Improved Third Committee Draft (3CD)
Minor Change Procedure for vote and comment

Clean version

Project:	New OIML Recommendation (OIML R xxx-2)
Title:	Continuous totalizing automatic weighing instruments of the arched chute type Part 2: Test procedures
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Convenership:	UK
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☐ Discussion at (date and place of meeting):

☐ Comments by:

☒ Vote (P-members only) and comments by: **13 March 2020**

Contents- TO BE FINALISED ON PUBLICATION

Explanatory Note

The continuous totalizing automatic weighing instrument described in this Recommendation is not a beltweigher.

Functionally the arched chute weigher described is comparable to a beltweigher. The current OIML R 50 is not applicable to such instruments because it only deals with the technical and metrological aspects of beltweighers. This can be seen from the title and scope of OIML R 50. From a historical point of view the focus of OIML R 50 on beltweighers is understandable and the arched chute weigher described in this new Recommendation is a rather recently developed technique.

The same is true for the continuous totalizing automatic weighing instruments as described in the European Measurement Instruments Directive (MID) and may be incorporated in the legislation in other regions or counties as well.

Since OIML Recommendations are intended to be independent of the technology applied it would be expected that OIML R 50 would fit the purpose, however OIML R 50 is restricted to the beltweigher type and although it was revised only a short time ago, for the time being it is considered to be more efficient to produce a Recommendation which only covers this new type of continuous totalizing automatic weighing instrument.

The vote results on the 3CD of the proposed "arched chute" Recommendation were as follows:

Yes: 12
No: 2
Abstain: 1

This means that 14 of the 26 P-members cast a vote, and 12/14, or 85.7 % were in favour. According to B 6-1, 15.12.2.2, this means that the 3CD is approved by the PG.

In accordance with the options in B 6-1, 6.4.2.4, the 3CD had received some non-editorial comments, which will improve the CD, and which I think can be easily and effectively implemented with a high probability of good consensus in the PG, in accordance with the “minor change procedure” in 6.5.2.5.

This amended 3CD is submitted for another round of votes and comments.

I am hoping that we can finalise this project in time for the October 2020 CIML. It is important to bear in mind that this is a new Recommendation for a specific type of instrument. The US has shown that the patent issue should not be a barrier, and OIML Recommendations are performance-based requirements not technology specific so it is difficult to address all technical issues to everyone's satisfaction. Time and usage of the Recommendation will provide opportunities for improvement.

Foreword

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Continuous totalizing automatic weighing instruments of the arched chute type

Part 2 – Test procedures

1 Examination for type approval

1.1 Documentation (Part-1, 6.1.1)

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

1.2 Compare construction with documentation

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

1.3 Metrological characteristics (Part-3, 1.7)

Note the metrological characteristics according to the test report format in Part-3 [24].

1.4 Technical requirements

Check for conformity with the technical requirements using the checklist given in the test report format in Part-3 [24].

1.5 Functional requirements

Check for conformity with the functional requirements using the checklist given in the test report format in Part-3 [24].

2 Examination for initial verification

2.1 Compare construction with documentation

Examine the instrument for conformity with the approved type.

2.2 Descriptive markings (Part-1, 4.6)

Check the descriptive markings according to the checklist given in the test report format in Part-3 [24].

2.3 Sealing and verification marks (Part-1, 4.7)

Check the arrangements for sealing and verification marks according to the checklist given in the test report format in Part-3 [24].

3 General requirements for equipment under test (EUT)

3.1 Power supply stabilizing time

Unless otherwise specified, prior to each performance test the equipment under test (EUT) shall be switched on and kept energized for a time period equal to or greater than the warm-up time specified by the manufacturer and subsequently kept energized for the duration of the test.

3.2 Zero-setting

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

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

3.3 Temperature

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

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

3.4 Recovery

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

3.5 Warm-up time (5.2, Part-1, 5.5.4)

The instrument shall be subjected to a warm-up test in accordance with 5.2.

3.6 Automatic zero-setting

During the tests, the effect of the automatic zero-setting device may be switched off by use of the interlock facility (see Part-1, 4.4.1). Where necessary the status of the automatic zero-setting is defined in the test description.

3.7 Evaluation of error (4.6)

The calculation of the relative errors is as specified in 4.6.

3.7.1 Greater resolution of the control instrument (9.2)

If a control instrument with sufficient resolution is not available for product tests as specified in 9.2, the greater resolution of the control instrument may be ensured by using change point weights in the way described below.

3.7.1.1 General method to assess error prior to rounding

At a certain load, L, the indicated value, I, is noted. Additional weights of 0.1 d are successively added until the indication of the instrument is increased unambiguously by one scale interval ($I + d$). The additional load of ΔL added to the force simulation platform gives the true indication, P, prior to rounding by using the following formula:

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

The error prior to rounding is:

$$E = P - L$$

Thus:

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

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

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

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

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

3.7.1.2 Correction for error at zero

Evaluate the error at zero load, (E_0) and the error at load L, (E), by the method of 3.7.1.1.

The corrected error prior to rounding, (E_c) is:

$$E_c = E - E_0$$

Example: if, for the example in A3.7.1.1, the error calculated at zero load was:

$$E_0 = +0.4 \text{ kg},$$

The corrected error is:

$$E_c = 0.2 \text{ kg} - (+0.4 \text{ kg}) = -0.2 \text{ kg}$$

3.7.2 Indication with a scale interval smaller than or equal to 0.2 *d*

When an instrument having a digital indication is equipped with a device displaying the indication by using a scale interval of less than 1 *d* (e.g. ≤ 0.2 *d*), this device may be used for calculation of the error. When such a device is used, this should be recorded in the test report.

3.7.3 Indication with a scale interval greater than 0.2 *d*

If a device with a scale interval smaller than or equal to 0.2 *d* is not available, the following method may be used to determine the error. Allow the instrument to run for a time such that the number of *d* is equal to five times the value in Part-1, 3.4 Table 3.

Example: Class 1 instrument:

a) MPE 0.35 % (from Part-1, 3.2.2 Table 2)

b) Σ_{min} value 400 *d* (from Part-1, 3.4 Table 3)

c) 5 × 400 *d* = 2 000 *d*

d) Therefore MPE= 7 *d*

The error can therefore be found to 1 *d*, i.e.: 1/7 of MPE.

This is equivalent to a test load of 400 *d* (Σ_{min} value from Part-1, 3.4 Table 3) using a test scale of 0.2 *d*, since:

a) MPE = 1.4 *d*

b) 1/7 MPE= 0.2 *d*

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

Note: Any error in the mass flow measurement must be taken into account.

3.8 Test program

3.8.1 Type evaluation (4)

All tests in clauses 5 to 9 shall be applied for type evaluation, using the test methods specified in 4.

3.8.2 Initial verification (4)

Clauses 8 and 9 shall be applied.

4 Test methods

4.1 General test procedure

In-situ product tests shall be done as follows:

a) in accordance with the descriptive markings in Part-1, 4.6;

b) under the conditions of use for which the arched chute weigher is intended;

c) applying a quantity of product not less than the minimum totalized quantity, Σ_{min}, for initial verification and in-service verification (see Part-1, 3.4, Table 3);

d) using test load(s) that represents the range and type of products for which the arched chute weigher is likely to be used or product(s) for which the instrument is intended;

e) at mass flowrates between the maximum and minimum values.

4.2 Verification standards

4.2.1 Control instruments and standard weights

A control instrument and standard weights meeting the appropriate requirements in 9.2 shall be available for determining the true quantity value of the mass of each test load.

The control instrument used for product testing shall enable the determination of the true quantity value of the mass of each test load to an accuracy of at least one-third of the appropriate maximum permissible error for automatic weighing in Part-1, 3.2.1 Table 1.

If necessary, the control instrument shall be checked immediately following completion of the weighing to ascertain whether or not its performance has changed.

The standard weights used as reference for the type examination or verification of an instrument shall meet the metrological requirements of OIML R 111 [5].

4.3 Simulation tests (test with static load)

For testing the metrological characteristics of arched chute weighers, standard weights may be used to simulate the mass flow. The EUT shall be fitted with:

a) a complete force receptor (including the arched chute),

b) a force simulation platform,

c) a device enabling the comparison of integrations of a constant load provided by weight(s) applied to the force simulation platform and integrations of constant mass flow as measured by the force receptor.

The test load is to be placed on the platform. The duration of each zero totalization shall be equal to the time needed to totalize at the maximum mass flowrate, Qm_{max}.

4.4 True quantity value of the mass of the test load

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

b) During simulation tests, the true quantity value of the mass of the test load shall be the totalised mass calculated from test parameters including the standard weight used as test load, and the totalization time span).

4.5 Indicated mass

a) When applying the in-situ tests control method (9), the known test load shall be used for an automatic bulk weighing operation and the indication of the totalized mass shall be observed and recorded.

b) During simulation tests, an automatic bulk weighing operation shall be conducted using standard weights placed on the force simulation platform. The indicated mass shall be observed and recorded, with simulated mass respectively increased to five times that at totalization of Σ_{min}. Alternatively, a supplementary totalization indicating device with a higher resolution (2.4.2.6) may be used to indicate the mass of the test load to at least ten times the resolution of the totalization scale interval.

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

4.6 Calculation of relative errors (3.7)

The relative error, E_r is given as:

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

Note: This only is true for non-rounded indications.

For the in-situ tests –control method:

$$E_r(\%) = \frac{(\text{Arched chute weigher indication} - \text{Control instrument indication})}{\text{Control instrument indication}} \times 100$$

For the simulation tests:

$$E_r(\%) = \frac{(\text{Totalization displayed} - \text{Totalization calculated})}{\text{Totalization calculated}} \times 100$$

The true quantity value is as specified in 4.4 and the indicated (or displayed) mass is as specified in 4.5.

The error value expressed as a percentage (%) shall be used for comparison with the appropriate maximum permissible errors for automatic weighing in Part-1, 3.2.1.

