INTERNATIONAL RECOMMENDATION

OIML R 60-2

Edition 2021 (E)

Metrological regulation for load cells

Part 2: Metrological controls and performance tests

Réglementation métrologique des cellules de pesée

Contrôles métrologiques et essais de performance

ORGANISATION INTERNATIONALE DE MÉTROLOGIE LÉGALE

INTERNATIONAL ORGANIZATION OF LEGAL METROLOGY

Contents

Foreword

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This publication — reference OIML R 60-2:2021 — is an updated edition (developed by the OIML Certification System Management Committee) of R 60-2:2017 (developed by Project Group 1 of OIML Technical Committee TC 9 *Instruments for measuring mass and density*). This updated edition consolidates the Amendment (2019-12-23) to R 60:2017, and includes other editorial and minor technical changes. It was approved for final publication by the International Committee of Legal Metrology at its 56th meeting in October 2021 and was sanctioned by the 16th International Conference on Legal Metrology in 2021. It supersedes the previous edition of R 60 dated 2017.

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Part 2 - Metrological controls and performance tests

1 Metrological controls

1.1 Liability to legal metrological controls

1.1.1 Imposition of controls

This Recommendation prescribes performance requirements for load cells used in devices or systems subjected to legal metrological control. National legislation may impose metrological controls that verify compliance with this Recommendation. Such controls, when imposed, may include type evaluation.

1.2 Measurement standards

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 [OIML G 1-100 *Guide to the Expression of Uncertainty in Measurement*] [7].

2 Type evaluation

2.1 Scope

This section provides test procedures for type evaluation testing of load cells.

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.

2.2 Test requirements

Test procedures for the type evaluation of load cells are provided in 2.10 and the Test Report Format is provided in OIML R 60-3. 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.

2.3 Selection of specimens for evaluation

Type evaluation shall be carried out on at least one specimen, which represents the type. The evaluation shall consist of the examination and tests specified in 2.10.

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

If a specimen does not pass a specific test as a result of the design of the type and therefore has to be modified, the applicant shall carry out this modification to all the specimens supplied for test. If the modification has been applied to all sub-types of the family which have the common design defect that required modification, it is then required that the other specimens that have been submitted shall be re-tested. Depending on the modification this may involve a repeat of the specific test or a complete re-test.

If during the evaluation the specimen experiences malfunction or breakage that necessitates a repair in order to complete the test, the applicant shall verify whether this repair concerns an incident or whether a modification will need be made to the design. In the latter case the modification shall be applied to all specimens supplied for the test and the applicable documentation shall be updated accordingly.

If the issuing authority has reason to believe that a modification or repair could cause a different outcome for test result(s) than the result(s) which was observed prior to any modification, these tests shall be repeated. The reason for repeating a test shall be given within the scope of the test report.

2.3.1 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 minimised (see practical example in Annex D).

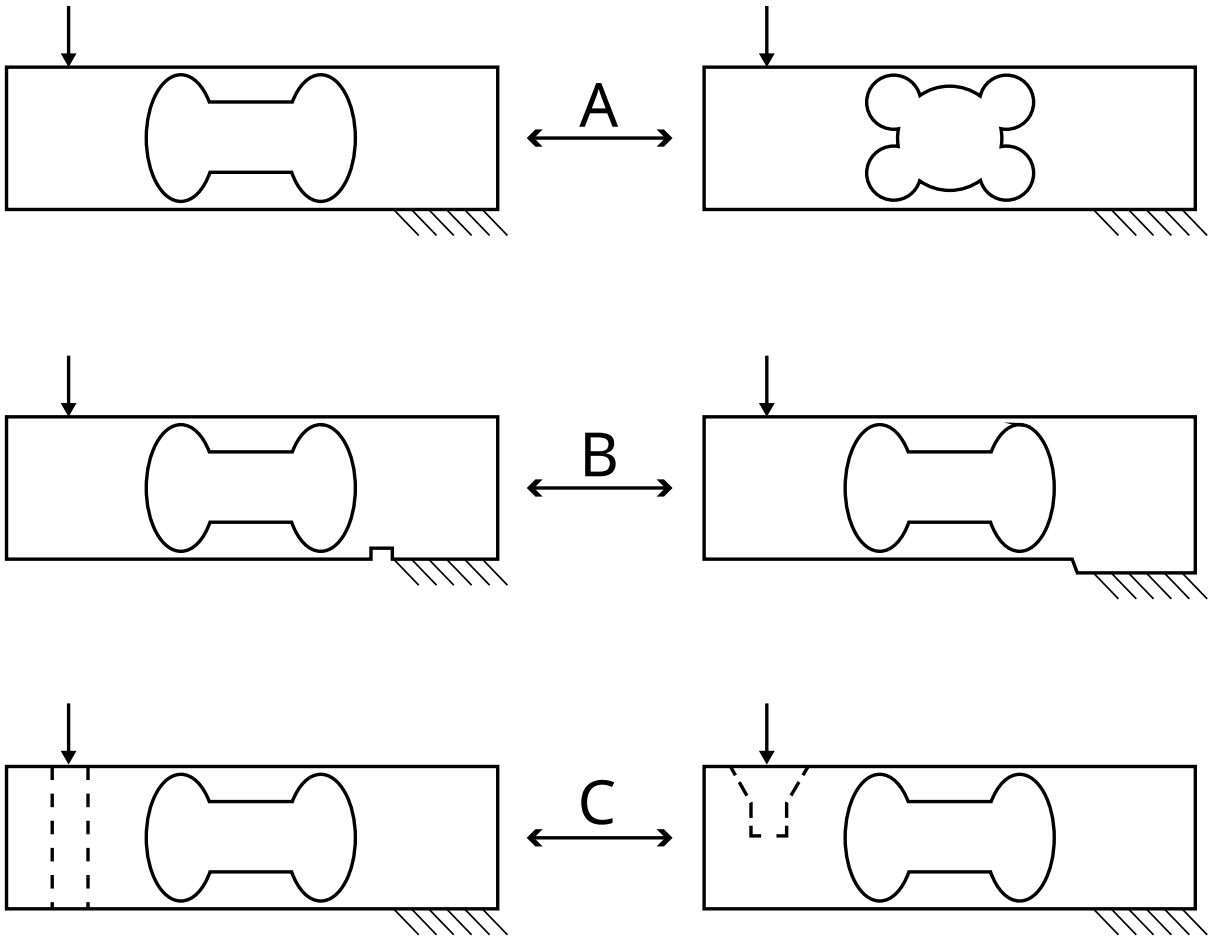
2.4 Selection of load cells within a family

