ORGANISATION INTERNATIONALE
DE MÉTROLOGIE LÉGALE

INTERNATIONAL RECOMMENDATION

Discontinuous totalizing automatic weighing instruments (totalizing hopper weighers) Part 1: Metrological and technical requirements - Tests

Instruments de pesage totalisateurs discontinus à fonctionnement automatique (peseuses totalisatrices à trémie)
Partie 1: Exigences métrologiques et techniques - Essais

OIML R 107-1

Edition 1997 (E)

CONTENTS

FOREWORD

The International Organization of Legal Metrology (OIML) is a worldwide, intergovernmental organization whose primary aim is to harmonize the regulations and metrological controls applied by the national metrological services, or related organizations, of its Member States.

The two main categories of OIML publications are:

1) **International Recommendations (OIML R)**, which are model regulations that establish the metrological characteristics required of certain measuring instruments and which specify methods and equipment for checking their conformity; the OIML Member States shall implement these Recommendations to the greatest possible extent;

2) **International Documents (OIML D)**, which are informative in nature and intended to improve the work of the metrological services.

OIML Draft Recommendations and Documents are developed by technical committees or subcommittees which are formed by the Member States. Certain international and regional institutions also participate on a consultation basis.

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

International Recommendations and International Documents are published in French (F) and English (E) and are subject to periodic revision.

OIML publications may be obtained from the Organization's headquarters:

Bureau International de Métrologie Légale
11, rue Turgot - 75009 Paris - France
Telephone: 33 (0)1 48 78 12 82 and 42 85 27 11
Fax: 33 (0)1 42 82 17 27

*
* *

This publication - reference OIML R 107-1, edition 1997 (E) - was developed by the OIML subcommittee TC 9/SC 2 *Automatic weighing instruments*. It was sanctioned by the International Conference of Legal Metrology in 1996 and supersedes the previous edition dated 1993.

TERMINOLOGY
(terms and definitions)

The terminology used in this Recommendation conforms to the *International Vocabulary of Basic and General Terms in Metrology* (VIM, 1993 edition) and the *Vocabulary of Legal Metrology* (VML, 1978 edition). In addition, for the purposes of this Recommendation, the following definitions apply.

T.1 General definitions

T.1.1 Weighing instrument

A measuring instrument that serves to determine the mass of a load by using the action of gravity.

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

T.1.2 Automatic weighing instrument

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

T.1.3 Discontinuous totalizing automatic weighing instrument (totalizing hopper weigher)

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

T.1.4 Electronic instrument

An instrument equipped with electronic devices.

T.1.5 Control instrument

A nonautomatic weighing instrument used to determine the mass of the product used as the test load during material tests.

T.2 Construction

Note: In this Recommendation the term “device” is applied to any part which uses any means to perform one or more specific functions.

T.2.1 Load receptor

The part of the instrument intended to receive the load.

T.2.2 Electronic parts

T.2.2.1 Electronic device

A device comprised of electronic subassemblies and performing a specific function. An electronic device is usually manufactured as a separate unit and is capable of being independently tested.

T.2.2.2 Electronic subassembly

A part of an electronic device comprised of electronic components and having a recognizable function of its own.

T.2.2.3 Electronic component

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

T.2.3 Indicating device

The part of the instrument that displays the value of a weighing result in units of mass.

T.2.3.1 Totalization indicating device

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

T.2.3.1.1 Principal totalization indicating device

The part of the instrument that indicates the sum of all the loads weighed and discharged to bulk.

T.2.3.1.2 Partial totalization indicating device

The part of the instrument that indicates the sum of a limited number of consecutive loads delivered to bulk.

T.2.3.1.3 Supplementary totalization indicating device

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

T.2.3.2 Control indicating device

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

T.2.4 Ancillary devices

T.2.4.1 Zero-setting device

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

T.2.4.1.1 Nonautomatic zero-setting device

A zero-setting device that must be operated manually.

T.2.4.1.2 Semi-automatic zero-setting device

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

T.2.4.1.3 Automatic zero-setting device

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

T.2.4.2 Printing device

The means to print the value of each discrete load weighed in the load receptor, and/or the sum of consecutive loads weighed and discharged to bulk.

T.3 Metrological characteristics

T.3.1 Scale interval

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

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

T.3.1.1 Totalization scale interval (d_t)

The scale interval of a principal totalization indicating device.

T.3.1.2 Control scale interval (d)

The scale interval on a control indicating device.

T.3.2 Weighing cycle

The sequence of weighing operations that includes the following:

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

T.3.3 Automatic weighing range

The range from minimum capacity to maximum capacity.

T.3.3.1 Maximum capacity (Max)

The largest discrete load that can be weighed automatically.

T.3.3.2 Minimum capacity (Min)

The smallest discrete load that can be weighed automatically.

T.3.3.3 Target load

The preset value of the load in the load receptor that causes the flow to stop in each weighing cycle.

T.3.4 Minimum totalized load (Σ_{min})

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

T.3.5 Warm-up time

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

T.4 Indications and errors

T.4.1 Methods of indication

T.4.1.1 Analogue indication

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

T.4.1.2 Digital indication

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

T.4.2 Errors

T.4.2.1 Error (of indication)

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

T.4.2.2 Intrinsic error

The error of an instrument under reference conditions.

T.4.2.3 Initial intrinsic error

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

T.4.2.4 Fault

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

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

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

T.4.2.5 Significant fault

A fault greater than d_t.

The following are not considered to be significant faults:

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

T.4.2.6 Span stability

The 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.

T.4.2.7 Maximum span stability error

A span stability error greater than one half of the absolute value of the maximum permissible error applicable to the load.

T.5 Influences and reference conditions

T.5.1 Influence quantity

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

T.5.1.1 Influence factor

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

T.5.1.2 Disturbance

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

T.5.2 Rated operating conditions

Conditions of use which give the ranges of the influence quantities for which the metrological characteristics are intended to lie within the specified maximum permissible errors.

T.5.3 Reference conditions

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

T.6 Tests

T.6.1 Material test

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

T.6.2 Simulation test

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

T.6.3 Performance test

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

T.6.4 Span stability test

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

DISCONTINUOUS TOTALIZING AUTOMATIC WEIGHING INSTRUMENTS (TOTALIZING HOPPER WEIGHERS)

1 General

1.1 Scope

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

It is intended to provide standardized requirements and test procedures to evaluate the metrological and technical characteristics of an instrument in a uniform and traceable way.

1.2 Application

This Recommendation applies to instruments having a load receptor in the form of a hopper.

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

- “weighing-in-motion” instruments;
- instruments that totalize the bulk load by multiplying the weight of a preset constant load by the number of weighing cycles.

1.3 Terminology

The terminology given in pages 4–9 shall be considered as a part of this Recommendation.

