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Part 2 – Metrological controls and performance tests

FOREWORD

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CONTINUOUS TOTALIZING AUTOMATIC WEIGHING INSTRUMENTS

(BELT WEIGHERS)

TERMINOLOGY (terms and definitions)

The terminology used in this Recommendation conforms to the *International Vocabulary of Basic and General Terms in Metrology* (VIM:2007) [1], the *International Vocabulary of Legal Metrology* VIML:2000 [2], the *OIML Certificate System for Measuring Instruments* B3:2003 [3], and to the *OIML D 11- International Document for General requirements for Electronic Measuring Instruments* OIML D 11, 3.4 [4]. In addition, for the purposes of this Recommendation, the following definitions apply.

T.1 General definitions

T.1.1 Weighing instrument

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

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

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

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

T.1.2 Automatic weighing instrument

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

T.1.3 Continuous totalizing automatic weighing instrument (belt weigher)

An automatic weighing instrument for continuously weighing a bulk product on a conveyor belt, without interrupting the movement of the conveyor belt.

Note: In this Recommendation a continuous totalizing automatic weighing instrument (belt weigher) is called an "instrument".

T.1.4 True quantity value

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

T.1.5 Belt speed control

T.1.5.1 Single speed belt weigher

A belt weigher that is installed with a conveyor belt designed to operate at a single speed.

T.1.5.2 Variable speed or multiple speed belt weigher

A belt weigher that is installed with a conveyor belt designed to operate at a variable speed (within a range) or at more than one set speed.

T.1.6 Control method

The method used to determine the mass of the product used as the test load during product tests. This will generally involve the use of a weighing instrument, referred to as the control instrument (see T.1.10).

T.1.7 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.

T.1.8 Legally relevant

The part of a measuring instrument, device or software subject to legal control.

T.1.9 Audit trail

Historical record (or continuous data file) of the instrument data, adjustments and weighing operations.

T.1.10 Control instrument

Separate weighing instrument used to determine the true quantity value of the mass of the test loads during product tests.

T.2 CONSTRUCTION

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

T.2.1 Load receptor

The part of the belt weigher intended to sense the load on the belt.

T.2.1.1 Weigh table

A load receptor that includes only part of a conveyor.

T.2.1.2 Inclusive of conveyor

A load receptor that includes an entire conveyor.

T.2.2 Belt conveyor

The equipment for conveying the product by means of a belt, (e.g., by resting on rollers turning about their axis, or by other devices).

T.2.2.1 Carrying rollers (Carrying supports)

The arrangements (commonly rollers) by which the conveyor belt is supported as it approaches and departs the load receptor.

T.2.2.2 Weighing (idle) rollers (Weighing supports)

The arrangements (commonly rollers) by which the conveyor belt is supported on the weighing unit.

Note: For an 'inclusive of conveyor' type belt weigher, all rollers/supports of the belt weigher are weighing rollers/supports.

T.2.3 Electronic instrument

Instrument equipped with electronic devices.

T.2.3.1 Electronic device

Device employing electronic sub-assemblies and performing a specific function. Electronic devices are usually manufactured as separate units and are capable of being tested independently. OIML D 11, 3.4[4]

Notes:

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

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

T.2.3.2 Electronic sub-assembly

Part of an electronic device employing electronic components and having a recognizable function of its own. OIML D 11, 3.4[4]

T.2.3.3 Electronic component

Smallest physical entity that uses electron or hole conduction in semiconductors, gases, or in a vacuum. OIML D 11, 3.4 [4]

Examples: electronic tubes, transistors, integrated circuits. OIML D 11, 3.4 [4]

T.2.3.4 Digital device

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

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

T.2.4 Belt Profile Correction Device

A device capable of correcting for variations in the load applied to the load receptor by an (empty) belt during a belt revolution. The device uses software to maintain a stored profile of the (empty) belt load over a full revolution and to manage the synchronization process of the profile to the belt.

T.2.5 Totalization device

A device that uses information supplied by the weighing unit and the displacement transducer to do either:

- an addition of partial loads, or
- an integration of the product of the load per unit length and the speed of the belt.

T.2.6 Zero-setting device

A device enabling zero totalization to be obtained over a whole number of revolutions of the empty conveyor belt.

T.2.6.1 Nonautomatic zero-setting device

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

T.2.6.2 Semi-automatic zero-setting device

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

T.2.6.3 Automatic zero-setting device

A zero-setting device that operates automatically without the intervention of the operator after the belt has been operating empty.

T.2.7 Printing device

Device to produce a printed output (T.4.4) of the weighing results in units of mass.

T.2.8 Operation checking device

A device that enables certain functions of the belt weigher to be checked.

T.2.9 Flowrate regulating device

A device intended to ensure a programmed flowrate.

T.2.10 Pre-selection device

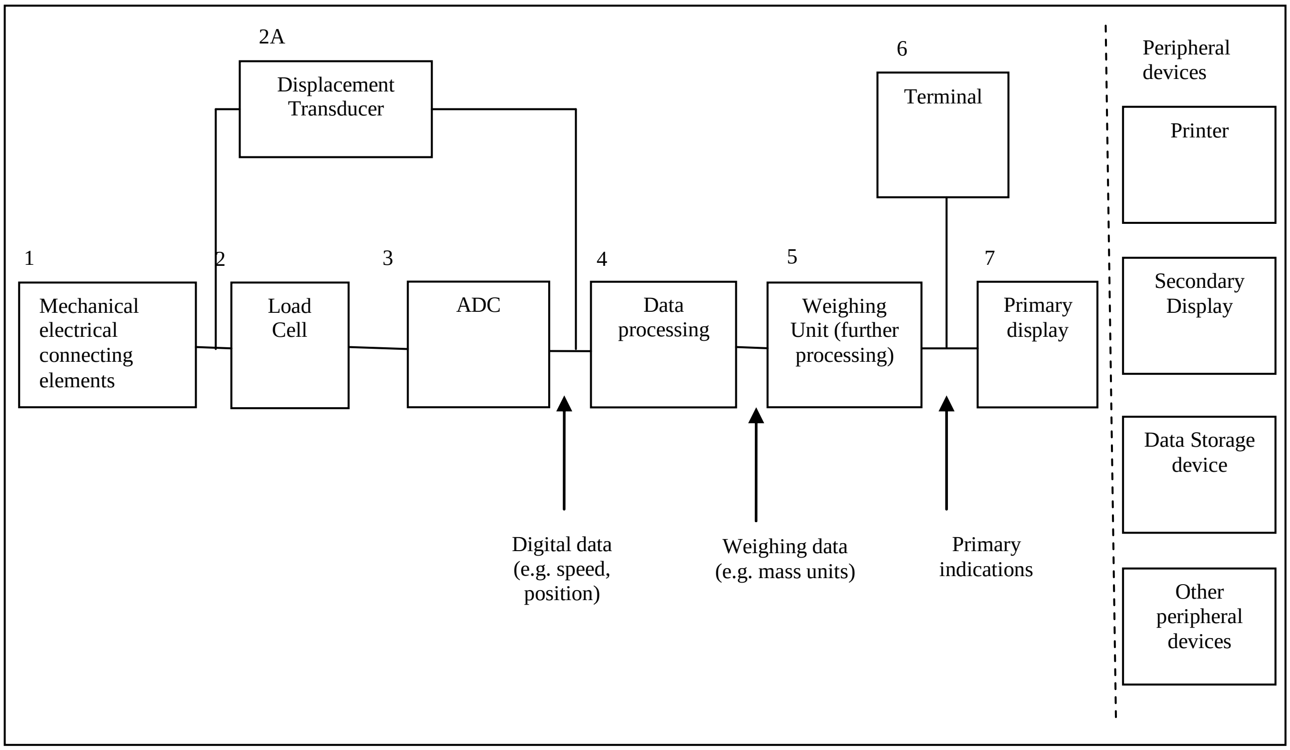
The means used to pre-set a weight value for a totalized load.

T.2.11 Module

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

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

Figure 1
Definition of typical modules according to T.2.11 and 5.1.6
(other combinations are possible)



load cell	(T.2.11.1)	2 + 3 + (4)*)
displacement transducer	(T.2.11.2)	2A
indicator	(T.2.11.6)	(3) + 4 + (5) + (6) + 7
analogue data processing device	(T.2.11.4)	3 + 4 + (5) + (6)
digital data processing device	(T.2.11.5)	(4) + 5 + (6)
primary display	(T.2.11.6) (T.2.11.9)	7
weighing module	(T.2.11.8)	1 + 2 + 3 + 4 + (5) + (6)
Terminal	(T.2.11.7)	(5) + 6 + 7

*) Numbers in brackets indicate options

T.2.11.1 Load cell

Force transducer, which after taking into account the effects of the acceleration of gravity and air buoyancy at the location of its use, measures mass by converting the measured quantity (mass) into another measured quantity (output). OIML R 60 [7].

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

T.2.11.2 Displacement transducer

A device on the conveyor providing information either corresponding to the displacement of a defined length of the belt or proportional to the speed of the belt.

T.2.11.3 Displacement simulation device

A device used in simulation tests on the belt weigher without its conveyor and intended to simulate displacement of the belt by activating the displacement transducer in a similar manner to how it would operate with the conveyor (e.g. by use of a pulse generator or a motor to simulate rotation of a wheel which incorporates the displacement transducer).

T.2.11.4 Analogue data processing device

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

T.2.11.5 Digital data processing device

Electronic device that processes digital data.

T.2.11.6 Indicator

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

T.2.11.7 Terminal

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

T.2.11.8 Weighing unit

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

T.2.11.9 Digital display

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

a) Primary 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.

b) Secondary display: Additional peripheral device (optional) which repeats the weighing result and any other primary indication, or provides further, non-metrological information.

Note: The terms “primary display” and “secondary display” should not be confused with the terms “primary indication” and “secondary indication” (T.4.1.1 and T.4.1.2)

T.2.12 Software

T.2.12.1 Legally relevant software

All software modules of a measuring instrument, electronic device, or sub-assembly that is legally relevant.

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

T.2.12.2 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.

T.2.12.3 Type-specific parameter

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

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

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

T.2.12.4 Device-specific parameter

Legally relevant parameter with a value that depends on the individual instrument. Device specific parameters comprise calibration parameters (e.g. span adjustments or other adjustments or corrections) and configuration parameters (e.g. maximum capacity, minimum capacity, units of measurement, etc.).

T.2.12.5 Software identification

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

T.2.12.6 Software separation

Software in measuring instruments/electronic devices/sub-assemblies can be divided into a legally relevant part and a legally non-relevant part. These parts communicate via a software interface.

T.2.13 Data storage device

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

T.2.14 Interface

Electronic, optical, radio or other hardware and software interface that enables information to be passed between humans, instruments and modules.

T.2.14.1 User interface

Interface that enables information to be interchanged between a human and the measuring instrument or its hardware or software components, e.g. switches, keyboard, mouse, display, monitor, printer, touch-screen, software window on a screen including the software that generates it.

T.2.14.2 Protective interface

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

T.3 METROLOGICAL CHARACTERISTICS

T.3.1 Scale intervals

T.3.1.1 Totalization scale interval (d_e)

The value, expressed in units of mass, of the difference between two consecutive indicated values, for general and partial totalization devices, with the instrument in its normal weighing mode.

T.3.1.2 Totalization scale interval for testing (d_t)

The value, expressed in units of mass, of the difference between two consecutive indicated values, for general and partial totalization devices, with the instrument in a special mode for testing purposes. Where such a special extended resolution mode is not available, the scale interval for testing (d_e) is equal to the totalization scale interval (d_t).

T.3.1.3 Minimum scale interval of electronics (e)

The minimum scale interval for which the analogue data processing device can fulfil the requirements.

T.3.2 Weigh length (W_L)

The distance between the two imaginary lines at the half distance between the axes of the end weighing rollers/support and the axes of the nearest carrying roller/support. When there is only one weighing roller, the weigh length is equal to half the distance between the axes of the nearest carrying rollers on either side of the weighing roller.

Note: The weigh length is not applicable to belt weighers inclusive of conveyor.

T.3.3 Complete Belt Revolution (Belt Length)

The total length (for one circulation) of the conveyor belt.

T.3.4 Maximum capacity (Max)

The maximum net load (load applied by the bulk product – not including load applied by the belt) that the weighing unit is intended to weigh on the portion of the conveyor belt representing the weigh length.

T.3.5 Minimum capacity (Min)

The minimum net load (load applied by the bulk product – not including load applied by the belt) that the weighing unit is intended to weigh on the portion of the conveyor belt representing the weigh length.

T.3.6 Flowrate

T.3.6.1 Maximum flowrate (Q_{max})

The flowrate obtained with the maximum capacity of the weighing unit and the maximum speed of the belt.

T.3.6.2 Minimum flowrate (Q_{min})

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

T.3.6.3 Feeding flowrate

The flowrate of product from a previous device onto the conveyor during the product test procedures.

T.3.7 Minimum totalized load ($\sum_{min}$)

The quantity, in units of mass, below which a totalization may be subject to excessive relative errors.

T.3.8 Maximum load per unit length of the belt

The quotient of the maximum capacity of the weighing unit and the weigh length.

T.3.9 Control value

The value, in units of mass, that is indicated by the totalization indicating device when a known additional mass has been simulated or deposited on the load receptor with the empty belt running for a prescribed number of complete revolutions.

T.3.10 Warm-up time

The time between the moment that power is applied to a belt weigher and the moment that the belt weigher is capable of complying with the requirements.

T.3.11 Repeatability

Refer to VIM, 2.21 [1].

T.3.12 Durability

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

T.3.13 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.

T.3.14 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, d, accuracy class, ...).

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

T.4 INDICATIONS AND ERRORS

T.4.1 Indication of a measuring instrument

Value of a quantity provided by a measuring instrument VIM, 4.1 [1].

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

T.4.1.1 Primary indications

Totalized load(s), signals and symbols that are subject to the requirements of this Recommendation.

T.4.1.2 Secondary indications

Indications, signals and symbols that are not primary indications.

T.4.2 Types of indicating device

T.4.2.1 Instantaneous load indicating device

A device that indicates the percentage of the maximum capacity (Max) or the mass of the load acting on the weighing unit at a given time.

T.4.2.2 Flowrate indicating device

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

T.4.2.3 Totalization indicating device

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

T.4.2.4 General totalization indicating device

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

T.4.2.5 Partial totalization indicating device

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

T.4.2.6 Supplementary totalization indicating device

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

T.4.2.7 Whole Belt Totalization Device

A totalization indicating device in which the indication of mass of loads conveyed is updated once in each belt revolution (i.e. at the same point in each belt revolution).

T.4.4 Printout

Printed output of the measurement results.

