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Contents

PART 1 METROLOGICAL AND TECHNICAL REQUIREMENTS 1

1. INTRODUCTION 1

2. SCOPE 1

3. TERMINOLOGY (TERMS AND DEFINITIONS) 2

3.1. General definitions 2
3.2. Categories of Load Cells 3
3.3. Construction of load cells 3
3.4. Metrological characteristics of a load cell 3
3.5. Range, capacity and output terms 4
3.6. Illustration of certain definitions 6
3.7. Measurement and error terms 7
3.8. Influences and reference conditions 10
3.9. Abbreviations 11

4. DESCRIPTION OF LOAD CELLS 12

5. UNITS OF MEASUREMENT 12

6. METROLOGICAL REQUIREMENTS 12

6.1. Principle of load cell classification 12
6.2. Maximum permissible load cell errors 15
6.3. Repeatability error 16
6.4. Permissible variation of results under reference conditions 16
6.5. Influence quantities (Rated operating conditions) 19
6.6. Requirements for load cells equipped with electronics 21

7. TECHNICAL REQUIREMENTS 26

7.1. Software 27
7.2. Presentation of information (Inscriptions) 28

PART 2 METROLOGICAL CONTROLS AND PERFORMANCE TESTS 35

8 METROLOGICAL CONTROLS 35

8.1 Liability to legal metrological controls 35
8.2 Responsibility for compliance with the requirements 35

9 TYPE EVALUATION 36

9.1 Scope 36
9.2 Test requirements 36
9.3 Submission of specimens for evaluation 37
9.4 Selection of load cells within a family 37
9.5 Documentation 39
9.6 Examinations 40
9.7 Performance Tests 40
9.8 Rules concerning the determination of errors 44
9.9 Variation of results under reference conditions 46
9.10 Test procedures 46
9.11 Test sequence 67
9.12 OIML certificate 68

ANNEX A (INFORMATIVE) SELECTION OF LOAD CELL(S) FOR TESTING - A PRACTICAL EXAMPLE A-1

ANNEX B (INFORMATIVE) LOAD TRANSMISSION TO THE LOAD CELL B-1

ANNEX C (MANDATORY) OIML CERTIFICATE OF CONFORMITY FOR LOAD CELLS - FORMAT OF CERTIFICATE C-1

ANNEX D (MANDATORY) OIML CERTIFICATE OF CONFORMITY FOR LOAD CELLS (ALTERNATE PROPOSAL) D-1

ANNEX E (MANDATORY) DEFINITIONS FROM OTHER APPLICABLE INTERNATIONAL PUBLICATIONS E-1

BIBLIOGRAPHY I

Part 1 Metrological and technical requirements

1

1. Introduction

The 1st Committee Draft copy of OIML R60 Parts 1&2 represents changes to the previous Working Draft and the OIML R60 (2000) edition as follows:

- this draft has incorporated the necessary changes noted in the 2000 edition erratum
- references to OIML Vocabularies, Documents, and other relevant publications have been updated
- the draft has been reorganized to comply with the 2009 edition Template for OIML Recommendations
- the 1st Committee Draft has incorporated comments submitted by TC9 member states in regard to the previous Working Draft

A characteristic that sets this Recommendation apart from others is that, while other Recommendations apply to complex instruments, the subject of this Recommendation, load cells comprise a distinct element or module within other complex instruments. Load cells do not produce distinct quantitative values that are inherently identified or associated with denominations or units. The data that can be extracted from a load cell is simply a measurement of change in the output of the load cell in relation to the input. This relative change must be converted by other elements or modules within an instrument into values that are meaningful measurements which can then be used to identify a quantity. Thus a number of requirements and test procedures that serve to evaluate the performance of a complex device in the template will not be relevant to the evaluation of load cells. In addition, the prescribed order of other tests within the template deviated from traditional routines that have been established for their efficiency in load cell testing procedures.

Rather than sacrificing the continuity of this Recommendation to fully comply with the constraints of the template, sections that did not translate well to a new format were preserved in the existing context.

To assist the reader in the review of the formatting of this First Committee Draft, the document has been placed in a tabular form using the following numbering scheme. As illustrated below in "2 Scope", the left-hand column contains reference numbers that are associated with the 2000 edition of R60. Paragraphs that appear without a reference number in the left-hand column represent new entries in the document.

Part 1 (Metrological and Technical Requirements) and Part 2 (Metrological Controls and Performance Tests) of this Recommendation are a combined publication, Part 3 (Test Report Format) is a separate document and will be presented in a future draft.

1 (2000 Ed.)

2. Scope

1.1	**2.1.** This Recommendation prescribes the principal metrological static characteristics and static evaluation procedures for load cells used in the measurement of mass. It is intended to provide authorities with uniform means for determining the metrological characteristics of load cells used in measuring instruments that are subjected to metrological controls. Although strain gauge technology is commonly recognized as the conventional form or benchmark of load cell of load cell design, there is no intent to exclude alternate technologies when applying this Recommendation. The further revision R60 is conducted in such a way so to be non-specific with regard to load cell design and their operating principles.
1.2	**2.2.** This Recommendation utilizes the principle that several load cell errors shall be considered together when applying load cell performance characteristics to the permitted error envelope. Thus, it is not considered appropriate to specify individual errors for given characteristics (non-linearity, hysteresis, etc.), but rather to consider the total error envelope allowed for a load cell as the limiting factor. The use of an error envelope allows the balancing of the individual contributions to the total error of measurement while still achieving the intended final result. Note: the error envelope may be defined as the curves that provide the boundary of the maximum permissible errors (see Table 4) as a function of the applied load (mass) over the measuring range. The combined errors determined may be positive or negative and include the effects of nonlinearity, hysteresis and temperature.
1.3	**2.3.** Instruments which are ~~associated with~~comprised of load cells and which give an indication of mass are the subjects of separate Recommendations.
2	# 3. Terminology (Terms and definitions) The terms most frequently used in the load cell field and their definitions are given below (see 3.7 for an illustration of certain definitions). The terminology used in this Recommendation conforms to OIML V 1 International Vocabulary of Basic and General Terms in Metrology (VIM) [1] [2], to OIML V 2 International Vocabulary of Terms in Legal Metrology (VIML) [3], to OIML D 9 Principles of metrological supervision [4], to OIML D 11 General Requirements for electronic measuring instruments [5], and to OIML B 3 OIML Certificate System for Measuring Instruments [6]. In addition, for the purposes of this Recommendation, the following definitions apply:
2.1	**3.1. General definitions**
2.1.2	3.1.1. Load cell Force transducer that, in response to an applied load will produce a proportional and measureable output. This output may be converted into units such as mass~~which, after taking~~

Comment [1]: As per conclusion of TC9/R60 meeting – definition has been revised to accommodate alternative technologies

	~~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)~~. ~~Note: Load cells equipped with electronics including amplifier, analog-to-digital converter (ADC), and data processing device (optionally) are called digital load cells.~~
2.1.3	3.1.2. Load cell equipped with electronics Load cell employing an assembly of electronic components having a recognizable function of its own. *Note*: strain gauge bridge circuits are not considered electronic components for the purpose of this recommendation *Note*: Load cells equipped with electronics that produce an output in digital form are often referred to as "digital load cells".~~*Examples of electronics:* p-n junction, amplifier, encoder, A/D converter, CPU, I/O interface, etc. (not including strain gauge bridge circuits).~~
~~*2.1.3.1*~~	~~*3.1.2.1. Electronic component*~~ ~~The smallest physical entity that uses electron or hole conduction in semiconductors, gases or in a vacuum.~~
2.1.4	3.1.3. Performance test Test to verify whether the load cell under test is capable of performing its intended functions.
	3.2. Categories of Load Cells
2.1.1	3.2.1. Application of load
2.1.1.1	*3.2.1.1. Compression loading* Compressive force applied to a load cell.
2.1.1.2	*3.2.1.2. Tension loading* Tension force applied to a load cell.
	3.3. Construction of load cells
	3.3.1. Strain gauge Device for measuring the changes in distances between points in solid bodies that occur when the body is deformed
2.2	**3.4. Metrological characteristics of a load cell**

Comment [2]: Note stricken.

Comment [JB3]: Note adder per NL

Comment [JB4]: Note added per Australia, Germany.

Comment [5]: Definition relocated to Annex

Comment [JB6]: New language to be reviewed by TC9

~~2.2.1~~	~~3.4.1. Accuracy Class~~ ~~Class of load cells that are subject to the same conditions of accuracy. [Adapted from VIM 4.25] *Accuracy class*~~
2.2.2	~~3.4.2.~~3.4.1. Humidity symbol Symbol assigned to a load cell that indicates the conditions of humidity under which the load cell has been tested.
2.2.3.	~~3.4.3.~~3.4.2. Load cell family For the purposes of type evaluation~~pattern~~ approval, a load cell family consists of load cells that are of: • the same material or combination of materials (for example, mild steel, stainless steel or aluminum); • the same design of the measurement technique (for example, strain gauges bonded to metal); • the same method of construction (for example, shape, sealing of strain gauges, mounting method, manufacturing method); the same set of specifications (for example, output rating, input impedance, supply voltage, cable details); and • one or more load cell groups. *Note:* The examples provided are not intended to be limiting.
2.2.3.1	~~3.4.3.1.~~3.4.2.1. *Load cell group* All load cells within a family possessing identical metrological characteristics (for example, class, n_{max}, temperature rating, etc.). *Note*: The examples provided are not intended to be limiting.
2.3	**3.5. Range, capacity and output terms**
2.3.1	3.5.1. Load cell interval Part of the load cell measuring range into which that range is divided.
2.3.2	3.5.2. Load cell measuring range Range of values of the measured quantity (mass) for which the result of measurement should not be affected by an error exceeding the maximum permissible error (MPE) (see 3.7.8).

Comment [7]: Definition now located in Annex D3

Comment [8]: "Pattern" replaced with "type" throughout document

2.3.3	3.5.3. Load cell output Measurable quantity into which a load cell converts the measured quantity (mass).
2.3.4	3.5.4. Load cell verification interval (v) Load cell interval, expressed in units of mass, used in the test of the load cell for accuracy classification.
2.3.5	3.5.5. Maximum capacity (E_{max}) Largest value of a quantity (mass) which may be applied to a load cell without exceeding the MPE (see 3.7.8).
2.3.6	3.5.6. Maximum load of the measuring range (D_{max}) Largest value of a quantity (mass) which is applied to a load cell during test or use. This value shall not be greater than E_{max} (see 3.5.5). For the limits on D_{max} during testing, see 9.7.4.4.
2.3.7	3.5.7. Maximum number of load cell verification intervals (n_{max}) Maximum number of load cell verification intervals into which the load cell measuring range may be divided for which the result of measurement shall not be affected by an error exceeding the MPE (see 3.7.8).
2.3.8	3.5.8. Minimum dead load (E_{min}) Smallest load that~~Smallest value of a quantity (mass)~~ which may be applied to a load cell without exceeding the MPE (see 3.7.8).
2.3.9	3.5.9. Minimum dead load output return (DR) Difference in load cell output at minimum dead load, measured before and after application of a load of E_{max} ~~load application.~~
2.3.10	3.5.10. Minimum load cell verification interval (v_{min}) Smallest load cell verification interval (mass) into which the load cell measuring range can be divided.

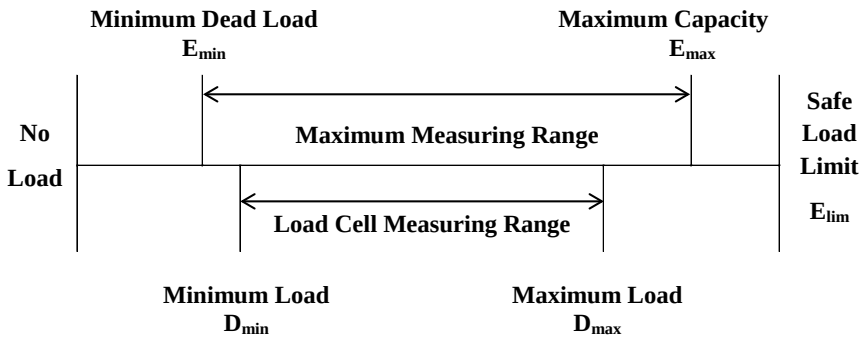
Comment [JB9]: Language amended per comment

Comment [JB10]: Language amended per comment

2.3.11	3.5.11. Minimum load of the measuring range (D_{min}) Smallest value of a quantity (mass) which is applied to a load cell during test or use. This value shall not be less than E_{min} (see 3.5.8). For the limits on D_{min} during testing, see 9.7.4.3.
2.3.12	3.5.12. Number of load cell verification intervals (n) Number of load cell verification intervals into which the load cell measuring range is divided.
2.3.13	3.5.13. Relative DR or Z Ratio of the maximum capacity, E_{max}, to two times the minimum dead load output return, DR. This ratio is used to describe multi-interval instruments.
2.3.14	3.5.14. Relative v_{min} or Y Ratio of the maximum capacity, E_{max}, to the minimum load cell verification interval, v_{min}. This ratio describes the resolution of the load cell independent from the load cell capacity
2.3.15	3.5.15. Safe load limit (E_{lim}) Maximum load that can be applied without producing a permanent shift in the performance characteristics beyond those specified.
2.3.16	3.5.16. Warm-up time Time between the moment power is applied to a load cell and the moment at which the load cell is capable of complying with the requirements.
2.6	**3.6. Illustration of certain definitions** The terms that appear above the central horizontal line in Figure 1 below are parameters that are fixed by the design of the load cell. The terms that appear below that line are parameters that are variable, dependent on the conditions of use or in the test of a load cell (in particular, those load cells used in weighing instruments).

Figure 1. Illustration of certain definitions

Comment [11]: Figure 1 amended



~~Minimum Dead Load E_{min}~~ ~~Maximum Capacity E_{max}~~ ~~No Load~~ ~~Maximum Measuring Range~~ ~~Safe Load Limit E_{lim}~~ ~~Load Cell Measuring Range~~ ~~Minimum Load D_{min}~~ ~~Maximum Load D_{max}~~

2.4 **3.7. Measurement and error terms**

2.4.1 3.7.1. Creep

Change in load cell output occurring with time while under constant load and with all environmental conditions and other variables also remaining constant.

2.4.2 3.7.2. Apportionment factor (P_{LC})

The value of a dimensionless fraction expressed as a decimal (for example, 0.7) used in

	determining MPE (see 3.7.8). It represents that apportionment of a whole error (as may apply to a weighing instrument) which has been assigned to the load cell alone.
2.4.3	3.7.3. Expanded uncertainty Quantity defining an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand. [*Guide to the Expression of Uncertainty in Measurement*, BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML, 2008] [7]
~~*2.4.4*~~	~~3.7.4. Fault~~ ~~Difference between the load cell error and the load cell intrinsic error (see 3.7.8).~~
2.4.5	~~3.7.5.~~3.7.4. Fault detection output Electrical representation issued by the load cell indicating that a fault condition exists.
2.4.6	~~3.7.6.~~3.7.5. Hysteresis error Difference between load cell output readings for the same applied load, one reading obtained by increasing the load from minimum load, D_{min}, and the other by decreasing the load from maximum load, D_{max}.
2.4.7	~~3.7.7.~~3.7.6. Load cell error Difference in agreement between a measured quantity value derived from the output of a ~~the~~ load cell ~~measurement result~~ and the true quantity value of the measurand ~~(the applied force expressed in mass)~~. [Adapted from VIM: 2012, 2.~~16~~13 measurement accuracy] [2]
2.4.8	~~3.7.8.~~3.7.7. Load cell intrinsic error Error resulting from~~of~~ a load cell, determined under reference conditions (see 3.8.3). [Adapted from ~~V2~~ VIM: (1993) 5.24] [1]
2.4.9	~~3.7.9.~~3.7.8. Maximum permissible error (MPE) Extreme values of an error permitted by this Recommendation (refer to clause 6.3) for a load cell. [Adapted from VIM 4.26] [2]

Comment [12]: Definition relocated to Annex D

2.4.10	~~3.7.10.~~3.7.9. Non-linearity Deviation of the increasing load cell signal output curve from a straight line.
2.4.11	~~3.7.11.~~3.7.10. Repeatability Measurement precision of a load cell under a set of repeatability conditions of measurement. [Adapted from VIM: 2012 2.21 Measurement Repeatability] [2]~~Ability of a load cell to provide successive results that are in agreement when the same load is applied several times and applied in the same manner on the load cell under constant test conditions.~~
2.4.12	~~3.7.12.~~3.7.11. Repeatability error Difference between load cell output readings taken from consecutive tests under the same loading and environmental conditions of measurement.
2.4.13	~~3.7.13.~~3.7.12. Sensitivity Quotient of the change in a response (output) of a load cell and the corresponding change in a value of the stimulus (load applied). [Adapted from VIM: 2012 4.12 Sensitivity of a measuring system] [2]~~Ratio of a change in response (output) of a load cell to a corresponding change in the stimulus (load applied).~~
2.4.14	3.7.13. Significant fault Fault greater than the load cell verification interval, v. The following are not considered significant faults, even when they exceed the load cell verification interval, v: • faults arising from simultaneous and mutually independent causes; • faults implying the impossibility to perform any measurements; • faults being so serious that they are bound to be noticed by all interested in the result of measurement; and • transitory faults being momentary variations in the load cell output which cannot be interpreted, memorized or transmitted as a measurement result. [Adapted from D 11: 2004 3.10] [5]~~Fault greater than the load cell verification interval, v. See also 6.9~~

Comment [JB13]: Amended:
NL: Definitions to be adjusted to VIM V2-200

Comment [JB14]: Amended:
NL: Definitions to be adjusted to VIM V2-200

Comment [JB15]: Terminology restored to 2000 edition of R60. Paragraph 6.9 derived from OIML Recommendation template has been deleted

2.4.15	3.7.14. Span stability Capability of a load cell to maintain the difference between the load cell output at maximum load, D_{max}, and the load cell output at minimum load, D_{min}, over a period of use within specified limits.
2.4.16	3.7.15. Temperature effect on minimum dead load output Change in minimum dead load output due to a change in ambient temperature.
2.4.17	3.7.16. Temperature effect on sensitivity Change in sensitivity due to a change in ambient temperature.
2.5	**3.8. Influences and reference conditions**
2.5.1	3.8.1. Influence quantity Quantity that, in a direct measurement, does not affect the quantity that is actually measured, but affects the relation between the indication and the measurement result. ~~is not the measurand but that affects the result of the measurement.~~ [VIM: 2012, 2.52] [2] (For example, temperature or humidity level at the instant the measurements on the load cell are being observed or recorded.)
~~*2.5.1.1*~~	~~3.8.2. *Disturbance*~~ ~~Influence quantity having a value within the limits specified in this Recommendation, but outside the specified rated operating conditions of the load cell.~~
~~*2.5.1.2*~~	~~3.8.3. *Influence factor*~~ ~~Influence quantity having a value within the specified rated operating conditions of the load cell. (For example, a specific temperature or a specific power voltage in which the load cell can be tested).~~
2.5.2	~~3.8.4.~~3.8.2. Rated operating conditions Conditions of use, for which the metrological characteristics of the load cell are intended to lie within the specified MPE (see 3.7.~~9~~8). *Note*: The rated operating conditions generally specify ranges or rated values of the measurand and of the influence quantities. [Adapted from VIM: 2012 4.9] [2]

Comment [16]: Paragraph relocated:
Japan: This clause shall be at the same level with the other terms in "*3.7 Measurement and error terms*". Therefore, the clause number shall be changed to 3.7.16.

Comment [17]: Paragraph relocated:
Japan: This clause shall be at the same level with the other terms in "*3.7 Measurement and error terms*". Therefore, the clause number shall be changed to 3.7.17.

Comment [18]: Updated to V2-200: 2012

Comment [19]: Definition provided in Annex D

Comment [20]: Definition provided in Annex D

2.5.3 ~~3.8.5.~~3.8.3. Reference conditions

Conditions of use prescribed for testing the performance of a load cell or for the intercomparison of results of measurements.

Note: The reference conditions generally include reference values or reference ranges for the influence quantities affecting the load cell. [Adapted from VIM 4.11] [2]

3.9. Abbreviations

Comment [21]: Abbreviations not used in this Recommendation deleted.

AC Alternating Current

~~AM Amplitude Modulation~~

~~ASD Acceleration Spectral Density~~

~~ADC Analog to Digital Converter~~

~~CPU Central Processor Unit~~

DC Direct Current

~~DIS Draft International Standard~~

~~EM Electro Magnetic~~

EMC Electro Magnetic Compatibility

~~e.m.f. electromotive force~~

~~ESD Electrostatic Discharge~~

~~EUT Equipment Under Test~~

~~FDIS Final Draft International Standard~~

~~GSM Global System for Mobile communication~~

~~ID International Document (issued by OIML)~~

IEC International Electrotechnical Committee

ISO International Organization for Standardization

I/O Input/Output

~~LC Load Cell~~

MPE Maximum Permissible Error

~~N.A. Not applicable~~

OIML International Organization of Legal Metrology

~~RMS Root Mean Square~~

VIM International Vocabulary of Metrology – Basic and General Concepts and Associated Terms

4. Description of Load Cells

A load cell provides an output proportionately related to an applied force or load. Designs of load cells include those intended for use in a system with other load cells and those used as a single transducer within a weighing instrument/system. The term "load cell" in this Recommendation is not limited to a particular type of technology or design principle.