2 Metrological requirements

2.1 Accuracy classes

Instruments are divided into four accuracy classes as follows:

0.2 0.5 1 2

2.2 Maximum permissible errors

2.2.1 Automatic weighing

The maximum permissible errors for each accuracy class shall be the appropriate values in Table 1 rounded to the nearest totalization scale interval. Maximum permissible errors apply to loads not less than the minimum totalized load (Σ_{min}).

Table 1

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

2.2.2 Influence quantities

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

Table 2

Maximum permissible errors	Load (m) expressed in totalization scale intervals
±0.5 d_t	$0 \leq m \leq 500$
±1.0 d_t	$500 < m \leq 2\,000$
±1.5 d_t	$2\,000 < m \leq 10\,000$

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

2.3 Form of the scale interval

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

2.4 Totalization scale interval (d_t)

The totalization scale interval shall be:

- not less than 0.01 % of maximum capacity, and
- not greater than 0.2 % of maximum capacity.

2.5 Minimum value of minimum totalized load (Σ_{min})

The minimum totalized load shall not be less than:

- the value of the load for which the maximum permissible error for automatic weighing on initial verification is equal to the totalization scale interval (d_t), and
- the minimum capacity (Min).

Note: It results from the first indent above that the maximum permissible error on initial verification (mpe in the following example) for a load equal to Σ_{min} shall not be less than d_t.

Therefore, using Table 1, Σ_{min} shall not be less than:

$1\,000 \times d_t$ for class 0.2 instruments,
$400 \times d_t$ for class 0.5 instruments,
$200 \times d_t$ for class 1 instruments,
$100 \times d_t$ for class 2 instruments.

Example: Maximum capacity = 1 000 kg;
minimum capacity = 200 kg;
totalization scale interval = 0.2 kg (see 2.4);
accuracy class of instrument = 0.5;
$\Sigma_{min} \geq 400 \times 0.2 = 80$ kg.
But to satisfy the second indent above:
$\Sigma_{min} \geq$ Min = 200 kg.

Therefore, in this example the minimum value of the minimum totalized load is 200 kg.

(The values used in this example are not intended to be typical.)

2.6 Agreement between indicating and printing devices

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

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

2.7 Influence quantities

2.7.1 Static temperature

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

For special applications, however, the limits of the temperature range may differ from the above provided that this range is not less than 30 °C and is specified in the descriptive markings.

Instruments shall be tested in accordance with the static temperatures test in A.8.3.1.

2.7.2 Mains power supply (AC)

Instruments that are powered by an AC supply shall comply with the appropriate metrological and technical requirements when operated under variations of voltage from –15 % to +10 % of the value marked on the instrument.

Instruments shall be tested in accordance with the mains power supply (AC) test in A.8.3.3.

2.7.3 Battery power supply (DC)

Instruments that are powered by a DC supply shall comply with the appropriate metrological and technical requirements in accordance with 4.3.8.

Instruments shall be tested in accordance with the battery power supply (DC) test in A.8.3.4.

3 Technical requirements

3.1 Suitability for use

Instruments shall be designed to suit the method of operation and the materials for which they are intended.

3.2 Security of operation

3.2.1 Accidental maladjustment

Instruments shall be constructed so that a maladjustment likely to disturb their metrological performance cannot normally take place without the effect being easily detected.

3.2.2 Purging of load receptor

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

3.2.3 Automatic weighing conditions

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

a) if the maximum capacity (Max) has been exceeded by more than 9 d,

b) if the value of the load to be weighed and discharged to bulk is less than minimum capacity (Min), unless processed as the last discrete load of the transaction.

3.2.4 Operational adjustments

It shall not be possible to make operating adjustments nor to reset the indicating devices during an automatic weighing operation, with the exception of the possibility to interrupt the weighing cycle during testing as described in 6.3.1.

3.2.5 Dust extraction

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

3.2.6 Zero-setting device

Instruments that do not tare-weigh after each discharge shall be provided with a zero-setting device.

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

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

A zero-setting device shall be capable of setting zero to ±0.25 of the smallest scale interval of all the indicating devices of the instrument and have a range of adjustment not exceeding 4 % of maximum capacity.

3.2.7 Fraudulent use

Instruments shall not have characteristics likely to facilitate their fraudulent use.

3.3 Instruments with control indicating devices

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

Table 3

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

3.4 Totalization indicating and printing devices

Instruments shall include a principal totalization indicating device and may include a supplementary totalization indicating device, partial totalization indicating devices, and printing devices.

On an instrument equipped with a printing device, the following shall apply:

a) it shall not be possible to reset the principal totalization indicating device to zero unless the printing device automatically prints the last total indicated before re-setting to zero;
b) an automatic printout of the last total shall be generated if the automatic operation is interrupted and operating adjustments can be made.

3.4.1 Quality of indication

A totalization indicating and printing device shall allow reliable, simple and unambiguous reading of the results by simple juxtaposition and shall bear the name or symbol of the appropriate unit of mass.

3.4.2 Scale interval

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

3.4.3 Supplementary totalization indicating devices

The scale interval of a supplementary totalization indicating device shall be at least equal to ten times the totalization scale interval indicated in the descriptive markings.

3.4.4 Combined indicating devices

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

3.5 Ancillary devices

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

3.6 Sealing

Components that are not intended to be adjusted or removed by the user shall be fitted with a sealing device or shall be enclosed. When enclosed, it shall be possible to seal the enclosure.

3.7 Descriptive markings

Instruments shall bear the following markings.

3.7.1 Markings shown in full

- identification mark of the manufacturer
- identification mark of the importer (if applicable)
- serial number and type designation of the instrument
- product(s) designation
- control scale interval (if applicable) ... g or kg or t
- electrical supply voltage ... V
- electrical supply frequency ... Hz
- working fluid pressure (if applicable) ... kPa or bar

3.7.2 Markings shown in code

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

3.7.3 Supplementary markings

Depending upon the particular use of the instrument, supplementary markings may be required on pattern approval by the metrological authority issuing the pattern approval certificate (for example, temperature range).

3.7.4 Presentation of descriptive markings

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

Markings shall be grouped together in a clearly visible place on the instrument, either on a descriptive plate fixed near the indicating device or on the indicating device itself.

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

3.8 Verification marks

3.8.1 Position

Instruments shall have a place for the application of verification marks. The following applies for this place:

- the part on which the marks are located cannot be removed from the instrument without damaging the marks;
- the place shall permit the easy application of the marks without changing the metrological qualities of the instrument;
- the marks shall be visible without requiring that the instrument or its protective covers be moved when it is in service.

