The calibration correction shall be added to the totalized indicated weight of each reference wagon weighed while stationary and uncoupled. In the case given above, the minus sign should be noted. Therefore, if the totalized indicated weight is 41.38, the corrected weight will be:

41.38 + (-0.01) = 41.37

Note: The calibration correction computed in this example is not intended to be typical.

SEVENTH SCHEDULE

HEADING—D

AUTOMATIC GRAVIMETRIC FILLING INSTRUMENTS

PART I

1. General definitions

(1) Weighing instrument:

Measuring instrument that serves to determine the mass of a load by using the action of gravity on that load. According to its method of operation, a weighing instrument is classified as automatic or non-automatic.

(2) Automatic weighing instrument:

An instrument which weighs without the intervention of an operator and follows a predetermined programme of automatic process characteristic of the instrument.

(3) Automatic gravimetric filling instrument:

An instrument which fills containers with predetermined and virtually constant mass of product from bulk by automatic weighing, and which comprises essentially an automatic feeding device or devices associated with one or more weighing units and the appropriate control and discharge devices.

(i) *Associative (selective combination) weigher:*

Automatic gravimetric filling instrument comprising one or more weighing units and which computes an appropriate combination of the loads and combines them for subsequent discharge as a fill.

(ii) *Cumulative weigher:*

Automatic gravimetric filling instrument with one weighing unit with the facility to affect the fill by more than one weighing cycle.

(iii) *Subtractive weigher:*

Automatic gravimetric filling instrument for which the fill is determined by controlling the output feed from the weigh hopper.

(4) Fill:

One or more loads discharged into a single container to make up the predetermined mass.

(5) Electronic instrument:

An instrument equipped with electronic devices

(6) Control instrument:

A weighing instrument used to determine the mass of the test fills delivered by the filling instrument.

2. Construction

Note: In this Part the term device is applied to any part which uses any means to perform one or more specific functions.

(1) Principal parts

(i) *Weighing units:*

A device which provides information on the mass of the load to be measured. This devise may consist of all or parts of non-automatic weighing instruments.

(ii) *Local receptor:*

Part of measurement instrument intended to receive the load.

(iii) *Feeding device:*

Device which provides the supply of the product from bulk to the weighing unit. It may operate in one or more stages.

(iv) *Control devices*

(a) Feed control device—Device which regulates the rate of the feed of the feeding device

(b) Fill setting device—Device which allows the setting of the pre-set value

(c) Final feed cut off device—Device which controls the cut off the final feed so that the average mass of the fills corresponding to the preset value. This device may include an adjustable compensation for the material in flight.

(d) Correction device—Device, which automatically corrects the setting of the filling instrument.

(2) Electronic parts

(I) *Electronic device:*

A device comprising electronic assemblies

and performing a specific function. Electronic devices are usually manufactured as separate units and capable of being independently tested.

(ii) *Electronic sub-assembly:*

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

(iii) *Electronic components:*

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

(3) Indicating device:

The part of a measuring instrument that displays an indication.

Notes: 1. For a weighing instrument, the indicating device is a set of components, which displays the value, in units of mass, of the result of a weighing operation.

2. For filling instrument, the indicating device may indicate either the mass of the load or difference between the mass and the preset value provided the intention is made clear.

(4) Ancillary devices

(i) *Zero setting device:*

A device for setting the indicating device to zero when the load receptor is empty.

(a) Non automatic zero setting device—A device for setting the indicating device to zero by an operator

(b) Semi automatic zero setting device—A device for setting the indicting device to zero automatically following a manual command

(c) Automatic zero setting device—A device for setting the indicating device to zero automatically without the intervention of an operator.

(ii) *Tare device:*

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

(a) without altering the weighing range for net loads (additive tare device),
or

(b) reducing the weighing range for net loads (subtractive tare device).

3. Metrological characteristics

(1) Scale interval (d):

Value expressed in units of mass, of the difference between—

(a) the values corresponding to two consecutive scales mark for analogue indication.

(b) two consecutive indicated values for digital indication.

(2) Reference particle mass of a product:

Mass equal to the mean of ten of the largest elementary particles or pieces of the product taken from one or more loads.

(3) Pre set value:

Value, expressed in units of mass, preset by the operator by means of the fill setting device, in order to define the nominal value of the fills.

(4) Static set point:

Value of the test weights or masses, which, in static tests, balance the value, selected on the indication of the fill setting device.

(5) Weighing cycle:

The sequence of the operation which includes:

(a) delivery of the material to the load receptor;

(b) a weighing operation; and

(c) the discharge of a single discrete load.

(6) Final feed time:

Time taken to complete the last stage of delivery of the product to a load receptor.

(7) Minimum capacity (min):

Smallest discrete load that can be weighed automatically on a load receptor.

(8) Maximum capacity (max):

The largest discrete load that can be weighed automatically on a load receptor.

(9) Warm up time:

The time between the moment power is applied to an instrument and the moment at which the instrument is capable of complying with the requirements.

(10) Average number of loads per fill:

Half the sum of the maximum and minimum number of loads per fill that can be set by the operator or, in cases where the number of loads per fill is not directly determined by the operator, either the

means of the actual number of loads per fill (if known) in a period of normal operation, or the optimum number of loads per fill as may be specified by the manufacturer for the type of product which is to be weighed.

(11) Rated minimum fill:

The rated value of the fill below which the weighing results may be subject to errors outside the limits specified in this part.

(12) Minimum discharge:

The smallest load that can be discharged by a subtractive weigher.

4. Indications and errors

(1) Methods of indication

(i) *Analogue indication:*

An indication allowing the evaluation of equilibrium position to a fraction of the scale interval.

(ii) *Digital indication:*

An indication in which the scale mark comprises a sequence of an aligned figure that do not permit interpolation to fraction of a scale interval.

(2) Errors

(i) *Error of indication:*

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

(ii) *Intrinsic error:*

The error of an instrument under reference conditions

(iii) *Initial intrinsic error:*

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

(iv) *Fault:*

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

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

(v) *Significant fault:*

A fault greater than 0.25 of the maximum permissible deviation of each fill [as specified in sub-paragraph (2) of para 2] for an in-service verification, for a fill equal to the rated minimum fill.

Note: The following are not considered to be significant faults even when they exceed the value defined above:

(a) Faults arising from simultaneous and mutually independent causes in the instrument.

(b) Faults implying the impossibility to perform any stage of operation.

(c) Faults being so serious that they are bound to be noticed by an operator.

(d) Transitory faults bring momentary variations in the indication or operation which cannot affect the final results of the automatic cycles.

Note: For instruments where the fill may be greater than one load, the value of significant fault applicable for a test on one static load shall be calculated in accordance with the test procedures.

(vi) *Span stability:*

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

(3) Reference value for accuracy class

The value of accuracy class determined by static testing of the weighing unit during influence quantity testing at pattern approval stage. The reference value for accuracy class is equal to the best accuracy class for which the instrument may be verified for operational use.

5. Influences and reference conditions

(1) Influence quantity

A quantity, which is not the subject of the measurement but which influences the value of measurand or the indication of the instrument.

(i) *Influence factor:*

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

(ii) *Disturbance:*

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

(2) Rated operating conditions

Conditions of use, giving the ranges of the measurand and the influence quantities for which the metrological characteristics are intended to lie within the maximum permissible deviation specified.

(3) Reference conditions

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

6. Tests

(1) Material test:

A test carried out on a complete instrument using the type of material, which it is intended to weigh.

(2) Simulation tests:

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

(3) Performance test:

A test to verify whether the equipment under test (EUT) is able to accomplish its intended functions

(4) Span stability test:

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

PART II

1. General

(1) Scope:

This Part specifies the metrological and technical requirements for automatic gravimetric filling instruments (hereafter called "filling instruments"), which sub-divide a bulk product into fills of predetermined and virtually constant mass by automatic weighing, the fills being kept separate.

Note: (1) This specification places no constrain on the maximum or minimum capacities of the instruments for which this specification is applicable.

(2) Filling instruments may also be required to comply with certain requirements e.g. an instrument which could operate as a non-automatic instrument will need to comply with the specification for non-automatic weighing instruments.

2. Metrological requirements

(1) Accuracy classes

The accuracy class and reference value for accuracy class shall be specified in accordance with sub-paragraph (2) of paragraph 2 and marked on the instrument in accordance with sub-paragraph (10) of paragraph 3.

Accuracy class shall be specified for intended usage, i.e. nature of the product to be weighed, type of installation, value of the fill, and operating rate.

Note: The limitation of accuracy classes to certain application may be determined by these Rules.

(2) Limits of error

(i) *Maximum permissible error for static tests:*

This instrument shall have a reference value for accuracy class Ref (x), applicable for static testing only, for which the maximum permissible error for influence factor tests shall be as specified in sub-paragraph (4) of paragraph 2, multiplied by the class designation factor (x).