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

All accuracy and influence tests, including a span stability test for digital load cells, shall be performed on the same unit. Disturbance tests on digital load cells may be (simultaneously) carried out on not more than two additional load cells.

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

When classifying load cells on the basis of the shape design, additional consideration should be given to design criteria such as the geometrical characteristics of the areas of the load cell created during fabrication. Examples of strain gauge-type load cells with identical outer dimensions but different geometries are shown below.



Key

A difference of geometry in the area of thin places (i.e. round or oval drilling)

B difference of geometry in the area of fixing/load introduction (i.e. groove, base, offset)

C difference of geometry in the inner of fixing/load introduction (i.e. drilling, thread, dropping)

Figure 1 — Examples of strain gauge-type load cell design shapes

2.4.1 Load cells of the same capacity belonging to different groups

Where load cells of the same family and same capacity belong to different groups, the selection of a load cell for testing requires a choice between characteristics of the load cells. In this case, the load cell requiring the most onerous tests shall be selected. This selection will result in the load cell with the most stringent metrological characteristics being tested.

2.4.2 Load cells with a capacity in between the capacities tested

Load cells of the same family with a capacity in between the capacities tested, as well as those above the largest capacity tested, but not over 5 times the largest capacity tested, may be included in the certificate and are deemed to fulfil the requirements of this Recommendation. This is under the provision that along with the change of capacity there is no change of measurement principle or material used in the construction of the load cell (e.g. from bending beam to shear beam or stainless steel replacing aluminium).

2.4.3 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 2.4.1 and 2.4.2 .

2.4.4 Ratio of largest capacity to the nearest smaller capacity

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.

2.4.5 Humidity test

If more than one load cell of a family has been submitted for testing, only one load cell shall be tested for humidity when applicable.

2.4.6 Selection of analogue-active and digital load cells

For analogue-active load cells (R 60-1, 3.1.3.2) with active electronics that do not differ between load cells and family and for digital load cells (R 60-1, 3.1.3.3) with an additional digital converter that does not differ between load cells and family all applicable tests shall be performed on the load cell with the minimum, $\mu V/v$min as input for the analogue to digital converter (same principle as OIML R 76 *Non-automatic weighing instruments* [1], Annex C, Table 12).

Notwithstanding this requirement, the criteria for assignment of a load cell to a family and the selection of test specimens found in 2.4.1 to 2.4.5 shall be observed.

2.5 Documentation

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

a) a description of its general principle of measurement;

b) mechanical drawings (including documents on the load transmission(s) as per Annex E);

c) electric/electronic diagrams;

d) installation requirements (physical and electrical) if appropriate;

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

f) documents or other evidence to support and demonstrate the manufacturer’s belief that the design and characteristics of the load cell will comply with the requirements of this Recommendation; and

g) documentation relative to software if appropriate.

If the test 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 fully define the approved type, or both.

If the manufacturer does not prescribe a specific load transmission, it will be the responsibility of the test laboratory to decide what kind of load transmission is to be used for testing (also see Annex E).

2.6 Examinations

Examinations and testing of load cells are intended to verify compliance with the requirements of R 60-1.

The load cell 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 (R 60-1, 5.1.1 and 6.2.4.1);

b) maximum number of load cell verification intervals (R 60-1, 5.1.2 and 6.2.4.5);

c) load cell measuring ranges (R 60-1, 3.5.2);

d) apportioning of errors (R 60-1, 5.3.2 and 3.7.2);

e) construction of load cells (R 60-1, 3.3);

f) software (R 60-1, 6.1) (if applicable);

g) inscriptions and presentation of load cell information (R 60-1, 6.2); and

h) installation instructions/recommendations.

2.7 Performance tests

2.7.1 Purpose

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

2.7.2 Test equipment

The basic equipment for type evaluation tests consists of a force-generating system and a suitable indicating instrument, which measures the output of the load cell (see 1.2).

2.7.3 General considerations for environmental and test conditions

2.7.3.1 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.

Conditions involving electrical power supplies, electromagnetic fields and radio frequency fields are to be measured/controlled when the load cell is being evaluated against the effects of these influences, and must also be considered when there is a potential for these types of conditions to impart effects on other tests.

2.7.3.2 Acceleration of gravity

The mass standards used to generate the force applied during 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.

2.7.3.3 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 specifications 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.

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, the installation of the load cell in the force-generating system shall be done with particular care. In addition, the installation shall be done with consideration given to the intended use of the load cell and the load transmission. The effect on the metrological performance caused by mounting/dismounting the load cell on/from the force-generating system should be negligible in order to establish the magnitude of the test parameter. If possible, the load cell should not be dismounted from the force-generation system during the entire period of the test.

