

INTERNATIONAL  
RECOMMENDATION

**OIML R 76-1**

Edition 202x (E)

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Non-automatic weighing instruments

Part 1: Metrological and technical  
requirements

Instruments de pesage à fonctionnement non automatique

Partie 1: Exigences métrologiques et techniques

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ORGANISATION INTERNATIONALE  
DE MÉTROLOGIE LÉGALE

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INTERNATIONAL ORGANIZATION  
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## **Foreword**

**LATEST FOREWORD TO BE ADDED BY THE BIML ON PUBLICATION**

## Non-automatic weighing instruments

### Part 1 – Metrological and technical requirements

#### 1 Introduction

This OIML Recommendation consists of five separate parts:

- Part 1: Metrological and technical requirements;
- Part 2: Testing procedures;
- Part 3: Test report format;
- Part 4: Type evaluation report format;
- Part 5: Verification and inspection procedures.

#### 2 Scope

This Recommendation specifies the metrological and technical requirements for non-automatic weighing instruments that are subject to official metrological control.

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

“Non-graduated” instruments are no longer covered by this Recommendation. Today, an indication of the weighing result is expected for new types of weighing instrument. The requirements specific to mechanical instruments are summarized in clause 8.

#### 3 Terms and definitions

The terminology used in this Recommendation conforms to OIML V 2-200:2012 *International Vocabulary of Metrology - Basic and General Concepts and Associated Terms* (VIM) [2], OIML V 1:2022 *International vocabulary of terms in legal metrology* (VIML) [3], OIML B 18:2022 *Framework for the OIML Certification System (OIML-CS)* [3] and other relevant OIML publications. In addition, for the purposes of this Recommendation, the following definitions apply. An index of all the terms, definitions and references defined below can be found in Annex B.

##### 3.1 General definitions

##### 3.1.1 weighing instrument

measuring instrument that serves to determine the mass of a body by using the action of gravity on this body.

*Note:* In this Recommendation “mass” (or “weight value”) is preferably used in the sense of “conventional mass” or “conventional value of the result of weighing in air” according to R 111 *Weights of classes  $E_1$ ,  $E_2$ ,  $F_1$ ,  $F_2$ ,  $M_1$ ,  $M_{1,2}$ ,  $M_2$ ,  $M_{2,3}$  and  $M_3$*  [11] and D 28:2004 *Conventional value of the result of weighing in air (Revision of R 33)* [14], whereas “weight” is preferably used for an embodiment (i.e. material measure) of mass that is regulated in regard to its physical and metrological characteristics.

*Note 2:* The instrument may also be used to determine other quantities, magnitudes, parameters or characteristics related to the determined mass.

*Note 3:* According to its method of operation, a weighing instrument is classified as an automatic weighing instrument or a non-automatic weighing instrument.

**Commented [ID1]:** Whole section renumbered to avoid “T.x.x” format.

**Commented [ID2]:** Is this necessary or useful? Not used in most other Recommendations.

**Commented [ID3]:** References added to bibliography

### 3.1.2 non-automatic weighing instrument

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

*Note 1:* Deciding that the weighing result is acceptable includes any intelligent action by the operator that affects the result, such as taking an action when an indication is stable or adjusting the mass of the weighed load, and to make a decision regarding the acceptance of each weighing result on observing the indication or releasing a print out. A non-automatic weighing process allows the operator to take an action (i.e. adjust the load, adjust the unit price, determine that the load is acceptable, etc.) which influences the weighing result in the case where the weighing result is not acceptable.

*Note 2:* In case of doubt as to whether an instrument is a non-automatic weighing instrument or an automatic weighing instrument, the definitions for automatic weighing instruments given in OIML Recommendations R 50:2014 [5], R 51:2006 [6], R 61:2017 [8], R 106:2011 [9], R 107:2007 [10], R 134:2006 [12] and R 150:2020 [13] have higher priority than the criteria of *Note 1* above.

*Note 3:* A non-automatic weighing instrument may be

- graduated or non-graduated; or
- self-indicating, semi-self-indicating or non-self-indicating.

*Note 4:* In this Recommendation a non-automatic weighing instrument is called an “instrument”.

*Note 5:* “Non-graduated” instruments are no longer covered by this Recommendation.

#### 3.1.2.1 graduated instrument

instrument allowing the direct reading of the complete or partial weighing result

#### 3.1.2.2 non-graduated instrument

instrument not fitted with a scale numbered in units of mass

#### 3.1.2.3 self-indicating instrument

instrument in which the position of equilibrium is obtained without the intervention of an operator

#### 3.1.2.4 semi-self-indicating instrument

instrument with a self-indicating weighing range, in which the operator intervenes to alter the limits of this range

#### 3.1.2.5 non-self-indicating instrument

instrument in which the position of equilibrium is obtained entirely by the operator

#### 3.1.2.6 electronic instrument

instrument equipped with electronic devices

#### 3.1.2.7 instrument with price scales

instrument that indicates the price to pay by means of price charts or scales related to a range of unit prices

#### 3.1.2.8 price-computing instrument

instrument that calculates the price to pay on the basis of the indicated weight value and the unit price

#### 3.1.2.9 price-labelling instrument

price-computing instrument that prints the weight value, unit price and price to pay for prepackages

#### 3.1.2.10 self-service instrument

**Commented [ID4]:** Made into a note since a definition shouldn't have more than one sentence.

instrument that is intended to be operated by the customer

#### **3.1.2.11 mobile instrument**

non-automatic weighing instrument mounted on or incorporated into a vehicle

*Note 1:* A vehicle-mounted instrument is a complete weighing instrument which is firmly mounted on a vehicle, and which is designed for that special purpose.

*Example:* Postal scale mounted on a vehicle (mobile post office).

*Note 2:* A vehicle-incorporated instrument uses parts of the vehicle for the weighing instrument.

*Examples:* Garbage weighers, patient lifters, pallet lifters, fork lifters, wheel chair weighers.

#### **3.1.2.12 portable instrument for weighing road vehicles**

non-automatic weighing instrument having a load receptor, in one or several parts, which determines the total mass of road vehicles, and which is designed to be moved to other locations

*Examples:* Portable weighbridge, group of associated non-automatic axle (or wheel) load weighers.

*Note:* This Recommendation covers only weighbridges and groups of associated non-automatic axle (or wheel) load weighers that determine simultaneously the total mass of a road vehicle with all axles (or wheels) being simultaneously supported by appropriate parts of a load receptor.

#### **3.1.2.13 grading instrument**

instrument which assigns a weighing result to a predetermined range of mass to determine a tariff or toll

*Examples:* Postal scales, garbage weighers.

### **3.1.3 indications of an instrument**

value of a quantity provided by a measuring instrument

*Note:* “Indication”, “indicate” or “indicating” includes both displaying and/or printing.

#### **3.1.3.1 primary indications**

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

#### **3.1.3.2 secondary indications**

indications, signals and symbols that are not primary indications

### **3.2 Construction of an instrument**

In this Recommendation the term “device” is used for any means by which a specific function is performed, 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 an instrument.

#### **3.2.1 Main devices**

##### **3.2.1.1 load receptor**

part of the instrument intended to receive the load

##### **3.2.1.2 load-transmitting device**

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

##### **3.2.1.3 load-measuring device**

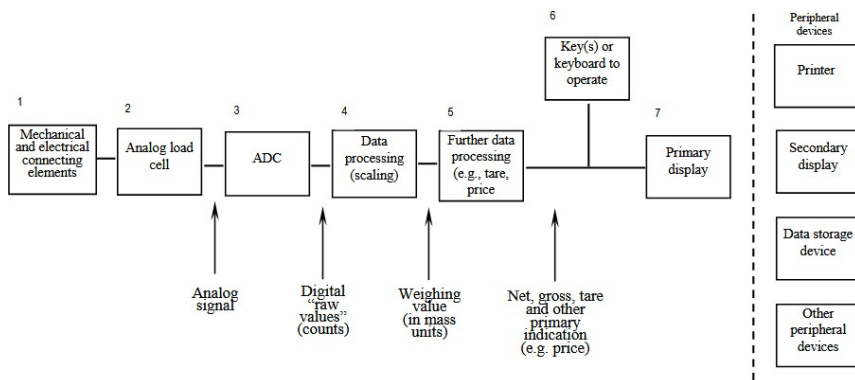
part of the instrument for measuring the mass of the load by means of an equilibrium device for balancing the force coming from the load transmitting device, and an indicating or printing device

### 3.2.2 module

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

*Not 1e:* Typical modules of a weighing instrument are: digital or analogue load cell, indicator, analogue or digital data processing device, weighing module, terminal, primary display.

*Note 2:* Independent OIML certificates according to R 76 can be issued for the modules mentioned in 3.2.2.2-3.2.2.7.



**Figure 1 - Definition of typical modules according to 3.2.2 and 5.9.2 (other combinations are possible)**

**Commented [ID5]:** Needs new figure.

Analogue load cell	(3.2.2.1)	2
Digital load cell	(3.2.2.1)	2 + 3 + (4)*
Indicator	(3.2.2.2)	(3) + 4 + (5) + (6) + 7
Analogue data processing device	(3.2.2.3)	3 + 4 + (5) + (6)
Digital data processing device	(3.2.2.4)	(4) + 5 + (6)
Terminal	(3.2.2.5)	(5) + 6 + 7
Primary display	(3.2.2.6)	7
Weighing module	(3.2.2.7)	1 + 2 + 3 + 4 + (5) + (6)

\* Numbers in brackets indicate options

#### 3.2.2.1 load cell

measuring transducer that will produce an output in response to an applied load. This output may be converted by another device into measurement units such as mass

[From OIML R 60: 2017, 3.1.3][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).

#### 3.2.2.2 indicator

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

#### 3.2.2.3 analogue data processing device

electronic device of an instrument that performs the analogue-to-digital conversion of the output signal of the load cell, further processes the data, and supplies the weighing result in a digital format via a digital interface without displaying it. It may optionally have one or more keys (or mouse, touchscreen, etc.) to operate the instrument

#### 3.2.2.4 digital data processing device

electronic device of an instrument that further processes the data, and supplies the weighing result in a digital format via a digital interface without displaying it. It may optionally have one or more keys (or mouse, touchscreen, etc.) to operate the instrument

#### 3.2.2.5 terminal

digital device that has one or more keys (or mouse, touch-screen, etc.) to operate the instrument, and a display to provide the weighing results transmitted via the digital interface of a weighing module or an analogue data processing device

#### 3.2.2.6 Digital display

A digital display can be realized as a primary display or as a secondary display.

*Note:* The terms “primary display” and “secondary display” should not be confused with the terms “primary indication” and “secondary indication” (3.1.3.1 and 3.1.3.2).

##### 3.2.2.6.1 Primary display

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

##### 3.2.2.6.2 Secondary display

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

#### 3.2.2.7 weighing module

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

*Note:* The weighing module may optionally have devices for further processing (digital) data and operating the instrument.

### 3.2.3 Electronic parts

#### 3.2.3.1 electronic device

device employing electronic sub-assemblies and performing a specific function

*Note 1:* Electronic devices are usually manufactured as separate units and are capable of being tested independently.

*Note 2:* An electronic device, as defined above, may be a complete instrument (e.g. an instrument for direct sales to the public), a module (e.g. indicator, analogue data processing device, weighing module) or a peripheral device (e.g. printer, secondary display).

**Commented [ID6]:** This has been separated into two separate definitions, 3.2.2.6.1 and 3.2.2.6.2 to comply with how definitions should be written.

**3.2.3.2 electronic sub-assembly**

part of an electronic device, employing electronic components and having a recognizable function of its own

*Examples:* A/D converter, display.

**3.2.3.3 electronic component**

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

*Examples:* Electronic tube, transistor, integrated circuit.

**3.2.3.4 digital device**

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

*Examples:* Printer, primary or secondary display, keyboard, terminal, data storage device, personal computer.

**3.2.3.5 peripheral device**

additional device which repeats or further processes the weighing result and other primary indications.

*Examples:* Printer, secondary display, keyboard, terminal, data storage device, personal computer.

**3.2.3.6 protective interface**

interface (hardware and/or software) which only allows the introduction of such data into the data processing device of an instrument, module or electronic component, which cannot

- display data which are not clearly defined and which could be taken for a weighing result,
- falsify displayed, processed or stored weighing results or primary indications, or
- adjust the instrument or change any adjustment factor, except releasing an adjustment procedure with incorporated devices or, in the case of class I instruments with external adjustment weights as well

**3.2.4 displaying device (of a weighing instrument)**

device providing the weighing result in visual form

**3.2.4.1 displaying component**

component that displays the equilibrium and/or the result

*Note 1:* On an instrument with one position of equilibrium it displays only the equilibrium.

*Note 2:* On an instrument with several positions of equilibrium it displays both the equilibrium and the result.

**3.2.4.2 scale mark**

line or other mark on a displaying component corresponding to a specified value of mass

**3.2.5 Auxiliary indicating devices****3.2.5.1 rider**

detachable poise of small mass that may be placed and moved either on a graduated bar integral with the beam or on the beam itself

**3.2.5.2 device for interpolation of reading (vernier or nonius)**

device connected to the displaying component and sub-dividing the scale of an instrument, without special adjustment

### 3.2.5.3 complementary displaying device

adjustable device by means of which it is possible to estimate, in units of mass, the value corresponding to the distance between a scale mark and the displaying component

### 3.2.5.4 indicating device with a differentiated scale division

digital indicating device of which the last figure after the decimal sign is clearly differentiated from other figures

### 3.2.6 extended displaying device

device temporarily changing the actual scale interval,  $d$ , to a value less than the verification scale interval,  $e$ , following a manual command

### 3.2.7 Supplementary devices

#### 3.2.7.1 levelling device

device for setting an instrument to its reference (horizontal) position

#### 3.2.7.2 zero-setting device

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

##### 3.2.7.2.1 non-automatic zero-setting device

device for setting the indication to zero by an operator

##### 3.2.7.2.2 semi-automatic zero-setting device

device for setting the indication to zero automatically following a manual command

##### 3.2.7.2.3 automatic zero-setting device

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

##### 3.2.7.2.4 initial zero-setting device

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

#### 3.2.7.3 zero-tracking device

device for maintaining the zero indication within certain limits automatically

#### 3.2.7.4 tare device

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

- without altering the weighing range for net loads (additive tare device), or
- reducing the weighing range for net loads (subtractive tare device).

*Note:* It may function as

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

##### 3.2.7.4.1 tare-balancing device

tare device without indication of the tare value when the instrument is loaded



**3.2.7.4.2 tare-weighing device**

tare device that stores the tare value and that is capable of displaying or printing it whether or not the instrument is loaded

**3.2.7.5 preset tare device**

device for subtracting a preset tare value from a gross or net weight value and indicating the result of the calculation

*Note:* The weighing range for net loads is reduced accordingly.

**3.2.7.6 locking device**

device for immobilizing all or part of the mechanism of an instrument

**3.2.7.7 auxiliary verification device**

device permitting separate verification of one or more main devices of an instrument

**3.2.7.8 selection device for load receptors and load-measuring devices**

device for attaching one or more load receptors to one or more load-measuring devices, whatever intermediate load-transmitting devices are used

**3.2.8 Software****3.2.8.1 legally relevant software**

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

*Examples:* Final results of the measurement, i.e. gross, net and tare / preset tare value (including the decimal sign and the unit), identification of the weighing range and the load receptor (if several load receptors have been used), software identification.

**3.2.8.2 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

**3.2.8.3 type-specific parameter**

legally relevant parameter with a value that depends on the type of instrument only

*Note:* Type-specific parameters are part of the legally relevant software. They are fixed at type approval of the instrument.

*Examples:* Parameters used for mass calculation, stability analysis or price calculation and rounding, software identification.

**3.2.8.4 device-specific parameter**

legally relevant parameter with a value that depends on the individual instrument

*Note 1:* Device-specific parameters comprise calibration parameters (e.g. span adjustment or other adjustments or corrections) and configuration parameters (e.g. maximum capacity, minimum capacity, units of measurement, etc.).

*Note 2:* They are adjustable or selectable only in a special operational mode of the instrument.

*Note 3:* Device-specific parameters may be classified as those that should be secured (unalterable) and those that may be accessed (settable parameters) by an authorised person.

### **3.2.8.5 long-term storage of measurement data**

storage used for keeping measurement data ready after completion of the measurement for later legally relevant purposes (e.g. conclusion of a trading transaction at a later date, when the customer is not present for the determination of the amount, or for special applications identified and legislated by the state)

### **3.2.8.6 software identification**

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

### **3.2.8.7 software separation**

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

*Note:* If no software separation exists, the whole software is to be considered as legally relevant

### **3.2.8.8 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

## **3.3 metrological characteristics of an instrument**

### **3.3.1 Weighing capacity**

#### **3.3.1.1 maximum capacity (Max)**

maximum weighing capacity, not taking into account the additive tare capacity

#### **3.3.1.2 minimum capacity (Min)**

value of the load below which the weighing results may be subject to an excessive relative error

#### **3.3.1.3 self-indication capacity**

weighing capacity within which equilibrium is obtained without the intervention of an operator

#### **3.3.1.4 weighing range**

range between the minimum and maximum capacities

#### **3.3.1.5 extension interval of self-indication**

value by which it is possible to extend the range of self-indication within the weighing range

#### **3.3.1.6 maximum tare effect ( $T = + \dots$ , $T = - \dots$ )**

maximum capacity of the additive tare device or the subtractive tare device

#### **3.3.1.7 maximum safe load (Lim)**

maximum static load that can be carried by the instrument without permanently altering its metrological qualities

### **3.3.2 Scale divisions**

#### **3.3.2.1 scale spacing (instrument with analogue indication)**

distance between any two consecutive scale marks

**3.3.2.2 actual scale interval,  $d$** 

value, expressed in units of mass of

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

**3.3.2.3 verification scale interval,  $e$** 

value, expressed in units of mass, used for the classification and verification of an instrument

**3.3.2.4 scale interval used for numbering**

value of the difference between two consecutive numbered scale marks

**3.3.2.5 number of verification scale intervals,  $n$** 

quotient of the maximum capacity and the verification scale interval:

$$n = \text{Max} / e$$

**3.3.2.6 multi-interval instrument**

instrument having one weighing range which is divided into partial weighing ranges each with different scale intervals, with the partial weighing range determined automatically according to the load applied, both on increasing and decreasing loads

**3.3.2.7 multiple range instrument**

instrument having two or more weighing ranges with different maximum capacities and different scale intervals for the same load receptor, each range extending from zero to its maximum capacity

**3.3.3 reduction ratio of a load transmitting device,  $R$** 

quotient of the forces acting on the load measuring device and on the load receptor:

$$R = F_M / F_L$$

where:  $F_M$  = force acting on the load measuring device,

$F_L$  = force acting on the load receptor

**3.3.4 type**

definitive model of a weighing instrument or module (including a family of instruments or modules) of which all of the elements affecting its metrological properties are suitably defined

**3.3.5 family**

identifiable group of weighing instruments or modules belonging to the same manufactured type that have the same design features and metrological principles for measurement (for example the same type of indicator, the same type of design of load cell and load transmitting device) but which may differ in some metrological and technical performance characteristics (e.g. Max, Min,  $e$ ,  $d$ , accuracy class, etc.)

[adapted from OIML B 3: 2011, 3.3] [3]

*Note:* The concept of a “family” primarily aims to reduce the testing required for OIML type evaluation. It does not preclude the possibility of listing more than one family in one certificate.

**Commented [ID7]:** Reworded to comply with form of a definition.

### 3.4 Metrological properties of an instrument

#### 3.4.1 sensitivity

quotient of the change,  $\Delta l$ , of the observed variable,  $l$ , and the corresponding change,  $\Delta m$ , of a given value of the measured mass,  $m$

#### 3.4.2 discrimination

ability of an instrument to react to small variations of load

#### 3.4.3 discrimination threshold

value, for a given load, of the smallest additional load that, when gently deposited on or removed from the load receptor, causes a perceptible change in the indication

**Commented [ID8]:** Separated from definition of “discrimination” which defined two things.

#### 3.4.4 repeatability

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

#### 3.4.5 durability

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

#### 3.4.6 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 of this Recommendation

#### 3.4.7 final weight value

weight value that is achieved when the instrument is completely at rest and balanced, with no disturbances affecting the indication

### 3.5 Indications and errors

#### 3.5.1 Methods of indication

##### 3.5.1.1 balancing by weights

value of metrologically controlled weights that balances the load (taking into account the reduction ratio of the load)

##### 3.5.1.2 analogue indication

indication enabling the evaluation of the equilibrium position to a fraction of the scale interval

##### 3.5.1.3 digital indication

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

#### 3.5.2 Weighing results

*Note:* The definitions in 3.5.2.1-3.5.2.3 apply only when the indication has been zeroed before the load has been applied to the instrument.

##### 3.5.2.1 gross value, G or B

indication of the weight value of a load on an instrument, with no tare or preset tare device in operation

**3.5.2.2 net value, N**

indication of the weight value of a load placed on an instrument after operation of a tare device

**3.5.2.3 tare value, T**

weight value of a load, determined by a tare weighing device

**3.5.3 Other weight values****3.5.3.1 preset tare value, PT**

numerical value, representing a weight, that is introduced into the instrument and is intended to be applied to other weighings without determining individual tares

**Note:** “Introduced” includes procedures such as: keying in, recalling from a data storage device, or inserting via an interface.

**Commented [ID9]:** New note as this isn't part of the definition.

**3.5.3.2 calculated net value**

value of the difference between a measured weight value (gross or net) and a preset tare value

**3.5.3.3 calculated weight value**

calculated sum or difference of more than one measured weight value and/or calculated net value

**3.5.4 Reading****3.5.4.1 reading by simple juxtaposition**

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

**3.5.4.2 overall inaccuracy of reading**

standard deviation of the same indication on an instrument with analogue indication, the reading of which is carried out under normal conditions of use by several observers

**Note:** It is customary to make at least ten readings of the result.

**Commented [ID10]:** Reworded to comply with form of a definition.

**Commented [ID11]:** New note as this is not part of the definition.

**3.5.4.3 rounding error of digital indication**

difference between the indication and the result the instrument would give with analogue indication

**3.5.4.4 minimum reading distance**

shortest distance that an observer is able freely to approach the displaying device to take a reading under normal conditions of use

**Note:** This approach is considered to be free for the observer if there is a clear space of at least 0.8 m in front of the displaying device (see Figure 2).

**Commented [ID12]:** New note as this is not part of the definition.

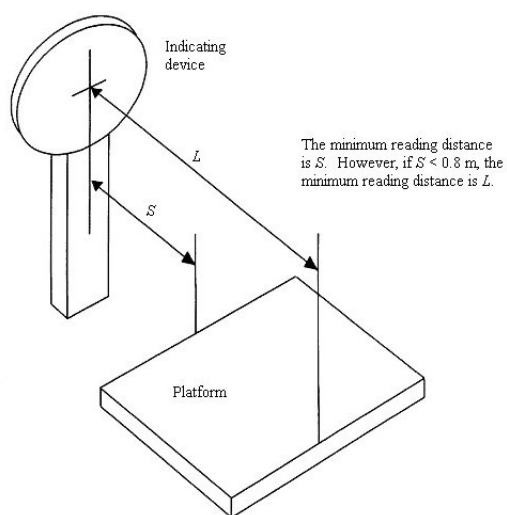


Figure 2 – Minimum reading distance

Commented [ID13]: New caption as this was missing.

### 3.5.5 Errors

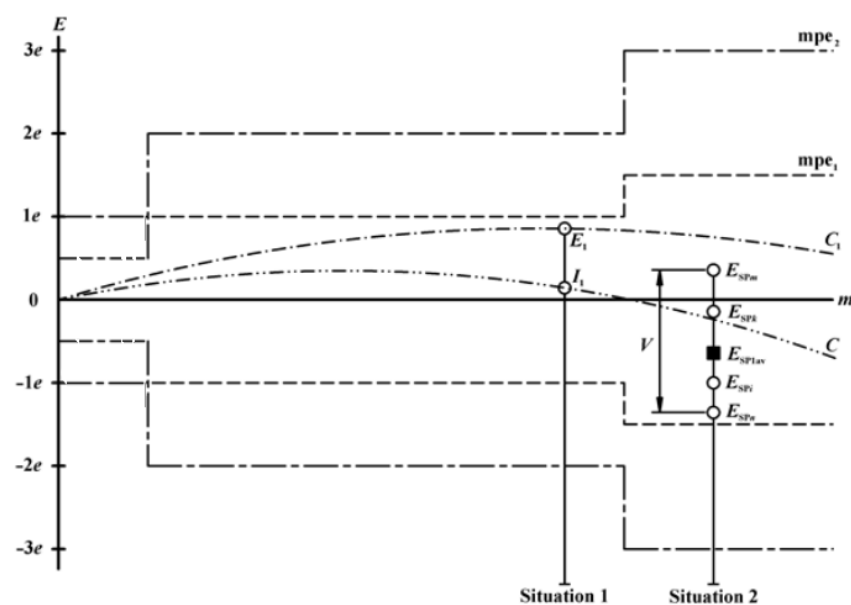


Figure 3 – Errors

Commented [ID14]: New caption as this was missing.