While many technologies are used in the design of load cells, those used in legal metrology applications are commonly designed to provide an output relative to an input stimulus based on electrical current. Both analog and digital outputs are recognized in load cells within that category. Variations of transducers that operate using alternative basis of input/output may include, but are not limited to: pressure (e.g., hydraulic, pneumatic); vibratory frequency; and magnetic forces.

The term load cell may describe an elemental component/module or a somewhat more complex instrument including constituents that perform functions such as signal filtering and analog-to-digital conversion.

Comment [JB22]: Proposed text. TC9 to review and amend as necessary

3

5. Units of measurement

Comment [23]: Amended to reflect resolution of the September 2011 TC9/R60 meeting where it was decided that the scope of R60 will be limited to the load cell itself.

The units of measurement of mass resulting from the output of a load cell that is incorporated as a component of a weighing instrument are required to conform to the Recommendation(s) applicable to the weighing instrument. ~~The units of measurement of mass are the gram (g), kilogram (kg) or tonne (t).~~

~~The result of the measurement shall be displayed and/or printed in the following units according to the International System of Units (SI): gram (g), kilogram (kg) or tonne (t)~~

~~In countries were other units mass are legal, the relevant requirements specified in this Recommendation may be converted to these legal units of mass, using simple interpolation.~~

4

6. Metrological requirements

4.1

6.1. Principle of load cell classification

The classification of load cells into specific accuracy classes is provided to facilitate their application to various mass measuring systems. In the application of this Recommendation, it should be recognized that the effective performance of a particular load cell may be improved by compensation within the measuring system with which it is applied. Therefore, it is not the intent of this Recommendation to require that a load cell be of the same accuracy class as the measuring system in which it may be used. Nor does it require that a measuring instrument, giving indications of mass, use a load cell which has been separately approved.

4.2

6.1.1. Accuracy classes and their symbols

Load cells shall be ranked, according to their overall performance capabilities, into four accuracy classes whose designations are as follows:

Class A; Class B; Class C; Class D.

4.3

6.1.2. Maximum number of load cell verification intervals

The maximum number of load cell verification intervals, n_{max}, into which the load cell measuring range can be divided in a measuring system shall be within the limits fixed in Table 1.

Comment [24]: Moved from 6.4 (1WD)

Table 1

Table 1. Maximum Number of Load Cell Verification Intervals (n_{max}) according to accuracy class.

	Class A	Class B	Class C	Class D
Lower Limit	**50 000**	**5 000**	**500**	**100**
Upper Limit	**Unlimited**	**100 000**	**10 000**	**1 000**

4.4

6.1.3. Minimum load cell verification interval

The minimum load cell verification interval, vmin, shall be specified by the manufacturer.

Comment [25]: Moved from 6.5 (1WD)

Comment [JB26]: Wording added per comment

4.5

~~6.1.2.~~6.1.4. Supplementary classifications

Load cells shall also be classified by the type of load applied to the load cell, i.e., compression loading or tension loading. A load cell may bear different classifications for different types of load applied to the load cell. The type of load for which the classification(s) applies(y) shall be specified. For multiple capacity load cells, each capacity shall be classified separately.

4.6

6.1.5. Complete load cell classification

The load cell shall be classified according to six parts:

a) accuracy class designation (see 6.1.1 and 7.3.4.1);
b) maximum number of load cell verification intervals (see 6.1.2 and 7.3.4.2);
c) type of load, if necessary (see 6.1.4 and 7.3.4.3);
d) special limits of working temperature, if applicable (see 7.3.4.4);
e) humidity symbol, if necessary (see 7.3.4.5); and
f) additional characterization information, as listed below in Figure 2, 6.1.6, and 6.1.7.

An example illustrating the six parts of the load cell classification is shown in Figure 2.

Comment [27]: Moved from 6.7 (1WD)

Comment [JB28]: Wording change per comment – ~~"if necessary"~~

Figure 2

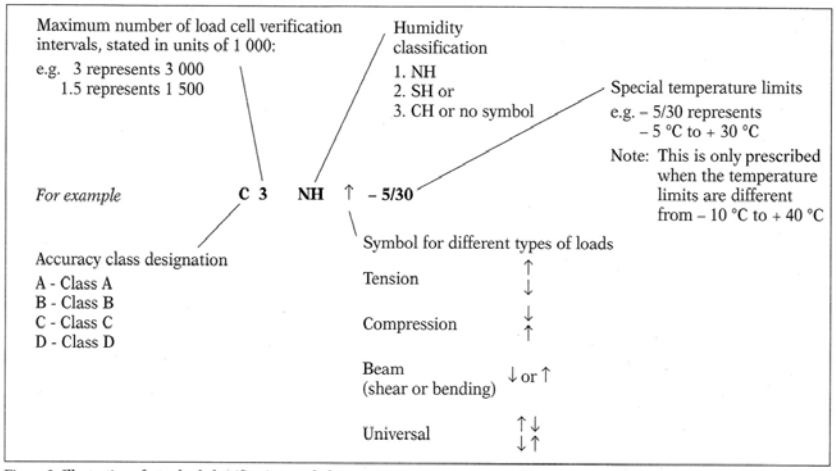


Figure 2 Illustration of standard classification symbols

4.6.7

6.1.6. Standard classification

Standard classifications shall be used; examples are shown in Table 2.

Comment [29]: Relocated from 7.3.9 in 1WD

Table 3

Table 2. Examples of load cell classification

Classification symbol	Description
C2	Class C, 2 000 intervals
C3 5/35	Class C, 3 000 intervals, compression, + 5 °C to + 35 °C
C2 NH	Class C, 2 000 intervals, not to be subjected to humidity test

4.6.8

6.1.7. Multiple classifications

Load cells that have complete classifications for different types of load shall be designated using separate information for each classification. Examples are shown in Table 3. An illustration of the standard classification symbols using an example is shown in Figure 2.

Comment [30]: Relocated from 7.3.10 in 1WD

Table 4

Table 3. Examples of Multiple Classifications

Classification Symbol	Description
C2 ↑	Class C, 2 000 intervals, shear beam
C1.5 ↓	Class C, 1 500 intervals, bending beam
C1 ↓↑ – 5/30	Class C, 1 000 intervals, compression, – 5 °C to + 30 C
C3 ↑↓ - 5/30	Class C, 3 000 intervals, tension, – 5°C to + 30 °C

5

6.2. Maximum permissible load cell errors

Under the rated operating conditions in 6.5, the maximum permissible error (MPE) shall not exceed the values stated in 6.2.1 and 6.2.2.

These MPEs are applicable after increasing as well as decreasing the measurand (i.e., they include hysteresis).~~Under the rated operating conditions in 6.8, the maximum permissible error (MPE) shall not exceed the following values:~~

~~MPE according to accuracy classes; or~~

~~MPE at type approval~~

~~These MPEs are applicable after increasing as well as decreasing the measurand (hysteresis).~~

Comment [31]: Paragraph amended. Bulleted statements within clause have been deleted

5.1

6.2.1. Maximum permissible errors for each accuracy class

The maximum permissible load cell errors for each accuracy class (the indicated load cell output having been adjusted to zero at minimum dead load, E_{min}) are related to the maximum number of load cell verification intervals (n_{max}) specified for the load cell (see 6.1.2) and to the actual value of the load cell verification interval, v.

Comment [32]: added per Austria comment

5.1.1 Table 5

6.2.1.1. ~~Pattern~~ Type evaluation

The MPE (see 3.7.8) on pattern evaluation shall be the values derived using the expressions contained in the left column of Table 4. The apportionment factor, P_{LC} shall be chosen and declared (if other than 0.7) by the manufacturer and shall be in the range of 0.3 to 0.8 ($0.3 \leq P_{LC} \leq 0.8$)[1].

Table 4. Maximum Permissible Errors (MPE) on Pattern Evaluation

MPE	Load, m			
	Class A	**Class B**	**Class C**	**Class D**
$P_{LC} \times 0.5$ v	$0 \leq m \leq 50\,000$ v	$0 \leq m \leq 5\,000$ v	$0 \leq m \leq 500$ v	$0 \leq m \leq 50$ v
$P_{LC} \times 1.0$ v	$50\,000$ v $< m \leq 200\,000$ v	$5\,000$ v $< m \leq 20\,000$ v	500 v $< m \leq 2\,000$ v	$50 \leq m \leq 200$ v
$P_{LC} \times 1.5$ v	$200\,000$ v $< m$	$20\,000$ v $< m \leq 100\,00$v	$2\,000$ v $< m \leq 10\,000$ v	200 v $< m \leq 1\,000$ v

The value of the apportionment factor, P_{LC} shall appear on the OIML certificate, if the value is not equal to 0.7. If the apportionment factor, P_{LC} is not specified on the certificate then the value 0.7 shall be assumed. The maximum permissible load cell errors may be positive or negative and are applicable to both increasing and decreasing loads.
The limits of error shown in Table 4 (above) include errors due to nonlinearity, hysteresis and temperature effect on sensitivity over certain temperature ranges, specified in 6.5.1.1 and 6.5.1.2. Further errors, not included in the Table 4 limits of error, are treated separately.

5.4

6.3. Repeatability error

Comment [33]: Relocated from 6.6 in 1WD

The maximum difference between the results of five identical load applications for classes A and B and of three identical load applications for classes C and D shall not be greater than the absolute value of the MPE for that load.

5.3

6.4. Permissible variation of results under reference conditions

Comment [34]: The following 6.4 – 6.4.2 paragraphs relocated from Part 2 (9.11)

[1] Associated with apportionment of error provisions contained within OIML R 76-1, 3.5.1 and 3.10.2.1 [9]; R 50-1, 2.2.3 [21]; R 51-1, 5.2.3.4 [20]; R 61-1, 5.2.3.3 [19]; R 106-1, 5.1.3.2 [23]; or R 107-1, 5.1.4.1 [22], when load cell is applied to such instruments.

5.3.1

6.4.1. Creep

The difference between the reading taken upon the application of a maximum load (D_{max}) and the reading observed after 30 minutes of exposure to D_{max} shall not exceed 0.7 times the value of MPE for the applied load. The difference in readings taken after 20 minutes of exposure to D_{max} and at 30 minutes of exposure to D_{max} shall not exceed 0.15 times the absolute value of MPE.

~~With a constant maximum load, D_{max}, between 90 % and 100 % of E_{max}, applied to the load cell, the max difference between the initial reading and any reading obtained during the next 30 minutes shall not exceed 0.7 times the absolute value of the MPE (see 9.10.1.1) for the applied load. The difference between the reading obtained at 20 minutes and the reading obtained at 30 minutes shall not exceed 0.15 times the absolute value of the MPE (see 9.10.1.1).~~

Comment [35]: New language. Must be reviewed by TC9.
Paragraphs edited to separate tests and requirements. Requirements located in Part 1, test located in Part 2.

5.3.1.1

6.4.1.1. Maximum permissible error for creep

Regardless of the value declared by the manufacturer for the apportionment factor, P_{LC}, the MPE for creep shall be determined from Table 4 using the apportionment factor, $P_{LC} = 0.7$.

5.3.2

6.4.2. Minimum dead load output return

The difference between the initial reading of the minimum load output (D_{min}) and the reading of D_{min} after being exposed to a maximum load (D_{max}) for 30 minutes shall not exceed half the value of the load cell verification interval (0.5 v).

~~The difference between the initial reading of the minimum load output and the reading after returning to minimum load, D_{min}, subsequent to the maximum load, D_{max}, between 90 % and 100 % of E_{max}, having been applied for 30 minutes, shall not exceed half the value of the load cell verification interval (0.5 v).~~

Comment [36]: New language. Must be reviewed by TC9.

Per Netherlands comment:
Paragraphs edited to separate tests and requirements. Requirements located in Part 1, test located in Part 2.

4.3
6.4

~~**8.1 Maximum number of load cell verification intervals**~~

~~The maximum number of load cell verification intervals, n_{max}, into which the load cell measuring range can be divided in a measuring system shall be within the limits fixed in Table 2.~~

4.3
Table 1
6.4

~~**Table 2. Maximum Number of Load Cell Verification Intervals (n_{max}) according to accuracy class.**~~

	~~Class A~~	~~Class B~~	~~Class C~~	~~Class D~~
~~Lower Limit~~	~~50 000~~	~~5 000~~	~~500~~	~~100~~
~~Upper Limit~~	~~Unlimited~~	~~100 000~~	~~10 000~~	~~1 000~~

~~*4.4*~~ **6.4**	**~~8.2 Minimum load cell verification interval~~** ~~The minimum load cell verification interval, v_{min}, shall be specified.~~
~~*5.4*~~ **6.6**	**~~8.3 Repeatability error~~** ~~The maximum difference between the results of five identical load applications for classes A and B and of three identical load applications for classes C and D shall not be greater than the absolute value of the MPE for that load.~~
~~*4.6*~~	**~~8.4 Complete load cell classification~~** ~~The load cell shall be classified according to six parts:~~ ~~a) accuracy class designation (see 6.2 and 7.3.1);~~ ~~b) maximum number of load cell verification intervals (see 6.4 and 7.3.2);~~ ~~c) type of load, if necessary (see 6.2.1 and 7.3.4);~~ ~~d) special limits of working temperature, if necessary (see 7.3.5);~~ ~~e) humidity symbol, if necessary (see 7.3.6); and~~ ~~f) additional characterization information, as listed below.~~ ~~g) An example illustrating the six parts of the load cell classification is shown in Figure 2.~~

~~Figure 2~~

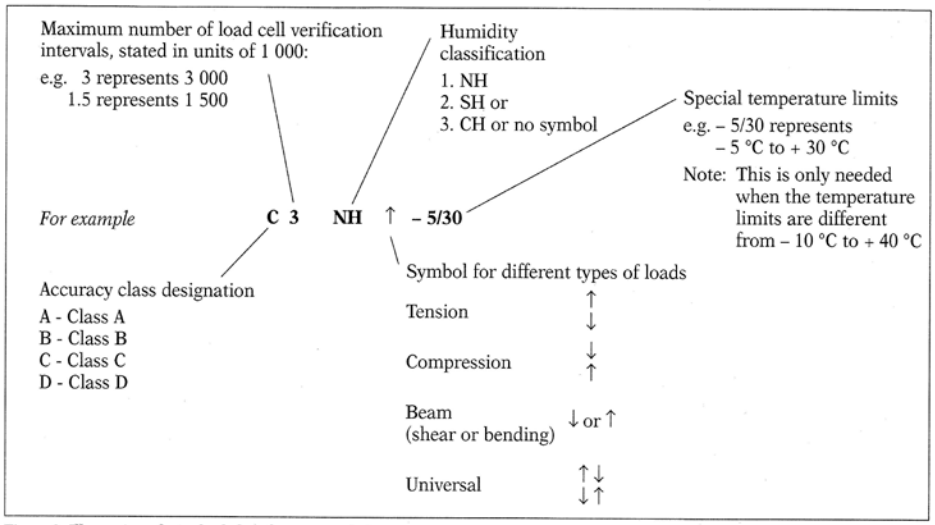


Figure 2 Illustration of standard classification symbols

5.5 **6.5. Influence quantities (Rated operating conditions)**

Load cells are to be evaluated under the conditions specified in 6.8.1 - 6.8.3. In addition, load cells that are equipped with functions typically performed by weighing instruments may be required to be evaluated against additional requirements contained in OIML Recommendations for those weighing instruments. These additional evaluations are outside the scope of this Recommendation.

Comment [37]: Title of paragraph amended per France comment. Additional language added per resolution of TC9/R60 meeting.

Comment [38]: Language needs review by TC9

5.5.1 ~~6.2.2.~~6.5.1. Temperature

5.5.1.1 ~~6.2.2.1.~~6.5.1.1. *Temperature limits*

Excluding temperature effects on minimum dead load output, the load cell shall perform within the limits of error in 6.2.2 over the temperature range of – 10 °C to + 40 °C, unless otherwise specified as in 6.5.1.2 below.

Note: National legislation may prescribe alternate temperature limits with a range of 50 °C as appropriate for local climatic conditions and the environmental conditions that can be anticipated.

Comment [39]: Note added per comment. To be reviewed by TC9

5.5.1.2 ~~6.2.2.2.~~6.5.1.2. *Special limits*

Load cells for which particular limits of working temperature are specified shall satisfy, within those ranges, the conditions defined in 6.2.2. These ranges shall be at least:

	5 °C for load cells of class A; 15 °C for load cells of class B; 30 °C for load cells of classes C and D.
5.5.1.3	~~6.2.2.3.~~6.5.1.3. *Temperature effect on minimum dead load output* The minimum dead load output of the load cell over the temperature range, as specified in 6.8.1.1 or 6.8.1.2, shall not vary by an amount greater than the apportionment factor, P_{LC}, times the minimum load cell verification interval, v_{min}, for any change in ambient temperature of: 2 °C for load cells of class A; 5 °C for load cells of class B, C and D. ~~The minimum load output shall be taken after the load cell has thermally stabilized at ambient temperature.~~
5.5.2	~~6.2.3.~~6.5.2. Barometric pressure The output of the load cell shall not vary by an amount greater than the minimum load cell verification interval, v_{min}, for a change in barometric pressure of 1 kPa over the range from 95 kPa to 105 kPa.
5.5.3	~~6.2.4.~~6.5.3. Humidity With respect to humidity conditions, there are 4 humidity classes: Standard, CH, NH, and SH. In case of class CH, NH, or SH, the class designation shall be marked on the load cell. ~~When a load cell is marked with the symbol NH, it shall not be subjected to the humidity test, as specified in 9.11.5 or 9.11.6. When a load cell is marked with the symbol CH or is not marked with a humidity symbol, it shall be subjected to the humidity test, as specified in 9.11.5. When a load cell is marked with the symbol SH, it shall be subjected to the humidity test, as specified in 9.11.6~~

Comment [40]: Language moved to Part 2 (9.10.1.16) Determine temperature effect on minimum dead load output (portion of test procedure)

Comment [41]: Amended text in this clause to transform the language into a requirement. Moved stricken language into Part 2 (9.10.5.15).

5.5.3.1

~~6.2.4.1.~~6.5.3.1. *Humidity error (applicable to load cells marked CH or with no humidity symbol marking and not applicable to load cells marked NH or SH).*

The difference between the average of the readings of the minimum load output attributed to cyclic changes in humidity as determined using test procedures in 9.10.5 shall not exceed the limits specified in 9.10.5.15

~~before the conduct of the humidity test and the average of the readings for the same load obtained after the conduct of the humidity test according to 9.11.5, shall not be greater than 4 % of the difference between the output at the maximum capacity, E_{max}, and that at the minimum dead load E_{min}.~~

~~The difference between the average of the three output values at the maximum load, D_{max}, for load cells of accuracy classes C and D, or five output values for load cells of accuracy classes A and B, (corrected for the minimum load output) obtained before the conduct of the humidity test according to 9.11.5, and the average of the three output values for load cells of accuracy classes C and D, or five output values for load cells of accuracy classes A and B obtained for the same maximum load, D_{max}, (corrected for the minimum load output) after the conduct of the humidity test, shall not be greater than the value of the load cell verification interval, v.~~

Comment [42]: Relocated this test procedure to Part 2. (9.10.5.15) New language to transform this clause into a requirement rather than a test procedure. Need review by TC9.

5.5.3.2

~~6.2.4.2.~~6.5.3.2. *Humidity error (applicable to load cells marked SH and not applicable to load cells marked CH or NH or with no humidity symbol marking).*

A load cell shall meet the applicable MPE when exposed to conditions of relative humidity up to 85% as specified in 9.10.6.

~~during the conduct of the humidity test, according to 9.10.6.~~

Comment [43]: Language amended per comment.

6

6.6. Requirements for load cells equipped with electronics

6.1

6.6.1. General requirements

In addition to the other requirements of this Recommendation, a load cell equipped with electronics (including load cells using strain gauge technology) shall comply with the following requirements. The MPE shall be determined using an apportionment factor, P_{LC}, equal to 1.0 (P_{LC} = 1.0) substituted for the apportionment factor, P_{LC}, that is declared by the manufacturer and applied to the other requirements.

If a load cell is configured with substantial additional electronic functions of an electronic weighing instrument then it may be required to undergo additional evaluation against other requirements contained in the OIML Recommendation for the weighing instrument. Such evaluation is outside the scope of this Recommendation.

Comment [44]: It appears that these requirements are applicable to load cells using strain gauge technology. This wording added to account for strain gauge not being defined strictly as electronic.

6.1.1	*6.6.1.1. Faults* A load cell equipped with electronics shall be designed and manufactured such that when it is exposed to electrical disturbances either: a) significant faults do not occur; or b) significant faults are detected and acted upon. Messages of significant faults should not be confused with other messages presented. *Note:* A fault ~~equal to or~~ smaller than the load cell verification interval, v, is allowed irrespective of the value of the error in output.
6.2	*6.6.1.2. Acting upon significant faults* When a significant fault has been detected, either the load cell shall be made inoperative automatically or a fault detection output shall be issued automatically. This fault detection output shall continue until the user acts on the fault or the fault disappears.
6.1.2	*6.6.1.3. Durability* The load cell shall be suitably durable so that the requirements of this Recommendation may be met in accordance with the intended use of the load cell.
6.1.3	*6.6.1.4. Compliance with requirements* A load cell equipped with electronics is presumed to comply with the requirements in 6.6.1.1 and 6.6.1.3, if it passes the examinations specified in 6.6.2 and 9.10.7
6.1.4	*6.6.1.5. Application of the requirements in 6.6.1.1* The requirements in 6.6.1.1 may be applied separately to each individual cause or significant fault. The choice of whether 6.6.1.1 a) or 6.6.1.1 b) is applied is left to the manufacturer.
~~*2.4.14*~~ ~~6.11~~ ~~6.11.1~~ ~~**6.11.2**~~	~~**8.5 Significant fault**~~ ~~A fault greater than the magnitude of the MPE on initial verification is a significant fault. The following are not considered significant faults, even when they exceed the load cell verification interval, v:~~ ~~• faults arising from simultaneous and mutually independent causes;~~ ~~• faults implying the impossibility to perform any measurements;~~ ~~• faults being so serious that they are bound to be noticed by all interested in the result of~~

Comment [JB45]: Per NL comment : PLC for electronic load cell should be < 1, only for a load cell including the platform and digital weight output the PLC could be 1.