(ii) *Maximum permissible deviation of each fills:*

The instrument shall have a specified accuracy class X(x) for which the maximum permissible deviation of each fill from the average shall be equal to the limits specified in Table I given below, multiplied by the class designation factor (x).

(x) shall be 1×10^k, 2×10^k, 5×10^k, k being a positive or negative whole number or zero.

TABLE 1

Value of the mass of the fill M(g)	*Maximum permissible deviation of each fill from the average for class X (1)*	
	Initial verification	In service Inspection
M < 50	6.3%	9%
50 < M < 100	3.15g	4.5g
100 < M < 200	3.15%	4.5%
200 < M < 300	6.3g	9g
300< M < 500	2.1%	3%
500 < M < 1000	10.5g	15g
1000 < M < 10000	1.05%	1.5%
10000 < M < 15000	105g	150%
15000 < M	0.7%	1%

(See Table 2 under sub-paragraph (3) of para

6 for the number of fills required to find the average value)

For in-service testing, when the reference particle mass exceeds 0.1 of the maximum permissible in-service deviation, the values derived from Table 1 shall be increased by 1.5 times the value of the reference particle mass. However, the maximum value of the maximum permissible deviation shall not exceed (x) x 9%.

Note: Particle mass correction is not applicable to limits, which are derived from Table 1, e.g. influence quantity test, zero setting, etc.

(3) Maximum permissible preset value error (setting error):

For instruments where it is possible to preset a fill weight the maximum difference between the preset value and the average mass of the fill shall not exceed 0.25 of the maximum permissible deviation of each fill from the average, as specified for in service inspection in item (ii) of sub-paragraph (2) of this paragraph. This limit will apply for initial verification and **for in-service inspection** testing.

(4) Maximum permissible error for influence factor tests:

The maximum permissible error for any static test load during influence factor tests shall be 0.25 of the maximum permissible deviation (as specified in item (ii) of sub-paragraph (2) of this paragraph for **in-service inspection**, corresponding to the value of a fill equal to that load.

Note: For instruments where the fill may not be equal to one load, the maximum permissible error applicable for a test on one static load shall be calculated in accordance with the test procedures.

(5) Influence factors: Refer to Annex A for test conditions.

(i) *Static temperatures:*

Instruments shall comply with the appropriate metrological and technical requirements at temperatures from -10°C to +40°C. However, for special applications the limits of the temperature range may differ from those given above but such a range shall not be less than 30°C and shall be specified in the descriptive markings.

(ii) *Power supply (AC):*

Instruments which are powered by an AC electricity supply shall comply with the appropriate metrological and technical requirements when operated at voltages from - 15% to +10% of the reference voltage.

(iii) *Tilting:*

Instruments which are not intended for installation in a fixed position and which do not have a level indictor shall comply with the appropriate metrological and technical requirements when tilted by 5%.

Where a level indictor is present it shall enable the instrument to be set to a tilt of 1% or less.

(6) Units of measurement:

The units of mass to be used on an instrument are the milligram (mg), the gram (g), the kilogram (kg) and the tonne (t).

3. Technical requirements

(1) Suitability for use

A filling instrument shall be designed to suit the method of operation and the products for which it is intended. It shall be of adequately robust construction so that it maintains its metrological characteristics.

(2) Security of operation

(i) *Accidental mal-adjustment:*

An instrument shall be so constructed that an accidental breakdown or a mal-adjustment of control elements likely to disturb its correct functioning cannot take place without its effect being evident.

(ii) *Use of a printer:*

Any print-out is for information purposes only and not for use in a commercial transaction, except for preset values and number of weighings.

(iii) *Ancillary devices:*

Any ancillary device provided for use with a filling instrument shall not affect the correct functioning of the instrument.

(iv) *Scale interval (d):*

Scale intervals of all indicating devices associated with a weighing unit shall be the same.

(3) Fill setting device

If fill setting is by means of a scale, it shall be graduated in units of mass.

If fill setting is by means of weights, they shall be either weights in accordance with these rules or purpose-designed of any nominal value, distinguishable by shape and identified with the filling instrument.

(4) Final feed cut-off device

The final feed cut-off device shall be clearly differentiated from any other device.

The direction of movement corresponding to the sense of the desired result shall be shown, where applicable.

(5) Feeding device:

The feeding device shall be designed to provide sufficient and regular flow rate(s).

An adjustable feeding device shall be fitted with an indication of the direction of movement corresponding to the sense of the adjustment of the feed where applicable.

(6) Load receptor

(i) The load receptor, and feed and discharge devices as appropriate, shall be designed to ensure that residual material retained after each discharge is negligible.

(ii) Instruments using the subtractive weighing principle shall be designed to ensure that residual material retained at feed from the discharge gate is negligible.

(iii) The load receptor shall provide access and facilities so that where necessary test weights or masses up to the maximum capacity can be placed in position, in a safe and secure manner. If these facilities are not a permanent fixture of the instrument, they should be kept in the vicinity for the instrument.

(iv) Manual discharge of the load receptor shall not be possible during automatic operation.

(7) Zero setting and tare devices

(i) The filling instrument shall be provided with a zero-setting device, which may also be used for the setting of tare. The device may be—

(a) Manual;

(b) Semi-automatic, or

(c) Automatic

(ii) Zero-setting and tare devices shall be capable of setting to less than or equal to 0.25 of the maximum permissible deviation for in-service inspection for a fill equal to the minimum capacity for instruments with one weighing unit, and for a fill equal to the rated minimum fill for selective combination weigher.

(iii) Non-automatic or semi-automatic zero-setting and tare device should be locked during automatic operations.

(iv) The weighing unit shall be in stable equilibrium when the zero setting and tare device is being set.

(8) Equilibrium mechanism

The equilibrium mechanism may be provided with detachable masses which shall be either weights in accordance with OIML requirements or purpose-designed masses of any nominal value, distinguishable by shape and identified with the filling instruments.

(9) Security

A security means shall be provided for components and pre-set controls to which access is prohibited.

(10) Descriptive markings

Filling instruments shall bear the following markings

(i) *Marking shown in full*

(a) Name or identification mark of the manufacturer

(b) Name or identification mark of the importer (if applicable)

(c) Serial number and type designation of the instrument

(d) Product(s) designation (i.e. materials that may be weighed)

(e) Temperature range (if applicable, see 2.5.1) in the form .....C/....C

(f) Electrical supply voltage in the form.....V

(g) Electrical supply frequency in the form...Hz

(h) Working fluid pressure (if applicable) in the form.....kPa

(i) Average number of loads/fill (if applicable)

(j) Maximum fill (if applicable)

(k) Minimum fill (if applicable)

(l) Rated minimum fill

(m) Maximum rate of operation (if applicable) in the form ..... Load per minute

(ii) *Marking shown in code*

(a) Pattern approval sign

(b) Indication of the accuracy class X(x)

(c) Reference value for accuracy class Ref (x)

(d) Scale interval (if applicable) in the form d = ...

(e) Maximum capacity (or minimum discharge where applicable) in the form Max=.....

(f) Maximum additive tare in the form T = + ...

(g) Maximum subtractive tare in the form T = -.....

An instrument may be verified for different materials for which different classes shall apply or which require different operating parameters to maintain limits of error. Marking shall be such that the alternative class or operating parameters are clearly associated with the appropriate material designation.

In the case of subtractive weigher the minimum load to be discharged shall be specified.

(iii) *Presentation of descriptive markings:*

The descriptive marking shall be indelible and of a size, shape and clarity to enable legibility under normal conditions of use of the filling instrument. They shall be grouped together in a clearly visible place on the filling instrument, either on a date plate fixed to the instrument or on the filling instrument itself.

Where the markings are placed on a date plate, it shall be possible to seal the plate bearing the markings. Where they are marked on the filling instrument itself it shall not be possible to remove them without destroying them.

The descriptive markings may be shown on a programmable display, which is controlled by software. In this case, means shall be provided for any access to reprogramming of the markings to be automatically and non-erasable, recorded, e.g. by traceable access software when a programmable display is used, the plate on the instrument shall bear at least the following markings:

(a) Type and designation of the instrument;

(b) Name or identification mark of the manufacturer;

(c) Pattern approval number;

(d) Electrical supply voltage;

(e) Electrical supply frequency; and

(f) Pneumatic pressure

(11) Verification marks

(i) *Position:*

The filling instruments shall have a place for the application of verification marks. This place shall:

(a) be such that the part of which it is located cannot be removed from the filling instrument without damaging the marks

(b) allow easy application of the mark without changing the metrological qualities of the filling instruments

(c) be visible without the filling instrument having to be moved when it is in service.

(ii) *Mounting:*

Filling instruments required to bear verification marks shall have a verification mark support, at the place provided for above, which shall ensure the conservation of the marks.