$m$	= mass to be measured
$E$	= error of indication (3.5.5.1)
$mpe_1$	= maximum permissible error on initial verification
$mpe_2$	= maximum permissible error in service
$C$	= characteristic under reference conditions
$C_1$	= characteristic due to influence factor or disturbance (For the purposes of this illustration it is supposed that the influence factor or the disturbance has an influence on the characteristic which is not erratic)
$E_{SP}$	= error of indication evaluated during span stability test
$I$	= intrinsic error (3.5.5.2)
$V$	= variation in the errors of indication during span stability test

*Situation 1:* shows the error  $E_1$  of an instrument due to an influence factor or a disturbance.  $I_1$  is the intrinsic error. The fault (3.5.5.5) due to the influence factor or disturbance applied equals  $E_1 - I_1$ .

*Situation 2:* shows the average value,  $E_{SP1av}$ , of the errors at the first measurement of the span stability test, some other errors ( $E_{SPi}$  and  $E_{SPk}$ ) and the extreme values of the errors  $E_{SPm}$  and  $E_{SPn}$ , all these errors being evaluated at different moments during the span stability test. The variation,  $V$ , in the errors of indication during the span stability test equals  $E_{SPm} - E_{SPn}$ .

#### 3.5.5.1 error (of indication)

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

[adapted from VIM:2012, 2.16] [1]

#### 3.5.5.2 intrinsic error

error of indication, determined under reference conditions

[VIML:2013, 0.06]

#### 3.5.5.3 initial intrinsic error

intrinsic error of an instrument as determined prior to the performance and span stability tests

#### 3.5.5.4 maximum permissible error, mpe

maximum difference, positive or negative, allowed by regulation between the indication of an instrument and the corresponding true value, as determined by reference standard masses or standard weights, with the instrument being at zero at no-load, in the reference position

#### 3.5.5.5 fault

difference between the error of indication and the intrinsic error of an instrument

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

#### 3.5.5.6 significant fault

fault greater than  $e$

*Note 1:* For a multi-interval instrument, the value of  $e$  is that appropriate to the partial weighing range.

*Note 2:* The following are not considered to be significant faults, even when they exceed  $e$ :

- faults arising from simultaneous and mutually independent causes in the instrument;
- faults implying the impossibility to perform any measurement;
- faults being so serious that they are bound to be noticed by all those interested in the result of measurement; or
- transitory faults, being momentary variations in the indication which cannot be interpreted, memorized or transmitted as a measuring result.

### **3.5.5.7 durability error**

difference between the intrinsic error over a period of use and the initial intrinsic error of an instrument

### **3.5.5.8 significant durability error**

durability error greater than  $e$

*Note 1:* A durability error can be due to mechanical wear and tear or due to drift and ageing of electronic parts. The concept of significant durability error applies only to electronic parts.

*Note 2:* For a multi-interval instrument, the value of  $e$  is that appropriate to the partial weighing range.

*Note 3:* Errors, occurring after a period of instrument use, are not considered to be significant durability errors, even when they exceed  $e$ , if they are clearly the result of the failure of a device/component, or of a disturbance and for which the indication

- cannot be interpreted, memorized, or transmitted as a measurement result,
- implies the impossibility to perform any measurement, or
- is so obviously wrong that it is bound to be noticed by all those interested in the result of measurement.

### **3.5.5.9 span stability**

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

## **3.6 Influences and reference conditions**

### **3.6.1 influence quantity**

quantity that is not the subject of the measurement but which influences the values of the measurand or the indication of the instrument

#### **3.6.1.1 influence factor**

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

#### **3.6.1.2 disturbance**

influence quantity having a value within the limits specified in this Recommendation, but outside the specified rated operating conditions of the instrument

### **3.6.2 rated operating conditions**

operating condition that must be fulfilled during measurement in order that a measuring instrument or measuring system perform as designed

[VIM:2012, 4.9] [1]



**3.6.3 reference conditions**

set of specified values of influence factors fixed to ensure valid inter-comparison of the results of measurements

**3.6.4 reference position**

position of the instrument at which its operation is adjusted

**3.7 performance test**

test to verify whether the equipment under test (EUT) is capable of performing its intended functions

### 3.8 Abbreviations and symbols

This Recommendation concerns metrological terms as well as technical and physical terms. Therefore ambiguity of abbreviations and symbols is not excluded. With the following explanations, however, any confusion should be avoided.

Abbreviation/symbol	Description	Clause(s)
$a$	temperature coefficient of cable material	C.3.3.2.4
$\rho$	specific resistance of cable material	C.3.3.2.4
A	load cell classification	F.2 Table 13, F.4
$A$	cross section of a single wire	C.3.3.2.4, F.1, F.4
AC	alternating current	5.8.3 etc.
A/D	analogue-to-digital	3.2.2
ADC	Analogue/digital-converter	3.2.2 Figure 1, Error! Reference source not found. Table 11
B	load cell classification	F.2 Table 13, F.4
B	gross weight value	3.5.2.1, 6.8.11
C	load cell classification	F.2 Table 13, F.4
C	mark for calculated weight value, when printed	6.8.11
C	rated output of a load cell	F.2, F.4
CH	additional load cell classification: cyclic temperature humidity tested	5.9.4.1, F.2, R 60: 4.6.5.2
CRC	cyclic redundancy check	5.5.3.3
$d$	(actual) scale interval	3.3.2.2, 3.2.6, 8.9.3
D	load cell classification	F.2 Table 13, F.4
DC	direct current	5.8.3 etc.
DL	dead load of load receptor	F.1, F.2.5, F.4
DR	dead load return	F.2, F.4
DSD	data storage device	5.5.3
$e$	verification scale interval	3.3.2.3, 5.1.2, 5.2, 4.2.2.1
$e_1, e_s, e_r$	verification scale interval, rules for indices	5.2, F.1, F.4
$E$	error of indication	3.5.5, Figure 3, A.4.4.3
$E_{in}$	intrinsic error	3.5.5, Figure 3
$E_{max}$	maximum capacity of the load cell	F.2, F.4
$E_{min}$	minimum dead load for the load cell	F.2, F.4
EMC	electromagnetic compatibility	B.3.7
EUT	equipment under test	3.7, 5.9.4, Annex B
G	gross weight value	3.5.2.1, 6.8.11
$i$	variable indices	5.3 etc.
$i, i_s$	scale spacing	3.3.2.1, 6.5.2, 8.2.2.2
$i_0$	minimum scale spacing	6.5.2, 8.9.3
$I$	indicated weight value	A.4.4.3 (Evaluation of errors), A.4.8.2

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**Commented [ID16]:** All highlighted cross-references in this table to be updated in next CD.

Abbreviation/symbol	Description	Clause(s)
I/O	input output	B.3.2
IZSR	initial zero setting range	F.1, F.4
$k$	variable exponent	5.4.2, 4.2.2.1
$l, L$	length of cable	C.3.3.2.4, F.1, F.4
$L$	reading distance	3.5.4.4, 6.5.2
L	load	A.4.4.3 (Evaluation of errors)
LC	load cell	Annex F
Lim	maximum safe load	9.1.2
$M$ or $m$	mass	5.5.1 etc.
Max	maximum capacity of the weighing instrument	3.3.1.1, F.1, F.4
Max <sub>1</sub> , Max <sub>i</sub> , Max <sub>r</sub>	maximum capacity of the weighing instrument, rules for indices	5.2, F.1, F.4
Min	minimum capacity of the weighing instrument	3.3.1.2
mpe	maximum permissible error	3.5.5, 3.5.5.4, 5.5 etc.
$n, n_i$	number of verification scale intervals	3.3.2.5, F.4
$n_{\max}$	maximum number of verification scale intervals	5.9.4.6 etc.
$n_{w1}$	maximum number of verification scale intervals of the weighing instrument	F.1, F.4
$n_{ind}$	maximum number of verification scale intervals for an indicator	F.3, F.4
$n_{LC}$	maximum number of load cell verification intervals	F.2, F.4
N, NET, Net, net	net value	3.5.2.2, 6.8.5, 6.8.11
$N$	number of load cells	F.1, F.4
NH	additional load cell classification: not humidity tested	5.9.2.4, F.2, R 60: 4.6.5.1
NUD	correction for non uniform distributed load	F.1, F.4
$p, p_i$	apportioning factor of mpe	5.9.2.1
$p_{ind}, p_{LC}, p_{con}$	fraction of mpe for indicator, load cell and conducting elements	5.9.2.1, F.4
$P$	indication prior to rounding	A.4.4.3 (Evaluation of errors)
$P$	price to pay	7.2.2
PC	personal computer	8.2.1.1, Table 11
PLU	price look up (unit, storage)	7.1.3.4
PT	preset tare	3.2.7.5, 6.9
Q	correction factor	F.1, F.4
$R$	reduction ratio of a load transmitting device	3.3.3
$R_{cable}$	resistance of a single wire	C.3.3.2.4
$R_L, R_{Lmin}, R_{Lmax}$	load resistance for an indicator	F.3, F.4
$R_{LC}$	input resistance of a load cell	F.2, F.4
SH	additional load cell classification: static temperature humidity tested	5.9.2.4, F.2, R 60: 4.6.5.3
T	tare value	3.5.2.3, 6.8.5, 6.8.11
T <sub>+</sub>	additive tare	9.1.2 etc.

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**Commented [ID17]:** This is now used in R 76-2, but can't have the same symbol as price to pay!

**Commented [ID18]:** This can't have the same symbol as indication prior to rounding!

Abbreviation/symbol	Description	Clause(s)
T <sub>-</sub>	subtractive tare	9.1.2 etc.
T <sub>min</sub> , T <sub>max</sub>	lower limit of temperature range, upper limit of temperature range	C.3.3.2.4
u <sub>m</sub>	unit of measurement	2.1, 6.14.1
ΔU <sub>min</sub>	minimum input voltage per verification scale interval	C.2.1.1, F.3, F.4
U	unit price	6.14.2
U	nominal voltage of power supply	5.8.3, A.5.4
U <sub>min</sub> , U <sub>max</sub>	voltage range of power supply	5.8.3, A.5.4
U <sub>exc</sub>	load cell excitation voltage	F.1, F.4
U <sub>min</sub>	minimum input voltage for indicator	F.3, F.4
U <sub>MRmin</sub>	measuring range minimum voltage for indicator	F.3
U <sub>MRmax</sub>	measuring range maximum voltage for indicator	F.3
V <sub>min</sub>	minimum load cell verification interval	F.2, F.4
V	variation in the error	Figure 3
W	weight	7.2.2
W1, W2	weighing instrument 1, weighing instrument 2	9.1.4
W1	weighing instrument	F.1
WR	weighing range	F
Y	ratio to minimum load cell verification interval: $Y = (E_{\max} - E_{\min}) / V_{\min}$	F.2, F.4
Z	ratio to minimum load cell dead load output return: $Z = (E_{\max} - E_{\min}) / (2 \times DR)$	F.2, F.4

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## 4 Description of the category of instruments

### 4.1 General

A non-automatic weighing instrument, as defined in 3.1.2, may be differentiated into groups of design, e.g.:

- a combination of a mechanical transmission system of several levers and joints and an electronic load measuring device (e.g. load cell plus A/D converter),
- a completely electronic design, without moving mechanical components (e.g. instruments with single-point strain gauge load cells, or
- a completely mechanical design based on a simple beam, or a mechanical transmission system of several levers and joints (e.g. knives and pans).

In this Recommendation, completely mechanical designed instruments are described in clause 8.

The requirements apply to all instruments, irrespective of their principles of measurement. Instruments are classified according to

- the verification scale interval, representing absolute accuracy; and
- the number of verification scale intervals, representing relative accuracy.

The maximum permissible errors are in the order of magnitude of the verification scale interval. They apply to gross loads, and when a tare device is in operation, they apply to the net loads. The maximum permissible errors do not apply to calculated net values when a preset tare device is in operation.

A minimum capacity (Min) is specified to indicate that use of the instrument below this value is likely to give rise to considerable relative errors.

General technical requirements apply to all types of instruments, whether mechanical or electronic, and are supplemented or modified with additional requirements for instruments used for specific applications or designed for a special technology. They are intended to specify the performance, not the design of an instrument, so that technical progress is not impeded.

In particular, functions of electronic instruments not covered by this Recommendation should be allowed, provided that they do not interfere with the metrological requirements, and if suitability for use and appropriate metrological control are ensured.

Testing procedures are provided to establish conformity of instruments with the requirements of this Recommendation. They should be applied, and the Test report format (R 76-3) and Type approval report format (R 76-4) should be used, to facilitate exchange and acceptance of test results by metrological authorities.

#### **4.2 Specific use cases**

Due to extended metrological or functional needs, a non-automatic weighing instrument may be designed for specific use, e.g.

- as a multi-range instrument,
- as a multi- interval instrument,
- as a portable / mobile / vehicle-mounted or vehicle-integrated instrument, or
- as an instrument for direct sales to the public.

#### **4.3 Modular approach**

Non-automatic weighing instruments may be of modular design. The typical examples are instruments equipped with electronics or completely electronic instruments. The modules load cell / load receptor, indicator / analogue data processing device and other modules as defined in clause 3.2.2 may be tested separately, while a portion of the maximum permissible error is assigned to the module.

The requirements of this Recommendation apply to all devices performing the relevant functions, whether they are incorporated in an instrument or manufactured as separate units.

However, devices that are not incorporated in the instrument may, by national legislation, be exempted from the requirements for special applications.

#### **4.4 Units of measurement**

The units of mass to be used on an instrument are

- the kilogram, kg,
- the milligram, mg,
- the gram, g, and
- the tonne, t.

For special applications, e.g. trade with precious stones, the metric carat (1 carat = 0.2 g) may be used as the unit of measurement. The symbol for the carat is ct.

## 5 Metrological requirements

### 5.1 Principles of classification

#### 5.1.1 Accuracy classes

The accuracy classes for instruments and their symbols\* are given in Table 1. Please note that the class denominations used in this Recommendation do not include the oval around the number for improved clarity of the Recommendation's text.

**Table 1 – Accuracy class symbols**

Name	Symbol marked on instrument*	Denomination used in this Recommendation
Special accuracy	I	I
High accuracy	II	II
Medium accuracy	III	III
Ordinary accuracy	III	III

\* Ovals of any shape, or two horizontal lines joined by two half-circles are permitted. A circle shall not be used because, in conformity with OIML R 34:1979 *Accuracy classes of measuring instruments* [4], it is used for the designation of accuracy classes of measuring instruments of which the maximum permissible errors are expressed by a constant relative error in %.

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#### 5.1.2 Verification scale interval

The verification scale interval for different types of instruments is given in Table 2.

**Table 2 – Verification scale intervals according to instrument type**

Type of instrument	Verification scale interval
without auxiliary indicating device	$e = d$
with auxiliary indicating device	$e$ is chosen by the manufacturer according to the requirements in 5.2 and 5.4.2

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### 5.2 Classification of instruments

The verification scale interval, number of verification scale intervals and the minimum capacity, in relation to the accuracy class of an instrument, are given in Table 3.

**Table 3 – Values of  $e$ ,  $n$ , and Min according to accuracy class**

Accuracy class	Verification scale interval, $e$	Number of verification scale intervals, $n = \text{Max}/e$		Minimum capacity, Min (Lower limit)
		minimum	maximum	
Special (I)	$0.001 \text{ g} \leq e^*$	50 000**	–	100 $e$
High (II)	$0.001 \text{ g} \leq e \leq 0.05 \text{ g}$	100	100 000	20 $e$
	$0.1 \text{ g} \leq e$	5 000	100 000	50 $e$
Medium (III)	$0.1 \text{ g} \leq e \leq 2 \text{ g}$	100	10 000	20 $e$
	$5 \text{ g} \leq e$	500	10 000	20 $e$
Ordinary (III)	$5 \text{ g} \leq e$	100	1 000	10 $e$

\* It is not feasible to test and verify an instrument to  $e < 1 \text{ mg}$ .

\*\* See exception in 5.4.4.

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The minimum capacity is reduced to  $5e$  for grading instruments, i.e. instruments that determine a transport tariff or toll (e.g. postal scales and instruments weighing waste material).

On multiple range instruments the verification scale intervals are  $e_1, e_2, \dots, e_r$  with  $e_1 < e_2 < \dots < e_r$ . Similar subscripts are also used with the terms Min,  $n$  and Max.

On multiple range instruments, each range is treated as if it were an instrument with one range.

For special applications that are clearly marked on the instrument, an instrument may have weighing ranges in classes I and II, or in classes II and III. The instrument as a whole shall then comply with the more severe requirements of 5.8 applicable to either of the two classes.

### 5.3 Additional requirements for multi-interval instruments

#### 5.3.1 Partial weighing range

Each partial range (index  $i = 1, 2, \dots$ ) is defined by

- its verification scale interval,  $e_i$ ,  $e_{r+1} > e_i$ ,
- its maximum capacity,  $\text{Max}_i$ , and
- its minimum capacity,  $\text{Min}_i = \text{Max}_i - 1$  (for  $i = 1$ , the minimum capacity is  $\text{Min}_1 = \text{Min}$ ). The number of verification scale intervals,  $n_i$ , for each partial range is equal to  $\text{Max}_i / e_i$ .

#### 5.3.2 Accuracy class

$e_i$  and  $n_i$  in each partial weighing range, and  $\text{Min}_1$  shall comply with the requirements given in Table 3 according to the accuracy class of the instrument.

#### 5.3.3 Maximum capacity of partial weighing ranges

With the exception of the last partial weighing range, the requirements in Table 4 shall be complied with, according to the accuracy class of the instrument.

**Table 4 – Maximum capacity of partial weighing ranges according to accuracy class**

Class	I	II	III	III
$\text{Max}_i / e_{i+1}$	$\geq 50\,000$	$\geq 5\,000$	$\geq 500$	$\geq 50$

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Example for a multi-interval instrument:

Maximum capacity,  $\text{Max} = 2\text{ kg} / 5\text{ kg} / 15\text{ kg}$ , class III, Verification scale interval,  $e = 1\text{ g} / 2\text{ g} / 10\text{ g}$

This instrument has one Max and one weighing range from  $\text{Min} = 20\text{ g}$  to  $\text{Max} = 15\text{ kg}$ . The partial weighing ranges are:

$\text{Min} = 20\text{ g}$ ,  $\text{Max}_1 = 2\text{ kg}$ ,  $e_1 = 1\text{ g}$ ,  $n_1 = 2\,000$

$\text{Min}_2 = 2\text{ kg}$ ,  $\text{Max}_2 = 5\text{ kg}$ ,  $e_2 = 2\text{ g}$ ,  $n_2 = 2\,500$

$\text{Min}_3 = 5\text{ kg}$ ,  $\text{Max}_3 = \text{Max} = 15\text{ kg}$ ,  $e_3 = 10\text{ g}$ ,  $n_3 = 1\,500$

The maximum permissible errors on initial verification (mpe) (see 5.5.1) are:

for $m = 0\text{ g}$ to $500\text{ g}$	$\text{mpe} = \pm 0.5 e_1$	$= \pm 0.5\text{ g}$
for $m > 500\text{ g}$ to $2\,000\text{ g}$	$\text{mpe} = \pm 1 e_1$	$= \pm 1\text{ g}$
for $m > 2\,000\text{ g}$ to $4\,000\text{ g}$	$\text{mpe} = \pm 1 e_2$	$= \pm 2\text{ g}$
for $m > 4\,000\text{ g}$ to $5\,000\text{ g}$	$\text{mpe} = \pm 1.5 e_2$	$= \pm 3\text{ g}$
for $m > 5\,000\text{ g}$ to $15\,000\text{ g}$	$\text{mpe} = \pm 1 e_3$	$= \pm 10\text{ g}$

Whenever the variation of the indication due to certain influence factors is limited to a fraction or multiple of  $e$ , this means, in a multi-interval instrument, that  $e$  is to be taken according to the load applied; particularly at or near zero, load  $e = e_1$ .

**5.3.4 Instrument with a tare device**

Requirements concerning the ranges of a multi-interval instrument apply to the net load, for every possible value of the tare.

**5.4 Auxiliary indicating devices**

**5.4.1 Type and application**

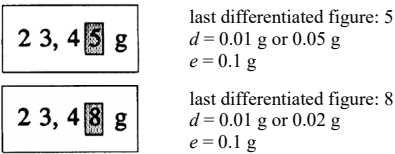
Only instruments of classes I and II may be fitted with an auxiliary indicating device, which shall be

- a device with a rider,
- a device for interpolation of reading,
- a complementary displaying device, or
- an indicating device with a differentiated scale division (see Figure 4). These devices are permitted only to the right of the decimal sign.

A multi-interval instrument shall not be fitted with an auxiliary indicating device.

*Note:* Extended displaying devices (see 3.2.6 and 6.6.3) are not regarded as auxiliary indicating devices.

**Figure 4 – Examples of indicating devices each with a differentiated scale division**



**5.4.2 Verification scale interval**

The verification scale interval,  $e$ , is determined by the expression:

$$d < e \leq 10 d \text{ (see Tables 5a and 5b)}$$
$$e = 10^k \text{ kg}$$

Where  $k$  is a positive or negative whole number, or zero.

For a self- or semi-self-indicating instrument, see 6.4.2.1.

**Table 5a – Example values of  $e$ , calculated following this rule**

$d =$	0.1 g	0.2g	0.5 g
$e =$	1 g	1 g	1 g
$e =$	10 $d$	5 $d$	2 $d$

This requirement does not apply to an instrument of class I with  $d < 1 \text{ mg}$ , where  $e = 1 \text{ mg}$ , as shown in Table 5b.



**Table 5b – Example values of  $e$  where  $d < 1$  mg**

$d =$	0.01 mg	0.02 mg	0.05 mg	<0.01 mg
$e =$	1 mg	1 mg	1 mg	1 mg
$e =$	100 $d$	50 $d$	20 $d$	>100 $d$

**5.4.3 Minimum capacity**

The minimum capacity of the instrument is determined in conformity with the requirements in Table 3. However, in the last column of this Table, the verification scale interval,  $e$ , is replaced by the actual scale interval,  $d$ .

**5.4.4 Minimum number of verification scale intervals**

For an instrument of class I with  $d < 0.1$  mg,  $n$  may be less than 50 000.

**5.5 Maximum permissible errors****5.5.1 Values of maximum permissible errors on initial verification and type approval**

The maximum permissible errors for increasing or decreasing loads are given in Table 6.

**Table 6 – Maximum permissible errors according to class and load**

Maximum permissible errors on initial verification	For loads, $m$ , expressed in verification scale intervals, $e$			
	Class I	Class II	Class III	Class IIII
$\pm 0.5 e$	$0 \leq m \leq 50\,000$	$0 \leq m \leq 5\,000$	$0 \leq m \leq 500$	$0 \leq m \leq 50$
$\pm 1.0 e$	$50\,000 < m \leq 200\,000$	$5\,000 < m \leq 20\,000$	$500 < m \leq 2\,000$	$50 < m \leq 200$
$\pm 1.5 e$	$200\,000 < m$	$20\,000 < m \leq 100\,000$	$2\,000 < m \leq 10\,000$	$200 < m \leq 1\,000$

*Note 1:* The absolute value of the maximum permissible error is  $0.5 e$ ,  $1.0 e$  or  $1.5 e$ , i.e. it is the value of the maximum permissible error without the positive or negative sign.

*Note 2:* For multi-interval instruments, refer to 5.3 (including the example).

**5.5.2 Values of maximum permissible errors in service**

The maximum permissible errors in service shall be twice the maximum permissible errors on initial verification (see 10.4.2).

**5.5.3 Basic rules concerning the determination of errors**

Regardless of what variation of results is permitted, the error of any single weighing result shall by itself not exceed the maximum permissible error for the given load.

**5.5.3.1 Influence factors (R 76-2, 1.4.1.1)**

Errors shall be determined under normal test conditions. When the effect of one factor is being evaluated, all other factors are to be kept relatively constant, at a value close to normal.

**5.5.3.2 Elimination of rounding error**

The rounding error included in any digital indication shall be eliminated if the actual scale interval is greater than  $0.2 e$ .

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### 5.5.3.3 Maximum permissible errors for net values (R 76-2, 1.4.6.1)

The maximum permissible errors apply to the net value for every possible tare load, except preset tare values.

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### 5.5.3.4 Tare weighing device (R 76-2, 1.4.6.3)

The maximum permissible errors for a tare weighing device are the same, for any tare value, as those of the instrument, for the same value of load.

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### 5.5.4 Repeatability (R 76-2, 1.4.10)

The difference between the results of several weighings of the same load shall not be greater than the absolute value of the maximum permissible error of the instrument for that load.