2.7.3.4 Measuring range limits

With consideration given to the capability of the force-generating system, the minimum load, $D_{\min}$, shall be as near as possible to but not less than the minimum dead load, $E_{\min}$, and shall not be higher than a value equal to 10 % of $E_{\max}$. The maximum load, $D_{\max}$, shall be not less than 90 % of $E_{\max}$, nor shall it be greater than $E_{\max}$ (refer to R 60-1, Figure 3).

2.7.3.5 Reference standards

All standards and measuring instruments used for the tests shall be traceable to national or international standards.

2.7.3.6 Stabilisation period

A stabilisation period for the load cell under test and the indicating instrument shall be provided, as recommended by the manufacturers of the equipment used.

2.7.3.7 Temperature conditions

It is important to allow sufficient time for temperature stabilisation of the load cell to be achieved. Particular attention shall be paid 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 the results.

2.7.3.8 Barometric pressure effects

Where changes in barometric pressure may significantly affect the load cell output, such changes shall be considered.

2.7.3.9 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 2.10.5.

When a load cell is marked with the symbol SH, it shall be subjected to the humidity test, as specified in 2.10.6.

Load cells marked with the symbol NH shall not be subjected to the humidity tests as described in 2.10.5 and 2.10.6 .

2.7.3.10 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 utilised frequently to ensure that the indicating instrument is within the accuracy required by the test being performed. Periodic checks on the calibration status of the indicating instrument shall be performed.

2.7.3.11 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(s).

2.7.3.12 Time and date 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 *Data elements and interchange formats — Information interchange — Representation of dates and times* [9] (Representation of dates and times) format of ccyy-mm-dd.

Note: ”cc” may be omitted in cases where there is no possible confusion as to the century.

2.8 Rules concerning the determination of errors

2.8.1 Conditions

The limits of error shown in Table 4 in OIML R 60-1 shall apply to all load cell measuring ranges complying with the following conditions:

$n \leq n_{LC}$

$v \Rightarrow v_{min}$

2.8.2 Limits of error

The limits of error shown in Table 4 in OIML R 60-1 shall refer to the error envelope defined in R 60-1, 2.2 and R 60-1, 5.3.2 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 OIML R 60-3 *Test report format for type evaluation*.

2.8.3 Initial readings

During the conduct of the tests, the initial reading shall be taken at a time interval after the initiation of loading or unloading, whichever is applicable, as specified in Table 1.

Table 1 — Combined loading and stabilisation times to be achieved prior to reading

Change in load		**Time allowed for loading and stabilisation**		
Greater than	**Up to and including**	**Classes C and D**	**Class B**	**Class A**
0 kg	10 kg	10 seconds	15 seconds	20 seconds
10 kg	100 kg	20 seconds	30 seconds	40 seconds
100 kg	1 000 kg	30 seconds	45 seconds	60 seconds

Table 1 *(continued)*

Change in load		Time allowed for loading and stabilisation		
Greater than	**Up to and including**	**Classes C and D**	**Class B**	**Class A**
1 000 kg	10 000 kg	40 seconds	60 seconds	80 seconds
10 000 kg	100 000 kg	50 seconds	75 seconds	100 seconds
100 000 kg		60 seconds	90 seconds	120 seconds

2.8.3.1 Loading/unloading times

The loading or unloading times shall be approximately half the time specified in Table 1. The remaining time shall be utilised for stabilisation. The tests shall be conducted under constant conditions. The loading or unloading time and the stabilising time shall be recorded in the test report in absolute, not relative values.

2.8.3.2 Adherence to loading/unloading times

When the specified loading or unloading times cannot be achieved, the applicant for evaluation should be consulted and 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.

   For example:

   1) A change in load of 10 kg for class C and D load cells, loading (or unloading) time (approximately 5 s) is increased to 7.5 s (150 % of 5 s), MPE is reduced to 50 %; or

   2) A change in load of 1500 kg for class C and D load cells, loading (or unloading) time (approximately 20 s) is increased to 25 s (125 % of 20 s), MPE is reduced to 75 %.

b) In all cases, the actual times shall be recorded in the Test report.

2.9 Variation of results under reference conditions

2.9.1 Creep

A load of D_{max} shall be applied as specified in 2.10.2.1 to 2.10.2.7 , at which time an initial reading shall be taken. The variation between the initial reading and subsequent readings of the load D_{max}, taken as specified in 2.10.2.8, shall comply with the limits specified in R 60-1, 5.5.1.

2.9.2 Minimum dead load output return

The difference between an initial reading at a load of D_{min} (as specified in 2.10.3.1 to 2.10.3.6) and a subsequent reading also of D_{min} (taken after the application of a load of D_{max} as specified in 2.10.3.7 to 2.10.3.8) shall not exceed the value in specified in R 60-1, 5.5.2.

2.10 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, repeatability, and minimum dead load output return tests can be conducted concurrently at the given test temperature before changing to the next test temperature (see 2.11, Figures 2 and 3). The barometric pressure and the humidity tests are conducted individually following completion of the above tests.

2.10.1 Determination of measurement error, repeatability error and temperature effect on minimum dead load output

This test is applied to verify compliance with the provisions in R 60-1, 5.3, 5.4, and R 60-1, 5.6.1.3.

2.10.1.1 Check test conditions

Refer to the test conditions in 2.7.3 to ensure that proper consideration has been given to those conditions, prior to performing the following tests.

2.10.1.2 Insert load cell

Insert the load cell into the force-generating system, load to the minimum test load, $D_{\min}$, and stabilise at $20\ °C\ (\pm 2\ °C)$.

2.10.1.3 Preload load cell

Preload 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 before commencing with further tests.

2.10.1.4 Check indicating instrument

Check the indicating instrument according to 2.7.3.10.