5 Metrological performance tests

5.1 General conditions

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

Standard weights may be used to simulate the effect of a mass flow.

The test weight on the force receptor is to be placed on the force simulation platform, if necessary, by using special equipment. The duration of each zero totalization shall be equal to the time needed to totalize the minimum totalized quantity, Σ_{min} at the maximum mass flowrate, $Qm_{max.}$

5.2 Warm-up time test (3.5, Part-1, 5.5.4)

Warm-up tests are used to verify that the arched chute weigher and the material flow have reached a state of equilibrium to support performance stability and maintain metrological performance in the period immediately after switch on.

The method is to check that errors comply with the requirements during the first 30 minutes of operation, or for a period of time at least equal to the warm-up time specified by the manufacturer. It shall be checked that the operation of the arched chute weigher is inhibited and that there is no indication or transmission of the result of weighing until the warm-up time has elapsed.

Zero-tracking and automatic zero-setting (if available) shall be disabled, unless if the zero-setting operates as part of every automatic weighing cycle in which case this function shall be enabled or simulated as part of the test.

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

Test A

Set the arched chute weigher to zero and carry out a totalization of Σ_{min} with a load on the force simulation platform to equate to $Q\mathrm{m}_{min}$. Note the totalization and the exact duration of the test.

Test B

Immediately carry out a totalization of Σ_{min} with a load corresponding to $Q\mathrm{m}_{max}$ for exactly the same duration as used in Test A. Note the totalization.

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

Calculation of error shall be made in accordance with 3.7.3. The relative errors, expressed as a percentage, shall not be greater than the maximum permissible error for the influence factor tests (R 50-1, 3.2.2, Table 2) appropriate for the class.

5.3 Product tests control method (4.1)

The product tests are conducted as indicated in 4 and 9.

This control instrument is used to weigh the product either before or after it is weighed on the arched chute weigher. The control instrument used for product testing shall comply with the requirements of 4.2.1.

The error for automatic weighing is calculated in accordance with 4.6 for in-situ tests. When calculating the error, it is necessary to consider the scale interval of the indicating device of the control instrument.

5.4 Variation in the mass inflow rate (Part-1, 3.7.1)

Simulate the arched chute load or operate the infeed device and allow it to stabilize.

Carry out each test over the same number of integrations of simulated mass flow without zero-setting after changing the mass flowrate setting using test loads or a simulated load and sequentially introducing a force corresponding to

a) a mass flowrate $Q\mathrm{m}_{min}$ or as indicated in 3.7.3) five times the value in Part-1, 3.4 Table 3;

b) a mass flowrate of 90 % of $Q\mathrm{m}_{max}$

c) a mass flowrate of 110 % of $Q\mathrm{m}_{max}$

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

The errors shall be calculated in accordance with 3.7.3. Errors shall not exceed the appropriate maximum permissible errors for influence factor tests in Part-1, 3.2.2 Table 2.

5.5 Eccentric inflow (Part-1, 3.7.2)

For proper operation the arched chute and mass inflow needs to be inline. (Part-1, 4.5.1.1) If because of the chute construction a deviation could occur this construction shall allow the aligning of the mass flow to the chute.

Under normal circumstances eccentric mass inflow will either have no effect if the alignment of inlet and chute is optimized or will have a huge effect causing the product to clog. If clogging occurs a mass flow control checking facility should activate an alarm.

Clogging however cannot be simulated without product therefore any response can only be verified in-situ (see 9.1.1).

5.6 Zero-setting (Part-1, 4.4)

5.6.1 Range of zero-setting device (Part-1, 4.4)

With the force receptor empty, set the arched chute weigher to zero. Place a test load (weights) on the force simulation platform and operate the zero-setting device. Continue to increment the test load until operation of the zero-setting device fails to re-zero the arched chute weigher. The maximum load that can be re-zeroed is the positive portion of the zero-setting range.

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

Re-zero the arched chute weigher without this additional load.

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

5.6.2 Accuracy of zero-setting (Part-1, 4.4.1)

After setting the arched chute weigher to zero, determine the error for loads equivalent to 50 % and 100 % of the positive and negative zero-setting ranges.

The errors shall be calculated in accordance with 3.7.3 and shall not exceed the appropriate maximum permissible errors for influence factor tests in Part-1, 3.2.2, Table 2.

The duration of each zero totalization shall be equal to the time required to weigh the minimum totalized quantity, Σ_{min} at the maximum mass flowrate, Q_{max}.

6 Additional functionality

6.1 Agreement between multiple indicating devices (Part-1, 3.3)

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

6.2 Adjustments in automatic operating mode (Part-1, 4.2.2)

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

6.3 Securing of components and pre-set controls (Part-1, 4.2.7)

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

6.4 Totalization indicating and printing devices (Part-1, 4.3)

For indication of the results, verify that

a) totalization indicating and printing devices are permanently engaged (Part-1, 4.3.6 a),

b) in automatic operation the totalization devices cannot be reset to zero (Part-1, 4.3.6 b),

c) when automatic operation is finished the partial totalization device cannot be reset to zero unless the total is automatically recorded. Test by disabling the general totalization indicating device and attempting to reset the partial totalization device (Part-1, 4.3.6),

d) the scale interval of a partial totalization indicating device is equal to the scale interval of the general totalization indicating device (Part-1, 4.3.3.2),

e) the scale interval of a supplementary totalization indicating device is at least equal to 10 times the totalization scale interval (Part-1, 4.3.8),

f) at least one totalization indicating device on arched chute weighers shall be capable of indicating a value equal to the quantity of product weighed in 10 hours of operation at maximum mass flowrate (Part-1, 4.3.4),

g) an automatic indication of the total is generated if the automatic operation is interrupted (Part-1, 4.3.6).

6.5 Retention of totalization value after power supply failure (Part-1, 5.5.5)

Switch off power to the arched chute weigher while the general totalization device is indicating a totalization value of not less than Σ_{min}. Verify that this totalization value is retained for at least 24 hours and is capable of indicating that information for at least 5 minutes following switch-on.

6.6 DC mains voltage or battery voltage variations (Part-1, 5.5.6)

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

7 Influence factors and disturbance tests during type evaluation

7.1 General

Arched chute weighers shall comply with the influence factor and disturbance tests conditions and requirements specified in Part-1.

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

It is not possible to apply these tests to an arched chute weigher that is performing an automatic operation with product loaded on the running arched chute. The arched chute weigher shall therefore be subjected to the influence factors and disturbances under simulated operation as defined herein. The

permissible effects of the influence factors or disturbances, under these conditions, are specified for each case.

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

Where parts of the arched chute weigher are examined separately, errors shall be apportioned in accordance with Part-1, 6.1.6.7.

The operational status of the arched chute weigher or simulator shall be recorded for each test.

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

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

7.1.1 Using a simulator (4.3)

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

The simulation should include standard weights and a force simulation platform, and the EUT shall be fitted as specified in 4.3. If a simulator is used to test a module, the repeatability and stability of the simulator shall make it possible to determine the performance of the module with at least the same accuracy as when a complete arched chute weigher is tested with weights, the MPE to be considered being those applicable to the module.

Other methods which enable the weighing function to be verified may be used as appropriate. The maximum permissible errors, in terms of mass, will be the same regardless of the method used.

Whichever method is used, this shall be noted in Part-3 (Test report format).

7.1.2 Interfaces (Part-1, 5.6)

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

7.2 Influence factor tests (Part-1, 3.7.3)

Summary of tests

Test	Criteria	§
Static temperatures	MPE*	7.2.1
Temperature effect at zero mass flowrate	See 7.2.1	7.2.2
Damp heat, steady-state test (non-condensing)	MPE*	7.2.3.1
Damp heat, cyclic test(condensing)	MPE*	7.2.3.2
AC mains voltage variation	MPE*	7.2.4
DC mains voltage variation	MPE*	7.2.5
Battery voltage variation	MPE*	7.2.6

* maximum permissible errors as specified in Part-1, 3.2.2

7.2.1 Static temperatures (Part-1, 3.7.3.1)

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

(See Figure 1 below as a practical approach to performing the temperature tests)

Table 1 – Static temperature test

Environmental phenomenon	Test specification	Test setup
Temperature	Reference temperature of 20 °C	
	Specified high temperature for 2 hours	IEC 60068-2-2
	Specified low temperature for 2 hours	IEC 60068-2-1
	Temperature of 5 °C, if the specified low temperature is ≤ 0 °C	IEC 60068-3-1
	Reference temperature	

Note 1: Use IEC 60068-3-1 for background information.

Note 2: The static temperatures test is considered as one test.

Object of the test:	To verify compliance with the provisions in Part-1, 3.7.3.1 under conditions of dry heat (non-condensing) and cold. The test in 7.2.2 may be conducted during this test.
Preconditioning:	16 hours.
Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. The zero-setting facilities shall be enabled as for normal operation.
Test procedure in brief:	The test comprises exposure to the specified high temperature in Part-1, 3.7.3.1 for 2 hours under “free air” conditions a) at the reference temperature of 20 °C, b) at the specified high temperature, c) at the specified low temperature, d) at a temperature of 5 °C, if the specified low temperature is below 0 °C, and e) at the reference temperature. “Free air” conditions mean a minimum air circulation to keep the temperature at a stable level.
Number of test cycles:	At least one test cycle is conducted.
Test information:	Adjust the EUT as close to zero indication as practicable prior to the test. The EUT shall not be readjusted at any time during the test. Changes in barometric pressure shall be taken into account. After stabilization at the reference temperature and again at each specified temperature, observe the indications for a test or simulated load, at least Σ_{min}, two times each at approximately the minimum mass flowrate, an

	intermediate mass flowrate, and the maximum mass flowrate and repeated again at the minimum mass flowrate. Record a) date and time, b) temperature, c) relative humidity, d) test load, e) indications (as applicable), f) errors, g) functional performance, h) barometric pressure.
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in Partt-1, 3.2.2, Table 2.