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### 5.5.5 Eccentric loading (R 76-2, 1.4.7)

The indications for different positions of a load shall meet the maximum permissible errors, when the instrument is tested according to 5.5.5.1-5.5.5.4.

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*Note:* If an instrument is designed in such a way that loads may be applied in different manners, it may be appropriate to apply more than one of the following tests.

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Unless otherwise specified hereafter, a load corresponding to 1/3 of the sum of the maximum capacity and the corresponding maximum additive tare effect shall be applied.

On an instrument with a load receptor having  $n$  points of support, with  $n > 4$ , the fraction  $1/(n - 1)$  of the sum of the maximum capacity and the maximum additive tare effect shall be applied to each point of support.

On an instrument with a load receptor subject to minimal off-centre loading (e.g. tank, hopper, etc.) a test load corresponding to 1/10 of the sum of the maximum capacity and the maximum additive tare effect shall be applied to each point of support.

On an instrument used for weighing rolling loads (e.g. vehicle scale, rail suspension instrument) a test load corresponding to the usual rolling load, the heaviest and the most concentrated one which may be weighed, but not exceeding 0.8 times the sum of the maximum capacity and the maximum additive tare effect, shall be applied at different points on the load receptor.

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### 5.5.6 Multiple indicating devices (R 76-2, 1.4.5-1.4.6.3)

For a given load the difference between the indications of multiple indicating devices including tare weighing devices, shall be not greater than the absolute value of the maximum permissible error, but shall be zero between digital displaying and printing devices.

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### 5.5.7 Different positions of equilibrium

The difference between two results obtained for the same load when the method of balancing the load is changed (in the case of an instrument fitted with a device for extending the self-indication capacity) in two consecutive tests, shall not exceed the absolute value of the maximum permissible error for the applied load.

## 5.6 Test standards

### 5.6.1 Weights

In principle, the standard weights or standard masses used for the type examination or verification of an instrument shall meet the metrological requirements of OIML R 111:2004 *Weights of classes E<sub>1</sub>, E<sub>2</sub>, F<sub>1</sub>, F<sub>2</sub>, M<sub>1</sub>, M<sub>1-2</sub>, M<sub>2</sub>, M<sub>2-3</sub> and M<sub>3</sub>* [11]. They shall not have an error greater than 1/3 of the maximum permissible error of the instrument for the applied load. If they belong to class E<sub>2</sub> or better, their uncertainty (rather than their error) is allowed to be not greater than 1/3 of the maximum permissible error of the instrument for the applied load, provided that the actual conventional mass and the estimated long-term stability is taken into account.

### 5.6.2 Auxiliary verification device

When an instrument is fitted with an auxiliary verification device, or when it is verified with a separate auxiliary device, the maximum permissible errors of this device shall be  $1/3$  of the maximum permissible errors for the applied load. If weights are used, the effect of their errors shall not exceed  $1/5$  of the maximum permissible errors of the instrument to be verified for the same load.

### 5.6.3 Substitution of standard weights at verification

When testing instruments at the place of use (application), instead of standard weights any other constant load may be used, provided that standard weights of at least  $1/2$  Max are used.

If the repeatability error is not greater than  $0.3 e$ , the portion of standard weights may be reduced to  $1/3$  Max.

If the repeatability error is not greater than  $0.2 e$ , this portion may be reduced to  $1/5$  Max.

The repeatability error has to be determined with a load (weights or any other load) of about the value where the substitution is made, by placing it three times on the load receptor.

## 5.7 Discrimination (self- or semi-self-indicating instruments)

### 5.7.1 Analogue indication

An extra load equivalent to the absolute value of the maximum permissible error for the applied load, but not less than 1 mg, when gently placed on or withdrawn from the instrument at equilibrium shall cause a permanent displacement of the indicating element corresponding to not less than 0.7 times the extra load.

### 5.7.2 Digital indication

An additional load equal to 1.4 times the actual scale interval, when gently placed on or withdrawn from the instrument at equilibrium shall change the indication unambiguously. This applies only to instruments with  $d \geq 5$  mg.

## 5.8 Variations due to influence quantities and time

An instrument shall comply, unless otherwise specified and as far as applicable, with 5.5 and 5.7 under the conditions of 5.8. Tests shall not be combined unless otherwise specified.

### 5.8.1 Tilting

#### 5.8.1.1 Instruments liable to be tilted

For an instrument of class II, III or IIII liable to be tilted, the influence of tilting shall be determined under the effect of a lengthwise tilting and a transverse tilting equal to the limiting value of tilting as defined in a) to d) below.

The absolute value of the difference between the indication of the instrument in its reference position (not tilted) and the indication in the tilted position (= limiting value of tilting in any direction) shall not exceed

- at no load, two times the verification scale interval (the instrument having first been adjusted to zero at no load in its reference position) except instruments of class II, and
  - at self indication capacity and at maximum capacity, the maximum permissible error (the instrument having been adjusted to zero at no load both in the reference and in the tilted position).
- a) If the instrument is fitted with a levelling device and a level indicator, 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.

*Note:* If, in exceptional circumstances, technical reasons forbid the level indicator to be fixed in a visible place this can be accepted only if the level indicator is easily accessible to the user without tools (e.g. below the removable load receptor), and if there is a legible notice provided on the instrument in a clearly visible place that points the user to the level indicator.

- 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. lamp, error signal) and shall inhibit the printout and data transmission if the limiting value of tilting has been exceeded (see also 7.6). The automatic tilt sensor may also compensate the effect of tilting.
- c) If neither a) nor b) applies, the limiting value of tilting is 50/1000 in any direction.
- d) 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, but the manufacturer may define a limiting value of tilting larger than 50/1000 (see also 7.6).

#### 5.8.1.2 Other instruments

The following instruments are regarded as being not liable to be tilted so that the tilting requirements under 5.8.1.1 do not apply:

- Class I instruments must be fitted with a levelling device and a level indicator but these need not be tested, because these instruments require special environmental and installation conditions and skilled operating staff;
- Instruments installed in a fixed position;
- Freely suspended instruments, for example crane or hanging instruments.

### 5.8.2 Temperature

#### 5.8.2.1 modules temperature limits

If no particular working temperature is stated in the descriptive markings of an instrument, this instrument shall maintain its metrological properties within the following temperature limits:

$$-10\text{ °C} / +40\text{ °C}$$

#### 5.8.2.2 Special temperature limits

An instrument for which particular limits of working temperature are stated in the descriptive markings shall comply with the metrological requirements within those limits.

The limits may be chosen according to the application of the instrument. The ranges within those limits shall be at least equal to:

- 5 °C for instruments of class I;
- 15 °C for instruments of class II; and
- 30 °C for instruments of classes III and IIII.

#### 5.8.2.3 Temperature effect on no-load indication

The indication at zero or near zero shall not vary by more than one verification scale interval for a difference in ambient temperature of 1 °C for instruments of class I and 5 °C for other classes.

For multi-interval instruments and for multiple range instruments this applies to the smallest verification scale interval of the instrument.

### 5.8.3 Power supply

An instrument shall comply with the metrological requirements, if the voltage of the power supply differs from the nominal voltage,  $U_{\text{nom}}$ , or from the voltage range,  $U_{\text{min}}$ ,  $U_{\text{max}}$ , of the instrument, at

- Public mains power (AC):
  - lower limit =  $0.85 U_{\text{nom}}$  or  $0.85 U_{\text{min}}$
  - upper limit =  $1.10 U_{\text{nom}}$  or  $1.10 U_{\text{max}}$
- External or plug-in power supply device (AC or DC), including rechargeable battery power supply if (re)charge of batteries during the operation of the instrument is possible:
  - lower limit = minimum operating voltage upper limit =  $1.20 U_{\text{nom}}$  or  $1.20 U_{\text{max}}$
- 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 = minimum operating voltage upper limit =  $U_{\text{nom}}$  or  $U_{\text{max}}$
- 12 V or 24 V road vehicle battery power supply: lower limit = minimum operating voltage
  - upper limit = 16 V (12 V battery) or 32 V (24 V battery)

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

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

### 5.8.4 Time

Under reasonably constant environmental conditions, an instrument of class II, III, or IIII shall meet the following requirements.

#### 5.8.4.1 Creep

When any load is kept on an instrument, the difference between the indication obtained immediately after placing a load and the indication observed during the following 30 minutes, shall not exceed  $0.5 e$ . However, the difference between the indication obtained at 15 minutes and that at 30 minutes shall not exceed  $0.2 e$ .

If these conditions are not met, the difference between the indication obtained immediately after placing a load on the instrument and the indication observed during the following four hours shall not exceed the absolute value of the maximum permissible error at the load applied.

#### 5.8.4.2 Zero return

The deviation on returning to zero as soon as the indication has stabilized, after the removal of any load which has remained on the instrument for half an hour, shall not exceed  $0.5 e$ .

For a multi-interval instrument, the deviation shall not exceed  $0.5 e_1$ .

On a multiple range instrument, the deviation on returning to zero from  $\text{Max}_i$  shall not exceed  $0.5 e_i$ . Furthermore, after returning to zero from any load greater than  $\text{Max}_1$  and immediately after switching to the lowest weighing range, the indication near zero shall not vary by more than  $e_1$  during the following five minutes.

#### 5.8.4.3 Durability

The durability error due to wear and tear shall not be greater than the absolute value of the maximum permissible error.

Adherence to this requirement is assumed if the instrument has passed the endurance test specified in R 76-2, 1.6, which shall be performed only for instruments with  $\text{Max} \leq 100 \text{ kg}$ .

#### 5.8.5 Other influence quantities and restraints

Where other influences and restraints, such as

- Vibrations,
- precipitations and draughts, and/or
- mechanical constraints and restrictions,

are a normal feature of the intended operating environment of the instrument, the instrument shall comply with the requirements of clauses 5 and 6 under those influences and restraints, either by being designed to operate correctly in spite of these influences, or by being protected against their action.

*Note:* Instruments installed outdoors without suitable protection against atmospheric conditions may normally not comply with the requirements of clauses 5 and 6 if the number of verification scale intervals,  $n$ , is relatively great. (In general, a value of  $n = 3\,000$  can only be exceeded with very special measures. Furthermore, for road or rail weighbridges the verification scale interval should not be less than 10 kg). These limits should also apply to each weighing range of combinations of instruments or of multiple range instruments or to each partial weighing range of multi-interval instruments.

### 5.9 Type evaluation tests and examinations

#### 5.9.1 Complete instruments

For type evaluation, the tests given in R 76-2 shall be performed, to verify adherence to the requirements in 5.5, 5.7, 5.8, 6.1.5, 6.1.6, 6.7, 6.8, and 8.1. The endurance test (R 76-2, 1.6) shall be performed after all the other tests in R 76-2, 1 and 2.

For software-controlled instruments, the requirements in 6.2 and R 76-2, 7 apply.

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#### 5.9.2 Modules

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

- where testing the instrument as a whole is difficult or impossible;
- where modules are manufactured and/or placed on the market as separate units to be incorporated in a complete instrument; or
- where the applicant wants to have a variety of modules included in the approved type.

Where modules are examined separately in the process of type approval, the following requirements apply.

##### 5.9.2.1 Apportioning of errors

The error limits applicable to a module,  $M_i$ , 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 as specified in 5.5. The fractions for any module have to be taken for at least the same accuracy class and at least the same number of verification scale intervals, as for the complete instrument incorporating the module.

The fractions  $p_i$  shall satisfy the following equation:

$$p_1 + p_2 + p_3 + \dots \leq 1$$

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

- For purely digital devices  $p_i$  may be equal to 0.
- For weighing modules  $p_i$  may be equal to 1.
- For all other modules (including digital load cells) the fraction shall not exceed 0.8 and shall not be less than 0.3, when more than one module contributes to the effect in question.

**Acceptable solution** (see explanation in the introductory note to clause 6):

For mechanical structures such as weighbridges, load transmitting devices and mechanical or electrical connecting elements evidently designed and manufactured according to sound engineering practice, an overall fraction  $p_i = 0.5$  may be applied without any test, e.g. when levers are made of the same material and when the chain of levers has two planes of symmetry (longitudinal and transversal), or when the stability characteristics of electrical connecting elements are appropriate for the signals transmitted, such as load cell output, impedance, etc.

For instruments incorporating the typical modules (see 3.2.2) the fractions  $p_i$  may have the values given in Table 7. This table takes into account that the modules are affected in a different manner depending on the different performance criteria.

**Table 7 – Values of  $p_i$  for modules**

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

\*\* According to OIML R 60 valid for SH tested load cells ( $p_{LC} = 0.7$ ).

The sign “–” means “not applicable”.

#### 5.9.2.2 Tests

As far as applicable the same tests shall be performed as for complete instruments. The applicable tests for indicators and analogue data processing devices are given in R 76-2, 9, the applicable tests for digital data processing devices, terminals and digital displays are given in R 76-2, 10, and the applicable tests for weighing modules are given in R 76-2, 11.

Purely digital modules need not be tested for static temperatures (R 76-2, 6.3.1), humidity (R 76-2, 8.2), and for span stability (R 76-2, 8.4). They need not be tested for disturbances (R 76-2, 8.3) if conformity to the relevant IEC Standards is otherwise established to at least the same level as required in this Recommendation.

For software-controlled modules the additional requirements in 6.2 and R 76-2, 13 apply.

#### 5.9.2.3 Compatibility

The compatibility of modules shall be established and declared by the manufacturer. For indicators and load cells this shall be done according to R 76-2, 12.6.

For modules with digital output, compatibility includes the correct communication and data transfer via the digital interface(s), see R 76-2, 12.5.

#### 5.9.2.4 Use of OIML certificates

If a respective OIML certificate exists, and if the requirements in 5.9.2.1, 5.9.2.2, and 5.9.2.3 are met, the following may be used without repeated testing:

- SH or CH tested load cells (but not NH marked load cells) that have been tested separately according to OIML R 60;
- indicators and analogue data processing devices that have been tested separately according to R 76-2, 12.3;
- digital data processing devices, terminals and digital displays that have been tested separately according to R 76-2, 12.4;
- weighing modules that have been tested separately according to R 76-2, 12.4 or R 76-2, 12.5;
- other modules (if relevant OIML Recommendations exist).

The OIML certificates must contain all relevant information required in R 76-2, 10.4. OIML certificates for modules must be clearly distinguishable from OIML certificates for complete instruments.

A representative complete instrument shall be submitted for testing of correct functioning if this is considered necessary by the responsible authority, e.g. to conduct tests that have not been performed such as tilting.

#### 5.9.3 Peripheral devices

Peripheral recipient devices need to be examined and tested only once while being connected to a weighing instrument, and may be declared as suitable for connection to any verified weighing instrument having an appropriate and protective interface.

Purely digital peripheral devices need not be tested for static temperatures (R 76-2, 6.3.1), humidity (R 76-2, 8.2), and for span stability (R 76-2, 8.4). They need not be tested for disturbances (R 76-2, 8.3) if conformity to the relevant IEC Standards is otherwise established to at least the same level as required in this Recommendation.

#### 5.9.4 Testing of a family of instruments or modules

Where a family of instruments or modules of various capacities and characteristics is presented for type examination, the following provisions apply for selecting the Equipment Under Test (EUT). For indicators, refer also to R 76-2, 9 and R 76-2, 10.

##### 5.9.4.1 Selection of EUTs

The selection of EUTs to be tested shall be such that their number is minimized but nevertheless sufficiently representative (see example in acceptable solution of 5.9.4.6).

Approval of the most sensitive EUTs implies approval of the variants with lower characteristics. Therefore, when a choice exists, the EUTs with the highest metrological characteristics shall be selected for test.

##### 5.9.4.2 Variants within a family to be tested

For any family, at least the variant with the highest number of verification scale intervals ( $n$ ) and the variant with the smallest verification scale interval,  $e$ , shall be selected as EUTs. Further EUTs may be required according to 5.9.4.6. If a variant has both characteristics, one EUT may be sufficient.

##### 5.9.4.3 Variants acceptable without testing

Variants other than the EUTs can be accepted without testing, if one of the following bulleted provisions is fulfilled (for comparable metrological characteristics):



- Their capacities,  $\text{Max}$ , fall between two tested capacities. The ratio between the tested capacities shall not exceed 10; or
- All of the following conditions a), b), and c) are fulfilled:
  - a)  $n \leq n_{\text{test}}$
  - b)  $e \geq e_{\text{test}}$
  - c)  $\text{Max} \leq 5 \times \text{Max}_{\text{test}} \times (n_{\text{test}} / n)$

*Note:*  $\text{Max}_{\text{test}}$ ,  $n_{\text{test}}$ , and  $e_{\text{test}}$  are the characteristics of the EUT.

#### 5.9.4.4 Accuracy class

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

#### 5.9.4.5 Other features to be considered

All metrologically relevant features and functions have to be tested at least once in an EUT as far as applicable and as many as possible in the same EUT.

For example, it is not acceptable to test the temperature effect on no-load indication on one EUT and the combined effect (see Table 7) on a different one. Variations in metrologically relevant features and functions such as different

- housings,
- load receptors,
- temperature and humidity ranges,
- instrument functions,
- 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.

#### 5.9.4.6 Summary of relevant metrological characteristics

The EUTs must cover

- highest number of verification scale intervals,  $n_{\text{max}}$ ,
- lowest verification scale interval,  $e_{\text{min}}$ ,
- lowest input signal,  $\mu\text{V}/e$  (when using analogue strain gauge load cells),
- all accuracy classes,
- all temperature ranges,
- single range, multiple range or multi-interval instrument,
- maximum size of load receptor, if significant,
- metrologically relevant features (see 5.9.4.5),
- maximum number of instrument functions,
- maximum number of indications,
- maximum number of peripheral devices connected,
- maximum number of implemented digital devices,

- maximum number of analogue and digital interfaces,
- several load receptors, if connectable to the indicator, and
- different types of power supply (mains and/or batteries).

Acceptable solution for the selection of EUTs of a family:

**Table 8 – Selection of EUTs for a type of a non-automatic weighing instrument with two families**

	Variant	Max	$e$	$d$	$n$	EUT
<b>Family 1</b> Accuracy class II Temperature range: 10 °C / 30 °C	1.1	200 g	0.01 g	0.001 g	20 000	
	1.2	400 g	0.01 g	0.001 g	40 000	X
	1.3	2000 g	0.05 g	0.05 g	40 000	
<b>Family 2</b> Accuracy class III Temperature range: –10 °C / 40 °C	2.1	1.5 kg	0.5 g	0.5 g	3 000	X
	2.2	3 kg	1 g	1 g	3 000	
	2.3	5 kg	2 g	2 g	2 500	
	2.4	15 kg	5 g	5 g	3 000	X
	2.5	60 kg	20 g	20 g	3 000	

*Note:* This example covers only the various capacities and metrological characteristics of the EUTs according to 5.9.4.2-5.9.4.4. The other metrologically relevant features according to 5.9.4.5 must also be taken into account in practice, and may result in one or more additional EUTs.

Remarks on the selection:

- Variants 1.2, 2.1 and 2.4 are selected as EUTs (marked in last column of Table 8).
- Variant 1.1 needs not be tested, because it has the same  $e$  and  $d$  as variant 1.2. Only the value of Max is reduced to 200 g (see 5.9.4.3).
- Variant 1.2 has the best metrological characteristics of family 1 and shall be tested completely according to 5.9.4.2.
- Variant 1.3 needs not be tested, because Max is not more than five times that for variant 1.2 (see 5.9.4.3).
- Variant 2.1 has the best metrological characteristics of family 2, the smallest  $e$  and the greatest  $n$ . Therefore variant 2.1 shall be tested (see 5.9.4.4). It is sufficient to perform additionally only the applicable tests for class III. It is not necessary to repeat those tests which are the same for class II and class III and which have already been performed on variant 1.2.
- Variants 2.2 and 2.3 need not be tested, because their values of Max are in between the tested variants 2.1 and 2.4 (see 5.9.4.3) and their metrological characteristics are less than or the same as for variants 2.1 and 2.4.
- Variant 2.4 shall be tested, because the ratio between variant 2.5 and 2.1 is greater than 10 (see 5.9.4.3). For variant 2.4, it is sufficient to perform additionally some important tests such as weighing test, temperature, eccentricity, discrimination, repeatability, etc. It is normally not necessary to repeat other tests (e.g. tilting, power supply, humidity, span stability, endurance, disturbance tests) which have already been performed on variants 1.2 and 2.1.
- Variant 2.5 needs not be tested, because Max is not more than five times that for variant 2.4 (see 5.9.4.3).

**Table 9 – Summary of the metrological characteristics presented in the OIML certificate**

	<b>Family 1</b>	<b>Family 2</b>
Accuracy class	II	III
Max	1 g ... 2000 g	50 g ... 60 kg
<i>e</i>	0.01 g 0.2 g	0.5 g ... 100 g
<i>d</i>	0.001 g 0.2 g	0.5 g ... 100 g
<i>n</i>	≤ 40 000	≤ 3 000
Tare balancing range	100 % of Max	100 % of Max
Preset tare range	100 % of Max	100 % of Max
Temperature range	10 °C / 30 °C	-10 °C / 40 °C

*Note:* The respective OIML certificate shall include either the complete family according to Table 8 with eight instruments in two families or may alternatively include the metrological characteristics of the families according to Table 9. In the latter case the Max values may be reduced (in comparison with the smallest EUT, Table 8) if it is an identical instrument with the same verification scale interval, *e*, and if the conditions of Table 3 are still met. The certificate covers all variants that meet the metrological characteristics in Table 9.

## 6 Technical requirements

The following requirements relate to the design and the construction of self or semi-self-indicating instruments, and are intended to ensure that instruments give correct and unambiguous weighing results and other primary indications, under normal conditions of use and proper handling by unskilled users. They are not intended to prescribe solutions, but to define appropriate operation of the instrument.

Certain solutions that have been tried over a long period have become accepted; these solutions are marked “acceptable solution”; while it is not necessary to adopt them, they are considered to comply with the requirements of the applicable provision.

### 6.1 General construction requirements

#### 6.1.1 Suitability

##### 6.1.1.1 Suitability for application

An instrument shall be designed to suit its intended purpose of use.

*Note:* “Intended purpose” includes aspects such as the nature and needs of the application and environment. Where the intended purpose needs to be restricted, a marking stating such restriction may be required according to national regulation.

##### 6.1.1.2 Suitability for use

An instrument shall be solidly and carefully constructed in order to ensure that it maintains its metrological qualities during a period of use.

##### 6.1.1.3 Suitability for verification

An instrument shall permit the tests set out in this Recommendation to be performed.

In particular, load receptors shall be such that the standard weight can be deposited on them easily and in total safety. If weights cannot be placed, an additional support may be required.

It must be possible to identify devices that have been subject to a separate type examination procedure (e.g.

load cells, printers, etc.).

## 6.1.2 Security

### 6.1.2.1 Fraudulent use

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

### 6.1.2.2 Accidental breakdown and maladjustment

An 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.

### 6.1.2.3 Controls

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

### 6.1.2.4 Securing of components and pre-set controls

Means shall be provided for securing components and pre-set controls to which access or adjustment is prohibited. National legislation may specify the securing that is required.

On a class I instrument, devices to adjust sensitivity (or span) may remain unsecured.

#### Acceptable solution:

For application of the control marks, the securing area should have a diameter of at least 5 mm.

Components and pre-set controls may be secured by software means provided that any access to the secured controls or functions becomes automatically evident. In addition the following requirements apply to software securing means.

- a) By analogy with conventional securing methods the legal status of the instrument must be recognizable to the user or any other person responsible at the instrument itself.

Securing measures shall provide the evidence of any intervention until the next verification or comparable official inspection.

#### Acceptable technical solution:

An event counter, i.e. a non-resettable counter that increments each time a protected operational mode of the instrument is entered and one or more changes are made to device-specific parameters. The reference number of the counter at the time of (initial or subsequent) verification is fixed and secured by appropriate hard- or software means at the modified instrument. The actual counter number can be indicated for comparison with the reference number by a procedure described in the manual and in the OIML certificate and Test Report.

*Note:* The term “non-resettable” above implies that if the counter has reached its maximum number it will not continue with zero without the intervention of an authorized person.

- b) The device-specific parameter and the reference number shall be protected against unintentional and accidental changes. For these data, the software requirements of 6.5.2.2 shall be met as far as applicable.

#### Acceptable technical solution:

The device-specific parameter should only be changed by an authorized person via a special PIN-code. The serial number (or other identification) of the instrument as affixed to the instrument's main plate (or other suitable parts) should additionally be stored, if the electronic component or sub-assembly with the memory device is not secured against exchange. These data should be secured by a signature (at least 2 bytes CRC-16 checksum with hidden polynomial), this is considered as a sufficient

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securing method. The reference number and serial number (respective other identification) should be displayed after manual command and should be compared with the same data affixed and secured on the main plate (or other suitable parts of the instrument).

- c) An instrument making use of a software securing method shall have adequate facilities for affixing the reference number on or near the main plate by an authorized person or body.