T.4.5 Reading

T.4.5.1 Reading by simple juxtaposition

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

T.4.6 Error (of measurement)

The value, in units of mass, of the difference between two readings from a totalization indicating device on a belt weigher, minus the (conventional) true value of the mass relating to those readings. VIM, 2.16 [1].

T.4.6.1 Intrinsic error

The error of a belt weigher, determined under reference conditions.

T.4.6.2 Initial intrinsic error

The intrinsic error of a belt weigher as determined prior to performance tests and durability evaluations.

T.4.6.3 Fault

The difference between the error of measurement and the intrinsic error of a belt weigher.

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

T.4.6.4 Significant fault

A fault greater than the absolute value of the appropriate maximum permissible error for a load equal to the minimum totalized load ($\sum_{min}$) for the designated class of the belt weigher.

A significant fault does not include:

- faults arising from simultaneous and mutually independent causes in the belt weigher,
- faults implying the impossibility of performing any weighing,

- transitory faults, momentary variations in the indications which cannot be interpreted, memorized or transmitted as a weighing result,
- faults being so serious they will inevitably be noticed by all those interested in the weighing result.

T.4.6.5 Maximum permissible errors (MPE)

Extreme values of an error permitted by specifications, regulations, etc. for a given instrument. VIM, 4.26 [1].

T.5 INFLUENCES AND REFERENCE CONDITIONS

T.5.1 Influence quantity

Quantity that is not the measurand but that affects the result of the measurement. VIM, 2.5.2 [1].

Note: An influence quantity does not affect the actual mass of the load being weighed, but affects the value (weighing result) indicated by the instrument.

T.5.1.1 Influence factor

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

T.5.1.2 Disturbance

An influence quantity having a value within the limits specified in this Recommendation but outside the rated operating conditions of the belt weigher.

T.5.2 Rated operating conditions

Conditions of use for which specified metrological characteristics of an instrument are intended to lie within given limits VIM, 4.9 [1].

Note: These conditions of use are the range of weight values and the range of influence quantity values for which the indication of an instrument is intended to lie within maximum permissible errors.

T.5.3 Reference conditions

Conditions of use prescribed for testing the performance of an instrument or for inter-comparison of results of measurements. VIM, 4.11 [1].

T.5.4 Typical weighing conditions

Usual conditions of use for the belt weigher including types of product, site and method of operation.

T.6 TESTS

T.6.1 Product test

A test carried out on a complete belt weigher using the type of product that it is intended to weigh.

T.6.2 Performance test

A test to verify whether the equipment under test (EUT) is capable of accomplishing its intended functions. OIML D 11, 3.20 [4].

T.6.3 Durability test

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

T.6.4 Simulation test

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

T.7 ABBREVIATIONS AND SYMBOLS

Symbols	Meaning
I	Indication of the belt weigher
I_n	n^{th} indication
L	Load
$\sum_{min}$	Minimum totalized load
Q	flowrate
Q_{max}	maximum flowrate
Q_{min}	minimum flowrate
v	operating speed
ΔL	Additional load to next changeover point
P	$I + 1/2\ e - \Delta L$ = Indication prior to rounding (digital indication)
E_r	$(I - L)/L$ or $(P - L)/L$ = Relative Error
E%	100 x (P-L)/L = percentage error

E_0	Error at zero load
d_t	Totalization scale interval
d_e	Scale interval for testing
W_L	Weigh length
p_i	Fraction of the MPE applicable to a module of the instrument which is examined separately.
MPE	Maximum permissible error
EUT	Equipment under test
sf	Significant fault
Max	Maximum capacity of the weighing instrument
Min	Minimum capacity of the weighing instrument
U_{nom}	Nominal voltage value marked on the instrument
U_{max}	Highest value of a voltage range marked on the instrument
U_{min}	Lowest value of a voltage range marked on the instrument
v_{min}	Minimum operating speed
v_{max}	Maximum operating speed
e.m.f	Electromotive force
I/O	Input / Output ports
RF	Radio frequency
V/m	Volts Per Meter
kV	kilovolt
DC	Direct current
AC	Alternating current
MHz	Megahertz

T.8 BASIC RELATIONSHIPS

T.8.1 Load per belt displacement = Q/v
e.g. Q = 1440 t/h = 400 kg/s, v = 2 m/s ➔ Load per belt displacement = 200 kg/m

T.8.2 Load per weigh length (the load seen by the weighing unit) = W_L. Q/v
e.g. W_L = 3 m ➔ Load per weigh length = 3 x 200 = 600 kg

So, the load seen by the weighing unit when operating at Qmax is W_L x Qmax / vmax, and hence Max = W_L x Qmax / vmax

PART 1: METROLOGICAL AND TECHNICAL REQUIREMENTS

1 GENERAL

1.1 Scope

This International Recommendation specifies the metrological and technical requirements for continuous totalizing automatic weighing instruments of the belt conveyor type, hereinafter referred to as “belt weighers”, 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.

1.2 Application

This Recommendation applies to:

1. belt weighers that determine the mass of a product in bulk by using the action of gravity on that product;
2. belt weighers that are intended for use with single speed belt conveyors, belt weighers that are intended for use with variable speed belt conveyors and multi-speed belt conveyors.

1.3 Terminology

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

2 METROLOGICAL REQUIREMENTS

2.1 Accuracy classes

Belt weighers are divided into four accuracy classes as follows:

0.2   0.5   1   2

2.2 Maximum permissible errors

Maximum permissible errors apply to loads equal to or greater than the minimum totalized load ($\sum_{min}$).

2.2.1 Maximum permissible errors for automatic weighing

The maximum permissible errors for each accuracy class, positive or negative, are the appropriate values in Table 1 rounded to the nearest totalization scale interval (d_t).

Table 1

Class	Percentage of the mass of the totalized load for:	
	Initial verification	In-service
0.2	0.10	0.20
0.5	0.25	0.50
1	0.50	1.0
2	1.0	2.0

2.2.2 Maximum permissible errors for influence factor tests

The maximum permissible errors for each accuracy class, positive or negative, are the appropriate values in Table 2 rounded to the nearest totalization scale interval (d_t).

Table 2

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

However, when testing with influence quantities on a module comprising an analogue component, e.g. a load cell or an electronic device, the maximum permissible error for the device under test shall be 0.7 times the appropriate value specified in Table 2 above.

2.3 Agreement between multiple indicating devices

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

2.4 Minimum value of minimum totalized load ($\sum_{min}$)

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

a) 2 % of the load totalized in one hour at maximum flowrate;
b) the load obtained at maximum flowrate in one revolution of the belt, except where the conditions in 2.8.5 are met;
c) the load corresponding to the appropriate number of totalization scale intervals in Table 3.

Table 3

Class	Totalization scale intervals (d_t)
0.2	2000
0.5	800
1	400
2	200

2.5 Minimum flowrate (Q_{min})

a) Single speed belt weighers

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

b) Variable and multi-speed belt weighers

Variable and multi-speed belt weighers may have a minimum flowrate less than 20 % of the maximum flowrate. The minimum instantaneous net load on the weighing unit shall be greater than 20 % of the maximum capacity.

2.6 Units of measurement

The units of mass to be used on a belt weigher are the:

a) gram (g),
b) kilogram (kg/h)
c) tonne (t/h).

2.7 Simulation requirements

2.7.1 Variation of simulation speed

For a variation of ±10 % of each nominal value of the belt speed, or over the range of belt speeds when continuously variable (with the use of a displacement simulation device), the errors shall not exceed the appropriate maximum permissible errors for influence factor tests specified in 2.2.2, Table 2.

2.7.2 Eccentric loading

The totalization errors for different positions of a load shall not exceed the appropriate maximum permissible errors for influence factor tests specified in 2.2.2, Table 2.

2.7.3 Zero-setting

Following any zero-setting within the range of the zero-setting device, the totalization error shall not exceed the appropriate maximum permissible error for influence factor tests specified in 2.2.2, Table 2.

2.7.4 Influence quantities and time

2.7.4.1 Temperature

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

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

It is expected that the temperature limits of a belt weigher shall be selected to be appropriate for the local environmental conditions of its use (this may be subject to national regulation).

2.7.4.2 Temperature effect at zero flowrate

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

a) 0.007% for class 0.2;
b) 0.0175 % for class 0.5;
c) 0.035 % for class 1;
d) 0.07 % for class 2.

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

The rate of temperature change between the two totalizations shall not exceed 5 °C per hour.

2.7.4.3 Voltage variation

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

a) AC mains voltage:
   Lower limit is 0.85 x U_{nom} or 0.85 x U_{min}, upper limit is 1.10 x U_{nom} or 1.10 x U_{max};
b) DC mains voltage:
   Lower limit is minimum operating voltage, upper limit is 1.20 x U_{nom} or 1.20 x U_{max}
c) Battery voltage DC (not mains connected) :
   Lower limit is minimum operating voltage, upper limit is U_{nom} or U_{max};

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 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.

2.7.4.4 Durability

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

2.7.5 Metrological characteristics

2.7.5.1 Repeatability

The difference between any two results obtained for the same load placed under the same conditions on the load receptor shall not exceed the absolute value of the appropriate maximum permissible error for influence factor tests specified in 2.2.2, Table 2.

2.7.5.2 Discrimination of the totalization indicating device

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

2.7.5.3 Stability of zero

[The working group recommended two proposals for this clause. Please indicate your preference in your comments. See also corresponding stability tests in A.5.5.4]

Proposal 1

The difference between zero-indications over a period of 3.5 hours of operation at maximum belt speed after zero-setting shall not exceed the following percentages of the load totalised in 1 hour at maximum flowrate:

a) Class 0.2: 0.0007%
b) Class 0.5: 0.0018%
c) Class 1: 0.0035%
d) Class 2: 0.007%

or

Proposal 2 - If the TC9/SC2 wished to retain separate criteria for short and long term stability, the following could be an alternative wording.

When assessed over a period of 15 minutes as described in A.5.5.4, the stability of zero shall not exceed the following percentages of the load totalised in 1 hour at maximum flowrate:

a) Class 0.2: 0.0005%
b) Class 0.5: 0.0013%
c) Class 1: 0.0025%
d) Class 2: 0.005%

When assessed over a period of 3.5 hours as described in A.5.5.4, the stability of zero shall not exceed the following percentages of the load totalised in 1 hour at maximum flowrate:

a) Class 0.2: 0.0007%
b) Class 0.5: 0.0018%
c) Class 1: 0.0035%
d) Class 2: 0.007%

2.8 In-situ requirements

2.8.1 Repeatability

The difference between the relative errors for several results obtained at practically identical flowrates, for approximately the same quantities of product and under the same conditions, shall not exceed the absolute value of the appropriate maximum permissible error for automatic weighing in 2.2.1.

2.8.2 Maximum permissible errors on checking of zero

After a whole number of belt revolutions and a duration as close as possible, but not less than 3 minutes, the variation of the indication at zero shall not exceed the following percentages of the load totalized at the maximum flowrate (Q_{max}):

a) 0.02% for class 0.2;
b) 0.05 % for class 0.5;
c) 0.1 % for class 1;
d) 0.2 % for class 2.

2.8.3 Discrimination of the indicator used for zero-setting

After a whole number of belt revolutions and a duration as close as possible, but not less than 3 minutes, there must be a visible difference between the indications of the zero indication at no load and for a load either deposited on or removed from the load receptor, equal to the following percentages of the maximum capacity:

a) 0.02% for class 0.2;
b) 0.05 % for class 0.5;
c) 0.1 % for class 1;
d) 0.2 % for class 2.

2.8.4 Maximum variation during zero-load test

During a whole number of belt revolutions and of a duration as close as possible, but not less than 3 minutes, the variation of the indication from its initial value shall not exceed the following percentages of the minimum load totalized (Σ_{min}) at the maximum flowrate (Qmax):

a) 0.07% for class 0.2;
b) 0.18 % for class 0.5;
c) 0.35 % for class 1;
d) 0.7 % for class 2.

Notes:

1) This is not applicable when all readings are obtained over a whole number of belt revolutions or where the indication of mass of loads conveyed is updated once in each belt revolution (i.e. at the same point in each belt revolution).

2.8.5 Indication over whole belt revolution (minimum test load)

Belt weighers may include a mean of only permitting totalized load to be obtained over a whole belt revolution. When such a facility is present and when material tests are conducted for the purpose of type approval 'in-situ' tests, initial verification or for subsequent re-verification, the minimum totalized load need not fulfill the requirement in 2.4 b).

Various means of permitting all load readings to be obtained over a whole number of belt revolutions may be used, such as:

a) Use of a whole belt totalisation device.
b) Manually ensuring during testing that test readings are obtained over a whole number of belt revolutions, by marking the belt.

In the case of either a) or b) above, the requirements in 3.6 b shall be met.

3 TECHNICAL REQUIREMENTS

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3.1 Suitability for use

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

3.2 Rated operating conditions

Belt weighers shall be so designed and manufactured that it does not exceed the maximum permissible errors under rated operating conditions.

3.3 Security of operation

3.3.1 Accidental breakdown and maladjustment

A belt weigher shall be constructed and installed so that an accidental breakdown or maladjustment likely to disturb its correct functioning cannot normally take place without the effect being evident.

Adjustable components such (e.g., carrying idlers, take-up weights, etc.) that can disturb the metrological performance of a belt weigher shall be held securely and the position of the component shall be accurately and permanently defined.

3.3.2 Operational adjustments

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

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

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

3.3.3 Fraudulent use

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

3.3.4 Operating devices

The operating devices of a belt weigher shall be so designed that it cannot normally come to rest in a position other than that intended, unless all indications and printing procedures are automatically disabled.

3.3.5 Conveyor interlock

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

3.3.6 Out-of-range and operation warning indication or checking device

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

a) the instantaneous load (T.4.2.1) is above the maximum capacity of the weighing unit;
b) the flowrate is above the maximum or below the minimum value;
c) a breakdown, maladjustment or fault has been detected (3.3.1);
d) a whole belt totalization device, if applicable, provides a totalization over less than a whole number of belt revolutions; or
e) the mpe on checking of zero (2.8.2) has been exceeded (3.5.1).

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

3.3.7 Securing and sealing of components and pre-set controls

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

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

3.3.7.1 Securing and sealing measures

Securing or sealing measures on a belt weigher shall ensure that:

a) Access to functions liable to affect metrological properties shall be restricted by means such as, a switch protected by a physical seal, a password, hard key or identification tag;
b) Software functions shall be secured against intentional, unintentional and accidental changes in accordance with the requirements of 4.8;
c) Transmission of metrological data via interfaces shall be secured against intentional, unintentional and accidental changes in accordance with the requirements of 4.6.1;
d) Measurement data held on storage devices shall be secured against intentional, unintentional and accidental changes in accordance with the requirements of 4.7;

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

a) Physical seals which must be broken to access the components or functions,

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

c) The traceability of the interventions shall be assured (e.g. by means of a counter which is incremented whenever the components or functions are altered, and an associated record of the value of this counter at a particular time) for at least a period of time specified by national legislation [typically the period between periodical verifications if these apply]. Records of interventions shall be retained. Records may not be overwritten, with the exception that if the storage capacity for records is exhausted, new records may replace the oldest record provided that the owner of the data has given permission to overwrite the records;

d) The sealing measures provided shall be easily accessible.