Comment [JB46]: It is presumed to comply with the requirements referring to "Faults" and "Durability" if it passes the tests specified in "Functional Requirements" and "Additional Tests" (Performance and Stability tests – Table X)(6.10.3.7) The referenced paragraph and Table moved to Part 2 (9.12.7.1).

Comment [47]: Clause relocated to 3.7.1.4. Terminology in clause 3.7.14 restored to 2000 edition of R60. Clause 6.9 derived from OIML Recommendation template has been deleted

~~measurement; and~~

- ~~transitory faults being momentary variations in the load cell output which cannot be interpreted, memorized or transmitted as a measurement result.~~

6.6.2. Functional requirements

6.3.5

~~6.2.4.3.~~6.6.2.1. *Disturbances*

When a load cell equipped with electronics is subjected to the disturbances specified in 9.10.7.1, the difference between the load cell output due to a disturbance and the load cell output without disturbance (**fault** ~~load cell intrinsic error~~) shall not exceed the load cell verification interval, ~~v~~ v_{min}, or the load cell shall detect and react to a significant fault.

6.3.6

~~6.2.4.4.~~6.6.2.2. *Span stability requirements (not applicable to class A load cells)*

A load cell equipped with electronics (including load cells using strain gauge technology) shall be subjected to the span stability test specified in 6.9.2.1 and 9.11.7.8. ~~The variation in load cell span shall not exceed half the load cell verification interval (0.5 v) or half the absolute value of the MPE (0.5 MPE), whichever is the greater, for the test load applied~~. The aim of this test is not to measure the influence on the metrological performances of mounting or dismounting the load cell on or from the force-generating system, so the installation of the load cell in the force-generating system shall be carried out with particular care.

Comment [JB48]: New sub-heading

Clauses (6.11.3.1 - 6.11.3.4) related to requirements applicable to load cells with indicators are deleted per resolution of TC9/R60 meeting

Comment [JB49]: Terminology changed to "fault" per Netherlands comment.

Comment [JB50]: TC9 to determine if this should be "load cell verification interval, v" or minimum load cell verification interval, v_{min}"

Comment [51]: This wording added to account for strain gauge not defined strictly as electronic.

Comment [52]: This wording relocated to Part 2, 9.10.7.10

Comment [53]: Language amended. Wording related to test relocated to Part 2 – 9.10.7.10

Table 7

Table 3. Performance and Stability Tests for a Load Cell Equipped with Electronics

Test	Section 9.11 test procedure	P_{LC}	Characteristic under test
Warm-up time	9.11.7.2	1.0	Influence factor
Power voltage variations	9.11.7.3		Influence factor
Short-time power reductions	9.11.7.4		Disturbance
Bursts (electrical fast transients)	9.11.7.5		Disturbance
Electrostatic discharge	9.11.7.6		Disturbance
Electromagnetic susceptibility	9.11.7.7		Disturbance
Span stability	9.11.7.8		Influence factor

Generally, the tests are carried out on fully operational equipment in its normal state or in a status as similar as possible thereto. If the load cell is equipped with an interface that permits it to be coupled to external equipment, all functions that are performed or initiated via an interface shall operate correctly.

Comment [JB54]: Table moved to 9.10.7.1

6.4 6.2.5. Additional tests

Comment [JB55]: Relocated to 9.10.7

6.4.1 *6.2.5.1. Performance and stability tests*

A load cell equipped with electronics shall pass the performance and stability tests according to 9.11.7 for the tests given in Table 3.

Comment [56]: These paragraphs 6.2.5 - 6.2.5.1 and Table relocated to Part 2 – 9.10.7

8.6 Presumption of compliance

The type of a measuring instrument according to this Recommendation is presumed to comply with the provisions in 6.2 to 6.10.2 if it passes the examination and tests specified in Part 2 of this Recommendation.

Comment [57]: Paragraph deleted per Germany's comment

6 **6.3. Requirements for load cells equipped with electronics**

Comment [58]: Paragraphs relocated to 6.6 – 6.6.1.5

~~*6.1*~~	~~6.3.1. General requirements~~ ~~In addition to the other requirements of this Recommendation, a load cell equipped with electronics shall comply with the following requirements. The MPE shall be determined using an apportionment factor, P_{LC}, equal to 1.0 (P_{LC} = 1.0) substituted for the apportionment factor, P_{LC}, that is declared by the manufacturer and applied to the other requirements.~~ ~~If a load cell is configured with substantially all the electronic functions of an electronic weighing instrument then it may be required to undergo additional evaluation against other requirements contained in the OIML Recommendation for the weighing instrument. Such evaluation is outside the scope of this Recommendation.~~
~~*6.1.1*~~	~~*6.3.1.1. Faults*~~ ~~A load cell equipped with electronics shall be designed and manufactured such that when it is exposed to electrical disturbances either:~~ ~~a) significant faults do not occur; or~~ ~~b) significant faults are detected and acted upon.~~ ~~Messages of significant faults should not be confused with other messages presented.~~ ~~*Note:* A fault equal to or smaller than the load cell verification interval, v, is allowed irrespective of the value of the error in output.~~
~~*6.1.2*~~	~~*6.3.1.2. Durability*~~ ~~The load cell shall be suitably durable so that the requirements of this Recommendation may be met in accordance with the intended use of the load cell.~~
6.1.3	~~*6.3.1.3.*~~*6.6.2.3. Compliance with requirements* A load cell equipped with electronics is presumed to comply with the requirements in 6.11.1.1 and 6.11.1.2, if it passes the examinations specified in 6.11.3 and 6.9.2
6.1.4	~~*6.3.1.4.*~~*6.6.2.4. Application of the requirements in 6.11.1.1* The requirements in 6.11.1.1 may be applied separately to each individual cause or significant fault. The choice of whether 6.11.1.1 a) or 6.11.1.1 b) is applied is left to the manufacturer.

~~6.2~~ ~~6.3.2. Acting upon significant faults~~

~~When a significant fault has been detected, either the load cell shall be made inoperative automatically or a fault detection output shall be issued automatically. This fault detection output shall continue until the user acts on the fault or the fault disappears.~~

Comment [59]: Paragraph relocated to 6.6.1.2

~~6.3~~ ~~6.3.3. Functional requirements~~

Comment [JB60]: Relocated to 6.6.2

~~6.3.1~~ ~~*6.3.3.1. Special procedure for load cell with indicator*~~

~~When a load cell equipped with electronics includes an indicator, a special procedure shall be performed upon application of power. This procedure shall show all relevant signs of the indicator in their active and nonactive states sufficiently long to be checked by the user.~~

~~6.3.2~~ ~~*6.3.3.2. Warm-up time*~~

~~During the design warm-up time of a load cell equipped with electronics there shall be no transmission of measurement results.~~

~~6.3.3~~ ~~*6.3.3.3. Mains power supply (AC)*~~

~~A load cell equipped with electronics that operates from a mains power supply shall be designed to comply with the metrological requirements if the mains power supply varies:~~

~~a) in voltage from – 15 % to + 10 % of the supply voltage specified by the manufacturer; and~~
~~b) in frequency from – 2 % to + 2 % of the frequency specified by the manufacturer, if AC is used.~~

~~6.3.4~~ ~~*6.3.3.4. Battery power supply (DC)*~~

~~A load cell equipped with electronics that operates from a battery power supply shall either continue to function correctly or not provide a measurement result whenever the voltage is below the value specified by the manufacturer.~~

Comment [61]: These paragraphs deleted per conclusion of TC9/R60 meeting

7. Technical Requirements

~~7.1~~ ~~8.7 **Construction**~~

~~The template recommends at this point including requirements regarding the construction of load cells which may include: materials used; hermetic sealing; etc. Text to be drafted by TC9.~~

Comment [62]: Section deleted,no recommendations made to introduce language regarding construction of load cells.

7.1. Software

Comment [63]: New language developed by work group (PTB) and conclusions of TC9 made during the September 2011 meeting – to be reviewed by TC9.

Provision shall be made for appropriate sealing by mechanical, electronic and/or cryptographic means, making any change that affects the metrological integrity of the device impossible or evident.

Any embedded programming (i.e., firmware) that influences the raw count output of the load cell will be evaluated under the terms of this Recommendation. In addition, if the software modifies load cell performance, not exceeding the functions of analog to digital conversion and the linearization of the load cell output, then that software shall be evaluated under the terms in this Recommendation and in accordance with OIML D31 Edition 2008(E) [8]. Any function of the software that results in an indication of mass shall be evaluated under other appropriate Recommendations for weighing instruments.

Functionality of any software which is not covered by this Recommendation, e. g. functionalities of weighing instruments, is outside the scope of this Recommendation and not evaluated. It may be required to undergo additional evaluations against other requirements contained in the applicable OIML Recommendations for weighing instruments.

The requirements given in OIML D 31 Edition 2008 (E) [8] have to be fulfilled for the load cell by taking into account the following aspects.

In general, for load cells, the severity level I, examined with validation procedure A, is required.

For load cells, communicating via an open network, the severity level II, examined with validation procedure B, is required. For achieving the severity level II, the use of cryptographic methods for protection are necessary.

For legally relevant software of digital load cells the following definitions according to OIML D31 shall be applied.

- The exception described in D 31, 5.1.1 [8] for an imprint of the software identification is allowed.
- The level of conformity of manufactured devices to the approved type is according to D 31, 5.2.5 (clause a) [8].
- Updating the legally relevant software of a load cell in the field is possible via verified or traced update according to D31, 5.2.6.2 and 5.2.6.3 [8]
- The software documentation shall include descriptions according to the applicable requirements of D 31, 6.1.1 [8]

The validation procedures are described in D 31, 6.4 [8]

~~*(TC9 to determine if relevant.)*~~

~~The software that is critical for metrological characteristics shall contain a routine generating an identification code that is automatically changed in case of any modification in the software. This software shall be designed such that changes in software are not possible without breaking a seal.~~

~~A fixed version number shall be assigned by the manufacturer to all software which, together with the identification code generated by the software itself, forms the full identification of the software. This version number shall be updated by the manufacturer in the case of a software change that may affect the functions and accuracy of the measuring device.~~

~~The instrument shall be provided with a facility to display the actual version of the identification code.~~

4.7

7.2. Presentation of information (Inscriptions)

Technical information markings including load cell classifications as indicated in 6.1.5 Complete Load Cell Classification must be specified for the load cell(s) under evaluation.

Comment [64]: Per comments from Germany and Austria - new structure for 7.3 incorporated. Additional load cell markings of accuracy class designation, temperature limits, and vmin added to required LC markings per member comments and conclusion of TC9/R60 meeting.

4.7.2

7.2.1. Required information not marked on load cell

Information required in 6.1.5 not marked on the load cell shall be provided in an accompanying document provided by the manufacturer. Where such a document is provided, the information required in 7.2.2 shall also be given therein.

4.7.1

~~7.1.1.~~7.2.2. Minimum load cell markings

The following minimum amount of information, required in 6.7, shall be marked on each load cell:

a. name or trademark of manufacturer;
b. manufacturer's designation or load cell model;
c. serial number;
d. maximum capacity, E_{max}.
e. OIML certificate number

Comment [65]: Added per Canada's comment

4.6.6.1

7.2.3. Mandatory additional information

In addition to the information included in 7.3.4 the following information shall be specified:

a. name or trademark of manufacturer;
b. manufacturer's designation or load cell model;
c. serial number and year of manufacture;
d. minimum dead load, E_{min}, maximum capacity, E_{max}, safe load limit, E_{lim} (all in units of g, kg or t, as applicable);

e. minimum load cell verification interval, v_{min};

f. other pertinent conditions that must be observed to obtain the specified performance (for example, electrical characteristics of the load cell such as output rating, input impedance, supply voltage, cable details, etc.); and

the value of the apportionment factor, P_{LC}, if not equal to 0.7

7.2.4. Specific markings

Comment [66]: New sub-heading

4.6.1 ~~7.1.1.1.~~7.2.4.1. *Accuracy class designation*

Class A load cells shall be designated by the character "A", class B by "B", class C by "C" and class D by the character "D".

4.6.2 ~~7.1.1.2.~~7.2.4.2. *Maximum number of load cell verification intervals*

The maximum number of load cell verification intervals for which the accuracy class applies shall be designated in actual units (e.g., 3 000) or, when combined with the accuracy class designation (see 7.2.4.1 above) to produce a classification symbol (see 6.1.6), it shall be designated in units of 1 000.

4.6.3 ~~7.1.1.3.~~7.2.4.3. *Designation of the type of load applied to the load cell*

The designation of the type of load applied to the load cell shall be specified when it is not clearly apparent from the load cell construction, using the symbols shown in Table 5.

Table 2

Table 5. Symbols for Different Types of Loads

Tension	↑ ↓
Compression	↓ ↑
Beam (shear or bending)	↑ **or** ↓
Universal	↑↓ ↓↑

4.6.4 ~~7.1.1.4.~~7.2.4.4. *Working temperature designation*

The special limits of working temperature, as referred to in 6.5.1.2, shall be specified when

	the load cell cannot perform within the limits of error in 6.2 to 6.5 over the temperature range specified in 6.4.1.1. In such cases, the limits of temperature shall be designated in degrees Celsius (°C).
4.6.5 4.6.5.1 4.6.5.2 4.6.5.3	7.2.4.5. *Humidity symbols* a). A load cell submitted for evaluation and not designed to meet performance criteria evaluated under 9.10.5 or 9.10.6 shall be marked by the symbol NH. ~~a. When a load cell is neither to be subjected to the humidity test as specified in 9.11.5 nor the humidity test as specified in 9.11.6, it shall be marked by the symbol NH.~~ b). A load cell submitted for evaluation and designed to meet performance criteria evaluated under 9.10.5 shall be marked by the symbol CH or not be marked with any humidity classification. ~~b. When a load cell is to be subjected to the humidity test as specified in 9.11.5, it may be marked with the symbol CH or have no humidity classification symbol.~~ c). A load cell submitted for evaluation and manufactured to meet performance criteria evaluated under 9.10.6 shall be marked by the symbol SH. ~~When a load cell is to be subjected to the humidity test as specified in 9.11.6, it shall be marked with the symbol SH.~~
~~4.6.6~~	~~8.7.1 Additional information~~
~~4.6.6.1~~	~~8.7.1.1 *Mandatory additional information*~~ ~~a. In addition to the information required in 7.3.2 to 7.3.6, the following information shall be specified:~~ ~~b. name or trademark of manufacturer;~~ ~~c. manufacturer's designation or load cell model;~~ ~~d. serial number and year of manufacture;~~ ~~e. minimum dead load, E_{min}, maximum capacity, E_{max}, safe load limit, E_{lim} (all in units of g, kg or t, as applicable);~~ ~~f. minimum load cell verification interval, v_{min};~~ ~~g. other pertinent conditions that must be observed to obtain the specified performance (for example, electrical characteristics of the load cell such as output rating, input impedance, supply voltage, cable details, etc.); and~~ ~~h. the value of the apportionment factor, P_{LC}, if not equal to 0.7~~
4.6.6.2	~~7.1.1.5.~~7.2.4.6. *Non-mandatory additional information*

Comment [67]: Combined clauses under one heading.

Comment [68]: Paragraph moved to 7.2.3

In addition to the information required in 7.3.2 to 7.3.7.1, the following information may optionally be specified:

a. for a weighing instrument (for example a multiple range instrument according to OIML R 76) [9], the relative v_{min}, Y, where $Y = E_{max} / v_{min}$ (see 3.5.14);

b. for a weighing instrument (for example a multi-interval instrument according to OIML R 76) [9], the relative DR, Z, where $Z = E_{max} / (2 \times DR)$ (see 3.5.13) and the value of DR (see 3.5.9) is set at the maximum permissible minimum dead load output return according to 9.10.2.

c. other information considered necessary or useful by the manufacturer.

Comment [JB69]: Added per comment

4.6.7

~~8.7.2 Standard classification~~

~~Standard classifications shall be used; examples are shown in Table 5.~~

Comment [70]: Paragraphs relocated to 6.1.6 – 6.1.7

Table 3

~~Table 5. Examples of load cell classification~~

~~Classification symbol~~	~~Description~~
~~C2~~	~~Class C, 2 000 intervals~~
~~C3 5/35~~	~~Class C, 3 000 intervals, compression, + 5 °C to + 35 °C~~
~~C2 NH~~	~~Class C, 2 000 intervals, not to be subjected to humidity test~~

4.6.8

~~8.7.3 Multiple classifications~~

~~Load cells that have complete classifications for different types of load shall be designated using separate information for each classification. Examples are shown in Table 6. An illustration of the standard classification symbols using an example is shown in Figure 2.~~

Table 4

~~Table 6. Examples of Multiple Classifications~~

~~Classification Symbol~~			~~Description~~
~~C2~~	~~↑~~		~~Class C, 2 000 intervals, shear beam~~
~~C1.5~~	~~↓~~		~~Class C, 1 500 intervals, bending beam~~
~~C1~~	~~↕~~	~~– 5/30~~	~~Class C, 1 000 intervals, compression, – 5 °C to + 30 °C~~
~~C3~~	~~↕~~	~~– 5/□0~~	~~Class C, 3 000 intervals, tension, – 5°C to + 30 °C~~

		↓		

4.7.2
8.4

8.7.4 Required information not marked on load cell

If the information required in 6.7 is not marked on the load cell then it shall be provided in an accompanying document provided by the manufacturer. Where such a document is provided, the information required in 7.3.1 shall also be given therein.

Comment [71]: Paragraph relocated to 7.2.1

Part 2 Metrological controls and performance tests

7

8 Metrological controls

7.1

8.1 Liability to legal metrological controls

7.1.1

8.1.1 Imposition of controls

This Recommendation prescribes performance requirements for load cells used in weighing instruments subjected to legal metrological control. ~~the measurement of mass.~~ National legislation may impose metrological controls that verify compliance with this Recommendation. Such controls, when imposed, may include ~~pattern~~ type evaluation.

8.2 Responsibility for compliance with the requirements

Notwithstanding the kind of legal metrological control in a country, the manufacturer (or ~~his~~ their formal representative) has the full responsibility that the ~~instruments~~ load cells comply with the requirements in Part 1 (Metrological and technical requirements) at the moment they are delivered to the user.

After assignment, the owner of the ~~instrument~~ load cell has the responsibility that the instrument is well maintained and complies with the requirements in Part 1 (Metrological and technical requirements) as long as the ~~instrument~~ load cell is in use. The operational presence of the ~~instrument~~ load cell in his premises is considered as “in use”.

~~8.3 Uncertainty of test results~~

~~Every test is subject to uncertainty. The uncertainty (of a measurement) is defined as (see VIM [1], 2.26):~~
~~"non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used" (For notes, please refer to VIM)~~
~~The uncertainty of the test method shall be taken into account in the decision on the applicability of the test method.~~

Comment [72]: Deleted per Germany’s comment

5.6

~~8.3.1~~8.2.1 Measurement standards , uncertainty of test results

The expanded uncertainty, U (for coverage factor k = 2), for the combination of the force-generating system and the indicating instrument (used during the tests to observe the load cell output) shall be less than 1/3 times the MPE of the load cell under test. [*Guide to the Expression of Uncertainty in Measurement, 2008*] [7]

Comment [JB73]: Wording added per comment.

Annex A

9 Type evaluation

A.1

9.1 Scope

This section provides test procedures for ~~pattern~~ type evaluation testing of load cells used in the measurement of mass.

Wherever possible, test procedures have been established to apply as broadly as possible to all load cells within the scope of OIML R 60.

The procedures apply to the testing of load cells only. No attempt has been made to cover testing of complete systems that include load cells.

~~A.2~~

~~**9.2 Purpose**~~

~~The following test procedures for quantitative determination of load cell performance characteristics are established to ensure uniform pattern evaluation.~~

Comment [74]: Paragraph deleted to eliminate redundancy with paragraph 9.7.1

A.2

~~9.3~~9.2 **Test requirements**

Test procedures for the ~~pattern~~ type evaluation of load cells are provided in Section 9 and the Test Report Format is provided in Part 3. Initial and subsequent verification of load cells independent of the measuring system in which they are used is normally considered inappropriate if the complete system performance is verified by other means.

~~A.3~~

~~**9.4 Test Conditions**~~

~~A.3.1~~

~~9.4.1 Test equipment~~

Comment [75]: Relocated to 9.7.2

~~The basic equipment for pattern evaluation tests consists of a force-generating system and a suitable linear instrument, which measures the output of the load cell (see 8.3.1.)~~

9.3 Submission of specimens for evaluation
~~**9.5 Units submitted to type test**~~

Type evaluation shall be carried out on at least one ~~unit~~specimen, which represents the definitive type. The evaluation shall consist of the examination and tests specified in 9.6 and 9.7

~~The applicant for the type test shall supply at least [...**To be completed by TC9**...] production sample(s) of the instrument for type testing.~~

In case the applicant wants to have approved several versions or measuring ranges, the ~~testing laboratory~~issuing authority decides which version(s) and range(s) shall be supplied.