7.2.2 Temperature effect at zero mass flowrate test (Part-1, 3.7.3.2)

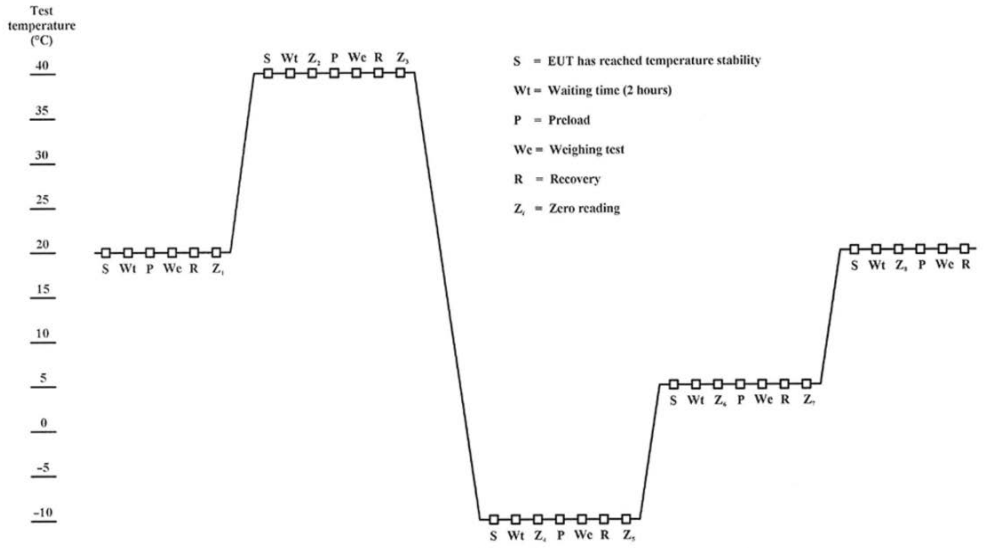
Supplementary test information:

Preconditioning:	None required.
Object of the test:	Dry heat (non-condensing) and cold. This test may be performed together with the temperature test in 7.2.1. To verify compliance with the provisions in Part-1, 3.7.3.2 over the operating temperature range.
Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to a zero indication as practicable prior to the test. It shall not be adjusted or readjusted at any time during the test except to reset the EUT if a significant fault has been indicated. It is important to ensure that the test result is unaffected by the automatic zero-setting function, which should therefore be disabled.
Test procedure in brief:	The test is conducted at the temperature points specified in 7.2.1 and the differences between indications as required in Part-1, 3.7.3.2 to be calculated for temperature differences of 5 °C. At each temperature, the EUT shall be tested at zero mass flowrate, using the totalization indicating device for zero-setting. The rate of change of temperature between totalizations shall not exceed 5 °C per hour. Test duration is for 2 hours.
Number of test cycles:	At least one test cycle is conducted.
Test information:	a) Stabilize the EUT in the chamber at the specified minimum temperature (normally –10 °C). Perform a zero-setting routine. b) Conduct the test as specified in the test procedure in brief and record the following data: i) date and time; ii) temperature;

	iii) relative humidity; iv) duration of test; v) totalized indication; vi) errors. c) Increase the temperature by 10 °C and allow to stabilize. Maintain at that temperature for 2 hours. Repeat the test and record the data as in b) above. d) Repeat c) above until the specified maximum temperature is reached (normally +40 °C).
Maximum allowable variations:	The difference between successive totalizations shall comply with the requirements in Part-1, 3.7.3.2.

Figure 1

Proposed test sequence for test **7.2.1** combined with **7.2.2**
(temperature test where the temperature limits are + 40 °C / – 10 °C



7.2.3 Damp heat test (Part-1, 5.5.3)

The tests in 7.2.3.1 or 7.2.3.2 may be performed alternatively in accordance with Part-1, 5.5.3, the option chosen being mentioned in the type approval certificate.

7.2.3.1 Damp heat, steady state test (non-condensing)

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

Table 2 – Damp heat, steady state test (non-condensing)

Environmental phenomenon	Test specification	Test setup
Damp heat, Steady state	Upper limit temperature and relative humidity of 85 % for 48 hours.	IEC 60068-2-78 IEC 60068-3-4

Note: Use IEC 60068-3-4 for guidance for damp heat tests.

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in Part-1, 5.1.1 under conditions of constant temperature (see 3.3) and a constant relative humidity. The steady-state test should always be used where adsorption or absorption play the main part. When diffusion but not breathing is involved, either the steady-state or the cyclic test shall be prescribed depending on the type of EUT and its application.
Preconditioning:	None required.
Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. The zero-setting facilities shall be enabled as for normal operation. The handling of the EUT shall be such that no condensation of water occurs on the EUT.
Test procedure in brief:	Stabilization is 3 hours at reference temperature and 50 % humidity. And at least 48 hours at the upper limit temperature as specified in Part-1, 3.7.3.1.
	Reference temperature is normally 20 °C or the mean value of the temperature range whenever 20 °C is outside this range, and the upper limit is as specified in Part-1, 3.7.3.1.
	Temperature-humidity 48 hour sequence: a) Reference temperature at 50 % humidity; b) Upper limit temperature at 85 % humidity; c) Reference temperature at 50 % humidity.
Test information:	After stabilization of the EUT at reference temperature and 50 % humidity, observe the indications for a test or simulated load, at least Σ_{min}, two times each at approximately the minimum mass flowrate, an intermediate mass flowrate, the maximum mass flowrate, and repeated again at the minimum mass flowrate. Record a) date and time, b) temperature, c) relative humidity, d) test load, e) indications (as applicable), f) errors, g) functional performance, h) barometric pressure. Increase the temperature in the chamber to the upper limit and increase the relative humidity to 85 %. Maintain the EUT at no load for a period of 48 hours. Following the 48 hours, apply the same test loads or simulated loads and record the data as indicated above.

	Decrease the relative humidity to 50 % and decrease the temperature in the chamber to the reference temperature. After stabilization of the EUT, apply the same test loads or simulated loads and record the data as indicated above. Allow full recovery of the EUT before any other tests are performed.
Number of test cycles:	At least one test cycle is conducted.
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in Part-1, 3.2.2, Table 2.

7.2.3.2 Damp heat, cyclic test (condensing)

Damp heat, cyclic tests are carried out according to basic standard IEC Publication 60068-3-4 [15] and IEC Publication IEC 60068-2-30 [26] and according to Table 3.

Table 3 – Damp heat, cyclic test (condensing)

Environmental phenomenon	Test specification	Test setup
Damp heat, cyclic test (condensing)	24 hour cyclic temperature variations between reference temperature and the appropriate upper temperature, maintaining the relative humidity above 95 % during the temperature change and low temperature phases, and at 93 % at the upper temperature phases	IEC 60068-2-30 IEC 60068-3-4

Note: Use IEC 60068-3-4 for guidance for damp heat tests.

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in Part-1, 5.1.1 under conditions of high humidity when combined with cyclic temperature changes. Damp heat, cyclic tests shall be applied in all the cases where condensation is important or when the penetration of vapour will be accelerated by the breathing effect.
Preconditioning:	None required.
Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. The zero-setting facilities shall be enabled as for normal operation. Condensation should occur on the EUT during the temperature rise.
Test procedure in brief:	The 24 hour cycle consists of a) temperature rise during the first 3 hours, b) temperature maintained at upper value until 12 hours from the start of the cycle, c) temperature lowered to lower value within a period of 3 to 6 hours, the rate of fall during the first hour and a half being such that the lower value would be reached in 3 hours, d) temperature maintained at the lower value until the 24 hour cycle is completed.

	The stabilizing period before and recovery after the cyclic exposure shall be such that all parts of the EUT are within 3 °C of their final temperature.
Test information:	After stabilization of the EUT at standard atmospheric conditions, observe the indications for a test or simulated load, at least Σ_{min}, two times each at approximately the minimum mass flowrate, an intermediate mass flowrate, and the maximum mass flowrate, and repeated again at the minimum mass flowrate. Record a) date and time, b) temperature, c) relative humidity, d) test load, e) indications (as applicable), f) errors, g) functional performance, h) barometric pressure. Repeat the above for the second test cycle. Allow full recovery of the EUT before any other tests are performed.
Number of test cycles:	At least two test cycles are conducted: Test 1: At reference temperature and 50 % R.H. immediately before the cyclic humidity test start. Test 2: At reference temperature and 95 % R.H. immediately after the last cycle has ended.
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in Part-1, 3.2.2, Table 2.

7.2.4 AC mains voltage variation (Part-1, 3.7.3.3, 5.5.5)

AC mains voltage variations tests are carried out in accordance with IEC 61000-4-11[17], and according to Table 4.

Table 4 – AC mains voltage variation test

Environmental phenomenon	Test specification		Test setup
AC mains voltage variation	U_{nom}		IEC 61000-4-11
	Upper limit:	$1.10 \times U_{nom}$ or $1.10 \times U_{max}$	
	Lower limit:	$0.85 \times U_{nom}$ or $0.85 \times U_{min}$	
	U_{nom}		

Note: Where an instrument is powered by a three phase supply, the voltage variation shall apply for each phase successively.

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in Part-1, 3.7.3.3 under conditions of AC mains voltage variation.

Preconditioning:	None required.
Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to zero indication as practicable, prior to the test. If it has an automatic zero-setting function then the instrument should be set to zero after applying each level of voltage.
Test procedure in brief:	The EUT shall be tested while observing the indications for a test or simulated load, at least Σ_{min} at the maximum mass flowrate, Q_{max}, for the duration of the test.
Test information:	Stabilize the EUT at the reference voltage within the defined limits and record the following data: a) date and time; b) temperature; c) relative humidity; d) AC voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance; i) barometric pressure. Repeat the test weighing for each of the voltages defined in IEC 61000-4-11 section 5 (noting the need in certain cases to repeat the test weighing at both ends of the voltage range) and record the indications.
Number of test cycles:	At least one test cycle is conducted.
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in Part-1, 3.2.2, Table 2.