3.4 Totalization indicating and printing devices

The belt weigher shall be equipped with a general totalization indicating device and may additionally be equipped with partial and supplementary totalization indicating devices.

3.4.1 Quality of indication

Totalization indicating and printing devices shall allow reliable, simple, and non-ambiguous reading of the primary indications (see T.4.1.1) under typical weighing conditions (see T.5.4):

a) the overall inaccuracy of reading of an analogue indicating device shall not exceed 0.2 d_t;
b) the figures forming the primary indications shall be of a size, shape and clarity for reading to be easy;
c) the scales, numbering and printing shall permit the figures which form the results to be read by simple juxtaposition (see T.4.5.1).

3.4.2 Form of the indication

3.4.2.1 Unit of mass

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

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

The units of mass shall be indicated in small letters (lower case) as shown in 2.6.

3.4.2.2 Digital indication

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

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

The unit of mass shall be chosen 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.

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 on one line with the bottom of the figures (example: 0.305 kg).

Examples of suitable displays:

Scale Interval	Suitable Display	Not suitable display
0.005 t, 5 kg	0.050 t, 50 kg	0.05 t, 0.0500 t
0.01 t, 10 kg	0.10 t, 0.100 t, 100 kg	0.1 t, 0.1000 t
0.02 t	0.20 t, 0.200 t	0.2 t, 0.2000 t
1 t	10 t	10.0 t, 10.00 t

3.4.3 Scale interval

3.4.3.1 Form of the scale interval

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

3.4.3.2 Scale interval of a partial totalization indicating device

The scale interval of a partial totalization indicating device shall be equal to the scale interval of the general totalization indicating device (d_t).

3.4.3.3 Scale interval of a supplementary totalization indicating device

The scale interval of a supplementary totalization indicating device shall be at least equal to 10 times the totalization scale interval.

Any supplementary totalization devices cannot be used for legal measurements when both general and supplementary totalization devices can be simultaneously used to indicate the totalized load.

3.4.4 Range of indication

At least one totalization indicating device on a belt weigher shall be capable of indicating a value equal to the quantity of product weighed in 10 hours of operation at maximum flowrate.

A larger range of indication may be required for installations where larger deliveries are anticipated.

3.4.5 Totalization indicating devices

a) It shall not be possible to reset the general totalization indicating device or any totalization device to zero;
b) It shall not be possible to reset the partial totalization indicating device to zero unless the last total indicated before resetting to zero is printed or stored in memory

with identification;

c) In the case of a multi function display an automatic indication of the total shall be generated if the automatic operation is interrupted or during automatic operation at the latest 20 seconds after indication of another information;
d) Where a device such as a whole belt totalization indicating device (T.4.2.7) is provided, the belt weigher shall provide a valid totalization over a whole number of complete belt revolutions. In this case the requirements of 3.4.6 apply.

3.4.6 Engagement of totalization indicating devices

a) Totalization indicating and printing devices (if printing takes place) shall be permanently engaged except when disengaged by the device mentioned in b). In this case the totalization indicating and printing devices shall clearly indicate when they are not engaged;
b) There may be a device which disengages the totalization indicating devices where it is definitely ensured that there is no movement of the belt or product feed cannot occur.

3.4.7 Printing device

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.

3.5 Zero-setting device

The effective mass of the belt shall be balanced by a zero-setting device of a type appropriate to the principle of operation of the belt weigher. The effect of zero-setting shall not be more than 4 % of the maximum capacity.

3.5.1 Semi-automatic and automatic zero-setting devices

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

a) setting to zero takes place after a whole number of belt revolutions, and
b) end of the zero-setting operation is indicated,
c) zero-setting range shall not exceed 4% of the maximum capacity (Max), and
d) automatic take-over of a zero-correction after the zero-load test is provided by an interlock when the maximum permissible error on checking of zero (2.8.2) has been exceeded (see also 3.3.6).

It shall be possible to disengage automatic zero-setting devices during testing as appropriate.

A belt weigher may include an automatic zero-setting device only if it is provided with an interlock to prevent zero-setting while it is possible for product to feed onto the belt conveyor.

3.6 Belt Profile Correction Device (T.2.4)

Where a belt weigher is fitted with a device such as a belt profile correction device, the device shall:

a) either be permanently in operation, or permanently disabled (any ability to enable or disable shall be sealed against user access), or incorporate a mechanism to reliably synchronise the belt position with the stored (empty) belt profile (for example, the use of a sensor to detect the passing of a tag fixed to the belt being one possibility); and
b) be combined with an automatic or semi-automatic zero-setting device - i.e. operation of the zero-setting device may acquire and store a new profile of the (empty) belt, or operate separately from an automatic or semi-automatic zero-setting device, in which case the automatic or semi-automatic zero-setting device may adjust the average (empty) belt profile value according to the average zero value determined over a whole number of belt revolutions.

3.7 Displacement transducer

The displacement transducer shall be designed so that there is no possibility of slip likely to affect the results whether the belt is loaded or not.

Displacement transducers shall be driven by the clean side of the belt.

Measurement signals shall correspond with displacements of the belt equal to or less than the weigh length. It shall be possible to seal adjustable parts.

3.8 Belt weighers inclusive of conveyor

The conveyor shall be constructed in a rigid manner and shall form a rigid assembly.

3.8.1 Installation conditions

Belt weighers shall only be installed where:

a) the frame support of the conveyor is constructed in a rigid manner;

b) in any straight longitudinal section, the roller track is such that the belt is constantly supported on the weighing rollers;
c) belt cleaning devices, if fitted, are positioned and operated so as to have no significant effect on the results;
d) the roller track does not cause slippage of the product.

Belt weighers shall be designed so that the installation of the roller track, the construction and mounting of the belt, and the arrangement of the product feed do not cause excessive additional errors.

3.8.1.1 Roller track

Belt weighers shall be protected against corrosion and clogging.

The contact surface of the weighing (idler) rollers / weighing supports and the carrying (idler) rollers / carrying supports shall be aligned practically in the same plane.

3.8.1.2 Conveyor belt

Variations in the mass per unit length of the belt (including belt joins) shall not have any significant effect on the results (so as to ensure the requirement of 2.8.4 is met). It is recommended that such variations are minimised.

3.8.1.3 Speed control

The belt weigher shall ensure that the speed of the belt is within the following defined speed range:

1) For single or multiple speed weighers, the speed of the belt during weighing shall not vary by more than 5 % of the nominal speed.

2) For variable speed belt weighers having a speed setting control, the speed of the belt shall not vary by more than 5 % of the set speed.

3.8.1.4 Weigh length

Belt weighers shall be installed in such a way that the weigh length and vertical alignment remains unchanged while in service.

It shall be possible to seal the weigh length adjusting devices on the belt weigher to prevent adjustments of the weigh length while in service.

3.8.1.5 Belt tension for belt weighers other than belt weighers inclusive of conveyor.

The longitudinal tension in the belt shall be maintained independent of the effects of temperature, wear, or load (by some form of automatic mechanism or device – e.g. a gravity tension unit). Tension shall be such that under typical weighing conditions, there is practically no slip between the belt and the driving drum.

3.8.1.6 Belt slope

The belt shall normally be installed in a fix position. If the slope of the load receptor in the running direction of the belt can change, the instrument must be fitted with a device to compensate the effect due to the slope

3.9 Descriptive markings (*)

(*) Markings given by way of example but variable according to national regulations.

Instruments shall bear the following markings.

3.9.1 Markings shown in full

- identification mark of the manufacturer
- serial number and type designation of the belt weigher
- the inscription: "Zero setting shall have a duration of at least .. revolutions" (*the number of revolutions in zero-setting shall be decided as a consequence of the type evaluation*)
- mains voltage ... V
- mains frequency ... Hz (if applicable)
- designation of type(s) of product to be weighed
- weigh length (W_L) .... m
-
- identification mark on each unit of the belt weigher consisting of separate but associated units

3.9.2 Markings shown in code

- type approval sign
- maximum capacity (Max) .... kg or t
- temperature range .... °C / ... °C, (If applicable, see 2.7.4.1)
- accuracy class = 0.2, 0.5, 1 or 2
- totalization scale interval d_t = ... g, kg or t
- as appropriate:
  - nominal speed(s) of the belt v = ... m/s, or
  - range of speeds of the belt v =.... / .... m/s
- maximum flowrate Q_{max} = ... g/h, kg/h or t/h

– minimum flowrate Q_{min} = ... g/h, kg/h or t/h
– minimum totalized load $\sum_{min}$ = ... g, kg or t

3.9.3 Supplementary markings

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

3.9.4 Presentation of descriptive markings

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

Descriptive markings may be either in the national language or in form of adequate, internationally agreed and published pictograms or signs.

They shall be grouped together in a visible place on the belt weigher, either on a descriptive plate fixed or sticker fixed permanently near the general totalization indicating device or on a non removable part of the indicating device itself. In case of a plate or sticker which is not destroyed when removed, a means of securing shall be provided, e.g. a non removable control mark that can be applied or it shall be possible to seal the plate bearing the markings

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

a) at least Max, Q_{max}, Q_{Min}, $\sum_{min}$ and d_t shall be displayed as long as the instrument is switched on;
b) the other marking may be shown on manual command;
c) it must be described in the type approval certificate;
d) the markings are considered as device-specific parameters (see T.2.12.4) and shall comply with the appropriate requirements for securing in 3.3.7 and 4.8.

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

– Max, Q_{max}, Q_{Min}, $\sum_{min}$ and d_t shall be shown near the display;
– type approval sign in accordance with national requirements;
– name or identification mark of the manufacturer;
– voltage supply;
– voltage supply frequency, (if applicable);
– pneumatic/hydraulic pressure, (if applicable);

3.10 Verification marks

3.10.1 Position

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

a) be such that the part on which it is located cannot be removed from the belt weigher without damaging the marks;
b) allow easy application of the mark without changing the metrological qualities of the belt weigher;
c) be visible without the belt weigher or its protective covers having to be moved when it is in service.

3.10.2 Mounting

Belt weighers required to bear verification marks shall have a verification mark support, at the place provided for above, which shall ensure the conservation of the marks. When the mark is made with a stamp, the support may consist of a strip of lead or any other products with similar qualities, inserted into a plate fixed to the belt weigher, or into a cavity in the belt weigher. When the mark consists of an adhesive transfer, a space shall be prepared for this purpose.

4 ADDITIONAL REQUIREMENTS FOR BELT WEIGHERS CONTAINING ELECTRONICS

Belt weighers containing electronics shall comply with the following requirements, in addition to the applicable requirements of all other clauses.

4.1 General requirements

4.1.1 Disturbances

Belt weighers containing electronics shall be designed and manufactured so that when exposed to disturbances, either:

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

Note: A fault equal to or less than the significant fault specified in T.4.6.4 is allowed irrespective of the value of the error of measurement.

4.1.2 Durability

The requirements in 2, 3, and 4.1.1 shall be met durably in accordance with the intended use of the instrument.

4.1.3 Evaluation for compliance

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

4.2 Application

4.2.1 The requirements in 4.1.1 may be applied separately to:

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

4.2.2 The choice as to whether to apply 4.1.1 (a) or (b) is left to the manufacturer.

4.3 Acting upon a significant fault

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

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

4.4 Indicator display test

Upon switch-on (at switch-on of indication in the case of an electronic belt weigher permanently connected to the mains), a special procedure shall be performed that indicates all the relevant signs of the indicating devices, in their active and non-active states for a sufficient time to be easily observed by the operator. This is not applicable for non-segmented displays, on which failures become evident, for example screen-displays, matrix-displays, etc

4.5 Functional requirements

4.5.1 Influence factors

An electronic belt weigher shall comply with the requirements in 2.7.4 and shall in addition maintain its metrological and technical characteristics at a relative humidity of 85 % at the upper limit of the temperature range of the belt weigher.

4.5.2 Disturbances

When an electronic belt weigher is subjected to the disturbances specified in 4.1.1 and the disturbance tests in Annex A, the difference between the weight indication due to the disturbance and the indication without the disturbance (intrinsic error) shall not exceed the significant fault specified in T.4.6.4, or the instrument shall detect and act upon a significant fault.

4.5.3 Warm-up time

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

4.5.4 Mains power supply failure

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

4.5.5 DC mains or battery supply failure (DC)

A belt weigher that operates from a DC mains or battery voltage supply shall, whenever the voltage drops below the manufacturer’s specified minimum value, either continue to function correctly or automatically be put out of service. The belt weigher shall retain the metrological information contained in the belt weigher at the time of failure for at least 24 hours, and shall be capable of indicating that information for at least 5 minutes following energization during the 24-hour period.

4.6 Interfaces

A belt weigher may be equipped with interfaces (T.2.14) permitting the coupling of the belt weighers to external equipment and to user interfaces enabling the exchange of information between a human user and the belt weighers. When an interface is used, the belt weighers shall continue to function correctly and its metrological functions (including all metrologically relevant parameters and software) shall not be influenced. Sufficient information on belt weigher interfaces shall be available, for example:

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

4.6.1 Interface security

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

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

a) Data is protected e.g., with a protective interface (T.2.14.2), against accidental or intentional interference;
b) Hardware and software functions shall comply with the appropriate requirements for securing in 3.3.7 and 4.8;
c) it shall be easily possible to verify the authenticity and integrity of data transmitted to and from the belt weigher;
d) Other devices required by national regulations to be connected to the interfaces of a belt weigher shall be secured to inhibit automatically the operation of the belt weigher for reasons of the non-presence or improper functioning of the required device.

4.7 Data storage device

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

4.7.1 Securing measures:

To ensure adequate security the following conditions apply:

a) The appropriate requirements of 3.3.7 for securing are applicable;
b) External storage devices identification and security attributes shall be automatically verified to ensure integrity and authenticity;
c) Exchangeable storage media for storing measurement data need not be sealed provided that the stored data is secured by a specific checksum or key code;

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

4.8 Software

The legally relevant software of the belt weigher shall be identified by the manufacturer, i.e., the software that is critical for measurement characteristics, measurement data and metrologically important parameters, stored or transmitted, and software programmed to detect system fault (software and hardware), is considered as an essential part of a belt weigher and shall meet the requirements for securing software specified below. Sufficient information on software controlled instruments information shall be available, for example:

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

4.8.1 Security of legally relevant software

There shall be adequate security to ensure that:

a) Legally relevant software shall be adequately protected against accidental or intentional changes. The appropriate requirements for securing given in 3.3.7 and 4.7 apply;
b) The software shall be assigned with appropriate software identification (T.12.5). This software identification shall be adapted in the case of every software change that may affect the functions and accuracy of the belt weigher.
c) Functions performed or initiated via connected interfaces, i.e., transmission of legally relevant software, shall comply with the securing requirements for interfaces in 4.6;

PART 2 METROLOGICAL CONTROLS AND PERFORMANCE TESTS

5 METROLOGICAL CONTROLS

The metrological controls of belt weighers may, in agreement with national regulations, consist of:

a) type evaluation;
b) initial verification;
c) subsequent verification;
d) in-service inspection.