*Note:* A difference between the indicated reference number (according to a)) and the fixed and secured reference number on the instrument indicates an intervention. The consequences are under national legislation (e.g. that the instrument shall no longer be used for legally controlled purposes).

#### Acceptable technical solution:

Adjustable (hardware) counter that is firmly mounted on the instrument and that can be secured after it has been adjusted to the actual counter number at the time of (initial or subsequent) verification.

#### 6.1.2.5 Adjustment

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

#### 6.1.2.6 Gravity compensation

A gravity sensitive instrument may be equipped with a device for compensating the effects of gravity variations. After securing, external influence on or access to this device shall be practically impossible.

#### 6.1.3 Faults

An instrument shall be designed and manufactured such that, when it is exposed to disturbances, either:

- significant faults do not occur; or
- significant faults are detected and acted upon. The indication of significant faults in the display should not be confusing with other messages that appear in the display.

*Note:* A fault equal to or smaller than  $e$  is allowed irrespective of the value of the error of indication.

The requirements in 5.5, 5.7, 5.8 and 6.1.3.1 shall be met durably, in accordance with the intended use of the instrument.

A type of an electronic instrument is presumed to comply with the requirements in 6.1.3.1,

6.1.3.2 and 6.1.5.2 if it passes the examinations and tests specified in 6.1.6.

The requirements in 6.1.3.1 may be applied separately to:

- each individual cause of significant fault; and/or
- each part of the (electronic) instrument.

The choice, whether 6.1.3.1 a) or 6.1.3.1 b) is applied, is left to the manufacturer.

#### 6.1.4 Acting upon significant faults

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

#### 6.1.5 Functional requirements

- 6.1.5.1 Upon switch-on (of indication), a special procedure shall be performed that shows all relevant signs of the indicator in their active and non-active state sufficiently long to be checked by the operator. This is not applicable for displays on which failure becomes evident, e.g. non-

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segmented displays, screen-displays, matrix-displays, etc.

- 6.1.5.2 In addition to 5.8, an electronic instrument shall comply with the requirements at a relative humidity of 85 % whilst at the upper limit of the temperature range. This is not applicable to an electronic instrument of class I, nor of class II if  $e$  is less than 1 g.
- 6.1.5.3 Electronic instruments, class I instruments excepted, shall be subjected to the span stability test specified in 6.1.6.4. The error near maximum capacity shall not exceed the maximum permissible error and the absolute value of the difference between the errors obtained for any two measurements shall not exceed half the verification scale interval or half the absolute value of the maximum permissible error, whichever is greater.
- 6.1.5.4 When an electronic instrument is subjected to the disturbances specified in 6.1.6.3, the difference between the weight indication due to the disturbance and the indication without the disturbance (intrinsic error), shall not exceed  $e$  or the instrument shall detect and react to a significant fault.
- 6.1.5.5 During the warm-up time of an electronic instrument there shall be no indication or transmission of the weighing result.
- 6.1.5.6 An electronic instrument may be equipped with interfaces permitting the coupling of the instrument to any peripheral devices or other instruments.
- 6.1.5.7 An interface shall not allow the metrological functions of the instrument and its measurement data to be inadmissibly influenced by the peripheral devices (for example computers), by other interconnected instruments, or by disturbances acting on the interface.
- 6.1.5.8 Functions that are performed or initiated via an interface shall meet the relevant requirements and conditions of clause 6.
- Note:* An “interface” comprises all mechanical, electrical and logic properties at the data interchange point between an instrument and peripheral devices or other instruments.
- 6.1.5.9 It shall not be possible to introduce into an instrument, through an interface, instructions or data intended or suitable to
- display data that are not clearly defined and which could be mistaken for a weighing result,
  - falsify displayed, processed or stored weighing results,
  - adjust the instrument or change any adjustment factor; however instructions may be given through the interface to carry out an adjustment procedure using a span adjustment device incorporated inside the instrument or, for instruments in class I, using an external standard weight or standard mass, or
  - falsify primary indications displayed in case of direct sales to the public.
- 6.1.5.10 An interface through which the functions mentioned in 6.1.5.6.1 cannot be performed or initiated, need not be secured. Other interfaces shall be secured as per 6.1.2.4.
- 6.1.5.11 An interface intended to be connected to a peripheral device to which the requirements of this Recommendation apply, shall transmit data relating to primary indications in such a manner that the peripheral device can meet the requirements.

## 6.1.6 Performance and span stability tests

### 6.1.6.1 Test considerations

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All electronic instruments of the same category, whether or not equipped with checking facilities, shall be subjected to the same performance test program.

#### 6.1.6.2 State of instrument under test

Performance tests shall be carried out on fully operational equipment in its normal operational state or in a status as similar as possible thereto. When connected in other than a normal configuration, the procedure shall be mutually agreed by the approval authority and the applicant and shall be described in the test document.

If an electronic instrument is equipped with an interface permitting the coupling of the instrument to external equipment, the instrument shall, during the tests R 76-2, 2.3.2, 2.3.3 and 2.3.4, be coupled to external equipment, as specified by the test procedure.

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#### 6.1.6.3 Performance tests

Performance tests shall be performed according to R 76-2, 1.5.2.1, 2.2 and 2.3.

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**Table 10 – Performance test characteristics**

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Test	Characteristic under test
Static temperatures	Influence factor
Damp heat, steady state	Influence factor
Voltage variations	Influence factor
AC mains voltage dips and short interruptions	Disturbance
Bursts (transients)	Disturbance
Electrostatic discharge	Disturbance
Surge (if applicable)	Disturbance
Immunity to radiated electromagnetic fields	Disturbance
Immunity to conducted radio-frequency fields	Disturbance
Special EMC requirements for instruments powered from road vehicle power supply	Disturbance

#### 6.1.6.4 Span stability test

Span stability test shall be performed according to R 76-2, 8.4.

### 6.2 Software requirements

This clause is applicable to devices with embedded software, personal computers (PCs) and other devices with loadable or programmable software.

*Note 1:* Examples to illustrate specific requirements may be found in D 31:2019 *General requirements for software-controlled measuring instruments* [15]. Here, examples are only provided if they provide additional information.

*Note 2:* Although these devices may be complete weighing instruments with loadable software or PC-based modules and components, etc., in the following they will simply be called “PC”.

*Note 3:* Unless stated otherwise, all requirements in this clause apply only to the legally relevant parts of a non-automatic weighing instrument, e.g. software or parameters.

*Note 4:* Unless stated otherwise, the term “certificate” refers to the OIML certificate.

#### 6.2.1 Hardware requirements for weighing instruments containing universal devices

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Universal devices as components incorporating the metrologically relevant analogue component(s) shall be treated according to R 76-2, 9, see Table 11, categories 1 and 2.

PCs acting as a purely digital components without incorporating metrologically relevant analogue components (e.g. used as terminals or price-computing point-of-sale devices) shall be treated according to Table 11, categories 3 and 4.

PCs used as purely digital peripheral devices shall be treated according to Table 11, category 5.

Table 11 also specifies how detailed the documentation to be submitted for both analogue and digital components of the PC shall be depending on the respective category (description of power supply, type of interfaces, mother board, housing, etc.).

**Table 11 – Tests and required documentation for PCs**

Category		Necessary tests	Documentation	Remarks
No.	Description		Hardware components	
1	PC as a module, primary indications on the monitor, PC incorporates the metrologically relevant analogue components (ADC) on a slot mounted circuit print board that is not physically protected ("open device"), power supply device for the ADC from the PC or PC-bus system	ADC and PC tested as unit: tests as for indicators according to Annex C; pattern shall be equipped with the maximum possible configuration (maximum power consumption)	ADC: As in 11.2.1.2 (circuit diagrams, layouts, descriptions, etc.) PC: As in 11.2.1.2 (manufacturer, type of the PC, type of housing, types of all modules, electronic devices and components including power supply device, data sheets, manuals, etc.)	Influences on the ADC from the PC possible (temperature, electromagnetic susceptibility)
2	PC as a module, primary indications on the monitor, PC incorporates the ADC, but the built-in ADC has a physically protected housing ("closed device"), power supply device for the ADC from the PC, but not via the PC-bus system	ADC and PC tested as unit: tests as for indicators according to Annex C; pattern shall be equipped with the maximum possible configuration (maximum power consumption)	ADC: As in 11.2.1.2 (circuit diagrams, layouts, descriptions, etc.) PC: Power supply device: As in 11.2.1.2 (manufacturer, type, data sheet) <u>Other parts</u> : Only general description or information necessary concerning the form of housing, mother-board, processor type, RAM, mass storage devices, controller boards, video controller, interfaces, monitor, keyboard, etc.	Influences on the ADC from the power supply device of the PC possible (temperature, EMC) Other influences from the PC not critical New EMC tests (PC) necessary if the power supply device is changed
3	PC as purely digital module, primary indications on the monitor, ADC outside the PC in a separate housing, power supply device for the ADC from the PC	ADC: tests as for indicators according to Annex C using the monitor of the PC for the primary indications PC: According to 5.10.2	ADC: As for category 2 PC: Power supply device as for category 2, other parts as for category 4	Influence (only EMC) on the ADC from the power supply device of the PC possible Other influences from the PC not possible or not critical New EMC tests (PC) necessary if the power supply device is changed
4	PC as purely digital module, primary indication on the monitor, ADC outside the PC in a separate housing having its own power supply device	ADC: as for category 3 PC: as for category 3	ADC: As for category 2 PC: Only general description or information necessary, e.g. concerning type of motherboard, processor type, RAM, mass storage devices, controller boards, video controller, interfaces, monitor, keyboard	Influences (temperature, EMC) on the ADC from the PC not possible
5	PC as purely digital peripheral device	PC: According to 5.10.3	PC: As for category 4	

*Note:* PC = Personal Computer



ADC = Relevant analogue component(s), including Analog to Digital Converter (see Figure 1)

EMC = Electromagnetic Compatibility

The term “module” is used here in the sense of a hardware part of a weighing instrument, see OIML V 1:2022, 4.04 [1].

### 6.2.2 Software identification

Software modules of a software-controlled non-automatic weighing instrument or component shall be unambiguously identified. The software identification (see XXX) linked to the software may consist of more than one part. But at least one part shall be dedicated to the legal purpose.

*Note:* The software identification is a legally relevant parameter.

The identification shall be displayed or printed by the measuring instrument

- on command,
- during operation, or
- at start-up for a measuring instrument that can be turned off and on again.

If a measuring instrument or component has neither display nor printer or if the instrument facilitates remote verification, the identification shall be sent via a communication interface, in order to be displayed/printed on another component or by the verification software.

If the software is modified in any way, a new software identification is required.

The software identification shall be easily provided by the device for metrological controls or inspections and listed in the OIML certificate. The software identification and the means of identification (e.g. software version, hash value, checksum, CRC) shall be stated in the certificate. Instructions on how to display or print the software identification shall be in the certificate.

### 6.2.3 Correctness of algorithms and functions

The measuring algorithms and functions of a non-automatic weighing instrument shall be appropriate and functionally correct for the given application and device type (accuracy of the algorithms, price calculation according to certain rules, rounding algorithms, etc.).

The measurement result (measured quantity value and measurement result relevant data) shall be displayed or printed correctly.

It shall be possible to examine algorithms and functions either by metrological tests, software tests or software examination (as described in Annex G).

No hidden or undocumented functions or parameters shall exist.

This Recommendation does not ask manufacturers for extra declarations that documentation is correct and complete. However, any member state may require this declaration, as a part of the specified software examination process.

### 6.2.4 Evidence and prevention of intervention

#### 6.2.4.1 Prevention of misuse

Software of a non-automatic weighing instrument shall be protected against any changes, for example due to physical effects and intentional misuse, i.e. modification, loading or changes by swapping the memory device, unauthorised updates.

*Note:* Downloading software into the weighing instrument or component is allowed if the requirements for download are fulfilled, see 6.3.7.1 and 6.3.7.2.

During processing, measurement data shall be protected and secured.

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*Note:* Protection of the measurement data can be achieved by ensuring that only legally relevant software can process them and that all interfaces are protected.

**Acceptable solution:**

- 1) The user is guided by menus. The legally relevant functions are combined into one branch in this menu. If any measurement values might be lost by an action, the user is warned and requested to perform another action before the function is executed. See also 6.3.3. A password is used to secure the legally relevant software.
- 2) All inputs from the user interface are redirected to a program that filters incoming commands. It only allows the documented ones and discards all others. This program is part of the legally relevant software. A password is used to secure the legally relevant software.

#### 6.2.4.2 Evidence of intervention

Software shall be protected in such a way that evidence of any intervention (e.g. software updates, parameters changes) shall be available. Mechanical sealing or software seals shall be used to protect measuring instruments or components. Software shall be secured against unauthorized modification, loading, or changes by swapping the memory device.

*Note:* In case of a software implemented seal, see clause 6.2.7.1 regarding requirements on checking facilities and appropriate reactions.

If necessary for the purpose of verification, data containing evidence of an intervention shall be displayed or printed on command and, if applicable, transmitted to the verification software.

*Note:* If legally relevant software runs on a universal device such as a smartphone, it may not be possible to fully secure the software as required. Instead, additional external protection means (e.g. cryptographic signatures for transmitted or indicated measurement data) may be used to check correct behaviour of the software.

**Acceptable solution:**

The software calculates a checksum of the executable code and compares it with a known nominal value. In case of a mismatch, the weighing instrument is made inoperative. The weighing instrument may use the calculated checksum result as the software identification, see 6.2.2. In case of a mismatch, the weighing instrument is made inoperative and the event is logged in the audit trail with a time stamp.

#### 6.2.4.3 Inputs from the user interface

All inputs from the user interface shall be handled by a protective interface. Any function that can be activated by the user interface shall

- be clearly documented (see 11.2.1), and
- not be able to influence the legally relevant characteristics of the instrument.

*Note:* The type evaluation authority decides whether all of these documented functions are acceptable.

#### 6.2.4.4 Inputs from communication interfaces

All inputs from communication interfaces shall be handled by a protective interface. Any function that can be activated through a communication interface shall

- be clearly documented (see 11.2.1), and
- not be able to influence the legally relevant characteristics of the instrument remotely such as through a remote verification procedure or a software download.

*Note:* The type evaluation authority decides whether all of these documented functions are acceptable.

Legally relevant parameters shall be secured and protected in such a way that evidence of an intervention shall be available. If necessary for the purpose of verification of a measuring instrument, displaying or printing and, if applicable, transmitting the current relevant parameter settings to the verification software shall be possible.

#### 6.2.4.5 Software protection

Software protection means shall comprise appropriate sealing by mechanical, software and/or cryptographic means, making an intervention impossible or evident.

#### 6.2.4.6 Audit trails

Audit trails and event counters are part of the legally relevant software and shall be secured and protected as such. It shall not be possible to delete or inadmissibly change the data of the event counter or audit trails and it shall not be possible to exchange the audit trails or the value of the event counter when the software is updated. The weighing instrument or module shall be fitted with a checking facility to ensure that if an irregularity is detected, the non-automatic weighing instrument stops weighing and displays an error. The audit trail shall contain at minimum the following information:

- Time stamp of the event;
- In the case of a traced update, see 6.3.7.2.8; and
- In the case of a parameter change:
  - Identification of the changed parameter; and
  - The old and new value of the changed parameter.

The audit trail or value of the event counter shall be displayed or printed on command and, if applicable, transmitted to the verification software. The certificate shall describe how the audit trail or the value of the event counter may be displayed or printed and specify if the audit trail or event counter is part of the remote verification procedure.

#### 6.2.5 Prevention of misuse of measurement data

Measurement data shall be protected and secured against modification. The weighing instrument/component shall be constructed in such a way that possibilities for unintentional, accidental, or intentional misuse are minimal.

Legally relevant software shall be secured against accidental or unintentional changes.

The presentation of the measurement results shall be unambiguous for all parties affected.

#### 6.2.6 Demands on the user

The software of a measuring instrument shall be designed in such a way that no unreasonable demands are required from the user to obtain a correct measurement result.

#### 6.2.7 Support of hardware features

##### 6.2.7.1 Detection of significant defects

The detection of significant defects by the checking facilities may be achieved by software. In such a case, this detecting software is considered part of the legally relevant software.

If software is involved in the detection of significant defects, it shall appropriately act upon any detected defect.

The documentation to be submitted for type evaluation shall contain a list of the significant defects that will be detected by the software, how it will act upon these defects and in case needed for understanding its operation, a description of the detecting algorithm, see 11.2.1.

##### 6.2.7.2 Durability protection

If software is involved in durability protection and durability is detected as being jeopardized, the software-controlled non-automatic weighing instrument shall either start measures to ensure further durability,

deactivate itself or generate an alarm and/or record in an error log.

The documentation to be submitted for type evaluation shall contain a list of the significant durability errors that will be detected by the software, how it will act upon these errors and, in case needed for understanding its operation, a description of the detecting algorithm, see **Error! Reference source not found.**11.2.1.

### 6.2.7.3 Information for remote verification

If support of 6.2.7.1 or 6.2.7.2 is part of the remote verification procedure it shall be possible to transmit data containing information in this respect to the verification software.

## 6.3 Software requirements for specific configurations

### 6.3.1 General

The following specific requirements (6.3.2 to 6.3.8) are needed when certain technologies, such as software separation, data storage or transmission, are employed in non-automatic weighing instruments. They shall be considered in addition to those described above.

### 6.3.2 Specification and separation of legally relevant components and software modules and requirements for interfaces

This requirement applies if the software-controlled non-automatic weighing instrument or component has interfaces for communicating with other devices, components or with other software modules besides the legally relevant software modules within the weighing instrument or component.

*Note:* With respect to the user interface, see 6.2.4.3.

Legally relevant software modules or hardware components shall not be inadmissibly influenced by another device or by other modules or components of the weighing instrument.

#### 6.3.2.1 Separation of components

- 6.3.2.1.1 Components of a non-automatic weighing instrument that perform legally relevant functions shall be identified, clearly defined and documented, see **Error! Reference source not found.**11.2.1.. They form the legally relevant hardware of the measuring instrument.

*Note:* With respect to separation of software modules, see 6.3.2.2.

- 6.3.2.1.2 A legally relevant software-controlled component shall communicate with other components or devices through a protective interface. It shall not be possible to inadmissibly influence the legally relevant software, parameters or measurement data through these interfaces, see also 6.3.6.2. It shall be demonstrated that legally relevant software, parameters and measurement data of components that are legally relevant cannot be inadmissibly influenced by commands received via the protective interface.

This implies that there is an unambiguous assignment of each command to all initiated functions or data changes in the component.

*Note:* If “legally relevant” components interact with other “legally relevant” components, refer to 6.3.5.**Error! Reference source not found.**

#### Acceptable solution:

The non-automatic weighing instrument has a communication interface through which commands are received. The software only accepts valid allowed commands and discards all others by replying with an error message.

- 6.3.2.1.3 If software seals are used to prevent components from being exchanged and pairing parameters are part of the seal, then these pairing parameters are legally relevant and shall be secured and protected in such a way that evidence of an intervention is available, see 0.

6.3.2.1.4 In case the authenticity and/or integrity check fails, or the other component is not available, the checking component shall appropriately act upon this. See 6.2.7.1.

In the case of a simple recipient printer only availability needs to be checked if a printer is mandatory.

6.3.2.1.5 If a component is shared by multiple components, e.g. one display for multiple sensors, then all the components that share another component shall be unambiguously identified.

*Note:* This requirement does not impose any restrictions on the manner of identification.

6.3.2.1.6 If some components of a non-automatic weighing instrument are not physically connected and therefore present in the same location, it might be difficult to establish if an indicated result actually stems from and is indicated by legally relevant software. In case the completeness of the measuring instrument cannot be visually checked (e.g. wireless or network-connected components), non-legally relevant software modules shall be prevented from calculation/presenting/spoofing the measurement result.

6.3.2.1.7 In case legally relevant components with limited functionality and limited securing/protection capabilities are applied (e.g. if a legally relevant operating system on a component cannot be configured according to 6.3.6), they shall have limited access to the measurement data, i.e. they shall use the measurement data without modification or further processing.

- The measurement data shall be prepared for transmission or storage for further processing by a component that can be fully secured and protected. This component ensures that the data are complete and protected.
- The measurement data shall be received or retrieved for further processing by a component that can be fully secured and protected. This component ensures that the data are complete and shall check their integrity. The component also ensures that the measurement result is printed or indicated in case of a dispute.

## 6.3.2.2 Separation of software modules

6.3.2.2.1 All software modules (programs, subroutines, objects, operating system parts etc.), that perform legally relevant functions or that process legally relevant measurement data, form the legally relevant software of a non-automatic weighing instrument or component. The requirement applies to this software and it shall be made identifiable as described in 6.2.2.

If the separation of the software is not possible or needed, the software shall be legally relevant as a whole.

Software separation takes either place in the complete measuring instrument or in a specified component.

- For separation of components, see 6.3.2.1.
- For communication between components, see 6.3.5 **Error! Reference source not found.**

### Acceptable solution:

A non-automatic weighing instrument consists of several digital load cells connected to a personal computer that displays the measurement result. The legally relevant software on the personal computer is separated from the legally non-relevant parts by compiling all procedures realizing legally relevant functions (including presentation of results) into a dynamically linkable library. One or several legally non-relevant applications may call program procedures in this library. These procedures receive the measurement data from the digital load cells, calculate the measurement result, display it in a software window, print the measurement result and then send the measurement result to the non-legally relevant applications for further processing.

**Commented [ME51]:** The PG will be informed about this requirement and a possible duplication of identification requirements. Related to US-09.

**Commented [ME52]:** The PG must decide on requirements for certain components to be on site. Related to US-10.

- 6.3.2.2.2 All legally relevant software modules shall communicate with other modules through a protective interface. It shall be demonstrated that the functions and data of modules that are legally relevant cannot be inadmissibly influenced by commands received via the protective interface. The legally relevant software modules and the protective interface shall be clearly documented, see 11.2.1.**Error! Reference source not found.** All legally relevant functions and data domains of the software shall be described to enable a type evaluation authority to decide on correct software separation.

The protective interface consists of program code and dedicated data domains. Defined coded commands or data are exchanged between the software modules by storing to the dedicated data domain by one part of the protective interface and reading from it by another part of the protective interface. Writing and reading code is part of the protective interface.

Measurement data shall not be made available to legally non-relevant modules prior to primary indication.

*Note 1:* Protection from interruptions (delayed execution or blocking by other processes) is addressed in 6.3.2.2.4.

*Note 2:* Software modules can be installed in a non-automatic weighing instrument or in a component. With respect to separation of components, see 6.3.2.1

#### Acceptable solution:

In the example described in , the software interface consists of the procedures in the library and their parameters and return values. The configuration of the operating system (see ) ensures that the legally relevant software part cannot be influenced except through the defined procedures.

- 6.3.2.2.3 There shall be an unambiguous assignment of each command to all initiated functions or data changes in the legally relevant software. Functions that are triggered through the protective software interface shall be declared and documented, see 11.2.1.**Error! Reference source not found.** Only documented functions shall be activated through the protective software interface. The manufacturer shall attest that no hidden or undocumented properties exist (e.g. parameters, commands, functions, backdoors). This Recommendation does not ask manufacturers for extra declarations that documentation is correct and complete. However, any member state may require this declaration, as a part of the specified software examination process.
- 6.3.2.2.4 Where the legally relevant software has been separated from the non-relevant software, the legally relevant software shall have priority using the resources over non-relevant software. The legally relevant process shall not be inadmissibly interrupted by legally non-relevant software. The measurement process (realised by the legally relevant software) shall not be delayed or blocked by other processes.

### 6.3.3 Shared indications

A display or printout may be employed to present both information from the legally relevant software and other information. If a display or printout is used both for legally relevant and legally non-relevant outputs, the legally relevant information shall always be readable, and clearly distinguishable from other information.

### 6.3.4 Storage of data

- 6.3.4.1 If measurement data are stored for legal purposes the requirements of 6.3.4.2**Error! Reference source not found.** to 6.3.4.7 shall apply. Requirements regarding storage of data also apply to software identification, log files, results of diagnostics, result of remote verification, etc.

*Note:* Redundant entries do not count toward the total stored count in the audit trail.

- 6.3.4.2 The stored measurement data shall include all relevant data necessary for future legally relevant

use.

*Note:* Legally relevant data include for example:

- gross or net values and tare values (if applicable, together with a distinction of tare and preset tare);
- the decimal sign(s);
- measurement unit(s) (may be encoded);
- unit price and price to pay;
- unambiguous identification of the data stored, e.g. time stamp of measurement or consecutive numbers enabling assignment to values printed on an invoice;
- the identification number of the weighing instrument or load receptor if several weighing instruments or load receptors are connected to the data storage device.

6.3.4.3 Stored legally relevant data shall be protected by appropriate means to guarantee the authenticity, integrity. The software that displays or further processes the measurement values and accompanying data shall check the authenticity and integrity of the data after having read them from the storage. The storing device shall ensure that if an irregularity is detected, the measurement data are discarded or marked unusable. The storage device shall have sufficient permanency to ensure that the stored data are not corrupted under normal storage conditions. Software modules that prepare data for storing, or that check or indicate stored data, are considered part of the legally relevant software.