2.10.1.5 Monitor load cell

Monitor the minimum test load output until stable.

2.10.1.6 Record indication

Record the indicating instrument indication at the minimum test load, $D_{\min}$.

2.10.1.7 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 1 in 2.8.3. These two time intervals shall be recorded.

2.10.1.8 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 values at or near those at which the maximum permissible error changes, as listed in Table 4 in R 60-1, 5.3.2.

2.10.1.9 Record indications

Record the indicating instrument indications at time intervals as near as possible to those specified in Table 1 in 2.8.3. These two time intervals shall be recorded.

2.10.1.10 Decrease test loads

Decrease the test loads to the minimum test load, D_{min}, using the same load points as described in 2.10.1.8.

2.10.1.11 Record indications

Record the indicating instrument indications at time intervals as near as possible to those specified in Table 1 in 2.8.3. These two time intervals shall be recorded.

2.10.1.12 Repeat procedures for different accuracy classes

Repeat the operations described in 2.10.1.7 to 2.10.1.11 four more times for accuracy classes A and B or two more times for accuracy classes C and D.

2.10.1.13 Repeat procedures for different temperatures

Repeat the operations described in 2.10.1.3 to 2.10.1.12 , first at the higher temperature, then at the lower temperature, in accordance with R 60-1, 5.6.1; then perform the operations in 2.10.1.3 to 2.10.1.12 at 20 °C (± 2 °C).

2.10.1.14 Determine magnitude of measurement error

The magnitude of the measurement 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 measurement errors in R 60-1, 5.3.2 (see Table 4 in OIML R 60-1).

2.10.1.15 Determine repeatability error

From the resulting data, the repeatability error may be determined and compared with the limits specified in R 60-1, 5.4.

2.10.1.16 Determine temperature effect on minimum dead load output

From the resulting data, the temperature effect on minimum dead load output may be determined and compared with the limits specified in R 60-1, 5.6.1.3.

2.10.2 Determination of creep error.

This test is applied to verify compliance with the provisions in R 60-1, 5.5.1.

2.10.2.1 Check test conditions

Refer to the test conditions in 2.7.3 to ensure that proper consideration has been given to those conditions prior to performing the following tests.

2.10.2.2 Insert load cell

Insert the load cell into the force-generating system, load to the minimum test load, D_{min}, and stabilise at 20 °C (± 2 °C).

2.10.2.3 Preload load cell

Preload 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.

2.10.2.4 Check indicating instrument

Check the indicating instrument according to 2.7.3.10.

2.10.2.5 Monitor load cell

Monitor the minimum test load output until stable.

2.10.2.6 Record indication

Record the indicating instrument indication at the minimum test load, D_{min}.

2.10.2.7 Apply load

Apply a constant maximum test load, D_{max} (between 90 % and 100 % of E_{max}).

2.10.2.8 Record indications

Record the initial indicating instrument indication at the time intervals specified in Table 1 in 2.8.3. Continue to record periodically thereafter, at recorded time intervals over a 30-minute period, ensuring that a reading is taken at 20 minutes.

2.10.2.9 Repeat procedures for different temperatures

Repeat the operations described in 2.10.2.2 to 2.10.2.8 , first at the higher temperature, then at the lower temperature, in accordance with R 60-1, 5.6.1.

2.10.2.10 Determine creep error

With the resulting data, and taking into account the effect of barometric pressure changes according to 2.7.3.8, the magnitude of the creep error can be determined and compared with the permissible variation specified in R 60-1, 5.5.1.

2.10.3 Determination of minimum dead load output return (DR)

This test is applied to verify compliance with the provisions in R 60-1, 5.5.2.

2.10.3.1 Check test conditions

Refer to the test conditions in 2.7.3 to ensure that proper consideration has been given to those conditions prior to performing the following test.

2.10.3.2 Insert load cell

Insert the load cell into the force-generating system, load to the minimum test load, D_{min}, and stabilise at 20 °C (± 2 °C).

2.10.3.3 Preload load cell

Preload 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 before commencing any further tests.

2.10.3.4 Check indicating instrument

Check the indicating instrument according to 2.7.3.10.

2.10.3.5 Monitor load cell

Monitor the minimum test load output until stable.

2.10.3.6 Record indication

Record the indicating instrument indication at the minimum test load, D_{min}.

2.10.3.7 Apply load

Apply a constant maximum test load, D_{max} (between 90 % and 100 % of E_{max}).

2.10.3.8 Record indications

Record the initial indicating instrument indication at time intervals as near as possible to those specified in Table 1 in 2.8.3. 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.

2.10.3.9 Record data

Record the time of initiation of unloading and return to the minimum test load, D_{min}.

2.10.3.10 Record indication

Record the indicating instrument indication at time intervals as near as possible to those specified in Table 1 in 2.8.3. These two time intervals shall be recorded.

2.10.3.11 Repeat procedures for different temperatures

Repeat the operations described in 2.10.3.3 to 2.10.3.8 , first at the higher temperature, then at the lower temperature in accordance with R 60-1, 5.6.1.

2.10.3.12 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 2.9.2.

2.10.4 Determination of barometric pressure effects (atmospheric pressure)

This test is applied to verify compliance with the provisions in R 60-1, 5.6.2.

2.10.4.1 Check test conditions

Refer to the test conditions in 2.7.3 to ensure that proper consideration has been given to those conditions prior to performing the following test.

2.10.4.2 Insert load cell

At room temperature, insert the unloaded load cell into the pressure chamber at atmospheric pressure.

2.10.4.3 Check indicating instrument

Check the indicating instrument according to 2.7.3.10.

2.10.4.4 Monitor load cell

Monitor the output until stable.