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

The importance of durability of belt weighers is recognised. Measures to ensure durability may be taken subject to national regulations, which may include assessments under items (a) to (d) above.

If such an assessment is included under (a) it should be recognised and taken into account that (lack of) durability may be a characteristic of a particular installation. Hence a decision not to type approve an instrument may only be warranted where the unacceptable durability is clearly a characteristic of the type.

Where measures to ensure durability are taken, authorities are encouraged to document these and provide details to TC9/SC2 to inform any future work on development of harmonised requirements or guidance regarding durability.

5.1 Type evaluation

5.1.1 Documentation

The application for type evaluation shall include documentation comprising:

- metrological characteristics of the belt weigher (2);
- a standard set of specifications for the belt weigher;
- a functional description of the components and devices;
- drawings, diagrams and photo of the instrument, explaining the construction and operation;
- description and application of securing components, interlocks, adjustment devices, controls, etc. (3.3, 4.8, 3.9);
- details of fractions Pi (modules tested separately) (5.1.6);
- totalization indicating and printing devices (3.4);
- data storage device (4.7);
- zero-setting devices (3.5);
- interfaces (types, intended use, immunity to external influences instructions, etc, (4.6);
- for software controlled instruments detailed software information (4.8);

- drawing or photo of the instrument showing the principle and the location of control marks, securing marks, descriptive and verification marks (3.9, 3.10);
- operating instructions, operating manual;
- any document or other evidence demonstrating that the design and construction of the instrument complies with the requirements of this Recommendation;

Note: Adherence to requirements for which no test is available, such as software-based operations, may be demonstrated by a specific declaration of the manufacturer (e.g. for interfaces as per 4.6, and for password protected access to set-up and adjustment operations as per 3.3.7.

5.1.2 General requirements

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

5.1.3 Type evaluation tests

Belt weighers shall comply with:

a) the metrological requirements in Clause 2, particularly with reference to maximum permissible errors, when the instrument is operated in accordance with the manufacturer's specifications for range and product(s);
b) all the technical requirements in Clause 3;
c) the requirements in Clause 4 for electronic instruments.

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

The metrological characteristics of the instrument in accordance with 3.9 and if applicable the specifications for the modular approach of the modules of the instrument in accordance with 5.1.6 shall be examined.

5.1.3.1 In situ product tests

In-situ product tests shall be conducted in accordance with 6.1.

The maximum permissible errors for automatic weighing shall be as specified in 2.2.1, Table 1, for initial verification, as appropriate for the class of the belt weigher.

5.1.3.2 Provision for means of testing

For the purposes of testing, the applicant may be required to furnish the metrological authority with the quantity of product, handling equipment, qualified personnel, and a control instrument (see 6.1).

5.1.3.3 Place of testing

Belt weighers submitted for type approval may be tested at the following places:

a) the premises of the metrological authority to which the application has been submitted;
b) any other suitable place mutually agreed upon between the metrological authority and the applicant.

5.1.4 Type approval certificate and determination of classes

The type approval certificate shall state the appropriate accuracy classes 0.2, 0.5, 1 or 2, as specified at type approval stage and be determined by compliance with the metrological requirements at initial verification of the instrument.

5.1.5 Influence factor tests

Influence factor tests shall be applied to the complete instrument or simulator as specified in 6.3 and in Annex A in a manner that will reveal a corruption of the weighing result of any weighing process to which the belt weigher could normally be applied, in accordance with:

a) subclause 2.7 for all belt weighers; and
b) Clause 4 for electronic belt weighers.

5.1.6 Testing of a family of instruments or modules

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

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

d) when a module is intended to be used for various kinds of belt weighers (in particular load sensors, indicators, data storage).

Where a family of instruments (T.3.14) or modules of various capacities and characteristics is presented for type examination, the following provisions apply for selecting the Equipment Under Test (EUT).

5.1.6.1 Selection of EUTs

The selection of EUTs to be tested shall be such that their number is minimized but nevertheless sufficiently representative of the type.

It is recommended that belt weighers be categorized primarily by the fundamental engineering design they are constructed upon. The categories of design may include but are not limited to the following basic operating principles:

- Mechanical – no electronics;
- Analogue, strain gauge type load cells;
- Digital load cells.

Those belt weighers using load cell technology may further be categorized by using the method that the load cells are mounted/connected to the weight receiving element and supporting structures. Examples may include but are not limited to:

- Direct mounting of load cells without check rods;
- Connection of the weighing elements to load cell via lever system;
- Isolated from load cell and with check rods or flexures.

An additional method of classifying belt weighers within a family can be based on the number and configuration of idlers used within the weighing element. Examples may include but are not limited to:

- Multiple idler, fully-suspended;
- Multiple Idler, modular;
- Multi Idler, approach/retreat weigh frame with lever connected to single load cell

In order to streamline type evaluation test procedures involving a family of devices, it is recommended to select an EUT that represents the “worst case” sample from that family. This is to ensure that not only the worst case be selected but also that an instrument representing a best (or better) case be evaluated to establish a range of performance data within the family of devices. For belt weighers, it is recommended that the worst case instrument be selected based on the following:

1) For testing performed in a laboratory setting:

- Lowest input signal from the force transducer(s) (see 5.1.6.6);
- Unit with the maximum number of interfaces (i.e. peripheral equipment, hardware components);
- Unit with the maximum number of load cells;
- Unit with the highest frequency of belt displacement transducer output.

2) For in-situ testing:
   - The fewest number of weigh idlers in the family.

5.1.6.2 Accuracy class

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

5.1.6.3 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 on a different one. Variations in metrologically relevant features and functions such as different:

a) housings;
b) load receptors;
c) temperature and humidity ranges;
d) instrument functions;
e) displacement transducer;
f) 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.

When evaluating a system using the fewest number of idlers as a basis, it is recommended that after an initial in-situ test is performed, a subsequent, durability test be performed to establish that the reduction of the number of idlers has not resulted in an unsatisfactory diminished ability of the belt weigher to perform as intended over a period of time and use.

5.1.6.4 Summary of relevant metrological characteristics

The EUTs must cover:

- lowest input signal, μV/d (when using analogue strain gauge load cells, see T.3.1.3 and 5.1.6.6);
- all accuracy classes;
- all temperature ranges;
- single speed, variable or multiple speed instrument;
- maximum size of load receptor, if significant;
- displacement transducer;
- metrologically relevant features (see 5.1.6.3);
- all possible instrument functions;
- all possible indications;
- all possible implemented digital devices;
- all possible interfaces;
- weigh idlers
- different types of load receptors, if connectable to the indicator; and different types of belt conveyors;

5.1.6.5 Minimum scale interval of electronics (e).

When the electronics contain an analogue data processing device the minimum scale interval e obtainable shall be determined as follows:

$$e = \text{Error} \times \text{Max} / Q_{Max}$$

Where Error is the maximum effect per 5 °C of temperature on totalization at zero flow rate (A.7.2.2)

5.1.6.6 Requirement to the minimum scale interval (v_{min}) of the used load cell(s).

When analogue strain gauge load cells are used then the minimum scale interval (v_{min}) of the load cell shall fulfil the following equation[1]:

$$\text{Max} \geq S \times v\text{min} \times R / \sqrt{N}$$

Where,

S = 15000 for class 0.2
S = 6000 for class 0.5
S = 3000 for class 1

[1] This formula can be derived based on the same requirements as for the control scale interval, just adding R and N, (Annex F, R76-1:2006).

S = 1500 for class 2

R is the reduction ratio of the load receptor
N is the number of load cells

When digital load cells are used the above formula shall also be used, but due to p_i equal 1 the following S values shall be used,

S = 10000 for class 0.2
S = 4000 for class 0.5
S = 2000 for class 1
S = 1000 for class 2

5.1.6.7 Apportioning of errors

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

The error limits applicable to a module which is examined separately are equal to a fraction p_i of the maximum permissible errors (clause 2.2.2 Table 2) or the allowed variations of the indication of the complete instrument. The fractions for any module have to be taken for the same accuracy class as for the complete instrument incorporating the module.

The fractions p_i shall satisfy the following equation:

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

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

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

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

5.2 Initial verification

5.2.1 General requirements

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

Belt weighers shall comply with the requirements in Clause 2 (except 2.7) and Clause 3 for a given product or products for which the belt weigher is intended and when operated under typical weighing conditions.

5.2.2 Tests

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

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

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

In appropriate situations and to avoid duplicating tests previously performed on the belt weigher for type evaluation under 5.1.3, the metrological authority may use the results of observed tests for initial verification at that site.

5.2.2.1 In-situ product tests

In-situ product tests shall be conducted in accordance with 6.1.

Before testing, the conveyor shall operate (preferably loaded) for at least 30 minutes at nominal speed. A control instrument meeting the requirements of 6.2 shall be available at all times in the vicinity of the belt weigher(s) submitted for testing**.** Storage and transport shall be arranged so as to prevent any loss of the product. Checking of the mass of the product used may take place before or after its passage over the belt weigher.

The maximum permissible errors for automatic weighing shall be as specified in 2.2.1, Table 1, for initial verification, as appropriate for the class of the belt weigher.

5.2.2.2 Provision of means of testing

For the purposes of testing, the applicant may be required to supply the equipment, quantity of product, handling equipment, and qualified personnel to perform the tests.

5.2.3 Conformity

Conformity to the approved type and this Recommendation shall cover:

a) compliance with the appropriate maximum permissible errors in 2.2.1, Table 1;
b) compliance of the belt weigher with the technical requirements in Clause 3.
c) correct functioning of all devices, e.g. interlocks, indicating and recording devices;
d) construction material and design, as far as they are of metrological relevance;
e) if appropriate a list of the tests performed

5.2.4 Visual inspection

Before testing, the belt weigher shall be visually inspected for:

a) metrological characteristics, i.e. scale interval, minimum capacity;
b) prescribed inscriptions and positions for verification and control marks

5.2.5 Marking and securing

According to national legislation, initial verification may be testified by verification marks as specified in 3.10. National regulations may also require securing of devices whose dismantling or maladjustment might alter the metrological characteristics of the instrument without the alterations being clearly visible. The provisions of 3.3 and 3.10 shall be observed.

5.2.6 Application of accuracy class

Accuracy class requirements shall be applied in accordance with the appropriate parts of 2.2.1 for initial verification.

Verify that the accuracy classes marked in accordance with 3.9 are equal to the accuracy class determined as above.

Note: The accuracy class that was achieved at type approval stage may not be achieved at initial verification if the loads used are significantly less stable or of different dimensions. In this case a lower accuracy class shall be marked in accordance with 2.2.1 and 3.9. Marking of a higher accuracy class than was achieved at type approval stage is not permitted.

5.3 Subsequent metrological control

Subsequent metrological control may be performed according to national regulations.

It is recommended that arrangements for subsequent metrological control incorporate means for reviewing intervals for subsequent verification and in-service inspection, based on performance of an instrument over time, so as to provide an incentive to produce equipment which is durable when installed and used, and as a deterrent to non-durable equipment. ILAC-G24/OIML D 10 (2007) "Guidelines for the determination of calibration intervals of measuring instruments" indicates (in clause 3) methods which may be useful for this purpose."

Should an instrument (installed in a particular location) be found to be of unacceptable durability, action may need to be taken to withdraw that instrument from use. If unacceptable durability was found to be a characteristic of the type (unacceptable durability regardless of the installation), withdrawal of the type approval may need to be considered.

5.3.1 Subsequent verification

Subsequent verification shall be carried out in accordance with the same provisions as in 5.2 for initial verification with the error limits being those on initial verification. Marking and securing may take place according to 5.2.5, the date being that of the subsequent verification.

5.3.2 In-service inspection

In-service inspection shall be carried out in accordance with the same provisions as in 5.2 for initial verification, with the exception that the in-service maximum permissible errors in 2.2.1 Table 1 shall be applied. Marking and securing may remain unchanged, or renewed as per 5.3.1.

6 TEST METHODS

6.1 General test procedure

In-situ product tests shall be done as follows:

a) in accordance with the descriptive markings;
b) under the conditions of use for which the belt weigher is intended;
c) with a quantity of product not less than the minimum totalized load $\sum_{min}$ in 2.4 Table 3 for initial verification and in-service verification;
d) with test load(s) that is representative of the range and type of products for which the belt weigher is likely to be used or product(s) for which the instrument is intended;
e) at flowrates between the maximum and minimum values;
f) at each belt speed for conveyors with more than one fixed speed, or throughout the speed range for variable speed conveyors;
g) in accordance with the test methods in Clause 6 and the test procedures in Annex A

6.2 Verification Standards

6.2.1 Control instruments and standard weights

A control instrument and standard weights meeting the appropriate requirements in Clause 6 shall be available for determining the true quantity value of the mass of each test load.

The control instrument used for product testing shall enable the determination of the true quantity value of the mass of each test load to an accuracy of at least one-third of the appropriate maximum permissible error for automatic weighing in 2.2.1, Table 1.

The control instrument shall be checked immediately following completion of the weighing to ascertain whether or not its performance has changed. For re-verification tests the combined error and uncertainty shall be as specified above for the control instrument.

6.2.2 Standard weights

The reference standard weights or masses used for the type examination or verification of an instrument shall meet the metrological requirements of OIML R 111 [5]. The error of the additional weights used to determine the rounding error of the control instrument shall not exceed one-fifth of the maximum permissible errors of the instrument to be verified for the load, as specified in 2.2.2, Table 2 for initial verification.