7.2.5 DC mains voltage variation (Part-1, 3.7.3.3 and 5.5.5)

Tests of instruments with external or plug-in mains voltage (AC or DC) shall be conducted in accordance with 7.2, with the exception of 7.2.4, which is to be replaced by the test according to basic standard IEC Publication 61000-4-11 [17] and IEC Publication 60654-2 [16] and according to Table 5.

Table 5 – DC mains voltage variation test

Environmental phenomenon	Test specification		Test setup
Voltage variations of DC mains power supply	U_{nom}		IEC 60654-2
	Upper limit:	$1.20 \times U_{nom}$ or $1.20 \times U_{max}$	
	Lower limit:	minimum operating voltage (see Part-1, 3.7.3.3)	
	U_{nom}		

Note: Where a voltage range is marked, use the average value as nominal U_{nom}

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in Part-1, 3.7.3.3 under conditions of voltage variation in the DC mains supply.
Preconditioning:	None required.
Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to zero indication as practicable, prior to the test.
Test procedure in brief:	Changes in barometric pressure shall be taken into account.
Test information:	Stabilize the EUT at the reference voltage within the defined limits and record the following data while observing the indications for a test or simulated load, at least Σ_{min} at the maximum mass flowrate, Qm_{max}, for the duration of the test: a) date and time; b) temperature; c) relative humidity; d) supply voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance; i) barometric pressure. Reduce the voltage until the instrument ceases to function properly according to the specifications and metrological requirements, and record the indications.
Number of test cycles:	At least one test cycle is conducted.
Maximum allowable variations:	All functions shall operate correctly. All indications shall be within the maximum permissible errors specified in Part-1, 3.2.2, Table 2.

7.2.6 Battery voltage variation, not mains connected (DC) (Part-1, 3.7.3.3 and 5.5.6)

Battery-powered instruments shall fulfil the tests in 7.2, with the exception of 7.2.4 and 7.2.5 which shall be replaced by the test in Table 6.

Table 6 – Battery voltage supply (not mains connected)

Environmental phenomenon	Test specification		Test setup
Low voltage variation of fully charged battery supply voltage (DC)	U_{nom}		No reference to standards for this test
	Upper limit:	U_{nom} or U_{max}	
	Lower limit:	minimum operating voltage (see Part-1, 3.7.3.3)	
	U_{nom}		

Note: Where a voltage-range is marked, use the average value as nominal U_{nom}

Supplementary test information:

Object of the test:	To verify compliance with the provisions in Part-1, 3.7.3.3 under conditions of battery voltage supply variation. The requirements shall be met either by use of an equivalent variable DC voltage source or by allowing the battery voltage to fail by use.
Preconditioning:	None required.
Condition of the EUT	The EUT is connected to the battery power and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to a zero indication as practicable prior to the test. If it has an automatic zero-setting function as part of the automatic weighing process then the instrument should be set to zero after applying each level of voltage.
Test procedure in brief:	The test consists of subjecting the EUT to DC power variation when the former is operating under normal atmospheric conditions, while totalizing Σ_{min} at the maximum mass flowrate. Supply voltage is the lower limit, the voltage at which the EUT clearly ceases to function (or is automatically put out of service).
Test information:	Stabilize the EUT at nominal battery voltage and record the following data, while observing the indications for a test or simulated load, at least Σ_{min} at the maximum mass flowrate: a) date and time; b) temperature; c) relative humidity; d) supply voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance; i) barometric pressure. Reduce the voltage supply to the EUT until the equipment clearly ceases to function and note the voltage. Switch the EUT “off” and increase the voltage to nominal battery voltage.

	Switch the EUT "on" and reduce the voltage to the above noted voltage (out of service voltage) of the noted voltage. Record the data indicated above while totalizing Σ_{min} at the maximum mass flowrate.
Number of test cycles:	At least one test cycle is conducted.
Maximum allowable variations:	All functions shall operate correctly. All indications shall be within the maximum permissible errors specified in Part-1, 3.2.2, Table 2.

7.3 Disturbances (Part-1, 5.1.2 and 5.5.2)

Summary of tests

Tests[2]	Criteria[1]	§
AC mains voltage dips, short interruptions and reductions	sf	7.3.1
Bursts (fast transient tests) on mains power lines and on signal, data and control lines	sf	7.3.2
Surges on AC and DC mains power lines and on signal, data and control lines	sf	7.3.3
Electrostatic discharge test	sf	7.3.4
Immunity to electromagnetic fields	sf	7.3.5
DC mains voltage dips, short interruptions and (short term) variations	sf	7.3.6
Ripple on DC mains power	sf	7.3.7

[1] Value of the fault limit value (see Part-1, 2.4.5.4).

[2] Tests shall be conducted to the appropriate classification for electrical tests. The severity level stated in the tests 7.3.1 to 7.3.5 apply to instruments installed and used in locations with significant or high levels of electromagnetic disturbances corresponding to those likely to be found in industrial environments.

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

7.3.1 AC mains voltage dips, short interruptions and reductions

AC mains voltage dips, short interruptions and reductions tests are carried out according to basic standard IEC Publication 61000-4-11 [17] and according to Table 7.

Table 7 – AC mains voltage dips, short interruptions and reductions

Environmental phenomena	Test specification			Test setup
	Test	Reduction of amplitude to	Duration / number of cycles	
Voltage dips and short interruptions	Test a	0 %	0.5	IEC 61000-4-11
	Test b	0 %	1	
	Test c	40 %	10/12(2)	
	Test d	70 %	25/30(2)	
	Test e	80 %	250/300(2)	
	Short interruption	0 %	250/300(2)	

Note 1: A test generator suitable to reduce for a defined period of time the amplitude of one or more half cycles (at zero crossings) of the AC mains voltage shall be used. The test generator shall be adjusted before connecting the EUT. The mains voltage reductions shall be repeated 10 times with an interval of at least 10 seconds.

Note 2: These values are for 50 Hz (Europe) / 60 Hz (USA), respectively.

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in Part-1, 5.1.2 under conditions of short time mains voltage interruptions and reductions while totalizing, at maximum mass flowrate, at least Σ_{min} (or a time sufficient to complete the test).
Preconditioning:	None required.
Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and shall not be adjusted at any time during the test except to reset if a significant fault has occurred.
Test procedure in brief:	Before any test stabilize the EUT under constant environmental conditions. Changes in barometric pressure shall be taken into account. Observe the indications for a test or simulated load, at least Σ_{min}, at the maximum mass flowrate, Q_{max}, for the duration of the test, and record the following:
Test information:	a) date and time; b) temperature; c) relative humidity; d) supply voltage; e) test load;

	f) indications (as applicable); g) errors; h) functional performance; i) barometric pressure In accordance with the test specification in Table 7, interrupt the voltages to the corresponding durations / number of cycles and conduct the test as detailed in IEC 61000-4-11 section 8.2.1. During interruption observe the effect on the EUT and record as appropriate.
Number of test cycles:	At least one test cycle is conducted.
Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed the fault specified in Part-1, 2.4.5.4, or the EUT shall detect and react to a significant fault. In the case of voltage interruptions (0 % for 250/300 cycles), the requirement is for the instrument to recover fully.

7.3.2 Bursts (fast transient tests) on mains power lines and on signal, data and control lines

Burst tests (fast transients) are carried out at the positive and the negative polarity for at least 1 minute at each polarity in accordance with the basic standard IEC 61000-4-4 [18] and according to Tables 8 and 9.

Table 8 – Bursts (transients) on signal, data and control lines

Environmental phenomenon	Test specification	Test setup
Fast transient common mode	1.0 kV (peak) 5/50 ns t_r/ t_d 5 kHz rep. frequency	IEC 61000-4-4

Note: Applicable only to lines or interfacing with cables whose total length exceeds 3 m according to the manufacturer's functional specification.

Table 9 – Bursts on AC and DC mains power lines

Environmental phenomenon	Test specification	Test setup
Fast transient common mode	2.0 kV (peak) 5/50 ns t_r/ t_d 5 kHz rep. frequency	IEC 61000-4-4

Note: DC power lines, not applicable to battery-operated appliance that cannot be connected to the mains while in use.

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in Part-1, 5.1.2 under conditions where fast transients are superimposed separately on the mains voltage, and on the I/O signal and communication lines while observing the indications for a test or simulated load, at least Σ_{min}, at the maximum mass flowrate, Qm_{max}, for the duration of the test.
Preconditioning:	None required.

Condition of the EUT:	The performance of the test generator shall be verified before connecting the EUT. The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and shall not be adjusted at any time during the test except to reset if a significant fault has occurred.
Test procedure in brief:	Both positive and negative polarity of the bursts shall be applied. The duration of the test shall not be less than one minute for each amplitude and polarity. The injection network on the mains shall contain blocking filters to prevent the burst energy being dissipated in the mains. For the coupling of the bursts into the input/output and communication lines, a capacitive coupling clamp as defined in the reference standard shall be used.
Test information:	Before any test stabilize the EUT under constant environmental conditions. Changes in barometric pressure shall be taken into account. Observe the indications for a test or simulated load, at least Σ_{min}, at the maximum mass flowrate, Qm_{max}, for the duration of the test, and record the following with and without the transients: a) date and time; b) temperature; c) relative humidity; d) supply voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance; i) barometric pressure.
Number of test cycles:	At least one test cycle is conducted.
Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed the fault specified in Part-1, 2.4.5.4, or the EUT shall detect and react to a significant fault.

7.3.3 Surges on AC and DC mains power lines and on signal, data and control lines

Electrical surge tests are carried out according to IEC 61000-4-5 [19] and according to Table 10.