When the mark is made with a stamp, this support may consists of a strip of lead or any together material with similar qualities, inserted into a plate fixed to the filling instrument or a cavity bored in the filling instrument itself.

When the marks consist of an adhesive transfer, a space shall be prepared for this purpose.

(12) Control instrument:

The control instrument may be separate from an integral part of the filling instrument.

4. Requirements for electronic instruments

Electronic filling instruments shall comply with the following requirements, in addition to the applicable requirements of all other clauses of this specification.

(1) General requirements

(i) *Rated operating conditions:*

Electronic operating conditions

Electronic instrument shall be so designed and manufactured that they do not exceed the maximum permissible errors under rated operating conditions.

(ii) *Influence factors:*

An electronic instruments shall comply with the requirements of sub-paragraph (5) of paragraph 2 and shall also comply with appropriate metrological and technical requirements at a relative humidity of 85% at the upper limit of the temperature range of the instrument.

(iii) *Disturbances:*

Electronic instruments shall be so designed and manufactured that when exposed to disturbances, either:—

(a) significant faults do not occur, i.e. the difference between the weight indication due to the disturbance and

the indication without the disturbance (intrinsic error) shall not exceed the value specified in paragraph 4(2)(v) of Part I; or

(b) significant faults are detected and acted upon.

Note: A fault equal to or less than the value in paragraph 4(2)(v) of Part I is allowed irrespective of the value of the error of indication.

(iv) *Evaluation for compliance:*

The pattern of an electronic instrument is presumed to comply with the requirements of paragraphs 4(1)(i), 4(1)(ii) and 4(1)(iii), if it passes the examination and tests specified in Annex A.

(v) *Application:*

The requirements in paragraph 4(1) (iii) may be applied separately—

(a) either to each individual cause of significant fault; or

(b) to each part of the electronic instrument; or

(c) to both.

The choice of whether sub-item (a) or sub item (b) above should be applied is left to the manufacturer.

(2) Functional requirements

(i) *Indicator display tests:*

If the failure of an indicator display element can cause a false weight indication, then the instrument shall have a display test facility which is automatically initiated at switch-on of indication, e.g. indication of all the relevant signs of the indicator in the active and non-active states for a sufficient time to be easily observed by the operator.

(ii) *Acting upon a significant fault:*

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

(iii) *Warm-up time:*

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

(iv) *Interface:*

An instrument may be equipped with an interface within allows it to be coupled to external equipment. When an interface is used, the instrument shall continue to function correctly and its metrological functions shall not be influenced.

(v) *Battery power supply:*

An instrument that operates from a battery power supply shall, whenever the voltage drops below the manufacturer's specified minimum value, either continue to function correctly or automatically be put out of service.

(3) Examination and tests:

The examination and testing of an electronic instrument is intended to verify compliance with the applicable requirements of this specification and especially with the requirements of this paragraph.

(i) *Examinations*

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

(ii) *Performance tests:*

An electronic instrument or electronic device, as appropriate, shall be tested as specified in Annex A to determine the correct functioning of the instrument.

Tests are to be carried out on the whole instrument except when either the size or the configuration or both of the instrument does not lend itself to testing as a unit. In such cases the electronic devices shall be tested, where possible as a simulated instrument including all electronic elements of a system which can affect the weighing result. In addition, an examination shall be carried out on the fully operational instrument.

Susceptibility that would result from the use of electronic interfaces to other equipment shall be simulated in the tests.

(iii) *Span stability:*

When an electronic instrument is subjected to the span stability test specified in paragraph 7 of Annexure A, the absolute value of the difference between the errors obtained for any two measurements shall not exceed half the maximum permissible error for influence factor tests for a near maximum capacity load.

5. Metrological controls

(1) General

(i) *Provision of means of testing:*

For the purposes of testing, the metrological authority may require from the applicant the product (i.e. the material to be weighed), the handling equipment, the appropriately qualified personnel and a control instrument.

(ii) *Material tests:*

(a) For pattern evaluation—The material used as the test load for pattern evaluation shall be representative of a product for which the instrument is designed. The test shall be conducted in accordance with the test procedure in paragraph 8(1) of Annexure A.

(b) For initial verification and in-service verification—The in-situ material tests shall be done in accordance with the descriptive marking under the normal conditions of which the instrument is intended. The test shall be conducted in accordance with the test procedure laid down in paragraph 8(2) of Annexure A.

(2) Pattern approval

(i) *Documentation:*

The application for pattern approval shall include documentation comprising:

(a) metrological characteristics of the instrument,

(b) a set of specifications for the instrument,

(c) a functional description of the components and services,

(d) drawings, diagrams and general soft ware information (if applicable), explaining the construction and operation, including interlocks,

(e) any document or other evidence that the design and construction of the instrument complies with the requirements of this specification.

(ii) *General requirements:*

The pattern evaluation shall be carried out on one or more (and normally not more than three) units that represent the definitive pattern. One or more of the units shall be complete and fully operational of the purposed of paragraph 5(2)(iii)(a). One or more of the units shall be submitted in a form suitable for simulation testing in a laboratory and shall include the whole of the electronics which affect the weighing result except in the case of an associative weigher where only one representative weighing unit may be included.

The instrument or simulated instrument shall have a load indicator, or an interface allowing access to a quantity that can be calibrated to provide an indication of load, so that the requirements of paragraph 2(2)(i) (maximum permissible errors for static tests) may be tested and so that the instrument may be tested for influence quantities. The scale interval of the load indicator shall not exceed 0.125 of the maximum permissible deviation for in-service verification for a fill equal to the minimum capacity.

The evaluation shall consist of the tests specified in paragraphs 5(1)(ii)(a) and 5(2)(iii).

(iii) *Pattern evaluation:*

The submitted documents shall be examined and tests carried out to verify that the instrument complies with:

(a) the requirements specified for static tests in paragraph 2,

(b) the technical requirements in paragraph 3,

(c) the requirements in paragraph 4 for electronic Instruments, where applicable.

The appropriate metrological authority shall conduct the test in a manner, which prevents an unnecessary commitment of resources.

Note: The appropriate metrological authority may accept with the consent of the applicant, equivalent test data obtained from other metrological authorities.

(a) Tests for compliance with technical requirements

Operational test with material shall be done in accordance with the procedure in paragraph 8(1) of Annex A on a complete instrument to assess compliance with the technical requirements of paragraph 3.

(b) Influence factor tests

Influence factors shall be applied during simulation tests in a manner that will reveal a corruption of the weighing results of any weighing process to which the instrument should applied, in accordance with—

(a) Paragraph 2(5) for all instruments; and

(b) Paragraph 4 for electronic instruments

(c) Apportioning of errors

Where parts of an instrument are examined separately in the process of pattern approval, the following requirements shall apply—

The error limits applicable in a part which is examined separately are equal to a fraction P_i of the maximum permissible errors or the allowed variations of the indication of the complete instruments. The fractions for any part have to be taken for the same accuracy class as for the complete instrument incorporating the part.

The fractions Pi shall satisfy the following equation:

$$(P_1^2 + P_2^2 + P_3^2 + \ldots) \leq 1$$

The fraction Pi, shall be chosen by the manufacturer of the part and shall be verified by an appropriate test. However, the fraction shall not exceed 0.8 and shall not be less than 0.3 when more than one part contributes to the effect in question.

Note: As the requirements of this sub-paragraph only apply to the instrument submitted for pattern evaluation and not to those subsequently submitted for verification, the means by which it will be possible to determine whether the appropriated maximum permissible error or maximum allowable variation has been exceeded while decided mutually between the metrological authority and the applicant. The means may be for example:

(a) the provision or adoption of the indicating device to give the required resolution,

(b) the use of change point weights, or

(c) any other means mutually agreed.

(iv) *Place to testing:*

Instruments submitted for pattern approval may be tested either—

(a) on the premises of the metrological authority to which the application has been submitted; or

(b) in any other suitable place agreed to between the metrological authority concerned and the applicant.

(v) *Certificate of approval and determination of paragraph [2(2)(i) and paragraph 5 of Annex A]:*

The pattern approval certificate shall state the reference value for the accuracy class as determined by the static tests in paragraph 5 of Annex A and shall state that the actual class (equal to the greater than the reference value) shall be determined by compliance with the metrological requirements at initial verification.

(3) Initial verification

(i) *General requirements:*

Instruments shall be examined for conformity with the approved pattern where applicable and shall be tested for compliance with paragraph 2 [excluding paragraph 2(2)(i) and paragraph 2(5)] for the intended products and corresponding accuracy classes under normal conditions of use.

Tests shall be carried out by the appropriate metrological authority, in-situ, with the instrument fully assembled and fixed in the position in which it is intended to be used. The installation of an instrument shall be so designed that an automatic weighing operation will be the same whether for the purposes of testing or for use for a transaction.