2.10.4.5 Record indication

Record the indicating instrument indication.

2.10.4.6 Change barometric pressure

Change the barometric pressure by a minimum of 1 kPa greater than atmospheric pressure and record the indicating instrument indication.

2.10.4.7 Determine barometric pressure error

With the resulting data, the magnitude of the barometric pressure influence can be determined and compared with the limits specified in R 60-1, 5.6.2.

2.10.5 Determination of humidity effects for load cells marked CH or not marked

This test is applied to verify compliance with the provisions in R 60-1, 5.6.3.1.

2.10.5.1 Check test conditions

Refer to the test conditions in 2.7.3 to ensure that proper consideration has been given to those conditions prior to performing the following test.

2.10.5.2 Insert load cell

Insert the load cell into the force-generating system, load to the minimum test load, $D_{\min}$, and stabilise at 20 °C (± 2 °C).

2.10.5.3 Preload load cell

Preload 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 before commencing any further tests.

2.10.5.4 Check indicating instrument

Check the indicating instrument according to 2.7.3.10.

2.10.5.5 Monitor load cell

Monitor the minimum test load output until stable.

2.10.5.6 Record indication

Record the indicating instrument indication at the minimum test load, $D_{\min}$.

2.10.5.7 Apply load

Apply a maximum test load, $D_{\max}$.

2.10.5.8 Record indications

Record the initial indicating instrument indication at time intervals as near as possible to those specified in Table 1 in 2.8.3. These two time intervals shall be recorded.

2.10.5.9 Remove load

Remove the test load to the minimum test load, $D_{\min}$.

2.10.5.10 Record indication

Record the indicating instrument indication at time intervals as near as possible to those specified in Table 1 in 2.8.3. These two time intervals shall be recorded.

2.10.5.11 Repeat procedures for different accuracy classes

Repeat the operations described in 2.10.5.7 to 2.10.5.10 four more times for accuracy classes A and B or two more times for accuracy classes C and D.

2.10.5.12 Conduct damp heat, cyclic test (CH)

This test is conducted to verify compliance with the provisions in R 60-1, 5.6.3.1 under conditions of high humidity combined with cyclic temperature changes

Applicable standards:

IEC 60068-2-30 [10]: *Environmental testing – Part 2: Tests*

Test Db and guidance: Damp heat cyclic (12 + 12-hour) cycle

IEC 60068-3-4 [11]: *Environmental testing — Part 2: Tests. Guidance for damp heat tests*

Test method	Exposure to damp heat with cyclic temperature variation
Test conditions	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.
Preconditioning of load cell	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) when lowering the temperature.
Initial measurements	Made according to 2.10.5.1 to 2.10.5.11
Test procedure in brief	This test consists of exposure to 12 temperature cycles of 24-hour duration each. Condensation is expected to occur on the load cell during the temperature rise. The 24 h cycle comprises: ▪ temperature rise during 3 hours, ▪ temperature maintained at upper value until 12 hours from the start of the cycle, ▪ temperature lowered to lower temperature level within a period of 3 to 6 hours, the declination (rate of fall) during the first hour and a half being such that the lower temperature level would be reached in a 3 hour period, ▪ temperature maintained at the lower level until the 24 h period is completed. The stabilising period before and recovery period after the cyclic exposure shall be such that the temperature of all parts of the load cell is within 3 °C of its final value. Recovery conditions and final measurements: According to 2.10.5.13 to 2.10.5.15 .

2.10.5.13 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).

2.10.5.14 Repeat test procedures

Repeat 2.10.5.1 to 2.10.5.11 ensuring that the minimum test load, $D_{\min}$, and the maximum test load, $D_{\max}$, applied are the same as previously used.

2.10.5.15 Determine the magnitude of humidity-induced variations

The difference between the average of the reading of the minimum load output and of the maximum output attributed to cyclic changes in humidity as determined using test procedures in 2.10.5 shall not exceed the limits specified in R 60-1, 5.6.3.1.

The difference between the average of the reading of the maximum load, D_{max}, attributed to cyclic changes in humidity as determined using test procedures in 2.10.5 shall not exceed the limits specified in R 60-1, 5.6.3.1.

2.10.6 Determination of humidity effects for load cells marked SH

This test is applied to verify compliance with the provisions in R 60-1, 5.6.3.2.

2.10.6.1 Check test conditions

Refer to the test conditions in 2.7.3 to ensure that proper consideration has been given to those conditions prior to performing the following tests.

2.10.6.2 Insert load cell

Insert the load cell into the force-generating system, load to the minimum test load, D_{min}, and stabilise at 20 °C (± 2 °C).

2.10.6.3 Preload load cell

Preload 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 before commencing any further tests.

2.10.6.4 Check indicating instrument

Check the indicating instrument according to 2.7.3.10.

2.10.6.5 Monitor load cell

Monitor the minimum test load output until stable.

2.10.6.6 Record indication

Record the indicating instrument indication at the minimum test load, D_{min}.

2.10.6.7 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 1 in 2.8.3. These two time intervals shall be recorded.

2.10.6.8 Apply loads

Apply increasing loads up to the maximum test load, D_{max_X}. 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 measurement errors, as listed in Table 4 in R 60-1, 5.3.2.

2.10.6.9 Record indications

Record the indicating instrument indications at time intervals as near as possible to those specified in Table 1 in 2.8.3. These two time intervals shall be recorded.

2.10.6.10 Decrease load

Decrease the test load to the minimum test load, D_{min}, using the same load points as described in 2.10.6.8.

2.10.6.11 Conduct damp heat, steady state test

This test is conducted to verify compliance with the provisions in R 60-1, 5.6.1 or R 60-1, 5.6.3 under conditions of high humidity and constant temperature.