Table 10 – Surges on mains power lines and on signal, data and control lines

Environmental phenomenon	Test specification	Test setup
Surges on mains power lines and on signal, data and control lines	a) 1.0 kV line to line b) 2.0 kV line to earth c) 3 positive and 3 negative surges applied synchronously with AC supply voltage in angles 0°, 90°, 180° and 270°. d) 3 positive and 3 negative surges applied on DC voltage lines and on signal, data and control lines.	IEC 61000-4-5

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in Part-1, 5.1.2 under conditions where electrical surges are applied separately to the mains power lines and to the signal, data and control lines (if any), while observing the indications test or simulated load, at least Σ_{min}.
Preconditioning:	None required.
Condition of the EUT:	The characteristics of the test generator shall be verified before connecting the EUT. The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and shall not be adjusted at any time during the test except to reset if a significant fault has occurred.
Test procedure in brief:	The test consists of exposure to surges for which the rise time, pulse width, peak values of the output voltage/current on high/low impendence load and minimum time interval between two successive pulses are defined in IEC 61000-4-5. The injection network depends on the lines the surge is coupled to and is defined in IEC 61000-4-5.
Test information:	Before any test stabilize the EUT under constant environmental conditions. Changes in barometric pressure shall be taken into account. Observe the indications for a test or simulated load, at least Σ_{min}, at the maximum mass flowrate, Qm_{max}, for the duration of the test, and record the following with and without the surges: a) date and time; b) temperature; c) relative humidity; d) supply voltage; e) test load;

	f) indications (as applicable); g) errors; h) functional performance; i) barometric pressure.
Number of test cycles:	At least one test cycle is conducted.
Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed the fault specified in Part-1, 2.4.5.4, or the EUT shall detect and react to a significant fault.

7.3.4 Electrostatic discharge test

Electrostatic discharge tests are carried out according to basic standard IEC 61000-4-2 [20], with test signals and conditions as given in Table 11.

Table 11 – Electrostatic discharge test

Environmental phenomenon	**Test specification**		**Test setup**
Electrostatic discharge	**Test voltage**	**Levels**[1]	IEC 61000-4-2
	contact discharge	6 kV	
	air discharge	8 kV	

Note 1: Tests shall be performed at the specified lower test levels, starting with 2 kV and proceeding in 2 kV steps up to and including the level specified above in accordance with IEC 61000-4-2.

Note 2: The 6 kV contact discharge shall be applied to conductive accessible parts. Metallic contacts, e.g. in battery compartments or in socket outlets, are excluded from this requirement.

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

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in Part-1, 5.1.2 under conditions where electrostatic discharges are applied while totalizing, at maximum mass flowrate, at least Σ_{min} (or for sufficient time to complete the test).
Preconditioning:	None required.

Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Reset the EUT if a significant fault has been indicated. Before any test stabilize the EUT under constant environmental conditions.
Test procedure in brief:	
Test information:	Apply a test or simulated load, at least Σ_{min}, at maximum mass flowrate, Qm_{max}, for the duration of the test, and record the following. Changes in barometric pressure shall be taken into account. a) date and time; b) temperature; c) relative humidity; d) supply voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance; i) barometric pressure
Number of test cycles:	At least one test cycle is conducted.
Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance either shall not exceed the fault specified in Part-1, 2.4.5.4, or the EUT shall detect and act upon a significant fault.

7.3.5 Immunity to electromagnetic fields

Note: Test time resources can be optimized if

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

7.3.5.1 Immunity to radiated (RF) electromagnetic fields

Radiated, radio-frequency, electromagnetic field immunity tests are carried out in accordance to IEC 61000-4-3 [21] and according to Table 12.

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

Table 12 – Immunity to radiated (RF) electromagnetic fields

Test specification			
Environmental phenomenon	**Frequency ranges MHz**	**Field strength V/m**	**Test setup**
Immunity to radiated electromagnetic fields	80 to 2000[1]	10	IEC 61000-4-3
	26 to 80[2]		
Modulation	80 % AM, 1 kHz sine wave		

Note 1: For EUTs having no mains or other I/O ports available so that the test according to 7.3.5.2 cannot be applied, the lower limit of the radiation test is 26 MHz.

Note 2: In this case for the frequencies from 26 MHz up to 80 MHz the similar test method as described in IEC 61000-4-3 shall be applied.

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in Part-1, 5.1.2 under conditions of specified radiated electromagnetic fields applied while totalizing, at maximum mass flowrate, at least Σ_{min} (or a time sufficient to complete the test).
Preconditioning:	None required.
Test procedure in brief:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and shall not be adjusted at any time during the test except to reset if a significant fault has occurred.
Test information:	Before any test stabilize the EUT under constant environmental conditions. Changes in barometric pressure shall be taken into account. In accordance with the note in 7.3.5, the frequencies are noted at which susceptibility is evident and then tests are conducted at the problem frequencies, while observing a test or simulated load, at least Σ_{min}, at maximum mass flowrate, Qm_{max}, for the duration of the test. Record the following with and without electromagnetic fields: a) date and time; b) temperature; c) relative humidity; d) supply voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance; i) barometric pressure.
Number of test cycles:	At least one test cycle is conducted.
Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed

	the fault specified in Part-1, 2.4.5.4, or the EUT shall detect and react to a significant fault.

7.3.5.2 Immunity to conducted electromagnetic fields

Conducted, radio-frequency, electromagnetic field immunity tests are carried out in accordance to IEC 61000-4-6 [22] and according to Table 13.

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

Table 13 – Immunity to conducted electromagnetic fields

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

Note 1: This test is not applicable when the EUT has no mains or other input port.

Note 2: Coupling and decoupling devices shall be used for appropriate coupling of the disturbing signal (over the entire frequency range, with a defined common-mode impedance at the EUT port) to the various conducting cables connected to the EUT.

Supplementary information to the IEC test procedures:

Object of the test:	To verify compliance with the provisions in Part-1, 5.1.2 under conditions of specified conducted electromagnetic fields applied while observing a test or simulated load, at least Σ_{min}, at maximum mass flowrate, Qm_{max}, for the duration of the test.
Preconditioning:	None required.
Condition of the EUT:	The EUT is connected to the mains power supply and switched on for at least the warm-up time specified by the manufacturer. During the test the electrical power supplied to the EUT shall not be switched off. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and shall not be adjusted at any time during the test except to reset if a significant fault has occurred. Radio-frequency electromagnetic current, simulating the influence of electromagnetic fields shall be coupled or injected into the mains power ports and I/O ports of the EUT using coupling/decoupling devices as defined in the referred standard.
Test procedure in brief:	In accordance with the note in 7.3.5, the frequencies are noted at which susceptibility is evident and then tests are conducted at the problem frequencies, if any, while observing a test or simulated load, at least Σ_{min}, at maximum mass flowrate, Qm_{max}, for the duration of the test. Record the following with and without electromagnetic fields:
Test information:	a) date and time; b) temperature;

	c) relative humidity; d) supply voltage; e) test load; f) indications (as applicable); g) errors; h) functional performance; i) barometric pressure.
Number of test cycles:	At least one test cycle is conducted.
Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not exceed the fault specified in Part-1, 2.4.5.4, or the EUT shall detect and react to a significant fault.

7.3.6 DC mains voltage dips, short interruptions and (short term) variations

Table 14 DC mains voltage dips, short interruptions and (short term) variations

Applicable standard	IEC 61000-4-29 [27]		
Test method	Introducing voltage dips, short interruptions and voltage variations on DC mains power lines using the test set-up defined in the applicable standard		
Applicability	Applicable for arched chute weighers which are temporarily or permanently connected to a DC mains power network while in operation. This test is only applicable to equipment powered by DC mains supply and is not applicable to equipment powered by a road vehicle battery.		
Object of the test	Verification of compliance with the provisions in Part-1, 5.1.2 under conditions of voltage dips, voltage variations and short interruptions on DC.		
Precondition	The electrical power of the EUT is switched on for at least the warm-up time specified by the manufacturer.		
Condition of the EUT	The electrical power supplied to the EUT shall not be switched off and the EUT shall not be readjusted at any time during the test except for a reset when a significant fault has been indicated.		
Test procedure in brief	A test generator as defined in the referred standard shall be used. Before starting the tests, the performance of the generator shall be verified. The EUT shall be exposed to voltage dips, short interruptions, for each of the selected combinations of amplitude and duration, using a sequence of three dips/interruptions and intervals of at least 10 s between each test event. The most representative operating modes of the EUT shall be tested three times at 10 s intervals for each of the specified voltage variations. The disturbances are applied during all the time necessary to perform the test; to that purpose more disturbances than indicated may be necessary.		
Voltage dips		Test Levels	unit
	Amplitude	40 and 70	% of the rated voltage
	Duration	0.01; 0.03; 0.1; 0.3; 1	s
Short interruptions	Test condition	High impedance and/or low impedance	
	Amplitude	0	% of the rated voltage
	Duration	0.001; 0.003; 0.01; 0.03; 0.1; 0.3; 1	s
Voltage variations	Amplitude	85 and 120	% of the rated voltage

	Duration	0.1; 0.3; 1; 3; 10	s
EUT performance	The EUT shall be applied and tested with a test load close to zero (10 *d*). The fault of the EUT is determined separately for each of the different dips and reductions. Sequentially during and after the exposure to the dips and interruptions the following parameters shall be recorded: a) date and time, b) temperature, c) relative humidity, d) measurand value, e) percentage of voltage reduction and duration, f) indicated values and error values, g) functional performance		
Permitted maximum deviation	The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not either shall not exceed the fault specified in Part-1, 2.4.5.4, or the EUT shall detect and react to a significant fault.		