6.3.4.4 When, considering the application, data storage is required, measurement data shall be stored automatically. A checking facility shall regularly check the availability of the storage and in the case the storage device is not available no measurement shall be possible, see 6.2.6.1.

6.3.4.5 There shall be sufficient memory storage for the intended application. When the storage is full, the instrument can no longer be used for new legal measurements.

6.3.4.6 When the data necessary for the calculation of the measurement result are relevant for legal purposes, all measurement result relevant data included in the calculation shall be automatically stored with the final value.

*Note:* Stored data does not need to be physically localised in one storage unit, as long as all requirements are met.

6.3.4.7 Measurement data stored in a component to construct the measurement result can be deleted if the next module or component state a proper completion of expected actions engaged.

The measurement result may be deleted if either

- the transaction is settled, or
- these data are printed by a printing device subject to legal control.

### 6.3.5 Transmission via communication lines

6.3.5.1 If measurement data are transmitted before they are used for legal purposes the requirements of 6.3.5.2 to shall apply.

6.3.5.2 The transmitted measurement data shall include all data necessary for future legally relevant use.

*Note:* Legally relevant data include for example:

- gross or net values and tare values (if applicable, together with a distinction of tare and preset tare);

**Commented [ID53]:** Marko Esche: Related to US-14. The PG will be asked to decide on an exact list of data to be transmitted.

- the decimal sign(s);
- measurement unit(s) (may be encoded);
- unit price and price to pay;
- unambiguous identification of the data stored, e.g. time stamp of the measurement or consecutive number enabling assignment to values printed on an invoice;
- the identification number of the weighing instrument or load receptor if several instruments or load receptors are connected to the data storage device.

6.3.5.3 The transmitted data shall be protected by software means to guarantee the authenticity and integrity. The software that displays or further processes the measurement data shall check the authenticity and integrity of the measurement data received from a transmission channel. If an irregularity is detected an appropriate reaction shall be required, the measurement data shall be discarded or marked unusable.

Software modules that prepare measurement data for sending, or that check measurement data after receiving, are considered part of the legally relevant software.

**Acceptable solution:**

Within a local network, the program of the sending device calculates a CRC32 checksum of the dataset and appends it to the dataset. It uses a secret initial value for this calculation instead of the value given in the standard. This initial value is employed as a key and stored as a constant in the program code. The receiving program also has stored this initial value in its program code. Before using the dataset, the receiving program calculates the checksum and compares it with that stored in the dataset. If both values match, the dataset is not falsified. Otherwise, the program assumes falsification and discards the dataset.

*Note:* It is appropriate to require a raised risk level when considering an open network.

Raised risk levels might require application of cryptographic methods. Means shall be provided whereby cryptographic keys used by these methods can only be input or read if a seal is broken.

6.3.5.4 The measurement shall not be inadmissibly influenced by a transmission delay. If network services become unavailable or very slow, no measurement data shall be lost. It may be necessary to stop the measurement process to avoid the loss of measurement data.

**Acceptable solution:**

The sending device waits until the receiver has sent an affirmation of correct receipt of the dataset. If no confirmation is received after a given interval, the device displays an error message.

## 6.3.6 Compatibility of operating systems and hardware

### 6.3.6.1 General

If an operating system is part of the software-controlled device, requirements according to 6.3.6.2 to 6.3.6.6 shall be met.

Each of the following operating system requirements shall be met by measures on application level, operating system level or a combination of both. For example, the protective interface may be implemented within the legally relevant application, the operating system, the physical layer, etc.

### 6.3.6.2 Hardware interfaces

Hardware interfaces not equipped with a protective interface shall not be able to inadmissibly influence the legally relevant software, parameters or measurement data.

**Acceptable solutions:**



- 1) A protective interface: The legally relevant application routinely checks all open physical interfaces for incoming traffic. In the case of unauthorized input, it inhibits measurements.
- 2) All open interfaces are physically protected (e.g. physical seal).
- 3) The open interfaces are disabled by the operating system. In that case the configuration of the interfaces is secured and protected in such a way that evidence of any intervention is available.

#### **6.3.6.3 Boot process**

- 6.3.6.3.1 If a secure boot process is needed to ensure protection of the legally relevant software, the requirements of 6.3.6.3.2 to 6.3.6.3.5 shall apply.
- 6.3.6.3.2 The boot process shall ensure integrity and authenticity of the legally relevant software.
- 6.3.6.3.3 If a chain of trust is established over the individual steps of the boot process to ensure 6.3.6.3.2, the processing of the chain of trust may be interrupted, as long as its integrity is preserved.
- 6.3.6.3.4 The boot configuration shall be secured and protected.
- 6.3.6.3.5 Booting via open interfaces shall be prohibited.

#### **Acceptable solution:**

Unauthorized access to the boot loader is prevented by means of a strong password.

#### **6.3.6.4 Protection during use**

- 6.3.6.4.1 The operation of software that is not legally relevant shall not inadmissibly influence the legally relevant application.
- 6.3.6.4.2 The combination of the legally relevant software and the operating system shall ensure that the legally relevant indication is distinguishable from other information.
- 6.3.6.4.3 The access control feature of the operating system shall be configured in such way that the intended use cannot be inadmissibly influenced.
- 6.3.6.4.4 The administration tasks of the legally relevant software shall be protected.

*Note:* The term “administration task” addresses all reconfigurations and updates of the operating system.

#### **6.3.6.5 Communication with legally relevant software**

Communication with legally relevant software shall be made via protective interfaces. It shall be demonstrated that the legally relevant software, parameters, and data of components that are legally relevant cannot be inadmissibly influenced by commands received via the protective interface, see also clause 6.3.2.2.2

#### **6.3.6.6 Identification and traceability**

- 6.3.6.6.1 The configuration of the operating system shall be identifiable. The identifier shall be displayed on command or during operation and, if applicable, transmitted to the verification software by the measuring instrument.
- 6.3.6.6.2 Legally relevant configuration settings of the operating system shall be protected, i.e. changes to the legally relevant configuration shall be traceable.

*Note 1:* Replacing one legally relevant operating system part with a different one, i.e. by a newer version, is considered a modification of the configuration.

*Note 2:* This implies that legally relevant operating system parts can only be changed by means of a verified update (see 6.3.7.1) or by means of a traced update (see 6.3.7.2) if an audit trail is used.

#### 6.3.6.7 Suitable environment

The manufacturer shall identify the hardware and software environment that is suitable. Minimum resources and a suitable configuration management (e.g. processor, memory, specific communication, version of operating system, configuration management of dynamic modules of legally relevant software, etc.) necessary to guarantee correct functioning of the legally relevant software shall be declared by the manufacturer and stated in the certificate.

#### 6.3.6.8 Constraints for operation

Technical means shall be provided in the legally relevant software to prevent operation, if the minimum resources or a suitable configuration are not met. The system shall be operated only in the environment specified by the manufacturer for its correct functioning.

For example, in case an invariant environment is specified for the correct functioning of the system, means shall be provided to keep the operating environment fixed. This especially applies to a universal computer performing legally relevant functions.

#### 6.3.7 Software updates

*Note:* Some member states may not allow the download of new software versions.

Downloading and installing of legally relevant software is allowed according to one of the following download procedures, 6.3.6.2 and 6.3.6.3. The required download procedure depends on national regulations.

Only versions of legally relevant software that conform to the certified type are allowed for use. These shall be stated in the certificate. The following options 6.3.6.2 and 6.3.6.3 are alternatives. In the case that device-specific parameters (especially calibration parameters) are concerned, only a verified update should be done.

This issue concerns verification in the field.

*Note 1:* In the case of dynamic modules of legally relevant software, this implies that the documentation submitted describes a means to validate the conformity of devices in use even in presence of dynamic parameter changes, see 11.2.1. **Error! Reference source not found.**

*Note 2:* OIML D 34:2019 [12] interprets certification as consisting of type evaluation and type approval. Therefore, the term “certified type” used here corresponds to the term “approved type” in D 34.

##### 6.3.7.1 Verified update

A verified update is the procedure of changing software in a verified device or component after which the subsequent verification is necessary. The software to be updated may be loaded locally, i.e. directly on the software-controlled non-automatic weighing instrument, or remotely via a network. Loading and installation may be two different steps (as shown in Fig. 1) or combined into one, depending on the needs of the technical solution. A protection measure (i.e. physical or electronic seal that must be broken for the update to take effect) provides evidence of an intervention. A person should be on the installation site of the weighing instrument to check that the updated software has been installed successfully. After the update of the legally relevant software of a weighing instrument (exchange with another certified version or re-installation) the software-controlled non-automatic weighing instrument should not be employed for legal purposes before a verification of the weighing instrument as described in clause **Error! Reference source not found.** has been performed and the securing means have been renewed and the protection means have been renewed or reactivated (if not otherwise stated in the certificate).

##### 6.3.7.2 Traced Update

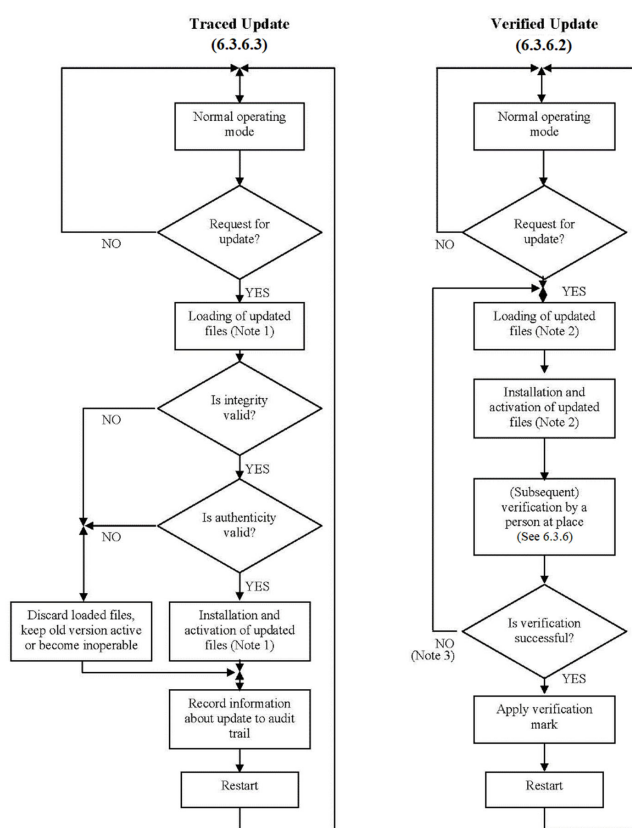
**Commented [ME54]:** Reference needs to be added once clauses on verification have been agreed upon.

- 6.3.7.2.1 Traced Update is the procedure of changing software in a verified instrument or component after which a subsequent verification is not necessary. This means the traced update shall not affect existing parameters. The software to be updated may be loaded locally, i.e. directly on the measuring instrument, or remotely via a network. The software update is recorded in an audit trail (see **Error! Reference source not found.**). The procedure of a Traced Update comprises several steps: loading, integrity checking, checking of the origin (authentication), installation, logging and activation. The software shall be implemented in the instrument according to the requirements for Traced update (6.3.7.2.2 to 6.3.7.2.9).
- 6.3.7.2.2 Depending on the needs and on national legislation it may be necessary for the user or owner of the weighing instrument to give their consent to a traced update. If so, the weighing instrument shall have a feature for the user or owner to express their consent prior to an update, e.g. by means of a push button. It shall be possible to enable and disable the feature, e.g. by a switch that can be sealed or by a secured and protected parameter. If the feature is enabled, each traced update needs to be initiated by the user or owner. If the user or owner denies consent, the update procedure should not start at all. If the feature is disabled, no activity by the user or owner is necessary to perform a traced update.
- 6.3.7.2.3 After initiation of the update procedure, a traced update of software shall run automatically. If some of the securing or protection measures of the weighing instrument are turned off to enable updating, they shall be turned on again immediately after update, independent of the result of the update process.
- Note:* Triggering of the traced update process may require intervention/manual actions by the user of the measuring instrument, see 6.3.7.2.2.
- 6.3.7.2.4 During a Traced update, any existing protection measures, e.g. audit trail information and event counter values, shall be retained.
- 6.3.7.2.5 Technical means shall be employed to guarantee the authenticity of the loaded software, i.e. that it originates from the owner of the certificate.
- Note:* A reference for encryption algorithms can be found in ISO/IEC 18033.
- 6.3.7.2.6 Technical means shall be employed to ensure the integrity of the loaded software, i.e. that it has not been inadmissibly changed before loading. This can be accomplished by adding a checksum or hash code of the loaded software and verifying it during the loading procedure.
- 6.3.7.2.7 If the loaded software fails the integrity test (6.3.7.2.6) or the authenticity test (6.3.7.2.5), the weighing instrument shall discard the new version and use the previous version of the software or switch to an inoperable mode. In this mode, the measuring functions shall be inhibited. It shall only be possible to resume the download procedure, or to show an error.
- 6.3.7.2.8 An audit trail shall be employed to ensure that Traced Updates of the legally relevant software are adequately traceable within the weighing instrument for subsequent verification and surveillance or inspection.
- The audit trail shall contain at minimum the following information:
- success/failure of the update procedure;
  - software identification of the installed version;
  - software identification of the previous installed version;
  - time stamp of the event; and
  - identification of the uploading party, i.e. the source of the update, if available.
- An entry is generated for each update attempt regardless of the success.

The storage device that supports the traced update shall have a sufficient capacity to ensure the traceability of traced updates of the legally relevant software between at least two successive verifications of a measuring instrument in the field/inspections. After having reached the limit of the storage for the audit trail, it shall be ensured by technical means that further downloads are impossible without breaking a seal. See also 6.2.4.6.

*Note:* This requirement enables inspection authorities, which are responsible for the metrological surveillance of legally controlled instruments, to back-trace traced updates of the legally relevant software over an adequate period of time (depending on national legislation).

- 6.3.7.2.9 If the audit trail has no more capacity (see 6.3.7.2.8), an appropriate response is required, i.e. either the oldest entry may be deleted or the update procedure should not start at all.



**Figure 1 – Software update procedure**

*Note 1:* In the case of a Traced Update, updating is separated into two steps: “loading” and “installing/activating”. This implies that the software is temporarily stored after loading without being activated because it shall be possible to discard the loaded software and revert to the old version, if the checks fail.

*Note 2:* In the case of a Verified Update, the software may also be loaded and temporarily stored before installation, but depending on the technical solution loading and installation may also be accomplished in one step.

*Note 3:* Here, only failure of the verification due to the software update is considered. Failure due to other reasons does not require re-loading and re-installing of the software, symbolised by the NO-branch.

6.3.7.2.10 When the software is updated, the audit trail should not be erased or overwritten.

### **6.3.8 Remote verification capability**

#### **6.3.8.1 General**

In case the instrument facilitates remote verification, the following requirements shall apply.

*Note:* There shall be a description of the remote verification procedure for accessing/reading of remote verification data and for executing remote verification procedures, and that shall be made available to the relevant authorities depending on national legislation, see clause 11.2.1 **Error! Reference source not found..**

6.3.8.1.1 The modules involved in the remote verification procedure are part of the legally relevant software and shall fulfil the relevant requirements.

6.3.8.1.2 It shall always be possible to establish and ensure the integrity of the instrument to be verified.

*Note:* This requirement specifically also applies to the legally relevant software which sends data, including the audit trail.

6.3.8.1.3 It shall be possible to establish the authenticity of the instrument, i.e. the instrument shall be uniquely identified and other means shall be provided to ensure authenticity.

*Note:* This requirement specifically also applies to the legally relevant software which sends data, including the audit trail.

6.3.8.1.4 The instrument shall store logging data, audit trails, and make these available for remote verification purposes.

6.3.8.1.5 The instrument shall use time stamps, provide evidence of an intervention (6.2.4), audit trails (6.2.4.6) and shall have a facility for detection of significant defects (6.2.7.1) for the purpose of remote verification.

6.3.8.1.6 An ongoing measurement shall not be influenced by remote verification or measurements shall be inhibited during the remote verification.

6.3.8.1.7 The use of the verification procedure shall not influence the compliance with other requirements.

Access to the verification procedures, specific test items or commands shall be available but can be restricted if these influence compliance with other requirements, such as

- requirements on battery life,
- on resources, or
- delays in the measurement process.

6.3.8.1.8 The software integrity of the instrument shall not be influenced by the remote verification procedure.

6.3.8.1.9 There shall be a legally relevant interface for data extraction for remote verification purposes.

6.3.8.1.10 Interfaces for remote verification shall be protected, see clause 6.3.2.1.2.

6.3.8.1.11 Access rights to the instrument for remote verification shall be described in the documentation and made available to the relevant authorities depending on national legislation, see clause 11.2.1.

6.3.8.1.12 Provisions shall be made to securely store the result of the remote verification in the measuring instrument. This data shall be protected and secured. Securing needs to ensure that only the remote verification software has write permissions.

The result of the remote verification shall contain, at least, a unique ID (at least identifying the verification authority) and the date of the verification shall be stored.

*Note 1:* Depending on the instrument type or the application, additional data may be required which is to be specified in the relevant Recommendation.

*Note 2:* The recognition of a verification mark and the data it contains are subject to national requirements. If not in compliance with national regulations, the manufacturer shall disable the remote verification functionality.

Stored results of the verification in the instrument shall comply with clause 6.3.4.

#### 6.3.8.2 Failure to pass remote verification

If an instrument does not pass remote verification, the consequences depend on national legislation. It is recommended to display a permanent disqualification message.

#### 6.3.8.3 Specific remote verification procedures

For specific remote verification procedures (see **Error! Reference source not found.**) the instrument shall fulfil the following requirement **Error! Reference source not found.**

**Commented [ME55]:** Reference needs to be added once clauses on verification have been agreed upon.

#### 6.3.8.4 Direct extraction of test items

6.3.8.4.1 When checking software integrity, the integrity measure (checksum, hash) shall be calculated immediately before transmitting the integrity measure to the remote verification software.

6.3.8.4.2 Test items shall be uniquely identified. The obtained test items shall be unambiguously linked to the measuring instrument to be verified.

6.3.8.4.3 Relevant test items identified by the PG (see **Error! Reference source not found.**) shall be available depending on the specific requirement to be tested and the instrument type (e.g. approved type number, serial number, legally relevant settings and parameters, verification information and status, software version identification, software integrity, audit logs/trails, change logs, event logs etc.).

**Commented [ME56]:** Reference needs to be added once clauses on verification have been agreed upon.

*Note:* See clause **Error! Reference source not found.** for examples of test items for a specific remote verification procedure.

**Commented [ME57]:** Reference needs to be added once clauses on verification have been agreed upon.

#### 6.3.8.5 Connection requirements

The connection to the remote verification software shall comply with 6.3.5.

### 6.4 Indication of weighing results

#### 6.4.1 Quality of reading

Reading of the primary indications (see 3.1.3.1) shall be reliable, easy and unambiguous under conditions of normal use:

- the overall inaccuracy of reading of an analogue indicating device shall not exceed 0.2 e; and
- the figures, units and designations forming the primary indications shall be of a size, shape and clarity

for reading to be easy.

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

#### 6.4.2 Form of the indication

##### 6.4.2.1 General

Weighing results and, if applicable, unit price and price to pay shall contain the names or symbols of the units in which they are expressed.

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

The scale interval for weighing results shall be in the form  $1 \times 10^k$ ,  $2 \times 10^k$  or  $5 \times 10^k$  units in which the result is expressed, the index,  $k$ , being a positive or negative whole number or equal to zero.

All displaying, printing and tare weighing devices of an instrument shall, within any one weighing range, have the same scale interval for any given load.

##### 6.4.2.2 Digital indication

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

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

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

The decimal sign shall be aligned with the bottom of the figures (example: 0.305 kg, not 0.305 kg). Zero may be indicated by one zero to the extreme right, without a decimal sign.

The unit of mass shall be chosen so that weight values have not more than one non-significant zero to the right. For values with decimal sign, the non-significant zero is allowed only in the third position after the decimal sign. For multi-interval instruments and multiple range instruments with automatic change over these requirements apply only to the smallest (partial) weighing range.

Examples for a multi-interval instrument or a multiple range instrument with automatic changeover:

**Example 1**

$\text{Max}_i$	$e_i$	Allowed indications			
$\text{Max}_1 = 150 \text{ kg}$	$e_1 = 50 \text{ g}$	xxx.050 kg	xxx.050 kg	xxx.05 kg	xxx.05 kg
$\text{Max}_2 = 300 \text{ kg}$	$e_2 = 100 \text{ g}$	xxx.100 kg	xxx.1 kg	xxx.10 kg	xxx.1 kg

**Example 2**

$\text{Max}_i$	$e_i$	Allowed indications
$\text{Max}_1 = 1500 \text{ kg}$	$e_1 = 500 \text{ g}$	xxxx.5 kg
$\text{Max}_2 = 3000 \text{ kg}$	$e_2 = 1000 \text{ g}$	xxx1.0 kg

#### 6.4.3 Maximum effect

There shall be no indication above  $\text{Max} + 9 e$ .

For multiple range instruments this applies to each weighing range. For multiple range instruments with

**Commented [ID58]:** First para was numbered again, but the following paras were not, so converted into subclauses with proper headings.

**Commented [ID59]:** Numbered paragraph again, but the following paras were not!

automatic change over, however,  $\text{Max}$  is equal to  $\text{Max}_r$  of the highest weighing range,  $r$ , and there shall be no indication above  $\text{Max}_i = n_i \times e_i$  for the smaller weighing range(s),  $i$ .

For multi-interval instruments there shall be no indication using  $e_i$  above  $\text{Max}_i = n_i \times e_i$  for the lower partial weighing range(s),  $i$ .

An indication below zero (with minus sign) is possible when a tare device is in operation and the tare load has been removed from the load receptor. It is also possible that negative values down to  $-20 d$  are displayed even if there is no tare device in operation, provided these values cannot be transmitted, printed or used for a price calculation.

#### 6.4.4 Approximate displaying device

The scale interval of an approximate displaying device shall be greater than  $\text{Max}/100$  without being smaller than  $20 e$ . This approximate device is considered as giving secondary indications.

#### 6.4.5 Extending the range of self-indication on a semi-self-indicating instrument

The extension interval of the range of self-indication shall not be greater than the value of the self-indication capacity.

##### Acceptable solutions:

- The scale interval of extension of the range of self-indication should be equal to the capacity of self-indication (comparator instruments are excluded from this provision).
- An extension device with accessible sliding poises is subject to the requirements of 8.2.2.
- On an extension device with enclosed sliding poises or weight switching mechanisms, each extension should involve an adequate change in the numbering. It should be possible to seal the housing and the adjusting cavities of the weights or masses.

#### 6.5 Analogue indicating device

The following requirements apply in addition to those in 6.4.1-6.4.4.

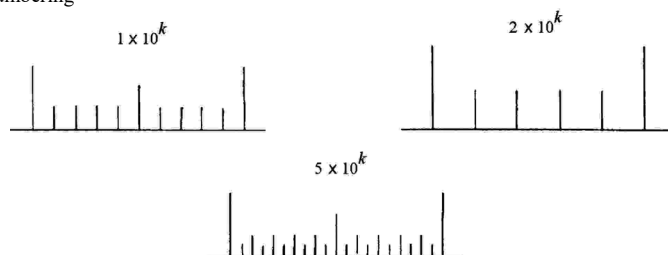
##### 6.5.1 Scale marks; length and width

Scales shall be designed and numbered so that reading the weighing result is easy and unambiguous.

##### Acceptable solutions:

- Form of scale marks  
Scale marks should consist of lines of equal thickness; this thickness should be constant and be between  $1/10$  and  $1/4$  of the scale spacing, without being less than  $0.2 \text{ mm}$ . The length of the shortest scale mark should be at least equal to the scale spacing.
- Arrangement of scale marks  
Scale marks should be arranged in accordance with one of the sketches in Figure 5 (the line joining the end of the scale marks is optional).



**Figure 5 – Examples of application to rectilinear scales****c) Numbering**

On one scale, the scale interval used for numbering should be

- constant,
- in the form  $1 \times 10^k$ ,  $2 \times 10^k$ ,  $5 \times 10^k$  units ( $k$  being a positive or negative whole number or equal to zero),
- not greater than 25 times the scale interval of the instrument.

If the scale is projected on a screen, at least two numbered scale marks should appear wholly in the projected zone.

The height of the numbers (real or apparent) expressed in millimetres should be not less than three times the minimum reading distance expressed in metres, without being less than 2 mm.

This height should be proportional to the length of the scale mark to which it relates.

The width of a number, measured parallel to the base of the scale, should be less than the distance between two consecutive numbered scale marks.

**d) Indicating component**

The width of the pointer of the displaying component should be approximately equal to that of the scale marks and of a length such that the tip is at least level with the middle of the shortest mark.