Applicable standards:

IEC 60068-2-78: *Environmental testing — Part 2: Tests. Test Ca: Damp heat, steady state,*

Environmental testing — Part 2: Tests. Test Cb: Damp heat, steady state, primarily for equipment [12].

IEC 60068-3-4: *Environmental testing — Part 2: Tests. Guidance for damp heat tests* [11].

Test method	Exposure to damp heat in steady state
Test conditions	Relative humidity of 85 %
Preconditioning of load cell	Place the load cell in the chamber with the output connection external to the chamber, and switched on.
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 2.10.6.1 to 2.10.6.10: 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 R 60-1, 5.6.1 for the load cell and a relative humidity of 85 %, 48 hours following temperature and humidity stabilisation; and c) at the reference temperature and relative humidity of 50 %. The load cell shall be handled such that no condensation of water occurs on it.

2.10.6.12 Recording indications

Record the indicating instrument indications at time intervals as near as possible to those specified in Table 1 in 2.8.3. These two time intervals shall be recorded.

2.10.6.13 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 R 60-1, 5.6.3.2.

2.10.7 Additional test for analogue-active load cells (disturbances)

These tests are applied to verify compliance with the provisions in R 60-1, 5.7.2.5, and R 60-1, 5.7.2.6.

2.10.7.1 Performance and stability tests

An analogue-active load cell shall pass the performance and stability tests according to 2.10.7.2 to 2.10.7.11 for the tests given in R 60-1, Table 5.

2.10.7.2 Evaluation of error for digital load cells

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 $0{,}1v$, 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, ΔL, added to the load cell gives the digital output value prior to rounding, P, by using the following formula:

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

where:

I = the indication or digital output value;

v = the load cell verification interval; and

ΔL = additional load added to the load cell.

The error, E, prior to rounding is:

$$E = P - L = I + \frac{1}{2}v - \Delta L - L$$

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

$$E_C = E - E_0 \leq MPE$$

where E_0 is the error calculated at the minimum test load, $D_{\min}$.

2.10.7.3 Warm-up time

Test procedure in brief:

Stabilise 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.

Insert the load cell into the force-generating system.

Preload the load cell by applying a maximum test load, $D_{\max}$, then, returning to the minimum test load, $D_{\min}$, three times.

Allow the load cell to rest for 5 minutes. Connect the load cell to the power supply and switch on.

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 1 in 2.8.3 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.

For load cells of class A, the provisions of the operating manual for the time following connection to electrical supply shall be observed.

2.10.7.4 Power voltage variations

This test is applied to verify compliance with R 60-1, 5.7.2.2, R 60-1, 5.7.2.3, and R 60-1, 5.7.2.4 under conditions of variations in voltage to the load cell's power supply.

Applicable standards:

For load cells powered by AC mains: IEC/TR3 61000-2-1 [13], IEC 61000-4-1 (set-up) [14]

For load cells powered by DC mains: IEC 61000-4-29 [15], IEC 61000-4-1 (set-up) [14]

Test method	Subject load cell to variations of power supply voltage
Test conditions	In accordance with 2.7.3.1 Environmental conditions
Preconditioning of load cell	Stabilise load cell under constant environmental conditions
Test level	Mains power voltage variations: ▪ upper voltage limit ($V + 10\%$); ▪ lower voltage limit ($V - 15\%$) Battery power voltage variations: ▪ upper voltage limit (not applicable); ▪ lower power voltage: (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}.
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 2.10.1.1 to 2.10.1.12 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.

2.10.7.5 Short-time power reductions (see R 60-1, 5.7.2.5 Disturbances)

This test is conducted to verify compliance with R 60-1, 5.7.2.2, R 60-1, 5.7.2.3, and R 60-1, 5.7.2.4 under conditions of short-time power reductions

Applicable standards:

For load cells powered by DC mains: IEC 61000-4-29 [15]; IEC 61000-4-1 [14]

For load cells powered by AC mains; IEC 61000-4-11 [16]; IEC 61000-6-1 [17]; IEC 61000-6-2 [18]

Test method	Expose load cell to specified short-timer power reductions
Test conditions	In accordance with 2.7.3.1 Environmental conditions
Preconditioning of load cell	Stabilise load cell under constant environmental conditions

<table>
<tr><td>Test load</td><td>The test shall be performed with no load or with one small test load (10 v).</td></tr>
<tr><td>Test level</td><td>
<table>
<tr><th>Test</th><th>Reduction to:</th><th>Duration/number of cycles</th></tr>
<tr><td>Test a</td><td>0 %</td><td>0.5</td></tr>
<tr><td>Test b</td><td>0 %</td><td>1</td></tr>
<tr><td>Test c</td><td>40 %</td><td>10</td></tr>
<tr><td>Test d</td><td>70 %</td><td>25</td></tr>
<tr><td>Test e</td><td>80 %</td><td>250</td></tr>
<tr><td>Short interruption</td><td>0 %</td><td>250</td></tr>
</table>
</td></tr>
<tr><td>Test procedure in brief</td><td>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 load cell shall be exposed to short interruptions of power. The mains voltage reductions shall be repeated ten times at intervals of at least 10 seconds.</td></tr>
</table>

2.10.7.6 Bursts (electrical fast transients) (see R 60-1, 5.7.2.5 Disturbances)

This test is conducted to verify compliance with the provisions in R 60-1, 5.7.2.5 during conditions where electrical bursts are superimposed on the mains voltage.

Applicable standards:

IEC 61000-4-4 [19]: No. 5 (Test 2+| severity), No. 6 (Test instrumentation), No. 7 (Test set-up), No. 8 (Test procedure).