If a specimen does not pass a specific test ~~and~~ as a result of the design of the type and therefore ~~and it~~ has to be modified ~~or repaired~~, the applicant shall carry out this modification to all the specimens supplied for test. After this modification, at least 2 different specimens shall be subjected to this particular test.

If during the evaluation the specimen experiences malfunction or breakage that necessitates a repair in order to complete the test, the applicant shall carry out this repair as required to all specimens supplied for the test.

If the ~~testing laboratory~~issuing authority has ~~sound reasons to fear~~reason to suspect that the modification or repair may have a~~has~~ negative influence on tests that already had a positive result, these tests shall be repeated.

7.3.1

9.3.1 Number of load cells to be tested

The selection of load cells to be tested shall be such that the number of load cells to be tested is minimized (see practical example in Annex B).

7.3

~~9.6~~9.4 **Selection of load cells within a family**

In order to accelerate the test procedure, the testing laboratory may carry out different tests simultaneously on different units. In this case, the ~~testing laboratory~~issuing authority decides which version or measuring range will be subjected to a specific test.

All accuracy and influence tests shall be performed on the same unit, but disturbance tests may be carried out on not more than 2 additional instruments. (See Table 6).

Table 6

Tests that shall be carried out on one and the same specimen	~~Tests that shall be carried out on one and the same specimen~~Tests that may be divided among no more than 2 additional specimens
Humidity tests for lowest capacity in highest precision specimen	*[To be completed by the TC9. See for an example Table 6 in OIML R 99]*

Comment [76]: Deleted per France's comment. General statement regarding the limitation on the number of load cells supplied should not be made. The submission of more than one load cell when needed should appear in the appropriate clause.

Comment [77]: This language adopted from template. Moved from 9.6 per France's comment.

Comment [78]: This language also adopted from template. Moved from 9.6 as per France's comment.

Comment [79]: There were no recommendations offered for language to complete table. To be reviewed and completed by TC9

~~If a specimen does not pass a specific test and as a result and it has to be modified or repaired, the applicant shall carry out this modification to all the instruments supplied for test. After this modification, at least 2 different specimens shall be subjected to this particular test. If the testing laboratory has sound reasons to fear that the modification has negative influence on tests that already had a positive result, these tests shall be repeated.~~

Where a family composed of one or more groups of load cells of various capacities and characteristics is presented for ~~pattern~~ type evaluation, the following provisions shall apply.

~~7.3.1~~

~~9.6.1 Number of load cells to be tested~~

~~The selection of load cells to be tested shall be such that the number of load cells to be tested is minimized (see practical example in Annex B).~~

Comment [80]: Relocated to 9.3.1

7.3.2

~~9.6.2~~9.4.1 Load cells of the same capacity belonging to different groups

Where load cells of the same capacity belong to different groups, approval of the load cell with the best metrological characteristics implies approval of the load cells with the lesser characteristics. Therefore, when a choice exists, the load cells with the best metrological characteristics shall be selected for test.

7.3.3

~~9.6.3~~9.4.2 Load cells with a capacity in between the capacities tested

Load cells with a capacity in between the capacities tested, as well as those above the largest capacity tested, but not over 5 times above the largest capacity tested, are deemed to ~~be approved.~~fulfill the requirements of this Recommendation.

Comment [81]: Amended per comment

7.3.4

~~9.6.4~~9.4.3 Smallest capacity load cell from the group

For any family, the smallest capacity load cell from the group with the best characteristics shall be selected for testing. For any group, the smallest capacity load cell in the group shall always be selected for test unless that capacity falls within the range of allowed capacities of selected load cells having better metrological characteristics according to the requirements of 9.4.1 and 9.4.2.

7.3.5

~~9.6.5~~9.4.4 Ratio of largest capacity to the nearest smaller capacity

When two load cells that would be ranked adjacent to one another in a series in terms of their capacity are selected for test, the cells shall have a proportional difference between their capacity rating of no less than 5 times and no greater than 10 times. If the available capacities within the series do not meet this criterion, the load cell which is next in line within

that series shall be selected.
~~When the ratio of the largest capacity load cell in each group to the nearest smaller capacity having been selected for test is greater than 5, then another load cell shall be selected. The selected load cell shall have a capacity between 5 and 10 times that of the nearest smaller capacity load cell which has been selected. When no capacity meets this criterion, the selected load cell shall be that having the smallest capacity exceeding 10 times that of the nearest smaller capacity load cell which has been selected.~~

Comment [82]: Amended language per Netherlands comment.
TC9 to review to verify that intent has not been changed by the amended language.

7.3.6

~~9.6.6~~9.4.5 Humidity test

If more than one load cell of a family has been submitted for testing, only one cell shall be tested for humidity when applicable~~, and only one cell shall be subjected to the additional tests for load cells equipped with electronics when applicable, that being the load cell with the most severe characteristics (for example, the greatest value of n_{max} or the lowest value of v_{min})~~.

Comment [83]: Per Germany's comment - humidity test section split in two sections to deal with analogue load cells and load cells equipped with electronics separately. See 9.4.6

New paragraph added for load cells equipped with electronics as proposed by Germany. Needs review.

9.4.6 Humidity test for load cells equipped with electronics

Only one cell shall be subjected to the additional tests for load cells equipped with electronics when applicable, that being the load cell selected for $\mu V/v_{min}$ as input of the analogue digital converter or that with the most severe characteristics (e.g., the greatest value of n_{max} or the lowest value of v_{min}).

Comment [84]: New paragraph added – content needs review.

~~9.7~~9.5 **Documentation**

The documentation submitted with the application for type approval shall include:

a) description of its general principle of measurement;

b) mechanical drawings;

c) electric/electronic diagrams;

d) installation requirements if appropriate;

e) operating instructions that shall be provided to the user if appropriate;,

f) documents or other evidence ~~that supports the assumption~~to support and demonstrate the manufacturer's belief that the design and characteristics of the ~~measuring instrument~~load cell will comply with the requirements of this Recommendation;

~~f)~~g) documentation relative to software if appropriate.

If the testing laboratory deems this necessary, it can require more detailed documentation; either to be able to study the quality of the instrument, or to be able to ~~lay down~~fully define the approved type, or both.

Comment [85]: Amendments per Austrailia, France, Netherland's comments

	~~9.8~~9.6 **Examinations** Examinations and testing of ~~instruments~~ load cells are intended to verify compliance with the requirements of Part 1 of this Recommendation. The load cell and the documentation shall be given a visual inspection to obtain a general appraisal of its design and construction and the documentation shall be studied. In particular, the following aspects shall be examined: a. accuracy classes and their symbols (6.1.1 and 7.3.4.1); b. (maximum number of verification) intervals (6.1.2 and 7.3.4.2); c. measuring ranges (3.5.2 and 3.6); d. apportioning of errors (3.7.2); e. construction (3.3); f. software (7.2); g. inscriptions (7.3); and ~~g.~~h. installation instructions/recommendations.
A.3	~~9.9~~9.7 **Performance Tests**
~~*A.1*~~	~~9.9.1 Scope~~ ~~This section provides test procedures for pattern evaluation testing of load cells used in the measurement of mass.~~
~~*A.1.1*~~	~~*9.9.1.1* Wherever possible test procedures have been established to apply as broadly as possible to all load cells within the scope of OIML R 60.~~
~~*A.1.2*~~	~~*9.9.1.2* The procedures apply to the testing of load cells only. No attempt has been made to cover testing of complete systems that include load cells.~~
A.2	~~9.9.2~~9.7.1 Purpose The following test procedures for quantitative determination of load cell performance characteristics are established to ensure uniform ~~pattern~~ type evaluation.
~~*A.3*~~	~~9.9.3 Test conditions~~
A.3.1	~~9.9.4~~9.7.2 Test equipment The basic equipment for pattern evaluation tests consists of a force-generating system and a suitable linear instrument, which measures the output of the load cell (see 8.2.1).

Comment [86]: Paragraphs 9.9.1 – 9.9.1.2 striken. Redundant with 9.1

A.3.2

~~9.9.5~~9.7.3 General Considerations for environmental and test conditions

Before adequate testing and evaluation of a load cell can be performed, careful attention shall be paid to the environmental and test conditions under which such evaluations are to be made. Significant discrepancies are frequently a result of insufficient recognition of such details. ~~The following shall be thoroughly considered prior to any pattern evaluation testing program.~~

A.3.2.2

9.7.3.1 Environmental conditions

Tests shall be performed under stable environmental conditions. The ambient temperature is deemed to be stable when the difference between extreme temperatures noted during the test does not exceed one fifth of the temperature range of the load cell under test, without being greater than 2 °C.

Except for the parameter being tested, the reference conditions in Table 7shall be kept by the testing laboratory during the tests

Table 7

	Influence	**Value**
a)	Temperature	20 °C ± 2 °C
b)	Humidity	65 % RH ± 5 %
c)	Atmospheric pressure	Ambient pressure, stable within 10 hPa
f)	AC mains voltage (1)	U_{nom} ± 1 %
g)	AC mains frequency (1)	f_{nom} ± 0,5 % (2)
j)	Conducted radio-frequency fields (1)	< 0,2 V e.m.f. (2)
k)	Electrostatic discharge	none
l)	Power frequency magnetic field	< 1 A/m (2)
m)	Bursts (transients) on signal, data and control lines (1)	negligible (2)
n)	Surges on signal, data and control lines (1)	negligible (2)
o)	AC mains voltage dips, short interruptions and voltage variations (1)	negligible (2)
p)	Bursts (transients) on AC and DC mains (1)	negligible (2)
r)	Surges on AC and DC mains power (1)	None (2)

(1) If applicable

(2) As in a normal laboratory condition these conditions can be expected to be fulfilled without specific measures, it is usually not deemed necessary to measure/monitor these values.

Comment [87]: Table added as proposed

	9.7.4 Test conditions
A.3.2.1	~~9.9.5.1~~9.7.4.1 *Acceleration of gravity* The mass standards used in testing shall be corrected, if necessary, for the site of testing and the value of the gravity constant, *g*, at the test site shall be recorded with the test results. The value of the mass standards used to generate the force shall be traceable to the appropriate national or international standard of mass.
~~A.3.2.2~~	~~9.9.5.2 Environmental conditions~~ ~~Tests shall be performed under stable environmental conditions. The ambient temperature is deemed to be stable when the difference between extreme temperatures noted during the test does not exceed one fifth of the temperature range of the load cell under test, without being greater than 2 °C.~~
A.3.2.3	~~9.9.5.3~~9.7.4.2 *Loading conditions* Particular attention shall be paid to loading conditions to prevent the introduction of errors not inherent to the load cell. Factors such as surface roughness, flatness, corrosion, scratches, eccentricity, etc., should be taken into consideration. Loading conditions shall be in accordance with the requirements of the load cell manufacturer. The loads shall be applied and removed along the sensitive axis of the load cell without introducing shock to the load cell.
A.3.2.4	~~9.9.5.4~~9.7.4.3 *Measuring range limits* The minimum load, D_{min}, (hereafter referred to as "minimum test load") shall be as near as possible to but not less than the minimum dead load, E_{min}, as permitted by the force-generating system. The minimum value D_{min} shall not be higher than the value of E_{min} increased by 10% of E_{max}. The maximum load, D_{max}, (hereafter referred to as "maximum test load") shall be not less than 90 % of E_{max}, nor shall it be greater than E_{max} (refer to Fig. 1).
A.3.2.5	~~9.9.5.5~~9.7.4.4 *Reference standards* All standards and measuring instruments used for the tests shall be traceable to (inter)national standards. ~~Periodic (depending on use) verification of standards shall be made.~~
A.3.2.6	~~9.9.5.6~~9.7.4.5 *Stabilization period* A stabilization period for the load cell under test and the indicating instrument shall be provided, as recommended by the manufacturers of the equipment used.

Comment [88]: Statement added per France's comment.

Comment [89]: Language changed per comment to reflect the specific meaning of "verification" as defined in VIML

A.3.2.7	~~*9.9.5.7*~~*9.7.4.6 Temperature conditions* It is important to allow sufficient time for temperature stabilization of the load cell to be achieved. Particular attention shall be devoted to this requirement for large load cells. The loading system shall be of a design which will not introduce significant thermal gradients within the load cell. The load cell and its connecting means (cables, tubes, etc.) which are integral or contiguous shall be at the same test temperature. The indicating instrument shall be maintained at room temperature. The temperature effect on auxiliary connecting means shall be considered in determining results.
A.3.2.8	~~*9.9.5.8*~~*9.7.4.7 Barometric pressure effects* Where changes in barometric pressure may significantly affect the load cell output, such changes shall be considered.
	9.7.4.8 Humidity effects When a load cell is marked with the symbol CH or is not marked with a humidity symbol, it shall be subjected to the humidity test, as specified in 9.10.5. When a load cell is marked with the symbol SH, it shall be subjected to the humidity test, as specified in 9.10.6 9.7.4.9 Load cells marked with the symbol NH shall not be subjected to the humidity tests as described in 9.10.5 and 9.10.6.
A.3.2.9	~~*9.9.5.9*~~*9.7.4.10 Stability of loading means* An indicating instrument and a loading means shall be used which will provide sufficient stability to permit readings within the limits specified in 8.3.
A.3.2.10	~~*9.9.5.10*~~*9.7.4.11 Indicating instrument checking* Some indicating instruments are provided with a convenient means for checking the indicating instrument itself. When such features are provided, they shall be utilized frequently to ensure that the indicating instrument is within the accuracy required by the test being performed. Periodic check on calibration status of the indicating instrument shall be performed. ~~verification of the indicating instrument calibration shall also be performed.~~
A.3.2.11	~~*9.9.5.11*~~*9.7.4.12 Other conditions* Other conditions specified by the manufacturer such as input/output voltage, electrical sensitivity, input impedance of the indicator, etc. shall be taken into consideration during the test.

Comment [JB90]: New clause. Relocated from Part 1

Comment [91]: Amended per Netherland"s comment

Comment [92]: Added per comment

A.3.2.12	~~9.9.5.12~~9.7.4.13 *Time and date ~~data~~ format* All time and date points shall be recorded such that the data can later be presented in test reports in absolute, not relative, units of local time and date. The date shall be recorded in the ISO 8601 (Representation of dates and times) [10] format of ccyy-mm-dd. *Note*: "cc" may be omitted in cases where there is no possible confusion as to the century.
A.3.2.13	~~9.9.5.13~~9.7.4.14 *Span stability* The installation of the load cell in the force-generating system shall be done with particular care, since the aim of this test is not to measure the influence on the metrological performances of mounting/dismounting the load cell on/from the force-generating system.
13.4.2	~~9.9.6~~9.7.5 Error under rated operating conditions The type of measuring instrument is presumed to comply with the provisions specified in 6.2 to 6.4 of this Recommendation, if it passes the tests (9.10), confirming that the error of the measuring instrument does not exceed the maximum permissible error specified in 9.9 under the reference conditions in 9.7.3.
5.2	~~9.10~~9.8 **Rules concerning the determination of errors**
5.2.1	~~9.10.1~~9.8.1 Conditions The limits of error shown in Table 4 shall apply to all load cell measuring ranges complying with the following conditions: $n \leq n_{max}$ $v \geq v_{min}$
5.2.2	~~9.10.2~~9.8.2 Limits of error The limits of error shown in Table 1 shall refer to the error envelope defined in 2.2 and 6.2.1 which is referenced to the straight line that passes through the minimum load output and the load cell output for a load of 75 % of the measuring range taken on ascending load at 20 °C. This is based upon the initial 20 °C load test. See Part 3 (Test ~~Format~~Report Format for Type Evaluation).
5.2.3	~~9.10.3~~9.8.3 Initial readings During the conduct of the tests, the initial reading shall be taken at a time interval after the

Comment [93]: Amended per Netherland"s comment

initiation of loading or unloading, whichever is applicable, as specified in Table 8.

Table 6

Table 8. Combined Loading and Stabilization Times to be Achieved Prior to Reading

Change in load		Time allowed for:	
Greater than	**Up to and including**	**Loading**	**Stabilization**
0 kg	10 kg	5 seconds	5 seconds
10 kg	100 kg	10 seconds	10 seconds
100 kg	1 000 kg	15 seconds	15 seconds
1 000 kg	10 000 kg	20 seconds	20 seconds
10 000 kg	100 000 kg	25 seconds	25 seconds
100 000 kg		30 seconds	30 seconds

Comment [94]: Column added. Table extended to include both loading and stabilization times.

5.2.3.1 ~~*9.10.3.1*~~*9.8.3.1 Loading/unloading times*

The loading or unloading times shall be ~~approximately half the time specified. The remaining time shall be utilized for stabilization~~as shown in Table 8. The tests shall be conducted under constant conditions. Time shall be recorded in the test report in absolute, not relative, units.

Comment [JB95]: Wording changed to reflect addition of column in Table 8

5.2.3.2 ~~*9.10.3.2*~~*9.8.3.2 Loading/unloading times impracticable*

When the specified loading or unloading times cannot be achieved, the following shall apply:

a) in the case of the minimum dead load output return test, the time may be increased from 100 % to a limit of 150 % of the specified time provided that the permissible variation of the result is proportionally reduced from 100 % to 50 % of the allowable difference between the initial reading of the minimum load output upon unloading and the reading before loading~~; and~~. For example:

(1). A change in load of 10 kg, loading time is increased to 7.5 seconds (150% of 5 s), MPE is reduced to 50%; or

(2). A change in load of 1500 kg, loading time of 20 seconds is increased to 25 seconds (125% of 20 seconds), MPE is reduced to 75%.

~~a)~~b) in other cases, the actual times shall be recorded in the Test Report.

Comment [96]: Examples added per Netherland's comment

5.3 ~~9.11~~9.9 ~~Permissible v~~Variation of results under reference conditions

~~5.3.1~~ ~~9.11.1 Creep~~

~~With a constant maximum load, D_{max}, between 90 % and 100 % of E_{max}, applied to the load cell, the max difference between the initial reading and any reading obtained during the next 30 minutes shall not exceed 0.7 times the absolute value of the MPE (see 9.10.1.1) for the applied load. The difference between the reading obtained at 20 minutes and the reading obtained at 30 minutes shall not exceed 0.15 times the absolute value of the MPE (see 9.10.1.1).~~

5.3.1 9.9.1 Creep

An initial reading shall be taken followed by a subsequent reading after the load cell has had a load of D_{max} (between 90 % and 100 % of E_{max}) constantly applied for 30 minutes. These readings shall not differ greater than the amount specified in 6.4.1. A reading shall also be taken after 20 minutes of exposure to D_{max} and compared with the reading taken after 30 minutes of exposure to D_{max}. The difference in these readings shall also comply with the limit specified in 6.4.1.

~~5.3.1.1 *Maximum permissible error for creep*~~

~~Regardless of the value declared by the manufacturer for the apportionment factor, P_{LC}, the MPE for creep shall be determined from Table 1 using the apportionment factor, $P_{LC} = 0.7$.~~

5.3.2 9.9.2 Minimum dead load output return

Readings of load cell output shall be taken prior to the addition of any load and subsequently after the removal of a load of D_{max}. The difference between readings shall not exceed the value specified in 6.4.2. D_{max} may range between 90% and 100% of E_{max}.

9.9.3

~~5.3.2~~ ~~9.11.2 Minimum dead load output return~~

~~The difference between the initial reading of the minimum load output and the reading after returning to minimum load, D_{min}, subsequent to the maximum load, D_{max}, between 90 % and 100 % of E_{max}, having been applied for 30 minutes, shall not exceed half the value of the load cell verification interval (0.5 v).~~

A.4 ~~9.12~~9.10 **Test procedures**

Each of the tests below is presented as a “stand alone” individual test. However, for the efficient conduct of the load cell tests, it is acceptable that the increasing and decreasing load, creep, and minimum dead load output return tests be conducted at the given test temperature before changing

Comment [97]: Permissible variation of results" defines a general metrological requirement and is not used only for type evaluation. The metrological requirement portions of the following requirements have been relocated to Part 1 – 6.4. New language developed for test portion of these requirements must be reviewed by TC9.

Comment [JB98]: Language amended and relocated to 6.4.1

Comment [99]: Paragraph split into requirement and test portions. Requirement portion inserted in Part 1, 6.4.1. New language, must be reviewed by TC9.