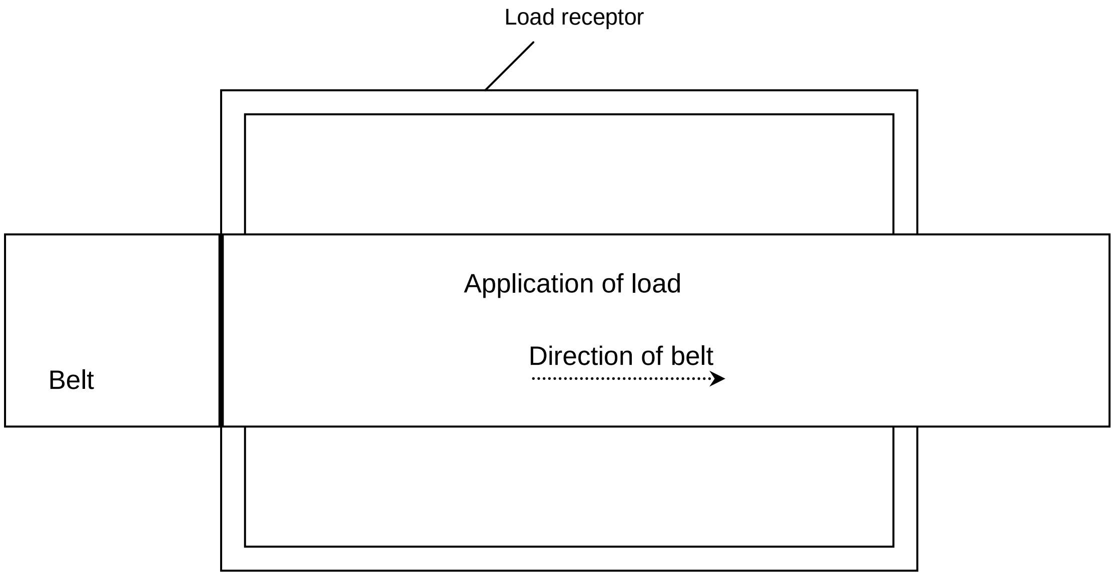
6.3 Simulation tests (Test with static load without the belt conveyor)

For testing the metrological characteristics on a belt weigher without its conveyor, standard weights and a displacement simulating device (see T.2.5) may be used to simulate the displacement of the belt. The EUT shall be fitted with:

a) a complete belt weigher without the belt conveyor;
b) a representative load receptor (normally the complete weigh table);
c) a platform (pan) for the standard weights;
d) a device (such as an operation checking device, T.2.8) enabling the comparison of integrations with a constant load over equal complete belt revolutions predetermined by the operator and measured by the displacement transducer;
e) a displacement simulation device

The test load, which should be distributed along the load receptor in line with the direction of belt travel as shown in Figure 2, is to be placed at various points across the (simulated) belt width. The duration of each zero totalization shall be equal to the time to weigh the minimum totalized load at minimum flowrate.

Figure 2



6.4 True quantity value of the mass of the test load

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

b) With the simulation tests, the true quantity value of the mass of the test load shall be the totalised weight calculated from the product of the static test load and the pulse count as indicated in the individual tests.

6.5 Indicated mass

a) With the in-situ tests control method, a test load shall be weighed as an automatic bulk weighing operation and the indicated mass on the belt weigher shall be observed and recorded.

b) With the simulation test, an automatic bulk weighing operation shall be conducted using standard weights distributed on the load receptor in line with the direction of belt travel. The indicated mass shall be observed and recorded, with the belt length or number of pulses respectively increased to five times that at totalization of ∑min. Alternatively, a supplementary totalization indicating device (T.4.2.6) with a higher resolution may be used to indicate the mass of the test load to at least ten times the resolution of the totalization scale interval.

Where possible, the procedures in A.3.7 shall be used to eliminate rounding errors included in any digital indication.

6.6 Calculation of error (A.3.7)

The relative error (E_r) is given as:

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

For the in-situ tests – control method:

$$\text{Relative Error (\%)} = \frac{\text{(Belt weigher indication – Control instrument indication)}}{\text{Control instrument indication}} \times 100$$

For the simulation tests:

$$\text{Relative Error (\%)} = \frac{\text{(Totalised weight displayed – Totalised weight calculated)}}{\text{Totalised weight calculated}} \times 100$$

The true quantity value is as specified in 6.4 and the indicated (or displayed) mass is as specified in 6.5.

The relative error value expressed as a percentage (%) shall be used for comparison with the appropriate maximum permissible errors for automatic weighing in 2.2.1.

6.7 Examination and tests

6.7.1 Examinations

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

6.7.2 Performance tests

A belt weigher or electronic device, as appropriate, shall be tested as defined in Annex A to determine its correct operation. Tests are to be conducted on the whole belt weigher except when its size and/or configuration does not lend itself to testing as a unit. In such cases, the separate electronic devices shall be subjected to testing. It is not intended that electronic devices be further dismantled for separate testing of components.

In addition, an examination shall be carried out on the fully operational belt weigher or, if necessary for practical reasons, on the electronic devices in a simulated set-up that sufficiently represents the belt weigher. The belt weigher shall continue to function correctly as specified in Annex A.

ANNEX A
TEST PROCEDURES
FOR CONTINUOUS TOTALIZING AUTOMATIC WEIGHING INSTRUMENTS

(Mandatory)

A.1 EXAMINATION FOR TYPE APPROVAL

A.1.1 Documentation (5.1.1)

Review the documentation that is submitted, including necessary photographs, drawings, relevant technical specifications of main components etc. to determine if it is adequate and correct. Consider the operational manual.

A.1.2 Comparing Construction with Documentation

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

A.1.3 Metrological characteristics

Note metrological characteristics according to the test report format in OIML R 50-2.

A.1.4 Technical requirements

Check for conformity with the technical requirements according to the checklist given in the test report format in OIML R 50-2.

A.1.5 Functional requirements

Check for conformity with the functional requirements according to the checklist given in the test report format in OIML R 50-2.

A.2 EXAMINATION FOR INITIAL VERIFICATION

A.2.1 Compare construction with documentation

Examine the instrument for conformity with the approved type.

A.2.2 Descriptive markings (3.9)

Check the descriptive markings according to the check-list given in the test report format

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

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

A.3 GENERAL REQUIREMENTS FOR INSTRUMENTS UNDER TEST (EUT)

A.3.1 Power supply stabilizing time

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

A.3.2 Zero-setting

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

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

A.3.3 Temperature

Except for the temperature test (A.7.2.1) and the humidity test (A.7.2.3), the test shall be performed at a steady ambient temperature, usually normal room temperature unless otherwise specified. The temperature is deemed to be steady when the differences between the extreme temperatures noted during the test does not exceed one-fifth of the temperature range of the instrument and the rate of change does not exceed 5 °C per hour.

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

A.3.4 Recovery

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

A.3.5 Warm-up time (4.5.3, A.5.2)

The warm-up test shall be performed as specified in A.5.2. Energize the EUT and maintain it energized for the duration of the tests. Check that, for a period of time at least equal to the warm-up time specified by the manufacturer, there is no indication or transmission of the result of weighing, and that automatic operation is inhibited.

A.3.6 Automatic zero-setting

During the tests, the effect of the automatic zero-setting device may be switched off by use of the interlock facility (see 3.5.1). Where necessary the status of the automatic zero-setting is defined in the test description.

A.3.7 Evaluation of error (6.6)

The calculation of the relative errors is as specified in 6.6.

A.3.7.1 Indication with a scale interval 0.2 d or smaller

If an instrument with digital indication has a device for displaying the indication with a smaller scale interval than d (e.g. ≤ 0.2 d), this device may be used to calculate the error. If such a device is used, it should be noted in the test report.

A.3.7.2 General method to assess error

For greater resolution of the control instrument it may be appropriate to use change point weights, as follows:

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

The true indication, P, prior to rounding is found by using the following formula:

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

The error prior to rounding is:

$$E = P - L$$

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

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

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

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

$$E = (100.2 - 100)\ \text{kg} = 0.2\ \text{kg}$$

A.3.7.3 Indication with a scale interval not smaller than 0.2 d

If a device with a scale interval smaller than 0.2 d is not available, the following method may be used to determine the error. Allow the instrument to run for a time such that the number of d is equal to 5 times the value in 2.4, Table 3.

Example: class 1 instrument:

- mpe 0.35 % (from 2.2.2 Table 2)
- $\sum_{min}$ value 400 d (from 2.4 Table 3)
- 5 x 400 d = 2 000 d
- Therefore mpe = 7 d.

The error can therefore be found to 1 d, i.e.: 1/7 of mpe.
This is equivalent to a test load of 400 d ($\sum_{min}$ value from Table 3) using test scale of 0.2 d, since:
- mpe = 1.4 d
- 1/7 mpe = 0.2 d.

By increasing the test load, the value of d is less significant to the mpe for the test load.

A.4 TEST PROGRAM

A.4.1 Type evaluation (5.1)

Note: The tests covered in clauses A.7 are to be conducted with static load without the belt conveyor (6.3).

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

A.4.2 Initial verification

Only clause A.8 In-situ tests, is normally required for initial verification tests.

A.5 METROLOGICAL PERFORMANCE TESTS

A.5.1 General conditions

The general test requirements in A.3 shall be applied as far as applicable.

A.5.2 Warm-up time test (4.5.3, A.3.5)

This test is to verify that metrological performance is maintained in the period immediately after switch on. The method is to check that errors comply with the requirements for a period of time at least equal to the warm up time specified by the manufacturer. It shall be checked that the operation of the instrument is inhibited until the warm up time has elapsed.

To ensure that the time period prior to a stabilized indication is adequate, the instrument shall be disconnected from the electric power supply for a period of at least 8 hours. The instrument shall then be connected and switched on. As soon as the indication has stabilized the following pairs of tests (A and B) shall be conducted. .

Note: The percentage of Max is derived from 2.5 and although nominally 20 %, it may be exceeded in certain cases.

Test A
Set the instrument to zero and carry out a totalization of $\sum_{min}$ with a load on the weigh table to equate to Q_{min} (nominally 20 % of Max) for fixed speed belt weighers or 20 % of Max for variable speed and multi-speed belt weighers at maximum belt speed. Note the totalization and the exact duration of the test (normally a preset number of pulses).

Test B

Immediately carry out a totalization at maximum capacity (Max) for exactly the same duration, and for variable and multi-speed belt weighers the same maximum speed and number of pulses used in Test A. Note the totalization.

Repeat tests A and B above consecutively with a time interval between each pair of tests to obtain not less than 3 pairs of totalizations in a total time as close as possible to 30 minutes.

Calculation of error shall be made in accordance with A.3.7.3. The relative error, expressed as a percentage, shall not be greater than the maximum permissible error for the influence factor tests (2.2.2, Table 2) appropriate for the class.

A.5.3 Product tests control method (5.1.3.1 and 5.2.2.1)

The product tests are conducted as indicated in Clause 6 and A.9.

The control instrument is used to weigh the product either before or after it is weighed on the belt weigher. The separate control instrument used for product testing shall comply with the requirements of 6.2.

The error for automatic weighing is calculated in accordance with 6.6 for the separate verification method. When calculating the error, it is necessary to consider the scale interval of the indicating device of the control instrument.

A.5.4 Tests with static load without the belt conveyor (6.3)

A.5.4.1 Variation of simulation speed (2.7.1)

Simulate the belt run or operate the displacement simulation device and allow it to stabilize. Carry out each test over the same integral number of simulated belt revolutions (i.e. the same number of displacement transducer pulses), without zero-setting after changing the speed.

With a simulated test totalization of $\sum_{min}$ or (as indicated in A.3.7.3) 5 times the value in 2.4 Table 3, and at a flowrate close to Q_{max}, totalize at 90 % of nominal speed. Repeat at 110 % of nominal speed.

For multi-speed belt weighers, carry out one test at each set speed.

For variable-speed belt weighers, carry out totalizations at:

a) 90 % and 110 % of minimum speed;
b) minimum plus 1/3 of speed range;

c) maximum minus 1/3 of speed range, and
d) 90 % and 110 % of maximum speed.

If flowrate control is to be used, a further test shall be carried out with the flowrate control in operation. The flowrate set-point is to be stepped down from maximum to minimum in five steps, remaining at each setting for 1 belt revolution.

The errors shall be calculated in accordance with A.3.7.3. Errors shall not exceed the appropriate maximum permissible errors for influence factor tests in 2.2.2, Table 2.

A.5.4.2 Eccentric loading (2.7.2)

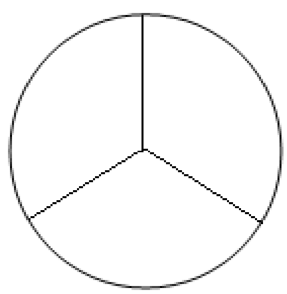
For each test, the load is to be distributed along the length of the load receptor in line with the direction of belt travel, and over a half of the simulated belt width.

For a load equivalent to half Max, carry out a separate totalization of a simulated totalized test load of $\sum_{min}$ or (as indicated in A.3.7.3) 5 times the value in 2.4, Table 3 with the load in each of three bands where:

Band 1 is from the centre of the load receptor to one edge of the (simulated) belt, Band 2 is centred on the centre of the load receptor, Band 3 is as band 1 but on the other side.

The errors shall be calculated in accordance with A.3.7.3 and shall not exceed the appropriate maximum permissible errors for influence factor tests in 2.2.2, Table 2.

Figure 3



Examples: A load receptor which transmits the force from the load:

directly into 1 single point load cell has 1 point of support;
directly into 3 load cells has 3 points of support; and
with 4 mechanical connection elements into a lever works has 4 points of support.

A.5.4.3 Range of zero-setting device (3.5)

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

To test the negative portion of the zero-setting range, first re-zero the instrument with an additional weight on the load receptor. This additional weight should be greater than the negative zero-setting range. Successively remove the weights, activating the zero-setting device each time one is removed. The maximum load that can be removed while the instrument can still be re-zeroed by the zero-setting device is the negative portion of the zero-setting range.

Re-zero the instrument without this additional weight.

The zero-setting range is the sum of the positive and negative portions and shall not exceed 4 % of Max.

A.5.4.4 Accuracy of zero-setting (2.7.3)

Carry out a totalization of $\sum_{min}$ at Q_{max} after setting the belt weigher to zero for loads on the weigh table equivalent to 50 % and 100 % of the positive and negative zero setting ranges.

The errors shall be calculated in accordance with A.3.7.3 and shall not exceed the appropriate maximum permissible errors for influence factor tests in 2.2.2, Table 2.

The duration of each zero totalization shall be equal to the time required to weigh the minimum totalized load at minimum flowrate.

A.5.5 Metrological characteristics

A.5.5.1 Repeatability (2.7.5.1)

1) Apply a distributed load of 20 % Max on the load receptor and carry out a totalization of $\sum_{min}$ or (as indicated in A.3.7.3) 5 x the value in 2.4 Table 3. Remove the load, allow the belt-weigher to run empty and reset the indication to zero if necessary. Repeat the test with the same load.
2) Repeat the whole test with a load of 50 % Max (Totalization ≈ $\sum_{min}$ or 5 ẋ value in 2.4 Table 3);
3) Repeat the whole test with a load of 75 % Max (Totalization ≈ $\sum_{min}$ or 5 ẋ value in 2.4 Table 3);
4) Repeat the whole test with a load of Max (Totalization ≈ $\sum_{min}$ or 5 ẋ value in 2.4 Table 3).

The difference between any two results obtained for the same load placed under the same conditions on the load receptor shall not exceed the absolute value of the appropriate maximum permissible error for influence factor tests specified in 2.2.2, Table 2.