(ii) *Material tests:*

Material test shall be carried out in compliance with paragraph 5(1)(ii) using the test methods specified in paragraph 6.

(iii) *Conduct of the test:*

The appropriate metrological authority:

(a) shall conduct the test in a manner which prevents an unnecessary commitment of resources,

(b) may, where appropriate and to avoid duplicating tests previously done on the instrument for pattern evaluation under paragraph 5(2)(iii) (a) use the results of observed tests to assess for initial verification.

(iv) *Determination of accuracy class:*

The appropriate metrological authority shall :—

(a) determine the accuracy class for the materials used in the tests in accordance with paragraph 5(2)(v) by reference to the material test results and the limits of error specified in paragraph 2(2)(ii) and paragraph 2(3) for initial verification,

(b) Verify that accuracy classes determined as above.

(4) In-service verification

In-service verification shall be as specified in para 5(3)(i) and para 5(3)(ii). The maximum permissible errors shall be as specified in para 2(2)(ii) for in-service verification.

The appropriate metrological authority shall conduct the test in a manner, which prevents an unnecessary commitment of resources.

Quite often a question is asked as to how to calculate R(x). The method is as follows:

Ref. (x) or simply x, is a numeral indicating the class of the gravimetric filling machine, which is to be assigned at the time of model approval. Once the value of x or Ref. (x) is assigned, one can determine its MPD by multiplying the figures given in Table I of this part of this book. At the time of verification, one has to see only for the compliance to the MPD and other requirements.

For calculating x or Ref. (x), one should calculate (1) value of setting error se and (2) maximum deviation md as explained in this part on. Remember $mpse_{(1)}$ is 1/4 of mpd_1 given in table of 5(3)(i) and last column of the observation sheet gives deviation from the mean fill, so maximum deviation md is calculated from here. Number of fills to be taken is chosen with the help of Table 2.

Then examine the values of se/mpse1 and md/$mpd_{(1)}$, these may be a whole number (including zero) plus a fraction like 2 + 0.325 and 2 + 0.545 then class of the instrument is one plus the whole number irrespective of the value of fraction, i.e. 3 in the given example. In case whole number is zero then Ref. (x) or x is 1.

If the values of se/mpse 1 and md/mpd_1 are 3.575 and 3.265 then Ref. (x) or x will be 5 and not 4, as x has to be either of 1, 2, 5 or multiples of 10 of 1, 2 and 5.

6. Test methods

(1) Determination of the mass of individual fills

The mass of the individual fills is determined using one of the methods specified in paragraph 6(5)(i) or in paragraph 6(5)(ii).

(2) Conduct of material tests

(a) The tests shall be carried out on fills using loads at or near to, the maximum capacity and also at, or near to, the minimum capacity. Material tests should only be carried out with the products the instrument is intended to be used for.

(b) Cumulative weighers shall be tested as above with the maximum practical number of load per fill and also with the minimum number of loads per fill, and associative weighers as above with the average (or optimum) number of loads per fill.

(c) If the minimum capacity is less than one third of the maximum capacity then tests shall also be carried out near the centre of the load weighing range preferably at a value close to, but not above, 100g, 300g, 1000g or 15000g as appropriate.

(d) All tests shall be conducted with any adjustable parameter critical to metrological integrity e.g. final feed time or rate, set to the most onerous condition allowed by the manufacturer's printed instructions and incorporated in the descriptive markings.

(i) *Testing the effect of a correction device*

(a) Any correction device e.g. in-flight correction or automatic zero setting fitted to an instrument shall be operated during the tests according to the manufacturer's printed instructions.

(b) If the correction device is not activated during each filling operation, then tests at minimum capacity shall be arranged to include the effect of one or more regular operations of the correction device, e.g. buy including in the test at least three fills immediately before and after the activation of the device.

(c) The initial fills after the charge between maximum capacity and minimum capacity shall be included in the test unless the instrument bears a clear warning to discard the stated number of fills after a change to the instrument settings.

(3) Number of fills

The number of individual tests fill depends upon the preset value (m) as specified in Table 2 below:—

TABLE 2

$m \leq 10kg$	60 fills
$10kg \leq m \leq 25kg$	32 fills
$25kg \leq m \leq 100kg$	20 fills
$100kg \leq m$	10 fills

(4) Accuracy of standards

The control instrument and standard weights used in testing shall ensure that checking of the test fills to an error not greater than either—

(a) one-third of the maximum permissible deviation and maximum permissible preset value error (as appropriate) for automatic weighing [paragraph 2(2) and paragraph 2(3) respectively] if the control instrument or the device used for control purposes is verified immediately prior to the material test; or

(b) one-fifth of the maximum permissible deviation and maximum permissible preset value error (as appropriate) for automatic weighing [paragraph 2(2) and paragraph 2(3) respectively] in all other cases.

(5) Material test methods

(i) *Separate verification method:*

The separate verification method requires the use of a (separate) control instrument to find the conventional true value of the mass of the test fill.

(ii) *Integral verification method:*

With this method the instrument being tested is used to determine the conventional true value of the mass of the test fill. The integral verification method shall be conducted using either:—

(a) an appropriately designed indicating device, or

(b) an indicating device with standard weights to assess the rounding error.

The total uncertainty of the test method (separate or integral verification) shall be not greater than one-third of the maximum permissible error for the instrument.

Notes: (1) The integral verification method depends on determining the masses of the loads. Limits of error as specified in paragraph 2(2) are for the mass of the fill. If it is not possible to ensure that in normal operation, all load is discharged at each cycle of operation, i.e. that the sum of the loads is equal to the fill, then the separate verification method [paragraph 6(5)(i)] should be used.

(2) When using the integral verification method for a cumulative weighing instrument a sub-division of the test fill is unavoidable. When calculating the conventional true value of the mass of the test fill, it is necessary to consider the increased uncertainty due to the division of the test fill.

(a) Interruption of automatic operation

An automatic filling operation of a test fill be initiated as for normal operation. However, the automatic operation shall be interrupted twice during each filling cycle i.e. after the load is assembled and after the load is discharged.

An automatic operation shall not be interrupted during consecutive weighing cycles if the speed of operation is so high that the interruption would significantly affect the mass of the fill.

(i) Pre-discharge (full) interrupt

The automatic operation shall be interrupted after the load receptor(s) has (have) been loaded and the feed of material has ceased. When the load receptor(s) has (have) stabilized, the net weight of the fill indicated or determined by balancing with standard weights shall be recorded and the instrument switched back to automatic operation.

(ii) Post-discharge (empty) interrupt

The automatic operation shall be interrupted after the load(s) has (have) been discharged and the load receptor(s) is (are) ready to receive a further load. When the load receptor(s) has (have) stabilized, the empty load receptor weight indicated or determined by balancing with standard weights shall be recorded and the instrument switched back to automatic operation.

(6) Preset value

The indicated preset value of the fill shall be noted where applicable.

(7) Mass and average value of the test fill

The test fill shall be weighed on a control instrument and the result shall be considered as being the conventional true value of the test fill. The average value of all the fills in the test shall be calculated and noted.

(8) Deviation for automatic weighing

The deviation for automatic weighing used to determine compliance of each fill with the maximum

permissible deviation for automatic weighing paragraph 2(2) shall be the difference between the conventional true value of the mass of the test fill [as defined in paragraph 6(7)] and the average value of all the fills in the test.

(9) Preset value error for automatic weighing

The preset value error for automatic weighing used to determine compliance with paragraph 2(3) shall be the difference between the average value of the conditional true value of the mass of the test fill (as defined in paragraph 6(7) and the preset value for the fills.

ANNEXURE A

TESTING PROCEDURES FOR AUTOMATIC GRAVIMETRIC FILLING

(Mandatory)

[See paragraph 2(5)]

Meaning of symbols

I = Indication

In = n^{th} indication

L = Load

ΔL = Additional load to next changeover point

P = I +1/2 d - Δ L + Indication prior to rounding (digital indication)

E = P - L = Error

mpd = Maximum permissible deviation of each fill from the average

EUT = Equipment under test

se = Setting error

mpse = Maximum permissible setting error

md = Maximum deviation of each fill from the average

1. Examination for pattern approval

(1) Administrative examination [paragraph 5(2)]

Review the documentation that is submitted to determine if it is adequate and correct. For pattern approval the documentation shall include:—

1(1)(a) metrological characteristics of the instrument,

1(1)(b) a set of specifications for the instrument,

1(1)(c) a functional description of the components and devices, and

1(1)(d) drawings, diagrams and general software information (if applicable), explaining the construction and operation, including interlocks.

Consider any document or other evidence that the design and construction of the instrument complies with the requirements of this specification.