3.8.2 Mounting

Instruments required to bear verification marks shall have a verification mark support located as specified above, which shall ensure the conservation of the marks as follows:

- when the mark is made with a stamp, the support may consist of a strip of lead or any other material with similar qualities inserted into a plate fixed to the instrument or in a cavity bored into the instrument;
- when the mark consists of an adhesive transfer, a space shall be provided for this purpose.

4 Requirements for electronic instruments

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

4.1 General requirements

4.1.1 Rated operating conditions

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

4.1.2 Disturbances

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

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

Note: A fault equal to or less than the value specified in T.4.2.5 (1 d_t) is allowed irrespective of the value of the error of indication.

4.1.3 Durability

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

4.1.4 Evaluation for compliance

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

4.2 Application of requirements for disturbances

4.2.1 The requirements in 4.1.2 may be applied separately to:

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

4.2.2 The choice as to whether to apply 4.1.2 (a) or (b) is left to the manufacturer.

4.3 Functional requirements

4.3.1 Acting upon a significant fault

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

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

4.3.2 Switch-on procedure

Upon switch-on (in the case of electronic instruments permanently connected to the mains at switch-on of indication), a special procedure shall be performed that indicates all the relevant signs of the indicator in their active and nonactive states for a sufficient time to be easily observed by the operator.

4.3.3 Influence quantities

An electronic instrument shall comply with the requirements in 2.7 and in addition it shall maintain its metrological and technical characteristics at a relative humidity of 85 % at the upper limit of the temperature range of the instrument.

4.3.4 Disturbances

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

a) the difference between the weight indication due to the disturbance and the indication without the disturbance (intrinsic error) shall not exceed the value specified in T.4.2.5 (1 d_t);
b) the instrument shall detect and act upon a significant fault.

4.3.5 Warm-up time

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

4.3.6 Interface

An instrument may be equipped with an interface permitting the coupling of the instrument to external equipment. When an interface is used, the instrument shall continue to function correctly and its metrological functions shall not be influenced.

4.3.7 Mains power supply (AC)

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

4.3.8 Battery power supply (DC)

An instrument that operates from a battery power supply shall, whenever the voltage drops below the manufacturer's specified value, either continue to function correctly or automatically be put out of service.

4.4 Examination and tests

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

4.4.1 Examination

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

4.4.2 Performance tests

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

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

4.4.3 Span stability tests

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

When the instrument is subjected to span stability test specified in A.9:

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

5 Metrological controls

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

- pattern evaluation;
- initial verification;
- in-service inspection.

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

5.1 Pattern evaluation

5.1.1 Documentation

The application for pattern evaluation shall include documentation comprising:

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

5.1.2 General requirements

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

5.1.3 Pattern evaluation tests

Instruments shall comply with:

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

The appropriate metrological authority:

- shall conduct the tests in a manner that prevents unnecessary commitment of resources;
- shall permit, when the same instrument is involved, the result of these tests to be assessed for initial verification;
- is advised to accept, with the consent of the applicant, test data obtained from other metrological authorities without repeating the tests;
- shall ensure that an instrument that can be operated as a nonautomatic weighing instrument meets the relevant requirements of OIML R 76-1 for class III or class IIII instruments.

5.1.3.1 Material tests

Instruments shall be subjected to in-situ material tests in accordance with either the separate verification method as specified in A.6.2.2 or the integral verification method as specified in A.6.2.3.

Where the material test is conducted using the integral control instrument the integral verification method weighing test in A.6.2.3.1 shall be performed.

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

- in accordance with the descriptive markings;
- under the rated operating conditions for the instrument;
- not less than three material tests shall be conducted, one at minimum capacity, one at maximum capacity and one at close to the minimum totalized load (Σ_{min});
- each test shall be conducted at the maximum rate of weighing cycles per hour;
- with a test load representative of the range and type of products for which the instrument is likely to be used or a product for which the instrument is specified to be used;
- with a quantity of material not less than the minimum totalized load (Σ_{min}) marked on the instrument;
- when the quantity of material equal to the minimum totalized load (Σ_{min}) can be totalized in less than five weighing cycles, the following additional material tests shall be conducted, five cycles each at maximum capacity (Max) and five cycles at minimum capacity (Min);
- equipment near the automatic weighing instrument, including conveyors, dust collection systems etc. that are in use when the instrument is in normal operation, shall be in use;
- if the instrument can divert weighed material through alternative discharge facilities, the test program shall be performed for each alternative unless it can be established that the weigh hopper is not affected for example by different air flow.

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

The error for automatic weighing shall be the difference between the conventional true value of the mass of the test load as defined in 6.2.2 or 6.3.3, as appropriate and the indicated weight observed and recorded as defined in 6.2.1 or 6.3.2 as appropriate.

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

5.1.3.2 Simulation tests

Influence quantities shall be applied during simulation tests in a manner that will reveal an alteration of the weighing result for any weighing process to which the instrument could be applied, in accordance with:

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

When conducting such tests on a load cell or on an electronic device equipped with an analogue component, the maximum permissible error for the device under test shall be 0.7 times the appropriate value specified in Table 2.

If the metrological characteristics of the load cell or other major component has been evaluated in accordance with the requirements of OIML International Recommendation R 60 or any other applicable Recommendation, that evaluation shall be used to aid in the pattern evaluation, if so requested by the applicant.

Note: Since the requirements of this clause apply only to the instrument submitted for pattern evaluation and not to those subsequently submitted for verification, the means used to determine if the appropriate maximum permissible error or maximum allowable variation has been exceeded will be decided and mutually agreed upon between the metrological authority and the applicant. Following are examples of these means:

- an adaptation of the totalization indicating device to give greater resolution than that of the totalization scale interval;
- the use of change point weights;
- any other means mutually agreed upon.

5.1.4 Provision of means for testing

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

5.1.5 Place of testing

Instruments submitted for pattern approval may be tested at the following places:

- the premises of the metrological authority to which the application has been submitted,
- any other suitable place mutually agreed upon by the metrological authority and the applicant.

5.2 Initial verification

5.2.1 Tests

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

Tests shall be carried out by the appropriate metrological authority, in-situ, in a normal installation. The instrument shall be installed so that an automatic weighing operation will be virtually the same for testing as it is for a transaction.

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

5.2.1.1 Nonautomatic weighing instruments

When an instrument can be operated as a nonautomatic weighing instrument, it shall meet the relevant requirements of OIML R 76-1 for class III or class IIII nonautomatic weighing instruments.

5.2.1.2 Material tests

Instruments shall be subjected to in-situ material tests in accordance with either the separate verification method as specified in A.6.2.2 or the integral verification method as specified in A.6.2.3.

Where the material test is conducted using the integral control instrument the integral verification method weighing test in A.6.2.3.1 shall be performed.