<table>
<tr><td>Test method</td><td>Introducing transients on the mains power lines</td></tr>
<tr><td>Test conditions</td><td>In accordance with 2.7.3.1 Environmental conditions</td></tr>
<tr><td>Preconditioning of load cell</td><td>Stabilise load cell under constant environmental conditions</td></tr>
<tr><td>Test level</td><td>Level 3 in accordance with referenced standard: IEC 61000-4-4 No.5
Open circuit output test voltage for:
▪ power supply lines: 2 kV;
▪ I/O signal, data, and control lines: 1 kV.</td></tr>
<tr><td>Test load</td><td>The test shall be performed with no load or with one small test load</td></tr>
<tr><td>(10 v).</td><td>Test procedure in brief</td></tr>
<tr><td></td><td>This test consists of exposing the load cell to specified bursts of voltage spikes.
A burst generator as defined in the referred standard [IEC 61000-4-4 Ed 3.0 (2012-04)] shall be used. The characteristics of the generator shall be verified before connecting the EUT.</td></tr>
</table>

	The test shall be applied separately to: a) power supply lines; b) I/O circuits and communication lines, if any.

2.10.7.7 Surge (see R 60-1, 5.7.2.5 Disturbances)

This test is conducted to verify compliance with the provisions in R 60-1, 5.7.2.5 during conditions where electrical surges are superimposed on the mains voltage and I/O and communication ports.

Applicable standards:

IEC 61000-4-5 [20]

Test method	Exposing the load cell(s) to electrical surges on the mains power lines or on signal, data and control lines
Test conditions	In accordance with 2.7.3.1 Environmental conditions
Preconditioning of load cell	Stabilise load cell under constant environmental conditions
Test level	Level 3 Amplitude (peak value) Power supply lines: 1 kV (line to line) and 2 kV (line to earth)
Test load	The test shall be performed with no load or with one small test load ($10v$).
Test procedure in brief	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 10 m or those lines partially or fully installed outside the buildings regardless of their length). This test shall be conducted unless there is justification provided regarding the specific details of the intended use and installation which would render this test unnecessary. The justification for not conducting this test shall be noted in the test report. 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.). 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. The test shall be applied to power supply 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.). 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.
Notes	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.

2.10.7.8 Electrostatic discharge (see R 60-1, 5.7.2.5 Disturbances)

This test is conducted to verify compliance with the provisions in R 60-1, 5.7.2.5 in case of direct exposure to electrostatic discharges or such discharges in the neighbourhood of the load cell.

Applicable standard:

IEC 61000-4-2 [21]: No. 6 (test generator), No. 7 (set-up), No. 8 (test procedure).

Test method	Exposure to electrostatic discharge (ESD)
Test conditions	In accordance with 2.7.3.1 Environmental conditions
Preconditioning of the load cell	Stabilise the load cell under constant environmental conditions
Test procedure in brief	The test comprises exposure of the load cell to electrical discharges. An ESD generator as defined in the referred standard shall be used and the test set-up shall comply with the dimensions, materials used and conditions as specified in the referred standard. Before starting the tests, the performance of the generator shall be verified. At least 10 discharges per preselected discharge location shall be applied. The time interval between successive discharges shall be at least 10 seconds. This test includes the paint penetration method, if appropriate; For direct discharges, the air discharge shall be used where the contact discharge method cannot be applied. Contact discharge is the preferred test method. Air discharge is far less defined and reproducible and therefore shall be used only where contact discharge cannot be applied. Direct application: In the contact discharge mode to be carried out on conductive surfaces, the electrode shall be in contact with the EUT before activation of the discharge. In such case the discharge spark occurs in the vacuum relays of the contact discharge tip. On insulated surfaces only the air discharge mode can be applied. The load cell is approached by the charged electrode until a spark discharge occurs Indirect application: The discharges are applied in the contact mode only on coupling planes mounted in the vicinity of the load cell. For load cells not equipped with a ground terminal, the load cell shall be fully discharged between discharges.
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.
Test load	The test shall be performed with no load or with one small test load ($10v$)

2.10.7.9 Exposure to radiated RF electromagnetic fields (see R 60-1, 5.7.2.5 Disturbances)

This test is conducted to verify compliance with the provisions in R 60-1, 5.7.2.5 under conditions of exposure to electromagnetic fields.

Applicable standard:

IEC 61000-4-3 [22]: No. 6 (test generator), No. 7 (test set-up), No. 8 (test procedure)

Test method	Exposure to specified electromagnetic fields
Test conditions	In accordance with 2.7.3.1 Environmental conditions
Preconditioning of the load cell	Stabilise the load cell under constant environmental conditions.
Test procedure in brief	The load cell is exposed to electromagnetic fields with the required field strength and the field uniformity as defined in the referred standard. The level of field strength specified refers to the field generated by the unmodulated carrier wave. The load cell shall be exposed to the modulated wave field. The frequency sweep shall be made only pausing to adjust the RF signal level or to switch RF-generators, amplifiers and antennas if necessary. Where the frequency range is swept incrementally, the step size shall not exceed 1 % of the preceding frequency value. The dwell time of the amplitude modulated carrier at each frequency shall not be less than the time necessary for the load cell to be exercised and to respond, but shall in no case be less than 0.5 s. Adequate EM fields can be generated in facilities of different type and set-up the use of which is limited by the dimensions of the load cell and the frequency range of the facility.
Test load	The test shall be performed with no load or with one small test load (10 v).
Test levels	Level 3: Frequency range: 80 MHz[a] to 3 000 MHz; Field strength: 10 Vm^{-1}; Modulation: 80 % AM, 1 kHz sine wave.
[a] Frequency range used in conventional testing shall be 80 MHz to 3 000 MHz, for load cells with power lines or I/O ports. The lower limit of frequency of electromagnetic field is 26 MHz for load cells without power lines or I/O ports, and for which the test for conducted electromagnetic field (2.10.7.10) is inapplicable.	