7.3.7 Ripple on DC mains power

Table 15 Ripple on DC mains power

Applicable standard	IEC 61000-4-17 [28]	
Test method	Introducing a ripple voltage on the DC input power port.	
Applicability	Applicable for arched chute weighers which are temporarily or permanently connected to a DC mains power network (distribution system) supplied by external rectifier systems while in operation and generally only applicable in industrial environment. This test is only applicable to equipment powered by DC mains supply and is not applicable to equipment powered by a road vehicle battery.	
Object of the test	Verification of compliance with the provisions in Part-1, 5.1.2 under conditions of the introduction of a ripple on the DC mains voltage to simulate the ripple introduced by rectifiers applied in a DC mains power network. This test is not applicable for arched chute weighers connected to battery charger systems with incorporated switch mode converters.	
Precondition	The electrical power of the EUT is switched on for at least the warm-up time specified by the manufacturer.	
Condition of the EUT	The electrical power supplied to the EUT shall not be switched off and the EUT shall not be readjusted at any time during the test. The automatic zero-setting or zero-tracking, where available, shall be enabled as for normal operation.	
Test procedure in brief	A test generator as defined in the referred standard shall be used. Before starting the tests, the performance of the generator shall be verified. The test comprises subjecting the EUT to ripple voltages such as those generated by traditional rectifier systems and/or auxiliary service battery chargers overlaying on DC power supply sources. The frequency of the ripple voltage is the applicable power frequency or a multiple (2, 3 or 6) dependant on the rectifier system used for the mains. The waveform of the ripple, at the output of the test generator, has a sinusoid-linear character. The test level is a peak-to-peak voltage expressed as a percentage of the nominal DC voltage, UDC.	
Test level	Percentage of the nominal DC voltage	2 %

EUT performance	After stabilization at the relevant a) date and time, b) temperature, c) relative humidity, d) test load value, e) indicated values, f) error values, g) functional performance
Permitted maximum deviation	The difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error) either shall not either shall not exceed the fault specified in Part-1, 2.4.5.4, or the EUT shall detect and react to a significant fault.

8 Metrological characteristics (Part-1, 3.7.4)

8.1 Repeatability (Part-1, 3.7.4.1)

1) Apply a test load, introducing a force corresponding with 20 % of Max, on the force simulation platform and carry out within 4 h a totalization of Σ_{min} or (as indicated in 3.7.3 if a device with a totalization scale interval smaller than or equal to 0.2 *d* is not available) five times the value in Part-1, 3.4, Table 3. Record the totalized mass value. Remove the load and allow the arched chute weigher to stabilize empty and if necessary reset the indication to zero. Repeat the test with the same load.

2) Repeat the whole test within 4 hours with a test load, introducing a force corresponding with 50 % of Max (Totalization ≈ Σ_{min} or 5 x value in Part-1, 3.4, Table 3).

3) Repeat the whole test within 4 h with a test load, introducing a force corresponding with 75 % of Max (Totalization ≈ Σ_{min} or 5 x value in Part-1, 3.4, Table 3).

4) Repeat the whole test within 4 h with a test load, introducing a force corresponding with Max (Totalization ≈ Σ_{min} or 5 x value in Part-1, 3.4, Table 3).

The difference between any two results obtained for the same test load on the force simulation platform under the same conditions shall not exceed the absolute value of the appropriate maximum permissible error for the influence factor tests specified in Part-1, 3.2.2, Table 2.

8.2 Discrimination of the totalization indicating device (Part-1, 3.7.4.2)

1) Apply a distributed load of 20 % Max on the force simulation platform and carry out a totalization of Σ_{min}, noting the exact duration of the test . Add additional weights (load):

   a) class 0.2: additional load = existing load × 0.07 %;

   b) class 0.5: additional load = existing load × 0.18 %;

   c) class 1: additional load = existing load × 0.35 %;

   d) class 2: additional load = existing load × 0.7 %.

2) Totalize again for the same equivalent parameters and set-up.

3) Repeat for a load of 50 % Max.

4) Repeat for a load of 75 % Max.

5) Repeat for a load of Max.

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

8.3 Discrimination of the totalization indicating device used for zero totalization (Part-1, 3.7.4.3)

1) Zero the arched chute weigher and disable any automatic zero-setting device.

2) Totalize with no load for 3 minutes and record the zero indicator reading. If the indicator can be reset to zero, reset it at the end of each 3-minute test. Add a small load on the force simulation platform as follows:

   a) class 0.2: max × 0.02 %;

   b) class 0.5: max × 0.05 %;

   c) class 1: max × 0.1 %;

   d) class 2: max × 0.2 %.

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

4) Remove the small load, totalize for 3 minutes and record the zero indicator reading.

5) Reset the arched chute weigher to zero with the load on the force simulation platform, disable any auto-zeroing device, and repeat the tests in 2) above but with the load removed from the zero point.

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

8.4 Stability of zero (Part-1, 3.7.4.4)

This test shall be carried out with no load and any automatic zero-setting device disabled.

Zero-setting shall be carried out prior to commencement of the test. No further zero adjustment shall be carried out before completion of the test (i.e. until all required observations have been obtained).

Totalization values shall be taken from the indicator used for zero totalization.

Totalize with no load at maximum mass flowrate and record the zero indicator reading, and the reading after each 3-minute interval for a period of 15 minutes. The difference between the highest and lowest indicated values obtained in this set of six readings shall not exceed the values specified in Part-1, 3.7.4.4.1 for assessment of stability over a period of 15 minutes.

Leave the unloaded arched chute weigher running for 3 hours at the maximum mass flowrate. After this period, without further adjustment, record the totalization indication and continue to record readings after each 3-minute interval for a further period of 15 minutes. The difference between the highest and lowest indicated values obtained in this second set of six readings, shall not exceed the value specified in Part-1, 3.7.4.4.1 for assessment of stability over a period of 15 minutes.

The difference between the smallest and largest of all 12 readings taken over the 3.5 hour period shall not exceed the value specified in Part-1, 3.7.4.4.2 for assessment of stability over a period of 3.5 hours.

9 In-situ product tests (R xx-1, 6.2.2.1, 7.1)

9.1 General

9.1.1 Conditions and product

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

In-situ product tests conducted for type evaluation, initial verification and in-service inspection shall determine that the maximum permissible errors for automatic weighing are in accordance with Part-1, 3.2.1, Table 1, for initial verification or in-service, as appropriate for the class of the arched chute weigher. The tests shall be performed using a number of different grain and/or the powder particle sizes as appropriate for the specific type or instrument an limited to three sizes and three densities

For “repeatability”, the relative errors (4.6 and Part 1, 3.8.1) for several results obtained at practically identical mass flowrates, for approximately the same quantities of product and under the same conditions, shall not exceed the absolute value of the appropriate maximum permissible error for automatic weighing in Part-1, 3.2.1.

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

During in-situ tests, if it is not possible to apply the same load, approximately the same load will be sufficient. In such cases, the difference between the loads shall be corrected.

9.2 Control method and accuracy of standards

The control instrument and standard weights used for the product test shall enable the determination of the mass of the product used for testing with an error not exceeding one-third of the appropriate maximum permissible error for automatic weighing in Part-1, 3.2.1, Table 1.

Note: It is advised to verify the correct and adequate operation of the control instrument or the device used for control purposes prior to executing the product test.

If a control instrument with sufficient resolution is not available, the greater resolution of the control instrument may be ensured by using change point weights as specified in 3.7.1.

The control method shall be conducted as follows:

a) with the arched chute weigher in automatic operation, conduct the necessary number of tests and record the indicated load value at the maximum, minimum and intermediate feeding mass flowrates, making sure that the test load of products can be weighed using a control instrument;

b) the indicated load value from the arched chute weigher is the difference between the indication at the start of the test and the indication at the end of the test using the general totalization device;

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

d) the error for automatic weighing shall be the difference between the true quantity value of the mass of the test load determined on the control instrument in c) above, and the values obtained from the general totalization indication in b) above. The relative errors are calculated as indicated in 4.6. This is the value that shall be used for comparison with the appropriate maximum permissible error for automatic weighing in Part-1, 3.2.1.

9.3 Product tests

9.3.1 Selection of products

For a chute weigher the infeed conveyor determines the mass flow. The weighing accuracy further depends on the product particle sizes and densities.

Product tests therefore need to be performed using a selection of products covering the size and density ranges for which the arched chute weigher is designed and applied.

These product ranges shall at least include those products combining

a) the highest density with the smallest particle size;

b) the lowest density with the largest particle size;

for which the arched chute weigher is designed as specified by the manufacturer.

9.3.2 Performing product tests

For each of the selected products the following procedure is applied to establish the accuracy of the totalized mass.

Before each test the zero-setting of the arched chute weigher shall be verified and, if necessary, the arched chute weigher is set to zero.

On completion of each of the tests the totalized mass of the product used in the run shall be recorded.

The following tests shall be performed at the following infeed mass flowrates:

a) for accuracy classes 1 and 2: 5 pairs of tests (10 totalizations) at the maximum mass flowrate, the minimum mass flowrate, and an intermediate mass flowrate;

b) for accuracy classes 0.2, and 0.5: 10 pairs of tests (20 totalizations) at the maximum mass flowrate, the minimum mass flowrate, and an intermediate mass flowrate

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

For “initial verification and in-service inspection” for each test the maximum permissible error shall be as specified in Part-1, 3.2.1, Table 1, as appropriate for the class of the arched chute weigher.

For “repeatability”, the difference between the errors (calculated as indicated in 4.6) for each test, of the same feeding mass flowrate and approximately the same totalized quantity, shall not exceed the absolute value of the appropriate maximum permissible error for automatic weighing in Part-1, 3.2.1.

9.3.3 Performing product infeed test

If the infeed mass flowrate is adjustable for aligning the product flow to the weighing segment a test shall be performed to establish the effect of the resulting eccentric infeed on the weighing segment.

For each of the selected products the following procedure is applied to establish the accuracy of the totalized mass.

Before each test the zero-setting of the arched chute weigher shall be verified and, if necessary, the arched chute weigher is set to zero.

On completion of each of the tests the totalized mass of the product used in the run shall be recorded

Performed this test at 80 % Qm_{max}

a) the highest density with the smallest particle size;

b) the lowest density with the largest particle size.

Annex A

Additional examinations and tests for software-controlled digital devices and instruments

(Mandatory)

A.1 Devices and instruments with embedded software

Review the descriptive documents according to R xx-1, 6.1.1 and check whether the manufacturer has described or declared that the software is embedded, i.e. that it is used in a fixed hardware and software environment and cannot be modified or uploaded via any interface or by other means after securing or sealing.