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

- in accordance with the descriptive markings;
- under the rated operating conditions for the instrument;
- not less than three material tests shall be conducted, one at minimum capacity, one at maximum capacity and one at close to the minimum totalized load (Σ_{min});
- each test shall be conducted at the maximum rate of weighing cycles per hour;
- with a test load of products or products for which the instrument is intended;
- with a quantity of material not less than the minimum totalized load (Σ_{min}) marked on the instrument;
- when the quantity of material equal to the minimum totalized load (Σ_{min}) can be totalized in less than five weighing cycles, the following additional material tests shall be conducted, five cycles each at maximum capacity (Max) and five cycles at minimum capacity (Min);
- equipment near the automatic weighing instrument, including conveyors, dust collection systems etc. that are in use when the instrument is in normal operation, shall be in use;
- if the instrument can divert weighed material through alternative discharge facilities, the test program shall be performed for each alternative unless it can be established that the weigh hopper is not affected for example by different air flow. Testing for the full range of products only needs to be done for one discharge facility.

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

The error for automatic weighing shall be the difference between the conventional true value of the mass of the test load as defined in 6.2.2 or 6.3.3, as appropriate and the indicated weight observed and recorded as defined in 6.2.1 or 6.3.2 as appropriate.

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

5.2.2 Provision of means for testing

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

5.3 In-service inspection

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

6 Test methods

6.1 Control instrument and test standards

The control instrument and standard weights used for tests shall ensure the checking of the test load to an error not greater than:

a) 1/3 of the maximum permissible error for automatic weighing when the control instrument or the device used for control purposes is verified immediately prior to the material test, or
b) 1/5 of the maximum permissible error for automatic weighing in all other cases.

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

6.2 Separate verification method

With this method, an instrument other than the instrument being verified is used to determine the conventional true value of the mass of the test load.

6.2.1 Indicated weight

A test load shall be weighed as an automatic bulk to bulk weighing operation and the indicated weight value on the principal totalization indicating device shall be observed and recorded.

6.2.2 Mass of the test load

The test load shall be weighed on a control instrument and the result shall be considered as the conventional true value of the mass of the test load.

6.3 Integral verification method

With this method, the instrument being verified is used to determine the conventional true value of the mass of the test load.

The integral verification method shall be conducted by using either of the following:

a) a partial totalization indicating device with standard weights to assess the rounding error, or
b) an appropriately designed control indicating device.

6.3.1 Interruption of automatic operation

An automatic weighing operation of a test load shall be initiated following the same procedure as for weighing bulk to bulk. However, the automatic operation shall be interrupted twice during each weighing cycle necessary to weigh and discharge a subdivision of the test load.

An automatic operation shall not be interrupted during consecutive weighing cycles if the instrument is installed as an air-enclosed system.

6.3.1.1 Predischarge (gross) interrupt

After the load receptor has been loaded and the instrument has automatically processed a gross weight, the automatic operation shall be interrupted. When the load receptor has stabilized, the gross weight indicated or determined by balancing with standard weights shall be recorded and the instrument switched back to automatic operation.

6.3.1.2 Postdischarge (tare) interrupt

After the load has been discharged and the instrument has automatically processed a tare weight, the automatic operation shall be interrupted. When the discharged load receptor has stabilized, the tare weight indicated or determined by balancing with standard weights shall be recorded and the instrument switched back to automatic operation.

6.3.2 Indicated weight

The principal totalization indicating device shall be used in obtaining the indicated weight of the test load.

6.3.3 Mass of the test load

For each discharge, the tare weight value subtracted from the gross weight value is the net weight of the material discharged. A summation of the net weight values of all the discharges in the test load shall be the conventional true value of the mass of the test load.

ANNEX A

TEST PROCEDURES FOR DISCONTINUOUS TOTALIZING AUTOMATIC WEIGHING INSTRUMENTS

(Mandatory)

Meaning of symbols:

I	=	Indication
L	=	Load
ΔL	=	Additional load to next changeover point
P	=	$I + 0.5\ d - \Delta L$ = Indication prior to rounding
E	=	P – L = error
E_0	=	Error calculated at zero
E_c	=	Corrected error
mpe	=	Maximum permissible error
EUT	=	Equipment under test

A.1 Documentation (5.1.1)

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

A.2 Comparing construction with documentation (5.1.1)

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

A.3 Initial examination

A.3.1 Metrological characteristics

Note metrological characteristics according to the test report format (see OIML R 107-2).

A.3.2 Descriptive markings (3.7)

Check the descriptive markings according to the checklist given in the test report format.

A.3.3 Sealing and verification marks (3.6 and 3.8)

Check the arrangements for sealing and verification marks according to the checklist given in the test report format.

A.4 General

A.4.1 General requirements for electronic instruments under test (EUT)

A.4.1.1 Power supply

Energize the EUT for a time period equal to or greater than the warm-up time specified by the manufacturer and maintain it energized for the duration of the test.

A.4.1.2 Zero-setting

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 it if a significant fault has been indicated.

A.4.1.3 Temperature

The tests shall be performed at a steady ambient temperature, usually normal room 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 be such that no condensation of water occurs on the instrument.

A.4.2 Control instrument and test standards (6.1)

A.4.2.1 Control instruments

A control instrument meeting the requirements of clause 6.1 shall be used for conduct of material tests. Where necessary, standard weights may be used to assess the rounding error.

A.4.2.2 Use of standard weights to assess rounding error

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

At a certain load, L, the indicated value, I, is noted. Additional weights of for example 0.1 d are successively added until the indication of the instrument is increased unambiguously by one scale interval (I + d). The additional load 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:

$$E = P - L$$

thus

$$E = (I + 0.5\ d - \Delta L) - L$$

The corrected error prior to rounding is:

$$E_c = E - E_0$$

where E_0 is the error calculated at zero.

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

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

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

$$E = (100.2 – 100)\ kg = 0.2\ kg$$

If the error prior to rounding as calculated above was E_0 = +0.4 kg, the corrected error is:

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

A.5 Test program

A.5.1 Pattern evaluation (5.1)

All tests in sections A.6 to A.9 shall normally be applied for pattern evaluation.

Section A.6.1 may be omitted if the integral instrument is not to be used as the control indicating device for material testing.

Tests in A.7.1, A.8.3.2, A.8.3.3 (AC supply), A.8.3.4 (DC supply) and A.8.4.1 to A.8.4.4 apply only for instruments that have an electrical power supply.

A.5.2 Initial verification (5.2)

Only section A.6 *Metrological performance tests* is normally required for initial verification tests.

A.6 Metrological performance tests

Metrological performance tests shall be applied to the complete instrument under normal operating conditions, except when the size and/or configuration of the instrument does not lend itself to testing as a unit. In such cases, the separate electronic devices shall be subjected to testing.