A.5.5.2 Discrimination of the totalization indicating device (2.7.5.2)

1) Apply a distributed load of 20 % Max on the load receptor and carry out a totalization of $\sum_{min}$, noting the exact duration of the test (normally a preset number of pulses). Add additional weights:
   a) additional load = existing load x 0.07 % for class 0.2;
   b) additional load = existing load x 0.18 % for class 0.5;
   c) additional load = existing load x 0.35 % for class 1;
   d) additional load = existing load x 0.7 % for class 2, and
   e) totalize again for the same equivalent belt length.

2) Repeat for a load of 50 % Max.
3) Repeat for a load of 75 % Max.
4) Repeat for a load of Max.

The difference between the indications with and without the additional load shall be at least equal to one half of the calculated value related to the additional load.

A.5.5.3 Discrimination of the totalization indicating device (2.7.5.2)

1) Zero the belt weigher and disable any automatic zero-setting device.
2) Totalize with no load for 3 minutes (or the equivalent number of preset pulses) and record the zero indicator reading. If the indicator can be reset to zero, reset it at the end of each 3-minute test. Add a small weight to the load receptor as follows:

   a) Max x 0.02 % for class 0.2;
   b) Max x 0.05 % for class 0.5;
   c) Max x 0.1 % for class 1;
   d) Max x 0.2 % for class 2.

3) Totalize for a further 3 minutes and record the zero indicator reading.

4) Remove the small weight, totalize for 3 minutes (or the equivalent number of preset pulses) and record the zero indicator reading.

5) Reset the belt weigher to zero with the weight on the load receptor, disable any auto-zeroing device, and repeat the tests in 2 above but with the weight removed from the zero point.

6) Repeat the test as necessary to eliminate the effect of short term zero drift or other transient effects. The difference between two consecutive indications, with and without the small weight, shall be clearly visible.

A.5.5.4 Stability of zero (2.7.5.3)

Stability test criteria in A.5.5.4 will be dependent on whether SC2 selects proposal 1 or 2 of 2.7.5.3.

Stability Test to go with Proposal 1 of 2.7.5.3

Zero the belt weigher and disable any automatic zero-setting device. Totalization values are to be taken from the indicator used for zero totalization.

Run the belt weigher with no load, record the initial totalization indication, and the reading after each 3-minute interval for a period of 15 minutes.

Leave the belt weigher running for 3 hours. After this period, without further adjustment, record the totalization indication and continue to record readings after each 3-minute interval for a further period of 15 minutes.

The difference between the smallest and largest of all 12 readings taken over the 3.5 hour period shall not exceed the value specified in 2.7.5.3.

The above test shall be carried out without any load being applied to the instrument. Zero setting shall be carried out prior to commencement of the test, no further zero adjustment shall be carried out before completion of the test (i.e. until all 12 readings have been obtained).

or

Stability Test to go with Proposal 2 of 2.7.5.3

Zero the belt weigher and disable any automatic zero-setting device. Totalization values are to be taken from the indicator used for zero totalization.

Run the belt weigher with no load, record the initial totalization indication, and the reading after each 3-minute interval for a period of 15 minutes. The difference between the smallest and largest indication obtained in this set of six readings shall not exceed values specified in 2.7.5.3 for assessment of stability over a period of 15 minutes.

Leave the belt weigher running for 3 hours. After this period, without further adjustment, record the totalization indication and continue to record readings after each 3-minute interval for a further period of 15 minutes. The difference between the smallest and largest indication obtained in this second set of six readings, shall not exceed the value specified in 2.7.5.3 for assessment of stability over a period of 15 minutes.

The difference between the smallest and largest of all 12 readings taken over the 3.5 hour period shall not exceed the value specified in 2.7.5.3 for assessment of stability over a period of 3.5 hours.

The above test shall be carried out without any load being applied to the instrument. Zero setting shall be carried out prior to commencement of the test, no further zero adjustment shall be carried out before completion of the test (i.e. until all 12 readings have been obtained).

A.6 ADDITIONAL FUNCTIONALITY

A.6.1 Agreement between multiple indicating devices (2.3)

During the tests verify that for the same load, the difference between any two indicating devices having the same scale interval is zero.

A.6.2 Adjustments in automatic operating mode (3.3.1)

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

A.6.3 Securing of components and pre-set controls (3.3.7)

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

A.6.4 Totalization indicating and printing devices (3.4)

For indication of weighing results, verify that:

a) totalization indicating and printing devices shall be permanently engaged (3.4.6);
b) in automatic operation the totalization devices cannot be reset to zero (3.4.6);
c) when automatic operation is finished the partial totalization device cannot be reset to zero unless the total is automatically recorded. Test by disabling the general totalization indicating device and attempting to reset the partial totalization device (3.4.6);

d) the scale interval of a partial totalization indicating device is equal to the scale interval of the general totalization indicating device (3.4.3.2);
e) the scale interval of a supplementary totalization indicating device shall be at least equal to 10 times the totalization scale interval (3.4.3.3);
f) at least one totalization indicating device on a belt weigher shall be capable of indicating a value equal to the quantity of product weighed in 10 hours of operation at maximum flowrate (3.4.4);
g) an automatic indication of the total is generated if the automatic operation is interrupted (3.4.6)

A.6.5 Retention of total load value after power supply failure (4.5.4)

Switch off power to the instrument while the general totalization device is indicating a total load value of not less than $\sum_{min}$. Verify that this total value is retained for at least 24 hours and is capable of indicating that information for at least 5 minutes following energization.

A.6.6 DC mains voltage or battery voltage variations (4.5.6)

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

A.7 INFLUENCE FACTORS AND DISTURBANCE TESTS DURING TYPE EVALUATION

A.7.1 General

Preliminary note 1: The tests which are specific to electronic instruments, as described in this Annex, have been taken as far as possible from the work of the International Electro-technical Commission (IEC) also taking into consideration the latest edition of the OIML International Document D 11 [4].

Preliminary note 2: Although references to current versions of IEC publications have been made, all EMC and other additional tests for electronic instruments should be conducted on the basis of most recent versions valid at the time of testing. This should be mentioned in the Test Report. The objective is to keep pace with future technical developments.

Further guidance on the metrological performance testing requirements for influence quantities and disturbances is provided in the appropriate reference standards as indicated for each test and in the OIML International Document D 11 [4].

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

It is not possible to apply these tests to an instrument that is performing an automatic operation_with product loaded on the running belt. The instrument shall therefore be subjected to the influence factors and disturbances under simulated operation as defined herein. The permissible effects of the influence factors or disturbances, under these conditions, are specified for each case.

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

Where parts of the instrument are examined separately, errors shall be apportioned in accordance with 5.1.6.6.

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

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

The deviation of the no-load indication due to any test condition shall be recorded, and any load indication shall be corrected accordingly to obtain the weighing result.

A.7.1.1 Simulated operation by test with static load without the belt conveyor

Influence factor and disturbances tests, during simulation testing, should include all electronic devices of the weighing system.

A.7.1.2 Using a simulator

If a simulator is used to test a module, the repeatability and stability of the simulator should make it possible to determine the performance of the module with at least the same accuracy as when a complete instrument is tested with weights, the MPE to be considered being those applicable to the module. The simulator must be capable of providing a minimum input signal, μV/d (normally minimum input voltage per scale interval).

If a simulator is used, this shall be noted in the Evaluation Report and its traceability referenced.

A.7.1.3 Interfaces (4.3.5)

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

A.7.1.4 Documentation

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

A.7.2 Influence factor tests (2.7)

Summary of tests

Test	Criteria	§
Static temperatures	MPE(*)	A.7.2.1
Temperature effect on no load indication	See A.7.2.2	A.7.2.2
Damp heat test steady-state	MPE	A.7.2.3
AC mains voltage variations	MPE	A.7.2.4
DC mains voltage variations	MPE	A.7.2.5
Battery voltage DC variations	MPE	A.7.2.6

(*) maximum permissible errors as specified in 2.2.2

A.7.2.1 Static temperatures (2.7.4.1)

Static temperature tests are carried out according to basic standard IEC Publication 60068-2-1 [11], IEC Publication 60068-2-2 [12] and IEC 60068-3-1 [13], and according to Table 5.

Table 5 -Static temperature test

Environmental Phenomena	Test specification	Test set-up
Temperature	Reference temperature of 20 °C	
	Specified high temperature for 2 hours	IEC 60068-2-2
	Specified low temperature for 2 hours	IEC 60068-2-1

	Temperature of 5 °C, if the specified low temperature is ≤ 0 °C	IEC 60068-3-1
	Reference temperature	
Notes:	a) Use IEC 60068-3-1 for background information. b) The static temperatures test is considered as one test.	

Object of the test: To verify compliance with the provisions in 2.7.4.1 under conditions of dry heat (non-condensing) and cold. The test in A.7.2.2 may be conducted during this test.

Preconditioning: 16 hours

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

Stabilisation: 2 hours at each temperature under «free air» conditions. «Free air» conditions mean a minimum air circulation to keep the temperature at a stable level.

Temperature: As specified in 2.7.4.1

Temperature sequence:

a) at the reference temperature of 20 °C
b) at the specified high temperature,
c) at the specified low temperature,
d) at a temperature of 5 °C, if the specified low temperature is below 0 °C, and
e) at the reference temperature

Number of test cycles: At least one cycle.

Test information: Adjust the EUT as close to zero indication as practicable prior to the test. The EUT shall not be readjusted at any time during the test. Changes in barometric pressure shall be taken into account.

After stabilisation at the reference temperature and again at each specified temperature, conduct the weighing operation consisting of the totalization of $\sum_{min}$, two times each at approximately the minimum flowrate, an intermediate flowrate, and the maximum flowrate and repeated again at the minimum flowrate. Record:

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

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

A.7.2.2 Temperature effect at zero flowrate test (2.7.4.2)

Supplementary test information:

Test method: Dry heat (non-condensing) and cold. This test may be performed together with the temperature test in A.7.2.1.

Object of the test: To verify compliance with the provisions in 2.7.4.2 over the operating temperature range.

Test procedures in brief: The test is conducted at the temperature points specified in A.7.2.1 and the differences between totalizations as required in 2.7.4.2 to be calculated for temperature differences of 5 °C.
At each temperature, the EUT shall be tested during a weighing operation consisting of the totalization over 6 minutes at zero flowrate, using the totalization indicating device for zero setting.

The rate of change of temperature between totalizations shall not exceed 5 °C per hour.

Test severity: Test duration: 2 hours.

Number of test cycles: At least one cycle.

Preconditioning: None

Condition of the EUT: The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the

	electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to a zero indication as practicable prior to the test. Not to be adjusted or readjusted at any time during the test except to reset the EUT if a significant fault has been indicated. It is important to ensure that the test result is unaffected by the automatic zero-setting function, which should therefore be disabled.
Test information:	a) Stabilize the EUT in the chamber at the specified minimum temperature (normally –10 °C). Perform a zero-setting routine. b) Conduct the test as specified in the test procedures in brief and record the following data: a) date and time; b) temperature; c) relative humidity; d) duration of test; e) totalized indication; f) errors. c) Increase the temperature by 10 °C and allow to stabilize. Maintain at that temperature for 2 hours. Repeat the test and record the data as in b) above. d) Repeat c) above until the specified maximum temperature is reached (normally +40 °C).
Maximum allowable variations:	The difference between successive totalizations shall comply with the requirements in 2.7.4.2.

A.7.2.3 Damp heat, steady state (4.5.1)

Damp heat, steady state tests are carried out according to basic standard IEC Publication 60068-2-78 [14] and IEC Publication 60068-3-4 [15], and according to Table 6.

Table 6 - Damp heat, steady state test

Environmental phenomena	Test specification	Test set-up

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

Supplementary information to the IEC test procedures:

Object of the test: To verify compliance with the provisions in 4.5.1 under conditions of constant temperature (see A.3.3) and a constant relative humidity.

Preconditioning: None required.

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

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

Stabilisation: 3 hours at reference temperature and 50 % humidity.
48 hours at the upper limit temperature as specified in 2.7.4.1.

Temperature: Reference temperature (20 °C or the mean value of the temperature range whenever 20 °C is outside this range) and at the upper limit as specified in 2.7.4.1.

Temperature-humidity 48 hour sequence:
a) Reference temperature of 20 °C at 50 % humidity;
b) Upper limit temperature at 85 % humidity;
c) Reference temperature of 20 °C at 50 % humidity.

Number of test cycles: At least one cycle.

Test information: After stabilisation of the EUT at reference temperature and 50 % humidity, the EUT shall be tested during a weighing operation consisting of the totalization of $\sum_{min}$, 2 times each at approximately the minimum flowrate, an intermediate flowrate, and the maximum flowrate. and repeated again at the minimum flowrate Record:

a) date and time;
b) temperature;

c) relative humidity;
d) test load;
e) indications (as applicable);
f) errors;
g) functional performance
h) barometric pressure.

Increase the temperature in the chamber to the upper limit and increase the relative humidity to 85 %. Maintain the EUT at no load for a period of 48 hours. Following the 48 hours, apply the same test loads or simulated loads and record the data as indicated above.

Decrease the relative humidity to 50 % and decrease the temperature in the chamber to the reference temperature. After stabilisation of the EUT, apply the same test loads or simulated loads and record the data as indicated above.

Conduct the weighing operation consisting of the totalization of $\sum_{min}$, 2 times each at approximately the minimum flowrate, an intermediate flowrate, and the maximum flowrate and repeated again at the minimum flowrate. Record the indications.

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

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

A.7.2.4 AC mains voltage variations (2.7.4.3 and 4.5.4)

AC mains voltage variations tests are carried out in accordance with OIML D 11 [4], and according to Table 7.

Table 7 - AC mains voltage variations test

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

Supplementary information to the IEC test procedures

Object of the test:	To verify compliance with the provisions in 2.7.4.3 under conditions of AC mains voltage variations.
Preconditioning:	None required.
Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to zero indication as practicable, prior to the test. If it has an automatic zero-setting function then the instrument should be set to zero after applying each level of voltage.
Number of test cycles:	At least one cycle.
Test information:	The EUT shall be tested while totalizing $\sum_{min}$ at the maximum flowrate. Stabilize the power supply at the reference voltage within the defined limits and record the following data while totalizing $\sum_{min}$ at the maximum flowrate: a) date and time; b) temperature; c) relative humidity; d) AC voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance; i) barometric pressure. Repeat the test weighing for each of the voltages defined in IEC 61000-4-11 section 5 (noting the need in certain cases to repeat the test weighing at both ends of the voltage range) and record the indications.
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 2.2.2, Table 2.