Check whether the securing means are described and provide evidence of an intervention.

Check whether there is a software identification that is clearly assigned to the legally relevant software and the legally relevant functions it performs as described in the documentation submitted by the manufacturer.

Check whether the software identification is easily provided by the instrument.

A.2 Computers and other devices with programmable or loadable software

A.2.1 Software documentation (Part-1, 5.8)

Check that the manufacturer has supplied software documentation according to Part-1, 5.8 containing all relevant information to examine the legally relevant software.

A.2.2 Software protection (Part-1, 5.8.1)

A.2.2.1 Software with closed shell (no access to the operating system and/or programs possible for the user)

Check whether there is a complete set of commands (e.g. function keys or commands via external interfaces) supplied and accompanied by short descriptions.

Check whether the manufacturer has submitted a written declaration of the completeness of the set of commands.

A.2.2.2 Operating system and / or program(s) accessible for the user

Check whether a checksum or equivalent signature is generated over the machine code of the legally relevant software (program module(s) subject to legal control and type-specific parameters).

Check whether the legally relevant software cannot be started if the code is falsified using a text editor.

A.2.2.3 In addition to the cases in A.2.2.1 or A.2.2.2

Check whether all device-specific parameters are sufficiently protected, e.g. by a checksum.

Check whether there is an audit trail for the protection of the device-specific parameters and a description of the audit trail.

Perform some practical spot checks to test whether the documented protections and functions work as described.

A.2.3 Software interface(s)

Check whether the program modules of the legally relevant software are defined and separated from the modules of the associated software by a defined protective software interface.

Check whether the protective software interface itself is part of the legally relevant software.

Check whether the functions of the legally relevant software that can be released via the protective software interface are defined and described.

Check whether the parameters that may be exchanged via the protective software interface are defined and described.

Check whether the description of the functions and parameters are conclusive and complete.

Check whether each documented function and parameter does not contradict the requirements of this Recommendation.

Check whether there are appropriate instructions for the application programmer (e.g. in the software documentation) concerning the protectiveness of the software interface.

A.2.4 Software identification

Check whether there is an appropriate software identification generated over the program module(s) of the legally relevant software and the type-specific parameters at runtime of the instrument.

Check whether the software identification is indicated by manual command and can be compared with the reference identification fixed at type approval.

Check whether all relevant program module(s) and type-specific parameters of the legally relevant software are included in the software identification.

Check also by some practical spot checks whether the checksums (or other signatures) are generated and work as documented.

Check whether an effective audit trail exists.

A.3 Data storage devices (Part-1, 5.7)

Review the documentation submitted and check whether the manufacturer has foreseen a device – whether incorporated in the instrument or connected externally – that is intended to be used for long-term storage of legally relevant data. If so:

- check whether the software used for data storage is realized on a device with embedded software (A.1) or with programmable/ loadable software (A.2). Apply either A.1 or A.2 to examine the software used for data storage;
- check whether the data are stored and retrieved correctly;
- check whether the storage capacity and the measures to prevent inadmissible data loss are described by the manufacturer and are sufficient;
- check whether the data stored contain all relevant information necessary to reconstruct an earlier weighing (relevant information is: gross or net values and tare values (if applicable, together with a distinction of tare and preset tare), the decimal signs, the units (e.g. kg may be encoded), the identification of the data set, the identification number of the instrument or force receptor if several instruments or force receptors are connected to the data storage device, and a checksum or other signature of the data set stored;
- check whether the data stored are adequately protected against accidental or intentional changes;
- check whether the data are protected at least with a parity check during transmission to the storage device;

- check whether the data are protected at least with a parity check in the case of a storage device with embedded software;
- check whether the data are protected by an adequate checksum or signature (at least 2 bytes, e.g. a CRC-16 checksum with hidden polynomial) in the case of a storage device with programmable or loadable software;
- check whether the data stored are capable of being identified and displayed, and that the identification number(s) is stored for later use and recorded on the official transaction medium, i.e. it is printed, for instance, on the printout;
- check whether the data used for a transaction are stored automatically, i.e. not depending on the decision of the operating person;
- check whether stored data sets which are to be verified by means of the identification are displayed or printed on a device subject to legal control.

A.4 Test report format

The test report format in Part-3 shall contain all relevant information about the hardware and software configuration of the PC examined and the test results.

Annex B

Equipment under test (EUT)

(Informative)

B.1 Selection of EUTs

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

- force transducers;

Those arched chute weighers using force transducer technology may further be categorized by using the method whereby the transducers are mounted and the way in which the force from the force receptor is introduced to the transducer. Examples may include, but are not limited to

- direct mounting of the transducers,
- connection of the transducers to the force receptor ,
- isolation from forces not directly derived from the weighed mass.

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

For testing performed in a laboratory setting:

- lowest input signal from the force transducer(s) (see R xx-1, 6.1.6.6);
- unit with all the interfaces (i.e. peripheral equipment, hardware components);
- unit with all the necessary force transducers;

B.2 Other metrological features to be considered

Testing for related characteristics should be carried out on a single EUT – for example, it is not acceptable to test the temperature effect on no-load indication on one EUT and the combined effect on a different one. Variations in metrologically relevant features and functions such as different

- housings,
- force receptors,
- temperature and humidity ranges,
- instrument functions,
- indications, etc.

may require additional partial testing of those factors which are influenced by that feature. These additional tests should preferably be carried out on the same EUT, but if this is not possible, tests on one or more additional EUTs may be performed under the responsibility of the testing authority.

The ability of the instrument to withstand all required performance tests during the evaluation may be a good indication of the durability.

Annex C

Durability testing requirements

(Informative)

C.1 Type approval

A durability assessment performed under type evaluation should take into account that (lack of) durability may be a characteristic of a particular installation. Hence a decision not to type approve an arched chute weigher may only be warranted where the unacceptable durability is clearly a characteristic of the type.

Where measures to ensure durability are taken, this shall be recorded in the test report format in R xx-3.

C.2 Subsequent metrological control

To reduce the risks of non-durable instruments, the arrangements for subsequent metrological control shall incorporate means for reviewing intervals for subsequent verification and in-service inspection, based on performance of an arched chute weigher over time. ILAC-G24/OIML D 10 [25] indicates methods (see D 10, 3) which are useful for this purpose.

If an arched chute weigher (installed in a particular location) is found to be of unacceptable durability, that instrument shall be withdrawn from use. If unacceptable durability was found to be a characteristic of the type (unacceptable durability regardless of the installation), withdrawal of the type approval shall be considered.

Annex D
Performing product test measurement example

(Informative)

As dynamic effects are highly likely with this type of weighing system (vibrations, flow rate transitions at start and stop of totalizing, homogeneity variation of the bulk material), mean values and standard deviations should be evaluated on a significant number of weighing.
Tests should be carried out, for each type of product, at least:

a) for accuracy classes 1 and 2: 10 totalisations Σ_{min} at Qm_{max}, Qm_{min} and Qm_{int} flowrate,
b) for accuracy classes 0.2 and 0.5: 20 totalisations Σ_{min} at Qm_{max}, Qm_{min} and Qm_{int} flowrate.

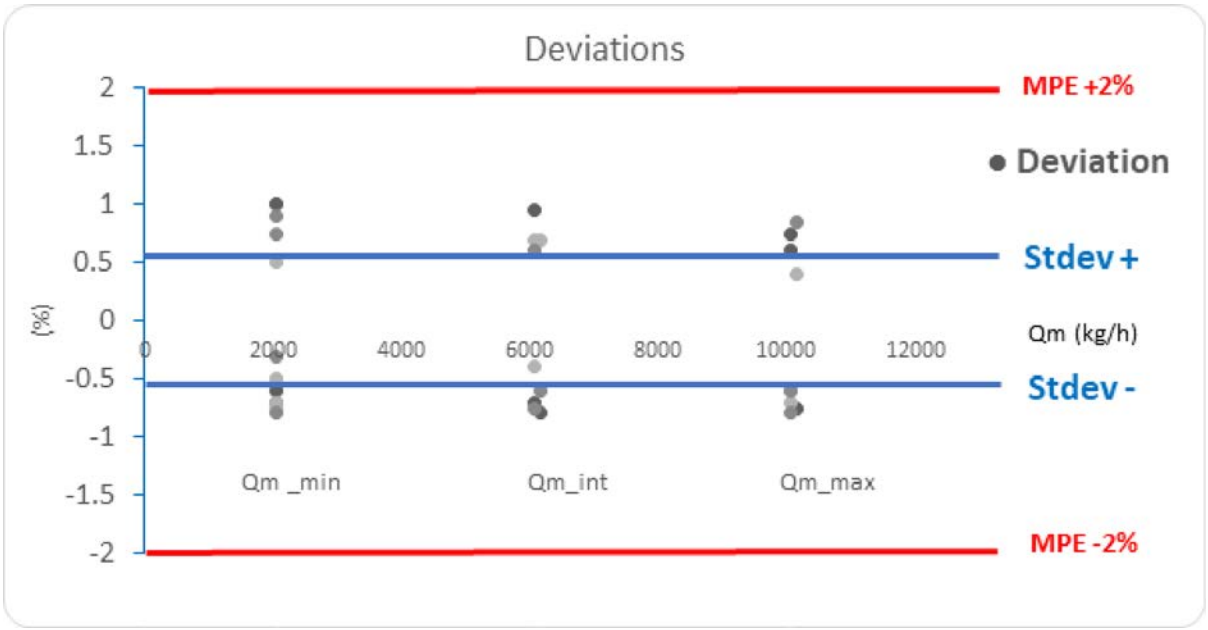
With a normal distribution of results (Gauss curve) and with the standard deviation σ, the probability of an accurate result is (i. e. deviation of measurement below k.σ):

68 % with a safety factor k= 1,
95 % with k= 2,
99.7 % with k= 3.

For trade transactions which are legally relevant, the safety factor k= 3 is mandatory.