A.6.1 Zero-setting device (3.2.6)

A.6.1.1 General

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

- Nonautomatic or semi-automatic zero;
- Automatic zero at switch-on;
- Automatic zero at start of automatic operation;
- Automatic zero as part of weighing cycle.

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

A.6.1.2 Range of zero-setting

Nonautomatic and semi-automatic zero-setting

Positive range

With the load receptor empty, set the instrument to zero. Place a test load on the load receptor and use the zero-setting device. Continue to increment the test load until the device fails to re-zero. The maximum load that can be re-zeroed is the positive portion of the zero-setting range.

Negative range

(1) Remove any load from the load receptor and set the instrument to zero. Then if possible remove non essential components of the load receptor, such that the instrument cannot be re-zeroed by use of the zero setting device. (If this is not possible then any mass that can be removed without disabling the zero function may be considered as the negative portion of the zero-setting range).

(2) Add weights to the load receptor until the instrument indicates zero again.

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

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

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

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

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

A.6.1.3 Accuracy of zero-setting

(1) Set the instrument to zero.

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

(3) Calculate the error at zero according to the description in A.4.2.

A.6.2 Material tests (5.1.3.1 and 5.2.1.2)

A.6.2.1 Material test requirements

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

- clause 5.1.3.1 for pattern examination;
- clause 5.2.1.2 for initial verification and in-service inspection;
- A.6.2.2 or A.6.2.3 (using one of the methods therein).

A.6.2.2 Separate verification method

For this method a separate control instrument is used to weigh the material either before or after it is weighed on the discontinuous totalizing automatic weighing instrument.

A.6.2.3 Integral verification method

For this method the integral control instrument is used for static weighing of material test loads by use of a special facility to interrupt operation during the automatic process.

A.6.2.3.1 Integral verification method weighing test

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

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

Determine the error at each test load using the procedure in A.4.2.2 if necessary to obtain the accuracy requirements of A.4.2.1.

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

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

A.6.2.3.2 Substitution material

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

Determine the error (A.4.2) and then remove the weights so that the no-load indication is reached.

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

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

Similar equivalent procedures may be applied.

A.6.2.3.3 Method

(1) Automatic gross weighing

Automatic operation is interrupted after the filling of the weigh hopper and completion of the automatic gross weighing but before discharge of the hopper. Thus the hopper remains loaded.

(2) Static gross indication

Then, all surrounding equipment such as dust extractors shall be stopped. When the system has come to a complete rest such that the conditions are identical to those for non-automatic testing, the static control weighing indication shall be obtained.

If necessary, standard weights may be used to interpolate between scale intervals. The static control indication shall be corrected for the errors determined in A.6.2.3.1 (for increasing loads).

(3) All surrounding equipment is started up again.

(4) Automatic tare weighing

Automatic operation is interrupted after the discharge of the weigh hopper and completion of the automatic tare weighing but before the hopper is loaded again.

(5) Static tare indication

Repeat stage (2) with an empty hopper. The static indication shall be corrected for the errors determined in A.6.2.3.1 (for decreasing loads).

(6) The complete system is started up again and stages (1) through (5) are repeated.

(7) The net weight of the material delivered at each cycle is determined by subtracting the corrected indication obtained at (5) from the corrected indication obtained at (2).

(8) The conventional true value of the mass of the total test load is determined by summation of the net weights obtained at each cycle.

If the instrument is installed in an air-enclosed system, the moving mass of material causes air turbulence that can affect the weighing results. To ensure that such an instrument is tested in normal conditions of use, the automatic operation shall not be interrupted during consecutive weighing cycles. In this case it is necessary for the automatic weighings made at stages (2) and (4) to be displayed or recorded so that a separate total may be derived for the automatic weighings which have also been carried out under static conditions.

A.6.2.4 Material test procedure (5.1.3.1 and 5.2.1.2)

The test procedure shall be as follows:

(1) Start up the automatic weighing system, including the surrounding equipment which is normally in use when the instrument is itself in use.

(2) Run the system for five weigh cycles (or more if necessary) to ensure normal working conditions.

(3) Halt the automatic weighing system and record the indication of totalized weight.

(4) Run the weighing system for a number of weighing cycles as specified for each test in 5.1.3.1 or 5.2.1.2, ensuring that the processed material can be weighed on the control instrument (integral or separate) in accordance with one of the alternative methods of A.6.2.2 or A.6.2.3.

(5) Halt the weighing system, and record the final indication of totalized weight.

(6) Determine the indicated totalized weight for the test from the difference between the indication at start (3) and finish (5).

(7) Repeat the above procedure for further tests as specified in 5.1.3.1 or 5.2.1.2.

(8) Determine the material test error from the difference between the indicated totalized weight as determined in (6) and the total weight of material determined using the control instrument as in (4).

A.6.2.5 Calculation of material test error (5.1.3.1 and 5.2.1.2)

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

Separate verification method (6.2)

The weight value(s) on the separate control instrument is (are) noted.

Integral verification method (6.3)

A The weight values obtained under static conditions on the control indicating device or those values obtained by balancing with standard weights are noted and totalized. For each weighing cycle, the net value is the difference between the values obtained in stages (2) and (5) in A.6.2.3.3.

B The weight values obtained automatically on the principal totalization indicating device are noted and totalized. For each weighing cycle, the net value is the difference between the values obtained in (1) and (4) in A.6.2.3.3.

For each method, the difference between the values obtained from the totalization indication and from the separate control instrument or between procedures A and B in the integral verification method, represents the automatic weighing error. This is the value that shall be used for comparison with the appropriate maximum permissible error for automatic weighing in 2.2.1.

A.7 Additional functionality

A.7.1 Warm-up time test (4.3.5)

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

(2) Reconnect the instrument and switch on while observing the control indicating device (if present) and the totalization indicator(s). Verify that it is not possible to initiate automatic weighing or printout until all indicators have stabilized, or until completion of the warm-up time if this is specified by the manufacturer.

(3) As soon as the indication of the control indicating device (if present) has stabilized, set the instrument to zero and determine the error of zero-setting according to A.6.1.3.

(4) Apply a load close to Max. Determine the error by the method in A.4.2.

(5) Repeat stages (3) and (4) after 5, 15 and 30 minutes.

A.7.2 Agreement between indicating and printing devices (2.6)

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

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

A.7.3 Automatic mode interlocks (3.2.4)

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

A.7.4 Printer interlocks (3.4)

If the instrument is equipped with a printing device, verify that:

- the principle totalization device cannot be reset to zero unless the printing device automatically records the total. Test by disabling the printer and attempting to reset the principle totalization indicator;
- an automatic printout of the total is generated if the automatic operation is interrupted.