A.7.2.5 DC mains voltage variations (2.7.4.3 and 4.5.5)

Tests of instruments with external or plug-in mains voltage (AC or DC) shall be conducted in accordance with A.7.2, with the exception of A.7.4, which is to be replaced by the test according to basic standard IEC Publication 60654-2 [18] and according to Table 8.

Table 8 – DC mains voltage variations test

Environmental phenomena	Test specification		Test set-up
Voltage variations of DC mains supply	U_{nom}		I EC 60654-2
	Upper limit:	1.20 x U_{nom} or 1.20 x U_{max}	
	Lower limit:	minimum operating voltage (see 2.7.4.3)	
	U_{nom}		
Note: In case a voltage-range is marked, use the average value as nominal U_{nom}			

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in 2.7.4.3 under conditions of voltage variations in the DC mains supply.
Preconditioning:	None
Condition of the EUT	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to zero indication as practicable, prior to the test.
Number of test cycles:	At least one cycle.

Test information: Changes in barometric pressure shall be taken into account. Stabilize the EUT at the reference voltage within the defined limits and record the following data while totalizing $\sum_{min}$ at the maximum flowrate:

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

Reduce the voltage until the instrument ceases to function properly according to the specifications and metrological requirements, and record the indications.

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

A.7.2.6 Battery voltage supply (DC), not mains connected (DC) (2.7.4.3and 4.5.5)

Battery-powered instruments shall fulfil the tests in A.7.3, with the exception of A.7.2.4 and A.7.2.5 which are to be replaced by the test in Table 9.

Table 9 - Battery voltage supply (not mains connected)

<table>
<tr><th>Environmental phenomena</th><th colspan="2">Test specification</th><th>Test set-up</th></tr>
<tr><td rowspan="4">Low voltage variations of fully charged battery supply voltage (DC).</td><td colspan="2">U_{nom}</td><td rowspan="4">No reference to standards for this test.</td></tr>
<tr><td>Upper limit:</td><td>U_{nom} or x U_{max}</td></tr>
<tr><td>Lower limit:</td><td>minimum operating voltage (see 2.7.4.3)</td></tr>
<tr><td colspan="2">U_{nom}</td></tr>
<tr><td colspan="4">Note: In case a voltage-range is marked, use the average value as nominal U_{nom}</td></tr>
</table>

Supplementary test information:

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

	source.
Object of the test:	To verify compliance with the provisions in 2.7.4.3under conditions of varying DC power supply. The requirements shall be met either by use of an equivalent variable DC power source or by allowing the battery voltage to fall by use.
Reference to standard:	No reference to international standards can be given.
Test procedures in brief:	The test consists of subjecting the EUT to DC power variations when the former is operating under normal atmospheric conditions, while totalizing $\sum_{min}$ at the maximum flowrate.
Test severity:	Supply voltage: lower limit, the voltage at which the EUT clearly ceases to function (or is automatically put out of service).
Number of test cycles:	At least one cycle.
Maximum allowable variations:	All functions shall operate correctly. All indications shall be within the maximum permissible errors specified in 2.2.2, Table 2.
Preconditioning:	None required.
Test equipment:	Variable DC power source; Calibrated volt meter; Load cell simulator, if applicable.
Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to a zero indication as practicable prior to the test. If it has an automatic zero-setting function as part of the automatic weighing process then the instrument should be set to zero after applying each level of voltage.
Test information:	Stabilize the power supply at nominal battery voltage and record the following data while totalizing $\sum_{min}$ at the maximum flowrate: a) date and time; b) temperature;

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

Reduce the power supply to the EUT until the equipment clearly ceases to function and note the voltage. Switch the EUT "off" and increase the power supply voltage to nominal battery voltage.
Switch the EUT "on" and reduce the power supply voltage to the above noted voltage (out of service voltage) of the noted voltage.

Record the data indicated above while totalizing $\sum_{min}$ at the maximum flowrate.

A.7.3 Disturbances (4.1.1 and 4.5.2)

Summary of tests

Tests[2]	Criteria	§
AC mains short time power reduction	sf [1]	A.7.3.1
Electrical bursts (fast transients) on mains voltage and on I/O signal and communication lines	sf	A.7.3.2
Electrical surges on mains voltage and on signal and communication lines	sf	A.7.3.3
Electrostatic discharge	sf	A.7.3.4
Immunity to electromagnetic fields	sf	A.7.3.5

[1] value of the significant fault (see T.4.6.4)

[2] Tests shall be conducted to the appropriate classification for electrical tests. The severity level stated in the tests A.7.3.1 to A.7.3.5 apply to class E2 instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in industrial buildings. OIML D 11:2005 [4].

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

A.7.3.1 AC mains short time power reductions

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

Table 11 - Short time power reductions

Environmental phenomena	Test specification			Test set-up
	Test	Reduction of amplitude to	Duration / Number of cycles	
Voltage dips and short interruptions	Test a	0 %	0.5	IEC 61000-4-11
	Test b	0 %	1	
	Test c	40 %	10	
	Test d	70 %	25/30(2)	
	Test e	80 %	250/300(2)	
	Short interruption	0 %	250/300(2)	
Notes:	1) A test generator suitable to reduce for a defined period of time the amplitude of one or more half cycles (at zero crossings) of the AC mains voltage shall be used. The test generator shall be adjusted before connecting the EUT. The mains voltage reductions shall be repeated 10 times with an interval of at least 10 seconds. 2) These values are for 50 Hz /60 Hz, respectively			

Supplementary information to the IEC test procedures

Object of the test:	To verify compliance with the provisions in 4.1.1 under conditions of short time mains voltage interruptions and reductions while totalizing - at maximum flowrate - at least $\sum_{min}$ (or a time sufficient to complete the test).
Preconditioning:	None required.
Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to re-set if a significant fault has occurred.
Number of test cycles:	At least one cycle.
Test information:	Before any test stabilize the EUT under constant environmental conditions. Changes in barometric pressure

	shall be taken into account. While totalizing - at maximum flowrate - at least $\sum_{min}$ (or a time sufficient to complete the test) record the following: a) date and time; b) temperature; c) relative humidity; d) supply voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance; i) barometric pressure In accordance with the test specification in Table 11, interrupt the voltages to the corresponding durations / number of cycles and conduct the test as detailed in IEC 61000-4-11 section 8.2.1. During interruption observe the effect on the EUT and record as appropriate.
Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed the fault specified in T.4.6.4, or the EUT shall detect and react to a significant fault. In the case of voltage interruptions (0% for 250/300 cycles), the requirement is for the instrument to recover fully.

A.7.3.2 Electrical bursts (fast transient tests) on mains voltage lines and on I/O signal and communication lines

Electrical bursts tests (fast transients) are carried out at the positive and the negative polarity for at least 1 minute at each polarity in accordance with the basic standard IEC 61000-4-4 [20] and according to Tables 12.1 and 12.2.

Table 12.1: Bursts on I/Q signal and communication lines

Environmental phenomena	Test specification	Test set-up
Fast transient common mode	1.0 kV (peak) 5/50 ns T_1 /T_h 5 kHz rep. frequency	IEC 61000-4-4
Note: Applicable only to lines or interfacing with cables whose total length exceed 3 m according to the manufacturer’s functional specification.		

Table 12.2: Bursts on AC and DC voltage supply lines

Environmental	Test specification	Test set-up

phenomena		
Fast transient common mode	2.0 kV (peak) 5/50 ns T_1/T_h 5 kHz rep. frequency	IEC 61000-4-4
Note: DC power lines, not applicable to battery-operated appliance that cannot be connected to the mains while in use.		

Supplementary information to the IEC test procedures

Object of the test: To verify compliance with the provisions in 4.1.1 under conditions where fast transients are superimposed separately on the mains voltage, and on the I/Q signal and communication lines, while totalizing – at maximum flowrate - at least $\sum_{min}$ (or a time sufficient to complete the test).

Preconditioning: None required.

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

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

Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to re-set if a significant fault has occurred.

Number of test cycles: At least one cycle.

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

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

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

Maximum allowable variations: The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed the fault specified in T.4.6.4, or the EUT shall detect and react to a significant fault.

A.7.3.3 Electrical surges on mains voltage lines and on signal and communication lines

Electrical surge tests are carried out according to IEC 61000-4-5 [21] and according to Table 13.

Table 13 - Electrical surges

Environmental phenomena	Test specification	Test set-up
Surges on mains power lines and on signal and communication lines	a) 1.0 kV line to line b) 2.0 kV line to earth c) 3 positive and 3 negative surges applied synchronously with AC supply voltage in angles 0°, 90°, 180° and 270°. d) 3 positive and 3 negative surges applied on DC voltage lines and on signal and communication lines.	IEC 61000-4-5
Note:	This test is only applicable in those cases where, based on typical situations of installation, the risk of a significant influence of surges can be expected. This is especially relevant in cases of outdoors installations and/or indoor installations connected to long signal lines (lines longer than 30 m or those lines partially or fully installed outside the buildings regardless of their length). The test is applicable to the power lines and other lines for signal and communication. It is also applicable to DC powered instruments if the voltage comes from a DC network.	

Supplementary information to the IEC test procedures:

Object of the test: To verify compliance with the provisions in 4.1.1 under conditions where electrical surges are applied separately to the mains voltage lines and to the signal and communication lines (if any), while totalizing – at maximum flowrate - at least $\sum_{min}$ (or a time sufficient to complete the test).
.

Preconditioning: None required.

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

The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off.
Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to re-set if a significant fault has occurred.

Number of test cycles: At least one cycle.

Test information: The test consists of exposure to surges for which the rise time, pulse width, peak values of the output voltage/current on high/low impendence load and minimum time interval between two successive pulses are defined in IEC 61000-4-5. The injection network depends on the lines the surge is coupled to and is defined in IEC 61000-4-5.

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

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

Maximum allowable variations: The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed the fault specified in T.4.6.4, or the EUT shall detect and react to a significant fault.

A.7.3.4 Electrostatic discharge test

Electrostatic discharge tests are carried out according to basic standard IEC 61000-4-2 [22], with test signals and conditions as given in Table 14.

Table 14 - Electrostatic discharge test

Environmental phenomena	Test specification		Test set-up
Electrostatic discharge	Test voltage	Levels[1]	IEC 61000-4-2
	contact discharge	6 kV	
	air discharge	8 kV	
Notes:	1) Tests shall be performed at the specified lower levels, starting with 2 kV and proceeding with 2 kV steps up to and including the level specified above in accordance with IEC 61000-4-2. 2) The 6 kV contact discharge shall be applied to conductive accessible parts. Metallic contacts, e.g. in battery compartments or in socket outlets are excluded from this requirement.		

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

Supplementary information to the IEC test procedures

Object of the test: To verify compliance with the provisions in 4.1.1 under conditions where electrostatic discharges are applied while totalizing - at maximum flowrate – at least $\sum_{min}$ (or for sufficient time to complete the test).

Test procedures in brief:

Preconditioning: None required.

Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Reset the EUT if a significant fault has been indicated.
Stabilization:	Before any test stabilize the EUT under constant environmental conditions.
Test information:	While totalizing - at maximum flowrate - at least $\sum_{min}$ (or a time sufficient to complete the test) record the following. Changes in barometric pressure shall be taken into account. a) date and time; b) temperature; c) relative humidity; d) supply voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance; i) barometric pressure
Maximum allowable variations:	The difference between the weight indication due to the disturbance and the indication without the disturbance either shall not exceed the fault specified in T.4.6.4, or the EUT shall detect and act upon a significant fault.

A.7.3.5 Immunity to electromagnetic fields

Note: Test time resources can be optimised if:

- the resolution of the flow rate display is fine enough to unambiguously discern the significant fault,
- the flow rate display can be permanently observed,
- a totalization is performed at those frequencies at which an influence on the displayed flow rate has been observed.

A.7.3.5.1 Immunity to radiated electromagnetic fields

Radiated, radio frequency, electromagnetic field immunity tests are carried out in accordance to IEC 61000-4-3 [23] and according to Table 15.

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

Table 15 - Immunity to radiated electromagnetic fields

Test specification			
Environmental phenomena	Frequency ranges MHz	Field strength (V/m)	Test set-up
Immunity to radiated electromagnetic fields	80 to 2000$^{(1)}$	10	IEC 61000-4-3
	26 to 80$^{(2)}$		
Modulation	80 % AM, 1 kHz sine wave		
Notes:	1) IEC 61000-4-3 only specifies test levels above 80 MHz. For frequencies in the lower range the test methods for conducted radio frequency disturbances are recommended (A.7.3.5.2). 2) For EUTs having no mains or other I/O ports available so that the test according to A.7.3.5.2 cannot be applied, the lower limit of the radiation test is 26 MHz.		

Supplementary information to the IEC test procedures:

Object of the test: To verify compliance with the provisions in 4.1.1 under conditions of specified radiated electromagnetic fields applied while totalizing - at maximum flowrate - at least ∑min (or a time sufficient to complete the test).

Preconditioning: None required.

Condition of the EUT: The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off.
Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to re-set if a significant fault has occurred.

Number of test cycles: At least one cycle.

Test information: Before any test stabilize the EUT under constant environmental conditions. Changes in barometric pressure shall be taken into account.

In accordance with the note is A.7.3.5, the frequencies are noted at which susceptibility is evident and then tests are conducted at the problem frequencies, if any, while totalizing - at maximum flowrate - at least $\sum_{min}$ (or a time sufficient to complete the test). Record the following with and without electromagnetic fields:

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

Maximum allowable variations: The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed the fault specified in T.4.6.4, or the EUT shall detect and react to a significant fault.

A.7.3.5.2 Immunity to conducted electromagnetic fields

Conducted, radio-frequency, electromagnetic field immunity tests are carried out in accordance to IEC 61000-4-6 [24] and according to Table 16.

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

Table 16 - Immunity to conducted electromagnetic fields

Test specification			
Environmental phenomena	Frequency range MHz	RF amplitude (50 ohms) V (e.m.f)	Test set-up
Immunity to conducted electromagnetic fields	0.15 to 80	10	IEC 61000-4-6
Modulation	80 % AM, 1 kHz sine wave		

Note:	1) This test is not applicable when the EUT has no mains or other input port. 2) Coupling and decoupling devices shall be used for appropriate coupling of the disturbing signal (over the entire frequency range, with a defined common-mode impedance at the EUT port) to the various conducting cables connected to the EUT.

Supplementary information to the IEC test procedures

Object of the test: To verify compliance with the provisions in 4.1.1 under conditions of specified conducted electromagnetic fields applied while totalizing - at maximum flowrate - at least ∑min (or a time sufficient to complete the test).

Preconditioning: None required.

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

Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to re-set if a significant fault has occurred.

Radio frequency electromagnetic current, simulating the influence of electromagnetic fields shall be coupled or injected into the mains power ports and I/O ports of the EUT using coupling/decoupling devices as defined in the referred standard

Number of test cycles: At least one cycle.