Measurement example: Product type	Type 1	
Density	1500 kg/m3	
Particle size	2 – 4 mm	
T_{min}	0.05 h	$\Sigma_{min} = Qm \times T_{min}$
Qm_{min}	2000 kg/h	100 kg
Qm_{int}	6000 kg/h	300 kg
Qm_{max}	10000 kg/h	500 kg

The picture below shows the dispersion of results for 3 x 10 totalisation Σ_{min} carried out at Qm_{min}, Qm_{int} and Qm_{max}:



Standard deviation for these 30 totalisations: $\sigma = 0.58$ %
If we apply the safety factor k=3, we get $3.\sigma = 1.74$ % : when referring to table 1, this system belongs to accuracy class 2 %. The accuracy class 1 % is out of reach.

Annex E

Bibliography

(Informative)

Below are references to publications of the International Electrotechnical Commission (IEC), the International Organization for Standardization (ISO) and the OIML, which are mentioned in this Recommendation.

Ref.	Standards and references	Description
[1]	International Vocabulary of Metrology - Basic and General Concepts and Associated Terms (VIM), Third Edition, 2012	Vocabulary, prepared by a joint working group consisting of experts appointed by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML.
[2]	International vocabulary of terms in legal metrology – VIML, 2013	Vocabulary including only the concepts used in the field of legal metrology. These concepts concern the activities of the legal metrology service, the relevant documents as well as other problems linked with this activity.
[3]	OIML B 3:2011 OIML Basic Certificate System for OIML Type Evaluation of Measuring Instruments	Provides rules for issuing, registering and using OIML Certificates of conformity.
[4]	OIML D 11:2013 General requirements for measuring instruments - Environmental conditions	Contains general requirements for electronic measuring instruments.
[5]	OIML R 111:2004 Weights of classes E_1, E_2, F_1, F_2, M_1, M_{1-2}, M_2, $M_{2–3}$ and M_3	Provides the principal physical characteristics and metrological requirements for weights used with and for the verification of weighing instruments and weights of a lower class.
[6]	OIML D 28:2004 Conventional value of the result of weighing in air (Revision of OIML R 33)	Provides the definition of the quantity “conventional mass” (conventional value of the result of weighing in air) as it is used for the characterization of weights and its relation to the physical quantities mass and density and the evaluation of its uncertainty.
[7]	OIML R 60:2017 Metrological regulation for load cells	Provides the principal static characteristics and static evaluation procedures for load cells used in the evaluation of mass.
[8]	OIML R 76-1:2006 Non-automatic weighing instruments	Provides the principal physical characteristics and metrological requirements for the verification of non-automatic weighing instruments.
[9]	OIML D 19:1988 Pattern evaluation and pattern approval	Provides advice, procedures and influencing factors on pattern evaluation and pattern approval.
[10]	OIML D 20:1988 Initial and subsequent verification of measuring instruments and processes	Provides advice, procedures and influencing factors on the choice between alternative approaches to verification and the procedures to be followed in the course of verification.

Ref.	Standards and references	Description
[11]	IEC 60068-2-1 Ed. 6.0 (2007-03)	Basic environmental testing procedures - Part 2: Tests, Test Ad: Cold, for heat dissipating equipment under test (EUT), with gradual change of temperature.
[12]	IEC 60068-2-2 (2007-07). Environmental testing Part 2: Tests, Test B: Dry heat	Contains test Ba : dry heat for non heat dissipating specimen with sudden change of temperature; test Bb dry heat for non heat dissipating specimen with gradual change of temperature; tests Bc : dry heat for heat dissipating specimen with sudden change of temperature; test Bd dry heat for heat dissipating specimen with gradual change of temperature.
[13]	IEC 60068-3-1 (2011): Environmental testing Part 3 Background information, Section 1: Cold and dry heat tests	Gives background information for Tests A: Cold (IEC 68-2-1), and Tests B: Dry heat (IEC 68-2-2). Includes appendices on the effect of: chamber size on the surface temperature of a specimen when no forced air circulation is used; airflow on chamber conditions and on surface temperatures of test specimens; wire termination dimensions and material on surface temperature of a component; measurements of temperature, air velocity and emission coefficient. Supplement A - Gives additional information for cases where temperature stability is not achieved during the test.
[14]	IEC 60068-2-78 (2012) Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state	Provides a test method for determining the suitability of electro-technical products, components or equipment for transportation, storage and use under conditions of high humidity. The test is primarily intended to permit the observation of the effect of high humidity at constant temperature without condensation on the specimen over a prescribed period. This test provides a number of preferred severities of high temperature, high humidity and test duration. The test can be applied to both heat-dissipating and non-heat dissipating specimens. The test is applicable to small equipment or components as well as large equipment having complex interconnections with test equipment external to the chamber, requiring a set-up time which prevents the use of preheating and the maintenance of specified conditions during the installation period.

Ref.	Standards and references	Description
[15]	IEC 60068-3-4 (2001-08) Environmental testing - Part 3-4: Supporting documentation and guidance - Damp heat tests	Provides the necessary information to assist in preparing relevant specifications, such as standards for components or equipment, in order to select appropriate tests and test severities for specific products and, in some cases, specific types of application. The object of damp heat tests is to determine the ability of products to withstand the stresses occurring in a high relative humidity environment, with or without condensation, and with special regard to variations of electrical and mechanical characteristics. Damp heat tests may also be utilized to check the resistance of a specimen to some forms of corrosion attack.
[16]	IEC 60654-2 (1979-01), with amendment 1 (1992-09). Operating conditions for industrial-process measurement and control equipment - Part 2: Power.	Gives the limiting values for power received by land-based and offshore industrial process measurement and control systems or parts of systems during operation.
[17]	IEC 61000-4-11 (2020) Electromagnetic compatibility (EMC). Part 4-11: Testing and measuring techniques - Voltage dips, short interruptions and voltage variations immunity tests	Defines the immunity test methods and range of preferred test levels for electrical and electronic equipment connected to low-voltage power supply networks for voltage dips, short interruptions, and voltage variations. This standard applies to electrical and electronic equipment having a rated input current not exceeding 16 A per phase, for connection to 50 Hz or 60 Hz AC networks. It does not apply to electrical and electronic equipment for connection to 400 Hz AC networks. Tests for these networks will be covered by future IEC standards. The object of this standard is to establish a common reference for evaluating the immunity of electrical and electronic equipment when subjected to voltage dips, short interruptions and voltage variations. It has the status of a Basic EMC Publication in accordance with IEC Guide 107.
[18]	IEC 61000-4-4 (2012) Electromagnetic compatibility (EMC). Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test.	Establishes a common and reproducible reference for evaluating the immunity of electrical and electronic equipment when subjected to electrical fast transient/burst on supply, signal, control and earth ports. The test method documented in this part of IEC 61000-4 describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon. The standard defines: ▪ test voltage waveform; ▪ range of test levels; ▪ test equipment; ▪ verification procedures of test equipment; ▪ test setup; and ▪ test procedure. The standard gives specifications for laboratory and post-installation tests.

Ref.	Standards and references	Description
[19]	IEC 61000-4-5 Ed. 2.0 (2014) + AMD1: 2017 Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test.	Relates to the immunity requirements, test methods, and range of recommended test levels for equipment to unidirectional surges caused by over-voltages from switching and lightning transients. Several test levels are defined which relate to different environment and installation conditions. These requirements are developed for and are applicable to electrical and electronic equipment. Establishes a common reference for evaluating the performance of equipment when subjected to high-energy disturbances on the power and inter-connection lines.
[20]	IEC 61000-4-2 Ed. 2.0 (2008) Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test.	Basic EMC Publication. Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test. Basic EMC Publication.
[21]	IEC 61000-4-3 (2006) + AMD1: 2007 and AMD2:2010 Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.	Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test.
[22]	IEC 61000-4-6(2013). Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields.	Relates to the conducted immunity requirements of electrical and electronic equipment to electromagnetic disturbances coming from intended radio-frequency (RF) transmitters in the frequency range 9 kHz up to 80 MHz. Equipment not having at least one conducting cable (such as mains supply, signal line or earth connection), which can couple the equipment to the disturbing RF fields is excluded. This standard does not intend to specify the tests to be applied to particular apparatus or systems. Its main aim is to give a general basic reference to all concerned product committees of the IEC. The product committees (or users and manufacturers of equipment) remain responsible for the appropriate choice of the test and the severity level to be applied to their equipment.
[23]	OIML D 31 2019 General requirements for software controlled measuring instruments	Contains general requirements for software controlled measuring instruments.
[24]	OIML R xx-3:2014 Continuous totalizing automatic weighing instruments of the arched chute type. Part 3: Test report format	Test report format.

Ref.	Standards and references	Description
[25]	ILAC-G24/OIML D 10 (2007) Guidelines for the determination of calibration intervals of measuring instruments	
[26]	IEC 60068-2-30 (2005) Environmental testing Part 2: Tests Test Db and guidance: Damp heat, cyclic(12 + 12-hour cycle)	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 1 replaces the third paragraph of clause 8, Recovery.
[27]	IEC 61000-4-29 (2000-08) Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 29: Voltage dips, short interruptions and voltage variations on DC input power port immunity tests	Provides test methods for immunity to voltage dips, short interruptions and voltage variations at the DC input power ports of electrical or electronic equipment. This standard is applicable to low voltage DC power ports of equipment supplied by external DC networks. This standard defines: - the range of test levels, - the test generator, - the test setup, - the test procedure.
[28]	IEC 61000-4-17 (1999) + AMD1: 2001 and AMD2:2008) Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 17: Ripple on DC input power port immunity test Stability date: 2015	Provides test methods for immunity to ripple at the DC input power port of electrical or electronic equipment. This standard is applicable to low-voltage DC power ports of equipment supplied by external rectifier systems, or batteries which are being charged. This standard defines: - test voltage waveform, - range of test levels, - test generator, - test setup, - test procedure. This test does not apply to equipment connected to battery charger systems incorporating switch mode converters.