A.7.5 Battery power supply interlocks (4.3.8)

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

A.7.6 Retention of total after power failure (4.3.7)

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

A.7.7 Zero offset interlock (3.2.6)

A.7.7.1 Positive offset

Set the instrument to zero by the method used for the tests in A.6.1.2 and A.6.1.3. Add a load to the load receptor of > d_t, for instruments with an automatic zero-setting device, or > $0.5d_t$, for instruments without an automatic zero-setting device. Confirm that automatic operation is no longer possible.

A.7.7.2 Negative offset

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

Set the instrument to zero by the method used for the tests in A.6.1.2 and A.6.1.3. Remove the test weights and confirm that automatic operation is no longer possible.

A.8 Influence factor and disturbance tests

A.8.1 General

It is generally not possible to apply the influence factors or disturbances to an instrument which is 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 minimum requirements for simulators are listed under the test equipment heading for each test. The permissible effects of the influence factors or disturbances, under these conditions, are specified for each case. Where it is possible to conduct the tests on a complete instrument under normal operation then this is the preferred option.

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

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

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

A.8.2 Simulator requirements

A.8.2.1 General

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

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

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.8.2.2 Weighing function

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

A.8.2.3 Totalization storage and indication function

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

A.8.3 Influence factor tests

Summary of tests

Test		Characteristic under test	Conditions applied
A.8.3.1	Static temperature	Influence factor	mpe(*)
A.8.3.2	Damp heat, steady state	Influence factor	mpe
A.8.3.3	Mains power supply voltage variation (AC)	Influence factor	mpe
A.8.3.4	Battery power supply voltage variation (DC)	Influence factor	mpe

(*) mpe: maximum permissible error

A.8.3.1 Static temperature tests (2.7.1)

Static temperature tests are carried out according to basic standard IEC Publication 68-2-1 (1990) and IEC Publication 68-2-2 (1974) as detailed in the Bibliography [1] and according to Table 4.

Table 4

Environmental phenomena	Test specification	Test set-up
Temperature	Reference of 20 °C	
	Specified high for 2 hours	IEC 68-2-2
	Specified low for 2 hours	IEC 68-2-1
	5 °C	IEC 68-2-1
	Reference of 20 °C	
Use IEC 68-3-1 (1974) for background information and refer to Bibliography [1] for specific parts of the IEC test.		

Supplementary information to the IEC test procedures

Object of the test: To verify compliance with the provisions in 2.7.1 under conditions of dry heat (non condensing) and cold.

Test procedures in brief:

Precondition: 16 hours.

Condition of the EUT:	Normal power supplied and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Power is to be “on” for the duration of the test.
Stabilization:	2 hours at each temperature under “free air” conditions.
Temperature:	As specified in 2.7.1.
Temperature sequence:	Reference temperature of 20 °C; Specified high temperature; Specified low temperature; A temperature of 5 °C; Reference temperature of 20 °C.
Number of test cycles:	At least one cycle.
Weighing test:	Adjust the EUT as close to zero indication as practicable prior to the test (if an automatic zero-tracking device is connected, adjust it to a value near zero). The EUT shall not be readjusted at any time during the test. The EUT shall display a recorded total not less than the minimum totalized load, Σ_{min}. After stabilization at the reference temperature and again at each specified temperature, apply at least five different test loads or simulated loads and record: a) date and time; b) temperature; c) relative humidity; d) test load; e) indications (as applicable); f) errors; g) functional performance.
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in Table 2.

A.8.3.2 Damp heat, steady state (4.3.3)

Damp heat, steady state tests are carried out according to basic standard IEC Publication 68-2-56 (1988) and IEC Publication 68-2-28 (1980) as detailed in Bibliography [2] and according to Table 5.

Table 5

Environmental phenomena	Test specification	Test set-up
Damp heat, steady state	Upper limit temperature and relative humidity of 85 % for 2 days (48 hours)	IEC 68-2-56
Use IEC 68-2-28 for guidance on damp heat tests and refer to Bibliography [2] for specific parts of the IEC test.		

Supplementary information to the IEC test procedures

Object of the test:	To verify compliance with the provisions in 4.3.3 under conditions of high humidity and constant temperature.
Precondition:	None required.
Condition of the EUT:	Normal power supplied and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Power is to be "on" for the duration of the test. Adjust the EUT as close to zero indication as practicable prior to the test (if an automatic zero-tracking device is connected, adjust it to a value near zero). The EUT shall not be readjusted at any time during the test. The EUT shall display a recorded total not less than the minimum totalized load, Σ_{min}. The handling of the EUT shall be such that no condensation of water occurs on the EUT.
Stabilization:	3 hours at reference temperature and 50 % humidity; 2 days (48 hours) at the upper limit temperature as specified in 2.7.1.
Temperature:	Reference temperature of 20 °C and at the upper limit as specified in 2.7.1.
Relative humidity:	50 % at reference temperature; 85 % at upper limit temperature.
Temperature-humidity sequence:	Reference temperature of 20 °C at 50 % humidity; the upper limit temperature at 85 % humidity; reference temperature of 20 °C at 50 % humidity.
Number of test cycles:	At least one cycle.

Weighing test and test sequence: After stabilization of the EUT at reference temperature and 50 % humidity, apply at least five different test loads or simulated loads and record:

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

Increase the temperature in the chamber to the upper limit and increase the relative humidity to 85 %. Maintain the EUT at no load for a period of 2 days (48 hours). Following the 2 days, apply at least five test loads 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 Table 2.

A.8.3.3 Mains power supply voltage variation (AC) (2.7.2)

Power voltage variation tests are carried out according to basic standard IEC Publication 1000-4-11(1994) as detailed in Bibliography [6] and according to Table 6.

Table 6

Environmental phenomena	Test specification	Test set-up
Voltage variation	Reference voltage	IEC 1000-4-11
	Reference voltage + 10 %	
	Reference voltage – 15 %	
	Reference voltage	
Reference voltage (rated voltage) shall be as defined in IEC 1000-4-11 section 5; refer to Bibliography [6] for specific parts of the IEC test.		

Supplementary information to the IEC test procedures

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

Test procedures in brief:

Precondition: None required.

Condition of the EUT: Normal power supplied and “on” for a time period equal to or greater than the warm-up time specified

by the manufacturer. Power is to be “on” for the duration of the test.

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.

The EUT shall display a recorded total not less than the minimum totalized load, Σ_{min}.

Number of test cycles: At least one cycle.

Weighing test: The EUT shall be tested at no load and with one test load or simulated load between 50 % and maximum capacity of the EUT.

Test sequence: Stabilize the power supply at the reference voltage within the defined limits and record:

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

Repeat the test weighing for each of the voltages defined in IEC 1000-4-11 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 Table 2.