The distance between the scale and the pointer should be at most equal to the scale spacing, without being greater than 2 mm.

**6.5.2 Scale spacing**

The minimum value,  $i_0$ , of the scale spacing is equal to:

- on an instrument of class I or II:
  - 1 mm for indicating devices,
  - 0.25 mm for complementary indicating devices. In this case,  $i_0$  is the relative displacement between the displaying component and the projected scale corresponding to the verification scale interval of the instrument;
- on an instrument of class III or IIII:
  - 1.25 mm for dial indicating devices,
  - 1.75 mm for optical projection indicating devices.

**Acceptable solution:**

The scale spacing (real or apparent),  $i$ , in millimetres, should be at least equal to:

$$(L + 0.5) i_0,$$

where:  $i_0$  = minimum scale spacing in millimetres,

$L$  = minimum reading distance in metres;  $L \geq 0.5$  m

The greatest scale spacing should not exceed 1.2 times the smallest scale spacing of the same scale.

### 6.5.3 Limits of indication

Stops shall limit the movement of the displaying component whilst allowing it to travel below zero and above the capacity of self-indication. This requirement does not apply to multi-revolution dial instruments.

#### Acceptable solution:

The stops limiting the movement of the displaying component should permit it to travel across zones of at least four scale spacings below zero and above the capacity of self-indication (these zones are not provided with a scale on fan charts and on dials with a single revolution pointer; they are called “blank zones”).

### 6.5.4 Damping

The damping of the oscillations of the displaying component or of the movable scale shall be adjusted to a value slightly below “critical damping”, whatever the influence factors.

#### Acceptable solution:

Damping should achieve a stable indication after three, four or five half periods of oscillation.

Hydraulic damping elements sensitive to variations in temperature should be provided with a automatic regulating device or an easily accessible manual regulating device.

It should be impossible for the fluid of hydraulic damping elements on portable instruments to spill when the instrument is inclined at 45°.

## 6.6 Digital indicating devices

The following requirements apply in addition to those in 6.4.1-6.4.5.

### 6.6.1 Change of indication

After a change in load, the previous indication shall not persist for longer than 1 second.

### 6.6.2 Stable equilibrium

An indication is defined as being in stable equilibrium if it is sufficiently close to the final weight value. Stable equilibrium is considered to be achieved if

- in the case of printing and/or data storage, the printed or stored weight values do not deviate more than  $1 e$  from the final weight value (i.e. two adjacent values are allowed), or
- in the case of zero or tare operations, correct operation of the device according to 6.7.4, 6.7.6, 6.7.7 and 6.8.8 within relevant accuracy requirements is achieved.

During continuous or temporary disturbance of the equilibrium, the instrument shall not print, store data, or set zero, or tare.

### 6.6.3 Extended indicating devices

An extended indicating device shall not be used on an instrument with a differentiated scale division.

When an instrument is fitted with an extended indicating device, displaying the indication with a scale interval smaller than  $e$  shall be possible only

- during pressing a key, or

Commented [ID60]: Cross-references from WD corrected.

- for a period not exceeding five seconds after a manual command.

In any case printing shall not be possible while the extended indicating device is in operation.

#### 6.6.4 Multiple use of indicating devices

Indications other than primary indications may be displayed or printed in the same indicating device, provided that

- any additional indications do not lead to any ambiguity in regard to the primary indications,
- quantities other than weight values are identified by the appropriate unit of measurement, or symbol thereof, or a special sign or designation, and
- weight values that are not weighing results (3.5.2.1-3.5.2.3) shall be clearly identified. Otherwise they may be displayed only temporarily on manual command and shall not be printed.

No restrictions apply if the weighing mode is made inoperative and this is clear and unambiguous (also for customers in the case of instruments used for direct sales).

#### 6.6.5 Printing devices

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.

Printing shall be inhibited when the equilibrium is not stable.

#### 6.6.6 Memory storage devices

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

#### 6.7 Zero-setting and zero-tracking devices

An instrument may have one or more zero-setting devices and shall have not more than one zero-tracking device.

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##### 6.7.1 accuracy

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

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

A wider range is possible for the initial zero-setting device if the instrument complies with 5.5, 5.7 and 5.8 for any load compensated by this device within the specified range.

##### 6.7.2 Accuracy

After zero setting the effect of zero deviation on the result of the weighing shall be not more than  $\pm 0.25 e$ .

##### 6.7.3 Multiple range instruments

Zero setting in any weighing range shall be effective also in the greater weighing ranges, if switching to a greater weighing range is possible while the instrument is loaded.

##### 6.7.4 Control of the zero-setting device

An instrument, except an instrument according to 7.1 and 7.2, whether or not equipped with an initial zero-setting device, may have a combined semi-automatic zero-setting and semi-automatic tare- balancing device

operated by the same key.

If an instrument has a zero-setting device and a tare-weighing device the control of the zero-setting device shall be separate from that of the tare-weighing device.

A semi-automatic zero-setting device shall function only when

- the instrument is in stable equilibrium, and
- it cancels any previous tare operation but not the preset tare value.

#### 6.7.5 Zero indicating devices on an instrument with digital indication

An instrument with digital indication shall have a device that displays a special signal when the deviation from zero is not more than  $\pm 0.25 e$ . This device may also work when zero is indicated after a tare operation.

This device is not mandatory on an instrument that has an auxiliary indicating or a zero-tracking device provided that the rate of zero-tracking is not less than  $0.25 d/\text{second}$ .

#### 6.7.6 Automatic zero-setting devices

An automatic zero-setting device shall operate only when

- the instrument is in stable equilibrium, and
- the indication has remained stable below zero for at least five seconds.

Commented [ID62]: Made consistent with previous clause.

#### 6.7.7 Zero-tracking devices

A zero-tracking device shall operate only when

- the indication is at zero, or at a negative net value equivalent to gross zero,
- the instrument is in stable equilibrium, and
- the corrections are not more than  $0.5 d/\text{second}$ .

Commented [ID63]: Made consistent with previous clause.

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

### 6.8 Tare devices

#### 6.8.1 General requirements

A tare device shall comply with the relevant provisions of 6.1-6.5.

#### 6.8.2 Scale interval

The scale interval of a tare-weighing device shall be equal to the scale interval of the instrument for any given load.

#### 6.8.3 Accuracy

A tare device shall permit setting the indication to zero with an accuracy better than

- $\pm 0.25 e$  for electronic instruments and any instrument with analogue indication, or
- $\pm 0.5 d$  for mechanical instruments with digital indication. On a multi-interval instrument  $e$  shall be replaced by  $e_1$ .

#### 6.8.4 Operating range

The tare device shall be such that it cannot be used at or below its zero effect or above its maximum indicated effect.

#### 6.8.5 Visibility of operation

Operation of the tare device shall be visibly indicated on the instrument. In the case of instruments with digital indication this shall be done by marking the indicated net value with the sign “NET”.

*Note 1:* “NET” may alternatively be displayed as “Net” or “net”.

*Note 2:* If an instrument is equipped with a device that allows the gross value to be displayed temporarily while a tare device is in operation, the “NET” symbol shall disappear while the gross value is displayed.

This is not required for an instrument with a combined semi-automatic zero-setting device and a semi-automatic tare-balancing device operated by the same key.

It is permitted to replace “NET” by complete words in an official language of the country in which the instrument is used.

#### Acceptable solution:

The use of a mechanical tare adding device should be shown by the indication of the tare value, or by the display on the instrument of a sign, e.g. the letter “T”.

#### 6.8.6 Subtractive tare devices

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.

#### 6.8.7 Multiple range instruments

On a multiple range instrument the tare operation shall be effective also in the greater weighing ranges, if switching to a greater weighing range is possible while the instrument is loaded. In that case the tare weight values shall be rounded to the scale interval of the actual weighing range which is in operation.

#### 6.8.8 Semi-automatic or automatic tare devices

These devices shall operate only when the instrument is in stable equilibrium.

#### 6.8.9 Combined zero-setting and tare-balancing devices

If the semi-automatic zero-setting device and the semi-automatic tare-balancing device are operated by the same key, 6.6.2, 6.6.5, and if appropriate 6.7.7 apply at any load.

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#### 6.8.10 Consecutive tare operations

Repeated operation of a tare device is permitted.

If more than one tare device is operative at the same time, tare values shall be clearly designated when indicated or printed.

#### 6.8.11 Printing of weighing results

Gross weight values may be printed without any designation. For a designation by a symbol, only “G” or “B” are permitted.

If only net weight values are printed without corresponding gross or tare values, they may be printed without any designation. A symbol for designation shall be “N”. This applies also where semi-automatic zero setting and semi-automatic tare balancing are initiated by the same key.

Gross, net, or tare values determined by a multiple range instrument or by a multi-interval instrument need not be marked by a special designation referring to the (partial) weighing range.

If net weight values are printed together with the corresponding gross and/or tare values, the net and tare values shall at least be identified by the corresponding symbols “N” and “T”.

However, it is permitted to replace “G”, “B”, “N” and “T” by complete words in an official language of the country where the instrument is used.

If net weight values and tare values determined by different tare devices are printed separately, they shall be suitably identified.

When gross, net and tare values are printed together, one of these values may be calculated from two actual determinations of mass. In the case of a multi-interval instrument the calculated weight value may be printed with a smaller scale interval.

The printout of a calculated weight value shall be clearly identified. This should preferably be done by the symbol “C” in addition to the symbol mentioned above if applicable or by complete words in an official language of the country where the instrument is used.

## 6.8.12 Examples of indications of weighing results

### 6.8.12.1 Notes to the subsequent clauses

The following annotations are used on some of the values given in 6.8.12.2-6.8.12.7:

- <sup>1)</sup> The maximum permissible errors are applicable to weighing results of gross (5.5.1), tare (5.5.3.4) and net (5.5.3.3) with the exception of calculated net weights because of a preset tare (5.5.3.3).
- <sup>2)</sup> On multi-interval and on multiple range instruments with automatic changeover in the higher (partial) weighing ranges more than one non-significant zeros may appear, depending on the smallest (partial) weighing range (6.4.2.2).
- <sup>3)</sup> On multiple range instruments the tare values shall be rounded to the scale interval of the actual weighing range which is in operation (6.7.7, 6.9.1).
- <sup>4)</sup> The displayed and printed weighing results (gross, tare weighing, net) shall be rounded each to the actual  $e$ . The  $e$  can be different depending on the actual weighing range or the actual partial weighing range, so a deviation of  $1 \times e$  may be possible between the gross weighing result and the calculation of net and tare values.

Consistent results are only possible according to paragraph 7 and 8 of 6.8.11 (see 6.8.12.7).

- <sup>5)</sup> The calculated net value is calculated from the displayed gross weight value and from the displayed and already rounded preset tare value (3.5.3.2), not from the internal values.

**Commented [ID65]:** These were given as “footnotes” after 6.7.12.6, but could have been confused as being part of it. They have not been inserted as Word footnotes because they are used as common notes across different pages.

### 6.8.12.2 Instrument with a tare-balancing device

Specifications of the instrument: Class III, Max = 15 kg,  $e = 5$  g

Unloaded instrument	displayed value = 0.000 kg
Loading with tare load, internal value = 2.728 kg,	rounded and displayed value = 2.730 kg <sup>1)</sup>
After releasing tare-balancing	displayed net value = 0.000 kg Net
Loading with net load, internal value = 11.833 kg,	rounded and displayed net value = 11.835 kg Net <sup>1)</sup>
Total loading, internal value = 14.561 kg,	rounded and displayed (if possible) gross value = 14.560 kg <sup>1)</sup>

Possible printouts according to 6.7.11:

- a) 14.560 kg B (or G) 11.835 kg N
- b) 14.560 kg 11.835 kg N
- c) 11.835 kg N
- d) 11.835 kg

### 6.8.12.3 Instrument with a tare-weighing device

Specifications of the instrument: Class III Max = 15 kg,  $e = 5$  g

Unloaded instrument	displayed value = 0.000 kg
Loading with tare load, internal value = 2.728 kg,	rounded and displayed value = 2.730 kg <sup>1)</sup>
After releasing tare weighing	displayed net value = 0.000 kg Net
Loading with net load, internal value = 11.833 kg,	rounded and displayed net value = 11.835 kg Net <sup>1)</sup>
Total loading, internal value = 14.561 kg,	rounded and displayed (if possible) gross value = 14.560 kg <sup>1)</sup>

Possible printouts according to 6.7.11:

- a) 14.560 kg B (or G) 11.835 kg N 2.730 kg T<sup>4)</sup>
- b) 14.560 kg 11.835 kg N 2.730 kg T<sup>4)</sup>
- c) 11.835 kg N 2.730 kg T
- d) 11.835 kg N
- e) 11.835 kg

### 6.8.12.4 Multiple range instrument with a tare-weighing device

Specifications of the instrument: Class III,  $\text{Max}_1 = 60 \text{ kg}$ ,  $e_1 = 10 \text{ g}$ ,  $\text{Max}_2 = 300 \text{ kg}$ ,  $e_2 = 100 \text{ g}$

Unloaded instrument	displayed value in weighing range (WR) 1 = WR1	0.000 kg
Loading with tare load, internal value = 53.466 kg,	rounded and displayed value = WR1	53.470 kg <sup>1)</sup>
After releasing tare-weighing	displayed net value = WR1	0.000 kg Net
Loading with net load, internal value = 212.753 kg,	rounded tare-weighing value = WR2	212.800 kg <sup>1)2)</sup>
With automatic change over to weighing range 2, the tare-weighing value shall be rounded to the actual $e$ of weighing range 2,	rounded tare-weighing value = WR2	53.500 kg <sup>2)3)</sup>
Total loading, internal value = 14.561 kg,	rounded and displayed (if possible) gross value = WR2	266.200 kg <sup>1)2)</sup>
Possible printouts according to 6.7.11:		
a) 266.200 kg B (or G)	212.800 kg N	53.500 kg T <sup>2)4)</sup>
b) 266.200 kg	212.800 kg N	53.500 kg T <sup>2)4)</sup>
c) 212.800 kg N	53.500 kg T <sup>2)</sup>	
d) 212.800 kg N <sup>2)</sup>		
e) 212.800 kg <sup>2)</sup>		

#### 6.8.12.5 Multi-interval instrument with a tare-weighing device

Specifications of the instrument: Class III,  $\text{Max} = 3/6/15 \text{ t}$ ,  $e = 0.5/2/10 \text{ kg}$

Unloaded instrument	displayed value in weighing range =	0.0 kg
Loading with tare load, internal value = 6674 kg,	rounded and displayed value =	6670.0 kg <sup>1)</sup>
After releasing tare-weighing	displayed net value =	0.0 kg Net
Loading with net load, internal value = 2673.7 kg,	rounded and displayed net value =	2673.5 kg <sup>1)</sup>
Total loading, internal value = 9347.7 kg,	rounded and displayed (if possible) gross value =	9350.0 kg <sup>1)2)</sup>
Possible printouts according to 6.7.11:		
a) 9350.0 kg B (or G)	2673.5 kg N	6670.0 kg T <sup>2)4)</sup>
b) 9350.0 kg	2673.5 kg N	6670.0 kg T <sup>2)4)</sup>
c) 2673.5 kg N	6670.0 kg T <sup>2)</sup>	
d) 2673.5 kg N <sup>2)</sup>		
e) 2673.5 kg <sup>2)</sup>		

#### 6.8.12.6 Multi-interval instrument with a preset tare device (6.9)

Specifications of the instrument: Class III,  $\text{Max} = 4/10/20 \text{ kg}$ ,  $e = 2/5/10 \text{ g}$

Unloaded instrument	displayed value =	0.000 kg
Loading with gross load, internal value = 13.376 kg,	rounded and displayed gross value =	13.380 kg <sup>1)</sup>
Input of the preset tare value = 3.813 kg,	displayed value during input =	3.813 kg
	rounded and temporarily displayed preset tare value =	3.814 kg PT
The tare value may be rounded up or down, because $e = 2 \text{ g}$ (or 3.812 kg PT)		
Internal calculation: 13.380 kg – 3.818 kg = 9.566 kg,	rounded and displayed net value =	9.565 kg Net <sup>5)</sup>
or: 13.380 kg – 3.812 kg = 9.568 kg,	rounded and displayed net value =	9.570 kg Net <sup>5)</sup>



Possible printouts according to 6.7.11:

- |                       |             |                           |
|-----------------------|-------------|---------------------------|
| a) 13.380 kg B (or G) | 9.565 kg N  | 3.814 kg PT <sup>4)</sup> |
| b) 13.380 kg          | 9.565 kg N  | 3.814 kg PT <sup>4)</sup> |
| c) 9.565 kg N         | 3.814 kg PT |                           |

or:

- |                       |             |                           |
|-----------------------|-------------|---------------------------|
| a) 13.380 kg B (or G) | 9.570 kg N  | 3.812 kg PT <sup>4)</sup> |
| b) 13.380 kg          | 9.570 kg N  | 3.812 kg PT <sup>4)</sup> |
| c) 9.570 kg N         | 3.812 kg PT |                           |

#### 6.8.12.7 Multi-interval instrument with a calculated weight value

Specifications of the instrument: Class III, Max = 20/50/150 kg,  $e = 10/20/100$  g

Unloaded instrument	displayed value =	0.000 kg
First weighing (empty container, tare value) = 17.726 kg	displayed value =	17.730 kg
unloaded instrument	displayed value =	0.000 kg
Second weighing (net load, net value) = 126.15 kg,	rounded and displayed net value =	126.200 kg
Possible printouts according to 6.7.11: Gross 143.930 kg C   Tare 17.730 kg   Net 126.200 kg		

### 6.9 Preset tare devices

#### 6.9.1 Scale interval

Regardless of how a preset tare value is introduced into the device, its scale interval shall be equal or automatically rounded to the scale interval of the instrument. On a multiple range instrument a preset tare value may only be transferred from one weighing range to another one with a larger verification scale interval but shall then be rounded to the latter (see also 6.12). For a multi-interval instrument, the preset tare value shall be rounded to the smallest verification scale interval,  $e_1$ , of the instrument, and the maximum preset tare value shall not be greater than  $\text{Max}_1$ . The displayed or printed calculated net value shall be rounded to the scale interval of the instrument for the same net weight value.

#### 6.9.2 Modes of operation

A preset tare device may be operated together with one or more tare devices provided that

- 6.8.10 is respected, and
- 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 of the load to be weighed).

#### 6.9.3 Indication of operation

Operation of the preset tare device shall be visibly indicated on the instrument. In the case of instruments with digital indication this shall be done by marking the indicated net value with “NET”, “Net” or “net” or by complete words in an official language of the country in which the instrument is used. If an instrument is equipped with a device that allows the gross value to be displayed temporarily while a tare device is in operation, the “NET” symbol shall disappear while the gross value is displayed.

It shall be possible to indicate the preset tare value at least temporarily.

6.8.11 applies accordingly, provided that

- if the calculated net value is printed, at least the preset tare value is printed as well, with the exception of an instrument covered by 7.1, 7.2 or 7.4, and
- preset tare values are designated by the symbol “PT”. However, it is permitted to replace the symbol “PT” by complete words in an official language of the country in which the instrument is used.

*Note:* 6.9.3 also applies to instruments with a combined semi-automatic zero-setting device and a semi-automatic tare-balancing device operated by the same key.

## **6.10 Locking positions**

### **6.10.1 Prevention of weighing outside the “weigh” position**

If an instrument has one or more locking devices, these devices shall only have two stable positions corresponding to “locked” and “weigh” and weighing shall only be possible in the “weigh” position.

A “preweigh” position may exist on an instrument of class I or II except those under 7.1, 7.2 and 7.4.

### **6.10.2 Indication of position**

The “locked” and “weigh” positions shall be clearly shown.

## **6.11 Auxiliary verification devices (removable or fixed)**

### **6.11.1 Devices with one or more platform(s)**

The nominal value of the ratio between the weights to be placed on the platform to balance a certain load and this load shall not be less than 1/5000 (it shall be visibly indicated just above the platform).

The value of the weights needed to balance a load equal to the verification scale interval shall be an integer multiple of 0.1 g.

### **6.11.2 Numbered scale devices**

The scale interval of the auxiliary verification device shall be equal to or smaller than 1/5 of the verification scale interval for which it is intended.

## **6.12 Selection of weighing ranges on a multiple range instrument**

The range which is actually in operation shall be clearly indicated. Manual selection of the weighing range is allowed

- from a smaller to a greater weighing range, at any load, and
- from a greater to a smaller weighing range, when there is no load on the load receptor, and the indication is zero or at a negative net value equivalent to gross zero; the tare operation shall be cancelled, and zero shall be set to  $\pm 0.25 e_1$ , both automatically.

Automatic change-over is allowed

- from a smaller to the following greater weighing range when the load exceeds the maximum gross weight  $Max_i$  of the range,  $i$ , of the range being operative, and
- only from a greater to the smallest weighing range when there is no load on the load receptor, and the indication is zero or at a negative net value equivalent to gross zero. The tare operation shall be cancelled and zero shall be set to  $\pm 0.25 e_1$ , both automatically.

### 6.13 Devices for selection (or switching) between various load receptors and/or load transmitting devices and various load measuring devices

#### 6.13.1 Compensation of no-load effect

The selection device shall ensure compensation for the unequal no-load effect of the various load receptors and/or load transmitting devices in use.

#### 6.13.2 Zero-setting

Zero-setting of an instrument with any multiple combination of various load measuring devices and various load receptors shall be possible without ambiguity and in accordance with the provisions of 6.7.

**Commented [ID66]:** Incorrect cross-reference in WD corrected.

#### 6.13.3 Impossibility of weighing

Weighing shall not be possible while selection devices are being used.

#### 6.13.4 Identification of the combinations used

Combinations of load receptors and load measuring devices used shall be readily identifiable. It shall be clearly visible which indication(s) correspond to which load receptor(s).

### 6.14 “Plus and minus” comparator instruments

For the purposes of verification, a “plus and minus” comparator instrument is considered to be a semi- self-indicating instrument.

#### 6.14.1 Distinction between “plus” and “minus” zones

On an analogue indicating device the zones situated on either side of zero shall be distinguished by “+” and “-” signs.

On a digital indicating device an inscription near the indicating device shall be given:

- range  $\pm \dots u_m$ ; or
- range  $-\dots u_m / + \dots u_m$

where  $u_m$  represents the unit of measurement according to 4.4.

#### 6.14.2 Form of scale

The scale of a comparator instrument shall have at least one scale division,  $d = e$ , on either side of zero. The corresponding value shall be shown at either end of the scale.

### 6.15 Modes of operation

An instrument may have different modes of operation, which can be selected on manual command.

Examples of weighing modes are:

- weighing ranges;
- combinations of platforms;
- multi-interval or single interval instrument;
- operator or self-service mode;
- preset-tare setting; and
- display or instrument switching-off, etc.

Examples of non-weighing modes (modes in which weighing is inoperative) are:

- calculated values;
- sums;
- counting;
- percentage;
- statistics;
- calibration; and
- configuration, etc.

The mode which is actually in operation shall be clearly identified by a special sign, symbol or words in the language of the country, in which the instrument is used. In any case the requirements in 6.6.4 also apply.

In any mode and at any time it shall be possible to switch back to the weighing mode.

Automatic selection of the mode is only permitted within a weighing sequence (e.g. a fixed sequence of weighings to produce a mixture). At the end of the weighing sequence the instrument shall switch back to the weighing mode automatically.

When returning from a non-weighing mode to the weighing mode, the actual weight value may be displayed.

When returning from the switch-off condition (display or instrument switch-off) to the weighing mode, zero shall be displayed (automatic zero- or tare-setting). Alternatively the actual weight value may be displayed, but only if the correct zero position has been automatically checked before.

#### 6.16 Technical requirement on modules

xxx

**Commented [ID67]:** Can this be updated with output of SG?

## 7 Specific technical requirements and uses

### 7.1 Instruments for direct sales to the public

*Note:* Interpretation of what is included in “direct sales to the public” is left up to national legislation.

The following requirements apply to an instrument of class II, III or IIII with a maximum capacity not greater than 100 kg designed to be used for direct sales to the public, in addition to the requirements of 6.1.1, 6.1.2, 6.3-6.13 and 6.15.

#### 7.1.1 Primary indications

On an instrument for direct sales to the public the primary indications are the weighing result and information about correct zero position, tare and preset tare operations.

#### 7.1.2 Zero-setting devices

An instrument for direct sales to the public shall not be fitted with a non-automatic zero-setting device unless operated only with a tool.

#### 7.1.3 Tare devices

A mechanical instrument with a weight receptor shall not be fitted with a tare device.

An instrument with one platform may be fitted with tare devices if they allow the public to see:

- whether they are in use; and
- whether their setting is altered.

Only one tare device shall be in operation at any given time.

*Note:* The restrictions in use are included under 7.1.3.2, 2nd indent.

An instrument shall not be fitted with a device which can recall the gross value while a tare or preset tare device is in operation.

#### **7.1.3.1 Non-automatic tare devices**

A displacement of 5 mm of a point of the control shall be at most equal to one verification scale interval.