Comment [JB100]: Relocated to 6.4.1.1

Comment [101]: New language. Must be reviewed by TC9. Requirement portion of this paragraph moved to Part 1– 6.4.2

Comment [102]: Time period for observing indication after unloading to be determined by TC9

Comment [JB103]: Language amended and relocated to 6.4.2

	to the next test temperature (see 9.11, Figures 3 and 4). The barometric pressure and the humidity tests are conducted individually following completion of the above tests.
A.4.1	~~9.12.1~~9.10.1 Determination of load cell error, repeatability error and temperature effect on minimum dead load output. This test is applied to verify compliance with the provisions in 6.2, 6.3, and 6.5.1.3.
A.4.1.1	~~*9.12.1.1*~~*9.10.1.1* *Check test conditions* Refer to the test conditions in 9.7.3 and 9.7.4 to ensure that proper consideration has been given to those conditions, prior to performing the following tests.
A.4.1.2	~~*9.12.1.2*~~*9.10.1.2* *Insert load cell* Insert the load cell into the force-generating system, load to the minimum test load, D_{min}, and stabilize at 20 °C **(± 2 °C)**.
A.4.1.3	~~*9.12.1.3*~~*9.10.1.3* *Exercise load cell* Exercise the load cell by applying the maximum test load, D_{max}, three times, returning to the minimum test load, D_{min}, after each load application. Wait 5 minutes.
A.4.1.4	~~*9.12.1.4*~~*9.10.1.4* *Check indicating instrument* Check the indicating instrument according to 9.7.4.11.
A.4.1.5	~~*9.12.1.5*~~*9.10.1.5* *Monitor load cell* Monitor the minimum test load output until stable.
A.4.1.6	~~*9.12.1.6*~~*9.10.1.6* *Record indication* Record the indicating instrument indication at the minimum test load, D_{min}.
A.4.1.7	~~*9.12.1.7*~~*9.10.1.7* *Test load points* All test load points in a loading and unloading sequence shall be spaced at approximately equal time intervals. The readings shall be taken at time intervals as near as possible to those specified in Table 8 in 9.8.3. These two time intervals shall be recorded.

Comment [104]: Uncertainty of temperature inserted per comment

A.4.1.8	~~*9.12.1.8*~~*9.10.1.8 Apply loads* Apply increasing loads up to the maximum test load, D_{max}. There shall be at least five increasing load points, which shall include loads approximating to the highest values in the applicable steps of maximum permissible load cell errors, as listed in Table 4 in 6.2.2.
A.4.1.9	~~*9.12.1.9*~~*9.10.1.9 Record indications* Record the indicating instrument indications at time intervals as near as possible to those specified in Table 8 in 9.8.3. These two time intervals shall be recorded.
A.4.1.10	~~*9.12.1.10*~~*9.10.1.10 Decrease test loads* Decrease the test loads to the minimum test load, D_{min}, using the same load points as described in 9.10.1.8.
A.4.1.11	~~*9.12.1.11*~~*9.10.1.11 Record indications* Record the indicating instrument indications at time intervals as near as possible to those specified in Table 8 in 9.8.3. These two time intervals shall be recorded.
A.4.1.12	~~*9.12.1.12*~~*9.10.1.12 Repeat procedures for different accuracy classes* Repeat the operations described in 9.10.1.7 to 9.10.1.11 four more times for accuracy classes A and B or two more times for accuracy classes C and D.
A.4.1.13	~~*9.12.1.13*~~*9.10.1.13 Repeat procedures for different temperatures* Repeat the operations described in 9.10.1.3 to 9.10.1.12, first at 20 °C, then at the higher temperature, then at the lower temperature, including the approximate temperature range limits for the accuracy class intended; then perform the operations in 9.10.1.3 to 9.10.1.12 at 20 °C **(± 2 °C)**.
A.4.1.14	~~*9.12.1.14*~~*9.10.1.14 Determine magnitude of load cell error* The magnitude of the load cell error shall be determined based on the average of the results of the tests conducted at each temperature level and compared with the maximum permissible load cell errors in 6.2.2.
A.4.1.15	~~*9.12.1.15*~~*9.10.1.15 Determine repeatability error*

Comment [105]: Added per comment

Comment [106]: Uncertainty of temperature inserted per comment

	From the resulting data, the repeatability error may be determined and compared with the limits specified in 6.3.
A.4.1.16	~~*9.12.1.16*~~*9.10.1.16* *Determine temperature effect on minimum dead load output* The minimum load output shall be taken after the load cell has thermally stabilized at ambient temperature. From the resulting data, the temperature effect on minimum dead load output may be determined and compared with the limits specified in 6.5.1.3.
A.4.2	~~9.12.2~~9.10.2 Determination of creep error. This test is applied to verify compliance with the provisions in 6.4.1.
A.4.2.1	~~*9.12.2.1*~~*9.10.2.1* *Check test conditions* Refer to the test conditions in 9.7.3 and 9.7.4 to ensure that proper consideration has been given to those conditions prior to performing the following tests.
A.4.2.2	~~*9.12.2.2*~~*9.10.2.2* *Insert load cell* Insert the load cell into the force-generating system, load to the minimum test load, D_{min}, and stabilize at 20 °C **(± 2 °C)**.
A.4.2.3	~~*9.12.2.3*~~*9.10.2.3* *Exercise load cell* Exercise the load cell by applying the maximum test load, D_{max}, three times, returning to the minimum test load, D_{min}, after each load application. Wait one hour.
A.4.2.4	~~*9.12.2.4*~~*9.10.2.4* *Check indicating instrument* Check the indicating instrument according to 9.7.4.11.
A.4.2.5	~~*9.12.2.5*~~*9.10.2.5* *Monitor load cell* Monitor the minimum test load output until stable.
A.4.2.6	~~*9.12.2.6*~~*9.10.2.6* *Record indication* Record the indicating instrument indication at the minimum test load, D_{min}.

Comment [JB107]: Language extracted from Part 1 - 6.5.1.3

Comment [108]: Uncertainty of temperature inserted per comment

A.4.2.7	~~*9.12.2.7*~~*9.10.2.7* *Apply load* Apply a constant maximum test load, D_{max}.
A.4.2.8	~~*9.12.2.8*~~*9.10.2.8* *Record indications* Record the initial indicating instrument indication at the time intervals specified in Table 8 in 9.8.3. Continue to record periodically thereafter, at recorded time intervals over a 30-minute period, ensuring that a reading is taken at 20 minutes.
A.4.2.9	~~*9.12.2.9*~~*9.10.2.9* *Repeat procedures for different temperatures* Repeat the operations described in 9.10.2.3 to 9.10.2.8, first at the higher temperature, then at the lower temperature, including the approximate temperature range limits for the accuracy class intended.
A.4.2.10	~~*9.12.2.10*~~*9.10.2.10* *Determine creep error* With the resulting data, and taking into account the effect of barometric pressure changes according to 9.7.4.7, the magnitude of the creep error can be determined and compared with the permissible variation specified in 6.4.1.
A.4.3	~~9.12.3~~9.10.3 Determination of minimum dead load output return (DR). This test is applied to verify compliance with the provisions in 6.4.2.
A.4.3.1	~~*9.12.3.1*~~*9.10.3.1* *Check test conditions* Refer to the test conditions in 9.7.3 and 9.7.4 to ensure that proper consideration has been given to those conditions prior to performing the following test.
A.4.3.2	~~*9.12.3.2*~~*9.10.3.2* *Insert load cell* Insert the load cell into the force-generating system, load to the minimum test load, D_{min}, and stabilize at 20 °C **(± 2 °C)**.
A.4.3.3	~~*9.12.3.3*~~*9.10.3.3* *Exercise load cell* Exercise the load cell by applying the maximum test load, D_{max}, three times, returning to the minimum test load, D_{min}, after each load application. Wait one hour.

Comment [109]: Uncertainty of temperature inserted per comment

A.4.3.4	~~*9.12.3.4*~~*9.10.3.4 Check indicating instrument* Check the indicating instrument according to 9.7.4.11.
A.4.3.5	~~*9.12.3.5*~~*9.10.3.5 Monitor load cell* Monitor the minimum test load output until stable.
A.4.3.6	~~*9.12.3.6*~~*9.10.3.6 Record indication* Record the indicating instrument indication at the minimum test load, D_{min}.
A.4.3.7	~~*9.12.3.7*~~*9.10.3.7 Apply load* Apply a constant maximum test load, D_{max}.
A.4.3.8	~~*9.12.3.8*~~*9.10.3.8 Record indications* Record the initial indicating instrument indication at time intervals as near as possible to those specified in Table 8 in 9.8.3. These two time intervals shall be recorded. Record the time at which the load is fully applied and maintain the load for a 30-minute period.
A.4.3.9	~~*9.12.3.9*~~*9.10.3.9 Record data* Record the time of initiation of unloading and return to the minimum test load, D_{min}.
A.4.3.10	~~*9.12.3.10*~~*9.10.3.10 Record indication* Record the indicating instrument indication at time intervals as near as possible to those specified in Table 8 in 9.8.3. These two time intervals shall be recorded.
A.4.3.11	~~*9.12.3.11*~~*9.10.3.11 Repeat procedures for different temperatures* Repeat the operations described in 9.10.3.3 to 9.10.3.10, first at the higher temperature, then at the lower temperature, including the approximate temperature range limits for the accuracy class intended.

A.4.3.12	~~9.12.3.12~~9.10.3.12 *Determine minimum dead load output return (DR)* With the resulting data, the magnitude of the minimum dead load output return (DR) can be determined and compared with the permissible variation specified in 9.9.2.
A.4.4	~~9.12.4~~9.10.4 Determination of barometric pressure effects (Atmospheric pressure). This test is applied to verify compliance with the provisions in 6.5.2. This test shall be conducted unless there is sufficient design justification to show that the load cell performance is not affected by changes in barometric pressure. The justification for not conducting this test shall be noted in the test report.
A.4.4.1	~~9.12.4.1~~9.10.4.1 *Check test conditions* Refer to the test conditions in 9.7.3 and 9.7.4 to ensure that proper consideration has been given to those conditions prior to performing the following test. ~~Normal electrical power supplied and "on" (for a time period equal to or greater than the warm-up time specified by the manufacturer, if applicable).~~
A.4.4.2	~~9.12.4.2~~9.10.4.2 *Insert load cell* At room temperature, insert the unloaded load cell into the pressure chamber at atmospheric pressure.
A.4.4.3	~~9.12.4.3~~9.10.4.3 *Check indicating instrument* Check the indicating instrument according to 9.7.4.11.
A.4.4.4	~~9.12.4.4~~9.10.4.4 *Monitor load cell* Monitor the output until stable.
A.4.4.5	~~9.12.4.5~~9.10.4.5 *Record indication* Record the indicating instrument indication.
A.4.4.6	~~9.12.4.6~~9.10.4.6 *Change barometric pressure* Change the barometric pressure in increments of 1 kPa within a range of 5 kPa greater than atmospheric pressure to 5 kPa less than atmospheric pressure ~~to a value of approximately 1 kPa lower or higher than atmospheric pressure~~ and record the indicating instrument indication.
A.4.4.7	~~9.12.4.7~~9.10.4.7 *Determine barometric pressure error* With the resulting data, the magnitude of the barometric pressure influence can be

Comment [110]: Statement added per comment

Comment [111]: Wording from OIML template deleted per France's comment

Comment [112]: Austria suggests amendment of this value to correspond with 6.8.2. Recommends a range of up to 5 kPa lower and higher than atmospheric pressure in increments of 1 kPa. NL suggest changes similar to comment from Austria however withdrew their comment.. Need review by TC9.

	determined and compared with the limits specified in 6.5.2. ~~All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 6.2.~~
A.4.5	~~9.12.5~~9.10.5 Determination of humidity effects for load cells marked CH or not marked. This test is applied to verify compliance with the provisions in 6.5.3.1.
A.4.5.1	~~*9.12.5.1*~~*9.10.5.1 Check test conditions* Refer to the test conditions in 9.7.3 and 9.7.4 to ensure that proper consideration has been given to those conditions prior to performing the following test.
A.4.5.2	~~*9.12.5.2*~~*9.10.5.2 Insert load cell* Insert the load cell into the force-generating system, load to the minimum test load, D_{min}, and stabilize at 20 °C (± 2 °C)..
A.4.5.3	~~*9.12.5.3*~~*9.10.5.3 Exercise load cell* Exercise the load cell by applying the maximum test load, D_{max}, three times, returning to the minimum test load, D_{min}, after each application. Wait 5 minutes.
A.4.5.4	~~*9.12.5.4*~~*9.10.5.4 Check indicating instrument* Check the indicating instrument according to 9.7.4.11
A.4.5.5	~~*9.12.5.5*~~*9.10.5.5 Monitor load cell* Monitor the minimum test load output until stable.
A.4.5.6	~~*9.12.5.6*~~*9.10.5.6 Record indication* Record the indicating instrument indication at the minimum test load, D_{min}.
A.4.5.7	~~*9.12.5.7*~~*9.10.5.7 Apply load* Apply a maximum test load, D_{max}.

Comment [113]: Language from template removed per France's comment

Comment [114]: Uncertainty for temperature inserted per comment

Comment [115]: Added per Austria's comment

A.4.5.8	~~*9.12.5.8*~~*9.10.5.8 Record indications* Record the initial indicating instrument indication at time intervals as near as possible to those specified in Table 8 in 9.8.3. These two time intervals shall be recorded.
A.4.5.9	~~*9.12.5.9*~~*9.10.5.9 Remove load* Remove the test load to the minimum test load, D_{min}.
A.4.5.10	~~*9.12.5.10*~~*9.10.5.10 Record indication* Record the indicating instrument indication at time intervals as near as possible to those specified in Table 8 in 9.8.3. These two time intervals shall be recorded.
A.4.5.11	~~*9.12.5.11*~~*9.10.5.11 Repeat procedures for different accuracy classes* Repeat the operations described in 9.10.5.7 to 9.10.5.10 four more times for accuracy classes A and B or two more times for accuracy classes C and D.
A.4.5.12	~~*9.12.5.12*~~*9.10.5.12 Conduct damp heat, cyclic test* Conduct a damp heat, cyclic test in accordance with IEC 60068-2-30 Ed. 3.0 (2005-08) Environmental testing Part 2: Tests. [11] Test Db and guidance: Damp heat cyclic (12 + 12-hour cycle. Background information concerning damp heat, cyclic tests is given in IEC 60068-3-4 Ed. 1.0 (2001) Environmental testing - Part 2: Tests. [12] Guidance for damp heat tests. *Test procedure in brief:* This test consists of exposure to 12 temperature cycles of 24-hour duration each. The relative humidity is between 80 % and 96 % and the temperature is varied from 25 °C to 40 °C, in accordance with the specified cycle. *Test severity:* 40 °C, 12 cycles. *Initial measurements:* According to 9.10.5.1 to 9.10.5.11 above. *State of load cell during conditioning:* Load cell placed in the chamber with the output connection external to the chamber, and switched off. Use variant 2 of IEC 60068-2-30 Ed. 3.0 (2005-08) [11] when lowering

	the temperature. *Recovery conditions and final measurements:* According to 9.10.5.13 below.
A.4.5.13	~~*9.12.5.13*~~*9.10.5.13* *Remove load cell from chamber* Remove the load cell from the humidity chamber, carefully remove surface moisture, and maintain the load cell at standard atmospheric conditions for a period sufficient to attain temperature stability (normally 1 to 2 hours). ~~Repeat 9.11.5.1 to 9.11.5.11 ensuring that the minimum test load, D_{min}, and the maximum test load, D_{max}, applied are the same as previously used.~~
	9.10.5.14 Repeat test procedures Repeat 9.10.5.1 to 9.10.5.11 ensuring that the minimum test load, D_{min}, and the maximum test load, D_{max}, applied are the same as previously used.
A.4.5.14	~~*9.12.5.14*~~*9.10.5.15* *Determine the magnitude of humidity-induced variations* With the resulting data, the magnitude of humidity-induced variations can be determined ~~and~~ when compared with the following limits ~~specified in 6.8.3.1~~. a). The difference between the average of the readings of the minimum load output before the conduct of the humidity test and the average of the readings for the same load obtained after the conduct of the humidity test shall not be greater than 4 % of the difference between the output at the maximum capacity, E_{max}, and that at the minimum dead load E_{min}. b). The difference between the average of the three output values at the maximum load, D_{max}, for load cells of accuracy classes C and D, or five output values for load cells of accuracy classes A and B, (corrected for the minimum load output) obtained before the conduct of the humidity test according to 9.10.5, and the average of the three output values for load cells of accuracy classes C and D, or five output values for load cells of accuracy classes A and B obtained for the same maximum load, D_{max}, (corrected for the minimum load output) after the conduct of the humidity test, shall not be greater than the value of the load cell verification interval, v.

Comment [116]: Paragraph created by splitting the previous paragraph into two separate test procedures per Netherlands comment.

Comment [117]: This language relocated from 6.8.3.1 Part 1

A.4.6	~~9.12.6~~9.10.6 Determination of humidity effects for load cells marked SH. This test is applied to verify compliance with the provisions in 6.5.3.2.
A.4.6.1	*~~9.12.6.1~~9.10.6.1 Check test conditions* Refer to the test conditions in 9.7.3 and 9.7.4 to ensure that proper consideration has been given to those conditions prior to performing the following tests.
A.4.6.2	*~~9.12.6.2~~9.10.6.2 Insert load cell* Insert the load cell into the force-generating system, load to the minimum test load, D_{min}, and stabilize at 20 °C (± 2 °C).
A.4.6.3	*~~9.12.6.3~~9.10.6.3 Exercise load cell* Exercise the load cell by applying the maximum test load, D_{max}, three times, returning to the minimum test load, D_{min}, after each load application.
A.4.6.4	*~~9.12.6.4~~9.10.6.4 Check indicating instrument* Check the indicating instrument according to 9.7.4.11.
A.4.6.5	*~~9.12.6.5~~9.10.6.5 Monitor load cell* Monitor the minimum test load output until stable.
A.4.6.6	*~~9.12.6.6~~9.10.6.6 Record indication* Record the indicating instrument indication at the minimum test load, D_{min}.
A.4.6.7	*~~9.12.6.7~~9.10.6.7 Test load points* All test load points in a loading and unloading sequence shall be spaced at approximately equal time intervals. The readings shall be taken at time intervals as near as possible to those specified in Table 8 in 9.8.3. These two time intervals shall be recorded.

Comment [118]: Uncertainty for temperature inserted per comment.

A.4.6.8	~~*9.12.6.8*~~*9.10.6.8 Apply loads* Apply increasing loads up to the maximum test load, D_{max}. There shall be at least five increasing load points which shall include loads approximating to the highest values in the applicable steps of maximum permissible load cell errors, as listed in Table 4 in 6.2.2.
A.4.6.9	~~*9.12.6.9*~~*9.10.6.9 Record indications* Record the indicating instrument indications at time intervals as near as possible to those specified in Table 8 in 9.8.3. These two time intervals shall be recorded.
A.4.6.10	~~*9.12.6.10*~~*9.10.6.10 Decrease load* Decrease the test load to the minimum test load, D_{min}, using the same load points as described in 9.10.6.8.
A.4.6.11	~~*9.12.6.11*~~*9.10.6.11 Conduct damp heat, steady state test* Conduct a damp heat, steady state test in accordance with IEC 60068-2-78 Ed 1.0 (2001) Environmental testing Part 2: Tests. [13] Test Ca: Damp heat, steady state, IEC 60068-2-78 Ed 1.0 (2001) Environmental testing - Part 2: Tests. [13] Test Cb: Damp heat, steady state, primarily for equipment and IEC 60068-3-4 Ed 1.0 (2001) Environmental testing - Part 2: Tests. [12] Guidance for damp heat tests. *Test procedure in brief:* This test involves exposure of the load cell to a constant temperature and a constant relative humidity. The load cell shall be tested as specified in 9.10.6.1 to 9.10.6.10: a) at a reference temperature (20 °C or the mean value of the temperature range whenever 20 °C is outside this range) and a relative humidity of 50 % following conditioning; b) at the high temperature of the range specified in 6.5.1 for the load cell and a relative humidity of 85 %, two days following temperature and humidity stabilization; and c) at the reference temperature and relative humidity of 50 %. *State of load cell during conditioning:* Place the load cell in the chamber with the output connection external to the chamber, and

switched on. Use IEC 60068-2-78 (2008) [13] when lowering the temperature.

A.4.6.12 ~~9.12.6.12~~9.10.6.12 *Recording indications*

Record the indicating instrument indications at time intervals as near as possible to those specified in Table 8 in 9.8.3. These two time intervals shall be recorded.

A.4.6.13 ~~9.12.6.13~~9.10.6.13 *Determine the magnitude of humidity-induced variations*

With the resulting data, the magnitude of humidity-induced variations can be determined and compared with the limits specified in 6.8.3.2.

A.4.7 ~~9.12.7~~9.10.7 Additional test for load cells equipped with electronics (Disturbances). These tests are applied to verify compliance with the provisions in 6.6.2.1, and 6.6.2.2.

6.4.1 *9.10.7.1 Performance and stability tests*

A load cell equipped with electronics (including strain gauge type load cells) shall pass the performance and stability tests according to 9.10.7.2 to 9.10.7.10 for the tests given in Table 9.

Comment [119]: As test – clause and Table relocated from Part 1, 6.9

Comment [120]: This wording added to account for strain gauge not defined strictly as electronic.

Table 7

Table 9. Performance and Stability Tests for a Load Cell Equipped with Electronics

Test	Section 9.10 test procedure	P_{LC}	Characteristic under test
Warm-up time	9.10.7.3	1.0	Influence factor
Power voltage variations	9.10.7.4		Influence factor
Short-time power reductions	9.10.7.5		Disturbance
Bursts (electrical fast transients)	9.10.7.6		Disturbance
Electrostatic discharge	9.10.7.7		Disturbance
Electromagnetic susceptibility	9.10.7.8		Disturbance
Span stability	9.10.7.9		Influence factor

Generally, the tests are carried out on fully operational equipment in its normal state or in a status as similar as possible thereto. If the load cell is equipped with an interface that permits it to be coupled to external equipment, all functions that are performed or initiated via an interface shall operate correctly.