A.8.3.4 Battery power supply voltage variation (DC) (2.7.3)

Test method: Variation in DC power supply. Where the EUT continues to operate below the stated battery voltage, the following test shall be conducted using an equivalent variable DC power source.

Object of the test: To verify compliance with the provisions in 2.7.3 under conditions of varying DC power supply. The requirements shall be met either by use of an equivalent variable DC power source or by allowing the battery voltage to fall by use.

Reference to standard: No reference to international standards can be given at the present time.

Test procedures in brief:	The test consists of subjecting the EUT to DC power variations when the former is operating under normal atmospheric conditions with one test load or simulated load between 50 % and maximum capacity of the EUT.
Test severity:	Supply voltage: lower limit, the voltage at which the EUT clearly ceases to function (or is automatically put out of service) +2 % of this voltage.
Number of test cycles:	At least one cycle.
Conduct of the test:	
Precondition:	None required.
Test equipment:	Variable DC power source; Calibrated voltmeter; Load cell simulator, if applicable.
Condition of the EUT:	Normal power supplied and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable prior to the test. If it has an automatic zero-setting function as part of the automatic weighing process, then the instrument should be set to zero after applying each level of voltage.
Test sequence:	Stabilize the power supply at nominal battery voltage ±2 % and record the following data at no load and with one load or simulated load between 50 % and maximum capacity of the EUT: a) date and time; b) temperature; c) relative humidity; d) power supply voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance. Reduce the power supply to the EUT until the equipment clearly ceases to function and note the voltage. Switch the EUT “off” and increase the power supply voltage to nominal battery voltage ±2 %. Switch the EUT “on” and reduce the power supply voltage to the above noted voltage (out of service voltage) +2 % of the noted voltage. Record the data indicated above.
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in Table 2.

A.8.4 Disturbance tests (4.1.2 and 4.3.4)

Summary of tests

	Test	Characteristic under test	Conditions applied
A.8.4.1	Voltage dips and short interruptions	Disturbance	sf(*)
A.8.4.2	Electrical fast transients/ burst immunity	Disturbance	sf
A.8.4.3	Electrostatic discharge	Disturbance	sf
A.8.4.4	Electromagnetic susceptibility	Disturbance	sf

(*) sf: value of the significant fault (see T.4.2.5)

A.8.4.1 Voltage dips and short interruptions

Short time power reduction (voltage dips and short interruptions) tests are carried out according to basic standard IEC Publication 1000-4-11(1994). As detailed in Bibliography [6] and according to Table 7.

Table 7

Environmental phenomena	Test specification	Test set-up
Voltage dips and short interruptions	Interruption from reference voltage to zero voltage for one half cycle Interruption from reference voltage to 50 % of reference voltage for two half cycles These mains voltage interruptions shall be repeated ten times with a time interval of at least 10 seconds	IEC 1000-4-11
The reference voltage (rated voltage) shall be as defined in IEC 1000-4-11 section 5. Refer to Bibliography [6] for specific parts of the IEC test.		

Supplementary information to the IEC test procedures

Object of the test:	To verify compliance with the provisions in 4.1.2 under conditions of short time mains voltage interruptions and reductions.
Test procedures in brief:	
Precondition:	None required.
Condition of the EUT:	Normal power supplied and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer.

	Adjust the EUT as close to zero indication as practicable prior to the test. The EUT shall not be re-adjusted at any time during the test except to reset if a significant fault has been indicated.
Number of test cycles:	At least one cycle.
Weighing test and test sequence:	Stabilize all factors at nominal reference conditions. Apply one load or simulated load between 50 % and maximum capacity of the EUT and record: a) date and time; b) temperature; c) relative humidity; d) power supply voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance. Interrupt the power supply to zero voltage for a period equal to one half cycle and conduct the test as detailed in IEC 1000-4-11 section 8.2.1. During interruption observe the effect on the EUT and record as appropriate. Reduce the power supply to 50 % of nominal voltage for a period equal to two half cycles and conduct the test as detailed in IEC 1000-4-11 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 values given in T.4.2.5, or the EUT shall detect and act upon a significant fault.

A.8.4.2 Electrical fast transients/burst immunity

Electrical fast transients/burst immunity tests are carried out according to basic standard IEC 1000-4-4 (1995), for 2 minutes with a positive polarity and for 2 minutes with a negative polarity. As detailed in Bibliography [5] and according to Tables 8.1, 8.2 and 8.3.

Table 8.1: Ports for signal lines and control lines

Environmental phenomena	Test specification	Test set-up
Fast transient common mode	0.5 kV (peak) 5/50 ns T_1/T_h 5 kHz rep. frequency	IEC 1000-4-4
Note: Applicable only to ports or interfacing with cables whose total length may exceed 3 m according to the manufacturer's functional specification.		

Table 8.2: Input and output DC power ports

Environmental phenomena	Test specification	Test set-up
Fast transient common mode	0.5 kV (peak) 5/50 ns T_1/T_h 5 kHz rep. frequency	IEC 1000-4-4
Note: Not applicable to battery operated appliances that cannot be connected to the mains while in use.		

Table 8.3: Input and output AC power ports

Environmental phenomena	Test specification	Test set-up
Fast transient common mode	0.5 kV (peak) 5/50 ns T_1/T_h 5 kHz rep. frequency	IEC 1000-4-4

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 in 4.1.2 under conditions where fast transients are superimposed on the mains voltage.

Test procedures in brief:

Precondition: None required.

Condition of the EUT: Normal power supplied and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer.

Adjust the EUT as close to zero indication as practicable prior to the test. The EUT shall not be readjusted at any time during the test except to reset if a significant fault has been indicated.

Stabilization: Before any test stabilize the EUT under constant environmental conditions.

Weighing test: Stabilize all factors at nominal reference conditions. Apply one load or simulated load between 50 % and maximum capacity of the EUT and record the following with and without the transients:

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

Maximum allowable variations: The difference between the weight indication due to the disturbance and the indication without the disturbance either shall not exceed the value given in T.4.2.5 or the instrument shall detect and act upon a significant fault.

A.8.4.3 Electrostatic discharge

Electrostatic discharge tests are carried out according to basic standard IEC 1000-4-2 (1995), with test signals and conditions as given in Table 9 and as detailed in Bibliography [3].

Table 9

Environmental phenomena	Test specification	Test set-up
Electrostatic discharge	8 kV air discharge 6 kV contact discharge	IEC 1000-4-2
Note: The 6 kV contact discharge shall be applied to accessible conductive parts. Metallic contacts e.g. in battery compartments or in socket outlets are excluded from this requirement.		