#### **7.1.3.2 Semi-automatic tare devices**

An instrument may be fitted with semi-automatic tare devices if

- the action of the tare devices does not permit a reduction of the value of the tare, and
- their effect can only be cancelled when there is no load on the load receptor.

In addition, the instrument shall comply with at least one of the following requirements:

- the tare value is indicated permanently in a separate display;
- the tare value is indicated with a “—” sign when there is no load on the load receptor; or
- the effect of the device is cancelled automatically and the indication returns to zero when unloading the load receptor after a stable net weighing result greater than zero has been indicated.

#### **7.1.3.3 Automatic tare devices**

An instrument shall not be fitted with an automatic tare device.

#### **7.1.3.4 Preset tare devices**

A preset tare device may be provided if the preset tare value is indicated as a primary indication on a separate display which is clearly differentiated from the weight display. The first paragraph of 7.1.3.2 applies.

It shall not be possible to operate a preset tare device if a tare device is in use.

Where a preset tare is associated with a price look up (PLU) the preset tare value should be cancelled at the same time as the PLU is cancelled.

#### **7.1.4 Impossibility of weighing**

It shall be impossible to weigh or to guide the indicating element during the normal locking operation or during the normal operation of adding or subtracting weights.

#### **7.1.5 Visibility**

All primary indications (7.1.1 and 7.2.1 if applicable) shall be indicated clearly and simultaneously to both the vendor and the customer. If this is not possible with one display device two sets are necessary, one set each for the vendor and the customer.

On digital devices that display primary indications, the numerical figures displayed to the customer shall be at least 9.5 mm high.

On an instrument to be used with weights it shall be possible to distinguish the value of the weights.

#### **7.1.6 Auxiliary and extended indicating devices**

An instrument shall not be fitted with an auxiliary indicating device nor an extended indicating device.

#### **7.1.7 Instruments of class II**

An instrument of class II shall comply with the requirements given in 5.8 for an instrument of class III.

**7.1.8 Significant fault**

When a significant fault has been detected, a visible or audible alarm shall be provided for the customer, and data transmission to any peripheral equipment shall be prevented. This alarm shall continue until such time as the user takes action or the cause disappears.

**7.1.9 Counting ratio**

The counting ratio on a mechanical counting instrument shall be 1/10 or 1/100.

**7.1.10 Self-service instruments**

A self-service instrument need not have two sets of scales or displays.

If a ticket or a label is printed, the primary indications shall include a designation of the product when the instrument is used to sell different products.

If a price-computing instrument is used as a self-service instrument then the requirements in 7.2 shall be met.

**7.2 Additional requirements for price-computing instruments for direct sales to the public**

The following requirements are to be applied in addition to 7.1.

**7.2.1 Primary indications**

On a price-indicating instrument the supplementary primary indications are unit price and price to pay and, if applicable, number, unit price and price to pay for non-weighed articles, prices for non-weighed articles and price totals. Price charts (as opposed to price scales, which are covered by 7.2.2), such as fan charts, are not subject to the requirements of this Recommendation.

**7.2.2 Instruments with price scales**

For unit price and price-to-pay scales, 6.3 and 6.5.1-6.5.3 apply accordingly; however, decimal fractions shall be indicated according to national regulations.

It shall be possible to read price scales such that the absolute value of the difference between the product of the indicated weight value,  $W$ , and the unit price,  $U$ , and the indicated price to pay,  $P$ , is not greater than the product of  $e$  and the unit price for that scale:

$$|W \times U - P| \leq e \times U$$

**7.2.3 Price computing instruments**

The price to pay shall be calculated and rounded to the nearest interval of price to pay, by multiplication of weight value and unit price, both as indicated by the instrument. The device or devices which perform the calculation and indication of the price to pay are in any case considered part of the instrument.

The interval of price to pay shall comply with the national regulations applicable to trade. The unit price is restricted to price/100 g or price/kg.

Notwithstanding the provision in 6.6.1:

- the indications of weight value, unit price and price to pay shall remain visible after the weight indication is stable, and after any introduction of the unit price, for at least one second and while the load is on the load receptor; and
- these indications may remain visible for no more than 3 seconds after removing the load, provided that the weight indication has been stable before and the indication would otherwise be zero. As long as there is a weight indication after removing the load, it shall not be possible to introduce or change a unit price.

If transactions performed by the instrument are printed, weight value, unit price and price to pay shall all be

printed.

The data may be stored in a memory of the instrument before printing. The same data shall not be printed twice on the ticket for the customer.

Instruments that can be used for price labelling purposes must also comply with 7.4.

#### **7.2.4 Special applications of price computing instruments**

Only if all transactions performed by the instrument or by connected peripherals are printed on a ticket or label intended for the customer, a price computing instrument may perform additional functions which facilitate trade and management. These functions shall not lead to confusion about the results of weighing and price computing.

Other operations or indications not covered by the following provisions may be performed, provided that no indication which could possibly be misunderstood as a primary indication is presented to the customer.

##### **7.2.4.1 Non-weighed articles**

An instrument may accept and record positive or negative prices to pay of one or several non-weighed articles, provided that the weight indication is zero or the weighing mode is made inoperative. The price to pay for one or more of such articles shall be shown in the price-to-pay display.

If the price to pay is calculated for more than one equal articles, the number of articles shall be shown on the weight display, without being possibly taken for a weight value, and the price for one article on the unit price display, unless supplementary displays are used to show the number of articles and the article price.

##### **Acceptable solution:**

A number of articles shown on the weight display is distinguished from a weight value by including an appropriate designation such as “X” or other clear designation in accordance with national regulations (if any).

##### **7.2.4.2 Totalization**

An instrument may totalize transactions on one or several tickets; the price total shall be indicated on the price-to-pay display, and printed accompanied by a special word or symbol, either at the end of the price-to-pay column, or on a separate label or ticket with appropriate reference to the commodities whose prices to pay have been totalized; all prices to pay that are totalized shall be printed, and the price total shall be the algebraic sum of all these prices as printed.

An instrument may totalize transactions performed on other instruments linked to it, directly or over metrologically controlled peripherals, under the provisions of 7.2.4 and if the price-to-pay scale intervals of all connected instruments are identical.

##### **7.2.4.3 Multi-vendor operation**

An instrument may be designed to be used by more than one vendor or to serve more than one customer at the same time, provided that the connection between the transactions and the relevant vendor or customer is appropriately identified (refer to 7.2.4).

##### **7.2.4.4 Cancellation**

An instrument may cancel previous transactions. Where the transaction has already been printed, the relevant price to pay cancelled shall be printed with an appropriate comment. If the transaction to be cancelled is displayed to the customer it shall be clearly differentiated from normal transactions.

##### **7.2.4.5 Additional information**

An instrument may print additional information if this is clearly correlated to the transaction and does not interfere with the assignment of the weight value to the unit symbol.

### 7.3 Instruments similar to those normally used for direct sales to the public

An instrument similar to one normally used for direct sales to the public which does not comply with the provisions of 6, 7.1 and 7.2 shall carry, near the display, the indelible marking “Not to be used for direct sales to the public”

### 7.4 Price-labelling instruments

Clauses 7.1.7, 7.2.3 (paragraphs 1 and 5), 7.2.4.1 (paragraph 1) and 7.2.4.5 apply.

A price-labelling instrument shall have at least one display for the weight value. It may be used temporarily for set-up purposes such as supervision of setting weight limits, unit prices, preset tare values, commodity names.

It shall be possible to verify, during use of the instrument, the actual values of unit price and preset tare value.

Printing below minimum capacity shall not be possible.

Printing of labels with fixed values of weight, unit price and price to pay is allowed provided that the weighing mode is obviously made inoperative.

### 7.5 Mechanical counting instruments with unit-weight receptor

For the purpose of verification, a counting instrument is considered to be a semi-self-indicating instrument.

#### 7.5.1 Indicating devices

To permit verification, a counting instrument shall have a scale with at least one scale division,  $d = e$ , on either side of zero; the corresponding value shall be shown on the scale.

#### 7.5.2 Counting ratio

The counting ratio shall be shown clearly just above each counting platform or each counting scale mark.

### 7.6 Additional technical requirements for mobile instruments (see also 5.8.1.1)

#### 7.6.1 General

Depending on the type of mobile instrument the following characteristics shall be defined by the applicant:

- warm-up procedure/period (in addition to 6.1.5.5) of the hydraulic lifting system when a hydraulic system is involved in the weighing process;
- the limiting value of tilting (upper limit of tilting) (see 5.8.1.1);
- special conditions if the instrument is designed to be used for weighing liquid products;
- description of special positions (e.g. weighing window) for the load receptor to ensure acceptable conditions during the weighing operation; and
- description of detectors or sensors that may be used to ensure that the weighing conditions are met (applicable e.g. for mobile instruments used outside in open locations).

Commented [ID68]: This para is not currently numbered.

#### 7.6.2 Mobile instruments used outside in open locations (see also 5.8.1.1 d)

*Note:* This section also applies to special indoor applications with uneven grounds or floors (e.g. fork lift vehicles in halls with uneven floors).

The instrument shall have appropriate means to indicate that the limiting value of tilting has been exceeded (e.g. display switch-off, lamp, error signal), and to inhibit the printout and data transmission in that case.

After each moving of the vehicle a zero-setting or tare balancing operation shall occur automatically at least after switching-on of the weighing instrument.



On instruments with a weighing window (special positions or conditions of the load receptor) it shall be indicated, when the instrument is not within the weighing window (e.g. display switch-off, lamp, error signal) and the printout and data transmission shall be inhibited. Sensors, switches or other means may be used to recognize the weighing window.

If the load measuring device of the instrument is sensitive to influences depending on the moving or driving, it shall be equipped with an appropriate protection system.

6.1.5.5 applies during a warm-up time or procedure, e.g. if a hydraulic system is involved in the weighing process.

**Commented [ID69]:** This para is not currently numbered.

Where an automatic tilt sensor is also used to compensate the effect of tilting by adding a correction to the weighing result, this sensor is regarded as an essential part of the weighing instrument that shall be submitted to influence factors and disturbance tests during the type approval procedure.

Where a Cardanic (gimbal type) suspension is used, appropriate provisions shall be taken to prevent the indication, printing or data transmission of wrong weighing results if the suspended system or the load receptor comes into contact with the surrounding frame construction, especially when tilted to more than the limiting value.

The OIML Test Report shall include a description of the tilting tests to be performed at verification.

### 7.6.3 Other mobile instruments

Mobile instruments not intended to be used outside in open locations (e.g. wheel chair weighers, patient lifters) shall have a device to prevent the influence of tilting according to 5.8.1.1 a), b) or d). If they are equipped with a levelling device and a level indicator according to 5.8.1.1 a), the levelling device shall be operated easily without tools. They shall bear an appropriate inscription pointing the user to the necessity of levelling after each movement.

### 7.7 Portable instruments for weighing road vehicles

Portable weighbridges shall be identified as such in the application for type approval and in the issued corresponding OIML certificate.

The applicant shall provide documentation describing the appropriate mounting surface.

*Note 1:* Groups of associated axle or wheel load weighers may be used for determining the total mass of the vehicle only if all wheels are supported simultaneously. Depending on national regulations, sequentially determining the axle or wheel loads using an axle/wheel weigher could be allowed to determine the total mass of a road vehicle, but this is not in the scope of this Recommendation. The total mass may be calculated from axle loads but this is not considered as being subject to legal control, for the reasons given in Note 2.

*Note 2:* When using single axle or wheel weighers the vehicle itself is the load and thus forms a link between the portable instrument and the fixed environment. This may lead to considerable errors if additional effects on the weighing result are not properly taken into account. These effects may be caused by

- lateral forces due to interactions of the weighbridge with the vehicle,
- forces on part of the vehicle by different transient behaviour and friction within the axle suspensions, or
- forces on part of the ramps if there are different levels between the weighbridge and ramp that could lead to varying distribution of the axle load.

### 7.8 Instruments installed in ships

#### 7.8.1 Additional sensors

Specially designed gravity compensated scales may incorporate two load cells. The additional load cell, if any, shall not necessarily be identical to that of the NAWI. The equipment shall be such that requirements about “g” variations are fulfilled. The same principle applies for tilt compensation and for acceleration.

### 7.8.2 g-compensation

Minimum value for g-compensation is  $\pm 3 \text{ m/s}^2$  unless the instrument display is blanked out, and the print-out and data transmission is inhibited at a lesser value.

The g-test

- is performed dynamically,
- with test loads near zero, near Max and if the number of scale divisions is higher than 500 e, at a load near but lower than 500 e,
- If no limiting value for g-compensation is specified, g-test should be carried out up to  $\pm 3 \text{ m/s}^2$  or, where the instrument display is blanked out at a lower value, g-test should be carried out up to this limited value, and
- shall be performed with a frequency that does not exceed 0.3 Hz.

During g-test, accuracy of zero setting and tare setting devices shall be tested.

### 7.8.3 Minimum value for tilt – Tilt test

Tilt testing should be carried out up to 25 % (15 degrees) unless the instrument display is blanked out, and the print-out and data transmission is inhibited at a lesser value. When a tilt-sensor is regarded as a module, the  $p_i$  factor shall be determined at the type approval stage.

Where a sensor (measuring the tilt angle) is used to compensate the effect of tilting on the weighing result, the sensor is regarded as an essential part of the weighing instrument. It should therefore be submitted to the essential tests such as temperature, humidity and EMC, during the approval procedure.

Tilt tests shall be introduced into “standard” tests as follows:

- at each temperature, at each step of humidity test, the equipment shall also be tested to a tilted position; only one direction of tilt is necessary; three test loads shall be applied, i.e. near zero, near Max and if the number of scale divisions is higher than 500 e, at a load near but lower than 500 e;
- EMC tests are performed with one tilted position with one load near 500 e, not necessary with a small test load (to optimize tests costs and duration);
- If no limiting value for tilt is specified, tilt-tests should be carried out up to 25 % (15 degrees) or, where the instrument display is blanked out at a lower value, tilt-tests should be carried out up to this limited value.

*Note:* As EMC tests may only be performed with tilted position with greater test load, there is a risk that the cause of a failed test is not known (i.e. either the weighing device or the tilt compensation device).

### 7.8.4 Test of behaviour of tilt compensation device in dynamic mode

A test of behaviour of tilt compensation device in dynamic mode shall be performed in the following conditions:

- with three test loads, i.e. near Min, near Max and with a load near to but lower than 500 e
- with an amplitude of the dynamic tilt of 25 % or the limiting value once in transversal direction and once in longitudinal direction
- with a frequency between 0.03 Hz and 0.3 Hz.

### 7.8.5 Tare weighing test in dynamic mode

A tare weighing test shall be performed during g-test in dynamic mode with a tare value close to 1/3 of Max with tests loads of [Max - T] and if applicable with tests loads of [500 e - T].

## 8 Technical requirements for non-self-indicating instruments

A non-self-indicating instrument shall comply with clauses 5 and 6, as far as applicable. This clause gives complementary provisions corresponding to some of the requirements of clause 6.

While the provisions of 8.1 are mandatory, those of 8.2 contain “acceptable solutions” as introduced in clause 6.

Provisions for certain simple instruments that may be submitted directly for initial verification are given in 8.3-8.9. These simple instruments are:

- simple equal arm and 1/10 ratio beams;
- simple steelyards with sliding poises;
- Roberval and Béranger instruments;
- instruments with ratio platforms; and
- instruments of the steelyard type with accessible sliding poises.

### 8.1 Minimum sensitivity

An extra load equivalent to the absolute value of the maximum permissible error for the applied load, but not less than 1 mg, shall be placed on the instrument at equilibrium and shall cause a permanent displacement of the indicating element of at least:

- 1 mm for an instrument of class I or II;
- 2 mm for an instrument of class III or IIII with  $\text{Max} \leq 30 \text{ kg}$ ;
- 5 mm for an instrument of class III or IIII with  $\text{Max} > 30 \text{ kg}$ .

The sensitivity tests shall be carried out by placing extra loads with a slight impact, in order to eliminate the effects of discrimination threshold.

### 8.2 Acceptable solutions for indicating devices

#### 8.2.1 General provisions

##### 8.2.1.1 Equilibrium indicating components

For an instrument with an indicating component which moves in relation to another indicating component, the two indices shall be of the same thickness and the distance between them shall not exceed this thickness.

However, this distance may be equal to 1 mm, if the thickness of the indices is less than this value.

##### 8.2.1.2 Non-self-indicating instruments

An extra load equivalent to 0.4 times the absolute value of the maximum permissible error for the applied load, but not less than 1 mg, when gently placed on or withdrawn from the instrument at equilibrium shall produce a visible displacement of the indicating element.

##### 8.2.1.3 Securing

It shall be possible to secure the sliding poises, the removable masses and the adjusting cavities or the housings of such devices.

##### 8.2.1.4 Printing

If the device permits printing, this shall be possible only if sliding bars or poises or a weight switching mechanism are each in a position corresponding to a whole number of scale divisions. Except for accessible sliding poises or bars, printing shall only be possible if the equilibrium indicating component is in the reference

**Commented [ID70]:** This clause, and many subsequent ones, used “are”, “is”, or similar instead of “shall be” or “shall”. This has been changed throughout to align with the correct grammatical expression for requirements according to B 6-2.

position to within the nearest half scale interval.

## **8.2.2 Sliding poise devices**

### **8.2.2.1 Form of scale marks**

On bars on which the scale interval is the verification scale interval of the instrument, the scale marks shall consist of lines of constant thickness. On other major (or minor) bars the scale marks shall consist of notches.

### **8.2.2.2 Scale spacing**

The distance between scale marks shall not be less than 2 mm and shall be of sufficient length that the normal machining tolerances for notches or scale marks do not cause an error in the weighing result exceeding 0.2 times the verification scale interval.

### **8.2.2.3 Stops**

The displacement of sliding poises and minor bars shall be limited to the graduated part of major and minor bars.

### **8.2.2.4 Displaying components**

Each sliding poise shall be provided with a displaying component.

### **8.2.2.5 Accessible sliding poise devices**

There shall be no moving parts in sliding poises, except sliding minor bars.

There shall be no cavities on sliding poises which could accidentally hold foreign bodies. It shall not be possible to secure parts that are detachable.

The displacement of sliding poises and minor bars shall require a certain effort.

## **8.2.3 Indication by use of metrologically controlled weights**

The reduction ratios shall be in the form  $10^k$ ,  $k$  being an integer or zero.

On an instrument intended for direct sales to the public, the height of the raised edge of the weight receptor platform shall not exceed one tenth of the greatest dimension of the platform, without being greater than 25 mm.

## **8.3 Conditions of construction**

### **8.3.1 Equilibrium indicating components**

An instrument shall be provided with two moving indices or one moving indicating component and a fixed datum mark, the respective position of which indicates the reference position of equilibrium.

On an instrument of class III or IIII designed to be used for direct sales to the public, the indices and scale marks shall allow equilibrium to be seen from opposite sides of the instrument.

### **8.3.2 Knives, bearings and friction plates**

#### **8.3.2.1 Types of connection**

Levers shall only be fitted with knives; these shall be pivoted on bearings. The line of contact between knives and bearings shall be a straight line.

Counter-beams shall be pivoted on knife-edges.

**8.3.2.2 Knives**

The knives shall be fitted to the levers in such a way that the invariability of the ratios of the lever arms is assured. They shall not be welded or soldered.

The edges of the knives of one and the same lever shall be practically parallel and shall be situated in one plane.

**8.3.2.3 Bearings**

The bearings shall not be welded or soldered to their supports or in their mountings.

It shall be possible for bearings of an instrument with ratio platforms and steelyards to oscillate in all directions on their supports or in their mountings. On such instruments anti-disconnection devices shall prevent the disconnection of articulated parts.

**8.3.2.4 Friction plates**

The longitudinal play of the knives shall be limited by friction plates. There shall be point contact between knife and friction plates and it shall be situated on the extension of the line(s) of contact between knife and bearing(s).

The friction plate shall form a plane through the point of contact with the knife and its plane shall be perpendicular to the line of contact between knife and bearing. It shall not be welded or soldered to the bearings or their support.

**8.3.3 Hardness**

Contact parts of knives, bearings, friction plates, sliding poise devices interlevers, interlever supports and links shall have a hardness of at least 58 Rockwell C.

**8.3.4 Protective coating**

A protective coating may be applied to the parts in contact of jointed components, provided that this does not lead to changes of metrological properties.

**8.3.5 Tare devices**

No instrument shall be fitted with a tare device.

**8.4 Simple equal arm beam****8.4.1 Symmetry of the beams**

The beam shall have two planes of symmetry: longitudinal and transversal. It shall be in equilibrium with or without the pans. Detachable parts which may be used equally well on either end of the beam shall be interchangeable and of equal mass.

**8.4.2 Zero setting**

If an instrument of class III or IIII is provided with a zero-setting device, this shall be a cavity below one of the pans.

This cavity may be secured.

**8.5 Simple 1/10 ratio beam****8.5.1 Indication of the ratio**

The ratio shall be indicated legibly and permanently on the beam in the form 1:10 or 1/10.

#### **8.5.2 Symmetry of the beam**

The beam shall have a longitudinal plane of symmetry.

#### **8.5.3 Zero setting**

The provisions of 8.4.2 apply.

### **8.6 Simple sliding poise instruments (steelyards)**

#### **8.6.1 General**

##### **8.6.1.1 Scale marks**

The scale marks shall be lines or notches, either on the edge, or on the flat of the graduated shank. The minimum scale spacing is 2 mm between notches and 4 mm between lines.

##### **8.6.1.2 Pivots**

The load per unit length on the knives shall be not more than 10 kg/mm.

The bores of bearings in the form of an annulus shall have a diameter at least equal to 1.5 times the largest dimension of the cross section of the knife.

##### **8.6.1.3 Equilibrium indicating component**

The length of the equilibrium indicating component, taken from the edge of the fulcrum knife-edge of the instrument, shall be not less than 1/15 of the length of the graduated part of the major sliding poise bar.

##### **8.6.1.4 Distinctive mark**

The head and the sliding poise of an instrument with detachable sliding poises shall bear the same distinctive mark.

#### **8.6.2 Instruments with single capacity**

##### **8.6.2.1 Minimum distance between knife-edges**

The minimum distance between knife-edges is:

- 25 mm for maximum capacities  $\leq 30$  kg, and
- 20 mm for maximum capacities  $> 30$  kg.

##### **8.6.2.2 Graduation**

The graduation shall extend from zero to the maximum capacity.

##### **8.6.2.3 Zero-setting**

If an instrument of class III or IIII is provided with a zero-setting device, this shall be a captive screw or nut arrangement with a maximum effect of 4 verification scale intervals per revolution.

#### **8.6.3 Instruments with dual capacity**

##### **8.6.3.1 Minimum distance between knife-edges**

The minimum distance between the knife-edges is:

- 45 mm for the lower capacity; and
- 20 mm for the higher capacity.

**8.6.3.2 Differentiation of suspension mechanisms**

The suspension mechanism of an instrument shall be differentiated from the load suspension mechanism.

**8.6.3.3 Numbered scales**

The scales corresponding to each of the capacities of the instrument shall permit weighing from zero to maximum capacity, without a break in continuity:

either without the two scales having a common part; or

with a common part of not more than  $1/5$  of the highest value of the lower scale.

**8.6.3.4 Scale intervals**

The scale intervals of each of the scales shall have a constant value.

**8.6.3.5 Zero-setting devices**

Zero-setting devices are not permitted.

**8.7 Roberval and Béranger instruments****8.7.1 Symmetry**

Detachable symmetrical parts occurring in pairs shall be interchangeable and of equal mass.

**8.7.2 Zero-setting**

If an instrument is provided with a zero-setting device, this shall be a cavity below the support of one of the pans. This cavity may be secured.

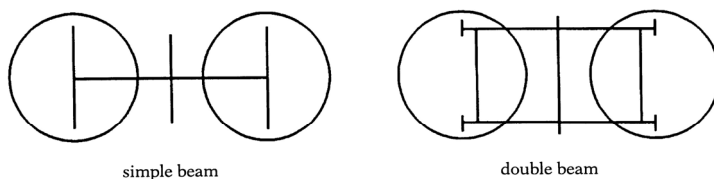
**8.7.3 Length of the knife-edges**

On an instrument having a simple beam:

- the distance between the outward ends of the load knife-edges shall be at least equal to the diameter of the bottom of the pan; and
- the distance between the outward ends of the centre knife-edge shall be at least equal to 0.7 times the length of the load knife-edges.

A double beam instrument shall have a stability of the mechanism equal to that obtained with a simple beam instrument.

**Figure 6** – Single and doublebeam instruments

**8.8 Instruments with ratio platforms****8.8.1 Maximum capacity**

The maximum capacity of the instrument shall be greater than 30 kg.

Commented [ID71]: Caption added

**8.8.2 Indication of the ratio**

The ratio between the weighed load and the equilibrium load shall be indicated legibly and permanently on the beam in the form 1:10 or 1/10.

