connected to the data storage device, and a checksum or other signature of the data set stored.

Check whether the data stored are adequately protected against accidental or intentional changes.

Check whether the data are protected at least with a parity check during transmission to the storage device.

Check whether the data are protected at least with a parity check in the case of a storage device with embedded software.

Check whether the data are protected by an adequate checksum or signature (at least 2 bytes, e.g. a CRC-16 checksum with hidden polynomial) in the case of a storage device with programmable or loadable software.

Check whether the data stored are capable of being identified and displayed, that the identification number(s) is stored for later use and recorded on the official transaction medium, i.e. it is printed, for instance, on the print-out.

Check whether the data used for a transaction are stored automatically, i.e. not depending on the decision of the operating person.

Check whether stored data sets which are to be verified by means of the identification are displayed or printed on a device subject to legal control.

B.4 Test Report Format

The Test Report OIML R50-3 shall contain all relevant information about the hardware and software configuration of the PC examined and the test results.

Annex C (Informative)

Equipment Under Test

C.1 Selection of EUTs

Filling instruments shall be categorized primarily by the fundamental engineering design they are constructed upon. The categories of design may include but are not limited to the following basic operating principles:

- Mechanical – no electronics;
- Analogue, strain gauge type load cells;
- Digital load cells.

Those Filling instruments using load cell technology may further be categorized by using the method that the load cells are mounted / connected to the weight receiving element and supporting structures. Examples may include but are not limited to:

- Direct mounting of load cells without check rods;
- Connection of the weighing elements to load cell via lever system;
- Isolated from load cell and with check rods or flexures.

In order to streamline type evaluation test procedures involving a family of devices, it is recommended to select at least the EUT that represents the "worst case" sample from that family. This is to ensure that not only the worst case be selected but also that an instrument representing a best (or better) case be evaluated to establish a range of performance data within the family of devices. For filling instruments, it is recommended that the worst case instrument be selected based on the following:

1) For testing performed in a laboratory setting:
    - Lowest input signal from the force transducer(s);
    - Unit with all the interfaces (i.e. peripheral equipment, hardware components);
    - Unit with all the necessary load cells;

C.2 Other metrological features to be considered

For example, it is not acceptable to test the temperature effect on no-load indication on one EUT and the combined effect on a different one. Variations in metrologically relevant features and functions such as different:

- housings;
- load receptors;
- temperature and humidity ranges;
- instrument functions;
- displacement transducer;
- indications; etc.

may require additional partial testing of those factors which are influenced by that feature. These additional tests should preferably be carried out on the same EUT, but if this is not possible, tests on one or more additional EUTs may be performed under the responsibility of the testing authority.

The ability of the instrument to withstand all required performance tests during the evaluation may be a good indication of the durability.

Annex D (Informative)
Durability testing requirements

D.1 Type Approval

A durability assessment performed under type evaluation should take into account that (lack of) durability may be a characteristic of a particular installation. Hence a decision not to type approve an instrument may only be warranted where the unacceptable durability is clearly a characteristic of the type.

Where measures to ensure durability are taken, this shall be recorded in R50-3 Test Report format.

D.2 Subsequent metrological control

To reduce the risks of non-durable instruments, the arrangements for subsequent metrological control shall incorporate means for reviewing intervals for subsequent verification and in-service inspection, based on performance of an instrument over time. ILAC-G24/OIML D 10 [25] indicates methods (see clause 3) which are useful for this purpose."

Should an instrument (installed in a particular location) be found to be of unacceptable durability, that instrument shall be withdrawn from use. If unacceptable durability was found to be a characteristic of the type (unacceptable durability regardless of the installation), withdrawal of the type approval shall be considered.

BIBLIOGRAPHY

Below are references to Publications of the International Electrotechnical Commission (IEC), where mention is made in some of the tests in Annex A. Use these or the most recent issue of the publication valid at the time of testing the instrument.

Ref.	Standards and reference documents	Description
[1]	International Vocabulary of Metrology -Basic and General Concepts and Associated Terms (VIM~~-3~~) (~~2007~~2012)	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~~2011 *OIML Certificate System for Measuring Instruments* (formerly OIML P 1)	Provides rules for issuing, registering and using OIML Certificates of conformity
[4]	OIML D 11:2004 *General requirements for electronic measuring instruments*	Contains general requirements for electronic measuring instruments
[5]	OIML R 111:2004 *Weights of classes* E_1, E_2, F_1, F_2, M_1, $M_{1–2}$, M_2, $M_{2–3}$ *and* M_3	Provides the principal physical characteristics and metrological requirements for weights used with and for the verification of weighing instruments and weights of a lower class
[6]	OIML 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 76-1:2006 *Non-automatic weighing instruments*	Provides the principal physical characteristics and metrological requirements for the verification of non-automatic weighing instruments
[8]	OIML D 19:1988 *~~Pattern~~Type evaluation and ~~pattern~~type approval*	Provides advice, procedures and influencing factors on ~~pattern~~type evaluation and ~~pattern~~type 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) Environmental testing, Part 2: Tests, Test A: Cold	Concerns cold tests on both non heat dissipating and heat dissipating equipment under test (EUT)
[11]	IEC 60068-2-2 (2007-07) Ed. 5.0 Environmental testing Part 2: Tests, Test B: Dry heat	Contains test Ba: dry heat for non heat dissipating specimen with sudden change of temperature; test Bb dry heat for non heat dissipating specimen with gradual change of temperature; tests Bc: dry heat for heat dissipating specimen with sudden change of temperature; test Bd dry heat for heat dissipating specimen with gradual change of temperature
[12]	IEC 60068-3-1 (1974-01) + Supplement A (1978-01): Environmental testing Part 3 Background information, Section 1: Cold and dry heat tests	Gives background information for Tests A: Cold (IEC 68-2-1), and Tests B: Dry heat (IEC 68-2-2). Includes appendices on the effect of: chamber size on the surface temperature of a specimen when no forced air circulation is used; airflow on chamber conditions and on surface temperatures of test specimens; wire termination dimensions and material on surface temperature of a component; measurements of temperature, air velocity and emission coefficient. Supplement A - gives additional information for cases where temperature stability is not achieved during the test