Contact discharge is the preferred test method. 20 discharges (10 with positive and 10 with negative polarity) shall be applied on each accessible metal part of the enclosure. The time interval between successive discharges shall be at least 10 seconds. In the case of a non-conductive enclosure, discharges shall be applied on the horizontal or vertical coupling planes as specified in IEC 1000-4-2 (1995). Air discharges shall be used where contact discharges cannot be applied. Tests with other (lower) voltages than those given in Table 9 are not required.

Supplementary information to the IEC test procedures

Object of the test: To verify compliance with the provisions in 4.1.2 under conditions where electrostatic discharges are applied.

Test procedures in brief:

Precondition: None required.

Condition of the EUT: Normal power supplied and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer.

Adjust the EUT as close to zero indication as practicable prior to the test. The EUT shall not be readjusted at any time during the test except to reset if a significant fault has been indicated.

Stabilization: Before any test stabilize the EUT under constant environmental conditions.

Weighing test: Stabilize all factors at nominal reference conditions. Apply one load or simulated load between

50 % and maximum capacity of the EUT and record the following with and without electrostatic discharge:

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

Maximum allowable variations: The difference between the weight indication due to the disturbance and the indication without the disturbance either shall not exceed the value given in T.4.2.5 or the instrument shall detect and act upon a significant fault.

A.8.4.4 Electromagnetic susceptibility

Electromagnetic susceptibility tests (radio frequency electromagnetic fields 26 MHz to 1000 MHz tests) are carried out in accordance to IEC 1000-4-3 (1995). As detailed in Bibliography [4] and according to Table 10.

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: Enclosure port

Environmental phenomena	Test specification	Test set-up
Radio-frequency electromagnetic field, 1 kHz, 80 % AM	26 MHz to 1 000 MHz 3 V/m (rms) (unmodulated)	IEC 1000-4-3

Supplementary information to the IEC test procedures

Object of the test: To verify compliance with the provisions in 4.1.2 under conditions of specified electromagnetic fields applied.

Test procedures in brief:

Precondition: None required.

Condition of the EUT: Normal power supplied and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer.

Adjust the EUT as close to zero indication as practicable prior to the test. The EUT shall not be re-adjusted at any time during the test except to reset if a significant fault has been indicated.

Stabilization: Before any test stabilize the EUT under constant environmental conditions.

Weighing test: Stabilize all factors at nominal reference conditions. Apply one load or simulated load between 50 % and maximum capacity of the EUT and record the following with and without electromagnetic fields:

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

Maximum allowable variations: The difference between the weight indication due to the disturbance and the indication without the disturbance either shall not exceed the value given in T.4.2.5 or the instrument shall detect and act upon a significant fault.

A.9 Span stability test (4.4.3)

Summary of test

	Test	Characteristic under test	Condition applied
A.9	Span stability	Stability	1/2 absolute mpe(*)

(*) mpe: maximum permissible error on initial verification in 2.2.2 Table 2. Note: the maximum permissible error for the zero point shall also be taken into consideration.

Test method: Span stability.

Object of the test: To verify compliance with the provisions in 4.4.3 after the EUT has been subjected to the performance tests.

Reference to standard: No reference to international standards can be given at the present time.

Test procedures in brief: The test consists of observing the variations of the error of the EUT or simulator under sufficiently constant ambient conditions (reasonable constant conditions in a normal laboratory environment) at various intervals: before, during, and after the EUT has been subjected to performance tests.

The performance tests shall include the temperature test and, if applicable, the damp heat test; an endurance test shall not be included. Other performance tests listed in this Annex may be performed.

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

• Initial measurement

Determine the span error using the following method:

1. Determine the initial zero error (E_o)

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

Either by use of an indicator with a suitable higher resolution scale interval or using the change point weight method in A.4.2.2 (noting the total addition change point weight ΔL_0) determine and record the initial zero error (E_0).

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

Carefully remove the change point weights (if used) and apply the test load (or simulated load) and note the indication (I_L).

Either by use of an indicator with a suitable higher resolution scale interval or using the change point weight method in A.4.2.2 (noting the total addition change point weight ΔL) determine and record the error at near Max capacity (E_L).

Record:

a) date and time;

b) temperature;

c) barometric pressure;

d) relative humidity;

e) value of 0.1 d;

f) test load;

g) total of added change point weights at zero load ΔL_0;

h) total of added change point weights at test load ΔL;

i) the following indications:

   • indication at zero (I_0);
   • indication of test load (I_L);

j) calculate:

   • initial zero error E_0;
   • error at test load (E_L);

k) change in location

and apply all necessary corrections resulting from variations of temperature, pressure, etc. between the various measurements.

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

• Subsequent measurements

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

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

The measurements shall continue until there are at least 8 measurements except where the difference of the results indicates a trend more than half the allowable variation specified, the measurements shall be continued until the trend comes to rest or reverses itself, or until the error exceeds the maximum allowable variation.

BIBLIOGRAPHY

Below are references to Publications of the International Electrotechnical Commission (IEC), where mention is made in some of the tests in Annex A.

[1] IEC Publication 68-2-1 (1990): Basic environmental testing procedures. Part 2: Tests, Test Ad: Cold, for heat dissipating equipment under test (EUT), with gradual change of temperature.

IEC Publication 68-2-2 (1974): Basic environmental testing procedures, Part 2: Tests, Test Bd: Dry heat, for heat dissipating equipment under test (EUT) with gradual change of temperature.

IEC Publication 68-3-1 (1974): Background information, Section 1: Cold and dry heat tests.

[2] IEC Publication 68-2-56 (1988): Environmental testing, Part 2: Tests, Test Cb: Damp heat, steady state. Primarily for equipment.

IEC Publication 68-2-28 (1980): Guidance for damp heat tests.

[3] IEC Publication 1000-4-2(1995): Electromagnetic Compatibility (EMC), Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test. Basic EMC publication.

[4] IEC Publication 1000-4-3(1995): Electromagnetic Compatibility (EMC), Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test.

[5] IEC Publication 1000-4-4(1995): Electromagnetic Compatibility (EMC), Part 4: Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test. Basic EMC publication.

[6] IEC Publication 1000-4-11(1994): Electromagnetic compatibility (EMC), Part 4: Testing and measurement techniques - Section 11: Voltage dips, short interruptions and voltage variations immunity tests. Section 5.2 (Test levels - Voltage variation). Section 8.2.2 (Execution of the test-voltage variation).

[7] IEC Publication 1000-4-11(1994): Electromagnetic compatibility (EMC), Part 4: Testing and measurement techniques - Section 11: Voltage dips, short interruptions and voltage variations immunity tests. Section 5.1 (Test levels - Voltage dips and short interruptions). Section 8.2.1 (Execution of the test-voltage dips and short interruptions).

Printed in France

GRANDE IMPRIMERIE DE TROYES
130, rue Général-de-Gaulle, 10000 Troyes