(2) Compare construction with documentation [paragraphs 4(3) and 5(2)]

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

(3) Technical requirements (Paragraph 3)

Examine the instrument for conformity with technical requirements according to the checklist given in the test report format.

(4) Functional requirements [Paragraphs 4(2) and 4(3)]

Examine the instrument for conformity with functional requirements according to the checklist given in the test report format.

2. Examination for initial verification

(1) Compare construction with documentation [paragraph 5(3)(i)]

Examine the instrument for conformity with the approved pattern.

(2) Descriptive markings [paragraph 3(10)]:

Check the descriptive markings according to the checklist given in the test report format.

3. General test requirements

(1) Power supply

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

(2) Zero-setting

Using the manual or semi-automatic zero-setting facility, adjust the EUT as closely as practicable to zero prior to each test, and do not readjust it at any time during the test, except to reset if a significant fault has been indicated.

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

(3) Temperature

The tests shall be performed at a steady ambient temperature, usually normal ambient 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 without being greater than 5°C, 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.

(4) Control instruments

(i)*Accuracy of test system [paragraph 6(4)]*

The control instrument and standard weights used in testing shall ensure the determination of the weight of test loads and fills to an error not greater than either:

(a) one-third of the maximum permissible error of the instrument i.e., in the case of material tests, one-third of the maximum permissible deviation and maximum permissible preset value error (as appropriate) for automatic weighing, if the control instrument or the device used for control purposes is verified immediately prior to the material test; or

(b) one-fifth of the maximum permissible error of the instrument i.e., in the case of material tests, one-fifth of the maximum permissible deviation and maximum permissible preset value error (as appropriate) for automatic weighing, in all other cases.

Note: Accuracy requirements for the test system depend on the limits of error which depend on the accuracy class. However, the class is determined from the results of the tests. It is, therefore, necessary that the metrological authority responsible for testing should be informed of the best accuracy class that may be achieved, prior to commencement of testing.

(ii)*Use of standard weights to assess rounding error*

(a) General method to assess error prior to rounding:

For instruments with digital indication having a scale interval d, changeover points may be used to interpolate between scale intervals, i.e. to determine the indication of the instrument, prior to rounding, as follows:—

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

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

The error prior to rounding is:

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

Example: An instrument with a scale interval, d, of 5g is loaded 1kg and thereby indicates 1000g. After adding successive weights of 0.5g, the indication changes from 1000g to 1005g at an additional load of 1.5g. Inserted in the above formula these observations give:

$$P = (1000 + 2.5 - 1.5)\ g = 1001g$$

Thus the true indication prior to rounding is 1001 g, and the error prior to rounding is:

$$E = (1001 - 1000)\ g = + 1\ g$$

(b) Correction for error at zero

Evaluate the error at zero load, (E 0) by the method specified in paragraph 3(4)(ii)(a) of this Annex.

Evaluate the error at load L, (E) by the method specified in paragraph 3(4)(ii)(a) of this Annex.

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

$$Ec = E - Eo$$

Example: if, for the example in paragraph 3(4)(ii)(a), the error calculated at zero load was:

$$Eo = + 0.5\ g$$

The corrected error is:

$$Ec = + 1 - (+ 0.5) = + 0.5g$$

4. Test program

(1) Pattern evaluation [paragraph 5(2)(iii)]

(i) Paragraphs 1, 5, 6, 7 and 8(1) of this Annex shall normally be applied for pattern evaluation.

(ii) For instruments in which the weighing function is provided by a non-automatic weighing instrument that has been approved of its model, the tests specified in paragraph 4(1)(i) may be omitted.

(2) Initial verification [Paragraph 5(3)]

Paragraph 2 and paragraph 8(2) of this Annex shall be applied for initial verification tests.

Static weighing test method (paragraph 5(4) of this Annex) may also be used if necessary to verify the indicator for the integral verification method of material tests.

5. Static tests (pattern approval stage)

(1) General Paragraph 5(2)(ii)

Electronic instruments or instrument simulators are required to have a load indicator, or an interface

allowing access to quantity that can be calibrated to provide an indication of load so that the effect of influence quantities may be tested and the reference accuracy class determined. This facility also enables testing of warm-up time and zero-and tare-setting where applicable. This static weighing tests are normally done as part of influence quantity testing.

Limits for warm-up time tests and for accuracy of zero-and tare-setting are derived from Paragraph 2(2), and are therefore dependent on the reference accuracy class. Therefore the results of these tests must be evaluated after the reference accuracy class has been determined.

(2) Warm-up time [Paragraph 4(2)(iii)]

This rest is to verify that in the period immediately after switch-on, operation is inhibited until the warm-up time is finished, i.e. until the metrological performance can be maintained. The method is to check that automatic operation is inhibited until a stable indication is obtained and to verify that zero and span errors comply with the specified requirements during the first 30 minutes of operation. If the zero is set as part of the normal automatic weighing cycle then this function shall be enabled or simulated as part of the test.

Other test methods which verify that metrological performance is maintained during the first 30 minutes of operation may be used:

(i) Disconnect the instrument from the power supply for a period of at least 8 hours prior to the test.

(ii) Reconnect the instrument and switch on while observing the load indicator.

(iii) Check that it is not possible to initiate automatic weighing until the indicator has stabilized.

(iv) As soon as the indication has stabilized, set the instrument to zero if this is not done automatically.

(v) Determine the error at zero by the method of para 3(4)(ii)(a) of Annexure A.

(vi) Apply a static load close to Max. Determine the error by the method of paragraphs 3(4)(ii)(a) and 3(4)(ii)(b) of this Annex.

(vii) Repeat steps (v) and (vi) after 5, 15 and 30 minutes.

(viii) From (v) verify that the zero-setting error is not greater than the limit specified in paragraph 3(7).

(ix) From steps (vi) and (vii) verify that:

(a) the error (corrected for zero error) for a static load close to Max is not greater than the limit specified in paragraph 2(4).

(b) after each time interval the error at zero is not greater than twice the limit specified in paragraph 3(7).

Note: Zero-setting accuracy is specified as 0.25 mpd so the additional allowance of 0.25 mpd is added for variation of zero after the initial zero-setting. This is consistent with paragraph 2(4) (mpe for a static test load) and paragraph 6(2)(ii) of this Annex (temperature effect on no load indication).

(3) Zero- and tare-setting paragraph 3(7)

(i) *General*:

Unless it is clear that zero and tare functions are performed by the same process then both function shall be tested separately.

Zero-and tare-setting may be by more than one mode, for example:

(a) non-automatic or semi-automatic,

(b) automatic at switch-on,

(c) automatic at start of automatic operation,

(d) automatic as part of weighing cycle.

It is normally only necessary to test the accuracy of zero-and tare-setting in one mode if it is clear that the same process is used for each mode. If zero or tare is set as part of the automatic weighing cycle then this mode shall be tested. To test automatic zero-or tare-setting it is necessary to allow the instrument to operate through the appropriate part of the automatic cycle and then to halt the instrument before testing.

(ii) *Accuracy of zero-setting [paragraph 3(7)]:*

(1) Set the instrument to zero in a mode as determined by paragraph 5(3)(i) of this Annex.

(2) Add weights to the load receptor to determine the additional load at which the indication changes from zero to one scale interval above zero.

(3) Calculate the error at zero according to the description in paragraph 3(4)(ii)(a) of this Annex.

(iii) *Accuracy of tare-setting [paragraph 3(7)]:*

Accuracy of tare shall be tested at the maximum tare as specified by the manufacturer.

(1) Place the tare load on the load receptor and allow the tare function to operate in a mode as determined by paragraph

5(3)(i) of this Annex and in accordance with the manufacturer's instructions.

(2) Add weights to the load receptor to determine the additional load at which the indication changes from zero to one scale interval above zero.

(3) Calculate the error according to the description in paragraph 3(4)(ii)(a) of this Annex.

(4) Static weighing test method [paragraph 5(2)(iii)]

Apply test loads from zero up to and including Max, and similarly remove the test loads back to zero. The test loads selected shall include values close to Max and Min and other critical loads as specified in paragraph 6(2)(a), subject to requirements of this Annex.

Determine the error at each test load, using the procedure of paragraph 3(4)(ii) of this Annex, if necessary, to obtain the accuracy requirements of paragraph 3(4)(i) of this Annex.

It should be noted that when loading or unloading weights, the load shall be progressively increased or progressively decreased.

(5) Determination of reference accuracy class [paragraph 5(2)(v)]

The static weighing tests during application of influence factors (as appropriate) shall be used at pattern approval stage to establish the reference value for accuracy class, i.e. Ref(x), as follows :—

(i) Perform static weighing tests for influence factors and loads as specified in this Annex.

(ii) For each load determine the maximum permissible error for influence factor tests for class X(1), $mpe_{(1)}$

(Refer to para 2(4) and to this Annex where appropriate).