A.4.7.1

~~9.12.7.1~~9.10.7.2 *Evaluation of error for load cells with digital output interval*

Comment [121]: This terminology is not defined, is it the same as digital load cell? TC9 to define

For load cells possessing a digital output interval greater than 0.20v, the changeover points are to be used in the evaluation of errors, prior to rounding as follows. At a certain load, L, the digital output value, I, is noted. Additional loads, for example 0.1 v, are successively added until the output of the load cell is increased unambiguously by one digital output increment (I + v). The additional amount of load, Δ L, added to the load cell gives the digital output value prior to rounding, P, by using the following formula:

$$P = I + 1/2\ v - \Delta L$$

where:

I = the indication or digital output value;

v = the load cell verification interval; and

Δ L = additional load added to the load cell.

The error, E, prior to rounding is:

$$E = P - L = I + 1/2\ v - \Delta L - L$$

and the corrected error, E_c, prior to rounding is:

$Ec = E - Eo \leq MPE$ ~~$E_c = E_o - E \leq MPE$~~

Comment [122]: Erroneous formula corrected.

where E_o is the error calculated at the minimum test load, D_{min}.

A.4.7.2

~~9.12.7.2~~9.10.7.3 *Warm-up time* ~~*(see 6.12.3.2)*~~

Test procedure in brief:
Stabilize the load cell at 20 °C **(± 2 °C)** and disconnect from any electrical supply for a period of at least 8 hours prior to the test.

Comment [123]: Uncertainty for temperature inserted.

Insert the load cell into the force-generating system.
Exercise the load cell by applying a maximum test load, D_{max}, ~~three times~~then, returning to the minimum test load, D_{min}, ~~after each load application~~three times.
Allow the load cell to rest for 5 minutes. Connect the load cell to the power supply and switch on.

Comment [124]: Language amended to clarify procedure as per Austria's comment

Record data:
As soon as a measurement result can be obtained, record the minimum test load output and the maximum test load, D_{max}, applied.

Loading and unloading:
The maximum test load output shall be determined at time intervals as close as possible to those specified in Table 8 in 9.8.3 and recorded and the load should be returned to the minimum test load, D_{min}. These measurements shall be repeated after 5, 15 and 30 minutes.

Maximum allowable variations:
The absolute value of the difference between the indication at the maximum test load, D_{max}, and that at the minimum test load, D_{min}, taken immediately prior to the application of the maximum test load, D_{max}, in the case of any of the individual measurements shall not exceed the absolute value of the MPE for the maximum test load, D_{max}, applied. For load cells of class A, the provisions of the operating manual for the time following connection to electrical supply shall be observed.

A.4.7.3

~~9.12.7.3~~9.10.7.4 *Power voltage variations* ~~*(see 6.12.3.3 and 6.12.3.4)*~~

This test is applied to verify compliance with condition of both variations in a DC mains network and variation in AC mains power voltage (single phase).

Test procedure in brief:
This test consists of subjecting the load cell to variations of power voltage.
A load test is performed in accordance with 9.11.1.1 to 9.11.1.12 at 20°C (± 2 °C), with the load cell powered at reference voltage. The test is repeated with the load cell powered at the upper limit and at the lower limit of power voltage.

Before any test:
Stabilize the load cell under constant environmental conditions.

Test severity:

Mains power voltage variations:
a) upper voltage limit (V + 10 %);
b) lower voltage limit (V – 15 %).

Battery power voltage variations:
a) upper voltage limit (not applicable);
b) lower voltage limit (specified by the manufacturer, below V).

The voltage, V, is the value specified by the manufacturer. If a range of reference mains power voltage (V_{min}, V_{max}) is specified, then the test shall be performed at an upper voltage limit of V_{max} and a lower voltage limit of V_{min}.

Comment [JB125]: Technical Committee input needed to determine if there is any justification to include testing of load cells powered directly by DC mains network.

Comment [126]: Australia: Does the variation of voltage apply to load cell itself or the indicator used to test? New language from template is confusing.

Comment [127]: Uncertainty added for temperature.

Maximum allowable variations:
All functions shall operate as designed.
All measurement results shall be within maximum permissible errors.
Note: Where a load cell is powered by a three-phase supply, the voltage variations shall apply to each phase successively and all phases simultaneously.

Reference to IEC Publication:
IEC Publication 61000-4-11 (2004-03) Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques – Section 11: Voltage dips, short interruptions and voltage variations immunity tests. Section 5.2 (Test levels – voltage variation), Section 8.2.2 (Execution of the test – voltage variation). [14]

A.4.7.4

~~*9.12.7.4*~~*9.10.7.5 Short-time power reductions (see 6.6.2.1)*

Test procedure in brief:
This test consists of exposing the load cell to specified short-time power reductions.

A test generator capable of reducing 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 to the load cell. The mains voltage reductions shall be repeated ten times at intervals of at least 10 seconds.

Test load:
During the test, the effect of any automatic zero-setting or zero-tracking features shall be switched off or suppressed, for example by applying a small test load. The test load need not be greater than necessary to accomplish this suppression.

Before any test:
Stabilize the load cell under constant environmental conditions.
Test severity:

Reduction:	100 %	50 %
Number of half cycles:	1	2

Maximum allowable variations:
The difference between the measurement result due to the disturbance and the measurement result without the disturbance shall not exceed one minimum load cell verification interval, v_{min}, or the load cell shall detect and react to a significant fault.

Reference to IEC Publication:
IEC Publication 61000-4-11 (2004-03) Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques – Section 11: Voltage dips, short interruptions and voltage variations immunity tests. Section 5.1 (Test levels – voltage dips and short interruptions), Section 8.2.1 (Execution of the test – voltage dips and short interruptions). [14]

A.4.7.5	~~9.12.7.5~~9.10.7.6 *Bursts (electrical fast transients) (see 6.6.2.1)* *Test procedure in brief:* This test consists of exposing the load cell to specified bursts of voltage spikes. *Test instrumentation:* In accordance with IEC 61000-4-4 (2004-07), No. 6. *Test set-up:* In accordance with IEC 61000-4-4 (2004-07), No. 7. *Test procedure:* In accordance with IEC 61000-4-4 (2004-07), No. 8. *Before any test:* Stabilize the load cell under constant environmental conditions. The test shall be applied separately to: a) power supply lines; b) I/O circuits and communication lines, if any. *Test load:* During the test, the effect of any automatic zero-setting or zero-tracking features shall be switched off or suppressed, for example by applying a small test load. The test load need not be greater than necessary to accomplish this suppression. *Test severity:* Level 2 (in accordance with IEC 61000-4-4 (2004-07), No. 5) [5]. Open circuit output test voltage for: • power supply lines: 1 kV; • I/O signal, data, and control lines: 0.5 kV. *Maximum Allowable Variations:* The difference between the measurement result due to the disturbance and the measurement result without the disturbance shall not exceed one minimum load cell verification interval, v_{min}, or the load cell shall detect and react to a significant fault. *Reference to IEC Publication:* IEC Publication 61000-4-4 (2004-07) Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test. Basic EMC publication. [15]
A.4.7.6	~~9.12.7.6~~9.10.7.7 *Electrostatic discharge (see 6.6.2.1)* *Test procedure in brief:*

Comment [JB128]: Comment from Gep Englar: Prescribing these tests is only relevant for load cells directly powered from the Mains network; do they exist indeed?
Need input from TC9.

	This test consists of exposing the load cell to specified direct and indirect electrostatic discharges. *Test generator:* In accordance with IEC 61000-4-2 (2008-12) Ed 2.0 Consolidated edition, No. 6. *Test set-up:* In accordance with IEC 61000-4-2 (2008-12) Ed 2.0 Consolidated edition, No. 7. *Test procedure:* In accordance with IEC 61000-4-2 (2008-12) Ed 2.0 Consolidated edition, No. 8. *Discharge methods:* 1. This test includes the paint penetration method, if appropriate; 2. For direct discharges, the air discharge shall be used where the contact discharge method cannot be applied. *Before any test:* Stabilize the load cell under constant environmental conditions. *Discharge type:* At least 10 direct discharges and 10 indirect discharges shall be applied. *Time interval:* The time interval between successive discharges shall be at least 10 seconds. *Test load:* During the test, the effect of any automatic zero-setting or zero-tracking features shall be switched off or suppressed, for example by applying a small test load. The test load need not be greater than necessary to accomplish this suppression. *Test severity:* Level 3 (in accordance with IEC 61000-4-2 (2008-12) Ed 2.0 Consolidated edition, No. 5). DC voltage up to and including 6 kV for contact discharges and 8 kV for air discharges. *Maximum allowable variations:* The difference between the measurement result due to the disturbance and the measurement result without the disturbance shall not exceed one minimum load cell verification interval, v_{min}, or the load cell shall detect and react to a significant fault. *Reference to IEC Publication:* IEC Publication 61000-4-2 (2008-12) Ed 2.0 Consolidated edition, Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test. [16]
A.4.7.7	~~9.12.7.7~~9.10.7.8 *Electromagnetic susceptibility (see 6.6.2.1)*

Test procedure in brief:
This test consists of exposing the load cell to specified electromagnetic fields.

Test generator:
In accordance with IEC 61000-4-3 (2006-02) Ed 3.0 Consolidated edition, No. 6.

Test set-up:
In accordance with IEC 61000-4-3 (2006-02) Ed 3.0 Consolidated edition, No. 7.

In accordance with IEC 61000-4-3 (2006-02) Ed 3.0 Consolidated edition, No. 8.

Before any test:
Stabilize the load cell under constant environmental conditions.

Electromagnetic field strength:
The load cell shall be exposed to electromagnetic fields of the strength and character as specified by the severity level.

Test load:
During the test, the effect of any automatic zero-setting or zero-tracking features shall be switched off or suppressed, for example by applying a small test load. The test load need not be greater than necessary to accomplish this suppression.

Test severity:
Level 2 (in accordance with IEC 61000-4-3 (2006-02) Ed 3.0 Consolidated edition, No. 6)

Frequency range: 26 MHz to 1 000 MHz;
Field strength: ~~3~~ 10 V/m;
Modulation: 80 % AM, 1 kHz sine wave.

Comment [129]: Per Netherlands comment – field strength changed from 3 V/m to 10 V/m to harmonize with R76.

Conducted immunity test

Comment [JB130]: TC9 input needed on whether conducted immunity test be added. (at 10 Vemf)
Draft language proposal for conducted immunity test needed from Technical Committee members.

Maximum allowable variations:
The difference between the measurement result due to the disturbance and the measurement result without the disturbance shall not exceed one minimum load cell verification interval, v_{min}, or the load cell shall detect and react to a significant fault.

Reference to IEC Publication:
IEC Publication 61000-4-3 (2006-02) Ed 3.0 Consolidated edition, Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test. [17]

A.4.7.8	~~*9.12.7.8*~~*9.10.7.9 Span stability (see 6.6.2.2) (not applicable to class A load cells)*

Test procedure in brief:

The installation of the load cell in the force-generating system shall be carried out correctly according to the technical specification of the manufacturer. Positions of frictions should be avoided. After installation the whole system should rest a minimal time period, which depends on the temperature's difference, before testing to attain temperature stability.

Comment [131]: New language added. Need review by TC9

This test consists of observing the variations of the load cell under sufficiently constant ambient conditions (i.e. ± 2 °C) before, at various intervals during, and after the load cell is subjected to ~~any of the applicable~~performance tests (i.e., temperature and damp heat test as a minimum) contained in this section.

Comment [132]: Amended per France's comment

The load cell shall be disconnected from the mains power supply, or battery supply where fitted, two times for at least 8 hours during the period of test. The number of disconnections may be increased if the manufacturer specifies so or at the discretion of the approval authority in the absence of any such consideration.

For the conduct of this test, the manufacturer's operating instructions shall be considered.
The load cell shall be stabilized at sufficiently constant ambient conditions after switch-on for at least 5 hours, but at least 16 hours after any temperature or humidity tests have been performed.

Test duration:
The time necessary to carry out all the required tests in this Section but not to exceed 28 days, for temperature and humidity tests~~whichever is shorter~~.

Comment [133]: Amended per Austria's comment

Time between measurements:
Between 1/2 day (12 hours) and 10 days (240 hours), with an even distribution of the measurements over the total duration of the test.

Test loads:
A minimum test load, D_{min}; the same test load shall be used throughout the test.
A maximum test load, D_{max}; the same test load shall be used throughout the test.

Number of measurements: At least 8.

Test sequence:
Identical test equipment and test loads shall be used throughout the test.
Stabilize all factors at sufficiently constant ambient conditions.
Each set of measurements shall consist of the following:

a) exercise the load cell by applying the maximum test load, D_{max}, three times, returning to the minimum test load, D_{min}, after each load application;
b) stabilize the load cell at the minimum test load, D_{min};
c) read the minimum test load output and apply the maximum test load, D_{max}. Read the

maximum test load output at time intervals as near as possible to those specified in Table 8 in 9.8.3, and return to the minimum test load, D_{min}. Repeat this four more times for accuracy class B or two more times for accuracy classes C and D;

d) determine the span measurement result, which is the difference in output between the mean maximum test load outputs and the mean minimum test load outputs. Compare subsequent results with the initial span measurement result and determine the error.

Record the following data:

a) date and time (absolute, not relative);
b) temperature;
c) barometric pressure;
d) relative humidity;
e) test load values;
f) load cell outputs;
g) errors.

Apply all necessary corrections resulting from variations in temperature, pressure, etc. between the various measurements.

Allow at least 3 hours for full recovery of the load cell before any other tests are performed.

Comment [134]: Amended per Austria's comment.

Maximum allowable variations:
The variation in the load cell span measurement results shall not exceed half the load cell verification interval or half the absolute value of the MPE for the test load applied, whichever is the greater on any of the measurements.

Where differences of results indicate a trend of more than half the allowable variation specified above, the test shall be continued until the trend comes to rest or reverses itself, or until the error exceeds the maximum allowable variation.

9.10.7.10 Surge

Comment [JB135]: Test added per Netherlands comment to harmonize with R76. TC9 to determine if language and test conditions are appropriate.

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 outdoor 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 power lines, communication lines (internet, dial up modem, etc.), and other lines for control, data or signal mentioned above (lines to temperature sensors, gas or liquid flow sensors, etc.).

It is also applicable to DC powered instruments if the power supply comes from DC mains.

	The test consists of exposing the load cell to surges for which the rise time, pulse width, peak values of the output voltage/current on high/low impedance load and minimum time interval between two successive pulses are defined in the referenced standard. The characteristics of the generator shall be adjusted before connecting the load cell. Before any test, stabilize the load cell under constant environmental conditions. The test shall be applied to power supply lines. On AC mains supply lines at least 3 positive and 3 negative surges shall be applied synchronously with AC supply voltage in angles 0°, 90°, 180° and 270°. On any other kind of power supply, at least three positive and three negative surges shall be applied. The test shall be performed with one small test load. Both positive and negative polarity of the surges 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 surge energy being dissipated in the mains. Test severity: Level 2 Amplitude (peak value) Power supply lines: 0.5 kV (line to line) and 1 kV (line to earth) Maximum allowable variations: The difference between the weight indication due to the disturbance and the indication without the disturbance shall either not exceed one minimum load cell verification interval, v_{min} or the load cell shall detect and react to a significant fault.
A.5.1	~~9.13~~9.11 **Test sequence** The recommended test sequence for each test temperature when all tests are carried out in the same force-generating system is shown in Figure 3.

Figure A.1

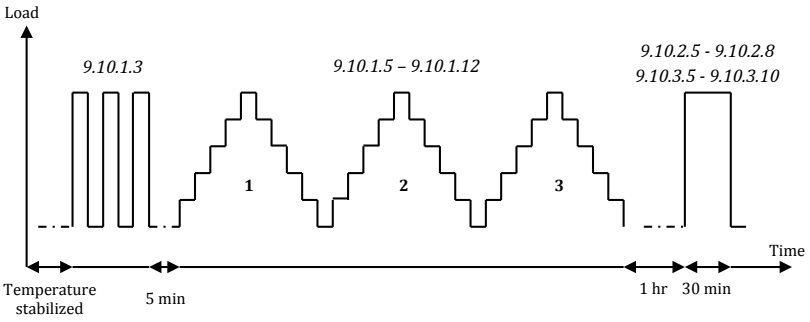


Figure 3 Recommended test sequence for each test temperature when all tests are carried out in the same machine

A.5.2

~~9.13.1~~9.11.1 Test sequence for minimum dead load output return

The recommended test sequence for each test temperature for the minimum dead load output return (DR) and creep tests when carried out in a force-generating system different to that used for the load tests is shown in Figure 4.

A.5.2 Figure A.2

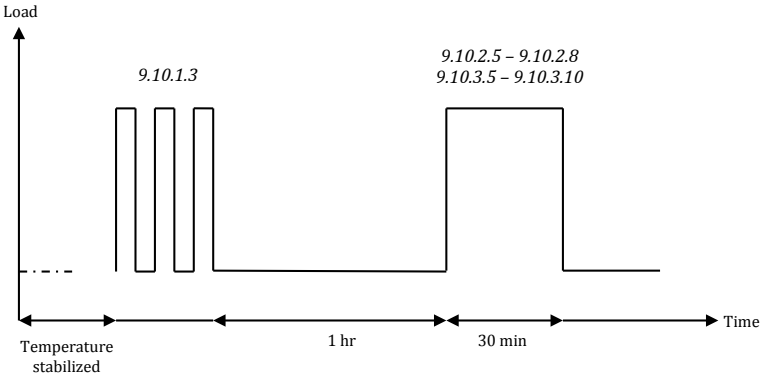


Figure 4 Recommended test sequence for each test temperature for the minimum dead load output return (DR) and creep tests when carried out in a machine different from that used for the load tests

4.8

~~9.14~~9.12 OIML certificate

4.8.1

~~9.14.1~~9.12.1 Preparation of certificate

The OIML certificate shall be prepared according to the rules contained within the OIML Publication OIML Certificate System for Measuring Instruments. The format of the certificate shall be as specified in Annex C, OIML Certificate of conformity for load cells.

4.8.2	~~9.14.2~~9.12.2 Reference of values on certificate Regardless of the evaluation result of any load cell in a load cell family, the certificate to be issued should not provide for any characteristics or values which are beyond those that the manufacturer has requested and for which the manufacturer intends to guarantee, for example, by expressing the relevant characteristics and values in its data sheet.

Annex A (Informative) Selection of load cell(s) for testing - a practical example

A.1. This Annex describes a practical example showing the complete procedure for the selection of test samples out of a load cell family.

A.2. Assume a family consisting of three groups of load cells, differing in class, maximum number of load cell verification intervals, nmax, and maximum capacities, Emax. The capacities, Emax, overlap between the groups according to the following example:

Group 1: Class C, n_{max} = 6 000, Y = 18 000, Z = 6 000

E_{max}: 50 kg, 100 kg, 300 kg and 500 kg

Group 2: Class C, n_{max} = 3 000, Y = 12 000, Z = 4 000

E_{max}: 100 kg, 300 kg, 500 kg, 5 000 kg, 10 t, 30 t and 50 t

Group 3: Class B, n_{max} = 10 000,Y = 25 000, Z = 10 000

E_{max}: 500 kg, 1 000 kg and 4 000 kg

A.2.1. Summarize and sort the load cells with respect to Emax and accuracy as follows:

Class nmax Group	Y Z	<--- lowest vmin, kg			Emax, kg			---> highest			
C3 3 000 2	12 000 4 000		100 0.0083	300 0.025	500 0.042			5 000 0.42	10 000 0.83	30 000 2.5	50 000 4.17
C6 6 000 1	18 000 6 000	50 0.0028	100 0.0055	300 0.0167	500 0.028						
B10 10 000 3	25 000 10 000				500 0.020	1 000 0.040	4 000 0.16				

A.2.2. Identify the smallest capacity load cells in each group to be tested, according to 9.4.3:

Class nmax Group	Y Z	<--- lowest vmin, kg			Emax, kg			---> highest			
C3 3 000 2	12 000 4 000		100 0.0083	300 0.025	500 0.042			5 000 0.42	10 000 0.83	30 000 2.5	50 000 4.17
C6 6 000 1	18 000 6 000	50 0.0028	100 0.0055	300 0.0167	500 0.028						
B10 10 000 3	25 000 10 000				500 0.020	1 000 0.040	4 000 0.16				

In this example, select and identify:

C6 - 50 kg (full evaluation test required)

B10 - 500 kg (full evaluation test required)

Although load cell C3 - 100 kg is the smallest capacity in its group, its capacity falls within the range of other selected load cells having better metrological characteristics. Therefore, it is not selected.

A.2.3. Begin with the group with the best metrological characteristics (in this example, B10) and in accordance with 9.4.4, select the next largest capacity between 5 and 10 times that of the nearest smaller capacity load cell which has been selected. When no capacity meets this criterion, the selected load cell shall be that having the smallest capacity exceeding 10 times that of the nearest smaller capacity load cell which has been selected. Continue this process until all load cell capacities in the group have been considered.