**8.8.3 Zero-setting**

An instrument shall have a zero-setting device consisting of either:

- a cup with a very convex cover; or
- a captive screw or nut arrangement, with a maximum effect of four verification scale intervals per revolution.

**8.8.4 Complementary balancing devices**

If an instrument is provided with a complementary device that avoids the use of weights which are of low value in relation to the maximum capacity, this device shall be a graduated steelyard with a sliding poise, the effect being additive and not more than 10 kg.

**8.8.5 Locking of the beam**

An instrument shall have a manual device for locking the beam, the action of which prevents the equilibrium indices coinciding when at rest.

**8.8.6 Provisions relating to wooden parts**

If certain parts of an instrument, such as the frame, the platform or the board are of wood, this shall be dry and free from defects. It shall be covered with a paint or an effective protective varnish.

No nails shall be used for the final assembly of wooden parts.

**8.9 Instruments with a load-measuring device having accessible sliding poises (of the steelyard type)****8.9.1 General**

The provisions of 8.2 relating to load measuring devices with accessible sliding poises shall be observed.

**8.9.2 Range of numbered scale**

The numbered scale of the instrument shall permit continuous weighing from zero to the maximum capacity.

**8.9.3 Minimum scale spacing**

The scale spacing  $i_x$  of the different bars ( $x = 1, 2, 3...$ ) corresponding to the scale interval,  $d_x$ , of these bars, shall be:

$$i_x \geq (d_x/e) \times 0.05 \text{ mm, but } i_x \geq 2 \text{ mm}$$

**8.9.4 Ratio platform**

If an instrument is provided with a ratio platform for extending the indicating range of the numbered scale, the ratio between the value of the weights placed on the platform to balance a load and the load itself shall be 1/10 or 1/100.

This ratio shall be indicated legibly and permanently on the beam in a position close to the ratio platform, in the form: 1:10, 1:100, or 1/10, 1/100.

**8.9.5 Zero-setting**

The provisions of 8.8.3 apply.



**8.9.6 Locking of the beam**

The provisions of 8.8.5 apply.

**8.9.7 Wooden parts**

The provisions of 8.8.6 apply.

**9 Marking of instruments and modules****9.1 Descriptive markings**

*Note:* The descriptive markings given here are by way of example, but variable according to national regulations.

An instrument shall carry the following markings.

**9.1.1 Compulsory in all cases**

- Manufacturer's mark, or name written in full (A);
- Metrological markings (B):
  - Indication of accuracy class in the form of a Roman number in an oval (see footnote to 5.1.1):
 

for special accuracy:	ⓐ
for high accuracy:	ⓑ
for medium accuracy:	ⓒ
for ordinary accuracy:	ⓓ
  - Maximum capacity in the form: Max ...
  - Minimum capacity in the form: Min ...
  - Verification scale interval in the form:  $e = \dots$

**9.1.2 Compulsory if applicable**

- Name or mark of manufacturer's agent for an imported instrument (C);
- Serial number (D);
- Identification mark on each unit of an instrument consisting of separate but associated units (E);
- Type approval mark (F);
- Supplementary metrological characteristics (G):
  - software identification (compulsory for software-controlled instruments)
  - scale interval, if  $d < e$ , in the form:  $d = \dots$
  - maximum additive tare effect, in the form:  $T = +\dots$
  - maximum subtractive tare effect if different from Max, in the form:  $T = -\dots$
  - counting ratio on a counting instrument according to 7.5, in the form: 1:... or 1/...
  - range of plus/minus indication of a digital comparator instrument, in the form:  $\pm \dots u_m$  OR  $-\dots u_m / +\dots u_m$
  - ( $u_m$  standing for the unit of mass as in 4.4)
  - ratio between weight platform and load platform as specified in 8.5.1, 8.8.2 and 8.9.4;

- Special limits (H):

- maximum safe load, in the form:  $\text{Lim} = \dots$   
(if the manufacturer has provided for a maximum safe load of more than  $\text{Max} + T$ )
- the special temperature limits according to 5.8.2.2 within which  
the instrument complies with the prescribed conditions  
of correct operation, in the form:  $\dots\text{ }^{\circ}\text{C} / \dots\text{ }^{\circ}\text{C}$ .

### 9.1.3 Additional markings (I)

Additional markings may, if necessary, be required on an instrument according to its particular use or to certain special characteristics, such as:

- not to be used for direct sales to the public/commercial transactions;
- to be used exclusively for: ..... ;
- the stamp does not guarantee/guarantees only: ..... ;
- to be used only as follows: .....

These additional markings may be either in the national language or in form of adequate, internationally agreed and published pictograms or signs.

### 9.1.4 Presentation of descriptive markings

The descriptive markings shall be indelible and of a size, shape and clarity allowing easy reading.

They shall be grouped in one or two clearly visible places either on a plate or sticker fixed permanently to the instrument, or on a non-removable part of the instrument itself. In case of a plate or sticker which is not destroyed when removed, a means of securing shall be provided, e.g. a control mark that can be applied.

As an alternative all applicable markings in 9.1.1 (B) and 9.1.2 (G) above may be simultaneously displayed by a software solution either permanently or on manual command. In this case the markings are considered as device-specific parameters (see 3.2.8.4, 6.1.2.4 and 7.5).

The markings: Max ...,

Min ...,

$e = \dots$ , and

$d = \dots$  if  $d \neq e$

shall be shown at least in one place and permanently either on the display or near to the display in a clearly visible position. All additional information as mentioned in 9.1.1 (B) and 9.1.2 (G) above may be shown alternatively on a plate or simultaneously displayed by a software solution either permanently or accessed by a simple manual command. In this case the markings are considered as device-specific parameters (see 3.2.8.4, 6.1.2.4 and 6.2).

It shall be possible to seal the plate bearing the descriptive markings unless its removal will result in its destruction. If the data plate is sealed, it shall be possible to apply a control mark to it.

#### Acceptable solutions:

a) Marking of Max, Min,  $e$  ... and  $d$  if  $d \neq e$ :

These values are permanently and simultaneously shown on the display of the weighing result as long as the instrument is switched on.

They may be automatically scrolled (displayed alternating one after each other) in one display. Automatically scrolling (but not on manual command) is considered as “permanently”.

b) Marking for multi-interval and multi range instruments:

In special cases, some of the markings should be in the form of a table. See examples in Figure 7.

**Figure 7**

**Commented [ID72]:** Table rather than figure?

For a multi- interval instrument	For an instrument with more than one weighing range ( $W_1$ , $W_2$ )		For an instrument with weighing ranges in different classes	
		$W_1$ $W_2$	$W_1$ $W_2$	
			II      III	
Max 2/5/15 kg	Max	20 kg      100 kg	Max	1 000g      5 000 g
Min 20 g	Min	200 g      1 kg	Min	1 g      40 g
$e = 1/2/5$ g	$e =$	10 g      50 g	$e =$	0.1 g      2 g
			$d =$	0.02 g      2 g

c) Fixing

If a plate is used it shall be secured e.g. by rivets or screws with one of the rivets of red copper or material having qualities recognized as similar or by using non removable control marks.

It should be possible to secure the head of one of the screws by appropriate means (e.g. by means of a cap of suitable material inserted in a device that cannot be dismantled or other appropriate technical solution).

The plate may be glued or consist of a transfer provided its removal results in its destruction.

d) Dimensions of the letters

The height of capital letters should be at least 2 mm.

### 9.1.5 Specific cases

9.1.1-9.1.4 apply in their entirety to a simple instrument made by one manufacturer.

When a manufacturer builds a complex instrument or when several manufacturers are involved in making a simple or complex instrument, the following additional provisions shall be applied.

#### 9.1.5.1 Instruments having several load receptors and load measuring devices

Each load measuring device which is connected, or can be connected, to one or more load receptors, shall bear the descriptive markings relating to these:

- identification mark;
- maximum capacity;
- minimum capacity;
- verification scale interval; and
- maximum safe load and maximum additive tare effect (if appropriate).

#### 9.1.5.2 Instruments consisting of separately-built main parts

If main parts cannot be exchanged without altering the metrological characteristics of the instrument, each unit shall have an identification mark which shall be repeated in the descriptive markings.

### 9.1.5.3 Separately tested modules

For load cells having an OIML R 60 certificate, the markings according to OIML R 60 apply.

For other modules (indicators and weighing modules) the markings according to R 76-2, 3 or 4 apply. Each module shall, however, bear at least the following descriptive markings for identification:

- type designation;
- serial number; and
- manufacturer (mark or name).

Other relevant information and characteristics shall be specified in the respective OIML certificate (kind of module, fraction  $p_i$  of the maximum permissible error, OIML certificate number, accuracy class, Max,  $e$ , etc.) and should be written in a document accompanying the respective module.

### 9.1.5.4 Peripheral devices

Peripheral devices that are mentioned in an OIML certificate shall bear the following descriptive markings:

- type designation;
- serial number;
- manufacturer; and
- other information as far as applicable.

## 9.2 Verification marks

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

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

*Note:* If technical reasons restrict or limit the verification mark(s) to be fixed only in a “hidden” place (e.g. when an instrument – in combination with another device – is integrated in other equipment) this can be accepted if these marks are easily accessible, and if there is a legible notice provided on the instrument in a clearly visible place that points to these marks or if its location is defined in the operation manual, the OIML certificate and OIML Test Report.

### Acceptable solution:

An instrument required to bear verification marks shall have a verification mark support, at the place provided for above, which ensures the conservation of the marks:

- a) when the mark is made with a stamp, this support may consist of a strip of suitable metal or any other material with qualities similar to lead (for example plastic, brass, etc. depending on national legislation), inserted into a plate fixed to the instrument, or a cavity bored in the instrument; or
- b) when the mark is of the self-adhesive type, a space should be provided on the instrument for the application of this mark.

For application of the verification marks a stamping area of at least 150 mm<sup>2</sup> is required.

If self-adhesive stickers are used as verification marks the space for these stickers should have a diameter of at least 15 mm. These marks should be adequately durable for the intended use of the instrument, e.g. by means of suitable protection.

## 10 Metrological controls

Commented [ID73]: Update these.

## 10.1 Liability to metrological controls

National legislation may impose controls to ensure that instruments used in specific applications comply with the requirements of this Recommendation.

If controls are imposed for conformity, they may consist of type approval and initial verification (or equivalent conformity assessment procedures) and subsequent – e.g. periodic verifications or service inspections or other equivalent metrological control procedures.

However, instruments according to 8.4-8.9 of this Recommendation shall not be subject to type approval, and national legislation may provide for initial verification without type approval for particular instrument applications.

## 10.2 Type approval

### 10.2.1 Application for type approval

The application for type approval shall include the submission to the approving authority of normally one instrument representative of the submitted type. The modular approach (5.9.2) and testing of a family of instruments or modules (5.9.4) may be more appropriate and efficient.

The applicant shall provide the following information, as far as applicable and in accordance with national legislation.

#### 10.2.1.1 Metrological characteristics

- characteristics of the instrument, as in 9.1; and
- specifications of the modules or components of the measuring system as in 5.9.2.

#### 10.2.1.2 Descriptive documents

*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 (e.g. platform, plus-minus scale, price labeller).
2	General characteristics (manufacturer; Class, Max, Min, $e$ , $n$ , single-/multi-interval, multiple range, 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. (6.1.2), protected access to set-up and adjustment operations (6.1.2.4).
4.2	Place for application of control marks, securing elements, descriptive markings, identification, conformity and/or approval marks 9.1, 9.2).
5	Devices of the instrument.
5.1	Auxiliary, or extended indicating devices (5.4, 6.4.5, 7.1.7).
5.2	Multiple use of indicating devices (6.6.4).
5.3	Printing devices (6.6.5, 6.8.11, 6.9.3, 7.2.4, 7.4).
5.4	Memory storage devices (6.6.6).

Item	Documentation required
5.5	Zero-setting, zero-tracking devices (6.7, 6.8.9, 7.1.2).
5.6	Tare devices (6.8, 6.12, 7.1.3) and preset tare devices (6.9, 7.1.4).
5.7	Levelling device and level indicator, tilt sensor, upper limit of tilting (5.8.1).
5.8	Locking devices (6.10, 7.1.5) and auxiliary limit devices (6.11).
5.9	Selection of weighing ranges on multiple range instruments (6.12).
5.10	Connection of different load receptors (6.13).
5.11	Interfaces (types, intended use, immunity to external influences instructions (6.1.5.6)).
5.12	Peripheral devices, e.g. printers, secondary displays, for including in the type approval certificate and for connection for the disturbance tests (6.1.6.2).
5.13	Functions of price-computing instruments (e.g. for direct sales to the public) (7.2), self-service (7.1.11), price labelling (7.4).
5.14	Other devices or functions, e.g. for purposes other than determination of mass (not subject to conformity assessment).
5.15	Detailed description of the stable equilibrium function (6.6.2, R 76-2, 1.4.12) 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 (6.1.2), reference to evaluation to R 60 for load cells (R 76-2, 12.2).
6.2	Special operating conditions (5.8.5).
6.3	Reaction of the instrument to significant faults (6.1.3.1, 6.1.4, 7.1.9).
6.4	Functioning of the display after switch-on (6.1.5.1).
7	Technical description, drawings and plans of devices, sub-assemblies, etc. particularly those in 7.1-7.4 below.
7.1	Load receptor, lever systems if not according to (8.3.2-8.3.4), 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 (necessary for surge test, see R 76-2, 2.3.3).
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 (6.1.5.6.1), for protected access to set-up and adjustment (6.1.2.4), 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.

**Commented [ID74]:** This para doesn't currently have a number.

**Commented [ID75]:** Update this cross-reference.

**Commented [ID76]:** Para not currently numbered.

**Commented [ID77]:** Para not currently numbered.

**Commented [ID78]:** Update this cross-reference.

**Commented [ID79]:** Para not currently numbered.

Item	Documentation required
10	For software controlled instruments or modules, additional documents according to 7.2.1 and <b>Error!</b> <b>Reference source not found.</b> (Table 11).
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 with the exception of the drawing or photograph (item 11) shall be kept confidential by the approving authority, except to the extent agreed with the manufacturer.

### 10.2.2 Type evaluation

The submitted documents shall be examined to verify compliance with the requirements of this Recommendation.

Suitable checks shall be performed to establish confidence that the functions are performed correctly in accordance with the submitted documents. Reactions to significant faults need not be triggered.

The instruments shall, on the basis of 5.9 and with test standards according to 5.6.1, be submitted to the testing procedures of R 76-2, 1 and 2 if applicable. For peripheral devices see 5.9.3.

It may be feasible to perform the tests on premises other than those of the authority.

The approving authority may, in special cases, require the applicant to supply test loads, equipment and personnel to perform the tests.

The approving authorities are advised to consider the possibility of accepting, with the consent of the applicant, test data obtained from other national authorities, without repeating these tests\*.

They may, at their discretion and under their responsibility, accept test data provided by the applicant for the submitted type, and reduce their own tests accordingly\*.

\* Refer to OIML B 3 [3], B 10-1 and B 10-2 [5].

### 10.2.3 Type evaluation using modules

### 10.2.4 Evaluation and certification of modules

## 10.3 Initial verification

**Commented [ID80]:** Update cross-references

**Commented [ID81]:** Change to B 18 now? The para above doesn't just mean OIML certificates though.

**Commented [ID82]:** Can this be updated with subgroup output?

**Commented [ID83]:** Moved to part 5

ANNEX A

(Mandatory)

Comparison table

Commented [ID84]: To be completed in next CD?

OIML R 76-1:20XX		OIML R 76-1:2006		Remarks
Ref.	Description	Ref.	Description	



**ANNEX B****(Informative)****Index of terms defined**

The numbers in brackets refer to important chapters of this Recommendation.

Actual scale interval.....	(3.4.3, 3.5.3.2, 3.8.2.2, A.4.8.2)	T.3.2.2
Analog data processing device.....	(3.10.2.2, 3.10.2.4, F.3)	T.2.2.3
Analog indication.....	(3.8.2.1, 4.6.3, A.4.8.1)	T.5.1.2
Automatic zero-setting device.....	(4.5.6, A.4.1.5, A.4.2.1.3)	T.2.7.2.3
Auxiliary indicating devices.....	(3.1.2, 3.4, 4.13.7)	T.2.5
Auxiliary verification device.....	(3.7.2, 4.9)	T.2.7.7
Calculated net value.....	(4.7.1)	T.5.3.2
Calculated weight value.....	(4.6.11)	T.5.3.3
Complementary indicating device.....	(3.4.1, 4.3.2)	T.2.5.3
Device for interpolation of reading.....	(3.4.1)	T.2.5.2
Device-specific parameter.....	(4.1.2.4, 7.1.4, G.2.2.3)	T.2.8.4
Digital indication.....	(3.5.3.2, 3.8.2.2, 4.2.2.2, 4.5.5, 4.13.6, A.4.1.6, A.4.4.3, A.4.8.2)	T.5.1.3
Digital device.....	(3.10.2.1, 3.10.4.6, 4.13.6, F.5, G)	T.2.3.4
Digital display.....	(3.10.2.4, C.1)	T.2.2.6
Discrimination.....	(3.8, 6.1, A.4.8)	T.4.2
Displaying component.....	(4.3, 6.2, 6.3, 6.6)	T.2.4.1
Displaying device.....	(2.4, 3.6.3, 4.2.1, 4.2.4, 4.3, 4.4, 4.17.1, 6.2, A.4.5, E.2.2)	T.2.4
Disturbance.....	(3.10.2.2, 3.10.3, 5.1.1, 5.3, 5.4.3, B.3)	T.6.1.2
Durability.....	(3.9.4.3, A.6)	T.4.4
Durability error.....	(3.9.4.3, A.6)	T.5.5.7
Electronic component.....	(4.1.2.4)	T.2.3.3
Electronic device.....	(5.5)	T.2.3.1
Electronic instrument.....	(2.3, 5, B)	T.1.2.6
Electronic sub-assembly.....	(4.1.2.4)	T.2.3.2
Error (of indication).....	(2.2, 3.1.1, 3.5, 3.6, 5.1.1, 8.3.3)	T.5.5.1
Extended displaying device.....	(3.4.1, 4.4.3, 4.13.7)	T.2.6
Extension interval of self-indication.....	(4.2.5)	T.3.1.5
Family.....	(3.10.4, 8.2.1)	T.3.5
Fault.....	(5.1, 5.2)	T.5.5.5
Final weight value.....	(4.4.2)	T.4.6
Grading instrument.....	(3.2)	T.1.2.13
Graduated instrument.....	(3.1.2)	T.1.2.1
Gross value.....	(4.6.5, 4.13.3)	T.5.2.1
Indications of an instrument.....	(3.8.2, 4.2, 4.3.3, 4.4, 4.6.12)	T.1.3
Indicating device with a differentiated scale division.....	(3.4.1)	T.2.5.4
Indicator.....	(3.10.2, 5.3.1, 5.5.2, 7.1.5.3, C, F)	T.2.2.2
Influence factor.....	(3.5.3.1, 5.4.3, A.5)	T.6.1.1
Initial intrinsic error.....	(A.4.4.1)	T.5.5.3
Initial zero-setting device.....	(4.5.1, 4.5.4, A.4.4.2)	T.2.7.2.4
Instrument with price scales.....	(4.14.2)	T.1.2.7
Intrinsic error.....	(5.3.4, A.4.4.1, A.6)	T.5.5.2
Legally relevant parameter.....	(5.5.2.2, 5.5.3)	T.2.8.2
Legally relevant software.....	(5.5.2, 5.5.3, G.1, G.2)	T.2.8.1
Levelling device.....	(3.9.1, 4.18.2)	T.2.7.1
Load cell.....	(3.10.2.1, 3.10.2.4, 7.1.5.3, C, F)	T.2.2.1
Load-measuring device.....	(2.4, 6.9, 4.11, 7.1.5.1)	T.2.1.3
Load receptor.....	(3.6, 4.11, 7.1.5.1, A.4.7)	T.2.1.1
Load-transmitting device.....	(3.10.2.1, 4.11)	T.2.1.2
Locking device.....	(4.8.1)	T.2.7.6
Long-term storage of measurement data.....	(5.5.3)	T.2.8.5
Maximum capacity.....	(3.3, 4.13, 6.6, 6.8)	T.3.1.1
Maximum permissible error.....	(2.2, 3.1, 3.5, A.4.4.1)	T.5.5.4
Maximum safe load.....	(7.1.2)	T.3.1.7

**Commented [ID85]:** Is this annex necessary or useful?  
Other Recommendations don't have this.

**Commented [ID86]:** This was previously 3.8. No  
definition xrefs have yet been updated, others have not yet  
been checked in case Annex is deleted.

Maximum tare effect .....	(A.4.6.1) .....	T.3.1.6
Metrologically relevant .....	(3.10.4) .....	T.2.9
Minimum capacity .....	(2.2, 3.2, 3.4.3) .....	T.3.1.2
Minimum reading distance .....	(4.3.1, 4.3.2) .....	T.5.4.4
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## BIBLIOGRAPHY

**Commented [ID87]:** All updated to latest editions, including replacing B 3 and B 10 with B 18.

Ref.	Standards and reference documents	Description
[1]	OIML V 1:2022 <i>International Vocabulary of Terms in Legal Metrology</i> (VIML)	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.
[2]	V 2-200:2012 <i>International Vocabulary of Metrology - Basic and General Concepts and Associated Terms</i> (VIM). 3rd Edition	Vocabulary, prepared by a joint working group consisting of experts appointed by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML
[3]	OIML B 18:2022 <i>Framework for the OIML Certification System</i> (OIML-CS)	System for issuing, registering and using OIML type examination certificates and associated OIML type evaluation reports for types of measuring instruments based on the requirements of OIML Recommendations.
[4]	OIML R 34:1979 <i>Accuracy classes of measuring instruments</i>	Lays down the principles for the classification of measuring instruments according to their accuracy. The measuring instruments to which this Recommendation applies are <ul style="list-style-type: none"> <li>▪ material measures,</li> <li>▪ measuring instruments,</li> <li>▪ measuring transducers,</li> </ul> where these instruments are intended for use in conditions in which errors due to inertia are negligible in relation to the maximum errors laid down for them.
[5]	OIML R 50:2014 <i>Continuous totalizing automatic weighing instruments (belt weighers)</i>	Specifies the metrological and technical requirements for continuous totalizing automatic weighing instruments of the belt conveyor type that are subject to national metrological control. It is intended to provide standardized requirements and test procedures for evaluating metrological and technical characteristics in a uniform and traceable way.
[6]	OIML R 51:2006 <i>Automatic catchweighing instruments</i>	Specifies the metrological and technical requirements and test procedures for automatic catchweighing instruments (catchweighers) that are subject to national metrological control. It is intended to provide standardized requirements and testing procedures to evaluate the metrological and technical characteristics in a uniform and traceable way.
[7]	OIML R 60:2021 <i>Metrological regulation for load cells</i>	Provides the principal static characteristics and static evaluation procedures for load cells used in the evaluation of mass.
[8]	OIML R 61:2017 <i>Automatic gravimetric filling instruments</i>	Specifies the metrological and technical requirements for automatic gravimetric filling instruments which produce predetermined mass of individual fills of products from one or more loads by automatic weighing.

Ref.	Standards and reference documents	Description
[9]	OIML R 106:2011 <i>Automatic rail-weighbridges</i>	Specifies the requirements and test methods for automatic railweighbridges which are used to determine the mass of railway vehicles when they are weighed in motion. It is intended to provide standardized requirements and test procedures to evaluate the metrological and technical characteristics of such instruments in a uniform and traceable way.
[10]	OIML R 107:2007 <i>Discontinuous totalizing automatic weighing instruments (totalizing hopper weighers)</i>	Specifies the requirements and test methods for discontinuous totalizing automatic weighing instruments (totalizing hopper weighers). 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.
[11]	OIML R 111:2004 <i>Weights of classes <math>E_1</math>, <math>E_2</math>, <math>F_1</math>, <math>F_2</math>, <math>M_1</math>, <math>M_{1-2}</math>, <math>M_2</math>, <math>M_{2-3}</math> and <math>M_3</math></i>	
[12]	OIML R 134:2006 <i>Automatic instruments for weighing road vehicles in motion and measuring axle loads</i>	Specifies the requirements and test methods for automatic instruments for weighing road vehicles in motion that are used to determine the vehicle mass, the axle loads, and if applicable the axle-group loads of road vehicles when the vehicles are weighed in motion. It provides standardized requirements and test procedures to evaluate the metrological and technical characteristics of such instruments in a uniform and traceable way.
[13]	OIML R 150:2020 <i>Continuous totalizing automatic weighing instruments of the arched chute type</i>	Specifies the metrological and technical requirements for arched chute weighers that are subject to national metrological control.
[14]	OIML D 28 <i>Conventional value of the result of weighing in air (Revision of R 33)</i>	
[15]	OIML D 31:2019 <i>General requirements for software-controlled measuring instruments</i>	