(iii) Calculate [Error/$mpe_{(1)}$] for each load.

(iv) From (iii) determine the maximum value of [Error/$mpe_{(1)}$] for all the influence factor tests, [Error/$mpe_{(1)\ max}$]

(v) Determine Ref (x) from [Error/$mpe_{(1)\ max}$] such that :

Ref (x)> [Error/$mpe_{(1)}$] max and

Ref (x) = 1×10^k , 2×10^k , or 5×10^k,

the index k being a positive or negative whole number or zero. Values for significant fault shall then be calculated from the mpd for the reference class.

6. Influence factor and disturbance tests

(1) Test conditions

(i) *General requirements :*

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

It is generally not possible to apply the influence factors or disturbances to an instrument which is processing material automatically. The instrument shall therefore be subjected to the influence factors or disturbances under static conditions or simulated operation as defined herein. The permissible effects of the influence factors or disturbances, under these conditions, are specified for each case. When the effect of one influence factor is being evaluated, all other factors are to be held relatively constant, at a value close to normal. After each test the instrument shall be allowed to recover sufficiently before the following test—

Where parts of the instrument are examined separately, errors shall be apportioned in accordance with paragraph 5(2)(iii)(c).

The operational status of the instrument or simulator shall be recorded for each test. When the instrument is connected in other than a normal configuration, the procedure shall be mutually agreed on by the approving authority and the applicant.

(ii) *Simulator requirements*

(a) General

The simulator for influence factor and disturbance tests should include all electronic elements of the weighing system.

(b) Load cell

The simulator should also include the load cell and a means to apply standard test loads. Where this is not possible, e.g. for high capacity instruments, then a load cell simulator may be used or alternatively the load cell interface

may be modified to incorporate a scaling factor to give the design output for a small test load. Repeatability and stability of a load cell simulator should make it possible to determine the performance of the instrument with at least the same accuracy as when the instrument is tested with weights.

(c) Interfaces

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.

(d) Documentation

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

(iii) Test limits for multi-load instruments :

For instruments where the fill may consist of more than one load, the value of a significant fault and the limit of error for influence factor tests must be determined by the metrological authority after considering the design of the instrument and the method of test, such that the effect on the fill is equivalent to the values specified in paragraph 4(2)(v) specified in Part I and paragraph 2(4) of Part II.

(a) Significant fault for multi-load instruments

The following examples show how to determine the value of a significant fault on selective combination weighers and cumulative weighers when testing.

(a-i) Significant fault for selective combination weighers

A fault greater than 0.25 of the maximum permissible deviation of each fill (as specified in Table 1) for in-service verification divided by the square root of the average (or optimum) number of loads in a fill, for a fill equal to the minimum capacity multiplied by the average (or optimum) number of loads in a fill.

Example : For a class X(1) instrument with Min = 200g designed for an average of 8 loads per fill, fill = 1600g, the maximum permissible deviation of each fill from the average fill (as specified in Table 1) for in-service verification is 1.5% = 24g. Hence the value of significant fault is :

$0.25 \times (24/\sqrt{8}) = 2.12g$

(a-ii) Significant fault for cumulative weighers :

A fault greater than 0.25 of the maximum permissible deviation of each fill (as specified in Table 1) for in-service verification, for a fill equal to the rated minimum fill, divided by the square root of the minimum number of loads per fill.

Example : For a class X (1) instrument with Max = 1200g and rated minimum fill of 8 kg : 8 kg/1.2 kg = 6.67; therefore the minimum number of loads per fill is 7.

The maximum permissible deviation (as specified in Table 1) for the minimum fill of 8 kg is 1.5% or 120g. Hence the value of significant fault is :

$0.25 \times (120/\sqrt{7}) = 11.34g$

Note : This definition of significant fault for cumulative weighers does not include Min. A cumulative weigher would normally be used at or near to Max.

(b) Limits of error for influence factor tests

The following examples show how to determine the limit of error for influence factor testing for selective combination weighers and cumulative weighers when testing.

(b-i) For selective combination weighers the maximum permissible error for

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any static test load during influence factor tests shall be 0.25 of the maximum permissible deviation for in-service verification for the appropriate mass of the fill divided by the square root of the average (or optimum) number of loads per fill.

Example : Class X(1) selective combination weigher, where the average number of loads per fill = 4. For a static test load = 100g the appropriate mass of the fill will be 400g for which the maximum permissible deviation for in-service verification is 3% i.e. 12g. Hence the maximum permissible error for influence factor tests is :

$0.25 \times (12g/4) = 1.5g$

(b-ii) For cumulative weighers the maximum permissible error for any static test load during influence factor tests shall be 0.25 of the maximum permissible deviation for in-service verification for the rated minimum fill divided by the square root of the minimum number of loads per fill.

Example : For a class X(1) instrument with Max = 1200g and rated minimum fill of 8 kg : 8 kg/1.2 kg = 6.67; therefore the minimum number of loads per fill = 7.

The maximum permissible deviation (as specified in Table 1) for the minimum fill of 8 kg is 1.5%, i.e. 120g. Hence the maximum permissible error for influence factor tests is :

$0.25 \times (120/\sqrt{7}) = 11.35g$

Note : For cumulative weighers the average number of loads per fill is not known. Therefore it is not possible to define the limit of error for influence factors in terms of average loads per fill and appropriate mass of the fill. The above definition is based on maximum load and rated minimum fill.

(2) Influence factor tests

SUMMARY OF TESTS

Test	*Characteristic under test*	*Conditions applied*
Static temperatures	Influence factor	Mpe(*)
Temperature effect on no-load indication	Influence factor	Mpe(*)
Damp heat, steady state	Influence factor	Mpe(*)
Power voltage variation	Influence factor	Mpe(*)
Tilting	Influence factor	Mpe(*)

(*) mpe : maximum permissible error

(i) *Static temperatures (paragraph 2(5)(i)*

Static temperature tests are carried out according to Table 3 given below :

TABLE 3

Environmental Phenomena	*Test specification*
	Reference of 20°C
Temperature	Specified high for 2 hours
	Specified low for 2 hours
	5°C
	Reference of 20°C

Object of the test : to verify complaince with the provisions in paragraph 2(5)(i) under conditions of dry heat (non condensing) and cold. The test specified in 6(2)(ii) of this Annex may be conducted during this test.

Test procedures in brief

Precondition :	16 hours
Condition of the EUT :	Normal power supplied and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Power is to be "on" for the duration of the test. The automatic zero-setting should be disabled.
Stabilization :	2 hours at each temperature under "free air" conditions.
Temperature :	As specified in paragraph 2(5)(i)
Temperature sequence :	Reference temperature of 20°C
	Specified high temperature
	Specified low temperature
	Temperature of 5°C
	Reference temperature of 20°C

Number of test cycles : At least one cycle.

Weighing test : After stabilization at the reference temperature and again at each specified temperature conduct the following :

Adjust the EUT as close to zero indication as practicable. It is important to ensure that the test result is unaffected by the automatic zero-setting function which should therefore be disabled. The EUT shall be tested with at least five different static test loads (or simulated loads) including Maximum and Minimum capacities. When loading or unloading weights the load must be respectively increased or decreased monotonically.

Record : (a) date and time
(b) temperature
(c) relative humidity
(d) test load
(e) indications
(f) errors
(g) functional performance

Maximum allowable variations : All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in paragraph 2(4).

(ii) *Temperature effect on no-load indication*

Note : This test should not be performed for instruments that have automatic zero-setting as part of the automatic weighing process.

The instrument is set to zero, the temperature is then changed to the prescribed highest and lowest temperatures as well as at 5°C. After stabilization, the error of the zero indication is determined. The change in zero indication per 5°C is calculated. The changes of these errors per 5°C are calculated for any two consecutive temperatures of this test.

This test may be performed during the temperature test [paragraph 6(2)(i) of this Annex].

Maximum permissible variations : The change in zero indication shall not vary by more than the maximum permissible error for influence factor tests for a load equal to the rated minimum fill, for a temperature difference of 5°C.

Condition of EUT : Normal power supplied and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Power is to be "on" for the duration of the test.

(iii) *Damp heat, steady state [paragraph 4(3)(ii)]*

Damp heat, steady state test are carried out according to Table 4.

TABLE 4

Environmental phenomena	*Test specification*
Damp heat, steady state	Upper limit temperature and relative humidity of 85% for 2 days

Supplementary information :

Object of the test : To verify compliance with the provisions of paragraph 4(3)(i) under conditions of high humidity and constant temperature.

Precondition : None required.

Test load : One static test load close to minimum capacity.

Condition of the EUT : Normal power supplied and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Power is to be "on" for the duration of the test.

The zero-setting and zero- tracking facilities shall be enabled as for normal operation. Adjust the EUT as close to zero indication as is practicable, prior to the test. The handling of the EUT shall be such that no condensation of water occurs on the EUT.