Class nmax Group	Y Z	<--- lowest			Emax, kg vmin, kg			---> highest			
C3 3 000 2	12 000 4 000		100 0.0083	300 0.025	500 0.042			5 000 0.42	10 000 0.83	30 000 2.5	50 000 4.17
C6 6 000 1	18 000 6 000	50 0.0028	100 0.0055	300 0.0167	500 0.028						
B10 10 000 3	25 000 10 000				500 0.020	1 000 0.040	4 000 0.16				

In this example, select and identify:

B10 - 4 000 kg (full evaluation test required)

A.2.4. Move to the group with the next best characteristics (in this example, C6) and, in accordance with 9.4.4, select the next largest capacity between 5 and 10 times that of the nearest smaller capacity load cell which has been selected. When no capacity meets this criterion, the selected load cell shall be that having the smallest capacity exceeding 10 times that of the nearest smaller capacity load cell which has been selected. Continue this process until all load cell capacities in the group have been considered.

Class nmax Group	Y Z	<--- lowest			Emax, kg vmin, kg					---> highest	
C3 3 000 2	12 000 4 000		100 0.0083	300 0.025	500 0.042			5 000 0.42	10 000 0.83	30 000 2.5	50 000 4.17
C6 6 000 1	18 000 6 000	50 0.0028	100 0.0055	300 0.0167	500 0.028						
B10 10 000 3	25 000 10 000				500 0.020	1 000 0.040	4 000 0.16				

In this example, **there is no change** to the load cells selected. The capacities of the load cells C6 - 300 kg and C6 - 500 kg exceed the capacity of the load cell C6 - 50 kg by greater than 5 times but not greater than 10 times. However, a 500 kg load cell of better metrological characteristics (from group B10) has already been selected. Therefore, in order to minimize the number of load cells to be tested according to 9.3.1, neither cell is selected.

A.2.5. Again, and repeating this process until all groups have been considered, move to the group with the next best characteristics (in this example, C3) and in accordance with 9.4.4, select the next largest capacity between 5 and 10 times that of the nearest smaller capacity load cell which has been selected. When no capacity meets this criterion, the selected load cell shall be that having the smallest capacity exceeding 10 times that of the nearest smaller capacity load cell which has been selected. Continue this process until all load cell capacities in the group and all groups have been considered.

Class nmax Group	Y Z	<--- lowest vmin, kg		Emax, kg			---> highest			
C3 3 000 2	12 000 4 000		100 0.0083	300 0.025	500 0.042			5 000 0.42	10 000 0.83	30 000 2.5	50 000 4.17
C6 6 000 1	18 000 6 000	50 0.0028	100 0.0055	300 0.0167	500 0.028						
B10 10 000 3	25 000 10 000				500 0.020	1 000 0.040	4 000 0.16				

In this example, select and identify:

C3 - 30 000 kg (full evaluation test required) Proceeding from smallest to largest capacity, the only capacity of load cell which is greater than 5 times the capacity of an already selected load cell but less than 10 times that capacity is the C3 - 30 000 kg load cell. Since the capacity of the C3 - 50 000 kg load cell does not exceed 5 times the capacity of the next smaller selected load cell, which is C3 - 30 000 kg, according to 9.4.2 it is deemed to be approved.

A.2.6. After completing steps A.2.2 to A.2.5 and identifying the load cells, compare load cells of the same capacity from different groups. Identify the load cells with the highest accuracy class and highest nmax in each group (see shaded portion of table below). For those load cells of the same capacity but from different groups, identify only the one with the highest accuracy class and nmax and lowest vmin.

Class nmax Group	Y Z	<--- lowest vmin, kg			Emax, kg			---> highest			
C3 3 000 2	12 000 4 000		100 0.0083	300 0.025	500 0.042			5 000 0.42	10 000 0.83	30 000 2.5	50 000 4.17
C6 6 000 1	18 000 6 000	50 0.0028	100 0.0055	300 0.0167	500 0.028						
B10 10 000 3	25 000 10 000				500 0.020	1 000 0.040	4 000 0.16				

Inspect the values of v_{min}, Y, and Z for all cells of the same capacity.

If any load cell of the same capacity has a lower vmin or higher Y than the identified load cell, that load cell (or load cells) is also liable for partial evaluation testing, specifically the conduct of additional temperature effect on minimum dead load, E_{min} and barometric pressure effect tests.

If any load cell of the same capacity has a higher Y than the selected load cell, that load cell (or load cells) is also liable for partial evaluation testing, specifically the conduct of additional creep and DR tests.

In this example, **the load cells identified above also have the best characteristics of lowest v_{min}, highest Y and highest Z.** This is normally the case, but not always.

~~A.2.2.~~A.2.7. If applicable, select the load cell for humidity testing in accordance with 9.4.5, that being the load cell with the most severe characteristics, for example the greatest value of nmax or the lowest value of vmin.

In this example, the load cell with the greatest value of nmax or the lowest value of vmin is the same load cell, therefore select:

B10 - 500 kg (humidity test required)

Note: The other B10 load cells also possess the same qualifications and are possible choices. The 500 kg load cell was chosen because it is the smallest of the applicable B10 capacities. Although the C6 - 50 kg load cell has the lowest v_{min} of 0.0028, the B10 load cells have the highest n_{max}, highest accuracy

class, and the highest Y and Z.

~~A.2.3.~~A.2.8. If applicable, select the load cell for the additional tests to be performed on load cells equipped with electronics in accordance with 9.4.6, that being the load cell with the most severe characteristics, for example the greatest value of nmax or the lowest value of vmin.

~~A.2.4.~~A.2.9. Summarizing, the load cells selected for test are:

In this example, no load cell in the family is equipped with electronics.

Summary	*Selected cells*
Load cells requiring full evaluation test	C6 - 50 kg B10 - 500 kg B10 - 4 000 kg C3 - 30 000 kg
Load cells requiring partial evaluation test	None
Load cell to be tested for humidity	B10 - 500 kg
Load cells equipped with electronics for additional tests	None

~~Annex A~~Annex B (Informative) Load transmission to the load cell

This Annex is taken from the WELMEC (European cooperation in legal metrology) Guide for Load Cells (Issue 2, published in August, 2001). With permission from WELMEC, the following portion of that document is reprinted here to provide guidelines for load cell evaluators, during load cell performance evaluations. Recognizing the critical role that load cell receptors and load transmission devices play in accurate measurements, this Annex is intended to provide information regarding the effect of load transmission and recommendations for test design and procedure. The annex is informational and not to be considered required practice.

For some types of load cells the kind of load transmission to the load cell has influence on the measurements and with this on the test results.

In this annex the standard load transmission devices are listed.

The manufacturer should define whether the load cell works with all standard load transmission devices for the type of load cell or with selected standard load transmission devices or with a load cell specific load transmission devices.

This information will be considered for the load cell tests and marked in the certificate.

Standard load transmission devices

Tables 1 and 2 identify different types of LCs, (compression, tension, ...) and typical load cell mounting devices suitable for them. The symbols below classify the mobility between one point of contact on the load cell and its counterpart on the load receptor or mounting base.

Symbol	Description
	Movement possible normal to load axis Note: allows for temperature dilatation
	Movement possible normal to load axis, with reversing force (spring-back effect) Note: allows for temperature dilatation, also used for damping of lateral shock
	Inclination possible Note: allows for tilt of load cell or deflection of load receptor, no movement normal to load axis possible
	Indicates auto-centering effect of the complete mounting assembly of one load cell

Remarks on the standard load transmission devices presented in Tables 1 and 2:

All combinations of load cell and transmitting device shown in Tables 1 and 2 can also be utilised in a completely reversed manner.

The load transmission device is independent of the encapsulation, potting or housing which are shown in the examples.

(a) Compression LCs (Table 1, upper part)
- The load transmissions 1 to 8 are presented for canister type LCs. Instead, all load transmissions may be constructed for S-type or ring type load cells.
- 6a shows a pendulum construction build as a complete unit.
- 6b and 6c show external pendulum rocker pins combined with ring-type LCs.
- The bearings for all compression load cells may be installed either below or above the LC.

(b) Tension LCs (Table 1, lower part)
- The load transmissions 1 and 2 are presented for canister type LCs. Alternatively, both load transmissions may be used for S-type LCs.

(c) Beam LCs (table 2, upper part)
- The drawings present double bending and shear beams, as well as plastic potted and encapsulated constructions; all these constructions may be combined with ether of the load transmissions 1 to 10.
- The direction of loading, which is given by the manufacturer, has to be observed.

(d) Single point LCs (Table 2, middle part)
- The load transmissions 1 to 10 for the beam LCs may be applied to all single point LCs.
- The direction of loading, which is given by the manufacturer, has to be observed.

(e) Double bending beam LCs (Table 2, lower part)
- The table shows examples of common constructions. Variations are possible provided the constructions allow enough horizontal flexibility between both ends.
- The direction of loading, provided by the manufacturer, has to be observed.

The single bending beams had been exempted for general acceptance, because very small displacements of the “force transducing point” may lead to a change of span and linearity.

Table 1: Schematic drawings for compression and tension LCs

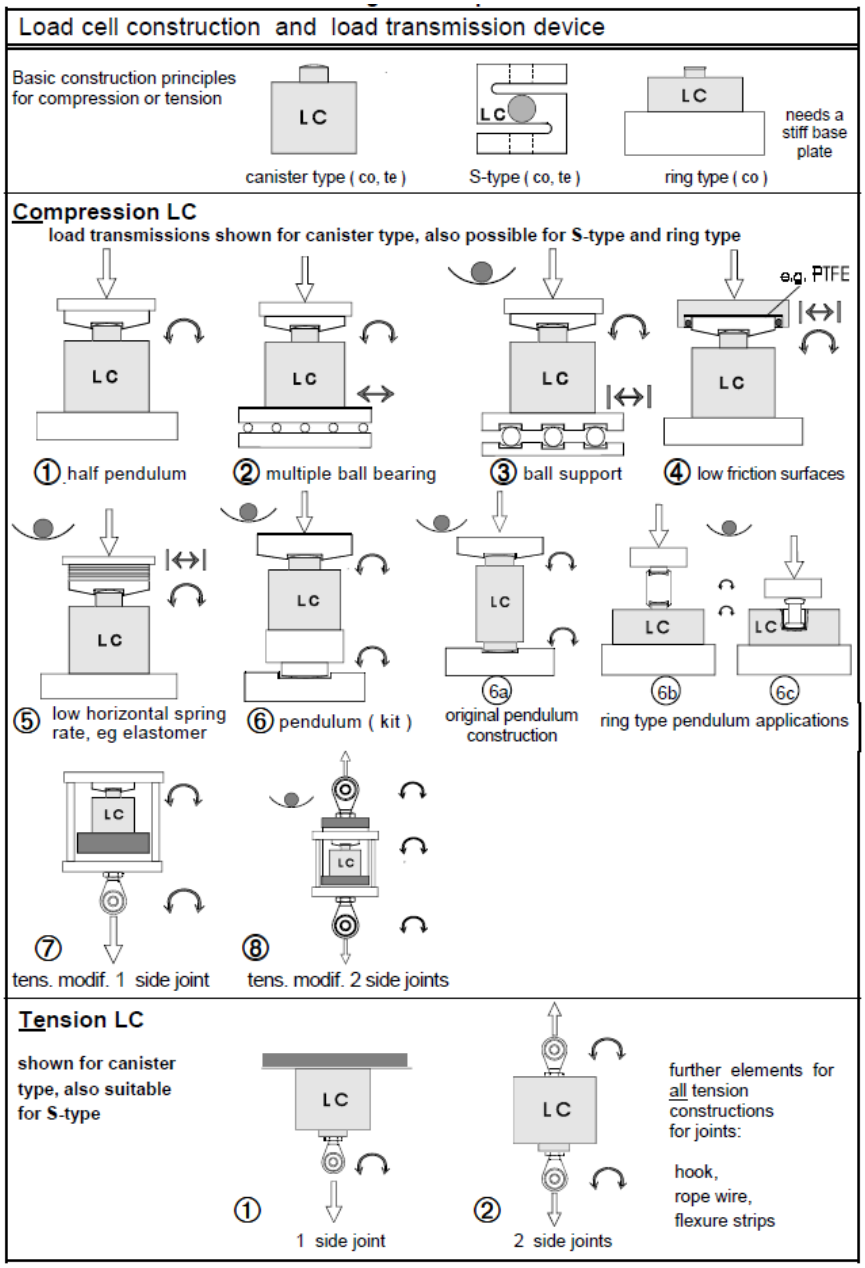
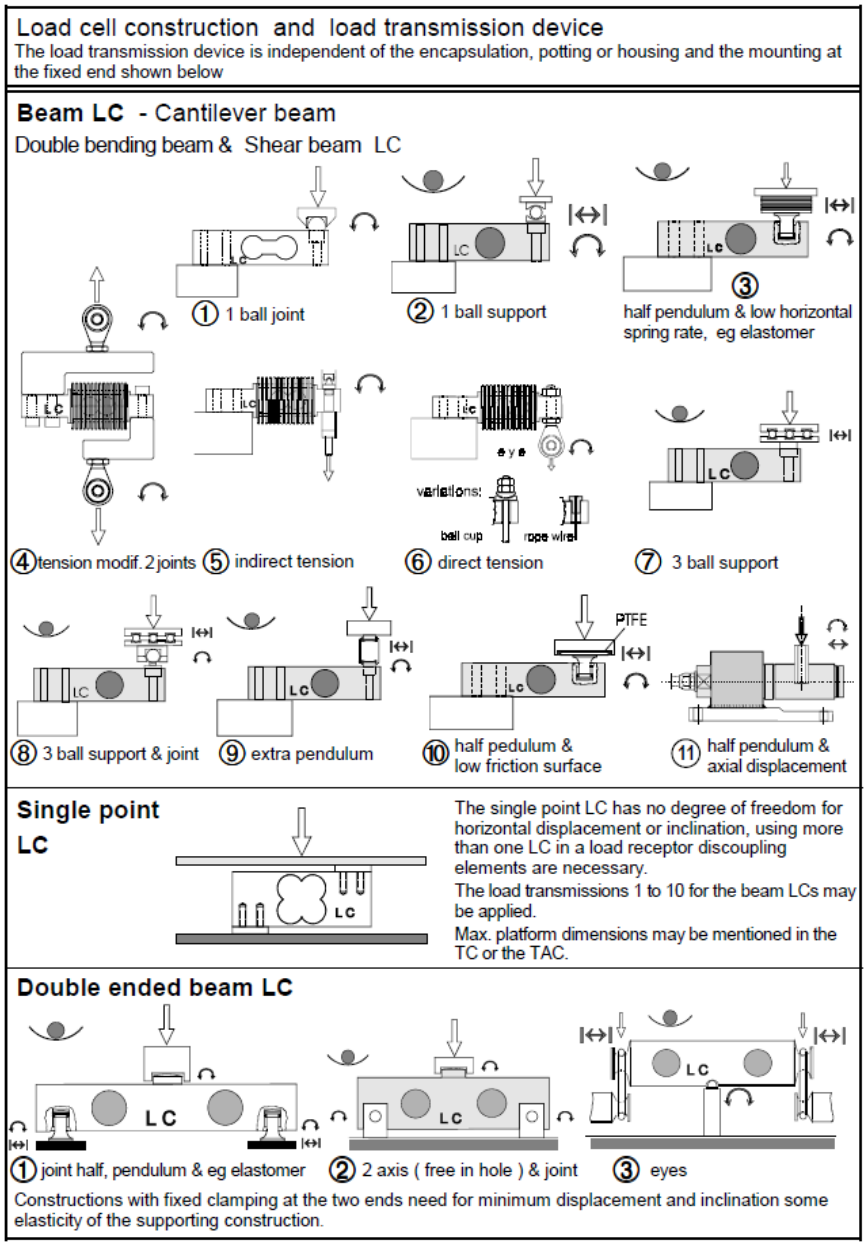


Table 2: Schematic drawings for beam LCs



~~Annex B~~Annex C (Mandatory) OIML Certificate of conformity for load cells - Format of certificate

Comment [136]: This Annex contains the existing formatting for OIML Certificates. The TC9 work group established at the September 2011 meeting in Braunschweig has offered an alternative format which is provided in the following Annex D. TC 9 will determine whether to replace the existing format, or whether to merge the two into a single format that contains elements of both.

Member State **OIML CERTIFICATE OF CONFORMITY** OIML certificate no.

Issuing Authority

Name:
.....
Address:
.....
Person responsible:
.....

Applicant

Name:
.....
Address:
.....
Manufacturer of the certified pattern (if the manufacturer is not the applicant) .....
Identification of the certified pattern: Load cell (construction principle, for example, strain gauge, compression, etc.)

.....

Model designation				
Maximum capacity, E_{max}				
Accuracy class				
Maximum number of load cell verification intervals, n_{max}				
Minimum verification interval, v_{min}				
Apportionment factor, p_{LC}				

(Additional characteristics and identification, as applicable according to R 60, 2.2.3 and 4.6, continued overleaf or on addendum if necessary)

This certificate attests the conformity of the above-mentioned pattern (represented by the samples identified in the associated test report(s) with the requirements of the following Recommendation of the International Organization of Legal Metrology - OIML):

R 60 *Metrological regulation for load cells* Edition ..... for accuracy class .....

This certificate relates only to the metrological and technical characteristics of the pattern of instrument concerned, as covered by the relevant OIML International Recommendation.
This certificate does not bestow any form of legal international approval.
The conformity was established by tests described in the associated test report no. ……, which includes ……. pages.

Identification(s) and signature(s) or stamp(s), of (as applicable):

Issuing Authority: CIML Member:

Date: ..... Date: .....

Page 1. This certificate includes ..... pages.

OIML certificate no.

* * *

Additional characteristics[1] and identification, as applicable to R 60, 2.2.3 and 4.6 *(continued)*

Model designation				
(Additional characteristics, per 2.2.3 and 4.6)				

Special conditions:

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Important note: Apart from the mention of the certificate's reference number and the name of the OIML Member State in which the certificate was issued, partial quotation of the certificate or the associated test report is not permitted, though they may be reproduced in full.

[1] The table with the essential technical data may, upon request by the manufacturer, be placed on the certificate or on an addendum.

Page 2. This certificate includes ..... pages.

C.1 Contents of addendum to test certificate (Informative)

Addendum to test certificate no. .....

(Name and type of the load cell) .....

C.2 Technical data

The essential technical data for the test certificates are listed on the certificate (at the request of the manufacturer) alternatively, in the case of limited space on the certificate the following information may be provided:

Table E.1 Technical data *Model designation*	*Designation*	*Example*				*Units*
Classification		C4				
Additional markings		–				
Maximum number of load cell verification intervals		4 000				
Maximum capacity	E_{max}	30 000				kg
Minimum dead load, relative	E_{min} / E_{max}	0				%
Relative v_{min} (ratio to minimum load cell verification interval)	$Y = E_{max} / v_{min}$	24 000				
Relative DR (ratio to minimum dead load output return)	$Z = E_{max} / (2 \times DR)$	7 500				
Rated output*		2.5				mV/V*
Maximum excitation voltage		30				V
Input impedance (for strain gauge load cells)	R_{LC}	4 000				Ω
Temperature rating		– 10/+ 40				°C
Safe overload, relative	E_{lim} / E_{max}	150				%
Cable length		3				m

Additional characteristics per 2.2.3 and 4.6**		–				

*

Note: For load cells with digital output this refers to the number of counts for E_{max}

**

Note: For load cells with digital output this is not required

Page 1. The Annex to the certificate includes ..... pages.

C.3 Tests

The tests listed in Table E.2 have been carried out in accordance with OIML R 60:

-at the laboratory ..... *(insert laboratory name)*

-as documented in the test report no. ..... *(insert test report number)*

Table E.2 Tests performed with load cell:

Serial no.: .....

Class:

.....

E: .....

E_{max}

n: .....

n_{max}

Y: .....

Z: .....

Test	*R 60 Ref.*	*Approved*	*Institute*
Temperature test and repeatability at 20 °C, 40 °C, – 10 °C, 20 °C	5.1.1, 5.4; A.4.1		
Temperature effect on minimum dead load output at 20 °C, 40 °C, – 10 °C, 20 °C	5.5.1.3; A.4.1		
Creep at 20 °C, 40 °C, – 10 °C	5.3.1; A.4.2		
Minimum dead load output return at 20 °C, 40 °C, – 10 °C	5.3.2; A.4.3		
Barometric pressure effects at room	5.5.2; A.4.4		

temperature			
Damp heat, cyclic: marked CH (or not marked)	5.5.3.1; A.4.5		
Damp heat, steady state: marked SH	5.5.3.2; A.4.6		
Additional tests for load cells equipped with electronics	6; A.4.7		
Warm-up time	6.3.2; A.4.7.2		
Power voltage variations	6.3.3, 6.3.4; A.4.7.3		
Short time power reductions	6.3.5; A.4.7.4		
Bursts (electrical fast transients)	6.3.5; A.4.7.5		
Electrostatic discharge	6.3.5; A.4.7.6		
Electromagnetic susceptibility	6.3.5; A.4.7.7		
Span stability	6.3.6; A.4.7.8		

~~Annex C~~Annex D (Mandatory) OIML Certificate of conformity for load cells (Alternate proposal)

Comment [137]: This Annex Proposed by TC9 work group. Must be reviewed by TC9. Selection of Annex C or Annex C1 shall be noted on comments from each Technical Committee member state.

Certificate history

Certificate release	Date	Essential changes
xxx	xxx	primary certificate

1. Technical Data

The metrological characteristics of the load cells type xxx are listed in Table 1. Further technical data are listed in the data sheet of the manufacturer at page 5 to 6 of this annex.