Ref.	Standards and reference documents	Description
[13]	IEC 60068-2-78 (2001-08) Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state (IEC 60068-2-78 replaces the following withdrawn standards: IEC 60068-2-3, test Ca and IEC 60068-2-56, test Cb)	Provides a test method for determining the suitability of electro-technical products, components or equipment for transportation, storage and use under conditions of high humidity. The test is primarily intended to permit the observation of the effect of high humidity at constant temperature without condensation on the specimen over a prescribed period This test provides a number of preferred severities of high temperature, high humidity and test duration. The test can be applied to both heat-dissipating and non-heat dissipating specimens. The test is applicable to small equipment or components as well as large equipment having complex interconnections with test equipment external to the chamber, requiring a set-up time which prevents the use of preheating and the maintenance of specified conditions during the installation period
[14]	IEC 60068-3-4 (2001-08) Environmental testing - Part 3-4: Supporting documentation and guidance - Damp heat tests	Provides the necessary information to assist in preparing relevant specifications, such as standards for components or equipment, in order to select appropriate tests and test severities for specific products and, in some cases, specific types of application. The object of damp heat tests is to determine the ability of products to withstand the stresses occurring in a high relative humidity environment, with or without condensation, and with special regard to variations of electrical and mechanical characteristics. Damp heat tests may also be utilized to check the resistance of a specimen to some forms of corrosion attack
[15]	IEC/TR 61000-2-1 (1990-05) Electromagnetic compatibility (EMC) Part 2: Environment Section 1	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 (2006-10) Ed. 3.0 Basic EMC Publication Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques. Section 1: Overview of IEC 61000-4 series	Gives applicability assistance to the users and manufacturers of electrical and electronic equipment on EMC standards within the IEC 61000-4 series on testing and measurement techniques Provides general recommendations concerning the choice of relevant tests

Ref.	Standards and reference documents	Description
[17]	IEC 60654-2 (1979-01), with amendment 1 (1992-09) Operating conditions for industrial process measurement and control equipment - Part 2: Power	Gives the limiting values for power received by land-based and offshore industrial process measurement and control systems or parts of systems during operation
[18]	IEC 61000-4-11 (2004-03) Ed 2.0 Electromagnetic compatibility (EMC) Part 4-11: Testing and measuring techniques - Voltage dips, short interruptions and voltage variations immunity tests	Defines the immunity test methods and range of preferred test levels for electrical and electronic equipment connected to low-voltage power supply networks for voltage dips, short interruptions, and voltage variations. This standard applies to electrical and electronic equipment having a rated input current not exceeding 16 A per phase, for connection to 50 Hz or 60 Hz AC networks. It does not apply to electrical and electronic equipment for connection to 400 Hz AC networks. Tests for these networks will be covered by future IEC standards. The object of this standard is to establish a common reference for evaluating the immunity of electrical and electronic equipment when subjected to voltage dips, short interruptions and voltage variations. It has the status of a Basic EMC Publication in accordance with IEC Guide 107
[19]	IEC 61000-4-4 (2004-07) Ed 2.0 Electromagnetic compatibility (EMC) Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	Establishes a common and reproducible reference for evaluating the immunity of electrical and electronic equipment when subjected to electrical fast transient/burst on supply, signal, control and earth ports. The test method documented in this part of IEC 61000-4 describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon. The standard defines: ▪ test voltage waveform; ▪ range of test levels; ▪ test equipment; ▪ verification procedures of test equipment; ▪ test set-up; and ▪ test procedure. The standard gives specifications for laboratory and post-installation tests

Ref.	Standards and reference documents	Description
[20]	IEC 61000-4-5 (2005-11) Ed. 2.0Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	Relates to the immunity requirements, test methods, and range of recommended test levels for equipment to unidirectional surges caused by over-voltages from switching and lightning transients. Several test levels are defined which relate to different environment and installation conditions. These requirements are developed for and are applicable to electrical and electronic equipment. Establishes a common reference for evaluating the performance of equipment when subjected to high-energy disturbances on the power and inter-connection lines.
[21]	IEC 61000-4-2 (2009) with amendment 1 (1998-01) and amendment 2 (2000-11) Consolidated Edition: IEC 61000-4-2 (2001-04) Ed. 1.2	Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test. Basic EMC Publication
[22]	IEC 61000-4-3 (2008-04) Ed. 3.1	Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test
[23]	IEC 61000-4-6 (2008-10) Ed. 3.0Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques. Section 6: Immunity to conducted disturbances, induced by radio-frequency fields	Relates to the conducted immunity requirements of electrical and electronic equipment to electromagnetic disturbances coming from intended radio-frequency (RF) transmitters in the frequency range 9 kHz up to 80 MHz. Equipment not having at least one conducting cable (such as mains supply, signal line or earth connection), which can couple the equipment to the disturbing RF fields is excluded. This standard does not intend to specify the tests to be applied to particular apparatus or systems. Its main aim is to give a general basic reference to all concerned product committees of the IEC. The product committees (or users and manufacturers of equipment) remain responsible for the appropriate choice of the test and the severity level to be applied to their equipment.
[24]	OIML R 87	
[25]	OIML D 28 Edition 2004 (E)	Conventional value of the result of weighing in air

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