Stabilization :	Three hours at reference temperature and 50% humidity. Two days at the upper limit temperature as specified in paragraph 2(5)(i).
Temperature :	Reference temperature of 20°C and at the upper limit as specified in paragraph 2(5)(i).
Relative humidity :	50% at reference temperature. 85% at upper limit temperature.
Temperature humidity sequence :	The reference temperature of 20°C at 50% humidity. The upper limit temperature at 85% humidity. The reference temperature of 20°C at 50% humidity.
Number of test cycles :	At least one cycle.
Weighing test and test sequence :	After stabilization of the EUT at reference temperature and 50 % humidity apply the test load.
Record :	(a) date and time (b) temperature (c) relative humidity (d) test load (e) indications (f) errors

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 2 days. Following the 2 days, apply the static test load and record the data as indicated above. Allow full recover of the EUT before any other tests are performed.

Maximum allowable variations : All errors shall be within the maximum permissible errors specified in paragraph 2(4).

(iv) *Power voltage variation [paragraph 2(5)(ii)]*

Power voltage variation tests are carried out according to Table 5.

TABLE 5

Environmental phenomena	*Test specification*
	Reference voltage
Voltage variation	Reference voltage +10%
	Reference voltage - 15%
	Reference voltage

SUPPLEMENTARY INFORMATION :

Object of the test :	To verify compliance with the provisions of paragraph 2(5)(ii) under conditions of voltage variations.

Test procedures in brief

Precondition :	None required.
Condition of the EUT :	Normal power supplied and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test. If it has an automatic zero-setting function then the instrument should be set to zero after applying each level of voltage.
Number of test cycles :	At least one cycle.
Weighing test :	The EUT shall be tested with a test load approximately equal to the minimum capacity. Zero-setting function shall be in operation.
Test sequence :	Stabilize the power supply at the reference voltage within the defined limits and apply the test load.
Record the following data :	(a) date and time (b) temperature (c) power supply voltage (d) test load (e) indications (as applicable) (f) errors (g) functional performance

Maximum allowable variations :	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in paragraph 2(4).

(v) *Tilting [paragraph 2(5)(iii)]*

Note : This test only applies to instruments that will not be permanently installed.

This test is not required for mobile instruments with a level indicator if it can be established that the tilt can be adjusted to 1% or less.

Test method :	Static tests whilst the EUT is tilted.
Object of the test :	To verify compliance with the provisions in paragraph 2(5)(iii) under conditions of tilt.
Test procedure in brief :	The test consists of tilting the EUT both forwards and backwards, longitudinally and from side to side (transversely), while observing the weight indications for a static test load.
Test severities :	Instruments without level indicators shall be tested at a tilt of 5%.
Maximum allowable variations :	All indications shall be within maximum permissible errors specified in paragraph 2(4).
Condition of EUT :	Normal power supplied and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Power is to be "on" for the duration of the test. Adjust the EUT in its reference position (not tilted) as close to zero indication as practicable. If the instrument is provided with automatic zero-setting it shall not be in operation. The test shall be performed with a test load approximately equal to the maximum capacity.
Test sequence :	Record the zero indication. Apply the test load and record the indication. Remove the test load. Tilt the EUT longitudinally to the appropriate extent and record the zero indication. Apply the test load and record the indication. Remove the test load. Without further adjustment to any control affecting metrological performance tilt the EUT to the appropriate extent in the opposite direction and repeat the static weighing tests as above. Tilt the EUT in the transverse direction to the appropriate extent and repeat the tests. Tilt the EUT in the opposite direction and repeat the tests. In order to determine the influence of tilting on the loaded instrument, the indication obtained at each tilt shall be corrected for the deviation from zero which the instrument had prior to loading.

(3) Disturbance tests [paragraph 4(1)(iii)]

(i) *Short time power reduction*

Short time power reduction (voltage dips and

short interruptions) tests are carried out according to Table 6.

TABLE 6

Environmental phenomena	*Test specification*
Voltage dips and short interruptions.	Interruption from reference voltage to zero voltage for one-half cycle. Interruption from reference voltage to 50% of reference voltage for two half cycles. These mains voltage interruptions shall be repeated ten times with a time interval of at least 10 seconds

Supplementary information to the test procedures :

Object of the test : To verify compliance with the provisions in paragraph 4(1) (iii) under conditions of short mains voltage interruptions and reductions while observing the weight indication for a static load approximately equal to the minimum capacity.

Test procedures in brief :

Precondition : None required.

Condition of the EUT : Normal power supplied and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer.

Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation. Not to be adjusted or readjusted at any time during the test except the reset if a significant fault has been indicated.

Number of test cycles : At least one cycle.

Weighing test and test variations : The EUT shall be tested with a test load approximately equal to the minimum capacity.

Stabilize all factors at nominal reference con-ditions. Apply the test load and record the following data :

(a) date and time

(b) temperature

(c) power supply voltage

(d) test load

(e) indications

(f) errors

(h) functional performance Interrupt the power supply to zero voltage for a period equal to one half cycle and conduct the test. During interruption observe the effect on the EUT and record, as appropriate.

Reduce the power supply to 50% of nominal voltage for a period equal to two half cycles and conduct the test. During reductions observe the effect on the EUT and record, as appropriate.

Maximum allowable variations : The difference between the weight indication due to the disturbance and the indication without the disturbance either shall not exceed the values given in paragraph 4(2)(v), or the EUT shall detect and act upon a significant fault.

(ii) *Electrical bursts (fast transient tests)*

Electrical bursts tests (fast transient tests) are carried out for two minutes with a positive polarity and for 2 minutes with a negative polarity according to Tables 7.1, 7.2 and 7.3 given below :

TABLE 7.1

Ports for signal lines and control lines

Environmental phenomena	*Test specification*
Fast transient common mode	0.5 kV (peak) 5/50 ns T_1/T_h 5 kHz rep. Frequency

Note : Applicable only to ports or interfacing with cables whose total length may exceed 3m according to the manufactures functional specification.

TABLE 7.2

Input and Output DC Power Ports

Environmental phenomena	*Test specification*
Fast transient common mode	0.5 kV (peak) 5/50 ns T_1/T_h 5 kHz rep. frequency

Note : Not applicable to battery operated appliances that cannot be connected to the mains while in use.

TABLE 7.3

Input and Output DC Power Ports

Environmental phenomena	*Test specification*
Fast transient common mode	0.5 kV (peak) 5/50 ns T_1/T_h 5 kHz rep. Frequency

A coupling/decoupling network shall be applied for testing AC power ports.

Supplementary information to the test procedures :

Object of the test : To verify compliance with the provisions in paragraph 4(1)(iii) under conditions where electrical bursts (fast transients) are super-imposed on the mains voltage while observing the weight indication for a static test load approximately equal to the minimum capacity.

Test procedures in brief :

Precondition : None required.

Condition of the EUT : Normal power supplied and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Reset the EUT if a significant fault has been indicated.

Stabilization : Before any test stabilize the EUT under constant environmental conditions.

Weighing test : With the single static load in place record the following with and without the transients :—

(a) date and time

(b) temperature

(c) test load

(d) indications (as applicable).

Maximum allowable variations : The difference between the weight indication due to the disturbance and the indication without the disturbance either shall not exceed the value given in paragraph 4(2)(v) of Part I, or the instrument shall detect and act upon a significant fault.

(iii) *Electrostatic discharge*

Electrostatic discharge tests are carried out with test signals and conditions as given in Table 8 below:

TABLE 8

Environmental phenomena	*Test specification*
Electrostatic discharge	8 kV air discharge 6 kV contact discharge

Note : The 6 kV contact discharge shall be applied to conductive accessible parts. Metallic contacts e.g. in battery compartments or in socket outlets are excluded from this requirement. Contact discharge is the preferred test method. 20 discharges (10 with positive and 10 with negative polarity) shall be applied on each accessible metal part of the enclosure. The time interval between successive discharges shall be at least 10 s. In the case of a non conductive enclosure, discharges shall be applied on the horizontal or vertical coupling planes. Air discharges shall be used where contact discharges cannot be applied. Tests with other (lower) voltages than those given in Table 8 are not required.

Supplementary information to the test procedures :

Object of the test : To verify compliance with the provisions of paragraph 4(1)(iii) under conditions where electrostatic discharges are applied while observing the weight indication for a static test load approximately equal to the minimum capacity.

Test procedures in brief :

Precondition : None required.

Condition of the EUT : Normal power supplied and "on" for a time period equal to or greater than the warm-up time specified by the manufacturer. Reset the EUT if a significant fault has been indicated.

Stabilization : Before any test stabilize the EUT under constant environmental conditions.