Test information: In accordance with the note is A.7.3.5, the frequencies are noted at which susceptibility is evident and then tests are conducted at the problem frequencies, if any, while totalizing - at maximum flowrate - at least $\sum_{min}$ (or a time sufficient to complete the test). Record the following with and without electromagnetic fields:

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

h) functional performance;
i) barometric pressure

Maximum allowable variations: The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not either shall not exceed the fault specified in T.4.6.4, or the EUT shall detect and react to a significant fault.

A.8 Metrological characteristics (2.7.5)

Note the repeatability test in 2.8.1 is a product test covered in clause A.9 below.

A.8.1 Maximum permissible errors on checking of zero (2.8.2)

When the minimum totalized load is equal to or less than 3 belt revolutions at Q_{max} the following test procedure shall be amended by the inclusion of the requirements in A.8.1.2.

Mark the stationary belt if not previously done. The instrument should be “on”, warm, and running. Set the instrument to zero noting the point on the belt at which the zero routine commences, and then disable the automatic zero-setting device. Carry out a whole number of revolutions of the empty belt, of a duration as close as possible to 3 minutes. Stop the belt, or if this is impractical stop or note the totalization and check that the error (the variation from zero displayed on the indicating device used for zero-setting) does not exceed the following percentages of the load totalized at Q_{max} for the duration of the test:

- 0.02 % for class 0.2;
- 0.05 % for class 0.5;
- 0.1 % for class 1;
- 0.2 % for class 2.

If the instrument fails, this procedure may be repeated once to attempt to obtain a satisfactory result.

A.8.1.1 Discrimination of the indicator used for zero-setting (2.8.3)

Mark the stationary belt if not previously done. The instrument should be “on”, warm, and running.

Test A

Run the belt and zero the instrument with the automatic zero-setting device disabled. Stop the belt, or if this is impractical, stop or note the totalization.

Run the belt with no load for a whole number of revolutions and of a duration as close as possible to 3 minutes. Record the indication on the indication device used for zero-setting. Stop the belt, or if this is impractical, stop or note the totalization.

Apply the discrimination load to the load receptor and run the belt for the same number of revolutions. Record the indication on the indication device used for zero-setting. Stop the belt, or if this is impractical, stop or note the totalization.

Test B

With the discrimination load applied to the load receptor, run the belt and zero the instrument with the automatic zero-setting device disabled. Stop the belt, or if this is impractical, stop or note the totalization.

Run the belt with the discrimination load applied for the same number of revolutions as in test A. Record the indication on the indication device used for zero-setting. Stop the belt, or if this is impractical, stop or note the totalization.

Remove the discrimination load from the load receptor and run the belt for the same number of revolutions. Record the indication on the indication device used for zero-setting.

There must be a visible difference between the above no-load indication and applied discrimination load indications on the indication device used for zero-setting in both tests A and B.

The discrimination load should be equal to the following percentages of the maximum capacity:

a) 0.02 % for class 0.2;
b) 0.05 % for class 0.5;
c) 0.1% for class 1;
d) 0.2 % for class 2.

Repeat tests A and B above 3 times consecutively.

A.8.1.2 Maximum variation during zero-load test (2.8.4)

When the minimum totalized load is equal to or less than 3 belt revolutions at Q_{max} the test procedure in A.8.1 Maximum permissible errors on checking of zero shall include a record of the totalization indicator reading at the commencement of the test and a record of the maximum and minimum totalization indicator readings seen during the test. The totalization indicator shall not vary from its initial indicated value by more than the following percentages of the load totalized at Q_{max} for the duration of the test:

a) 0.07 % for class 0.2;
b) 0.18 % for class 0.5;
c) 0.35 % for class 1;
d) 0.7 % for class 2.

A.9 In-situ tests (2.8, 5.1.3.1 and 5.2.2.1)

A.9.1 General

A.9.1.1 Conditions and product

In-situ product tests with the belt weigher fully assembled and fixed in the position in which it is intended to be used shall be carried out under the typical conditions of use of the belt weigher and with the specified product or products which are or will be used.

In-situ product tests conducted for type evaluation, initial verification and in-service inspection shall determine that the maximum permissible errors for automatic weighing are in accordance with 2.2.1, Table 1, for initial verification, as appropriate for the class of the belt weigher. , and that for “Repeatability” the relative errors for several results obtained at practically identical flowrates, for approximately the same quantities of product and under the same conditions, shall not exceed the absolute value of the appropriate maximum permissible error for automatic weighing in 2.2.1..

All product tests are carried out in pairs to allow assessment of repeatability. (For clarity a pair may be defined as a re-run with the same product load and other specified parameters (as far as practicable)).

A.9.2 Control method

The control method used for product test shall enable the determination of the weight of the product used for testing with an error not exceeding one-third of the appropriate maximum permissible error for automatic weighing in 2.2.1, Table 1.

If a control instrument with sufficient resolution is not available the greater resolution of the control instrument may be ensured by using change point weights as specified in A.3.7.2.
The control method shall be conducted as follows:

a) With the belt weigher in automatic operation, conduct the necessary number of tests and record the indicated weight at the maximum, minimum and intermediate feeding flowrates, making sure that the test load of products can be weighed using a control instrument.

b) The weight value indication from the belt weigher is the difference between the indication at the start of the test and the indication at the end of the test using the general totalization device.

c) The true quantity value of the mass of the test load is determined by weighing the test load on the separate control instrument.

d) The error for automatic weighing shall be the difference between the true quantity value of the mass of the test load determined on the separate control instrument in (a) above, and the values obtained from the general totalization indication in (b) above. The relative errors are calculated as indicated in as 6.6 and A.3.7.

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

A.9.3 Product tests

A.9.3.1 Single speed belt weigher

This test of a single speed belt weigher is not applicable to type approval.

Before the tests the conveyor shall operate for at least 30 minutes.

Before each test check the zero-setting and, if necessary, set the instrument to zero.

On completion of each test record the totalization of the test load.

The following tests shall be carried out at the following feeding flowrates:

a) 2 pairs of tests at maximum feeding flowrate;
b) 2 pairs of tests at minimum feeding flowrate;
c) 1 pair of test at intermediate feeding flowrate.

If the minimum feeding flowrate is not smaller than:

a) 50% of maximum flow than perform a) and b) or
b) 80 % of the maximum flow, perform a) and b) with only one pair of tests each or only 2 pairs of tests, at any available feeding flowrate.

To conform with the test data requirements for “Repeatability” the tests that form a pair should be approximately the same totalized load and duration.

For “Initial verification and in-service inspection” for each test the maximum permissible error shall be as specified in 2.2.1 Table 1, as appropriate for the class of the belt weigher.

For “Repeatability” the difference between the relative errors (calculated as indicated in 6.6) for each test, of the same feeding flowrate and approximately the same totalized load, shall not exceed the absolute value of the appropriate maximum permissible error for automatic weighing in 2.2.1.

A.9.3.2 Multi-speed belt weigher

For each speed, the tests specified in A.9.3.1 shall be carried out with only one pair of tests at each feeding flow rate for minimum, medium and maximum speed.

A.9.3.3 Variable speed belt weigher

The tests specified in A.9.3.1 shall be carried out with only one pair of tests at each feeding flow rate for minimum, medium and maximum speed and one additional single test shall be carried out at each of the feeding flowrates in A.9.3.1, varying the speed throughout its range during each of them.

However precautions shall be taken to avoid that the load on the load receptor does not exceed Max or goes below Min.

BIBLIOGRAPHY

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

Ref.	Standards and references	Description
[1]	International Vocabulary of Basic and General Terms in Metrology (VIM:2007)	Vocabulary, prepared by a joint working group consisting of experts appointed by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML.
[2]	International Vocabulary of Terms in Legal Metrology, BIML, Paris (2000)	Vocabulary including only the concepts used in the field of legal metrology. These concepts concern the activities of the legal metrology service, the relevant documents as well as other problems linked with this activity.

[3]	OIML B 3 (2003) OIML Certificate System for Measuring Instruments (formerly OIML P1)	Provides rules for issuing, registering and using OIML Certificates of conformity
[4]	OIML D 11 (2004) General requirements for electronic measuring instruments	Contains general requirements for electronic measuring instruments
[5]	OIML R 111 (2004) Weights of classes E1, E2, F1, F2, M1, M1–2, M2, M2–3 and M3	Provides the principal physical characteristics and metrological requirements for weights used with and for the verification of weighing instruments and weights of a lower class.
[6]	OIML D 28 Conventional value of the result of weighing in air (Revision of R 33)	Provides the definition of the quantity “conventional mass” (conventional value of the result of weighing in air) as it is used for the characterization of weights and its relation to the physical quantities mass and density and the evaluation of its uncertainty.
[7]	OIML R 60 (2000) Metrological regulation for load cells	Provides the principal static characteristics and static evaluation procedures for load cells used in the evaluation of mass
[8]	OIML R 76-1 (2006) Non-automatic weighing instruments.	Provides the principal physical characteristics and metrological requirements for the verification of non-automatic weighing instruments
[9]	OIML D 19 (1988) Pattern evaluation and pattern approval.	Provides advice, procedures and influencing factors on pattern evaluation and pattern approval
[10]	OIML D 20 (1988) Initial and subsequent verification of measuring instruments and processes	Provides advice, procedures and influencing factors on the choice between alternative approaches to verification and the procedures to be followed in the course of verification
[11]	IEC 60068-2-1 Ed. 6.0 (2007-03)	Basic environmental testing procedures - Part 2: Tests, Test Ad: Cold, for heat dissipating equipment under test (EUT), with gradual change of temperature.
[12]	IEC 60068-2-2 (2007-07). Environmental testing Part 2: Tests, Test B: Dry heat	Contains test Ba : dry heat for non heat dissipating specimen with sudden change of temperature; test Bb dry heat for non heat dissipating specimen with gradual change of temperature; tests Bc : dry heat for heat dissipating specimen with sudden change of temperature; test Bd dry heat for heat dissipating specimen with gradual change

		of temperature.
Ref	Standards and references	Description
[13]	IEC 60068-3-1 (1974-01) + Supplement A (1978-01): Environmental testing Part 3 Background information, Section 1: Cold and dry heat tests	Gives background information for Tests A: Cold (IEC 68-2-1), and Tests B: Dry heat (IEC 68-2-2). Includes appendices on the effect of: chamber size on the surface temperature of a specimen when no forced air circulation is used; airflow on chamber conditions and on surface temperatures of test specimens; wire termination dimensions and material on surface temperature of a component; measurements of temperature, air velocity and emission coefficient. Supplement A - Gives additional information for cases where temperature stability is not achieved during the test.
[14]	IEC 60068-2-78 (2001-08) Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state (IEC 60068-2-78 replaces the following withdrawn standards: IEC 60068-2-3, test Ca and IEC 60068-2-56, test Cb)	Provides a test method for determining the suitability of electro-technical products, components or equipment for transportation, storage and use under conditions of high humidity. The test is primarily intended to permit the observation of the effect of high humidity at constant temperature without condensation on the specimen over a prescribed period. This test provides a number of preferred severities of high temperature, high humidity and test duration. The test can be applied to both heat-dissipating and non-heat dissipating specimens. The test is applicable to small equipment or components as well as large equipment having complex interconnections with test equipment external to the chamber, requiring a set-up time which prevents the use of preheating and the maintenance of specified conditions during the installation period.
Ref.	Standards and references	Description

[15]	IEC 60068-3-4 (2001-08) Environmental testing - Part 3-4: Supporting documentation and guidance - Damp heat tests	Provides the necessary information to assist in preparing relevant specifications, such as standards for components or equipment, in order to select appropriate tests and test severities for specific products and, in some cases, specific types of application. The object of damp heat tests is to determine the ability of products to withstand the stresses occurring in a high relative humidity environment, with or without condensation, and with special regard to variations of electrical and mechanical characteristics. Damp heat tests may also be utilized to check the resistance of a specimen to some forms of corrosion attack.
[16]	IEC 60654-2 (1979-01), with amendment 1 (1992-09). Operating conditions for industrial-process measurement and control equipment - Part 2: Power.	Gives the limiting values for power received by land-based and offshore industrial process measurement and control systems or parts of systems during operation.

Ref.	Standards and references	Description
[17]	IEC 61000-4-11 (2004-03) Electromagnetic compatibility (EMC). Part 4-11: Testing and measuring techniques - Voltage dips, short interruptions and voltage variations immunity tests	Defines the immunity test methods and range of preferred test levels for electrical and electronic equipment connected to low-voltage power supply networks for voltage dips, short interruptions, and voltage variations. This standard applies to electrical and electronic equipment having a rated input current not exceeding 16 A per phase, for connection to 50 Hz or 60 Hz AC networks. It does not apply to electrical and electronic equipment for connection to 400 Hz AC networks. Tests for these networks will be covered by future IEC standards. The object of this standard is to establish a common reference for evaluating the immunity of electrical and electronic equipment when subjected to voltage dips, short interruptions and voltage variations. It has the status of a Basic EMC Publication in accordance with IEC Guide 107.
[18]	IEC 61000-4-4 (2004-07) Electromagnetic compatibility (EMC). Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test.	Establishes a common and reproducible reference for evaluating the immunity of electrical and electronic equipment when subjected to electrical fast transient/burst on supply, signal, control and earth ports. The test method documented in this part of IEC 61000-4 describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon. The standard defines: – test voltage waveform; – range of test levels; – test equipment; – verification procedures of test equipment; – test set-up; and – test procedure. The standard gives specifications for laboratory and post-installation tests.

Ref.	Standards and references	Description
[19]	IEC 61000-4-2 Ed. 2.0 (2008-12) Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test.	Relates to the immunity requirements, test methods, and range of recommended test levels for equipment to unidirectional surges caused by over-voltages from switching and lightning transients. Several test levels are defined which relate to different environment and installation conditions. These requirements are developed for and are applicable to electrical and electronic equipment. Establishes a common reference for evaluating the performance of equipment when subjected to high-energy disturbances on the power and inter-connection lines.
[20]	IEC 61000-4-2 Ed. 2.0 (2009) Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test.	Basic EMC Publication. Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test. Basic EMC Publication.
[21]	IEC 61000-4-3 (2008-04) Ed. 3.1. Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.	Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test.
[22]	IEC 61000-4-6 (2008-10) Ed. 3.0. Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields.	Relates to the conducted immunity requirements of electrical and electronic equipment to electromagnetic disturbances coming from intended radio-frequency (RF) transmitters in the frequency range 9 kHz up to 80 MHz. Equipment not having at least one conducting cable (such as mains supply, signal line or earth connection), which can couple the equipment to the disturbing RF fields is excluded. This standard does not intend to specify the tests to be applied to particular apparatus or systems. Its main aim is to give a general basic reference to all concerned product committees of the IEC. The product committees (or users and manufacturers of equipment) remain responsible for the appropriate choice of the test and the severity level to be applied to their equipment.