Table 1: Essential data

Accuracy class			C3
Maximum number of load cell intervals	n_{LC}		3000
Rated output		mV/V	2
Maximum capacity	E_{max}	kg	150 / 200 / 250 / 300 / 500 / 750
Minimum load cell verification interval	$v_{min} = (E_{max} / Y)$		E_{max} / 15000
Minimum dead load output return	DR = (½ E_{max} / Z)		½ E_{max} / 5000

Dead load: xxx%·E_{max}; Safe overload: xxx%·E_{max}; Input impedance: xxx Ω

2. Tests

The determination of the load cell error, the stability of the dead load output, repeatability and creep in the temperature range of –10°C to +40°C as well as the tests of barometric pressure effects and the determination of the effects of static damp heat have been performed according to OIML R60 (2000) as shown in Table 2 on the load cell nominated in the test report with the reference No. xxx, dated xxx.

Table 2: Tests performed

Test	R60 (2000)	tested samples	result
Temperature test and repeatability at (20 / 40 / -10 / 20°C)	5.1.1; A.4.1 5.4	150 kg	+
Temp. effect on minimum dead load output at (20 / 40 / -10 / 20°C)	5.5.1.3 A.4.1.1 6	150 kg	+

Creep test at (20 / 40 / -10 / 20°C)	5.3.1	A.4.2	150 kg	+
Minimum dead load output return at (20 / 40 / -10 / 20°C)	5.3.2	A.4.3	150 kg	+
Barometric pressure effects at ambient temperature	5.5.2	A.4.4	150 kg	+
Damp heat test , static, marked SH	5.5.3.2	A.4.6	150 kg	+

3. Description of the load cell

The load cells (LC) of the series xxx are double bending beam load cells. They are made of aluminium, the strain gauge application is hermetically sealed. Further essential characteristics are given in the data sheet, see chapter 6 of this annex.

Picture of load cell

Figure 1: Load cell type xxx

The complete type designation is indicated as follows in the example on the name plate:

Picture of name plate

4. Documentation

- Test Report No. PTB xxx; C3; Y=xxx; Z=xxx; E_{max}=xxx kg; SN: xxx

- Datasheet No. Xxx
- Technical Drawing No. Xxx

5. Further information

The manufacturing process, material and sealing of the produced load cells have to be in accordance with the tested patterns; essential changes are only allowed with the permission of the notified body.

The typical errors related to linearity, hysteresis and temperature coefficient as indicated in the data sheet point out possible single errors of a pattern; however the overall error of each pattern is determined by the maximum permissible error according OIML R60 No 5.1.

The technical data, the dimensions of the load cell and the principle of load transmission are given in chapter 6 of this annex, have to be complied with.

6. Data sheet and dimensions

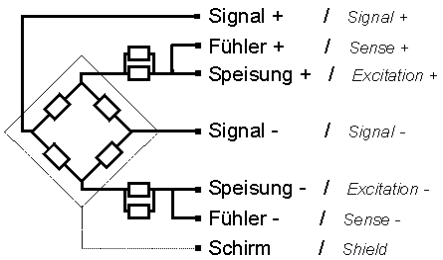
Specifications of the Load Cell Family

Accuracy class acc. to OIML R60			C3
Rated output	C_n	mV/V	2,0 ± 0,2
Maximum capacity	E_{max}	kg	150 / 200 / 250 / 300 / 500 / 750
Max. number of load cell intervals	n_{LC}		3000
Min. load cell verification interval	v_{min}		E_{max} / 15000
Minimum dead load output return (MDLOR)	*DR*		½·E_{max} / 5000
Minimum dead load		%·E_{max}	0
Safe load limit		%·E_{max}	150
Ultimate load		%·E_{max}	300
Excitation voltage, recommended		V	10 – 12 DC
Excitation voltage, maximum		V	15 DC
Input resistance	R_{LC}	Ω	404 ± 10
Output resistance	R_{out}	Ω	350 ± 3
Insulation resistance		MΩ	≥ 2000
Compensated temperature range		°C	- 10 ... + 40
Load cell material			Aluminium
Cable length		m	2
Degree of protection according to IEC529 [18]			IP65

Coating		Silicone rubber

Wiring

The load cell is provided with a shielded 4 or 6 conductor cable. The cable length is indicated in the accompanying document. The shield will be connected or not connected to the load cell according to customers preference.



Connections

Connections	4-wires	6-wires
Excitation +	red	red
Excitation –	black	black
Signal +	green	green
Signal –	white	white
Sense +	--	blue
Sense –	--	yellow
Shield	purple	purple
Cable length	2 m	

Load cell dimensions in mm

Picture of the load cell dimensions

Figure 2: Dimensions of the load cell type xxx in mm

Annex E (Mandatory) Definitions from other applicable international publications

E.1 Definitions from VIM [1]

E.1.1 Measured (quantity) value [VIM 2.10)]

Quantity value representing a measurement result
(For notes, please refer to VIM)

E.1.2 Error (of measurement) [VIM 2.16)]

Measured quantity minus a reference quantity value.
(For notes, please refer to VIM)

E.1.3 Influence quantity [VIM 2.52]

Quantity that, in a direct measurement, does not affect the quantity that is actually measured, but affects the relation between the indication and the measurement result.
(For examples and notes, please refer to VIM)

E.1.4 Reference (operating) condition [VIM 4.11]

Operating condition prescribed for evaluating the performance of a measuring instrument or measuring system or for comparison of measurement results

E.1.5 (For notes, please refer to VIM)Resolution [VIM 4.14]

Smallest change in a quantity being measured that causes a perceptible change in the corresponding indication
(For note, please refer to VIM)

E.1.6 Resolution of a displaying device [VIM 4.15]

Smallest difference between displayed indications that can be meaningfully distinguished

E.1.7 Maximum permissible (measurement) error [VIM 4.26]

Extreme value of measurement error, with respect to a known reference quantity value, permitted by specifications or regulations for a given measurement, measuring instrument, or measuring system.

Note 1 Usually the term “maximum permissible errors” or “limits of error” are used, where there are two extreme values.
Note 2 The term “tolerance” should not be used to designate ‘maximum permissible error’.

E.2 Definitions from the VIML [2]

E.2.1 legal metrology [VIML 1.2]

Part of metrology relating to activities which result from statutory requirements and concern measurement, units of measurement, measuring instruments and methods of measurement and which are performed by competent bodies.

Note 1 The scope of legal metrology may be different from country to country.
Note 2 The competent bodies responsible for legal metrology activities or part of these activities are usually called legal metrology services.

E.2.2 metrological supervision [VIML 2.3]

Control exercised in respect of the manufacture, import, installation, use, maintenance and repair of measuring instruments, performed in order to check that they are used correctly as regards the observance of metrology laws and regulations.

Note Metrological supervision includes checking the correctness of quantities indicated on and contained in pre-packages.

E.2.3 type (pattern) evaluation [VIML 2.5]

Systematic examination and testing of the performance of one or more specimens of an identified type (pattern) of measuring instruments against documented requirements, the results of which are contained in the evaluation report, in order to determine whether the type may be approved

E.2.4 type approval [VIML 2.6]

Decision of legal relevance, based on the evaluation report, that the type of a measuring instrument complies with the relevant statutory requirements and is suitable for use in the regulated area in such a way that it is expected to provide reliable measurement results over a defined period of time

E.2.5 preliminary examination [VIML 2.12]

Partial examination of certain elements of a measuring instrument of which verification will be completed at the place of installation or an examination carried out before certain elements of the measuring instrument are fitted

E.2.6 verification of a measuring instrument [VIML 2.13]

Procedure (other than type approval) which includes the examination and marking and/or issuing of a verification certificate, that ascertains and confirms that the measuring instrument complies with the statutory requirements

E.2.7 verification by sampling [VIML 2.14]

Verification of a homogeneous batch of measuring instruments based on the results of examination of a statistically appropriate number of specimens selected at random from an identified lot

E.2.8 initial verification [VIML 2.15]

Verification of a measuring instrument which has not been verified previously

E.2.9 subsequent verification [VIML 2.16]

Any verification of a measuring instrument after a previous verification and including: mandatory periodic verification; verification after repair

Note: Subsequent verification of a measuring instrument may be carried out before expiry of the period of validity of a previous verification either at the request of the user (owner) or when its verification is declared to be no longer valid.

E.2.10 inspection of a measuring instrument [VIML 2.21]

Examination of a measuring instrument to ascertain all or some of the following:
verification mark and/or certificate is valid,
no sealing marks are damaged,
after verification the instrument suffered no obvious modification,
its errors do not exceed the maximum permissible in-service errors

Note: Inspection of a measuring instrument may be done only after verification.

E.2.11 inspection by sampling [VIML 2.22]

inspection of a homogeneous batch of measuring instruments based on the results of evaluation of a statistically appropriate number of specimens selected at random from an identified lot

E.2.12 marking [VIML 2.23]

Affixing of one or more of the marks as described in (VIML) 3.7, 3.8, 3.9 and 3.10

Note 1 Verification and sealing marks may be combined.
Note 2 The manufacturer may be authorized to apply other marks.

E.2.13 verification mark [VIML 3.7]

Mark applied to a measuring instrument certifying that the verification of the measuring instrument was carried out with satisfactory results

Note The verification mark may identify the body responsible for verification and/or indicate the year or date of verification or its expiry date.

E.2.14 rejection mark [VIML 3.8]

Mark applied to a measuring instrument in a conspicuous manner to indicate that the measuring instrument does not comply with the statutory requirements and obliterating the previously applied verification mark

E.2.15 sealing mark [VIML 3.9]

Mark intended to protect the measuring instrument against any unauthorized modification, readjustment, removal of parts, etc.

E.2.16 type approval mark [VIML 3.10]

Mark applied to a measuring instrument certifying its conformity to the approved type

E.3 Definitions from OIML D 11 [4]

(For definitions in OIML D 11 that are copied from the VIM, see A.1)

E.3.1 Electronic measuring instrument (OIML D 11, 3.1)

Measuring instrument intended to measure an electrical or non-electrical quantity using electronic means and/or equipped with electronic devices.

Note: For the purpose of this Recommendation, auxiliary equipment, provided that it is subject to metrological control, is considered to be a part of the measuring instrument.

E.3.2 Electronic device (OIML D 11, 3.2)

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.

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” [2].

E.3.3 Electronic sub-assembly (OIML D 11, 3.3)

Part of an electronic device, employing electronic components and having a recognizable function of its own. Examples: amplifiers, comparators, power converters.

Note: For the definition of a module, according to OIML B 3 [5], see A.4.4.

E.3.4 Electronic component (OIML D11, 3.4)

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

Comment [138]: Definition relocated from 3.1.2.1

~~E.3.4~~E.3.5 Initial intrinsic error (OIML D 11, 3.8)

Intrinsic error of a measuring instrument as determined prior to performance tests and durability evaluations.

~~E.3.5~~E.3.6 Fault (OIML D 11, 3.9)

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

Notes:
1. Principally, a fault is the result of an undesired change of data contained in or flowing through an electronic measuring instrument.
2. From the definition it follows that in this Document, a “fault” is a numerical value which is expressed either in a unit of measurement or as a relative value, for instance as a percentage.

~~E.3.6~~E.3.7 Significant fault (OIML D 11, 3.10)

Fault greater than the value specified in 6.3.

~~E.3.7~~E.3.8 Durability error (OIML D 11, 3.11)

Difference between the intrinsic error after a period of use and the initial intrinsic error of a measuring instrument.

~~E.3.8~~E.3.9 Significant durability error (OIML D 11, 3.12)

Durability error greater than the value specified in the relevant Recommendation.

~~E.3.9~~E.3.10 Influence factor (OIML D 11, 3.13.1)

Influence quantity having a value within the rated operating conditions of a measuring instrument specified in the relevant Recommendation.

~~E.3.10~~E.3.11 Disturbance (OIML D 11, 3.13.2)

Influence quantity having a value within the limits specified in 6.8, but outside the specified rated operating conditions of a measuring instrument

.

Note: An influence quantity is a disturbance if the rated operating conditions for that influence quantity are not specified.

~~E.3.11~~E.3.12 Rated operating conditions [OIML D 11, 3.14; and adapted from VIM 5.5]

Conditions of use giving the range of values of influence quantities for which specified metrological characteristics of a measuring instrument are intended to lie within given limits.

~~E.3.12~~E.3.13 Performance (OIML D 11, 3.16)

Ability of a measuring instrument to accomplish its intended functions.

~~E.3.13~~E.3.14 Durability (OIML D 11, 3.17)

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

~~E.3.14~~E.3.15 Automatic checking facility (OIML D 11, 3.18.1)

Checking facility that operates without the intervention of an operator.

~~E.3.15~~E.3.16 Permanent automatic checking facility (type P) (OIML D 11, 3.18.1.1)

Automatic checking facility that operates at each measurement cycle.

~~E.3.16~~E.3.17 Intermittent automatic checking facility (type I) (OIML D 11, 3.18.1.2)

Automatic checking facility that operates at certain time intervals or per fixed number of measurement cycles.

~~E.3.17~~E.3.18 Non-automatic checking facility (type N) (OIML D 11, 3.18.2)

Checking facility that requires the intervention of an operator.

~~E.3.18~~E.3.19 Durability protection facility (OIML D 11, 3.19)

Facility that is incorporated in a measuring instrument and which enables significant durability errors to be detected and acted upon.

~~E.3.19~~E.3.20 Test (OIML D 11, 3.20)

Series of operations intended to verify the compliance of the equipment under test (EUT) with specified requirements.

~~E.3.20~~E.3.21 Test procedure (OIML D 11, 3.20.1)

Detailed description of the test operations.

~~E.3.21~~E.3.22 Test program (OIML D 11, 3.20.2)

Description of a series of tests for certain types of equipment.

~~E.3.22~~E.3.23 Performance test (OIML D 11, 3.20.3)

Test intended to verify whether the EUT is able to accomplish its intended functions

~~E.3.23~~E.3.24 Durability test (OIML D 11, 3.20.4)

Test intended to verify whether the EUT is able to maintain its performance characteristics over a period of use.

~~E.3.24~~E.3.25 Mains power (OIML D 11, 3.21)

Primary external source of electrical power for an instrument, including all sub-assemblies. Examples: public power (AC or DC), generator, external battery or other DC supply systems

~~E.3.25~~E.3.26 Power converter (power supply device) (OIML D 11, 3.22)

Sub-assembly converting the voltage from the mains power to a voltage suitable for other sub-assemblies.

~~E.3.26~~E.3.27 Auxiliary battery (OIML D 11, 3.23)

Battery that is:
Mounted in, or connected to, an instrument that can be powered by the mains power as well; and
Capable of completely powering the instrument for a reasonable period of time.

~~E.3.27~~E.3.28 Back-up battery (OIML D 11, 3.24)

Battery that is intended to power specific functions of an instrument in the absence of the primary power supply. Example: to preserve stored data.

E.4 Definitions from OIML B 3 [5]

E.4.1 Category of instruments [B 3, 2.2]

Identification or classification of instruments according to unique metrological and technical characteristics that may include the measured quantity, the measuring range, and the principle or method of measurement.

E.4.2 Family of measuring instruments [B 3, 2.3]

Identifiable group of measuring instruments belonging to the same manufactured type within the same category that have the same design features and metrological principles for measurement but which may differ in some metrological and technical performance characteristics, as defined in the relevant Recommendation.

E.4.3 Module [B 3, 2.4]

Identifiable part of a measuring instrument or of a family of measuring instruments that performs a specific function or functions and that can be separately evaluated according to prescribed metrological and technical performance requirements in the relevant Recommendation.

E.4.4 Family of modules [B 3, 2.5]

Identifiable group of modules belonging to the same manufactured type that have similar design features but may differ in some metrological and technical performance requirements as defined in the relevant Recommendation

Bibliography

Reference Identifier	Publication Title	Description
1]	"ISO/IEC Guide 99 OIML V 2-200 International Vocabulary of Metrology - Basic and General Concepts and Associated Terms," 1993.	An international agreement on terminology, prepared as a collaborative work of experts appointed by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML. This vocabulary covers subjects relating to measurement and includes information on the determination of physical constants and other fundamental properties of materials and substances.
[2]	"ISO/IEC Guide 99 OIML V 2-200 International Vocabulary of Metrology - Basic and General Concepts and Associated Terms," 2012.	2012 edition of above publication
[3]	"OIML V2 International Vocabulary of Terms in Legal Metrology," 2000.	An international agreement on terminology, prepared as a collaborative work of experts from ISO, BIPM, IEC, and OIML. This vocabulary covers general terms used in metrology.
[4]	"OIML D9 Principles of metrological supervision," 2004.	Provides elements to be considered for developing a model of metrological supervision in Member States which can be used as a basis for the harmonization of metrological supervision at an international level.
[5]	"OIML D11 General requirements for electronic measuring instruments.," 2004.	The primary aim of this International Document is to provide OIML Technical Committees and Subcommittees with guidance for establishing appropriate metrological performance testing requirements for influence quantities that may affect the measuring instruments covered by International Recommendations.
[6]	"OIML B3 OIML Basic Certificate System for OIML Type Evaluation of Measuring Instruments," 2011.	Defines the general requirements for the implementation of the OIML Basic Certificate System.

[7]	"Guide to the Expression of Uncertainty in Measurement, BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML," 2008.	This Guide establishes general rules for evaluating and expressing uncertainty in measurement that are intended to be applicable to a broad spectrum of measurements. It was prepared by a joint working group consisting of experts nominated by the BIPM, the International Electrotechnical Commission (IEC), the International Organization for Standardization (ISO), and the International Organization of Legal Metrology (OIML).
[8]	"OIML D31 General requirements for software controlled measuring instruments," 2008.	Specifies the general requirements applicable to software related functionality in measuring instruments and gives guidance for verifying the compliance of an instrument with these requirements.
[9]	"OIML R76 Non-automatic weighing instruments," 2006.	Specifies the general requirements applicable to software related functionality in measuring instruments and gives guidance for verifying the compliance of an instrument with these requirements.
[10]	"ISO 8601 Data elements and interchange formats - Information interchange - Representation of dates and times," 2004.	International standard covering the exchange of date and time-related data to provide an unambiguous and well-defined method of representing dates and times, so as to avoid misinterpretation of numeric representations of dates and times
[11]	"IEC Publication 60068-2-30 Ed. 3.0," 2005.	Determines the suitability of components, equipment and other articles for use and/or storage under conditions of high humidity when combined with cyclic temperature changes. Amendment No. 1 replaces the third paragraph of Clause 8, Recovery.
[12]	"IEC Publication 60068-3-4 Ed. 1 Environmental testing," 2001.	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.

[13]	"IEC Publication 60068-2-78," 2008.	Provides a test method for determining the suitability of electrotechnical products, components or equipment for transportation, storage and use under conditions of high humidity. The test is primarily intended to permit the observation of the effect of high humidity at constant temperature without condensation on the specimen over a prescribed period. This test provides a number of preferred severities of high temperature, high humidity and test duration. The test can be applied to both heat-dissipating and non-heat dissipating specimens. The test is applicable to small equipment or components as well as large equipment having complex interconnections with test equipment external to the chamber, requiring a set-up time which prevents the use of preheating and the maintenance of specified conditions during the installation period.
[14]	"IEC Publication 61000-4-11," 2004.	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.
[15]	"IEC Publication 61000-4-4," 2004.	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.

[16]	"IEC Publication 61000-4-2," 2008.	This publication is based on IEC 60801-2 (second edition: 1991). It relates to the immunity requirements and test methods for electrical and electronic equipment subjected to static electricity discharges, from operators directly, and to adjacent objects. It additionally defines ranges of test levels which relate to different environmental and installation conditions and establishes test procedures. The object of this standard is to establish a common and reproducible basis for evaluating the performance of electrical and electronic equipment when subjected to electrostatic discharges. In addition, it includes electrostatic discharges which may occur from personnel to objects near vital equipment.
[17]	"IEC Publication 61000-4-3 Ed. 3.0," 2006.	Applies to the immunity of electrical and electronic equipment to radiated electromagnetic energy. Establishes test levels and the required test procedures. Establishes a common reference for evaluating the performance of electrical and electronic equipment when subjected to radio-frequency electromagnetic fields.
[18]	"IEC 60529 (529)," 1989.	Applies to the classification of degrees of protection provided by enclosures for electrical equipment with a rated voltage not exceeding 72.5 kV. Has the status of a basic safety publication in accordance with IEC Guide 104.
[19]	"OIML R61 Automatic gravimetric filling instruments," 2004.	This OIML Recommendation prescribes the metrological requirements and evaluation procedures for instruments that fill containers with predetermined and virtually constant mass of product from bulk by automatic weighing.
[20]	"OIML R51 Automatic catchweighing instruments," 2006.	This OIML Recommendation prescribes the metrological requirements and evaluation procedures for weighing instruments used to weigh pre-assembled discrete loads or single loads of loose materials.
[21]	"OIML R50 Continuous totalizing automatic weighing instruments (belt weighers)," 1997.	This OIML Recommendation prescribes the metrological requirements and evaluation procedures for belt weighers used in the measurement of mass.
[22]	"OIML R107 Discontinuous totalizing automatic weighing instruments (totalizing hopper weighers)," 2007.	This OIML Recommendation prescribes the metrological requirements and evaluation procedures for weighing instruments that weigh bulk product by dividing it and determining the mass in descrete loads, and summing the results.

[23]	"OIML R106 Automatic rail-weighbridges," 2011.	This OIML Recommendation prescribes the metrological requirements and evaluation procedures for automatic weighing instrument having one or more load receptor(s), inclusive of rails for conveying railway vehicles, that determines the mass of wagons and/or the whole train by weighing them in motion