Weighing test : With the single static load in place, record the following with and without electrostatic discharge :—

(a) date and time

(b) temperature

(c) test load

(d) indications (as applicable).

Maximum allowable variations : The difference between the weight indication due to the disturbance and the indication without the disturbance either shall not exceed the value given in paragraph 4(2)(v) of Part I or the instrument shall detect and act upon a significant fault.

7. Span stability test [paragraph 4(3)(iii)]

Test method : Span stability.

Object of the test : To verify compliance with the provisions of paragraph 4(3)(iii) after the EUT has been subjected to the performance tests.

Reference to standard : No reference to international standards can be given.

Test procedure in brief : The test consists of observing the variations of error of the EUT under sufficiently constant ambient conditions (reasonably constant conditions in a normal laboratory environment) at various intervals, before, during and after the EUT has been subjected to performance tests.

The performance tests shall include the temperature test and, if applicable, the damp heat test. Other performance tests listed in this Annex may be performed.

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

In the conduct of this test, the operating instructions for the instrument as supplied by the manu-facturer shall be considered.

The EUT shall be stabilized at sufficiently constant ambient conditions after

	switch-on for at least five hours, and at least sixteen hours after the temperature and damp heat tests have been performed.
Test severities :	Test duration : Twenty eight days or over the period necessary for the conduct of the performance tests, whichever is less. Time t (days) between tests : $0.5 \leq t \leq 10$.
	Test load : a static test load near maximum capacity (Max); the same test weights shall be used throughout the test.
Maximum allowable variations :	The variation in the indication of the test load shall not exceed 1/2 the absolute value of the mpe for influence factor tests paragraph 2(4) for the test load applied on any of the (n) tests conducted.
Number of tests (n) :	$n \geq 8$. If the test results indicate a trend more than half the permissible variation specified above, conduct additional tests until the trend comes to rest or reverses itself, or until the error exceeds the maximum permissible variation.
Precondition :	None required.
Test equipment :	Verified mass standards.
Condition of the EUT :	Adjust the EUT as close to zero indication as practicable before each test.
Test sequence :	Stabilize all factors at nominal reference conditions. If the instrument is provided with automatic zero-setting it shall not be in operation. Apply the test load (or simulated load) and record the following data :—
	(a) date and time
	(b) temperature
	(c) barometric pressure
	(d) relative humidity
	(e) test load
	(f) indication
	(g) errors
	(h) changes in test location
	and apply all necessary corrections resulting from variations of temperature, pressure, etc. between the various measurements.
	At the first measurement immediately repeat zeroing and loading four times to determine the average value of error. For the next measurements perform only one, unless either the result is outside the specified tolerance or the range of the five readings of the initial measurement was more than 1/10 of the maximum permissible variation.
	Repeat this test at periodic intervals during and after the conduct of the various performance tests.
	Allow full recovery of the EUT before any other tests are performed.

8. Procedure for material tests

(1) Material tests at pattern evaluation [paragraph 5(1)(ii)(a) and paragraph 5(2)]

Operational tests with material shall be done on a complete instrument to assess compliance with the technical requirements of sub-paragraph (3) with material for the test load as specified in paragraph 5(1)(ii)(a).

(i) *Feeding device [paragraph 3(5)]*

Check that the feeding device provides sufficient and regular flow rate.

Check that any adjustable feed device has an indication of the direction of movement corresponding to the sense of the adjustment of the feed (where applicable).

For instruments using the subtractive weighing principle check that residual material retained at the feeding device after each load is delivered, is negligible relative to limits of error.

(ii) *Load receptor [paragraph 3(6)]*

For instruments that weigh material in a separate load receptor prior to discharge to a container, check that the residual material retained at the load receptor after each discharge is negligible relative to limits of error.

Check that manual discharge of the load receptor is not possible during automatic operation.

(2) Material tests at initial verification [paragraph 5(1)(ii)(b) and paragraph 5(3)]

Metrological tests with material shall be done on a complete instrument, fully assembled and fixed in the position in which it is intended to be used and as specified in paragraph 5(1)(ii)(b).

The accuracy class (or classes) shall be determined from the results.

(i) *Requirements for metrological material tests*

Types of loads [paragraph 5(3)(i) and paragraph 6(2)(a)] :	The materials used as the test load shall be as specified in paragraph 6(2)(a).
Mass of test loads and fills [paragraph 6(2)] :	The mass of the test loads and fills shall be as specified in paragraphs 6(2)(a, b and c).
Adjustments [paragraph 6(2) (d)] :	The adjustments shall be set as specified in paragraph 6.(2)(d).
Correction devices [paragraph 6(2)(i)] :	Any correction device shall be operated as specified in paragraph 6(2)(i).
Number of fills [para 6(3)] :	The number of fills shall be as specified in Paragraph 6(3).

(ii) *Methods for metrological material tests (paragraph 6(5)]*

One of the following verification methods shall be used :

(a) Separate verification method : the separate verification method is as defined in paragraph 6(5)(i).

(b) Integral verification method : the integral verification method is as defined in paragraph 6(5)(ii).

(iii) *Procedure for metrological material tests*

STEPS :

(1) Set up the instrument in accordance with paragraph 6(2) (d) and 6(2)(i).

(2) Select a preset value for the fill and set the load value if different from the fill, in accordance with paragraph 6(2). Record the indicated preset value.

(3) Run the instrument to produce a number of fills as specified in paragraph 6(3).

(4) Weigh all the fills by one of the methods in paragraphs 6(5)(i) or 6(5)(ii).

(5) Calculate the average value of all the fills in the test and the preset value error [paragraph 2(3)].

(6) Calculate the deviation of each fill from the average paragraph [2(2)].

(7) Repeat stages (2) to (6) for other loads as specified in paragraph 6(2).

Concerning paragraph 6(7) :	The result of weighing the test fill on the control instrument shall be considered as the conventional true value of the test fill.
Concerning Paragraph 6(8) :	The deviation for automatic weighing used to determine compliance of each fill with the maximum permissible deviation for automatic weighing [paragraph 2(2)] shall be the difference between the conventional true value of the mass of the test fill as defined in paragraph 6(7) and the average value of all the fills in the test.
Concerning paragraph 6(9) :	The preset value error for automatic

weighing used to determine compliance with paragraph 2(3) shall be the difference between the average value of the conventional true value of the mass of the test fills, as defined in para 6(7) and the preset value for the fills.

(iv) *Determination of accuracy class [paragraph 5(2)(v)]*

(1) For each preset value of the test fill, determine the preset value error (i.e. the setting error, se) and the maximum permissible preset value error for class X(1), $mpse_1$:

Then calculate $[se/mpse_1]$ for each preset value of the test fill.

(2) For each preset value of the test fill determine the maximum actual deviation from the average (md) and the maximum permissible deviation from the average for class X(1), mpd_1.

Then calculate md/mpd_1 for each preset value of the test fill.

(3) From (1) determine the maximum value of $[se./mpse_1]$, $[se/mpse_1]$ max

(4) From (2) determine the maximum value of md/mpd_1, $[md/mpd_1]$ max.

(5) Determine the accuracy class (x) such that

$(x) > [se/mpse_1]$ max

and $(x) > [md/mpd_1]$ max

and $(x) = 1 \times 10^k$, 2×10^k, or 5×10^k,

the index k being a positive or negative whole number or zero.

SEVENTH SCHEDULE

HEADING–E

DISCONTINUOUS TOTALIZING AUTOMATIC WEIGHING INSTRUMENTS

(TOTALIZING HOPPER WEIGHERS)

PART I

1. General definitions

(1) Weighing instrument

A measuring instrument that serves to determine the mass of a load by using the action of gravity. According to its method of operation, a weighing instrument is classified as automatic or non-automatic.

(2) Automatic weighing instrument

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

(3) Discontinuous totalizing automatic weighing instrument (totalizing hopper weigher)

An automatic weighing instrument that weighs a bulk product by dividing it into discrete loads, determining the mass of each discrete load in sequence, summing the weighing results and delivering the discrete loads to bulk.

(4) Electronic instrument

An instrument equipped with electronic devices.

(5) Control instrument

A non-automatic weighing instrument used to determine the mass of the product used as the test load during material tests.

2. Construction

Note : In this Part and Part II, the term "device" is applied to any part which uses any means to perform one or more specific functions.

(1) Load receptor

The part of the instrument intended to receive the load.

(2) Electronic parts

(i) *Electronic device*

A device comprised of electronic sub-assemblies and performing a specific function. An electronic device is usually manufactured as a separate unit and is capable of being independently tested.

(ii) *Electronic sub-assembly*

A part of an electronic device comprised of electronic components and having a recognizable function of its own.

(iii) *Electronic component*

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

(3) Indicating device

The part of the instrument that displays the value of a weighing result in units of mass.

(i) *Totalization indicating device*

The part of the instrument that indicates