2.10.7.10 Exposure to conducted (common mode) currents generated by RF EM fields (see R 60-1, 5.7.2.5 Disturbances)

This test is conducted to verify compliance with the provisions in R 60-1, 5.7.2.5 while exposed to electromagnetic fields

Applicable standard: IEC 61000-4-6 [23]

Test method	Exposure of the load cell to disturbances induced by radiated radio-frequency fields.

Test conditions	In accordance with 2.7.3.1 Environmental conditions
Preconditioning of the load cell	Stabilise the load cell under constant environmental conditions.
Test procedure in brief	A RF EM current, simulating the influence of EM fields shall be coupled or injected into the power ports and I/O ports of the load cell using coupling/decoupling devices as defined in the referred standard. The characteristics of the test equipment consisting of an RF generator, (de-)coupling devices, attenuators, etc. shall be verified before connecting the load cell.
Test load	The test shall be performed with no load or with one small test load ($10v$).
Test level index	Level 3 (in accordance with the referred standard) Frequency range: 0,15 MHz—80 MHz RF amplitude (50 Ω): 10 V(emf) Modulation: 80 % AM, 1 kHz, sine wave
Notes	This test is not applicable for load cells without mains power supply or other input port.

2.10.7.11 Span stability (see R 60-1, 5.7.2.6) (not applicable to class A load cells)

Test procedure in brief:

The test consists in observing the variations of the output of the load cell under reasonably constant (± 2 °C) conditions (e.g. in a normal laboratory environment) at various intervals before, during and after the load cell has been subjected to performance tests. The performance tests shall include (as a minimum) the temperature test. The damp heat test shall be performed when applicable but may be performed after a series of span stability tests if the conduct of that test during the span stability test imposes an increased risk that the principles expressed under 2.7.3.3. would be compromised. This may be a greater concern when conducting tests on higher capacity load cells.

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 stabilised 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:

28 days or the period necessary for the performance tests to be carried out, whichever is shorter, for temperature and humidity tests.

The duration may be increased to 40 days for CH marked load cells only.

Time between measurements:

Between 1/2 day (12 hours) and 10 days (240 hours) for SH marked load cells, and 14 days for CH marked load cells, 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.

Stabilise all factors at sufficiently constant ambient conditions.

Each set of measurements shall consist of the following:

a) preload 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) stabilise 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 1 in 2.8.3, 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 for full recovery of the load cell before any other tests are performed.

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.

2.11 Test sequence

2.11.1 Test sequence for test temperatures

The recommended test sequence for each test temperature when all tests are carried out in the same force-generating system is shown in Figure 2.

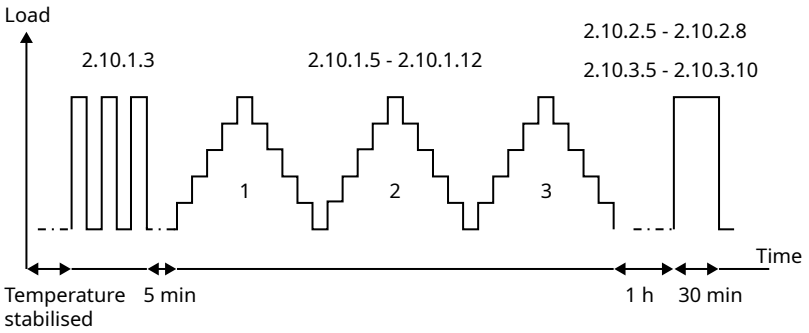


Figure 2 — Recommended test sequence for each test temperature when all tests are carried out in the same force-generating system

2.11.2 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 3.

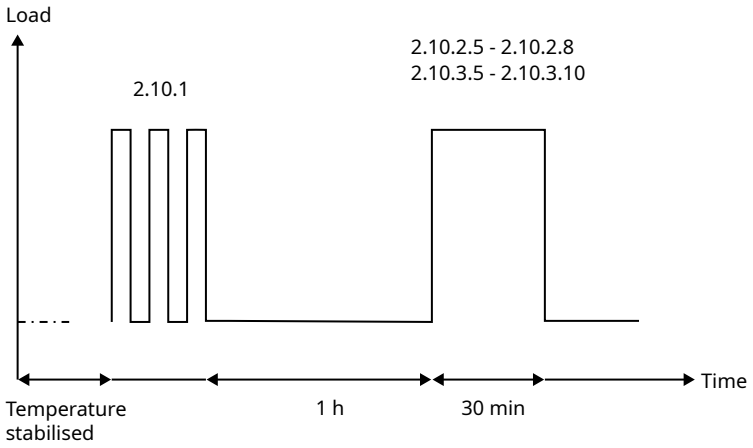


Figure 3 — Recommended test sequence for each test temperature for the minimum dead load output return (DR) and creep tests when carried out in a machine different from that used for the load tests

2.12 OIML certificate

2.12.1 Preparation of certificate

The OIML certificate shall be prepared according to the rules contained within OIML B 18 *Framework for the OIML Certification System (OIML-CS)* [6] and OIML-CS Procedural DocumentPD-05 [29]. The certificate template (which may be downloaded from the "Documentation" section under the OIML-CS part of the OIML website) shall be supplemented with the information as specified in Annex B. In addition, Annex C provides an example of the supplemental information that may be included in the OIML certificate and is included in this Recommendation to complement the template.

2.12.2 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.